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**P001**

### **Combined traumatic injuries of the brachial plexus and spinal cord**

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**Introduction:** Patients with combined trauma involving both the brachial plexus and the spinal cord are very rare. Our aim was to determine the clinical features of patients with combined brachial plexus paralysis and spinal cord injury and assess the results of surgical treatment for the brachial plexus lesion.

**Methods:** We retrospectively reviewed 11 patients with combined traumatic injuries of the brachial plexus and spinal cord at Hoshigaoka Koseinenkin Hospital.

**Results :** All the patients were men, with a mean age of 27.6 years at injury. The causes of injury were; a motorcycle accident in eight patients, a fall from a height in two and being struck by a heavy steel object in one.

The brachial plexus lesion was complete C5-T1 in six patients, incomplete C5-C6 in two patients, complete C7-T1 in one patient, incomplete C5-7 in one patient, and incomplete C7-T1 in one patient. The mean time from injury to diagnosis of the plexus lesion was 106.8 days . Nine of the 11 patients underwent direct surgical exploration. The mean time from injury to surgical exploration was 162.4 days. The results obtained in the nine patients were generally poor.

In four patients, the spinal cord lesion was associated with cervical vertebral injury and seven patients had thoracic spinal injuries. The associated injuries were head injury in nine patients, thoracic injury in nine patients, and upper limb fracture in seven patients (all on the same side as the brachial plexus lesion) .

**Conclusion:** These associated injuries were responsible for the delayed diagnosis of brachial plexus paralysis, while the poor prognosis was due to delay in starting treatment and the severity of the associated injuries. When associated injuries are detected in patients with spinal cord trauma, it is important to consider the possibility of brachial plexus involvement.



**P002**

**Muscular pathology in brachial plexus birth injury with elbow flexion contracture**

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The aim of this study was to determine whether limited range of motion of the elbow and the forearm in patients with permanent brachial plexus birth injury (BPBI) is correlated with specific patterns of muscular pathology.

**Patients:** For 15 BPBI patients with a mean extension deficit of  $31^\circ$  ( $10^\circ$ – $90^\circ$ ) of the elbow joint, total active motion (TAM) of the elbow (extension–flexion) and the forearm (pronation–supination) were clinically measured. MR imaging of both elbow joints and musculature of the arms and forearms allowed assessment of congruency of the elbow, grading of fatty infiltration and size reduction of the muscles. Statistical analysis was performed with the Wilcoxon Signed-Rank Test and Spearman's two-tailed correlation test.

**Results:** The mean TAM of the elbow was  $113^\circ$  ( $50^\circ$ – $140^\circ$ ) and that of the forearm  $91^\circ$  ( $10^\circ$ – $165^\circ$ ). The higher the age and the greater the size reduction of the brachioradial muscle, the more diminished was TAM of the elbow. The more extensive the BPBI and muscle pathology of the pronator teres, the more limited was the TAM of the forearm. Muscle pathology of the supinator and brachial muscles appeared in every patient .

**Conclusions:** Extensive permanent BPBI may result in marked limitation of TAM, especially when both the agonist and antagonist muscles are affected. Elbow flexion contracture seems to be caused mainly by brachial muscle pathology. Rotation of the forearm is better preserved when the pronator teres is not severely affected.

**References:** Tiina Pöyhiä et al., 2005.



**P003**

### **Brachial plexus reconstruction outcome measures**

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**Introduction :** Currently, motor return after brachial plexus reconstruction is measured using manual methods that are quite imprecise.

**Methods :** A comprehensive review of the literature on brachial plexus reconstruction reveals a paucity of detailed measures of outcome. Motor return is generally measured using manual muscle testing (MMT) with the British Medical Research Council (BMRC) scale of M0-M5. MMT, especially when performed by various examiners from several medical centers, results in a high variability of measures. Higher variability requires larger number of patient to prove efficacy of treatment. One way to reduce variability is to use isometric motor testing with force plate gauges which are highly sensitive to small variations in strength. Various isometric strength testing devices already exist for the shoulder and elbow motions. Unfortunately, these machines do not eliminate the effect of gravity. Therefore, early recovery, when the muscle is not strong enough to overcome gravity, is not detected. Our group has developed specific, reproducible testing of muscle strength using standardized placement of force plates in such a way as to eliminate the effects of gravity. These techniques measure the isometric force generated by a muscle group in a standardized fashion. Specifically, force is measured in shoulder flexion, extension, abduction, internal rotation, and external rotation. Elbow flexion and extension, and forearm pronation are also measured. Using these protocols we hope to establish standards of measurement that will aid in future research on the success of brachial plexus reconstruction. These protocols will be described as they pertain to specific types of brachial plexus reconstruction. We will also present preliminary results from illustrative cases.

**Conclusion:** Force plate measurements of upper extremity strength following brachial plexus reconstruction yields more precise data than current manual techniques.



**P004**

**The ultrasound diagnosis of traumatic injury of brachial plexus combined with rotator cuff tear and long head of biceps brachii**

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**Objective :** To explore the ratio of traumatic injury of brachial plexus combined with rotator cuff tear and injury of long head of tendon of biceps brachii.

**Methods :** To check the patients diagnosed by Ultrasound as brachial plexus injury so as to know whether combined rotator cuff tear and injury of long head of biceps brachii lies.

**Result :** 50 patients were divided into two groups, 35 upper brachial plexus injury and 15 total brachial plexus injury individually. The ratio of complete tear of rotator cuff and injury of long head of biceps brachii is 5/50, partly is 17/50. The total injury ratio of traumatic injury of upper brachial plexus combined with rotator cuff tear and injury of long head of biceps brachii is 21/50. However the injury ratio of total brachial plexus is 1/15.

**Conclusion :** There is high occurrence of traumatic injury of upper brachial plexus combined with rotator cuff tear and injury of long head of biceps brachii (21/50).



**P005**

### **Estimation of Depression with Self-rating Depression Scale for Brachial Plexus Injury Patients**

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Previous studies have shown that depression often exists in the patients of chronic painful disease such as rheumatoid arthritis, spinal cord injury, lumbar spinal canal stenosis and fibromyalgia affecting their clinical course. The patients of brachial plexus injury (BPI) suffer not only from pain and numbness but from disability because of the palsy of upper limbs. These symptoms may make the patients depressive and depression may produce an adverse effect on their pain control and functional reconstruction.

In this study we evaluated the extent of depression in BPI patients, and investigated how the depressive status changed during the course of treatment and which factor correlated with depression.

31 patients of BPI who underwent surgery at our hospital during these three years. The age ranged from 17 to 56 (28.5 years old on average). There were 14 whole palsies, four C5-8 palsies, six C5-7 palsies, two C5-6 palsies and five other types.

The evaluation was performed using Zung Self-rating Depression Scale (SDS) twice when the patients first visited our hospital and when the re-innervation was recognized by EMG after the operation. Several factors supposed to be correlated with depression, such as pain, age, type of injury, time from injury and work status were investigated.

22 patients (71.0%) was estimated to be depressive. Pain, age, type of injury and time from injury were not significantly correlated with depression, However, SDS score had significantly decreased at the second evaluation after the operation, and the score at the second evaluation was significantly correlated with work status.

The greater part of BPI patients exhibited to be in depressive state. SDS score was correlated only with work status among several factors.





**P006**

## **Clinical Utility of Functional Assessment for Children with Obstetrical Brachial Plexus Palsy**

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**Purpose:** The purpose of this systematic review is to evaluate the clinical utility of functional assessments for children with Obstetrical brachial plexus palsy (OBPP).

**Method:** Medline and CINAHL databases were searched for surgical outcome studies on children with OBPP. Inclusion criteria were studies with level of evidence 1-4 published between 1996-2006. Functional assessments were classified using the International classification of function, disability and health (ICF). Clinical utility of the most frequently used measures were evaluated with an adapted Rudman and Hannah instrument evaluation framework.

**Results:** Forty-five studies were evaluated. 34 studies measured body function and structure, 1 activity, 2 participation, and 8 combined classification. Range of motion (n=21), Mallet (n=16), Medical Research Council (n=11), Active Movement Scale (AMS) (n=6), and Gilbert Shoulder (n=6) were measures of body function and structure most frequently used. Only 6 activity and participation measures were found. Of these 12 assessments, 83% are both descriptive and evaluative, 50% have specificity to OBPP and 42% are designed for infants to childhood/adulthood. 67% use clinical observation and 33% use self or parental report. Quantitative methods of evaluation were used in all measures. 33% included qualitative methods. 50% of these measures have established some components of reliability and validity.

**Conclusion:** No studies included all components of ICF to define function. The AMS and Mallet are outcome measures of body function specific to children with OBPP with excellent clinical utility. An outcome measure of activity and participation specific to OBPP, with excellent clinical utility, needs to be established.



**P007**

**Functional results of restoration of biceps brachii muscle function in surgical treatment of patients with brachial plexus injuries**

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**Aims:** To compare two different methods for neurotization of the biceps brachii muscle as well as muscle autotransplant after brachial plexus injury.

**Methods:** Restoration of flexion movements at an elbow joint was performed by neurotization of the biceps brachii muscle or muscle autotransplants in 43 patients. Indications for operative treatment were determined on the basis of clinical and electro-physiological examination. For reinnervation of a biceps brachii muscle we used direct neurotization of the musculocutaneous nerve with intercostal nerves (17 patients) or with an accessory nerve using a nerve autograft, usually the sural nerve (14 patients).

For atrophy of the biceps brachii muscle secondary to long term brachial plexus injury we used muscular autotransplants and neurotization with intercostal nerves (12 patients).

**Results:** Good to excellent and functional results (M3 to M5) of musculocutaneous nerve neurotization have been obtained with intercostal nerves (82 %) and accessory nerves (86 %).

Function  $\geq$ M3 of reinnervated muscular transplants has been obtained only in 7 of 12 patients in spite of muscular reinnervation being observed in 11 of 12 patients. The advantages of intercostal nerves were the possibility of direct connection, without requirement of nerve grafting, however the operation was more traumatic than using accessory nerve with sural nerve autograft.

**Conclusion:** We prefer accessory nerves for neurotization, because dissection was quicker and less traumatic. If the accessory nerve is too damaged by the brachial plexus trauma then neurotization with intercostal nerves gives almost equivalent outcome.



**P008**

**Usefulness of diffusion-Weighted MR imaging in the diagnosis of brachial plexus lesions**

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**Purpose:** To clarify the diagnostic potential of magnetic resonance imaging (MRI) with diffusion-weighted imaging (DWI) in determining the type and the location of brachial plexus lesions.

**Methods:** Five healthy volunteers and 16 patients with brachial plexus lesions underwent MRI with DWI using a 1.5-T MRI scanner. The type of lesion was traumatic palsy in 8 patients, birth palsy in 3 and neurogenic tumor in 5. Three-dimensional reconstruction of the bilateral brachial plexus was performed and the pattern of signal distribution of the affected side was compared with that of the healthy side on the patients.

**Results:** The brachial plexus could be visualized in all the volunteers. Identification of each structure was feasible at the root and at the trunk level, although difficult at the portion distal to the division level. Complete disappearance of root images were noted in case of root avulsion and partial disappearance of some cranial root images was also seen in longstanding cases. Hyperintense signal abnormalities were noted both at the site of post-ganglionic lesion and of tumor involvement.

**Conclusion:** MRI with DWI can be a useful tool in the non-invasive evaluation of brachial plexus lesions.



**P009**

**Investigation of upper extremity function by 3D motion analysis: Study in probands and clinical use in patients with brachial plexus lesions**

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**Introduction:** A new evaluation method of upper extremity function is presented. It is a video based system providing accurate and reproducible 3D kinematic data by tracking movements which was actually designed for clinical gait analysis. The transfer of the system from lower to upper extremity intends to overcome the deficiencies of subjective investigations of upper extremity function.

**Methods:** A 3D optoelectronic camera system with passive markers was used to capture the possible active ROM. 27 markers coated with retroreflective tape were applied over anatomical landmarks on both upper limbs and recorded simultaneously by 6 cameras. A 3-dimensional reconstruction of the position of markers was done by special designed software. We investigated healthy probands to demonstrate the use and reproducibility. Patients with brachial plexus lesions were additionally investigated before and after humeral derotation to demonstrate the clinical use of the system.

**Results:** The motion curves of probands argue for a reproducible motion sequence. Obtained pre- and postoperative kinematic data of patients group document the enhancement of the involved limbs` function: The rotational-positioning of the upper arm was shifted outwards about 30 ° averages. Active shoulder rotation increased in all patients, the average improvement was 10°. The system measured increased abduction (6° to 20°). Active elbow flexion didn't increase, however postoperative motion curves – containing kinematic information during the whole movement and not only the maximum of joint deflection – run smoother and faster.

**Discussion:** The method enabled objective analysis of upper extremity motion. The proband study which was performed revealed measured angles to be reliable and reproducible but generally lower than angles obtained from physical measurements. This is due to several reasons concerning the biomechanical model. Because of the more complex nature of upper limb kinematics the transfer of the system from lower to upper extremity still involves unsolved problems.



**P010**

**Restoration of the forearm supination deformity in the pediatric brachial plexus palsy patients by bony procedures**

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Obstetrical palsy of the upper extremity represents a severe traumatic complication, which involves the brachial plexus and occasionally the osteoarticular structures and muscles of the shoulder. Our aim is to describe and find an adequate modality of treatment for the relatively frequent obstetrical palsy sequela represented by forearm supination deformity. Forearm supination deformity tends to be progressive and therefore early recognition of this deformity is of paramount importance to prevent fixed deformities, which increase the hand deficit. A number of surgical techniques to correct supination deformity have been described in the literature. A soft tissue technique can be used to correct a supple deformity. However in fixed deformities bony procedures should attempt to reposition the forearm by osteotomy of the radius and/or ulna.

In this study we used osteotomy techniques of the forearm bones (consisting of excision of the radial head, radius pronation osteotomy, distal radio-ulnar fusion and wrist arthrodesis) to restore forearm posture and wrist stability in patients with supination deformity secondary to brachial plexus birth palsy. Twenty-one children (13 male, 8 female) whose age ranged between 3 and 14 years (mean age 7.6) operated between 1998 and 2006 were included in this study. Selected techniques were excision of the radial head for 7 patients, radius pronation osteotomy for 6 patients, distal radio-ulnar fusion for 4 patients, wrist arthrodesis for 10 patients. A combination of several procedures was often necessary to achieve the desired results. Additional tendon transfer procedures were performed if required.

In our series, the average gain in pronation was 96 degrees in radial head excision, 61 degrees in radioulnar synostosis, 66 degrees in radius distal rotation osteotomies, 58 degrees in wrist arthrodesis.



**P011**

**Harvest full length ulnar nerve by means of endoscope for contralateral C7 nerve root transfer in treatment of brachial plexus injuries**

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To avoid long scar formation after contralateral C7 transfer for treatment of brachial plexus avulsion injuries, endoscope was used to harvest the full-length ulnar nerve. The surgical procedure and its clinical effect are reported here. In our study, 6 patients with total root avulsion were recruited. Three 2-3 cm long incisions were made in the mid upper arm, elbow, and wrist , and the full-length ulnar nerves were harvested using the EVHS endoscope system. The surgery time was recorded, the vascularity of the dissected ulnar nerves was observed, and the recovery of the injured limb after contralateral C7 nerve root transfer was also measured. Compared with the traditional technique, there were no significant differences in surgery time, vascularity of the dissected ulnar nerve, or the recovery of the injured limb when the full-length ulnar nerve was harvested with endoscope (as part of the contralateral C7 nerve root transfer operation), but the degree of scarring after the surgery was markedly reduced. While the same levels of curative effect was ensured, the new endoscope-aided method for harvesting the full-length ulnar nerve for contralateral C7 nerve root transfer was not complicated and caused markedly less scarring.





**P012**

## **The pathophysiology of shoulder contractures in obstetric brachial plexus palsy and a modified surgical technique**

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**Introduction:** Obstetric Brachial Plexus palsy (OBPP) is often associated with internal rotation contractures of the ipsilateral shoulder. The purported mechanism is overaction of subscapularis/underaction of the shoulder external rotators. This does not explain the tightness of the shoulder in adduction rather than abduction or the elevation of the medial border of the scapula at extremes of passive shoulder external rotation in abduction. The mechanism of elongation of the coracoid whilst the elbow flexors are weak is also not explained. I propose a new explanation which is confirmed by surgical findings and offers an improved operation for surgical correction of this contracture.

**Methods/Materials:** Pathophysiology: At operation the coracoid is elongated but unless the shoulder is dislocated posteriorly does not prevent external rotation. Rather it is elongated due to a stiff thickened coraco-acromial ligament. The lower  $\frac{1}{2}$  -  $\frac{2}{3}$  of the subscapularis muscle is grossly normal but the upper  $\frac{1}{3}$ - $\frac{1}{2}$  is fibrotic as is the coracohumeral ligament. Thus a fibrous antero-superior band occurs in some cases of OBPP which prevents adequate shoulder external rotation even with dedicated physiotherapy. **Operative technique:** Via a deltopectoral approach the coraco-acromial ligament is divided (but the coracoid left). The coracohumeral ligament is divided and the upper  $\frac{1}{3}$  -  $\frac{1}{2}$  of the subscapularis muscle. Correction of the shoulder contracture is achieved without dividing most of the subscapularis muscle.

**Results:** This technique has been used in 6 cases of OBPP aged 3-8 with correction at >2 years follow-up of >45° external rotation without complications.

**Conclusion:** This description of the pathophysiology explains the clinical findings better than before and offers a simpler and less destructive operation that may result in a smaller loss of shoulder internal rotation. Whether the fibrosis is neurologically mediated or due to birth trauma is not clear.



**P013**

**Are brachial plexus blocks safe and effective for patients undergoing upper limb surgery?**

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**Objectives:** To assess whether patients can be safely discharged from hospital before the brachial plexus block has worn off and record any complications and concerns.

**Study design:** Prospective cohort study

**Methods:** 139 consecutive patients who had a brachial plexus block alone or combined with a general anaesthetic for upper limb surgery were assessed. The adequacy of the block and the outcome of the block was assessed.

**Results:** 100 patients received a general anaesthetic as well as the block and 39 patients received a brachial plexus block alone. The mean time to discharge was 27.5 hours (2-222 hours). The block provided adequate pain relief in 117 patients (84%). Sensation recovered in 15.4 hours (SD- 20.1) and motor power recovered in 14.7 hours (SD- 13.9). The most frequent complication was swelling of the limb which occurred in 5 patients. 3 patients developed Horner's syndrome and 1 patient developed chest tightness and facial tingling. Four patients had prolonged numbness for 192 hours following the block without any untoward effect. 121 patients (87%) were happy to care for themselves following discharge.

**Conclusion:** Patients can be discharged before the brachial plexus block has worn off with good advice. Patients should be warned of symptoms of Horner's syndrome and phrenic nerve anaesthesia.



**P014**

**Pronator rerouting to restore supination in obstetric palsy**

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Loss of supination of forearm is a major functional deformity in children with obstetric brachial plexus palsy. Even when the nerve repair is undertaken early, supination of forearm is not restored and it requires a separate surgery. Pronated forearm is cosmetically also not acceptable. Many methods have been described to correct this deformity. Our preference is the pronator rerouting technique described by Tubby. Though he described the procedure to restore supination in spastic hand children, we found it extremely useful in children with obstetric palsy also. Between 2004 & 2006, we have operated 10 children for loss of supination. The age ranges from 2 years to 10 years. The procedure involves rerouting the lengthened pronator teres muscle by Z plasty through the interosseous membrane to provide supination of forearm. We have obtained moderately good results in all the patients operated. In this paper, we describe the indications for the procedure, our operative technique and post operative rehabilitation. The results obtained after the procedure and the other procedures are also discussed.



**P015**

**Restoration of elbow flexion in brachial plexus injuries**

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Restoration of elbow flexion is the most important goal in brachial plexus injuries. This is the function of prime importance in upper trunk as well as in global plexus palsy. Choosing the appropriate procedure depends upon the time duration since injury and available proximal motor source. In cases of rupture, the best option would be bridging the proximal nerve root to upper trunk using sural nerve cable grafts. In C5,6 root avulsion, ipsilateral C7 can be transferred to upper trunk. When proximal motor source is not available, the next option is to do a nerve transfer. Various donor nerves used to neurotise biceps are phrenic, spinal accessory, intercostals, cervical plexus, two fascicles of ulnar or median nerves, thoracodorsal nerve, medial pectoral nerve and contralateral C7 nerve root. In delayed presentations, the only option available is muscle transfer. Trapezius and Latissimus dorsai can be used as pedicle donor muscles. Free functional gracilis transfer is the only option when adjacent muscles are not available. This paper reviews various options available. We would like to present our experience with the various procedures. Also we would like to point out how to find out the best possible option in a given patient.



**P016**

### **Sensory evaluation of the hands in children with brachial plexus birth injury**

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Ninety-five patients with 64 upper (C5-6), 19 upper and middle (C5-7) and 12 total (C5-Th1) type injuries were included. Obstetric plexus surgery had been performed in 14 patients. The sensibility of 32 palmar areas of both the affected and the normal hand was tested with Semmes- Weinstein filaments (calibers 2.83, 3.61, 4.31, 4.56, 6.65).

In upper type injuries abnormal values (4.31 – 4.56) were recorded in 7/64 affected hands. In C5-7 and total plexus involvement decreased sensibility was found in 5/19 (4.31 – 6.65) and in 4/12 (4.31 – no sensation) BPBI hands respectively. Patients treated conservatively had better sensation compared to those treated surgically.

Sensory recovery of the hands in BPBI is generally good especially in upper plexus injuries. Impairment of fine sensation is not uncommon in more extensive permanent BPBI. In total injuries protective sensation of the hand is not always restored.



**P017**

**Tendon transfer around the shoulder following paralysis of the brachial plexus**

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**Purpose:** To demonstrate that the correct operative technique can improve abduction of the paralyzed shoulder.

**Methods:** The operation most commonly performed was for abduction, namely for paralysis of the deltoid. The second type of operation was performed for external rotation of the upper extremity. The operation consists of 1) transfer of the insertion of the trapezius, with piece of bone to the greater tuberosity. 2) levator scapulae to the greater tuberosity. 3) latissimus dorsi and teres major transfer to the outer border of the humerus. 4) short head of biceps to acromion. 5) long head of triceps to acromion.

**Summary:** Results of the different tendon transfers were evaluated. Excellent 8; Good 12; Fair 10.

**Conclusion:** Transfer of the trapezius to the upper humerus has produced marked improvement in shoulder function.



**P017a**

**Glenohumeral joint dysplasia in children with sequelae from obstetric Brachial plexus palsy: Diagnosis and surgical strategy**

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**Introduction:** Medial rotation contracture of the glenohumeral joint combined with various bone deformations is the major sequel after severe upper brachial plexus palsy in children. The functional deficit is addressed by physiotherapy and/or surgery, but the underlying progressive joint changes are frequently missed or underdiagnosed. Magnetic resonance tomography (MRT) examination in transverse body sections allows secure and precise evaluation of all anatomic components of the shoulder girdle in these children; we present our first study illustrating the variety of deformities.

**Material and Methods:** Out of 800 children examined in the last 10 years, about 250 shoulders presented problems of severe medial rotation malposition and underwent shoulder release and/or tendon/ muscle transfers. Since 2004, in a continuous series of available patients with that condition, we performed so far over 70 MRT exams; the first 50 were evaluated.

**Results:** Mean age at examination was 8 (1-19) years. There was glenohumeral joint congruence in 37 cases, dorsal subluxation in 10 and real dorsal luxation in 2 children. There was one true joint dislocation.

The humeral head was round in 38 children, oval in 11 and bilobated in 1 case.

The glenoid was flat in 23, concave in 16, biconcave in 7 and convex in 3. There was one case with a new posterior glenoid.

The glenoid neck appeared normal in 35 and rather distorted in 15 children; the scapula was tilted in 32 and rather normally positioned in 18. Our examination did not reveal substantial muscle changes in volume or tissue quality.

**Conclusion:** MRT allows precise illustration of all tissue changes in glenohumeral dysplasia and might be the imaging tool to assess postoperative evolution after joint relocation procedures (anterior shoulder release) or tendon transfers.

**Conclusion**



**P017b**

**Free functional gracilis muscle transfer to restore finger flexion in severe complete obstetric brachial plexus palsy**

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**Introduction:** In severe total obstetric brachial plexus palsy (obpp), the lower trunk might not recover due to a severe nerve lesion (avulsion of C8 and/or Th1), wrong reconstruction strategy (insufficient or absent neurotisation-inspired by the neurosurgical strategy for adult brachial plexus surgery) or insufficient functional reinnervation-leaving a flail hand.

If basic sensation is present and if the wrist is stable with active extension possible, global finger flexion might be achieved by a free neurovascular gracilis muscle transfer, as described by Manktelow (1978)

**Material and Methods:** In the last 3 years, we performed this surgery in 4 children aged 5 to 7 years. The motor nerve was the distal branch of the spinal accessory nerve, prolonged with a sural graft down to the forearm. The muscle transfer was done as a second surgery about one year after the nerve was grafted and reinnervation was shown at the distal level by neuropathologic examination, showing outgrowing new myelinated nerve fibers.

**Results:** There are actually two good functional outcomes shown on video. The first case was a failure, probably due to insufficient nerve supply. The last case was done 2 months ago.

**Discussion and conclusion:** The permanent flail hand is a great challenge in all children suffering from total obpp lesion. A tailored free muscle innervated by a good motor nerve might be a valuable tool to render basic grip and hand function.





**P017c**

**Cortical reorganization after contralateral c7 transfer in treating brachial plexus avulsion injury**

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Peripheral nerve injury in a limb may cause cortical reorganization in human brain. The plastic change was complicate and variable. The surgery of contralateral seventh cervical nerve transfer is a complex peripheral nerve re-arrangement for patients with brachial plexus roots avulsion injury(BPAI). To explore the changes in brain function after such operation, human brain image study and animal research were carried out. Eight adult male patients with left BPAI were studied by using positron emission tomography (PET), and six adult healthy male subjects were used as control. Selective shoulder adduction on the right upper limb induced activation of the bilateral somatomotor cortices (SMCs), with the right region being more significantly activated, the bilateral occipital lobes and the ipsilateral parietal lobe in the patients. This activation pattern of the cortex was strikingly different from that obtained in the normal subjects. In rat model with left BPAI and treated by contralateral c7 nerve root transfer, both intracortical microstimulation and somatosensory evoked potential(SEP) were used to study the time course of plastic changes in bilateral primary motor cortex (MI) and somatosensory cortex (SmI).It showed that the original silence function area was reactivated 5 months after operation. From the result we first demonstrate that contralateral C7 transfer may induce the interaction of bilateral cerebral cortex and an extensive functional shift may occur between two hemispheres based on neural plasticity in the CNS. These findings may result in a better understand of the outcome after contralateral C7 transfer and offer new strategy of treatment.



**P017d**

**Relationship between treatment outcome and function of Latissimus dorsi muscle at patients with incomplete injury of upper trunk of brachial plexus repaired by transfer of Ipsilateral c7 root**

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**Objective:** To evaluate the relationship between treatment outcome and function of latissimus dorsi muscle at patients with incomplete injury of upper trunk of brachial plexus repaired by transfer of ipsilateral C7 root.

**Methods:** From march 1997 to September 2002, 9 cases of brachial plexus upper trunk lesions or incomplete injures of upper and middle trunk with injury of phrenic nerve were involved in the study. Restoration of elbow flexion was achieved by transfer of ipsilateral C7 root to the anterior division of upper trunk. The muscle strength of latissimus dorsi was checked preoperatively. Relationship between the treatment outcome of ipsilateral C7 root and muscle power of latissimus dorsi was assessed after the operation.

**Results:** For 6 patients with normal muscle strength of latissimus dorsi operation, restoration of elbow flexion was obtained after transfer of ipsilateral C7 root to the anterior division of upper trunk. However, for another 3 patients with decrease in or absent for muscle power of latissimus dorsi, no recovery of elbow flexion was achieved after operation.

**Conclusions:** For patients with incomplete injuries of upper and middle trunk of brachial plexus when the muscle strength of latissimus dorsi was decreased or absent, the ipsilateral C7 should not be chosen as donor nerve.



**P018**

**Functional results of pollicization for grade IV or V hypoplastic thumb - Isolated hypoplastic thumb vs hypoplastic thumb associated with symphalangism and/or congenital radial clubhand**

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**Purpose:** Congenital hypoplasia of the thumb often associated with symphalangism and congenital radial clubhand. We compared the results of pollicization for Blauth type 4 or 5 thumb hypoplasia who had associated symphalangism and/or radial clubhand, with those who had thumb hypoplasia alone.

**Materials and Methods:** Sixteen thumbs in 14 patients who had type 4 or 5 thumb hypoplasia, were operated by pollicization using Buck-Gramcko technique from November 1988 to June 2004. Depending on the existence of associated anomalies with morbid hand, this study classified all cases into 4 groups, 7 cases of thumb hypoplasia alone, 4 cases associated with radial clubhand, 2 cases with symphalangism, and 3 cases with both of radial clubhand and symphalangism. Based on Percival's functional assessment method, the results of operation for both hands in each group were assessed by the strength and accuracy of fingertip and pulp, opposition, grasp, sensibility, and satisfaction at appearance respectively.

**Results:** In terms of postoperative results according to Percival's functional assessment method, a group of thumb hypoplasia alone without associated anomalies accompanied in morbid hands showed the best results, 4 excellent, 2 good, and 1 fair. On the other hand, the group with only radial clubhand associated, showed 1 good, 2 fair and 1 poor. The group with symphalangism associated, showed 2 fair. The group with both radial club hand and symphalangism associated, showed 1 fair and 2 poor.

**Conclusion:** Functional results after pollicization were better in patients with hypoplastic thumb only, than those who had associated symphalangism and/or radial clubhand. Pollicised index finger were functioning as a thumb even in the patients who had associated symphalangism and/or radial clubhand.

**Key Words:** Thumb hypoplasia, Pollicization, Congenital radial clubhand, Symphalangism



**P019**

## **Late cocoon-hand release in a 15 year old girl with dystrophic epidermolysis bullosa - A case report**

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**Introduction:** Dystrophic epidermolysis bullosa (DEB) is a bullous disorder of the skin characterized by skin blistering following minor trauma. The hands, because of constant use during normal daily activity, are especially exposed to blistering, with progressive scarring leading to pseudosyndactyly, flexion contracture of the fingers and finally a cocoon-hand deformity.

**Patients and Methods:** A 15-year old girl presented with a bilateral cocoon hand deformity. On the left side there was still a fairly independent thumb, with some basic grasp function. On the right side there was a thumb-in-palm deformity, therefore we decided to operate this side first. After opening of the cocoon, the thumb was extended and the first web space deepened using blunt and sharp dissection. The thumb was fixed with axial K-wire in maximal abduction. Next the fingers were freed using blunt and sharp dissection, fully extended and fixed with an axial K-wire each. The speed up closure of the wound cultured allogenic keratinocytes were applied. A Mepithel hand dressing with caution to fully fill up the web spaces was applied for 7 days. The dressing was changed under anaesthesia twice. After 4 weeks the K-wires were removed and a splint moulded. Cultured allogenic keratinocytes were applied on residual skin defects. Physiotherapy was started 7 weeks after surgery.

**Result :** 3 months after operation there is complete wound closure. Daily physiotherapy is applied and basic grip functions are restored. Because of recurrent skin blistering the splint had to be revised 2 times.

**Discussion:** Usually cocoon hand release is performed between 4 and 6 years of age, in order to avoid additional secondary deformities. In spite of a remaining MP V subluxation function was satisfactory in our patient. Up to now there is not yet sufficient data to recommend one special technique for surface coverage after release of the deformity. Although we cannot quantify the influence of allogenic cultured keratinocytes, the potential benefit has no donor site morbidity like in autologous skin grafting. Prevention of deformity is of utmost interest. If deformity occurs, adequate treatment and timing should be done. However even in late release, basic hand functions can be achieved provided a multidisciplinary approach.



**P020**

## **Congenital constriction ring syndrome - A case of intrauterine amputation with ectopic implantation and review of literature**

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Congenital constriction ring syndrome is a sporadic group of congenital anomalies. The prevalence for live births is 7.7:10000 and 178:10000 for spontaneous abortions.

The clinical manifestations are mainly distal deformities (50%) such as amputation of limbs and digits, syndactyly, pseudosyndactyly, acrosyndactyly, rudimentary toes, and constriction of limbs and digits. Other anomalies such as clubfoot, leg length discrepancies, and cleft lip and palate can be associated with this condition.

Patterson classified constriction ring syndrome into four stages from a simple constriction ring to intrauterine amputation.

Here we report a case of a boy who had constriction rings involving both upper and lower limbs. His left hand showed a constriction ring at the interphalangeal level of the thumb and on the ring finger at the distal interphalangeal level and distal pulp. He also had amputations to his distal phalanges of index, middle, ring and little fingers.

In addition to this he had a soft tissue swelling on the lateral aspect of his left leg with nail remnants within the soft tissue swelling, which most likely represents the amputated tips from his digits. He also had pulmonary atresia, ventricular septal defect and a common atrium with two atrioventricular valves

This is a very unusual case which led us to revisit the pathophysiology of this condition.

Both intrinsic and extrinsic factors have been proposed to explain the cause of congenital constriction ring syndrome. Streeter stated that constriction rings were caused by an intrinsic defect of the subcutaneous germ plasm causing tissue breakdown and the resultant healing led to constriction rings. Torpin maintained that it was caused by amniotic bands becoming entangled around the digits. Evidence for both is discussed.

This case supports the exogenous theory although this does not explain the other anomalies present in this patient.



**P021**

### **An anatomical study of radial polydactyly**

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**Background:** Successful treatment of radial polydactyly requires a detailed understanding of the associated anatomy. Commonly used systems of classification e.g. Wassel, are based on the radiographically visible skeleton. However, such systems may underestimate the complexity of this condition.

**Aim:** To study the anatomical features of radial polydactyly associated with different skeletal levels according to the Wassel classification of duplication.

**Methods:** A prospective recording of anatomical findings was completed in 15 patients with thumb duplications undergoing primary corrective surgery. All surgery was performed by the senior author.

**Results:** 20 thumb duplications were studied. Patient age at surgery ranged between 8 and 127 months. All Wassel types were represented except type I. The ulnar duplicate was larger in all thumbs. Tight skin of the first web space was prevalent in more proximal duplications. Thenar muscles were attached to the radial duplicate in Wassel III and more proximal duplications. Extensor pollicis brevis was attached to the radial duplicate in Wassel IV and more proximal duplications. Anomalous insertion of flexor tendons was more common than anticipated with interconnections between flexor and extensor mechanisms. There was more independence of digital nerves than of digital arteries. The presence of skeletal malalignment was not specific to particular Wassel groups.

**Discussion:** This study highlights the complexity of the anatomical anomalies associated with radial polydactyly. Careful focus on the specific anatomical features will assist with surgical planning and ultimately optimize outcome.



**P023**

### **Staged reconstruction for hands and feet macrodactyly in Proteus-like syndrome**

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Proteus syndrome is an extremely rare and variable hamartomatous disorder characterized by malformations present at birth and multiple tissues overgrowth including partial gigantism and asymmetry of the distal part of limbs, connective tissue naevi, hemangiomas, lipomas, lymphangiomas, linear verrucous epidermal naevi, hyperostosis and tubular bone overgrowth. It affects patients in a mosaic manner with estimated prevalence less than 1 per million.

Macrodactyly in hands and feet, a common clinical finding in Proteus syndrome, apart from concerns regarding shoe wear, is both functionally unacceptable and cosmetically unappealing.

We present a clinical case of an eight-year old girl who was followed from birth onwards for features consistent with Proteus syndrome which included bilateral radial hand hypertrophy with thumb, index and middle finger gigantodactyly and bilateral hypertrophy of distal two-thirds of the feet with toes I-III gigantodactyly.

Reconstruction consisted of serial procedures which included epiphysiodesis, wedge and vertical osteotomies with osteosynthesis of metatarsal bones and phalanges, ray resections, amputations and debulking procedures. We recommend carefully planned and timely-fashioned staged reconstruction according to local progression and patients growth with a combination of proposed surgical modalities.



**P024**

**Lengthening of phalanges and metacarpal bone using a new modified Ilizarov method**

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**Background:** Distraction lengthening is one of the surgical reconstructive methods used to obtain length of a digit and to improve functional and cosmetic disorder. In this study we evaluated the results of lengthening the phalanges and metacarpal bones by the Ilizarov minifixator (Ito Medical Instruments, Tokyo, Japan).

**Materials And Methods:** We treated 4 fingers of 2 males and 1 female (mean age 28 years; range 11 to 56 years). Etiologies of lengthening were trauma in 3 fingers and congenital brachymetacarpia in one. Incised fingers were 1 distal phalanx of the thumb, 1 proximal phalanx of the middle finger, 1 proximal phalanx of the ring finger and 1 fifth of the metacarpal bone. As the method of lengthening, callus distraction were adopted for all cases, but cancellous bone graft was performed after lengthening in 2 cases. The distraction rate was 0.25-0.5mm/day for all cases, and lengthening started after a 4-day waiting period.

**Results:** In all cases, procedures of distraction lengthening were completed without early consolidation or bone failure related to traction wires. All patients tolerated the procedure and were finally satisfied with the cosmetic and functional results. The mean gain of lengthening was 16.3mm (13-19mm). The mean duration of distraction was 31 days (18-60 days) and external fixation was removed at the mean of 88 days (57-132 days) after surgery. In callus distraction, the mean gain of lengthening was 14mm (13-15mm) and external fixation index (EFI) mean was 58.8 days/cm (31-69.5 days/cm). Two fingers had cancellous bone graft performed at 57 days after surgery, and additional techniques (plate fixation) were needed to achieve bony consolidation in one finger with bone graft.

**Conclusion:** The Ilizarov minifixator has several advantages for bone lengthening in hand surgery.





**P025**

### **Type of Madelung's deformities and its treatment**

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**Purpose:** To classify Madelung's deformities by the degree of angulation of distal radius and involvement of lunate fossa, and to determine the methods of surgical treatment.

**Methods:** Thirteen wrists in 9 patients with Madelung's deformities, 11 congenital (4 bilateral, 3 unilateral, 7 females) and 2 post-traumatic (1 female, 1 male), were preoperatively evaluated by plain radiography, 3D-CT (7), and MRI (3). Three types were defined as the first, mild degree involvement showing accentuation of radial inclination and palmar tilt with relatively preserved radiocarpal joint surface (7 cases), the second, moderate degree involvement showing more severely involved lunate fossa than scaphoid fossa (3 cases), and the third, severe degree involvement showing severely involved lunate fossa extending scaphoid fossa (3 cases). Distal radial osteotomy only for the first type, intra-articular wedge-in osteotomy of lunate fossa for the second type, and three-dimensional intra-articular double osteotomy for the third type were performed. Ulnar shortening or Sauve-Kapandji operations were combined according to the distal radioulnar joint (DRUJ) condition. Mean age at the time of operations was 10.9 years, and mean follow-up period was 18 months. The clinical results were evaluated using subjective cosmetic appearance, radiologic evaluation, ROM, grip strength, VAS (visual analog pain score).

**Results:** All patient satisfied about cosmetic appearance, and lunate coverage, DRUJ alignment, ROM and grip strength ( $p < 0.05$ ), and VAS were improved. In two cases the deformity was recurred and needed for additional correction.

**Conclusion:** Three types of operation, which were designed in accordance with the degree of deformity and the involvement of scaphoid and lunate fossae, were efficient for the improvement of cosmetic appearance, pain relief, and restoration of wrist anatomy.



**P026**

**Non-vascular transfer of the phalanges from foot to hand in cases of congenital aphyalangia**

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**Purpose:** A cessation of the longitudinal finger development in embryological life results in a condition called *congenital aphyalangia*. Free transfer of the toe phalanges to hand without vascular anastomosis is a proposed option for reconstruction of the hand suffering congenital aphyalangia.

**Work plan:** 6 patients, clinically and radiographically diagnosed as congenital aphyalangia who scheduled for 18 nonvascular free toe transfer procedure in our clinic were followed up for their functional capacity, yearly median longitudinal growth, epiphyseal viability, bone resorption or necrosis, digital tip necrosis, fracture, angulation, subluxation, and recipient or donor site infection.

**Results:** Median yearly longitudinal growth of the 18 transferred phalanges was found to be 2,4 mm. The number of the phalanges with persistent epiphyseal lining seen at the last graphies was 14 (78%). One of the cases was reoperated for postoperative subluxation. No fractures or angulation above 15 degrees was detected. Partial bone resorption was seen in 3 patients (16%), while total resorption of the graft was seen in 1 patient (5%). In regards of soft tissue complication, digital tip necrosis was seen in 1 patient (5%). No infection was seen in the follow-up. Minimal donor digit shortening was seen in all cases.

**Prospects:** Non vascular phalanx transfer is an alternative rehabilitation method which may be offered for certain congenital hand anomalies that are not suitable for vascular phalanx transfer like congenital aphyalangia, in an effort to ease the use of the prosthetics and gain certain functions.

**Key Words:** Congenital anomalies; aphyalangia: non vascular phalanx transfer

**Key References:** F Unglaub 2006, AV Cavallo, T Gohla 2005



**P027**

### **Macrodystrophia lipomatosa in the pediatric hand**

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Macrodystrophia lipomatosa is a congenital macrodactyly characterized by proliferation of all mesenchymal components, particularly fibroadipose tissue s. Especially, macrodactyly is a rare congenital anomaly of the hand that is difficult to treat.

A 6-year old girl present ed with enlarged index, middle and ring finger , particularly pronounced hypertrophy of middle fin ger and cerebriform hypertrophy of her right palm. And her DIP & PIP joint s of marked enlarged 3 rd finger didn't function. MR imaging demonstrated proliferation of fatty tissue in the territory of the median nerve in the hand.

We corrected the macrodctyly through staged operations: on the first stage, we performed en bloc resection of radial side of marked enlarged 3 rd finger as soft tissue debulking procedure . In order to limit growth, we did epiphygeal ablation, stripping of the digital nerve. Also tip plasty was done. Second stage, we did debulking procedure to ular side with preservation of digital artery & nerve in this side.

The degree of reduction was marked , however, the finger is still a little bit bigger than the normal one of the opposite hand. Although the pediatric patient may require additional surgeries because the deformity will continue to grow, early treatment can allow this child the benefit of a cosmetically appearance and provide psychological effects. Furthermore, follow up of this case is need ed conti nuously. We consider decompression of median nerve also.

We report a case of macrodystrophia lipomatosa of the hand with a review of the literatures.



**P028**

**A new small distractor for bone lengthening in congenital hand deficiencies.**

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**Introduction:** We evaluated progressive bone lengthening in congenital hand deficiencies with a new small distractor.

**Patients and Method:** Between 1999 and 2005, a total of 10 patients (2- 11 years old) underwent lengthening of 12 bones. Nine metacarpi and 3 phalanx were lengthened. We used a small distractor (13 ounces, 45 millimeters).

**Results:** The distraction was stopped after 32 (range, 25-40) days, giving a median lengthening of 16 (range, 9-20) mm. It took an average of 107 days for bony consolidation. Bone lengthening was 16 mm and time of treatment was about 107 days. Complication rate was 33 percent (fracture, non-union). There were no complications involving nerve and vessel injuries, tendon ruptures or altered sensation.

**Discussion:** Bone lengthening without bone graft is a good technique for congenital hand deficiencies. The use of a small and light distractor improve the possibility in young patients. But this technique require family education and good cooperation with of the children.



**P028a**

### **Anatomy of Kirner's deformity**

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The aetiology of radial and palmar curvature of the distal phalanx in this congenital deformity of the little finger is not known.

In two girls (12 and 13 years) with a bilateral palmar deviation up to 50° in the diaphysis of the distal phalanx we performed high resolution MRs at 3 Tesla, but the unusual distal insertion of the flexor digitorum profundus tendon along the palmar surface according to the theory of CARSTAM (1970), DUBRANA (1995) and BENATAR (2004) was not found.

We planned a serial palmar opening wedge osteotomy according to CARSTAM. Intraoperatively an unusual cord of the flexor digitorum profundus tendon to the radial lateral interosseous ligament of FLINT, extending from the unguis spine of the unguis tuberosity to the lateral tubercle of the base of the distal phalanx was found. After opening wedge osteotomy there was still a high tension to palmar curvature noticed. We cut the accessory tendon cord distally and the lateral ligament proximally at the lateral tubercle and now the opening was very easy.

These findings reveal a more pathophysiological explanation of the deformity of the nail unit of the distal phalanx like a rein than simple distal insertion of the flexor tendon and it appears that KIRNER 's deformity may be the result of an accessory cord of the flexor digitorum profundus tendon to the (short?) lateral interosseous ligament of FLINT.



**P028b**

**The missing link in Madelung's deformity**

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According to VICKERS the essential lesion in MADELUNG's deformity (MD) is in the ulnar component of the distal radius physis and the adjacent bony epiphysis. In the majority of his cases VICKERS found an abnormal ligament links the proximal pole of the lunate to the palmar and ulnar cortex of the distal radius, proximal to and bypassing the growing zones. This ligament tether could be the primary cause of MD.

In 2004 we diagnosed the deformity in two sisters (16 and 12 years old, Leri-Weill's syndrom). The older girl had typical signs of the deformity, the younger girl beginning deformity signs. A high resolution MR at 3 Tesla of both wrists of the two girls showed a typical VICKERS- ligament only in the 16 year old girl, but not in the 12 year old girl.

Intraoperatively both wrists of the younger girl showed a great atypical muscle (M. flexor carpi radialis profundus vel brevis -FANO 1851) and a bridging of the bone over the epiphysial cartilage on the ulnar palmar distal radius.

This muscle extended from the palmar surface of the radius and ulna – with absence of the pronator quadratus – to the tuberculum of the scaphoid and dorsal horn of the lunate and triquetrum. According to the theory of Richards (1852) this muscle is the missing tibialis posterior muscle in the hand (tibialis postérieur l'avantbras). It appears, that a ligament - arising from distal palmar ulnar metaphysis of the radius to the proximal row and palmar radioulnar ligament - is an atavism of a lost wrist muscle and the primary cause of the premature epiphyseal closure in the ulnar and palmar part of the radius epiphysis.



**P029**

## **Laser therapy - an important treatment adjunct in hand and upper limb tendon management**

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**Introduction:** Laser Therapy (LT) is an integral part of hand and upper limb tendon treatment and rehabilitation. This is due to its unique stimulatory properties through bio-activation from wavelength specific polarized infra-red light. Tendon, as a low vascular tissue, is dependent on healing from internal cellular repair and regeneration rather than facilitated external blood supply.

**Methods:** The mechanism of LT action occurs at multiple levels from the atomic through to the organelle, cell, local tissue and finally systemic at the organism level. These effects on living tissue occur both locally at the time and site of irradiation and latently away from the site through 10 designated and documented pathway actions. LT is optimally applied through single or multiple 'cluster' probes in a wavelength ( $\lambda$ ) range from 790nm - 906nm.

**Results:** LT locally generated affects include cellular changes of: 1) increased ATP production through direct action on the respiratory chain of the mitochondria and 2) via light wave particle energy transfer; cellular activity is optimized through 3) cellular lipid bi-layer repolarization, 4) singlet oxygen formation and 5) afferent pain transmission reduction. Local tissue changes include 6) lymphatic flow and 7) fascial layer permeability. Systemic effects are induced through 8) endogenous opioid production, 9) neural axoplasmic flow facilitation and 10) modulation of cells and plasma within circulating blood with subsequent autonomic changes. Laser is non-thermal and will not directly increase effusion, vasodilation or blood flow. **Conclusion:** Damaged tissue, specifically tendon, is receives bio-activation from the LT action to produce ATP for normal function and self repair, plus normalization of neural circulation. This restores optimal repair at a rate that is faster and less painful than untreated tissue with increased collagen strength and tissue structural stability.



**P030**

**The midline Zig Zag incision in hand surgery**

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We report on the use of the midline zig zag incision. This incision has been successfully used for over 30 years in both the adult and paediatric patients. It provides an easy, reliable and safe access yet free from immediate and delayed complications. Skin flap necrosis, scar hypertrophy or contractures have not been observed to date.

The midline of the finger is identified. The Zig - Zag incision is designed along the midline such that it joins the digital flexion creases at 45 degrees. The lateral limits of this incision do not encroach on to the path of the neurovascular bundles. The flaps raised are of uniform thickness,

This incision permits easy access to the midline structures such as the flexor tendons and joints. Dividing the Grayson's ligament facilitates access to the neurovascular bundles. By accessing the nerve from the midline a large scar on the border of the digit is avoided. Skin flap necrosis has not been observed to date





**P031**

**Effect of hyaluronic acid to flexor tendon-pulley interaction after tendon repair: A biomechanical in vitro study in a modified human model**

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**Introduction:** Postoperative finger functions after flexor tendon repairs are occasionally unsatisfactory. The final goal of flexor tendon repair is to allow maximal excursion of the tendons and enough strength of repaired tendons producing as little friction as possible. Postoperative adhesion inhibits the restoration of tendon gliding. The purpose of this study is comparing the gliding resistance between the repaired tendon and intact A2 pulley before and after administration of hyaluronic acid in a modified human model.

**Materials and methods:** The concept of friction measurement and its application to the tendon-pulley unit has been verified and validated, as previously (An et al.). The tendon was cut and repaired by a modified Kessler suture technique with running epitendinous suture, and soaked in HA with 3 different concentrations. The measurement group was classified as follows; intact tendon group, only repaired tendon group, tendon soaked in 0.1mg/ml, 1mg/ml, 10mg/ml HA group. Three trials were performed for each of 5 angle positions (20-60 degree).

**Result:** The resistance increased after repairing, and then it decreased after soaking in hyaluronic acid solution.

**Discussion:** Many factors may contribute to the final results of tendon repair. A critical factor contributing to poor function after surgery is postoperative adhesion. Early rehabilitation is one of the most important factors to prevent the adhesion. We believe that another factor may be the lubricant. Hyaluronic acid has a beneficial effect on both the repaired tendon and synovial sheath. Administration of hyaluronic acid may be a definitive surgical adjunctive in flexor tendon repair.

**Conclusion:** Decrease of the frictional resistance may be an important advantage for early rehabilitation. In vivo study should be performed in the future.



**P032**

**Comparison of tissue reactions of adenoviral, adeno-associated viral, and liposome-plasmid vectors in tendons with early-stage healing responses of injured flexor tendons**

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**Purpose:** Delivery of growth factor genes that may substantially increase the healing rate of injured digital flexor tendons is a new application of gene therapy. Adenoviral, adeno-associated viral (AAV), and liposome-plasmid vectors have been used to deliver genes to tendons, but tissue reactions to these vectors by tendons, in particular in contrast to the healing responses in the injured tendons, were unknown. This study was designed to compare tissue reactions of above-mentioned vectors in tendons and healing responses of injured flexor tendons.

**Methods:** Forty-two flexor digitorum profundus tendons of 6 New Zealand white rabbits were used. Eighteen tendons were divided into 3 groups of 6 each and injected with different vectors: adenoviral vector (Ad5-lacZ,  $1 \times 10^{10}$  viral particles), AAV2-luciferase ( $1 \times 10^{10}$  viral particles), or pCMV- b with liposome. Another 12 tendons were cut and repaired. At 3, 7, and 14 days, the tendons were harvested and stained with hematoxylin and eosin. Normal flexor tendons were harvested as control.

**Results:** Tissue reactions of the liposome-plasmid vector in tendons were the most prominent among the 3 vectors tested. The adenoviral vector elicited a moderate degree of tissue reaction. AAV2 vector caused remarkable reactions in endotenon but almost no reactions in the epitenon. Early-stage tissue reactions were remarkable in the injured tendons. Compared with early-stage inflammatory and healing responses, the reactions elicited by these vectors were less severe.

**Conclusions :** Compared with early-stage healing responses in injured flexor tendons, the 3 gene delivery systems tested elicit less severe tissue reactions in flexor tendons. Adenoviral and AAV vectors elicit less severe tissue reactions than liposome-plasmid vectors. AAV2 appears to cause almost no reactions in endotenon. In terms of tissue reactions, adenoviral and AAV2 vectors, in particular AAV2, are suitable gene delivery systems for future gene transfer to the tendon *in vivo*.



**P033**

**Flexor tendon retrieval – A helping hand.**

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**Introduction:** Flexor tendon repair within Bunnell's no-man's land (zone II) remains technically challenging. Optimal healing is achieved through atraumatic tendon retrieval and primary repair with retention of pulleys. Muscle contraction and vincular rupture following tendon division can lead to significant retraction of the proximal end outwith the digital fibro-osseous sheath. Delivery of this tendon beneath the pulleys to allow approximation and repair can be an awkward manoeuvre with the potential for further injury to an already traumatised tendon.

**Method:** We describe a cheap, reliable, atraumatic method of delivery of the proximal tendon end through the flexor sheath without venting / release of pulleys. The finger of a sterile glove is passed over the exposed tendon and secured proximal to the site of repair by a ligature / transfixion suture. The glove fingertip is then passed through the pulley / sheath and twisted to gather the tendon end reducing its cross-sectional area, minimising impingement, thus facilitating its passage beneath tight pulleys.

**Conclusion:** Other methods of tendon retrieval address tendons retained within the sheath or involve tendon suture / traction in the region of repair. We feel this method avoids tendon trauma within the zone of injury whilst retaining the pulleys thus preserving economy and efficiency of finger flexion.



**P034**

### **Universal tendon spacer to improve two stage tendon grafting**

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Carrying out a two stage tendon graft procedure involves placement of a silicone rod. The digital canal is not made up of a tunnel of constant diameter, and the works of Strauch demonstrate the perfect congruity existing between the pulleys and the passage of the underlying superficialis and profundus tendons, particularly at the level of the A1, A2, A3, A4 and A5 pulleys. It is apparent that the dimensions of the digital canal are not the same during the passage of the superficial and profundus tendons through the A1 pulley, then after the chiasma of the superficialis at the level of the A2 pulley and at its flattening during the passage through the A3 pulley.

For the last five years we have been using a conformable universal tendon spacer, developed by AREX®, following studies carried out on fresh anatomical specimens. The universal tendon spacer is made from high-resistance silicone and has an oval cross section and its two axes vary in thickness from 1.5-3 mm, and in width from 3-6 mm over a total length of 49 cm.

The advantage of this conformable tendon rod with its conical shape is that it occupies completely the space left around the pulleys. The device is introduced into the digital canal via the most proximal pulley and advanced until it abuts against the most distal pulleys, at which point it is very gently withdrawn. The proximal end of the universal conformable tendon rod must be completely free of obstruction in order to avoid a 'serpentine' effect occurring during passive mobilisation exercises.

As part of good operating theatre management this universal tendon spacer provides solutions to all surgical problems encountered, and avoids the need to stock four widths of silicone rod which do not in any case get round the 'container – contents' problem.



**P035**

**Biomechanical evaluation of spiral linking technique for tendon repair: Looking for an optimal configuration**

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**Introduction:** A previous (AAOS, 2006) biomechanical study of Spiral Linking Technique for tendon repairs showed that it was strong enough to be used in clinical practice as an alternative to Pulvertaft (1956) weave tendon repair. However, lack of stiffness and the need of longer tendon ends were identified when compared to Pulvertaft

**Methods:** The technique is to spiral one tendon around another. Sutures are placed through each resulting spiral. We used an identical protocol to our original study set up to enable direct comparison: pigs' trotters extensor tendons, 2-0 Ethibond suture material and same Instron testing machine to load to failure etc1. We started with reducing number of spirals to 3, 2, 1 and eventually sutured parallel tendons, while maintaining the overlapping length at 35-40 mm and same number (6) of mattress sutures.

2. We used an alternative cross stitch technique to reduce the number of sutures employed in repairs by assuming, that the cross stitch is equivalent to two mattress sutures

**Results Table:** Mean peak load to failure in Newtons and stiffness in N/mm

	<b>Parallel</b>	<b>1 spiral</b>	<b>2 spirals</b>	<b>3 spirals</b>	<b>4 spirals</b> previous test
<b>Load, N</b>	<b>77.463</b>	<b>89.927</b>	<b>95.489</b>	<b>101.334</b>	<b>102.255</b>
<b>Stiffness, N/mm</b>	<b>9.439</b>	<b>9.789</b>	<b>10.577</b>	<b>7.134</b>	<b>6.78</b>

Statistical analysis – SPSS 12.0.2 for Windows.

**Conclusion:** Creating two spirals appears to give the optimal configuration to spiral tendon repairs. This reduces the tendon length required and improves stiffness. Using one cross stitch in the middle of a joint of repair can further augment the repair.



**P036**

**Prospective randomized trial of injection of dexamethasone versus triamcinolone for idiopathic trigger finger**

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**Introduction:** There are no data to help guide the use of a soluble corticosteroid vs. insoluble corticosteroid for trigger fingers. We performed a prospective clinical trial of dexamethasone vs. triamcinolone for the treatment of idiopathic trigger finger.

**Materials and methods:** 84 patients were enrolled, 68 patients completed the 6-week follow-up, and 63 patients completed the 3-month follow-up. Outcome measures included the Disability of the Arm, Shoulder and Hand (DASH) questionnaire, trigger finger grading according to Quinnell, and satisfaction on a visual analog scale (SVAS). Patients were permitted additional injections and operative treatment at any time.

**Results:** At the 6-week follow-up, the triamcinolone group demonstrated a statistically significant improvement in satisfaction ( $p < 0.05$ ) and a trend toward improvement in Quinnell score over the dexamethasone groups ( $p = 0.17$ ). At the 3-month follow-up, there was no difference in satisfaction ( $p = 0.54$ ) and a significant improvement in Quinnell score in patients receiving triamcinolone ( $p = 0.01$ ). Absence of triggering was recorded in 45% of patients at 6 weeks and 60% of patients at 3 months with significant difference seen favoring the triamcinolone group at 6 weeks only ( $p = 0.066$  and  $p = 0.12$ , respectively)

**Conclusion:** Patients should be advised that the overall success rate within 3 months is approximately 60%. Triamcinolone was superior to dexamethasone in terms of Quinnell score, requests for surgery, and cure rate six weeks after injection, but not DASH, satisfaction, repeat injections, or cure rate at 3 months.



**P037**

**Subcutaneous rupture of the extensor pollicis longus tendon with extension lag of the thumb metacarpophalangeal joint**

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Five cases were investigated into subcutaneous rupture of the extensor pollicis longus tendon (EPL) with active extension lag of the thumb metacarpophalangeal (MP) and interphalangeal joint. In four cases, tendon ruptures occurred after undisplaced fractures of the distal radius, and in the other one occurred following rheumatoid arthritis.

All cases were females, their ages ranged from 54 to 83 years. The mean intervals between fracture and EPL tendon rupture was 13.5 days in the cases which were treated with casting and was 2.5 days in the cases without fixation. Extensor indicis proprius tendon transfer was performed in all cases. There were attrition rupture of EPL stump at Lister tubercle in all cases. At operative findings in the first extensor compartment, the cause of extension lag of the thumb metacarpophalangeal joint was due to absence of the extensor pollicis brevis tendon (EPB) with four cases, and hypoplasia and adhesion of EPB with a case. Tendon rupture at a median 8 days from the injury suggested that traumatic factors at injury and poor tendon nutrition were more important, furthermore, the excessive force was added to EPL because extension of MP joint was compensated for by EPL in the absence of EPB.

As a result, we considered that EPL tendon rupture of these cases occurred earlier than presence cases of EPB that have been previously reported as before.



**P038**

***In vitro* engineering of extensor tendon complex: A preliminary study**

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**Purpose :** Repairing defects of an extensor tendon in zones 3 and 4 is challenging in hand surgery because of the lack of autologous donor tissues with appropriate structural features. This study was to develop a novel approach to construction of scaffold layout and biosynthesis of extensor tendon complex *in vitro*.

**Methods:** We developed a spring device that can position polyglycolic acids (PGA) fibers of a desired pattern of polymer layout. Group 1, cultured human extensor tenocytes were seeded onto the PGA fibers to construct cell-scaffold constructs. Group 2, human dermal fibroblasts were seeded; and Group 3, cell-free scaffolds (control). These constructs were under static culture for 4 weeks and dynamic culture in the nude mice we designed for additional 8 weeks. At 12 weeks, constructs were harvested and compared histologically and biomechanically, and observed under an electron microscope.

**Results:** In the scaffold seeded with tenocytes, we found fine cell attachment to the scaffolds and abundant ECM secretion. PGA fibers were mostly degraded after 12 weeks. Constructs of PGA with two cell sources had similar appearance of human extensor tendon complex: one central slip, two lateral bands. The connection bands formed distinctively. In contrast, no tendon structure formed in the cell-free control. In both cell-seeded groups, immunohistochemistry showed expression of collagen I, decorin and fibronectin in these constructs. The ultimate strength of the constructs seeded with tenocytes was  $3.0 \pm 0.3N$ , which did not differ statistically from those seeded with dermal fibroblasts ( $2.8 \pm 0.3N$ ).

**Conclusions :** Extensor tendon complex with central, lateral, and connecting bands was engineered *in vitro* with a novel device and polymer layout method. Constructs using dermal fibroblasts have similar histological and biomechanical characters compared with those using extensor tenocytes. To our knowledge, our investigation is the first attempt of construction of a tissue-engineered digital extensor complex.





**P039**

### **Histological study of the Flexor Digitorum Profundus insertion**

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**Introduction:** The tendon bone enthesis at the insertion of flexor digitorum profundus (FDP) into the distal phalanx of the digits is a clinically important structure which has not been well described histologically. We set out to describe the nature of the tendinous insertion.

**Methods:** The distal phalanx – FDP complex was harvested from 25 digits from 5 fresh frozen cadavers. The fingertips were fixed in formalin and prepared for histological processing. Slides were produced of sagittal sections through the distal phalanx and stained with haematoxylin and eosin and safarin-o. Slides were examined under polarised and non-polarised light.

**Results and Conclusions:** The FDP insertion was found to have a collagenous layer, demonstrated by direct vision of chondrocytes and uptake of safarin-o. The enthesis can therefore be classified as a fibrocartilagenous tendon insertion. The fibres of reticular collagen do not insert directly into the bony distal phalanx – rather they follow an oblique insertion angle. The angle of insertion and its fibrocartilagenous nature may have a bearing on the ideal repair method in the clinical setting.



**P040**

### **A new twist to Lister's spiral – An anatomical study of the flexor digitorum superficialis**

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**Introduction:** The superficialis spiral refers to the spiraling nature of the fascicular collagen bundles of flexor digitorum superficialis (FDS) as the slips pass around flexor digitorum profundus (FDP) to join at the chiasm of Camper. If the tendon slips are transected at this level, the proximal and distal ends will rotate through 90 degrees, but in different directions. The unwary surgeon could reattach the slips in this contra-rotated arrangement, thus narrowing the aperture for FDP and predisposing to poor gliding and triggering. We set out to demonstrate this phenomenon in cadaveric hands.

**Methods:** The flexor tendons of 5 fresh frozen cadaveric hands were used for this study. The flexor Sheath was exposed, keeping the annular pulley system intact. Lacerations were created in the tendons in zone II, and the interrelations of the tendons and orientation of the slips of FDS was noted before and after application of force through the divided proximal ends of the tendons

**Results:** Spiraling tendon fibres were identified in the FDS and FDP tendons. Counter rotation of the slips of FDS occurred in every finger after traction on the divided proximal tendon. In three of the five hands studied, the FDS tendon proper also rotated around FDP, making accurate restoration of anatomy more problematic

**Conclusions:** We have demonstrated that the superficialis spiral is a real entity, which has the potential to distort the normal anatomy of the flexor tendons in zone II lacerations. Surgeons must be cognizant of the changing relationships of the FDS slips after transaction to avoid repairing the tendon in an incorrect orientation.



**P041**

**The longer pullout suture technique for early active motion in repair of flexor tendon lacerations at the proximal zone-2**

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Generally, it's advocated to use the stronger suture techniques and also suture materials to decrease suture rupture or gap formation and adhesions in the flexor tendon repairment especially in the zone-2. But it's possible to solve this problem by transmitting the stresses on the suture site to the proximal part of the repaired cut ends of the tendon. This meticulous suture technique provides easy gliding of repaired tendon and decrease complex regimes of physiotherapy.

**Materials&Method:** At any level of the 2nd zone, the proximal cut end of the tendon is prepared. A longer pullout suture in a nonlocking fashion is applied to the proximal stump of cut-ends and is pulled through the pulleys to the suture site. The arms of the pullout suture are passed through the distal pulleys via a soft and thin stylet which has two holes at the front, and finally pulled out just over the nail with using two needles. While the arms of the pullout suture are being pulled distally, a meticulous tendon suture is completed without grasping the pullout sutures. A dorsal splint, slightly flexing the wrist and MP joints, is applied. Early active motion is advised without fear of gap formation or rupture. Splint was removed at the end of the sixth week and the pullout suture tenth week.

In this study we included only the cases of proximal 2nd zone deep flexor tendon lacerations repaired with this technique. Nineteen cases were aged 6-55 years.

**Results:** Satisfactory function recovered (according to Strickland's system) in all of these cases due to clean cut injury, except one case in whom a late rupture has occurred due to early removal of the pullout suture.

**Conclusion:** Longer pullout suture technique is a safe and easy method for the laceration of finger flexor tendons in the 2nd zone.



**P042**

**Is repair of a divided flexor digitorum superficialis of the little finger necessary?**

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**Introduction:** The little finger makes the smallest contribution to grip strength and in addition, the flexor digitorum superficialis (FDS) of the little finger is usually small, making a strong repair difficult. In view of this, we wanted to study if the FDS of the little finger is essential and determine if repair of the divided tendon necessary.

**Methods:** We examined the little finger in 402 normal subjects for the presence or absence of the flexor digitorum superficialis. All subjects also had their grip strength measured. Statistical analysis of the results was carried out using the statistical software program SPSS (Version 14), with the grip strength values of subjects with or without the FDS of the little finger adjusted for age, gender, hand dominance and occupation.

**Summary:** No statistically significant difference was seen in the grip strength measurements between subjects who had a flexor digitorum superficialis tendon to the little finger and those who did not. This study demonstrates that absence of the flexor digitorum superficialis to the little finger is not associated with decreased grip strength.

**Conclusion:** Our study suggests that repair of the divided FDS of the little finger is not necessary.



**P043**

**Is the attachment of the tendon of flexor digitorum superficialis a signature of phylogenetic heritage? An anatomical study and bio-mechanical evaluation**

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**Background:** We aim to study the anatomy of FDS and FDP tendon and correlate it with descriptions of equine FDS anatomy in an attempt to correlate structure and function.

**Materials And Methods:** 48 FDS and FDP tendons from 12 hands were dissected from the wrist to their insertion to the middle and distal phalanges. The medio-lateral and AP diameters were measured proximally where the tendons were round with vernier callipers. The area of insertion of both tendons was measured and a 3 dimensional model created to analyse the bio-mechanics. The anatomical details were compared with descriptions of flexor tendons in horses.

**Results:** FDS was present in all the fingers dissected. The ratio of medio-lateral diameter of FDS to FDP was 0.86 average for index, middle and ring fingers (range 0.8-0.98, SD=0.8), compared to the little finger which was an average of 0.39 (range 0.36-4, SD=0.3). The antero-posterior diameter ratio was an average of 0.98 (range 0.86-1.1, SD=0.6). The morphology of equine FDS tendon is very similar to its human counterpart. The area of insertion of the two tendons showed a significant larger area of insertion of FDS over FDP

**Conclusions:** The FDS tendon splits to enclose the FDP tendon and forms a semitubular structure dorsal to the FDP tendon. This arrangement not only prevents bow-stringing but also being closer to the mechanical axis of the PIP Joint is best suited for generating propulsive power. The difference in area of insertion may suggest a more active role of FDS in gripping and propulsive activities.



**P044**

### **Stabilisers of flexor pollicis longus tendon**

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**Background:** Flexor pollicis longus (FPL) is one of the muscles in the body whose tendon passes through an osseo-fibrous tunnel and changes direction before being inserted. We studied the anatomy of the FPL tendon with particular emphasis on the structures stabilising and directing it.

**Materials And Methods:** Six cadaveric upper limbs were dissected to display the anatomic relations of the FPL tendon and its sheath with particular emphasis on structures stabilising the FPL tendon. The displayed structures were photographed using a Fuji finepix S5600 digital camera.

**Results:** The oblique head of adductor pollicis muscle and flexor pollicis brevis arise medial to the tendon and arch over it (with some of the fibres attached to the sheath of FPL) to be attached to the ulnar and radial sesamoid respectively thus stabilising the tendon. In all cases the point of angulation was the distal aspect of medial wall of trapezium which together with the attached flexor retinaculum forms the osseo-fibrous tunnel and functions as a static stabiliser. With progressive flexion of the thumb this osseo-fibrous tunnel was seen to deepen and conceivably could provide dynamic stability to the tendon. In all cases the segment of the tendon in contact with trapezium was flattened suggesting that this might be an area of increased external pressure and hence relatively tenuous perfusion.

**Conclusion:** Several structures contribute towards directing and stabilising the FPL tendon thereby facilitating optimal direction. In the context of FPL repair the tendon may potentially snag at the point of bending and could contribute to early ruptures following repair.



**P045**

**Collagen as biomechanical barrier: Role in modifying post-operative tendon adhesions**

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**Introduction:** Post-operative tendon adhesions formation is the commonest and disabling complication following tendon surgery. Improved surgical techniques and physical therapy regimens have improved the functional outcome but still adhesions are common. We have tried to histologically assess the effects of Integra® as a biomechanical barrier around tendon repair site.

**Methods:** 26 male white leghorn chickens were operated under anesthesia according to IACUC guidelines. 2nd and 4th toes were utilized. Long flexor tendons were exposed over proximal phalanx and sharply divided. Half the toes received a modified Kessler's repair as a standard of method. The other toes were repaired with same surgical technique but a piece of Integra (dermal component only) was wrapped around site of repair. After 21 days of immobilization with splint and post-operative care, the animals were euthenized and 18 specimens were histologically reviewed by three different observers for adhesions formation around the repair site. All the histological specimens were graded from 1-5 according to severity of adhesions. An average of grade was derived for each specimen and the two groups were compared for statistical difference using t-test. Rest of the 8 specimens was analyzed for biomechanical differences. Work of flexion was calculated. The biomechanics analysis is ongoing.

**Results:** Histological review showed that adhesion formation was significantly lower in Integra wrapped group than controls. (Integra group- mean 1.9, Controls- mean 3.1,  $p < 0.05$ ). Biomechanical analysis showed consistent difference between groups. Integra wrapped group required 4 times less force for work of flexion and the difference was statistically significant ( $p < 0.01$ ).

**Conclusions:** Integra may help reduce formation of post-operative adhesions when used as a biomechanical barrier. Further studies in to the strength of repair and mechanical properties of glide and adhesions are required.



**P046**

**Paediatric flexor tendon injuries- A three year audit**

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**Introduction:** We present an audit of paediatric flexor tendon injuries presenting to our unit, the management of these injuries and their subsequent outcome.

**Methods:** Twenty patients with flexor tendon injuries (35 tendons) were identified from 2010 paediatric hand injury referrals between 1997-2000. The case notes and physiotherapy records were reviewed.

**Results:** There were 13 males (mean age 10.5 years, range 6 months to 15 years) and 7 females (mean age 7.6 years, range 2 years to 13 years). Falling onto or holding glass was the mechanism of injury in 14 out of 20 cases. Four further cases had a similar mechanism involving other sharp objects. There were 2 cases of closed avulsion injuries, which were both sustained in contact sport. Injuries to zones I, II and III included 18 cases in keeping with the mechanism of injury. The total number of injured tendons was 35 (63% complete and 37% incomplete). All injured tendons were managed operatively. Fourteen patients were rehabilitated with an Early Active Mobilisation regime, 3 cases were mobilised without restriction and 3 younger cases were treated with immobilisation for 4 weeks.

The mean follow up period was 6.7 months (range 1-20 months). A full range of motion was documented in 16 cases, 2 cases had inadequate documentation. There was one rupture post delayed primary repair of an FPL tendon which was subsequently reconstructed resulting in full range of motion).

**Conclusions:** Paediatric flexor tendon injuries are more common in males than females with a mechanism of injury often involving glass. Operative repair produces excellent functional results with minimal complications. Paediatric flexor tendon injuries are more common in males than females with a mechanism of injury often involving glass. Operative repair produces excellent functional results with minimal complications.





**P047**

**Expression profiles of growth factor genes and their signal pathway genes in healing flexor tendons and peritendinous adhesions**

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**Purpose:** Regulation of molecular events is a novel approach to improve healing rate of flexor tendons. Understanding growth factor activities in the healing processes is critical to this effort. We investigated gene expression profiles of growth factors (bFGF, PDGF-B, IGF-1, TGF- $\beta$ 1, and VEGF) and signal pathways (NF- $\kappa$ B, MAPK, JAK-STAT, and Smad) in healing tendons and adhesions in injured digital flexor tendons.

**Methods:** 40 white Leghorn chicken were divided into 2 groups. In the experimental chicken (n = 26), the digitorum profundus tendon in the long toes were cut and repaired surgically. At 3, 7, 14, 21 days and at the end of 8 weeks after surgery, tendon segments were taken for molecular analysis. Adhesions arising from the segments taken at 8 weeks were also harvested. Expression of VEGF, bFGF, TGF- $\beta$ 1, IGF-1, and PDGF-B genes and NF- $\kappa$ B, Erk2, Stat1, and Smad2 of the pathways NF- $\kappa$ B, MAPK, JAK-STAT, and Smad was assessed by quantitative analysis of the products of reverse transcription-polymerase chain reaction. The tendons taken from the uninjured chicken (n=14) were analyzed as the control.

**Results:** Expression of the bFGF, IGF-1, and TGF- $\beta$ 1 genes was increased significantly in both tendons and adhesions (p < 0.001). In most samples, VEGF and PDGF-B genes were not expressed. Expression of these genes was significantly stronger in the tendons than in adhesions. Expression of NF- $\kappa$ B gene was significantly elevated in both tendons and the adhesions. In contrast, expression of Erk2, Stat1, and Smad2 genes was not changed significantly.

**Conclusions:** We conclude that bFGF, IGF-1, and TGF- $\beta$ 1 genes were activated in healing flexor tendons and adhesions. VEGF and PDGF-B genes are minimally or not activated in majority of the tendon during the healing process. NF- $\kappa$ B pathway may be an important signaling pathway in tendon healing processes and adhesion formation.



**P048**

### **A rare accessory extensor pollicis longus**

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**Introduction:** The significance of variations of the extensor tendons has been recognized in hand surgery . Many variations of the thumb extensors have been reported. The purpose of this report is to present a rare case of a true aEPL, highlight its unique anatomical differences with the previously published three cases, briefly review some of the pertinent aspects of the literature and discuss potential clinical implications.

**Case Report:** During surgery for the treatment of a transscaphoid perilunate fracture-dislocation in a 25-year-old man, the accessory muscle was observed running on the ulnar side of the EPL. The accessory muscle had a separate origin, insertion and muscle belly. This case is unique however due to the fact that in contrast to the previous reports, both EPL and aEPL tendons were located within the third extensor compartment and in separate sheaths. Both EPL and aEPL had independent tendon insertions at the base of the distal phalanx. Independent traction was successively applied to the thin tendon of the aEPL and tendon of the EPL and extension of the thumb was observed in both cases.

**Discussion:** The case presented herein is unique in that the muscle, in addition to being a true aEPL, it lay in the third extensor compartment, in contrast to the previously published cases where the muscle originated in the fourth extensor compartment. It was found on the ulnar side of the EPL and there was not a presence of a dorsal tubercle separating it from the EPL as described previously. This particular variation may be of potential clinical significance; in case of a complete EPL rupture, it is possible that this anomalous variation will cause confusion to the examiner because the aEPL would allow some degree of extension and therefore, a false conclusion of "partial laceration of the EPL" could be drawn.



**P049**

**Flexor digitorum profundus tendon repair to bone: A biomechanical comparison of suture anchors and button fixation**

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**Purpose:** Treatment of distal flexor digitorum profundus injuries presents a challenge to the orthopaedic surgeon. Presently available techniques for repair of flexor digitorum profundus tendon injuries include button or suture anchor fixation. This study evaluates a newly proposed absorbable suture anchor and compares it to techniques using non-absorbable suture anchor of comparable size and traditional button fixation.

**Methods:** Thirteen fresh-frozen cadaveric hands were used. The index, long, and ring finger were harvested for testing. Thirteen digits were randomly assigned to each of the three fixation techniques. Tendon-to-bone repair was done using the button, absorbable suture anchor, and non-absorbable suture anchor technique. Specimens were tested to failure using the Bionex-MTS system. Mode of failure and force to failure of fixation was recorded and statistically analyzed.

**Results:** Force to failure was not significantly different ( $p>0.05$ ). The modes of failure for the three techniques differed and are as follows; 1) Button technique: suture pull-out through tendon (100%). 2) Absorbable suture anchor: rupture at the anchor-suture interface (80%) and anchor pull-out (20%). 3) Non-absorbable suture anchor: suture pull-out through the tendon (60%) and rupture at the anchor-suture interface (40%).

**Discussion:** Bone quality, bone-anchor interface, and suture material play an important role in fixation strength. The button technique failed by shearing through the flexor tendon in all specimens. Therefore, if the tendon quality is poor, a different mode of fixation may be chosen. The absorbable anchor failed primarily by suture breakage. The strength of the tendon repair and bone/anchor interface was greater than the strength of the suture. The mode of failure of the non-absorbable suture was pullout through the tendon or suture failure. It did not fail at the anchor bone interface suggesting that this fixation is as good as the traditional button technique for fixation in compromised bone. fixation is as good as the traditional button technique for fixation in compromised bone.



**P050**

**The modified savage repair – Is the dual cross grasp superior to a single cross grasp in flexor tendon repair?**

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Many techniques of flexor tendon repair exist. The ideal technique should be easy to perform, and possess adequate strength to allow for early mobilization. New core suture designs have been developed to meet these needs and have influenced suture configurations (Savage 1985).

A dual cross grasp four strand modified Savage suture technique was compared with a single cross grasp Adelaide suture technique in a human cadaver flexor tendon repair model. These were compared with a side by side modified Kessler suture such that all repairs were four strand grasping loops. All core sutures were performed with a 4/0 Ethibond & peripherally using a 6/0 Prolene. Thirty repairs were performed in total in zone two. The average age of the cadavers was 73years old. Repairs were statically loaded to failure. Load was noted at the first yield point (2mm gapping) and ultimate failure.

The Adelaide repair showed the highest ultimate load (76N), followed by the side by side modified Kessler (65N), and then the modified Savage technique (62N). The ultimate strength was significantly higher in the Adelaide compared with the modified Savage.

We conclude that using a double cross grasp in a four strand repair is not superior to a single cross four strand repair. This may be due to double cross loops tightening off during static loading which would not allow load equilibration amongst the four strands. This would ultimately function as a double two strand repair (modified Kessler repair) which may not be evenly loaded. Results may vary if these repairs are dynamically tested.



**P051**

**Analysis of closed treatment of acute mallet finger using different splints**

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**Background:** Mallet finger is caused by an avulsion of the extensor tendon in zone I, closed treatment is recommended. The aim of this study was to analyse the different fixation techniques used at our department.

**Methods:** In a retrospective analysis we examined 326 patients, managed between 1999 and 2005. The average patient age at the time of injury was 46 years, with a mean delay to treatment of 1,8 days. Injury pattern: middle finger (153), ring finger (107), little finger (52) index finger (14). The main cause of injury: direct trauma, household and sport activities. For immobilization we used Stack splint ( 197), Momsen cast( 86), thermoplastic splint(23), finger cast (15) or finger splint (5). The mean duration of fixation was 49,4 days.

**Results:** 93 of 113 patient with a Stack splint fixation were satisfied, 20 complained about pain, reduced finger function or the final appearance of the digit. The complication rate was 8,6 %.

In 86 cases the immobilisation occurred with a Momsen cast for at least 12,5 days, followed by a Stack splint( 57 ). In this group 52 patients were satisfied, 11 patients were less satisfied. Skin complications were observed in 4 cases.

Thermoplastic splint was used in 23 cases. After 16,7 days treatment was changed to a Stack splint in 9 cases with 1 complication.

In the groups where a finger cast or splint was used, 1 patient was not satisfied with the result, 1 skin irritation was complained.

**Conclusion:** Splinting tendon mallet injury is state of the art. Full-time splinting for 6-8 weeks is necessary, often skin irritations or maceration occur using the Stack splint. To prevent skin maceration, splint follow up should be done weekly, patients must be informed about finger hygiene.



**P052**

**Early active wrist mobilisation in extensor tendon injuries zones 5, 6 & 7**

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**Introduction:** Despite active mobilisation of the fingers after extensor tenorrhaphy in zone 5-7 complications leading to functional limitations were experienced. The aim of this clinical message is to introduce a modified treatment program in which early active mobilisation of the wrist is added.

**Methods:** A new protocol to treat patients after tenorrhaphy of extensor tendons in zones 5, 6 and 7 was developed on the basis of literature and expert practise.

**Results:** The protocol was based on anatomical and physiological fundamentals like the layers of fascia and the compartments on the one hand and the nutritional pathway and the phases of wound healing on the other hand. To prevent adhesions, to stimulate tendon gliding and to avoid gapping of the tendon, active mobilisation of the wrist was added to the treatment protocol. Active wrist mobilisation is started at the inflammatory phase of wound healing, which is 3 to 5 days after tenorrhaphy. Furthermore, it appeared unnecessary to add hinges to the splint, which saves costs and time (Chinchalkar 2005). Loosening of the proximal bandages seemed to be sufficient and reliable to mobilise the wrist.

**Conclusion:** Mobilisation of the wrist is advocated to avoid complications after extensor tendon repair in zone 5-7. The modified treatment protocol and a simple splinting technique are introduced.



**P053**

**Flexor tendon rehabilitation in University Malaya Medical Centre, Kuala Lumpur**

**Say Beng Soh**

*University Malaya Medical Centre, Kuala Lumpur, Malaysia*

Post flexor tendon repair rehabilitation has gradually become recognized as a critical part of the flexor tendon injury management. Functional recovery from a flexor tendon injury has proven to be a formidable challenge throughout the history of hand surgery. The return of satisfactory digital performance following flexor tendon repair is still described as one of the most difficult and challenging problem following the surgery due to formation of adhesions and limiting tendon gliding, as well as rupture of tendons when the injured fingers are actively flexed.

Thus, flexor tendon injuries present a greater challenge to the hand surgeons and therapists. The combined efforts of hand surgeons and therapists to establish effective postoperative treatment programs can greatly enhance the results of tendon surgery. Postoperative therapy program must be client-centered, evidence-based and carefully instituted based on the unique status of the patient.

It is therefore extremely important that patients are monitored closely with individualized programs depending on factors unique to his/her injury. This has to include the patient's level of injury, techniques used for the tendon repair, current level of function, mobility, and type of vocation, social status and life aspirations.

This poster presentation will show the rehabilitation protocol for 2-strand and 4-strand flexor tendon repair in University Malaya Medical Centre, Kuala Lumpur, Malaysia.



**P054**

**A study to investigate patient adherence with home exercise programs following a flexor tendon or extensor tendon repair**

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Early mobilization following tendon repairs in the hand is now broadly acknowledged as a critical component of the rehabilitation of flexor and extensor tendon repairs. Patient adherence to home exercise prescriptions following tendon repair is widely thought to be the most uncontrollable factor in a patient's outcome. However there is very little research to offer reasons or recommendations to improve adherence.

**Study Objectives:** The purpose of this study was to assess if patients understand and carry out the set exercise programs prescribed following hand plastic surgery to repair flexor tendons or extensor tendons. Results aim to assess whether modifications to the exercise or teaching of the exercises programs need to be made to increase adherence from patients and thus treatment and outcomes following surgery.

**Method:** One hundred subjects were required to ensure significant results were achieved. The patients were given two questionnaires, the first, one week post operatively and the second at the fifth week post surgery. A qualitative analysis study assessing questionnaire answers was carried out.

**Results:** Comprehensive data analysis is currently in process but early results show initial adherence with home exercises was high. The wearing of a splint seemed to provide a strong reminder to exercise. Interestingly no positive correlation has been found between numbers or severity of tendons repaired and reported adherence.

**Conclusions:** The study demonstrates the importance for therapists to consider patient attitudes, beliefs and methods of exercise instruction in the process of prescribing home exercise programs for their clients. Following completion of this investigation, recommendations regarding the teaching method and type of exercise prescription will be made.





**P055**

**Experienced impairments and disabilities after traumatic flexor tendon injury of the hand in zone II**

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**Objective:** To determine two years post trauma the experienced impairments and disabilities after a first flexor tendon injury of the hand in zone II.

**Design:** Cohort study

**Setting:** Rehabilitation department of a general teaching hospital

**Subjects:** 10 adult patients with an isolated traumatic flexor tendon injury of finger II –V in zone II, which have been operated and followed a three month rehabilitation program using the modified Kleinert splint.

**Main outcome measures:** Grip force was measured with the Jamar dynamometer and presented as a percentage of the non-affected hand. Range of motion was measured with a goniometer and expressed as percentage of the non-affected side using Strickland criteria. Sensibility was measured with Semmes-Weinstein monofilaments. Disabilities were assessed with the Dutch Language Version of the Disabilities of the Arm Shoulder and Hand score (DASH-DLV).

**Preliminary results:** up till now 6 patients are included. The mean grip force was 93.3% from the non-affected hand. The range of motion was 85.7%. Sensibility was disturbed in 80% of the examined patients. The DASH-DLV mean score was 23.1 (sd 19.9 – min 1.7 – max 47.5). The score is able to range from 0-100 with 100 indicating poorer function. Five patients spontaneously mentioned pain and an uncomfortable feeling with cold weather as well as tingling.

**Conclusions:** Most patients reported mild impairments and disabilities 2 years after flexor tendon injury of the hand. Surprisingly, sensibility disturbances were reported by 80% of patients.



**P056**

**The results of modified Kleinert method in zone 1 and 2 flexor pollicis longus repair**

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Early mobilization techniques are preferred to prevent flexion contractures and gain maximum functional outcome in flexor tendon injuries. In our study we aimed at assessing the results of the cases where we applied modified Kleinert method after zone 1 and 2 flexor pollicis longus repair. We evaluated 33 patients who were treated Hand and Microsurgery Hospital between 1991-2005 and whose average follow-up period was 11,5 months (min 2 max 60)concomitant injuries were: 18 digital nerve, 8 digital artery, 4 palmar plate, 6 pulley and 2 joint capsule.5 thumb were injured in zone 1 and 28 thumb were injured in zone 2. Repairs were performed as: 24 primary, 7 delayed and secondary. The thumbs were evaluated according to Buck-Gramcko method. Results were 26 excellent (%78,78), 3 good (%9,09), 3 poor (%9,09) and 1 ruptures. Functional results in accordance with literature and low rate of rupture indicate that this method can be confidently utilised in flexor pollicis longus repairs.



**P056a**

**Auto-crosslinked hyaluronic acid gel accelerates healing of rabbit flexor tendons in vivo; A biomechanical and histological study**

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**Introduction:** Adhesion formation still constitutes a threat to flexor tendon surgery outcome. Hyaluronic acid (HA), a natural synovial component, is known to have adhesion and wound healing modulating properties. Effects are, however, limited by its rapid degradation in the body. This study assessed the effect of auto-cross linked HA gel, a highly viscous HA derivative with an increased body residence time, on adhesion formation and tendon healing after rabbit flexor tendon repair.

**Methods:** 48 digital flexor tendons, from 48 rabbits, were cut and repaired and received either HA gel (n=24), or no gel (n=24) around the repair site. At 2,3,6 and 12 weeks following surgery, 6 tendons from each group were mechanically tested with a custom built strain gauge for the presence of adhesions and the state of tendon healing. Adhesions were represented by the maximum force needed to pull the tendon from the tendon sheath, tendon healing by the breaking strength of the repairs. Mechanical data were compared to qualitative and quantitative histological evaluation of the repair site.

**Results:** Maximum pull-out force increased from 8.2 N at 2 weeks to 17.7 N at 12 weeks in the HA group and 4.8 N to 13.5 N respectively in controls. No significant differences existed between groups. Breaking strength increased from 19.0 N at 2 weeks to 60.0 N at 12 weeks in the HA group and from 15.4 N to 46.5 N in controls. Breaking strength was higher in the HA group at all times, reaching significance at 6 and 12 weeks ( $p \leq 0.02$ ). Histology showed an accelerated healing in the HA group, both qualitatively and quantitatively ( $p \leq 0.01$ ).

**Conclusion:** Treatment with auto-cross linked HA gel had no effect on adhesions but accelerated healing of repaired rabbit flexor tendons in vivo. This could speed up rehabilitation after tendon injury.



**P056b**

**Balancing the Epitenon stitch; which core suture provides optimum load sharing?**

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**Introduction:** Flexor tendon repair comprises a core and an epitenon suture. It has been shown, that the latter is mechanically the most important suture. The strength of a repair is determined by successful load sharing of both sutures. Load sharing is likely to vary with core suture geometry. This was tested in the present study for three types of core sutures and a simple running epitenon suture.

**Methods:** 48 fresh pig cadaver superficial flexor tendons were cut and randomly repaired by a Modified Kessler repair (K), Double modified Kessler repair (DK), or McLarney repair (ML), or a combination of one of these and an epitenon suture. (EK, EDK, EML). Repairs were statistically compared for gapping at 15N and failure loads, maximum load at failure and mode of failure.

**Results:** At 15N most gapping occurred in K and least in EDK repairs ( $6.6 \pm 3.0$  v  $0.0 \pm 0.00$  mm;  $p \leq 0.001$ ), at failure load in ML and EDK repairs respectively ( $12.8 \pm 3.1$  v  $1.2 \pm 1.2$  mm,  $p \leq 0.001$ ) . A significant gap reduction by addition of the epitenon suture was observed in DK repairs only (87%,  $p \leq 0.01$ ). Maximum load was lowest in K and highest in EDK repairs ( $28.6 \pm 6.4$  v  $57.9 \pm 7.4$  N resp.,  $p \leq 0.01$ ). A significant increase in maximum load by the epitenon suture was observed in DK repairs only (33%,  $p \leq 0.01$ ). EK and EDK repairs snapped immediately after epitenon suture failure, EML sutures, failed by earlier slow core suture pull-out.

**Conclusion:** Our results show that core suture geometry influences the role of the epitenon suture. Demonstrated by superior gapping and strength characteristics and preservation of the repair until failure of the epitenon suture, the double modified Kessler repair provides the best geometry for load sharing with the epitenon suture.



**P057**

**Percutaneous release of Dupuytren's contracture prior to surgical excision-does it influence the outcome?**

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Dupuytren's contracture of the hand is a common condition. Patients present at various stages of their disease ranging from a mild band with no deformity to fixed flexion of the metacarpophalangeal joint and the proximal and distal interphalangeal joints of the involved digits. Percutaneous release of early contracture at the level of the metacarpophalangeal joint is a well described procedure. But most published results show that percutaneous release offers only a temporary correction and usually the deformity recurs.

**Aims / Objectives:** We wanted to compare patients who had a percutaneous release of Dupuytren's before surgical excision with those who hadn't.

**Patients and Methods:** A series of 15 patients who had more than 90 degrees of fixed flexion at the metacarpophalangeal joint and who needed surgical excision underwent percutaneous release at the time they were listed for surgery in the hand clinic. They all subsequently had surgical excision of the contracture on an average of six months from the time of percutaneous release. A control group of ten patients matched for age and same level of deformities underwent surgical release without percutaneous release.

**Results:** Percutaneous release group patients all had good correction of deformity at the time of release ranging from 60 to 70 degrees and had less extensive surgery at the time of definitive surgery measured by extent of dissection and operative time. They also had better correction of deformity at one year follow up.

**Conclusion:** Percutaneous release of Dupuytren's contracture is a safe first stage procedure prior to surgical excision.



**P058**

**Dupuytren's disease in a patient with Marfan's syndrome: Manifestations of defective connective tissue remodeling and repair**

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A case study will be presented in which a patient was found to have both Dupuytren's Disease (DD) and Marfan's Syndrome (MaS). The relevance of these coexisting pathologies in reference to current knowledge of connective tissue remodeling and repair will be discussed.

DD is a familial connective tissue disorder characterized by the development of nodules and cords in the palmar and digital fascia, leading to contracture of the palm and digits. The pathophysiology involves intense proliferation of myofibroblasts (Saar and Grothaus, 2000). At present the triggers that underlie the manifestation of this disease are not well understood.

MaS is an autosomal connective tissue disorder involving the cardiovascular, musculoskeletal and ocular systems caused by an inherent structural weakness in collagen (Dean, 2002). This syndrome is the result of mutations in the fibrillin-1 gene.

There is evidence in the literature suggesting that the fibrillin-1 protein helps regulate tissue growth factor activity (Kartinen and Warburton, (2003). Upregulated tissue growth factor activity has been suggested in the pathophysiology of DD.

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**P059**

**The corkscrew cord in Dupuytren's disease**

**Ian Edmunds**

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The purpose of this poster is to describe a new pattern of Dupuytren's disease.

The spiral cord is a well recognised pattern of Dupuytren's disease. It is composed of connections between a pretendinous band, spiral band, lateral digital sheet and Grayson's ligament. It puts the neurovascular bundle at increased risk during surgery.

The retrovascular cord has also been previously described. It forms dorsal to neurovascular bundle and can cause a contracture of the distal interphalangeal joint. It usually does not cause displacement of neurovascular bundle.

I am reporting a double spiral or corkscrew cord in which the neurovascular bundle wraps twice around the Dupuytren's cord. I believe this configuration arises as a consequence of a confluence between a spiral cord and a retrovascular cord. To my knowledge, such a pattern has not previously been described.



**P060**

**Formation of bone spurs in Dupuytren's disease- A marker for disease severity**

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**Background:** Despite a wealth of literature on Dupuytren's disease, bone spur formation is an uncommon finding. We present our series of bone spur formation in Dupuytren's disease, and identify possible etiological triggers and risk factors for their formation.

**Method:** Data was collected from 122 patients who had surgery performed by the senior author (BC) over a four year period. Those with bone spur formation were assessed for any association with: age of onset, progression of disease, severity of disease, recurrent operations, medical risk factors, cigarette smoking, alcohol intake, manual workload, total flexion deformity, postoperative correction and joint, nerve or skin involvement, compared to non bone spur Dupuytren's. Patient interview was conducted to enquire about pre operative symptoms and satisfaction of surgical outcome. Excised bone samples were examined macroscopically and histologically.

**Findings:** 13 of 122 patients demonstrated bone spur formation (1 ring and 12 little fingers). Severity of Dupuytren's disease, in particular deformity of proximal interphalangeal joint, was associated with bone spur formation ( $p=0.008$ ). Residual deformity at the proximal interphalangeal joint (PIPJ) immediately post operatively was more prevalent in patients with bone spur formation ( $p=0.017$ ) however deformity was usually correctable following 6 months of physiotherapy. Following individual standardized interview, the majority of patients who had bone spurs in their Dupuytren's disease were satisfied with their surgical correction (9/13). Histological examination of the bone spurs revealed fibroblastic metaplastic change at the insertion of Dupuytren's disease onto bone.

**Conclusion:** Bone spurs in Dupuytren's disease occur in severe contractures of the PIPJ and frequently arise from the middle phalanx of the little finger. They are evidence of fibroblastic metaplasia in an attempt to deal with stress at distal attachments of Dupuytren's disease. The significance of bone spurs could be that they are a marker for repeated and recurrent surgical intervention.





**P061**

### **Results of excision of palmar Dupuytren's nodule**

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Dupuytren's nodules are mainly managed conservatively. Surgery is not usually recommended as it is thought to lead to worsening of disease. We aim to examine the outcome of excising these nodules

Between September 2003 & April 2005, 6 patients underwent excision of palmar Dupuytren's nodules under one surgeon. We retrospectively analysed the notes of these patients and conducted a telephonic interview to assess the outcome.

Mean age at surgery was 57 years (range 38-77). All patients complained of substantial pain restricting their work or life style. Nodule was in the region of the distal palmar crease of the middle finger, ring finger and or little finger in all cases.

Surgery was performed under axillary block or Bier's block in all cases. Mean operating time was 20 minutes (range 11-23). Patients were all seen at 2 days, 2 weeks, 6 weeks, 3 months and 6 months. The wound healed well in all cases with no evidence of infection or excess scar formation. Results of the telephonic interview revealed that for three patients the nodule interfered with work. Two had discomfort while driving. One patient reported recurrence and one reported a nodule in the opposite palm. All patients were satisfied with the operation and said they would undergo the same surgery if they had a similar nodule in the other palm. All patients returned to work at an average of 36 days (range 28-42) from the operation.

Advantage of this surgery is that it is a quick operation, can be performed as day case, patients return to work early and achieve overall improvement of pain and hand function. Results of our study though small seem to suggest that excision of symptomatic Dupuytren's nodule provides patients with good symptom relief. We believe that excision of palmar nodules in carefully selected patients provides good functional outcome



## **P061a**

### **Hand therapy after surgery for Dupuytren's disease**

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**Background:** Postoperative hand therapy in patients after surgery for Dupuytren's contracture is common medical practice to improve outcomes. Until now, patients are referred for post-operative hand rehabilitation on an empirical basis.

**Purpose:** To evaluate whether referral criteria after surgery because of Dupuytren's disease were actually adhered to, and, to analyse differences in outcomes between patients who were referred according to the criteria (correctly referred) and those who were not referred but should have been (incorrectly not referred).

**Methods:** Referral pattern was evaluated prospectively in 46 patients. Total active and passive range of joint motion (TAM/TPM), sensibility, pinch force, the Disability Arm Shoulder Hand questionnaire (DASH) and the Michigan Hand outcomes Questionnaire (MHQ) were used as outcome measures pre-operatively and 10 months post-operatively.

**Results:** In total 21 patients were referred correctly and 17 patients were incorrectly not referred. Significant improvements on TAM, TPM, DASH and MHQ were found at follow-up for the total group. No differences in outcomes were found between patients correctly referred and patients incorrectly not referred for postoperative hand therapy.

**Conclusion:** Since referral criteria were not adhered to, further specification of the criteria is needed. Given the lack of differences in outcomes between patients correctly referred and patients incorrectly not referred, postoperative hand therapy in Dupuytren's disease should be reconsidered.

**References:** Abbott, K 1987, Au-Yong, IT 2005, Mullins, PA 1999.



**P062**

**Comparison of proximal radioulnar synostosis excision after trauma and after distal biceps repair**

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**Background:** The results of operative resection of a proximal radioulnar synostosis were thought to be unfavorable until recently. It remains unclear which synostosis are more responsive to treatment. We tested the hypothesis that operative resection of a proximal radioulnar synostosis is more successful when the synostosis is due to a distal biceps repair than when it occurs after trauma.

**Methods:** Over a 5-year period, two surgeons resected a proximal radioulnar synostosis in 24 adult patients: 11 with a synostosis after distal biceps repair and 13 with a synostosis after trauma. All of the patients in the distal biceps cohort and four patients in the trauma cohort had a focal, extra-articular area of synostosis. In the remaining 9 patients in the trauma cohort, the synostosis involved the articular area of the radial head.

**Results:** Five patients had recurrence of the synostosis (four [31%] in the trauma cohort and one [9%] in the biceps cohort). An average of 40 months after the index surgery, and after all subsequent surgeries, the arc of forearm rotation averaged 131 degrees in the biceps cohort and 101 degrees in the trauma cohort. These differences were not statistically significant with the numbers available.

**Conclusions and significance:** The results of operative resection of a proximal radioulnar synostosis seem better when the synostosis results from a distal biceps repair than when it results from trauma, perhaps because the synostosis is focal and extra-articular, and it is not associated with any articular incongruity or malalignment.



**P063**

**Ulnar shortening effects on pressure in the distal radioulnar joint with muscle load: A biomechanical study**

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**Purpose:** The ulnar-shortening procedure could stabilize the distal radioulnar joint (DRUJ) by increasing tension of the triangular fibrocartilage complex (TFCC). This procedure, however, might induce degenerative changes in the DRUJ by increasing the pressure in the DRUJ. The purpose of this study was to examine changes in the DRUJ pressure after the ulnar-shortening procedure in several TFCC tear conditions with muscle load.

**Methods:** Seven fresh-frozen cadaver arms amputated at the midportion of the humerus were used. An external fixator was attached to the distal ulna leaving space for a 10-mm resection of the ulna to allow progressive shortening. The pressure sensors were inserted in the DRUJ to record the pressure distribution in the DRUJ. After loads of 20 N were applied on the selected 8 muscles, i.e., extensor carpi ulnaris, extensor carpi radialis longus and brevis, flexor carpi ulnaris, flexor carpi radialis, pronator quadratus, pronator teres, supinator, and biceps, the peak pressure in the DRUJ was examined at 1 mm intervals through 6 mm of shortening length at 60 ° pronation, neutral position and 60 ° supination. The tests then were repeated after sectioning either the dorsal or palmar portion of the RUL, and finally after complete sectioning of the RUL.

**Results:** In the intact specimens, the peak pressure on the DRUJ greatly increased as the amount of ulnar shortening increased in all 3 rotatory positions. The peak pressure in the specimens of partial RUL sectioning demonstrated smaller increase with ulnar shortening than that in the intact specimens. Complete section of the RUL indicated further smaller increase.

**Conclusions:** The present study found that the tightened TFCC by ulnar shortening greatly increased the pressure on the DRUJ. The amount of the ulnar shortening should be minimum to avoid increasing pressure on the DRUJ.



**P064**

**Clinical results of ulnar-shortening osteotomy using a single-cut stacked blade technique**

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Many techniques have been described for shortening of the ulna. Labosky 1 published a biomechanical study in cadavers demonstrating accurate shortening and bony apposition with a single saw cut. Shortening is controlled by varying the number and size of stacked blades and angle at which the cut is made. There are no reports documenting the clinical effectiveness of this technique.

Fifteen osteotomies were created in 14 ulnas. 9 patients were female, 5 male with a mean age of 40. Seven cases were preceded by trauma, 8 were not. Average follow-up was 19 months. Pre-operative ulnar variance averaged + 2.3 mm. Pronated grip PA view increased the average measured ulnar variance by 0.8 mm. An average of 2.8 mm of shortening was estimated at the time of surgery, and 2.6 mm of shortening (final average -0.3 mm ulnar variance) was actually achieved by "stacking" 2- 3 saw blades together and varying cut angles between 45° and 60° to the ulnar axis. Fixation was achieved with a standard 2.7 or 3.5 mm DCP plate. Additional simultaneous procedures include arthroscopic TFCC repair (n=5) or debridement (n=9), Adams DRUJ stabilization (n=1), and luno-triquetral fusion (n=1). 14/15 osteotomies healed (one lost to follow-up), and pain relief was satisfactory in all patients. One complication occurred- a synovial cutaneous fistula at an arthroscopy portal site which required an I&D procedure. Full forearm rotation was achieved in all cases, except 4 with an average loss of 20 degrees. 7 of 15 plates required removal at a median of 17 months, because of painful hardware prominence on the subcutaneous border of the ulna. This procedure is easy, quick, and cost-effective. It achieves a predicable amount of shortening and bony union.

1. Labosky DA, Waggy CA. Oblique Ulnar Shortening Osteotomy by a Single Saw Cut. J Hand Surg 1996; 21A: 48-59.



**P065**

**Treatment of ulnar styloid fracture using miniscrew and tension band suture augmentation**

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**Introduction:** Ulnar styloid fractures combined with distal radius fractures have been associated with worse outcome. Obtaining of bony union with internal fixation can avoid non-union and late DRUJ instability. We performed open reduction and internal fixation of combined ulnar styloid base fractures using miniscrew. The fixation was augmented with tension band suturing.

**Materials and methods:** Since January 1, 2005, eleven displaced type 2 ulnar styloid fractures combined with distal radius fractures were managed with open reduction and internal fixation using a miniscrew and tension band suture augmentation. Short arm splint immobilization was maintained for 4 weeks postoperatively and then ranged of motion exercise was started. The Radiologic bony union, ulnar sided wrist pain and range of pronation-supination motion were evaluated. The follow up period were ranged from 8 months to 12 months.

**Results:** Seven of 11 patients showed radiologic bony union within 12 weeks and 3 patients showed delayed union during the time periods of 3 to 5 month periods postoperatively. One remained patient revealed loosening of screws associated with inadequate purchase of bony fragment resulted in DRUJ instability. Two of 11 patients complained mild ulnar wrist pain and all but one revealed functional range of protation/suination motion.

**Conclusion:**

Our method of open reduction and internal fixation of ulnar styloid base fractures using miniscrew and tension band suture augmentation, which provided additional stability and allowed earlier range of motion exercise, could result in better radiologic and functional outcome.



**P066**

**Assessment of distal radioulnar joint instability after distal radius fracture: Comparison of results using computed tomography with clinical examination**

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**Purpose:** To analyze the reliability of clinical examination and computed tomography in assessing distal radioulnar joint(DRUJ) instability after distal radius fractures.

**Materials and Methods:** Thirty-four patients with distal radius fractures were evaluated after a mean follow-up period of 18.1 months. The stress test and computed tomography(CT) were used to detect DRUJ instability. CT scans were obtained with the forearm at 70 ° pronation, neutral, and 70 ° supination. Three CT methods were used to diagnose the DRUJ instability; the radioulnar ratio, the epicenter method, and the modified radioulnar line. The results of CT assessment were compared with the findings of stress test using kappa statistics. Relationships between DRUJ instability and parameters of plain radiographs, such as volar tilt, radial inclination, and radial shortening were analyzed.

**Results:** Twelve patients were suspected of having DRUJ instability based on the stress tests. DRUJ instability was determined in 14, 8, and 15 patients using the radioulnar ratio, the epicenter method, and the modified radioulnar line, respectively. Reliability analysis between the results of stress test and CT assessment showed moderate or fair agreement (kappa value; 0.43 for the radioulnar ratio, 0.56 for the epicenter method, and 0.33 for the modified radioulnar line). DRUJ instability diagnosed by the stress test and CT assessment showed no statistic correlation with radiographic parameters, but volar instability determined by CT assessment appeared to be related with the dorsal tilt deformity.

**Conclusion:** Following a distal radius fracture, CT assessment of DRUJ instability was influenced by residual deformities such as dorsal tilt, and not correlated with the stress test. Although CT assessment is objective, clinical examination should be considered as a critical step in diagnosing DRUJ instability after distal radius fractures.

**References:** (Lo et al, 2001), (Mino et al, 1985), (Wechsler et al, 1987)



**P067**

**Treatment of unstable fractures of distal ulna associated with fractures of distal radius with mini-plate fixation anchored to the triangular fibro-cartilage complex**

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The authors review the results of mini plate fixation of unstable fractures of the distal ulna associated with fracture of the distal radius, anchoring the TFC complex to the plate with non-absorbable suture to access greater stability to the distal fragment of the ulna fixation, allowing early post-operative mobility.

Eleven patients underwent this surgical treatment between March 2002 and December 2005, using the extended volar approach and volar plate with locking screws to treatment of the radius fracture. According to the Q modifier of the Comprehensive Classification of Fractures, there were 5 fractures Q2 type, 1 fracture Q3 type and 5 fractures Q5 type.

We allow free pronation-supination mobility from the first post-operative day and free carpal mobility after 1 week. There was no infections, non-union or lose of reduction. Implant removal was not necessary in any patient. The average total range of motion at 6 months follow-up was 94% of oppositive wrist. According Gartland and Werley system there were 8 excellent, 2 good and 1 fair results at final evaluation.

The use of mini-plates for fixation anchoring of the TFC complex to the plate is a good choice in the treatment of distal ulna fractures associated with distal radius fractures, allowing early mobility to the wrist which has afforded a good clinical result for the patients.





**P068**

### **Distal oblique metaphysio-epiphyseal osteotomies of the ulna: a new approach for ulna abutment**

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**Purpose:** We propose the distal oblique metaphysio-epiphyseal osteotomies for ulna impaction syndrome. These have two main objectives: to evaluate the union time and the functional results compared to diaphyseal osteotomies. They are classified in three types. Type 1-metaphysio-epiphyseal osteotomy-oblique from proximal to distal and lateral to medial-preserving the ulnar styloid and ulnar continuity. Type 2 -pure metaphyseal osteotomy-oblique from proximal to distal and lateral to medial-interrupting the ulnar continuity-Type 3-pure metaphyseal osteotomy -oblique from proximal to distal and medial to lateral-interrupting the ulnar continuity

**Methods:** 16 patients (8 men and 8 women) underwent a distal oblique metaphysio-epiphyseal osteotomy of the ulna. 8 patients presented ulno-carpal pain associated with distal radio-ulnar pain, 6 isolated ulno-carpal pain and 2 isolated distal radio-ulnar pain. The choice of the osteotomy type was based on the clinical exam, radiographs and CT. A clinical and radiographic review of the results was performed.

**Results:** With a follow-up of 2 to 5 years, the pre-operative pain disappeared in 14 cases, residual pain with forced prono-supination persisted in 2 cases. The wrist frontal and sagittal mobility was not modified by the surgery, prono-supination was complete in 13 cases, 2 patients had 20° supination deficit and 1 patient had 30° of supination and pronation. The grip strength was 90% compared to the opposite side. Union was obtained in all patients, after 3 to 4 weeks of immobilisation in 14 cases and 2 months in 2 cases.

**Conclusion:** The distal oblique osteotomies reduce the union time compared to diaphyseal osteotomies. They adjust better to the variable distal radio-ulnar anatomy and ulno-radio-carpal pathology. Our results on pain relief led us to extend the indications of these osteotomies in cases of DRUJ arthritis.



**P069**

**Ulnar tunnel widening after anatomic reconstruction of the distal radioulnar ligaments: A case report**

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**Introduction:** It has been demonstrated that bone tunnel widening could appear after knee anterior cruciate ligament reconstruction. Many things have been considered as possible factors, but the etiology is still remains unknown. We report a case of ulnar tunnel widening after anatomic reconstruction of the distal radioulnar ligaments.

**Case Report:** A 38-year-old woman visited our hospital with left wrist pain. She had treated left distal radius fracture conservatively 2 years ago. Under the diagnosis of the chronic distal radioulnar joint instability and ulnar impaction syndrome due to malunited distal radius fracture, we performed anatomic reconstruction of the distal radioulnar ligaments using palmaris longus tendon and ulnar shortening osteotomy. The radiograph taken postoperatively showed good reduction of the distal radioulnar joint with a 3.5mm tunnel in the distal ulna. On the final follow-up radiograph, which was taken 9 months after surgery, we observed a distal ulnar tunnel widening ranged from 6.7mm to 7.3mm on two different views. The patient scored 92 and 11 on the modified Mayo wrist score and Korean DASH questionnaire respectively. There was no distal radioulnar joint instability and supination/pronation motion limitation.

**Conclusion:** We present a case of a patient with ulnar tunnel widening after anatomic reconstruction of the distal radioulnar ligaments with no adverse effect on functional outcome. Possible reasons for tunnel widening may be mechanical, so fixation method of the distal ulnar tunnel may be changed to the stronger one such as interference screw fixation.



**P070**

### **Rectangular epi-metaphyseal ulnar shortening (R.E.M.U.S) osteotomy in ulnar impaction syndrome**

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We propose an epi-metaphyseal ulnar shortening procedure for the treatment of the ulnar impaction syndrome.

The operative solutions for the ulnar impaction syndrome have been a subject of discussion for many years. Different techniques can be found in the literature, and these vary depending on coexisting lesions of the TFC , DRUJ arthrosis or instability around the distal ulna. Resectional arthroplasty (Darrach), partial resection of the ulnar head using the wafer procedure (Feldon), hemiresection interposition arthroplasty (Bowers), matched ulnar resection (Watson), ulnar shortening (Milch), the Sauvé-Kapandji procedure and replacement arthroplasty have all been proposed.

We only treated patients with a positive ulnar variance, with or without a non-traumatic central TFC lesion. We performed a rectangular epi-metaphyseal distal ulna osteotomy without impairment of the ulnar styloid pillar. A cortical sleeve of 2 to 3 mm was resected. This was afterwards reattached with a single Herbert cortical screw. Preoperative investigations included plain-film radiographs , MRI and bone scintigraphy. Postoperative evaluation consisted of a clinical examination and calculation of the DASH score.

This procedure decreases the ulnar load. No postoperative instability of the proximal stump of the ulna is observed, the TFC can be evaluated and the DRUJ is not manipulated. Hardware implantation, with only one Herbert screw inserted, and casting period were kept to a minimum.

The results of this technique are encouraging. However, we recommend paying special attention to technical pitfalls, delayed union and atypical cases of ulnar-sided wrist pain.

Bowers WH 1992, Feldon P 1992, Baek GH 2005, Watson HK 1986, Friedman SL 1991, Markolf KL 2005



**P071**

**Radiographic evaluation of the modified Sauvé-Kapandji procedure for the wrist reconstruction**

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The Sauvé-Kapandji (S-K) procedure is considered a useful treatment option for the distal radio-ulnar joint (DRUJ) disorders, but the original S-K procedure sometimes decreases the width of the wrist in case of poor bone stock at the DRUJ, such as advanced stage of rheumatoid arthritic wrist. Since 1994, we performed a modified S-K procedure, in which the resected ulnar shaft was inserted as a bridge between the DRUJ to maintain the width of the wrist. In this study, we analyze the radiographic findings of the modified S-K procedure.

The patients included in this study were 37 wrists in 34 patients with a mean age of 59 years. Rheumatoid arthritis was found in 31 patients, malunited radius fractures in 2, and dislocation of the DRUJ in one case. Average follow-up was 3 years. Radiographic evaluation includes width of the wrist, ulnar translation distance, ulnar translation index of the carpus, radio- ulnar distance, and the gap of the resection area of the ulna.

Arthrodesis was achieved in all cases. The width of the wrists was maintained well until the final follow up. The ulnar translation of the carpus and the mean carpal translation index remained unchanged soon after the operation and the final follow up. The average of radio-ulnar distance was 6.6mm, which is smaller than the previous reports, while the postoperative decrease of the radial translation of the proximal ulnar stump was minimal throughout follow up (average 0.4mm). The ulnar gap was also maintained well and the reunion of ulna was not found.

The modified S-K procedure provides sufficient osseous support of the carpus throughout the period with minimal radial translation of the ulnar stump. We recommend this modification of the S-K procedure, especially for the patients with poor bone stock at the DRUJ.



**P072**

**Sauvè-Kapandji procedure as treatment for gunshot fracture of radius and ulna – Case report**

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We present a case of a police officer, male, 33 years-old, who was shot in the left forearm during a robbery in March, 2005. He was taken to the Emergency Room thirty minutes after the injury. Physical Examination: Conscient, Glasgow Coma Scale = 15. In the left forearm was found an entry gunshot wound in the ulnar side, and an exit wound more distally, in the radial side of the forearm. No tendon or nerve injury was found at the moment. Radial and Ulnar pulses were present distally to the injury. No other gunshot wounds were found. Radiografic findings: Comminuted extra articular fracture of both radius and ulna with presence of several bullet fragments.

The patient was taken immediatelly to the Operation Room, and was submitted to extensive debridement and irrigation of the wounds. Bone samples were taken and sent to culture. External fixation of the radius and intramedullary pinning of the Ulna were performed. Antibiotics IV were given.

Three weeks after, all the wounds were healed, the patient was taken again to the operation room where were removed the external fixator and the intramedullary K-wire of the ulna.

Due to the extensive comminution and bone loss of the fractures, difficult to restore the DRUJ, and bad prognosis for prono-supination function, the solution in this case was performed a plate and screws osteossintesis of the radius and artrodesis of the distal radio-ulnar joint, accepting the bone loss of the ulna to promote the prono-supination.

Eight weeks after the surgery, the patient was asymptomatic, with full range of motion, included complete prono-supination, and normal grip strength. He has returned to his previous job with no complaints.



**P073**

### **A three-dimensional analysis of the sigmoid notch**

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**Purpose:** Sigmoid notch involvement following distal radius fractures seems underestimated in x-ray. Currently no classification system for disruption patterns of the sigmoid notch of the radius associated with distal radius fractures exists. This study quantifies the anatomy of the sigmoid notch and identifies the landmarks of the articular surface and the proximal boundaries of the distal radioulnar joint capsule.

**Methods & Materials:** Fifteen freshly frozen, unpaired mid-brachium hand specimens were used. CT Scans were taken, followed by dissection and reconstruction of the distal radius. The sigmoid notch surface was divided into two surfaces – the articulating averaging 79.78 mm<sup>2</sup> (69.13%); and the non-articulating averaging 35.84 mm<sup>2</sup> (30.87%). The AP and PD width of the articulating surface and the PD width of the sigmoid notch were reviewed, as well as the radius of curvature, version angle and depth of the sigmoid notch.

**Results:** Our measurements of the AP width and radius of curvature of the sigmoid notch were compatible to previous studies. We defined the version angle and maximum depth of the sigmoid notch, as well as the proximal border of the Distal Radioulnar Joint (DRUJ) and the articular surface. Results showed: AP width 12.9 mm; PD width of the articulating surface 5.1 mm; and PD width of the sigmoid notch 8.1 mm. The inclination of the sigmoid notch toward the radial axis is 1.64°.

**Conclusion:** The study showed that the sigmoid notch is flatter than previously believed. Only the distal 69% of its surface is covered by cartilage. On average, it has about 9 degrees of retroversion and its average inclination is almost parallel to the anatomical axis of the radius. Clinical implications exist for evaluation of the DRUJ involvement in distal radius fractures or degenerative diseases, as well as future evaluation of hemiarthroplasty replacement of the distal radius.



**P074**

**A consecutive case observational study of distal radius fracture treatment outcomes**

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**Introduction:** Distal Radius fractures are common. Persons affected experience reduced function during treatment and, occasionally, for an indefinite period. The potential for loss of function has been cited as support for liberal use of internal fixation strategies. Proponents of some ORIF methods purport that recovery of function may be more rapid in patients fixed with "their" method. We hypothesize that fixation methods are more similar than different. Also, we hypothesize that an observational study design can be used to detect the presence or absence of differences related to the treatment and outcome

**Methods:** IRB approval was obtained at 6 separate centers for an observational study of distal radius fracture care and outcome with data to be collected via the Internet using an independent organization (BoundaryMedical). Patients were consecutively offered enrollment. Surgeon determined Fracture Type, associated injuries, operative methods, and post-operative data and Patient (Pre and Post injury DASH) data was collected during the first post-operative year.

**Results:** 5 of the six sites that received IRB approval entered patients into the study. At these sites, 166 of 223 patients enrolled. The gender and age distribution is similar to previous demographic reports. The fracture type, gender, and age distribution of fractures did not differ significantly between sites. B fractures occurred rarely (<5%). 57% of the fractures studied were C type with the remaining being A type. For both A and C fractures, the most frequent treatment type was Fixed-angle Volar Plating. Other treatments included Bridging External Fixation, Fixed-angle Dorsal Plating (used only in C fractures), Fixed-angle Radial Plating, and Locked Intra-medullary fixation. DASH outcomes examined by fracture type versus treatment method at 2, 6, and 12 weeks post treatment does not reveal any significant difference (a trend for faster recovery is suggested for A type fractures treated with Intra-medullary fixation but statistical significance is not reached).

**Summary:** Statistically significant patient measured (DASH) outcome differences were not seen between distal radius treatment methods. An observational study can collect meaningful data useful to compare treatments without randomization. Clinician equipoise may be impossible to achieve among the many methods currently used for distal radius care. Because an ethical randomized trial demands clinician "equipoise", the proof of value of an observational method of treatment effectiveness study is important. Of additional significance, in this study of expert surgeons, all of whom operatively treat more than 25 distal radius fractures per year, the treatment effect was sufficiently small so as to preclude discrimination between treatment choices by fracture type. Thus, if a treatment effect exists it will be necessary to examine a very large patients group (possibly 200 in each of several groups).



**P075**

**Open reduction and plate fixation of displaced AO type C fracture of the distal radius: Indications of dorsal and volar plate fixation**

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**Purpose:** The aim of this study is to discuss the fracture types according to their lateral view CT scan appearance and classify them into three types, and suggest which type of plate is appropriate for each fracture type.

**Material and Method:** Thirty-two displaced AO type C fractures of the distal radius. Patients were 10 men and 22 women (mean age, 60 years; range, 31-80). Type I fractures have no depression fragments and no dispersed volar and dorsal fragments (Simple intra-articular) . Type II fracture types have dorsal depression fragments and a small volar fragment (Dorsal depression). Type III fractures have central depression fragments and dispersed volar and dorsal fragments (Central depression). Patient outcomes were evaluated using Mayo Modified Wrist Score .

**Result:** Functional results of the volar locking plate were excellent in 9 cases and good in 5 cases; those of the dorsal plate were excellent in 5 cases, good in 4, and fair in 1 case for type I fractures. Functional results of the dorsal plate were excellent in 3 cases and good in 1 case for type II fractures. Functional results of the volar locking plate were good in 1 case, that of the dorsal plate was fair in 1 case, and, those of the dorsal and volar plate were good in 1 case and fair in 1 case for type III fractures.

**Conclusion:** Type I fractures are reducible by manual or intrafocal pinning and stable fixation is obtained using a volar locking plate. The dorsal approach and plating is advisable for type II fractures. Dual plate fixation was advisable in cases where reduction and temporary fixation was not possible, but careful and elaborate planning was necessary because of maximum invasion and limitation of the range of motion for type III fractures.





**P076**

## **Evaluation of gripping power for functional assessment of post-distal radius fractures**

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**Purpose:** Various methods are used to clinically evaluate distal radius fractures. Since the demerit-point system of Gartland and Werley, as modified by Sarmiento, is lenient, the Mayo Wrist Score has been used. However, the gripping power ratio has not been clearly investigated for a normal value, and has the possibility of being requested for a numerical value that is higher than before injury. To evaluate the clinical result appropriately, we investigated the healthy gripping power ratio according to age.

**Materials and Method:** Three hundred right-handed women between 55 and 85 years old who consulted our hospital were investigated. They were divided into six groups (A: 55–59, B: 60–64, C: 65–69 old, D: 70–74, E: 75–79, and F: 80–84 years). The right and left grip power was measured twice with a Smedley type digital hand dynamometer.

**Result:** The 95% reference value of the gripping power ratio of the right hand (mean value  $\pm$  1.96 S.D.) is  $106.5 \pm 27.4\%$ , and that of left hand is  $95.4 \pm 23.8\%$ . The 95% reference value of the gripping power ratio of right hand (one-sided test, mean value  $- 1.645$  S.D) is  $83.5\%$  (A:  $84.0\%$ , B:  $84.5\%$ , C:  $85.1\%$ , D:  $85.6\%$ , E:  $82.9\%$ , and F:  $80.1\%$ ) and that of the left hand is  $75.5\%$  (A:  $76.7\%$ , B:  $78.0\%$ , C:  $78.3\%$ , D:  $78.0\%$ , E:  $75.8\%$ , and F:  $67.4\%$ ).

**Conclusion:** The gripping power ratio was almost constant for women less than 80 years old. The mean values of the right and left gripping power ratios were about  $105\%$  and  $95\%$ , respectively. When the right and left gripping power ratios were less than  $83\%$  and  $75\%$ , respectively, it was considered that the gripping power decreased in women less than 80 years old.



**P077**

**Effect of location of ball joint in external fixator on wrist motion in distal radius fractures**

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**Purpose:** To analyze effect of change of location of ball joint from axis of rotation on postoperative wrist motion in dynamic external fixator for displaced intra-articular fractures in distal radius.

**Materials and Methods:** 33 Patients who had dynamic external fixative surgery after closed reduction within acceptable range and could be followed at least 1 year were reviewed. They were divided into two groups according to distance (5 mm, 10 mm) of ball joint center from axis of wrist rotation which located in proximal cortex of capitate. These groups were compared by clinical results which were evaluated by range of motion of wrist (flexion, extension, radial deviation, ulnar deviation, pronation, supination) and pain evaluation system at last follow up. They were also divided into two groups according to direction of ball joint migration (proximal, distal) and evaluated by same methods.

**Results:** No difference in range of motion and pain was observed between distance 0 mm-5 mm group ( $p>0.05$ ). Distance 0 mm-10 mm group showed statistically significant more range of motion in extension, supination and pronation than  $>10$  mm group ( $p<0.05$ ). But there was no significant difference in flexion, radial deviation, ulnar deviation and pain ( $p>0.05$ ). Also no difference in range of motion and pain was observed between proximal migration group and distal group ( $p>0.05$ ).

**Discussion and Conclusion:** In retrospective analysis of dynamic external fixator, range of wrist motion should be preserved by decrease of changes of ball joint location within 10 mm from center of rotation.



**P078**

**Radial head dislocations with ulnar plastic deformation in children: An osteotomy within the middle third of the ulna**

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This retrospective study of a dislocation of the radial head and ulnar plastic deformation due to injury includes five patients with an average age 8.4 years. Four patients had injury on the left and another on the right upper extremity. All were Monteggia fractures, Bado Type I equivalents. The location of the maximum ulnar bow occurred near mid ulna. The mean length of time from injury to surgery varied from five days to 90 days with an average of 36 days. Based on previous studies concerning the attachment of the interosseous membrane, all patients underwent an ulnar osteotomy with elongation and angulation within the middle third of the ulna where the maximum ulnar bow occurred, as well as open reduction of the radial head. The osteotomy sites were stabilized by a plate and screws or K-wires. Annular ligament reconstruction was not performed in any case. The mean follow up period was 3.8 years.

Average range of motion of elbow extension was 0 ° , elbow flexion 138 ° , forearm supination 90 ° and forearm pronation 88 ° . According to Abe's rating system, results in all of five patients were evaluated as excellent. There were no postoperative complications. There were no patient complaints regarding cosmesis, or posterior ulnar bowing due to ulnar osteotomy.

An osteotomy performed within the middle third of the ulna and radial head relocation resulted in satisfactory clinical results.

(Lincoln TL, J Pediatr Orthop 14: 1994.)



**P079**

**How reliable is a digital semi-automated system in measuring radiological angles in distal radial fractures?**

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**Introduction:** Radiological measurements are used as criteria to identify quality of fracture reduction in distal radial fractures. Digital imaging system has been introduced in many hospitals in UK. We hypothesized that digital imaging system would improve inter-observer and intra-observer reliability of radiological measurements.

**Methods:** Ten consecutive adult extra-articular distal radial fractures were chosen. All patients required manipulation but none underwent operative fixation. Five consultants and five registrars took part in the study. Picture Archive Communications System (PACS) was used. This is a semi-automated system which, once lines are drawn, automatically measures length and angles. Participants documented pre-reduction and initial post-reduction radial height, radial inclination and radial/volar tilt of each fracture. Measurements were repeated after a week. Data was stored in excel spreadsheet and two way ANOVA statistical tests performed.

**Results:** Radial inclination and dorsal/volar angulation showed good inter and intra-rater reliability. Radial height measurement was found to be less reliable. Residual standard deviation, or measurement error of radial height calculation, was still small at less than 1 mm.

**Conclusion:** In a patient with high demand activity radiological measurements in distal radial fracture have strong predictive value of patient outcome. Radiological measurements are less predictive of outcome in elderly low demand patients. However, it is general practice to decide treatment plan on the basis of standard radiological criteria. Our study shows radiological measurement using the new digital semi-automated system has good inter-rater and intra-rater reliability. Results from studies using this system could in future be pooled for larger meta-analysis.



**P080**

**Surgical treatment of unstable distal radius fractures with volar locking plates**

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**Purpose:** This study was undertaken to determine whether volar locking plate fixation could be used to treat unstable distal radius fractures.

**Methods :** This retrospective follow-up study assessed 15 fractures in 15 patients with unstable distal radius fractures surgically treated with one of three types of volar locking plate systems. According to the AO classification system, five patients had type A3 fractures, two patients type C2 fractures, and the remaining eight patients had type C3 fractures. Radiographic measurements included volar tilt, radial inclination, and ulnar variance. Clinical outcomes were evaluated by active range of motion of the wrist and forearm, grip strength, the Disabilities of Arm, Shoulder, and Hand (DASH) questionnaire, and Saito's wrist score.

**Results:** At the time of final follow-up (six months minimum), mean volar tilt was  $7.4^{\circ}$ , mean radial inclination  $19.3^{\circ}$ , and mean ulnar variance 0.4mm. Mean wrist extension was  $58^{\circ}$ , mean wrist flexion  $55^{\circ}$ , mean radial deviation  $23^{\circ}$ , mean ulnar deviation  $35^{\circ}$ , mean pronation  $88^{\circ}$ , and mean supination  $87^{\circ}$ . Grip strength recovered to a mean of 81% of the grip strength in the contralateral limb for patients who had injured their dominant hand and to a mean of 75% for patients who had injured their non-dominant hand. Saito's wrist score calculations revealed 13 excellent and 2 good results. Mean DASH disability/symptom score was 7.5 points, and mean DASH work module score was 6.7 points.

**Conclusions:** The present study demonstrated that the unstable distal radius fractures could be successfully treated with volar locking plate systems.



**P081**

**Volar locking plate for distal radius fractures in comparison with bone mineral density**

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**Purpose:** The purpose of this study was to determine whether osteoporosis influenced the clinical outcome using volar locking plate of distal radius fractures in female.

**Materials and methods:** This study included patients with comminuted unstable intra-articular and extra-articular distal radius fractures treated by single surgeon. The authors reviewed 25 female patients with 25 fractures who were treated by open reduction and internal fixation using the volar distal radius AO locking compression plate and locking compression distal radius plate. The patients had been followed up for an average of 14.5 months (range, 9-24 months). Prospective data were obtained on 25 patients who had had their forearm bone mineral density (BMD) measured. Patients were divided into two groups, osteoporotic group (T - score < -2.5 SD using DXA) and non osteoporotic group. Mean BMD of osteoporotic group (11 patients) was 0.429g/cm<sup>2</sup> and that of non osteoporotic group (14 patients) was 0.593g/cm<sup>2</sup>. Outcome between two groups were compared using Cooney's criteria. The mean age of osteoporotic group was 72.7 years (range, 61-85) and that of non osteoporotic group was 61.5 years (range, 35-81). Four patients of non osteoporotic group were older than 70. The loss of reduction was evaluated from radiographs taken at between just post operation and the last follow-up visit.

**Results:** The functional outcome of osteoporotic group was excellent in 7 and good in 4 patients. That of other group was excellent in 10 and good in 4 patients. On an average of the osteoporotic patients, the loss of ulnar variance increased 0.38 mm, volar tilt increased 0.5 degrees, and radial inclination increased 1.1 degrees. There was no significant difference between two groups. Malunion of the distal radius was not seen.

**Conclusion:** Use of volar locking plate is effective for comminuted unstable radius fractures even if osteoporotic patients.



**P082**

**Results of external fixation for distal radius fracture -Investigation by comparing external fixation alone with external fixation using additional manipulation-**

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Thirty three fractures of the distal radius treated by using an external fixator were evaluated radiographically at the critical time of treatment, which were just after surgery, just before removal of the external fixator, after removal of the fixator and the end of treatment. Long term results of nineteen cases among them were evaluated with Saito's evaluation system and bilateral radiography. Treatment group were divided to 4 groups due to additional manipulation to external fixation, isolated ( external fixation alone ) , with pinning ( percutaneous or open ) , with iliac bone graft and with plate fixation. In all of the 19 cases, results were evaluated "good" or "excellent" with Saito's evaluation system. On radiographic evaluation of the 33 cases, average volar tilt during treatment was decreased except the plate group. There was no significant difference in the values of volar tilt of each group at the end of treatment. Number of the cases of decreased ulnar inclination during treatment were less than the increased ones. Values of ulnar inclination at the end of treatment of the isolated and pinning groups were lower than the iliac bone graft group significantly. The average ulnar variance was increased in all groups, however statistical significance was only seen in the isolated group. There was no significant difference of ulnar variance between right and left hand in 19 cases. So comparing with

contralateral wrist should important in the case with considerable ulnar variance. In the cases with major deformity of dorsal tilting ( > 5 degree ) , radial inclination ( >5 degree ) , ulnar plus variance ( >3 mm ) , the deformity during external fixation was unexpectedly large in comparison with deformity after removal of the fixator, though the amount of it was acceptable.



**P083**

**Palmar plate fixation of distal radius fractures using the ITS locking plate, mid term results after 1-5 years**

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**Question:** We developed a locking plate for palmar fixation of comminuted fractures of the distal radius.

**Method:** Implant: stability of the angle between screws and plate, achieved by a different hardness of the locking plate and the screws (pure titanium and titanium alloy), screw holes allow angulation between 70 and 110 degrees, anatomically contoured, low profile plate. The plate can be positioned on the palmar aspect of the radius without expecting a loss of correction. Surgery one week after trauma, palmar approach, open reduction, bone substitute if necessary, dorsal splint for two weeks, physiotherapy. **Follow-up:** Retrospective study, period of follow up examinations: 1-5 years, radiological and clinical examination.

**Results:** From 2000 until 2004 241 patients with fractures of distal radius underwent open reduction and internal fixation with ITS locking plate. Age between 25-81 years, 2/3 of the patients were women, 1/3 men. We did the score according to Cooney and the DASH-Score. We could find approximately 80 percent excellent and good results in both scores. Radiological findings: we compared the intraoperativ reduction with the healthy other side: an anatomical reduction was achieved in more then 90 percent. At follow up time we measured length and radial angulation. Shortening was between 0-3 mm, radial tilt maximum 3 degrees.

**Conclusion:** The anatomical results of reduction could be stabilized until bony union. In mid term follow up examinations most patients reached functional range of motion and normal health related quality of life.





**P084**

**Comparison of clinical outcomes of treatment by volar locking plate and those of external fixator for unstable fractures of distal radius in elderly patients**

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**Purpose:** Surgery is generally recommended to treat unstable fractures of the distal radius in elderly patients. Although the reported outcomes after open reduction and internal fixation using volar locking plates and external fixators are good, the optimal treatment of unstable distal radius fractures especially in the elderly is not apparent. The present study compares the outcomes of open reduction and internal fixation using a volar locking plate with those using an external fixator and bone grafting by the dorsal approach.

**Methods:** Thirty patients over the age of 60 y had dorsally displaced distal radius fractures. Eleven of them were treated using an external fixator with a bone graft, and a volar locking plate was applied to 19 of them. All patients were followed up for at least 6 months. We investigated the radiographic parameters, range of motion, grip strength, amount of pain, daily activities, and time taken to return to work. Total functional outcome was also evaluated using a modified Cooney scoring system.

**Results:** Radiographic parameters did not significantly change in patients treated with the volar locking plate, whereas in patients treated with the external fixator, volar tilt angle was decreased at the final follow-up compared with that immediately after surgery. Functional outcomes were better in patients treated with the volar locking plate than with the external fixator. One patient with an external fixator developed reflex sympathetic dystrophy, which resulted in a poor functional outcome.

**Conclusions:** Treatment with the volar locking plate is optimal to maintain reduction after surgery and severe complications such as reflex sympathetic dystrophy did not arise. Thus, the volar locking plate is the best choice of treatment for unstable distal radius fractures in elderly patients.

**Reference:** Tamara D. 2006 , Rozental TD. 2006



**P085**

**Evaluation of a new concept based non-bridging external fixator: A report of 67 cases**

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We have developed a new non-bridging external fixator based on a new concept of “fragment-specific fixation” of distal radius fractures. The purpose of this study is to evaluate the outcome of this new method. Our new low-profiled external fixation device was characterized by an arch-shaped distal pin-clamp that can fix distal radius fragments by multiple 1.6 mm threaded pins. The new concept for this fixator is; these distal pins could be inserted multiply from any dorsal aspects of the radius to reduce and fix each of the distal fragments (Fig). After closed manual/ percutaneous -pin reduction of displaced intra-articular fragments, multiple distal pins were inserted fluoroscopically into the subchondral bone parallel to the joint surface. Then all the distal pins were applied to its distal pin-clamp to make a “fixed distal fragments” (Fig). Two 3 mm threaded proximal pins were introduced to proximal radial shaft and applied to a proximal-clamp. Finally, reduction of the “fixed distal fragments” was performed using the clamps as “joysticks”, and then connected each other by a rod. All patients were allowed to use the injured wrist from the first postoperative day. We have studied 67 closed displaced and unstable fractures of the distal radius in 67 patients (49 women, 18 men; mean age of 51 y/o; mean follow up 31 weeks; AO-A2: 6, A3: 20, B2: 2, C1: 10, C2: 8, C3: 21) treated with this method. Functional results were excellent in 46, good in 17 and fair in 4 patients (The Cooney system). All of the patients had regained their preinjury level of activities with no severe complication. Our new concept based non-bridging external fixator had achieved an adequate reduction in almost all types of distal radius fractures except those with comminuted volar cortex, and resulted in early functional recovery in all of the patients.





**P086**

**Treatment of distal radius fracture using a new non-bridging type external fixator**

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**Purpose:** External fixator is one of the essential procedures for a treatment of distal radius fractures. Bridging type external fixators, however, have critical problems such as limitation of range of motion or CRPS. We have performed the treatment for distal radius fracture using the external fixator of non-bridging type. However, confirmation of an articular surface was difficult because conventional external fixator was not radiolucent. Accordingly, we have developed a new radiolucent external fixator. This paper is a comparative review of the strength test results of our new fixator, the F wrist (non-bridging type), and Poan Fix (bridging type).

**Materials and Methods:** The newly developed CP lucent (KISCO DIR, Osaka, Japan) is made of carbon. The entire body is radiolucent and weighs 29 g. For strength testing, Pin Slides A (distal) and B (proximal), the ball joint and the rod slide were selected for torque and maximum load measurements.

**Result:** Table 1 shows the test results. CP lucent scores best with regard to maximum load of the ball joint. The maximum load of the pin slides and the rod slide are lower than those of other devices. However, the load values are adequate for clinical treatment.

**Conclusion:** One of the applications of the non-bridging external fixator is distal radius fractures. The entire body of our new external fixator is translucent and is very useful for diagnosing bony fractures. In terms of dynamics, the test results indicate no obvious problems for clinical use.

	<b>Table 1</b>				<b>ML: Maximum Load</b>	
	CP lucent		F wrist		Poan Fix	
	torque(N.m)	ML(N)	torque(N.m)	ML(N)	torque(N.m)	ML(N)
Pin slide A	0.6	280	0.5	539		
Pin slide B	0.6	329	0.5	882	1.6	563
ball joint	3	164	1.2	52	1.6	153
rod slide	0.6	537			2	860



**P087**

**Minimally invasive plate osteosynthesis of distal radius fractures with a comminution of the metaphysis**

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**Purpose:** Difficulties in reduction, and the maintenance of alignment and stability make displaced distal radius fractures with a comminution of the metaphysis a challenge to treat. Recently minimally invasive plate osteosynthesis (MIPO) has been described. But as yet no one has reported the adaptation of MIPO technique for this fracture. This technique used the volar locking plate and left the pronator quadratus intact. Although the twenty cases in the current series are recent, we believe the quality of clinical results is of interest.

**Material and Methods:** From 2001 to 2005, twenty patients who sustained closed, displaced and comminuted fractures of the distal metaphysis of the radius were treated with our new surgical technique . Two palmar skin incisions, each about 3 cm long, are made. An AO LCP plate is inserted through the distal skin incision passed under the pronator quadratus . According to the AO classification, the type of fracture of the radius in all cases was 23-A3-3. The patients were followed for an average follow-up of 18 months.

**Results:** According to the clinical rating modified from Green and O'Brien, 7 cases were excellent , 10 cases were good and 3 cases were fair. The averaged ranges of motions were almost satisfactory. Radial inclination, volar tilt, ulnar variance were restored without loss of reduction in the twenty cases.

**Conclusions :** We acknowledge that this is a short-term study of a small series, but they assert that the patients were followed up systematically on a regular basis for both clinical radiological evaluations. The current study indicates that adaptation of minimally invasive plate osteosynthesis may be very efficient to minimize soft tissue damage, devascularize of the fracture fragments and mobilize the joint at the early stage for these complex fractures of the radius.



**P088**

**Volar locking plate fixation for AO type C fractures of the distal radius**

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**Purpose :** Since 2003, we performed open reduction and internal fixation for unstable distal radius fractures using a new designed volar locking plate and early active wrist mobilization. We describe the results of treatment for AO type C intra-articular fractures in a prospective cohort of 55 patients.

**Methods :** Fifty-five patients with AO type C fractures of the distal radius were treated with the DRV Locking plate (Mizuho Ikakogyo, Co., Ltd., Tokyo, Japan). There are 6 distal holes with threads, which can accept either a 2.0 mm locking pin, a 2.7 mm locking screw, or a 2.7 mm non-locking screw . There were 19 men and 36 women with an average age of 59 years. According to the AO classification, one fracture was type C1.2, 6 were C2.1, 5 were C2.2, 24 were C3.1, 16 were C3.2, and 3 were C3.3. None of the patients underwent bone grafting or artificial bone packing because the plate provided sufficient stability of the fracture without those procedures. Full active motion of wrist joint was encouraged immediately after operation. The average follow-up period was 13 months.

**Results :** All fractures united radiographically. The radial inclination, the volar tilt, and the articular congruity after surgery were well preserved until the time of bony union but the ulnar variance was increased slightly during bony union. Redisplacement of fracture fragments after surgery occurred in 6 fractures, all of which were type C3 fractures with severely comminuted or osteoporosis. According to the Cooney evaluation, there were 46 excellent, 8 good, and 1 fair result. The DASH score averaged 6.4 in this series. There was 1 case of tendon rupture.

**Conclusions :** The DRV Locking plate is a safe and effective tool in treating AO type C fractures of the distal radius.



**P089**

**Double-plating fixation for unstable distal radius fracture compromising the radiocarpal joint**

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Intra-articular fractures of the distal end of the radius are difficult to treat. Displaced articular fractures require open stable osteosynthesis to achieve and maintain anatomical restoration, and the dorsal double-plating technique (Rikli DA 1996) based on the three-column concept at the distal radius and ulna is ideal for this purpose. We report a prospective study of a consecutive series of 46 distal radius fractures compromising the radiocarpal joint which were treated using two plates of 1.2mm thickness.

The majority of fractures were group C2- and C3-type fractures the *Comprehensive Classification of Fractures*. The patients consisted of 20 males and 26 females, with a mean age of 56 years (range, 21-83 years). Within the average follow-up time of 29 months, the mean arc of flexion-extension regained 86 % and the mean grip strength 89 % of those on the uninjured side. At 6 months postoperatively palmar tilt was 12 ° (range, 1 ° to 20 ° ), the radial tilt 24 ° (range, 16 ° to 31 ° ), the radial length 12 mm (range, 6-18 mm), and the ulnar variance 1.3 mm (range, -1.5-5.0 mm) in average. All of the measurements did not differ from those obtained immediately after surgery except the ulnar variance which increased from 0.9 mm to 1.3 mm ( $p < 0.001$ ). According to the modified Green and O'Brien clinical rating system, forty of the patients had a good or excellent result. According to the modified Gartland and Werley demerit-point system, all of the patients belonged to good or excellent group. Postoperatively finger stiffness occurred in one patient and minor irritation of extensor tendon in three.

The double-plating fixation, though technically demanding, can provide satisfactory functional results for difficult intra-articular fractures of the distal radius with a low rate of complications.



**P090**

**Treatment of forearm fractures with extracorporeal shock wave therapy**

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Extracorporeal shock wave therapy (ESWT) became popular in the past decade as a treatment in general orthopedic cases, like delayed bone unions or non-unions in long bones, bone necroses and tendopathies.

The aim of our study is to present the positive effect of high energy extracorporeal shock wave therapy in complicated forearm fractures.

The enclosed group consists of 10 patients with 10 injured forearms. Seven of them had closed fractures and 3 of them had open ones. All of them underwent surgery followed by infected or noninfected non-union.

Applying ESWT in appropriate doses – one procedure of 22 Kv and 1800 shocks we got X-ray evidences of primary bone consolidation in 7(70%) patients on the 45 th day. The 8 th patient underwent secondary procedure and got bone union one month later. The left 2 patients were admitted for secondary surgery - reosteosynthesis.

The high rate of success in treatment of difficult forearm cases after application of ESWT confirms the benefit of this method and makes it more applicable in the daily practice.



**P091**

**Treatment Outcome of Osteosynthesis for Distal Radius Fracture Associated with TFCC: DASH Score Evaluation**

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**Purpose:** With use of arthroscopy, various treatments have been applied for distal radius fracture. Our institution has been conducting osteosynthesis on patients with distal radius fracture, which is frequently accompanied by TFCC injury (triangular fibro-cartilaginous complex). The purpose of our study was to evaluate the treatment outcome of distal radius fracture associated with TFCC injury using DASH (Disability of The Arm, Shoulder and Hand) score.

**Subjects and Methods:** Our subjects consisted of 23 patients (3 males and 20 females, average 62 years old) who had distal radius fracture associated with TFCC injury and had been followed up for 6 months or more. According to AO classification, types of fractures included A2 (5 patients), B2 (2), B3 (2), C1 (10), and C2 (4). Following confirmation of the intra-articular condition by arthroscopy, osteosynthesis was done using the Titanium Distal Radius Plate ® for the palmar side. Temporary wire fixation of DRUJ was performed on two patients which showed the DRUJ instability after osteosynthesis. At 6 months after operation, subjects were classified into either a continuing-pain group (showing pain or compressive pain at the ulnar joint, or showing positive in the ulnocarpal stress test), or a no-pain group (showing no such pain). DASH scores were evaluated between the two groups.

**Results:** Intraoperative arthroscopy showed 13 patients had a rupture at the radial attachment in the TFCC, and 10 patients had a rupture at the ulnar attachment site. Average DASH score of the continuing-pain group (6 patients) was 11.8 points, and that of the no-pain group (17 patients) was 12.5 points. A statistically significant difference was not observed between the two groups.

**Discussion:** Our DASH score results revealed surgical fixation is not necessary for distal radius fracture, even with TFCC injury.





## **P092**

### **The dorsal approach for open reduction and internal fixation of distal radial fractures – Experience with the matrix dorsal plate**

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A retrospective study of the treatment of unstable fractures of the distal radius by means of an angularly stable plate system (the Matrix plate Stryker UK) inserted by a dorsal approach was performed at Southend General Hospital in the United Kingdom.

A total of 78 fractures were treated by this method over a two year period between 2004 and 2006. Fractures considered suitable for dorsal plating were those with dorsal angulation and displacement as well as intra-articular fractures. Fractures with volar displacement were treated by a volar approach and excluded from the study.

All patients started early mobilization without external support the day after operation.

The study group consisted of 30 men and 48 women with a mean age of 61 years.

The average time to follow up was 17 month (range 6-29). The tourniquet time was an average of 35 minutes (25-60).

Assessment consisted of measurement the range of movement of the wrist, patient satisfaction, and a quick DASH questionnaire.

Complications consisted of 1 EPL rupture and 1 excessive EPL tendon tethering. Bone grafting or use of bone substitutes was not required with this system. To date only 1 of plates have been removed because of problems with the extensor tendons.

Our experience demonstrates that dorsal plating using a low profile and angularly stable plate and early mobilization produces results comparable to volar plating. We believe that the combination of a low profile, angular stable plate, together with a modification of the standard dorsal approach, developed by the senior author (a sub-periosteal approach via the fourth and deep to the third extensor compartment) reduces the incidence of problems with the extensor tendons.

This approach allows direct visualization of the fracture and direct reduction with the plate being used in both and angularly stable and buttress mode.

The operative time is reduced by this direct approach.



**P093**

**A three-dimensional finite element analysis for mechanism of the development of distal radius fractures. A difference of fracture pattern with or without osteoporosis**

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**Purpose:** The purpose of this study is to reproduce a fracture in a normal and osteoporotic bone with a finite elemental method, and to analyze the difference in the pattern of development of distal radius fractures.

**Methods:** Computed tomography (CT) images of the distal forearm were taken with the wrist dorsiflexed to 70° in a 32-year-old healthy man and in a 76-year-old woman having osteoporosis. Surface models were made from the CT data using a three-dimensional reconstruction software. The models included the distal part of the radius and the ulna, and the proximal carpal row. We calculated material properties of cortical and cancellous bones from the CT number of each subject, entered them in the model, and built up two models, i.e., a normal bone model and an osteoporotic model. The number of elements was 57854 and 54722, respectively. Furthermore, we added radiocarpal articular cartilage, the radiocarpal ligament, and intercarpal ligaments to the bone model. A finite element analysis was restricted at the proximal end of the radius and the ulna in all courses. Carpal bones were moved proximally along the radius axis, and von Mises stress of the radius surface was calculated. Von Mises stress of each element larger than the yielding stress of cortical bone was regarded as a fracture of the element. All the calculations were done as the linear elasticity analysis using ANSYS LS-DYNA10.0.

**Results:** In either the normal bone model or the osteoporotic model, a fracture was reproduced at the dorsal cortex of the radius (a Colles type fracture). Compared with the normal bone model, the fracture occurred with less force in the osteoporotic model. In addition, the fracture occurred more close to the articular rim in the osteoporotic model.

**Conclusion:** The pattern of distal radius fractures differs in the presence or absence of osteoporosis.



**P094**

### **Ulnar recession osteotomy for malunited radius**

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**Introduction:** Malunited distal radius fracture with persistent wrist pain and malfunction is not a rare condition. The morphological sequelae consists of a relative elongation of the ulna (ulna plus deformity) and a malalignment in the tilt and inclination of the distal radius. Recession osteotomy in the distal ulna was carried out instead of elongation correction in the radius.

**Methods:** Patients with symptomatic malunion of the distal radius fracture that were resistant to conservative treatments underwent surgery. Five patients with persistent wrist pain, dorsal angulation of the radius and positive ulnar variance were included. The procedure consisted of distal radius dorsal open-wedge osteotomy and ulnar arched osteotomy. An open-wedge osteotomy was performed at the distal radius, followed by interposition with a  $\beta$ -TCP graft. In order to level the ulnar variance an arched recession osteotomy was made at the distal ulna. The parameters evaluated were pre- and post- operative Mayo 's wrist score, ulnar variance (UV), inclination of sigmoid notch (SI), inclination of ulnar sheath (UI), palmar tilt (PT) and radial inclination (RI).

**Results:** The clinical outcome showed excellent post-operative function and pain relief. Significant changes include pain reduction and increase in the ROM of supination and pronation. All patients were evaluated as excellent and returned to their former job. UV was improved from -11mm to -2.1mm on average, PT from -20.6 degrees to +5.2, RI from 22.2 degrees to 22.8. The advantages of the procedure are as follows: good bony union of the osteotomized radius due to preservation of the volar cortex, preservation of the distal part of the extensor retinaculum by using small-sized fixation plates, and avoidance of excessive soft tissue tightness due to elongation of the radius.

**Conclusion:** Ulnar arched osteotomy with distal radial osteotomy improved the wrist pain and the joint surface alignment in patients that sustained distal malunion.



**P095**

**Acute compartment syndrome: An unusual case of an multiple level fracture in ipsilateral upper extremity by axial loading force -- Case report and literature review**

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**Purpose:** The objective was to demonstrate through one case which we experienced that acute compartment syndrome is a cause of severe forearm pain and upper limb dysfunction and that emergency decompression of the forearm compartment with sufficient extent can relieve the associated symptoms and minimize the sequela.

**Methods:** This article presents a case of forearm compartment syndrome with multiple level injury including severe segmental comminuted fracture in ipsilateral forearm, wrist, and hand injury by axial loading force , that was treated with emergency multiple fasciotomy and plating for all fracture. The follow -up period was 7 months and 2 weeks. Functional results were evaluated using Broberg and Morrey's functional scale.

**Results:** The patient displayed excellent relief of forearm pain following decompression and open reduction and exhibited no neurological and circulatory deficits. Multiple fasciotomy wounds were managed by delayed repair of only the skin on the posterior aspect of forearm and dorsum of hand at POD #2 days, and by skin graft on the anterior aspect of forearm at POD #7 wks. Bone union was obtained 5 months after operation. The most recent follow up revealed excellent results by the Broberg and Morrey's functional scale.

**Conclusion:** Forearm compartment decompression was most effective in relieving the symptoms and minimizing the sequela. When fasciotomy is indicated, a possibility of difficult postoperative wound management should not prohibit or postpone immediate operative intervention with sufficient extension.



**P096**

**The TriMed wrist fixation system: A single surgeon's early experience**

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Nine patients with eleven displaced intra-articular wrist fractures were selected for a review with a minimum of three months follow up. All fractures were high energy with joint fragment displacement greater than 2mm of angulated greater than 15° away from normal.

All fractures healed with no loss of position. Patients were assessed using the DASH (Disabilities of the arm, shoulder and hand) and PWRE (Patient rated wrist evaluation) scores. Their range of motion and grip strength were also assessed clinically.

The average DASH score was 15.8 (0.0-50.9) and the PRWE score average 29.6(5.0-86.0). There was an average decrease of 10.6% range of motion over all movements and an average decrease of 19.4% in grip strength.

This system allows for stable fragment specific fixation with early mobilisation. Particular advantages of the system include stable support for "die punch" and dorso-ulnar fragments. The technique can be demanding but early results are very encouraging.



**P097**

**Clinical results of locking palmar plate fixation for dorsally displaced fractures of the distal radius**

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Sixty-two patients with dorsally displaced fractures of the distal radius, including 20 extra-articular and 43 intra-articular, were treated with volar plating systems at our institution between 2002 and 2006. There were 24 men and 38 women. Their mean age was 57.2 years (range: 19-87 years). A volar AO/ASIF distal radius plate (DRP) was applied in 45 cases, an AO/ASIF locking compression T-plate (LCP) in 3 cases, an AO/ASIF locking distal radius system 2.4 (DRS) in 3 cases, and a Japan Universal Technologies volar distal radius plate (v-DRP) was used in 12 cases. In the DRP group, buttress pins were inserted into the distal holes, excluding the radial-most hole. In other groups, locking screws or pins inserted into all distal holes. The results were evaluated using Gartland and Werley method, range of motion, grip strength, and a radiological assessment to measure ulnar inclination (UI), volar tilt (VT), and ulnar variance (UV). The mean follow-up period was 37 weeks (range: 16-108 weeks). Thirty-five patients were rated excellent, twenty-six good, and one fair. The mean range of motion of the injured wrist as compared to the uninjured wrist at final follow-up visit was 91% in dorsiflexion, 89% in volarflexion, 97% in radial deviation, 95% in ulnar deviation, 97% in supination, and 98% in pronation. The mean grip strength of the affected hand at final evaluation was 79% that of the uninjured hand. At follow-up examination, the average loss of correction of UI, VT and UV was 0.1°, 0.7°, and 0.9 mm, respectively. The results suggest that the fixed-angled volar plating systems result in early functional recovery after dorsally displaced fractures of the distal radius, although slight shortening of the radius may occur.



**P098**

**Radioulnar ligament avulsion in distal radius fractures associated with ulnar styloid fractures**

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**Background:** Fractures of ulnar styloid process are often associated with distal radius fractures, but their influence to the treatment outcome of distal radius fractures are not well known. Recently it has become clear that a radioulnar ligament that fasten the articular disc to the ulna at its fovea is important in stability of the distal radioulnar joint (DRUJ). We examined radioulnar ligament injuries from arthroscopic and intraoperative findings in fractures of the distal radius with fractured ulnar styloid process, and evaluated the influence that fractured ulnar styloid process exert on the treatment outcome of fractures of the distal radius from a standpoint of instability of DRUJ.

**Methods:** From September 2003 to July 2006, 66 cases were subjected to surgery. Twenty-four men and 42 women with a mean age of 55 years (range, 14-85 years) were identified. Twenty-eight right wrists and 38 left were involved. Fractures of the distal radius were classified in AO classification. Fractures of the ulnar styloid process were classified in Nakamura's classification. We evaluated TFCC injuries by arthroscopy, and evaluated a radioulnar ligament directly when we repaired fractured ulnar styloid process.

**Results:** In the 15 cases (23%), a radioulnar ligament was avulsed in the fovea of ulna. Avulsion of a radioulnar ligament was found in nine cases (38%) out of 24 distal radius fractures of AO classification C2 or C3, and found in 10 cases (33%) out of 30 ulnar styloid fractures of Nakamura's classification base or proximal.

**Conclusions:** When a radioulnar ligament is lacerated in a fovea of ulna, it occurs with instability of DRUJ. Possibility of radioulnar ligament avulsion should be considered in the cases with fracture of the distal radius of AO classification C2 or C3, or the cases with fractured ulnar styloid process of Nakamura's classification base or proximal.



**P099**

**Corrective osteotomy for limitation of supination following volarly angulated radius fractures**

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Volarly angulated malunited radius fractures may lead to limitation of rotation, particularly the supination motion due to malalignment of distal radioulnar joint and pronation deformity. We analyzed the results of osteotomy to correct pronation contracture in patients with malunited radius fractures.

Twelve patients who had complained of functional difficulties mainly due to limitation of supination following radius fractures were included in this study. The mean age was 42.3 years (15 to 59 years). The mean supination was 24 degrees (from 0 degrees to 60 degrees), and the mean pronation was 69 degrees (from 50 degrees to 90 degrees). Osteotomy of the malunited radius was performed to correct pronation contracture. Clinical results were assessed using the modified Mayo wrist score. The mean follow-up period was 9 months.

Osteotomy sites were successfully healed in all patients. At the final follow-up, the mean supination increased to 70 degrees (from 50 degrees to 90 degrees), and the mean pronation was 73 degrees (from 60 degrees to 90 degrees). Radiographic measurements showed improvement of volarly angulated deformity (from 20 degrees to 6 degrees), radial inclination (from 19 degrees to 23 degrees), and ulnar positive variance (3.9mm to 0.7mm). The mean grip power increased from 49 Ib preoperatively to 69 Ib after the operation. The mean modified Mayo score increased from 64.5 to 88.1.

Unlike the limitation of pronation, which can be compensated by shoulder abduction, limitation of supination frequently causes significant functional disabilities. In patients with radius fractures, we should pay attention especially to the volary angulated deformity to avoid the risk of limited supination as a late complication. Osteotomy of the malunited radius can improve the supination arc with good functional results.





**P100**

### **Volar transverse incision technique for the fixed-angle plating of distal radius fractures**

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**Purpose:** Patients who undergo volar plate fixation of distal radius fractures using longitudinal volar approach sometimes complain of cosmetic problems and scar formation at the site of the incision. We used transverse skin incision on the wrist crease in the surgical treatment of distal radius fractures as minimally invasive surgery to prevent power loss of pronator quadratus(PQ) and cosmetic problems after surgery.

**Methods:** The transverse incision on the wrist crease was begun at the styloid process of the radius and extended ulnarly, approximately 2.5 cm long in the first place. The subcutaneous tissue was spread to expose the distal margin of the PQ muscle with the flexor carpi radialis tendon retracted ulnarly. The volar fixed-angle plate was inserted beneath the PQ muscle from the distal margin without incision of the attachment of the muscle to the radius radially. The plate was secured with locking screws distally and cortical screws proximally through a small longitudinal incision at the distal forearm, supporting the subchondral bone in order to stabilize complex fractures. The skin was closed with a running subcuticular nylon suture following repair of the distal margin of the PQ muscle.

**Result:** All patients resulted in stable fixation of the distal articular fragments, allowing early post operative wrist motion. Female patients were satisfied with minimal transverse incision, because of nearly identical to the proximal wrist crease, and never confused with the scar of self-cutting. This transverse incision did not cause problems in the palmar cutaneous branch of the median nerve.

**Conclusion:** Volar fixed-angle plating with a transverse incision and PQ-conserving approach may be advantageous for function of the wrist and cosmetic concerns in the treatment of unstable distal radius fractures.



## **P101**

### **Case presentation: Remembering it's original shape; The pre-bent AO stainless steel distal radius buttress plate**

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The pre-bent AO stainless steel distal radius buttress plate is a popular operative choice for the repair of Barton's fractures. We present a case report highlighting how inversely bending the angulation of a pre-bent plate will result in the long-term gradual failure of the procedure as a consequence of the plate's 'elastic memory'.

A 53 year old patient sustained a left volar Barton's fracture following a fall. The operating surgeon turned over a right sided AO stainless steel distal radius buttress plate and bent the angulation from dorsal to volar distally to fix the fracture. Post operative check x-ray was satisfactory. 13 months later the patient was seen in clinic following a trivial injury with pain and deformity in the left wrist. X-ray demonstrated a left dorsal Barton's fracture with the plate still fixed. During intra-operative repair it was observed that the fracture site had healed and therefore this was not a new injury. The plate deformation caused by the operating surgeon was elastic and the recoil to its original shape resulted in the dorsal Barton's fracture.

A material is said to be elastic if it deforms under stress and returns to its original shape when the stress is removed. The amount of deformation is the strain. This phenomenon can be explained using Young's modulus of elasticity (E), a measure of a material's resistance to elastic deformation, whereby  $E = \text{stress} / \text{strain}$ . Approximate values for stainless steel and bone are  $200 \times 10^9 \text{ N/M}^2$  and  $9 \times 10^9 \text{ N/M}^2$  respectively (Halliday et al., 1997). This explains the greater elasticity exerted by the plate effectively 'pulling' the bone across the healed fracture site.

It is essential that manufacturers inform Orthopaedic surgeons not to inversely bend the angulation of the pre-bent stainless steel distal radius buttress plates otherwise a gradual deformation at the fracture site will inevitably occur.



**P102**

### **Corrective osteotomy for the malunion of the distal radius**

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Corrective osteotomy and free iliac bone graft is standardized operative method for the malunited distal radius. We retrospectively analysed our 62 cases of corrective osteotomy with at least 1-year follow up.

**Patients and methods:** There were 36 male and 26 female with an average age of 43 years, in which 34 cases were classified as the Colles' type malunion, and 28 cases as the Smith's type malunion. Indications of this method were referred as deformity appearance with severe motion pain, loss of ROM, more than 20 ° of dorsal or palmar tilt, and without severe osteoarthritic changes on the radiocarpal joint. Mean final follow-up period was 3 years 4 months.

**Results:** There was no non-union at the corrected site. In Colles' type malunion, radiographs indicated preoperative 26.5 ° of dorsal tilt were corrected to 3.0 ° of palmar tilt postoperatively. Radial inclination increased to 19.8 ° postoperatively from 9.0 ° preoperatively. Ulnar variance was 4.4 mm preoperatively and 0.9 mm postoperatively. ROM improved to 59 ° of extension, 56 ° of flexion, 33 ° of ulnar deviation, 82 ° of pronation, 80 ° of supination postoperatively. We obtained 18 excellent, 12 good and 4 fair results. In Smith's type malunion, palmar tilt decreased to 10.0 ° from 32.0 ° preoperatively. Radial inclination increased to 17.2 ° postoperatively from 21.2 ° preoperatively. Preoperative 5.7 mm of ulnar variance was corrected to -0.2 mm postoperatively. ROM improved to 72 ° of extension, 60 ° of flexion, 24 ° of radial deviation, 33 ° of ulnar deviation, 81 ° of pronation, 75 ° of supination postoperatively. Most patients of Smith's type indicated severe limitation of supination preoperatively and obtained satisfactory ROM postoperatively. We obtained 15 excellent, 10 good and 3 fair results.

**Conclusions:** Although there were a couple of fair clinical results, the corrective osteotomy with iliac bone graft promises improvement of clinical symptoms, and radiographic indexes in both type of malunion.



**P103**

**Osteotomy for malunited fractures of the distal radius with fragment-specific fixation and injectable bone substitute**

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**Background:** Malunion is a known complication after a distal radius fracture. In order to restore the anatomy of the wrist and to decrease the symptoms as pain, decreased range of motion and decreased grip strength an osteotomy of the radius has proven effective. Injectable bone substitute has been used with good results for fixation of the radius fractures and could be an option also for the osteotomy. In this study we present an alternative technique for distal radius osteotomy using a bone substitute Norian SRS instead of bone grafting but also combining modern fixation techniques with the bone substitute. Our goal is to avoid the complications from bone graft harvest.

**Materials and methods:** Between November 2002 and October 2005, 25 patients underwent a distal radial osteotomy for a malunited distal radial fracture. Nine patients were men and 16 women with a mean age of 52 years (26-73). All fractures were dorsally displaced. Skeletal fixation was achieved with the Tri-Med system. A bone substitute consisting of calcium phosphate, Norian SRS ®, was injected in the bone defect.

**Results:** Radiographically dorsal angulation decreased, radial inclination increased and ulnar variance improved. ROM increased 19 degrees in forearm rotation, 16 degrees flexion/extension and 10 degrees radial- ulnar deviation. Grip strength increased from 63% to 81% of the uninjured side. Mean DASH score decreased from 34 to 21. Pain at rest and at physical activity decreased.

**Conclusion:** Osteotomy performed with the TriMed system and an injectable bone substitute Norian SRS ®, an effective method to increase range of motion, grip strength and to decrease DASH scores and pain after a distal radial fracture. The operation can be performed as an outpatient procedure and permits early rehabilitation.



**P104**

**Evaluation of a treatment protocol for distal radial fractures. A prospective study in 518 patients using DASH as outcome**

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**Background:** Distal radius fractures are among the most common fractures, consisting of about 1/6 of all fractures showing up at the ER. This is a study of patient related outcome scores measured with the DASH- score (Disabilities of the Arm Shoulder and Hand) in a large patient cohort treated in a standardized way depending on displacement and stability of the fracture.

**Materials and methods:** Between September 2001 and August 2003 a prospective study was performed in an unselected adult cohort of 581 consecutive patients to evaluate a standardized treatment protocol for distal radial fractures. Age, gender, fracture side and type of treatment were registered and a validated outcome instrument (DASH) was sent to the patients directly after and at 3 and 12 months post injury. 518 patients entered the study whereof 133 patients with unstable or intra-articular fractures were operated. A control-group matched to age and gender also received the form.

**Results:** The median DASH -score was 18.3 (7.5-37.5) at 3 months and 7.5 (1.7-25.4) at 12 months. Scores did not differ between non-displaced, reduced and operated fractures or between type of fracture and time from injury to operation. Operative treatment manages to restore function to a level equal to patients with fractures considered to be stable after reduction and casting.

**Conclusion:** It seems that some patients still have residual symptoms at three months but that the majority has normalized at one year. With the proposed treatment protocol equivalent final subjective results are achieved regardless of initial severity of the fracture.



**P105**

### **External fixator for the treatment of distal radius fractures**

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**Purpose:** The purpose of this study was to assess the effectiveness of external fixation in the treatment of intraarticular fracture of distal radius and to identify factors that might affect the final outcome.

**Materials and Methods:** Twenty-nine cases of intraarticular fracture of distal radius (AO type C1, 2, 3) which underwent external fixation and internal fixation with Kirschner wires were analyzed radiographically. Radiographic parameters measured included volar tilt, radial inclination, radial height, and ulnar variance at surgery and at the last follow-up. The average follow-up period was 9 months ranged from 6 to 16 months.

**Result:** Volar tilting averaged  $-3.9^{\circ}$  before surgery; this value was corrected to  $11.1^{\circ}$  at surgery and then progressed to  $9.1^{\circ}$  at the last follow-up. The average radial height was 9.8 mm before surgery and 13.7 mm at surgery, and 12.8 mm at the last follow-up. The average radial inclination was  $17.2^{\circ}$  before surgery,  $24.1^{\circ}$  at surgery, and  $22.7^{\circ}$  at the last follow-up. The average ulnar variance was + 1.4 mm before surgery, +0.4 mm at surgery and +1.3 mm at the last follow-up. Patient age, initial fracture types, presence of ulnar styloid process fracture, and the methods of treatment included open reduction, closed reduction, numbers of K-wires, arthroscopy aided reduction and fixation of ulnar styloid process were not predictors of loss of reduction statistically (multivariate binary logistic regression analysis, Epi-Info Ver. 3.3.2. CDC Atlanta USA).

**Conclusion:** External fixation augmented with Kirschner wires is thought to be one of the good surgical options in the treatment of intraarticular fracture of distal radius. No specific predictor which affected to obtain and maintain the reduction was noted.

**Key Words:** Distal radius fracture, External fixation supplemented with K-wire



**P106**

### **Non-locking plate fixation for AO type C3 fracture of the distal radius**

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**Purpose:** The purpose of this study is to review our experience with open reduction and non-locking plate fixation for AO-type C3 fractures of the distal radius.

**Methods:** Thirteen consecutive AO-type C3 fractures of the distal radius were treated by ORIF with non-locking plate. The average age was 55 years. Five had AO type C3-3 fracture, and eight had AO type C3-2 fracture. Volar plate was used in 11 cases, and dorsal plate in 2. Bone graft was used in 3 cases and external fixation in 2. We measured radiographic parameters (radial inclination, volar tilt, ulnar variance, intraarticular gap and step off) throughout the period of fracture healing. Clinical outcome were evaluated according to scoring system by Cooney. Relationship between radiographic parameters and clinical score in thirteen patients was analyzed, and C3-3 group was compared with C3-2 group regarding clinical and radiological parameters.

**Results:** Average follow up period was 11.7 months. Overall clinical outcome was excellent for 1: good for 5: fair 4: poor for 3. According to Cooney's scoring system, average score in AO type C3-3 group was 62 points, and AO type C3-2 group averaged 76 points ( $P=0.13$ ). With regard to radiographic parameter, final volar tilt angle had a definite correlation with the clinical outcome (Spearman corrective coefficient analysis:  $P=0.007$ ). Statistical comparison of the two groups (AO type C3-3 and C3-2) revealed that volar tilt angle in AO type C3-3 group at the final follow up was significantly less than that for the others (Mann-Whitney U-test,  $P=0.03$ ). Other parameters in AO type C3-3 showed no statistically significant difference compared to that of the other.

**Conclusion:** AO type C3-3 fracture treated with non-locking plate is difficult to maintain reduction during postoperative observation. Alternative procedure (locking plate, sandwich plates, and distraction plate) should be applied to prevent loss of reduction.



**P107**

**A case report of Salter Harris IV injury of distal radius**

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Epiphyseal injuries represent between 18.5 & 30 % of pediatric fractures. A 15 year old boy sustained injury to right dominant wrist when he landed onto his outstretched hand from a car's bonnet. He presented on the next day with a tender swelling on the dorsum of his right wrist. It was an isolated closed injury without neurovascular compromise. A radiograph showed a Salter Harris (SH) IV fracture of the dorsal aspect of the radius with 2-3 mm displacement. The fracture was reduced and fixed with a Kirchner wire in an acceptable position. The K-wire was removed 4 weeks later and the patient had a good pain free range of motion. It is understood that in the long term the patient is likely to experience pain and restriction of movements. Patients with injuries that cross physes can be good candidates for internal fixation with bio-absorbable materials, so that stability is provided until the time of fracture union but there is minimum interference with physeal growth.





**P108**

### **First Results with a Multidirectional Fixed Angle Implant for Internal Fixation of Fractures at the Distal Radius**

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The management of fractures of the distal radius are constantly in the focus of analysis. This study reviews the results of 20 patients with a fracture of the distal radius that were treated with a new multidirectional fixed angle plate.

20 patients with closed Colles type fractures of the distal radius were treated with Medartis (Aptus) palmar fixed-angle plates. Patients were evaluated postoperatively at an average of 26 (ranges: 23-28) weeks in a prospective manner. Pain, range of motion, grip strength, DASH score, modified Mayo wrist score and radiograms were obtained. Level of significance was set at 95%, the chi-squared and ANOVA tests in combination with a post-hoc Tukey test were used for analysis.

The average range of motion (ROM) in extension / flexion was 87° (76% of the contralateral side) and in ulnar- / radial deviation was 42° (88% of the contralateral side). Immediate post-operative pain values (Visual Analogue Scale 0-100) were 57 (non-stress) and 66 (17). Both were significantly reduced at follow-up (3 (non-stress) and 24 (17)). Grip strength improved to 84% of the contralateral side. The mean DASH-score was 13 ±13 points. The modified Mayo wrist score showed with 83 ± 27 points an excellent result. The patients reported low disability in the overall function of the injured extremity with 78% of the pre-operative function. The overall treatment of the fracture was found to be satisfactory by 82% of the patients. Surgeons reported a satisfactory handling of the implant in 92% of the cases. Radiological examination showed an ulnavariance of 0,9 ± 0,4 mm, radioulnar inclination of 21 ± 5 degree and palmar inclination of 4 ± 6 degree.

Our preliminary data show that treating unstable distal radius fractures with multidirectional palmar fixed-angle plates is reliable and effective. It offers good and satisfactory functional and radiological results.



**P109**

**Three cases of acute plastic bowing of the forearm**

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Although acute plastic bowing of the forearm is a comparatively rare injury, an exact diagnosis is required. This report examines three cases of acute plastic bowing of the forearm, including two examples in adult patients. A 12-year-old boy had bowing of the ulna with an anterior dislocation of radial head, while a 21-year-old man had bowing of the ulna associated with an angulated shaft fracture of the radius. Both patients had sustained the injuries by falling on their outstretched hands during sporting activities. A 24-year-old woman whose hand and forearm had been caught in a roller had bowing of both the ulna and radius, but there was no obvious fracture. If acute plastic bowing is not diagnosed and treated exactly, the resulting limitation in rotational movement of the forearm will remain permanently. It is therefore important to pay particular attention to cases of forearm fracture and dislocation. Although cortical defects were not observed in roentgenograms in any of our cases, we were able to detect hematosteon in MRI and bone scans, indicating that these latter procedures are useful for confirming an exact diagnosis. Although acute plastic bowing occurs mainly in children, it may also occur in adults, as evidenced by a literature search that found eleven previous reports of acute plastic bowing of the forearm in adult patients. In the two of our cases underwent a wedge osteotomy, limitation of pronation and supination has remained. While the remaining case was not operated on due to having no limitation in pronation or supination. We therefore consider that two-dimensional osteotomy may not be sufficient in cases of acute plastic bowing. In the future study, it is essential to evaluate acute plastic bowing in three-dimensional CT scans, in order to prepare a plan for a three-dimensional osteotomy.



**P110**

**The endoscopic extensor indicis transposition for EPL tendon rupture following radius fracture**

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The standard operation for extensor indicis transposition to reconstruct a ruptured EPL tendon requires three incisions, over the 1 st metacarpal, the MP II and the 4 th tendon compartment at wrist level. We describe a new endoscopic technique requiring only a single incision over the 1 st metacarpal.

A tunnel is made from the incision towards the MP II area and the 4 th compartment at the wrist. A 4 mm face lift endoscope with a dissector at the tip is inserted. The whole dissection of the tendon and the transposition is done endoscopically. The Pulvertaft suture is made in the wound on the metacarpal.

The authors have used this technique so far only in cases of EPL rupture following radius fracture without significant synovitis.

The advantage of the endoscopic procedure is in the reduction in external and internal scarring. We consider this operation to be a reasonable step to introduce endoscopic techniques into reconstructive hand surgery.



**P111**

**Late rupture of flexor pollicis longus tendon after volar distal radius plating: A case report and review of the literature**

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**Background:** Tendinitis and tendon rupture are recognized complications of plating for distal radius fracture. Flexor tendon rupture after volar plating occurs less frequently than extensor tendon rupture complicating dorsal plating. 1,2 Most reported cases of tendon rupture occur less than one year after fixation.

**Methods:** We report a case of atraumatic late rupture of the flexor pollicis longus tendon occurring 5 and a half years after volar plating of distal radius fracture.

**Results:** The implant was removed and the flexor pollicis longus tendon repaired using an ipsilateral palmaris longus tendon graft. She regained full active flexion of the thumb interphalangeal joint at 3 months.

**Discussion:** Late rupture occurring more than 5 years post-fixation has not been reported. We believe the pathogenesis in our patient to be multifactorial: mechanical, inflammatory and vascular in nature. 3,4,5

**Conclusion:** Early implant removal after volar plate fixation can be considered bearing in mind the possibility of late flexor tendon rupture especially when the distal edge of the plate is in direct contact with the tendon.

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**P112**

**The efficacy of dosiflexion practice for the recovered of grip strength in the patients of the distal radius fracture**

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**Introduction:** In most patients after the treatment of fracture of the distal radius, range of motion of wrist joint was recovered earlier than that of grip strength. There were some reports that indicate the importance of corporation of the strength of finger flexion and wrist extention. We compared the efficacy of practice of dosiflexion in two groups. One group was strengthen of dosiflexion practice (Group M), and the other was non strengthen of dosiflexion practice (Group N).

**Methods:** The average age at surgery was 64.1 years in Group M (n=12) and 63.0 years in Group N (n=9). Both groups started range of motion exercise at 1 week after operation. Moreover, they started grip strength exercise at 3 week after operation. Group M started practice of muscle strength exercise of dosiflexion when they started wrist range of motion exercise. We measured range of motion, grip strength and dosiflexion strength with both groups.

**Result:** There were no significant differences between both groups with range of motion of wrist joint. Average of grip strength was 50.3% of the contralateral side in Group M and 32.4% in Group N at 1 month after operation. It was 68.7% in Group M and 46.5% in Group N at 2 months, and it was 76.1% in Group M and 60.2% in Group N at 3 months. Grip strength was significantly higher in Group M than Group N at 1 month, 2 months and 3 months after operation ( $p<0.05$ ). The dosiflexion strength in Group M was significantly increased ( $p<0.01$ ).

**Conclusion:** Range of motion of wrist joint was no significant differences between both groups. Strengthening exercises of the dosiflexion accelerated the grip strength recovered significantly earlier in Group M. This result suggested that dosiflexion strengthen was important factor for grip strength by stabilizing wrist joint dosiflexion posture.



## P112b

### Gain of function after corrective osteotomy of malunited Colles` fractures

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**Introduction:** Correction of length and angulation of the radius and ulnar seams to ameliorate function and force of the wrist (Prommersberger KJ, 2002).

**Method:** From July 1998 to November 2005 patients with malunited Colles`fractures were examined with a standard protocol preoperative and at the end of postoperative physiotherapy when osteotomy or arthrodesis was consolidated and no further gain of motion was seen. Ulnar impingement was treated by shortening osteotomy and when associated to arthrosis by a Kapandji procedure. Dorsal dislocated radius surface  $> 20^\circ$  was object to corrective additive osteotomy. Exclusion was due to important arthrosis, osteoporosis or fixed carpus.

**Results:** End of therapy was within 5-18 month. 34 patients were included. I: 14 additive distal radius osteotomies. II: 2 more combined with arthrodesis of the DRUJ. III: 14 subtractive osteotomies of the ulnar and IV: 4 more with arthrodesis of the DRUJ.

**Table I :** Achieved Correction and Function: pre-op. / post-op.

Extension °	37	+/- 17,2	46	+/- 14,2	Pronation °	61	+/- 24,9	63	+/- 24,1
Flexion °	31	+/- 18,7	47	+/- 17,1	Ulnar index mm	4,6	+/- 3,4	-0,7	+/- 1,6
Ulnar abduction°	14	+/- 9,1	28	+/- 8,8	Radial tilt °	19	+/- 12	-1,7	+/- 7,9
Radial abduction°	21	+/- 21,0	23	+/- 7,2	Ulnar inclin. °	17	+/- 6,0	20	+/- 6,8
Supination °	65	+/- 26,2	73	+/- 29,1	Force Kpa	26	+/- 17,1	38	+/- 19,2

**Complications:** 1 necrosis of a small articular fragment also osteotomised, 2 plate failures after radius osteotomy, 1 partial loss of correction after angle stable plate osteosynthesis due to important osteoporosis, 2 malunion in arthrodesis of DRUJ, 2 tendon ruptures by dorsal approach, 1 wound infection.

**Conclusion:** Corrective osteotomy significantly ameliorates range of motion and force. Important osteoporosis has a high risk for complications.



**P112c**

**Multidirectional fixed-angle plate fixation of unstable distal radial fractures based on a new locking principle**

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**Introduction** : The preferred treatment of unstable distal radius fractures nowadays has changed to palmar plating with fixed angle devices. Easier reduction of the fracture from the palmar view, no need for bone graft, no risk of tendon interference and mostly no need for hardware removal are obvious advantages. Distal radius fractures occur in many different ways and to adjust the implant according to the fracture type seems preferable. By unidirectional screw placement however based on the normal anatomy the surgeon is limited.

**Methods** : Based on a new locking principle (Trilock\*) different plate devices were developed with screw placement by 15° of freedom in all directions (Medartis\*). As the multidirectional angular stability is not realized by means of distortion of the plate hole (thread forming) but by means of force and friction, the material can be produced of high grade titanium in combination with a low profile design. Depending on the fracture type – comminuted, ulnar, radial - the screw placement with sufficient subchondral bone support can be individually chosen avoiding safely intraarticular position.

**Material** : 55 patients with a mean age of 54years were treated using this device without bone graft. The majority demonstrated intraarticular patterns of the C-type according to the AO classification. Follow up examination showed no relevant secondary loss of reduction. X-rays revealed 8° of palmar inclination and an ulnar variance of +0,2mm. Wrist motion averaged 58° of extension, 61° of flexion, 36° of ulnar and 20° of radial deviation, 89° of pronation and 88° of supination. Patients regained good function represented in a mean DASH score of 14 and modified Cooney wrist score of 82 points

**Conclusion** : Multidirectional fixed-angle plate fixation offers the possibility to adjust plate and screws precisely according to the fracture type. The stability of the locked screw is sufficient till refilling of the bone defect has occurred and by the anatomical healing is achieved.

\* Medartis Basel Switzerland



**P112d**

**Interesting course of a distal radius fracture type Aitken I (Salter II)**

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Interesting course of a distal radius fracture type Aitken I (Salter II)

The result of a premature closure of the epiphyseal area of the distal radius led to a extreme ulna lengthening with mainly cosmetic handicap.

The 14 years old girl asked for a correction of wrist deformity.

Lengthening of the distal radius by callus distraction and unexpected problems required intensive care after first surgery.

In conclusion in spite of the complications we could get a very good functional and cosmetic result.





**P112e**

**Treatment of radio-ulnar discrepancy using a new technique of long oblique osteotomy for equalization and reorientation of the two bones**

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An ulna that is too long or too short may be responsible for symptoms

about the wrist. Several techniques are available to shorten or lengthen the ulna. We have used, among other techniques, an oblique osteotomy which allows the length of the ulna to be modified by sliding the two fragments over each other, taking care to keep good contact between them. The main advantage of this technique is that it combines length modification with a reorientation of the distal ulna so as to restore congruency of the distal radioulnar joint.

When shortening a long ulna, this may help to regain a normal range of pronation and supination. When used to lengthen a short ulna, it stabilizes the distal ulna stump, which may be a cause of pain if unstable and can impinge on the radius. This lengthening is combined with soft tissue procedures to further stabilize the distal stump.

Our experience in using it for shortening was mainly in post-traumatic cases and Madelung's deformity, and for lengthening, the sequelae of too large a distal ulna resection.

Key words

Long ulna Short ulna Ulna oblique osteotomy Madelung



**P113**

**Palmar lunate luxation combined with a comminutive fracture of the lunate fossa: A rare case report**

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**Aim:** We present an extremely rare case of a lunate luxation combined with an intraarticular fracture of the Lunate-fossa (distal radius).

**Methods:** Male patient, 35 years old, which suffered since 27 hours a lunate luxation-radius compressive fracture, has been operated in our hospital, one hour after his reception. Through a dorsal approach, the lunate was reduced and a first row-median ray and a wrist diagonal immobilization by 3 K-wires were performed. A Scapfo-lunate ligament reattachment by Miteck anchors was performed. After a fracture distraction by a Pening external fixation, we reduced the fracture and after an immobilization by 2 K-wires we filled the fracture space by bone allografts. A wrist plaster has been applied for 6 weeks.

**Results:** 5 months postoperatively the fracture seems to be completely healed and the joint surface reconstructed. No lunate necrosis signs appeared and the Scapholunate joint is clinically stable. The wrist flexion was recovered because the extension was 50% restricted the therapy program became intensified.

**Conclusion:** According our early results, our management choice seems to be adequate. Considering that the described injury is rare clinical entity and is not included in the literature, we must offer a special scientific interest regarding such as the operative technique, as and the evolution and prognosis of this type of injury.



**P114**

**Indications for excision of distal pole of the scaphoid**

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Excision of the distal pole of the scaphoid has been used for treatment of scaphoid non-unions with intercarpal arthritis and for treatment of isolated arthritis of the scapho-trapezio-trapezoid (STT) joint. Traditional treatment options include proximal row carpectomy or scaphoid excision with "four corner" arthrodesis. STT joint arthritis is commonly managed by fusion or by resection arthroplasty, with or without soft tissue interposition. We have utilized the excision of distal pole of the scaphoid for the management of chronic scaphoid non-unions, STT arthritis, and to increase wrist range of motion after radioscapholunate fusion. The patients presented marked reduction in pain, required minimal postoperative immobilization and had improved wrist range of motion. We analyze our indications for excision of the distal pole of the scaphoid and present our series in this report.



**P115**

### **Cystic lesion in carpal bones**

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**Background:** Four cases with cystic lesion in carpal bones were reviewed.

**Materials and Methods:** There were one male and three females with a mean age of 31.5 years (range, 14 to 42). Three cases had wrist pain and one had no symptom. Cystic lesions occurred in scaphoid, lunate, trapezoid, and capitate. The average of maximum diameter of the cystic lesion was 8.9mm (range, 7 to 13mm). Three cases with wrist pain underwent curattage and iliac bone graft. The remaining one was followed up conservatively. The observation periods ranged from 19 to 117 months (mean, 48 months). The outcome, including wrist pain and range of wrist motion, was assessed.

**Result:** All of the three cases which underwent surgery had no complaint and radiography showed no radiolucent lesion. The conservative case had no complaint although the size of cystic lesion had slowly increased.

**Discussion:** Curattage and iliac bone graft provided successful outcome for cystic lesion in carpal bones. Surgery should be recommended to symptomatic cystic lesion in carpal bones, and care must be taken to prevent pathological fracture of carpal bone with a relatively large cystic lesion.



**P116**

**An extremely rare case of perilunate dislocation with radial dislocation of scaphoid**

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Perilunate dislocation is a relatively uncommon injury. The majority of perilunate dislocations are dorsal type. We report an extremely rare case of perilunate dislocation with radial dislocation of the scaphoid. A 49-year-old man was involved in a traffic accident while riding on a motorcycle. Radiograph demonstrated radial styloid fracture and radial dislocation of the scaphoid. The scaphoid invaginated in the fracture site of the styloid. The dislocated scaphoid and other carpal bones were easily reduced with manipulation, but re-dislocated without traction force. Surgery was performed under general anesthesia. Dorsal approach, Berger's incision, was applied. The fracture of the styloid, scapholunate and lunotriquetral joint were fixed with Kirschner-wires respectively, and the scapholunate ligament was sutured with bone-anchors. After surgery the wrist was immobilized with a plaster for 4 weeks, followed by ROM exercises. Six months after the surgery there was no evidence of scapholunate dissociation, and ROM improved to 60 ° of extension, 60 ° of flexion, 90 ° of pronation, 90 ° of supination. The extent and configuration of a dislocation is dependent on the anatomical variation of the carpal bones, the direction of the traumatizing force, and the position of the hand in relation to the forearm at the time of injury. Most perilunate dislocations result from a dorsiflexion force acting on the wrist with the lunate buttressed and held by the dorsal lip of the radius. In our case, the patient thought to have gripped the handle with his wrist slightly flexed. Simultaneously radial deviation force might be applied with the axial load from the trapezoid, and the radial styloid fractured and, with rupture of the scapholunate ligament, allowed radial escape of the scaphoid with the other carpal bones to produce this unusual perilunate dislocation. To the best of our knowledge this type of perilunate dislocation has been scarcely reported previously.



**P117**

## **Use of "carpal button" in four bone arthrodesis**

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**Introduction:** Four bone arthrodesis is one of numerous techniques in wrist reconstruction after severe SNAC or SLAC wrist. The use of carpal button simplifies significantly the procedure, avoiding cancellous bone graft and extensor tendons lesions because the plate is fully countersunk.

**Material and Methods:** All patients were operated on as outpatient's basis under local regional anesthesia using a pneumatic tourniquet. The arm is laid flat on an arm table. By a dorsal approach, after the extensor tendons have been retracted laterally, a T-shape incision is made in the articular capsule. A scaphoidectomy is performed followed by resection of the cartilage and the subchondral bone in the midcarpal joint. After reduction of the first row over the second, the four bones are drilled with an adapted burr to a depth that is equal to the thickness of the plate. Then the plate is completely embedded into the four fused bones.

We operated on 6 patients using this technique.

The average age was 46 years old (range 27 to 62). We had 2 women for 4 men. All patients had, disabling pain. Average previous surgery was 3 (range 1 to 7). All men were manual workers with work injury. There were 2 snac wrists and 4 slac wrists.

**Results:** Our average follow up is 26 months (range 13 to 38 months). Fusion was obtained in all cases with an average delay of 4 months (range 2 to 6). Pain disappeared in 3 cases, was moderated in 2 cases and stayed disabling in one case of manual worker. The range of motion was improved in all cases. We have to remove one plate.

**Discussion:** The indications are rare but the four bones arthrodesis is an interesting technique for wrist reconstruction in cases with severe radioscaphoid and midcarpal arthritis. The use of carpal button simplifies the procedure avoiding bone graft and leading to the union in all cases.



**P118**

**Volar percutaneous scaphoid osteosynthesis with cannulated absorbable screw and arthroscopic assistance**

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**Introduction:** The goal of the treatment is to obtain a perfectly anatomical reduction of the osseous fragments by avoiding any malrotation. The patients can take again their activity quickly .

**Material and methods:** The patients always were operated on outpatient basis under local regional anaesthesia and tourniquet. Osteosynthesis was done by a very short palmar approach located at the base of the distal tubercle of the scaphoïde. The arthroscope was placed by a 3-4 radiocarpal portal and radial mediocarpal portal. The reduction, when it was necessary, was carried out with a small size chisel by a 1-2 mediocarpal portal. Final osteosynthesis called upon a Herbert screw or an absorbable cannulated screw. Mobility was begun immediately by letting the patient choose itself his range of motion. We operated on only 34 patients by this technique (23 men for 11 women). The average age was 31 years (between 18 and 51 years). The average time between the fracture and the surgery was short (13 days). It always acted of fracture of the waist of the scaphoïd.

**Results:** Our average follow-up was 27 months (range 9 to 37). The average time of union was 7.1 weeks (range 5 to 8). We never had any non-union. Mobilities and the muscular strength were improved in all cases. The pains disappeared completely in all cases. We had to remove the screw in 5 cases because these patients had small pain on the slightly external head of screw.

The use of modified "Mayo Wrist Score" showed 28 excellent results and 6 good results.

**Conclusion:** This technique appears simple to us and very comfortable for the patients. It makes it possible to quickly find a painless and functional wrist by avoiding the installation of a cast. But a surgical training period seems to be absolutely necessary, because the technique is not so simple.



**P119**

### **The strategy for treatment of scaphoid fracture**

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**Introduction:** The classification of Herbert could not show us strategy for the treatment. We made a new classification, which directly indicate treatment strategy.

**Material and Method:** We have treated 101 scaphoid fractures using Herbert screws, AO 3.0 mm cannulated screws, or Acutrak screws. Our classification was according to the radiographic findings such as: linear type; cystic type; and displaced type. The linear and cystic type did not have any displacement more than 1 mm. If the fracture line had sclerotic zone thicker than 1 mm, it was classified to the displaced type. Osteosynthesis was performed with bone graft in the displaced type but not in the linear and cystic type. Then we compared the results of these treatments (Table 1).

**Results:** There were one failure case in the Herbert group and four cases in the AO group. There were no failure cases in the Acutrak group.

**Discussion:** Following our treatment strategy, we could get satisfied results. There were no failure cases using the Acutrak screw following our strategy so far.

**Conclusion:** Our simple classification was useful for treatment of the scaphoid fracture. The period before the surgery was not important factor of this classification.

Table 1. Classification of the strategy for the scaphoid fracture by the radiograms

Fracture type	<b>Herbert (1988-1997)</b>	<b>AO 3.0 (1998-2002)</b>	<b>Acutrak (2003-2006)</b>	
<b>Linea</b>	55 (5)	23 (2)	18 (2)	14 (1)
<b>Cystic</b>	15 (11)	4 (3) *1	4 (3) *1	7 (5)
<b>Displaced</b>	31 (30)	9 (9)	16 (16)*3	6 (5)

( ) : delayed union cases ( more than 3 months untreated period before the surgery)

\*: Cases of union failure after the surgery





**P121**

**Perilunate, lunate & perilunate fracture dislocations: Initial diagnoses & management**

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**Introduction:** Perilunate, lunate & perilunate fracture dislocations are devastating closed injuries of the wrist. They are often missed on initial evaluation, leading to devastating complications. With high-energy wrist injuries radiographs must be scrutinized for the presence of perilunate dislocation or one of its variants. Prompt reduction is necessary to achieve favourable results. We reviewed consecutive wrist injuries and diagnoses and management.

**Methods:** Retrospective review of 14 consecutive patients from 2002 to 2005. Data collected on mechanism of injury, diagnoses, seniority of doctor examining, x-ray views requested, delays in diagnoses and treatment.

**Results:** 12 male, 2 female mean age 38 range (20- 66). Injuries: 7 perilunate, 2 lunate, 5 trans-scaphoid perilunate. Mechanism; 7 RTA, 4 falls from height, 2 crush injury, 1 FOOSH. 12 patients presented to A&E same day, 2 the next day.

8 seen by SHO, 5 by SpR, 1 by consultant. All had AP & Lat view x-rays, 3 had additional oblique views. 9 out of 14 diagnosed correctly, 5 missed: 3 perilunate & 2 trans-scaphoid perilunate. 5 missed injuries sent to fracture clinic, delay 5- 10 days. 4 missed by SHO, 1 by SpR. All 5 taken to theatre immediately after diagnoses, 2 closed reductions, 3 open reductions. 9 correctly diagnosed in A&E, 4 seen by SpR, 1 orthopaedic SHO, 4 A&E SHO. 2 patients had median nerve symptoms. 3 reduced in A&E with sedation, 6 in Theatre: 5 closed, 1 open reduction

**Conclusion:** A high proportion of these injuries were initially missed, emphasizing the importance of initial history and examination. One should have a high index of suspicion when evaluating x-rays & senior colleagues should be consulted. These injuries are emergencies and should be reduced as soon as possible to achieve optimal results.



**P122**

**Assessment of fragment vascularity in non-unions of the scaphoid fracture using dynamic MRI**

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In cases of non-union of scaphoid fracture, vascular supply to the fragment has been evaluated with T1 weighted MR imaging, but it is not always an accurate indicator. We predicted that the blood flow status in the fragment assessed with Gadolinium-DTPA dynamic MR imaging before surgery could be used to determine the necessity of vascularized bone grafting.

**Materials and methods:** We performed Gadolinium-DTPA dynamic MR imaging in six patients with low density fragments on T1 weighted MR imaging. All patients were examined using the T1-weighted spoiled gradient recall (SPGR) sequence with gadolinium (Gd)-DTPA enhancement (0.1 mmol/kg body weight). Regions of interest (ROI) were both fragments of the scaphoid. Then, percent enhancement as a function of the time after the injection was calculated as the percent increase in signal intensity (signal intensity ratio; SIR).

**Result:** Curves for SIR *versus* time showed three patterns. Four had a large peak value when compared to the same curve for normal bones (type A), one had rapid onset with a gradual increase associated with strong enhancement (type B), and one had gradual onset, gradual increase, no peak, and weak enhancement (type C). One patient with type B and three of four patients with type A were treated with iliac bone grafts and screw fixation, because punctate bleeding of the fragment was found at the surgery. The other patient with type A was considered to have a delayed union by arthroscopic evaluation, and was treated without bone grafting. One patient with type C required vascularized bone grafting because of absence of punctate bleeding. Unions were established in all of our patients at last observation.

**Conclusions:** Decreased density in T1 weighted MR imaging does not always indicate avascular status. Dynamic MR imaging is one of the useful indicators to evaluate vascularity of the fragment.



**P123**

### **Is the occult scaphoid fracture indicative of operation?**

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**Introduction :** Cannulated screw fixation through a small incision has been increasingly popular in treatment of nondisplaced scaphoid fractures. We hypothesized that not only those visible fractures but also radiographically occult scaphoid fractures that are invisible on initial 4 or 5 view wrist radiographs, are indicated of operation. To test the hypothesis, we compared CT findings of occult and visible scaphoid fractures.

**Methods :** Diagnosis protocol in our institution: MRI was performed within 7 days after trauma to all patients with suspected scaphoid fractures. CT (slice thickness 1 mm) was followed to the patients who had scaphoid fractures on MRI. Patients who had scaphoid fracture on X-ray followed CT without MRI. Forty wrists with scaphoid waist fractures treated from 1999 to 2006 in Tominaga- Kusano Hospital, were investigated. The average age was 25.5 years (11-80). Seventeen wrists had visible scaphoid fractures. Twenty- three wrists had occult scaphoid fractures. The average time from injury to CT was 4.0 days (1-10) in occult scaphoid fractures and 3.8 days (1-9) in visible scaphoid fractures. We divided severity of fractures into 3 categories to compare CT findings of occult and visible scaphoid fractures: displaced (a gap or displacement at the fracture site 1 mm or more), nondisplaced and invisible fractures on CT.

**Results :** CT identified 3 displaced fractures (13%), 17 nondisplaced fractures (74%) and 3 invisible fractures (13%) in occult scaphoid fractures, and 3 displaced fractures (18%) and 14 nondisplaced fractures (82%) in visible scaphoid fractures. No statistical difference between two groups was found in severity of fractures.

**Conclusion :** CT revealed that most of radiographically occult scaphoid fractures had displaced or nondisplaced fractures as well as visible scaphoid fractures. Our results support that cannulated screw fixation with a small incision is indicated for radiographically occult scaphoid fractures with displacement or no displacement on CT.



**P124**

### **Evaluation of Acute Scaphoid Fractures with Cystic Change**

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**Purpose:** Acute scaphoid fractures are non-operatively treated with a thumb spica cast, or surgically treated with a percutaneous compression screw. We sometimes see patients with acute scaphoid fracture with cystic change. There is no consensus whether bone graft is necessary or not when surgically treated. This is a retrospective study on 8 acute scaphoid fractures with cystic change.

**Methods:** The average age at injury was 23 years (range, 13 to 42 years). All patients were male. According to Herbert classification, one fracture was classified into acute stable (B1), and 7 acute unstable (B2). Two fractures were treated with thumb spica cast; one with percutaneous compression screw; and 5 with iliac bone graft in addition to screw fixation.

**Results:** All fractures were united. The average modified Mayo wrist score were 90 points (range, 90 to 100 points). Of 5 fractures treated with open surgery, cartilage was apparently intact in 3, and the remaining 2 with cartilage damage associated with instability.

**Conclusions:** In the present series, instability can not be diagnosed preoperatively in acute scaphoid fracture. This study demonstrated that acute scaphoid fracture with cystic change can be surgically treated well without bone graft, or well conservatively.



**P126**

### **Space measurement for safe placement of screw in scaphoid through 3 dimensional analysis**

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**Purpose:** The position of the headless screw in scaphoid fracture is very important. Most surgeon want the screw to be placed in the center of scaphoid because of avoidance of damage to the adjacent articular surface, its enhanced strength and more rapid bony union. The purpose of this study is to investigate the safe position of the screw through collision experiment by three-dimensionally reconstructed scaphoid and screw models.

**Materials and Methods :** From January 2004 to February 2005, 14 wrist computed tomograms of adult male which were interpreted as normal and had no arthritic change were included in this study. (Their height was between 165cm and 185cm) We reconstructed the 1mm interval cutting axial images of wrist CT and made three-dimensional model of scaphoid. And we applied the reconstructed screw model which had 4mm proximal diameter and 3mm distal diameter to the virtual scaphoid model. We made a special program which could make a collision experiment between the scaphoid and the headless screw according to the position of the screw in the bone.

**Results:** We could know the individual safe angle in which the screw do not collide with the cortex. And when the center of screw is in the middle of scaphoid long axis, the range of safe angle was maximum. Generally the range of safe angle between the screw and anteroposterior scaphoid line was 9 to 29 degrees in anteroposterior view and that between the screw and lateral scaphoid line was 11 to 32 degrees in lateral view if the center of screw is in the middle of scaphoid long axis.

**Conclusion:** This range can be used as a guide when the surgeon insert the screw and want to confirm the screw to be in safe position. And surgeon should pay close attention when they insert the headless screw in the scaphoid fractures because the range of safe angle is relatively narrow.

**Key Words:** Scaphoid, Computed tomogram, Headless screw, 3-Dimensional reconstruction



**P127**

**Clinical outcome following scaphoid micro-fractures. A case controlled study**

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**Background:** With the increasing use of Magnetic Resonance Imaging (MRI) for the diagnosis of Occult wrist injuries, microfracturing or bruising of scaphoid is being recognised as a distinct entity. The aim of our study was to study the clinical significance of scaphoid microfractures.

**Materials and Methods:** From our data base of 611 MRI scans for occult wrist injuries from January 2003 to November 2005, a total of 48 subjects (33 males and 15 females) with scaphoid microfractures were identified. Average age was 18.7 years (SD 8.9, range 9-41). They were all treated symptomatically with a futura splint. Each of them was matched for age and gender with a control with normal MRI from our data base. Case notes and X-rays were reviewed. A telephonic interview using the Harvard pain scale and Functional component of modified Mayo wrist score was carried out for the cases and controls (best score 8 and worst score 32) at least 6 months following the injury. Statistical significance was calculated using paired student t test.

**Results:** At a minimum follow up of 6 months (range 6 months to 3 years), there was no statistically significant difference between the cases and controls with respect to symptoms [8 out of 48 (16.7%) Vs 9 out of 48 (18.75%)], Severity of pain (mean Harvard pain score 1.36 Vs 1.34), or functional status (functional component of modified Mayo wrist score 8.67 Vs 8).

**Conclusion:** Scaphoid micro-fractures occur predominantly in the young and behave in a benign fashion clinically. There does not appear to be any residual problems after these injuries. Long-term prospective studies are, however, necessary to determine the natural history of this injury.



**P128**

### **Surgical treatments for idiopathic and posttraumatic osteonecrosis of the scaphoid**

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**Background:** Preiser's disease and avascular necrosis following scaphoid fractures continue to be problem sequelae, and there have been many procedures implemented for these conditions. In 22 cases of scaphoid necrosis we have performed revascularization procedures for patients whose scaphoid could be retained and four-corner arthrodesis for patients with osteoarthritis.

**Materials:** The patients investigated were 16 men and six women, ages at operation ranged from 16 to 71 years, average 32. Six patients had idiopathic necrosis and the remaining 16 patients had post-traumatic necrosis. Vascular bundle implantation (group V) was indicated in six cases and vascularized bone graft (group B) in 10 cases, in which a donor bone was harvested from the distal radius. Four-corner arthrodesis (group A) was performed in the other six cases. Mean follow-up periods were 119 months in group V, 19 months in group B, and 38 months in group F.

**Results:** Bone union was achieved in 11 of 12 post-traumatic cases in groups V and B. Radiographic revascularization of the scaphoid was successful in three of four cases with idiopathic necrosis. In group A, arthrodesis was accomplished within three months in all six cases. On roentgenogram, no osteoarthritic change was seen at the radiolunate joint.

**Conclusion:** Vascularized bone graft is superior to vascular bundle implantation, and vascularized bone graft is indicated in cases with no osteoarthritis at the wrist joint, and four-corner arthrodesis is indicated in cases with osteoarthritis.



**P129**

**Treatment of scaphoid non-union. Comparative study of the use of vascularized and nonvascularized bone graft from the dorsal distal tip of the radius**

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The clinical, functional and radiographic aspects of 86 patients presenting with scaphoid non-union were evaluated in this study. Forty-six patients undergoing the technique of vascularized bone graft from the dorsal distal tip of the radius, based on the intercompartmental supraretinacular artery 1, 2\* (Group I), and 40 patients undergoing the technique of usual nonvascularized bone graft of the same area (distal radius) (Group II), are compared with the purpose of determining the best procedure concerning healing and function. Our sample comprised non-unions in 25 middle-third and 21 proximal-pole patients (Group I), and in 22 middle-third, 2 distal-pole, and 16 proximal-pole patients (Group II). Intraoperatively, 30 scaphoids in Group I patients and 20 in Group II patients were considered sclerotic. Scaphoid stabilization was achieved with three K-wires and, postoperatively, all patients wore an antebrachio-palmar cast for four weeks. The average postoperative follow-up time was 24.4 months for Group I, and 21.7 months for Group II. Healing was achieved in 89.1% of Group I patients, with an average healing time of 9.7 weeks. Within Group II, healing was achieved in 72.5% of patients, with an average healing time of 12 weeks. The functional results were satisfactory in 72% of Group I patients and 57.5% of Group II patients. We therefore conclude, from the healing and function indices, that the vascularized bone graft technique produces superior results than the nonvascularized bone graft procedure, being more efficient when the proximal pole of the scaphoid is sclerotic.

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**P130**

**Late treatment of unreduced volar lunate dislocation - A report of two cases**

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Result of treatment of acute lunate dislocation and perilunate dislocations are satisfactory if the patient is seen early, but these injuries are occasionally unrecognized, leading to the difficult problem of late treatment. We present two case reports of the old volar lunate dislocation which were treated by open reduction and K-wire fixation. The interval between injury and operation was 11 and 13 months, respectively. Both palmar and dorsal surgical approaches were needed to reduce the old dislocation on both cases. Both patients had a mild pain occasionally but they returned to the same job they had before their injury. The wrist flexion-extension arc were 66% and 91% and the grip strength were 82% and 75%, compared with the opposite side. Radiographic examination at final follow-up showed some degenerative changes mid-carpal joint on both cases. One of two cases was complicated by a ganglion on the dorsal surface of the wrist 13 years after injury, which was treated by aspiration. MRI showed aseptic necrosis of the lunate in part but the most part of lunate seemed to be survived. Various treatment options for the old volar lunate dislocation exist: wrist arthrodesis, proximal row carpectomy, open reduction and internal fixation, lunate excision. Despite the delay in treatment, all patients had satisfactory outcomes by open reduction and K-wire fixation. We believe that although open reduction for old dislocation carries the potential risks of avascular necrosis and osteoarthritis, an initial attempt should be made to restore the anatomy of the carpus.



**P131**

### **Scaphoid fractures in junior high school and high school athletes**

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**Introduction:** In this study, we evaluate the outcomes of scaphoid fracture surgical treatments in junior high school and high school athletes.

**Materials and Methods:** We treated 15 wrists of 15 young male athletes, with a mean age of 16 years, for scaphoid fractures. The group of athletes comprised six soccer players, three baseball players, three gymnasts, two basketball players, and one judo competitor. Eight cases, classified as acute fractures or fibrous unions, were treated by internal fixation with Herbert screws only, while seven also received iliac bone grafts after diagnoses of pseudoarthrosis. We investigated the time required for bone union, the period of time needed to return to sports, the range of motion (ROM) of the wrist, and the grip strength.

**Results:** Radiographic union occurred in all cases. The athletes returned to sports 3 to 32 weeks after the operation. Two months post-surgery, the average wrist ROM in flexion and extension was 72.4% that of uninjured wrists; in radial deviation and ulnar deviation, 80.5%; and in supination and pronation, 100.2%. After three and six months of follow-up, the average wrist ROM in flexion and extension was 75.8% and 84.3%; in radial deviation and ulnar deviation, 86.7% and 87.7%; and in supination and pronation, 100.3% and 103.7%. The average grip strength was 79.1% two months after the operation, increasing to 81.9% and 90.8% at follow-up three and six months after surgery.

**Conclusion:** Athletes with pseudoarthrosis have a tendency to return to sports later than athletes with an acute or fibrous union. Soccer players are usually able to return faster than gymnasts. The ROM of the wrist improved with time, as did grip strength. Within two months of the operation, the ROM in supination and pronation was comparable to that observed in unaffected wrists and remained constant throughout the 6-month follow-up period.



**P132**

**Study of the use of radiographs and the role of clinical tests in the diagnosis of fractures of the scaphoid in a busy district general hospital**

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Accurate diagnosis of a scaphoid fracture is known to be fraught with difficulty thus clinical skills are paramount in the diagnosis of this condition.

This study was a prospective analysis of 6 months of data from a busy district general hospital and aimed to provide further data on the predictive value of clinical tests. We have studied how many patients had appropriate radiographs and appropriate clinical assessment and how this correlates to proven scaphoid fracture. Plain AP and lateral radiographs were determined to be inadequate as compared to full scaphoid views. Clinical tests assessed included tenderness in the anatomical snuffbox, pain on pressure over the anterior tubercle of the scaphoid and pain on telescoping of the thumb metacarpal. 39 patients were enrolled in the study of which 12 were eventually found to have fractures of the scaphoid. Logistic regression was used to analyse the datasets. Our results showed that clinicians who used all three clinical tests had an improved ability to predict scaphoid fracture. The oblique scaphoid view radiograph did not in our series prove to aid in the diagnosis of scaphoid fractures. Our data suggested that junior members of staff were less likely to use the full range of clinical tests and were hence less accurate in diagnosis.

Our study confirms previous findings that clinical tests have a statistically significant role in the diagnosis of fractures of the scaphoid. We have also shown that junior members of staff are less likely to perform an adequate clinical examination of such cases and thus recommend further teaching on this subject in orthopaedic departments. We are currently repeating the study having presented this data to the department with the aim of seeing if teaching sessions are capable of increasing the ability of junior staff in accurately diagnosing scaphoid fractures.



**P133**

**Screw fixation for scaphoid fracture: A comparison of volar and dorsal approach**

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Percutaneous or small incision screw fixation of acute minimally displaced scaphoid fracture is an attractive treatment alternative compared with cast immobilization and can be performed with either a volar or dorsal approach. Central screw placement within the scaphoid appears to be an important factor for successful fixation. The purpose of this study is to investigate whether the volar or dorsal approach for minimal incision screw scaphoid fixation allows for a good clinical result and for more central placement of the screw. We retrospectively reviewed the results for sixteen patients with a scaphoid fracture. The patients were divided into two groups; Group V consisted of 8 patients who were treated with a cannulated screw placement with volar approach, and Group D consisted of 8 patients with dorsal approach. After screw placement, each patient underwent 3-D computed tomography to evaluate central placement of the screw. The image of the scaphoid was sectioned evenly into quarters along with the longitudinal axis. For each section the distance from the center of the screw hole to the edges of the dorsal/volar /radial/ulnar axes was measured, and the displacement ratio of the screw in the 2 groups was compared statistically to determine central screw placement and tendency of screw eccentricity. There was no difference between the two groups related to clinical results and central screw placement. We found statistically significant differences between the two groups related to screw eccentricity, which included tendency of the volar location of Group V and the dorsal location of Group D at distal and proximal section ( $p=0.015$ ). Based on the result of no difference of central placement between the two groups, we supposed both group has similar stiffness of screw fixation. Each approach has definite tendency of direction of screw eccentricity, and appropriate surgical approach of the scaphoid fracture should be selected depending on location and direction of the fracture line.



**P134**

**Scaphoid non-union treated by three methods of internal fixation and bone grafting**

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**Purpose:** We retrospectively studied a consecutive cohort of thirty-seven symptomatic established scaphoid non-unions treated by bone grafting and internal fixation via a volar approach.

**Material & Methods:** Exclusion criteria were use of a dorsal approach, previous operative management and follow up of less than three months. Seven patients were excluded from the study for one of these reasons. The fractures were classified according to the Herbert classification. The mean interval between injury and surgery was 27 months. Two non-unions were fixed with AO minifragment screw, ten with Herbert screw (Zimmer USA) and eighteen with Acutrack screw (Acumed, USA). Radiological union was achieved in both of the cases where the AO screw was used, 70% where the Herbert screw was used and 78 % of the Acutrack screw group. The mean time to union for the Acutrack screw group was 9.8 months, Herbert screw group 7.5 months and for AO screw patients was 4.5 months. The average scapholunate angle in all patients who had achieved union was 54 degrees (Range 30-72).

**Conclusion:** Our results showed the overall union rate of 76%. Operative fixation with AO cannulated screw demonstrates faster union time and greater union rate, although in our series we had only two patients. The AO technique is based on lag screw and tension band principles, which may encourage compression at the fracture site when managed with early postoperative mobilization.



**P135**

**Outcome following treatment of coronal fractures of the hamate**

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Fractures of the Hamate body are uncommon and are predominantly caused by a crush injury or an axial load transmitted along the ulnar metacarpal axis. Most of these injuries are sustained during a forceful punch with the fist.

14 patients with a fracture of the hamate body fracture were followed up to determine the functional outcome following either conservative or operative management. Patients were reviewed for a mean of 14.8 months after the injury. The fractures involved the body of the hamate body and were all in the coronal plane. The fractures were associated with different degrees of subluxation of the 4<sup>th</sup> and/or 5<sup>th</sup> metacarpal. The degree of subluxation was the main determinant for operative management. 3 of the patients had associated fractures of the 4<sup>th</sup> metacarpal and 1 had a fracture of the 5<sup>th</sup> metacarpal. The mean age of the patients was 26.6years (range 18 to 44 years). Initial patient management consisted of either conservative management (2 patients with Futura TM splints and 3 patients with cast immobilisation) or surgical stabilisation (6 patients had Kirschner wires alone and 2 patients had Kirschner wires and 1.5mm screws inserted across the hamate fracture and 1 patient had 1.5mm screws alone) in addition the cast immobilization.

The functional outcome was measured using the DASH questionnaire. Other indices such as time to return to work and general patient satisfaction with the treatment were determined.

We conclude that management of these fractures should take into account the amount of metacarpal subluxation and patient compliance with treatment.



**P136**

## **Evidence based practice in management of suspected pediatric scaphoid injuries**

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**Background:** Pediatric scaphoid injuries differ markedly from adult ones in that most of the fractures can be diagnosed at initial visit on 4-view scaphoid radiographs ('scaphoid views'), fracture site is usually the distal pole of scaphoid, the incidence of avascular necrosis is low and the rate of fracture union is high. However there are no management guidelines which take account of these facts.

**Methods:** A retrospective audit of 46 pediatric patients who presented over a period of 3 months and were suspected of having a scaphoid injury. Case cards were studied for mechanism of injury, examination finding and management at both presentation and at 2 weeks' follow up, reports of radiographs, final diagnosis and time spent in plaster. Only AP and lateral radiographs were taken on the initial visit, while 'scaphoid views' were taken at 2 weeks' appointment.

**Results:** At presentation 23 had sustained injury by falling onto outstretched hand (FOOSH). Examination showed 29 patients to have tenderness localized to the anatomical snuff box (ASB), 17 were diffusely tender around the wrist. Also 20 were tender on axial loading of the scaphoid and 8 were tender on the dorsum of the scaphoid. All patients had a plaster applied. After 2 weeks, 25 patients were asymptomatic, 15 were still tender in ASB, 3 were doubtful. 2 scaphoid fractures were documented on scaphoid views. Of the patients who did not have a scaphoid fracture, 2 patients spent 4 weeks in plaster, 1 patient spent 5 weeks, 2 patients spent 6 weeks and 2 patients spent 7 weeks in plaster.

**Conclusion:** Only patients injured by FOOSH, having localized ASB tenderness and tenderness on axial loading of the thumb should be managed aggressively. Rest of the patients can be managed conservatively with a removable splint & follow up by local doctor. Scaphoid views are recommended on initial visit.



**P137**

**Attritional rupture of the small finger flexor tendons following local steroid injections of a hook of hamate fracture non-union**

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**Background:** Digital flexor tendon rupture of the small and ring fingers are known complications of non-union of fracture of the hamate hook arising from undiagnosed or inappropriately treated fractures. 1,2 Tendon rupture is also a recognized complication of local steroid injection. 3,4,5

**Methods:** A case of flexor digitorum profundus (FDP) and superficialis (FDS) rupture following local steroid injections in a regular golfer with hook of hamate fracture non-union is presented. The fracture had been conservatively managed prior to rupture.

**Results:** Attritional rupture of both flexor tendons of the little finger, and abrasion of both flexor tendons of the ring finger was discovered. The fracture fragment was excised and fracture site smoothed. Free interposition palmaris longus graft reconstruction of the FDP tendon and side-to-side tenorrhaphy of the FDS tendon was performed. He returned to golf at 2 months.

**Conclusion:** Conservative fracture management requires immobilization and is appropriate for acute, undisplaced fractures. Even then, non-union is common. It is suggested that local steroid injections be avoided or used with extreme caution as it may impede wound healing and exacerbate attritional changes.

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**P138**

**A suggestion of newer nomenclature of the palmer capsular ligaments of the wrist joint**

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Although the anatomical features of the palmar carpal ligaments of the wrist joint and the triangular fibrocartilage complex (TFCC) are well described in many historical articles, variations and controversies remain unresolved. To revise the details of the palmar carpal ligaments, gross anatomical dissection was performed on cadaveric wrists.

The radioscaphocapitate ligament (RSCL) was divided into three bundles according to their carpal attachments, i.e. radioscaphoid ligament (RSL), radiocapitate ligament (RCL) and radiotriquetrum ligament (RTL). A continuous bundle between radius and triquetrum covered the distal portions of the palmar aspect of the long radiolunate ligament (LRLL) and the palmar portion of the interosseous lunotriquetral ligament (PLTL) and should be called the radiolunotriquetral ligament (RLTL). From this point of view, the space of Poirier exists between two bundles that connect radius and triquetrum, i.e. RTL and RLTL. The short radiolunate ligament (SRL) seemed to be an elastic ligament which made up the inner palmar wall of the TFCC. Five ligaments attach to or surround the TFCC: ulno-lunate ligament (ULL), ulno-capitate ligament (UCL), ulno-triquetral ligament (UTL) and palmar and dorsal distal radioulnar ligaments (PDRUL and DDRUL). PDRUL and DDRUL both divide into proximal and distal bundles at their attachments to the ulna. Their proximal fibers interdigitate with ulnocarpal ligaments and attach to the fovea of ulnar head; their distal fibers attach to the tip of the styloid process surrounded by the ulnocarpal ligaments and the distal extension of PDRUL. Since the proximal portion of these ulnar capsular ligaments were not clearly separable, they can be called the radioulnar-ulnocarpal ligament complex (RUUCLC). The RUUCLC forms a major ligamentous support of TFCC. Our study revealed several differences from previous descriptions. These findings may permit better understanding of the anatomy of the palmar carpal ligaments.



**P139**

### **Extensor retinaculum, a stabiliser of the wrist**

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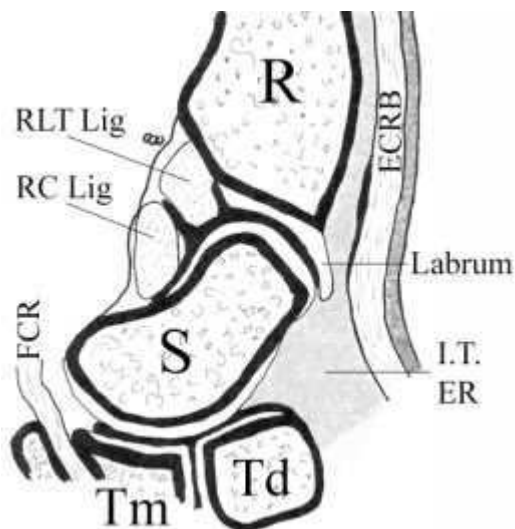
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The two layers, supra and infratendinous of the extensor retinaculum (ER) extend distally beyond the radius. The infratendinous layer fuses with the capsule of the radiocarpal joint. An investigation of this layer, overlooked in arthroscopies, was undertaken.

Ten embalmed cadaveric wrists were frozen with liquid nitrogen and serial sections of 2-3mm were carried out with a miniature band saw.

A fibrocartilaginous labrum, continuing posteriorly the articular surface of the radius was found constantly on our sections. This labrum together with the anterior labrum formed by the radio-luno-triquetral band of the palmar radiocarpal ligament increases the glenoid cavity of the radius and enhances the stability of the wrist joint. While the ulnar part of the ER stabilises the wrist in a sagittal plane (Tubiana and Fahrer, 1981) the complex of the extensor tendons, ER and the dorsal fibrocartilaginous labrum of the radius stabilizes the wrist against posterior dislocation.

Diagram: R, Radius; S, Scaphoid; Tm, Trapezium; Td, Trapezoid; RLT Lig, Radio-Luno-Triquetral Ligament; RC Lig, Radiocapitate Ligament; FCR, Flexor Carpi Radialis; ECRB, Extensor Carpi Radialis Brevis.





**P140**

**Functional evaluation of scaphotrapeziotrapezoid fusion: A retrospective study**

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**Introduction:** The effectiveness of scaphotrapeziotrapezoid (STT) fusion is under discussion. In this study we evaluated the functional outcome of STT fusion. The indication for surgery included Kienböck´s disease, STTarthrosis and radiocarpal instability combined with pain.

**Methods:** 25 patients, 15 women and 10 men, underwent STT arthrodesis between January 2000 and June 2005 in our clinic. 15 patients suffered from arthrosis, 7 from Kienböck´s disease and 3 had pain combined with radiocarpal instability. A long term follow up was made where the patients were re-examined at a mean follow -up time of 35 months. Conventional X-ray and CT scan with 3D reformation were performed. Active range of motion (AROM) was verified with a goniometer; grip strength was measured with a JAMAR-Dynamometer II. The Key pressure grip was measured with pinch gauge. Pain, for stress and during resting condition, was evaluated against a visual analogue scale (VAS) from zero to ten. Disabilities of the Arm, Shoulder and Hand questionnaire (DASH) were used to capture the patients´ upper-extremity function. Occupational conditions were evaluated.

**Results:** Postoperative X-ray showed bone consolidation of the STT arthrodesis in all cases. AROM was 63%, gripstrength was 87 % and Key pressure grip was 94 % of the opposite side. The average DASH score was 28 points. Pain at rest was completely reduced in over 90 % and reduced during stress. About ¾ of the patients returned to work although 1/3 had to change their occupation. 85 % of the patients were so satisfied that they would undergo the operation again if needed.

**Conclusion:** Our results support previous studies that fusion of the STT joint is a reliable procedure for treating isolated STT arthrosis and Kienböck´s disease both in pain relief and in preserving considerable range of motion.



**P141**

## **Management of Radiocarpal Instability in Universal Total Wrist Arthroplasty: A Case Report**

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**Introduction:** Recent designs of total wrist implants show acceptable durability and low rates of complication. The occurrence of prosthetic instability is rare, and is either treated by casting, capsular enforcement or conversion to panarthrodesis. We describe a stabilization technique reconstructing volar and dorsal radiocarpal ligaments.

**Case report:** A 41 year old woman developed instability of a Universal Total Wrist Arthroplasty 3 years after implantation. Our aim was to re-establish stability. An autologous gracilis tendon was harvested. A transosseous fixation was executed in the capitate entering dorsally and leaving volarly. Radial fixation was achieved by a Fiber Wire® loop with its free ends on the dorsal aspect of the styloid. The tendon graft was passed over the ulnar border of the carpus and fixed by means of a Fiber Wire® anchor reconstructing the volar radiocarpal ligaments RSC and RLT. After implantation of the new +1mm higher polyethylene insert we were able to tether and fix the volar ligaments definitely. We then placed another Fiber Wire® into the radius. With the carpus in adequate position and maximum volar stability we now reconstructed the dorsal radiotriquetral ligament forming a threefold sling of the tendon transplant. This provided satisfactory dorsal stability with loss of at least 30% of preoperative ROM. Plaster fixation was administered for 4 weeks. Stability remains till now.

**Discussion:** To our knowledge we are first to publish not indistinct wrap around stabilization but meticulous reconstruction of the radiocarpal ligaments in total wrist arthroplasty instability.

**Conclusion:** Although this case is one of first series of the Universal Total Wrist which gave less stability than the recent design, this remark seems important and the solution promising.



**P142**

### **Three-dimensional analysis of ligamentous attachments of the capitate and hamate**

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**Purpose:** The purpose of the study is to clarify, measure, and show the anatomic locations and areas of specific ligamentous attachments and paths of the capitate and hamate on a three-dimensional (3-D) surface model.

**Methods:** Ten fresh-frozen cadaver wrists were used to dissect and identify the ligaments attached to the capitate and hamate. Their ligamentous attachments and whole bone surfaces were digitized three-dimensionally and their areas calculated using a MicroScribe-3DX Digitizer and original software. The attachments of each ligament were represented in a model combining CT surfaces overlaid by a digitized 3-D surface, and were also visually demonstrated with a specific color on 3-D images of the bones.

**Results:** Two dorsal and one palmar carpometacarpal ligaments of the capitate were identified and three dorsal and four palmar carpometacarpal ligaments of the hamate were identified. An intra-articular ligament between the third metacarpal, the fourth metacarpal, capitate and hamate was identified. Four dorsal and three palmar intercarpal ligaments of the capitate were identified and three dorsal and four palmar intercarpal ligaments of the hamate were also identified. Two and one intercarpal interosseous ligaments were identified on the capitate and hamate respectively. All ligament attachments on the capitate and hamate occupied  $8.6\% \pm 5.5\%$  and  $12.4\% \pm 1.3\%$  of the whole capitate and hamate surface areas respectively. The ratios of palmar to dorsal ligament attachment areas on the capitate and hamate were approximately 4 to 5 and 2 to 3 respectively.

**Conclusions:** The anatomic 3-D attachment sites of the ligaments of both the capitate and hamate were visually depicted qualitatively, and their areas quantified. This 3-D information will not only afford a better understanding of the anatomy and mechanics of the ligaments attached to the capitate and hamate, but will also assist in the assessment of radiographic images and treatment of various injuries.



**P143**

### **Surgical treatment of chronic volar plate injury of the metacarpophalangeal joint of the thumb**

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**INTRODUCTION:** In patients with chronic pain and instability of the metacarpophalangeal (MP) joint of the thumb, many studies had been reported that instability of the joint was mainly caused by radial or ulnar collateral ligament injury. However, it is hard to find the report on the instability of the thumb MP joint caused by chronic volar plate injury without collateral ligament injury.

**MATERIALS AND METHODS:** Five thumbs in five patients were included in this study. There were one boy and four women, whose age was average 39 (range, 10 to 58) years. All of them complained of pain on opposition and pinching, and subsequent weakness of the thumb. On physical examination, all of them showed tenderness on volar aspect of 1st MP joint, and instability in hyperextension. The mean duration of symptom was 7.65 years (range, 6 months to 30 years).

Volar lazy S-shaped incision was used, and all thumbs showed rupture of the volar plate at their proximal sites. Three of five thumbs were found that the proximal volar plate was completely ruptured transversely between sesamoid bones and metacarpal neck, and two ruptured between radial sesamoid bone and radial side of metacarpal neck, which is called proximal radial longitudinal palmar ligament. It was repaired with nonabsorbable suture or suture anchor, and the MP joint was temporarily fixed in 10 degree of flexion, by a K-wire for six weeks.

**RESULTS:** All the patients showed good stability without any pain of the MP joint. Average 10 (range, 5 to 15) degrees of extension lag was remained after average follow-up of three years (range, 10 months to 4 years and 9 months).

**CONCLUSION:** Chronic volar plate injury of the thumb MP joint can cause pain and weakness of the thumb, which can be improved by surgical repair.



**P144**

**Proximal vascular control in scapulothoracic dissociation associated subclavian and axillary artery injuries**

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**Background:** Scapulothoracic dissociation (ScThD) is an infrequent injury with devastating outcomes. ScThD with subclavian or axillary artery tear is potentially life threatening injury. Proximal arterial control could be very challenging especially on the left side.

**Methods:** During the 18-month period ending in July 2006 cases of left sided ScThD with arterial injury and haemodynamic instability were prospectively identified and followed until the end of the rehabilitation. The significance of minimally invasive proximal control with inflatable angiographic balloon is described. Data are presented as means.

**Results:** Three patients aged 16, 50 and 58 years suffered ScThD with left subclavian/axillary artery and vein injury. All patients were severely injured (mean Injury Severity Score: 30) and presented in haemorrhagic shock (Systolic blood pressure: 94 mmHg, arterial base deficit: 9 mmol/L). Patients who had angiographic proximal arterial balloon control required less transfusion (4 Units versus 10 Units) and had shorter operating times (3.5 hours versus 8 hours). All of the patients survived, the one without efficient proximal control had lost the limb later. All of them ended up with functionless upper extremity secondary to the brachial plexus avulsion.

**Conclusion:** The current knowledge on ScThD is based on case series and case reports. The patients' long-term outcome is determined by the brachial plexus injury. The short term outcome (survival or death) is depending on the associated injuries and the local haemorrhage control. Based on our experience on-table angiographic balloon catheter proximal arterial control is an efficient tool to provide safe exploration in a surgically challenging anatomic location (left periclavicular vascular trauma). This method for proximal control is valuable also in cases where vascular reconstruction is not feasible.



**P145**

**Intraoperative three-dimensional imaging at the wrist with an isocentric mobile C-arm**

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In addition to conventional radiological C-arm image amplifiers used for intraoperative imaging, now a new mobile C-arm image amplifier with an option for three-dimensional imaging (Iso-C 3D) is available to visualize reduction of fractures and position of implants.

In a wrist-model three titanium pins were placed and three holes of different length were drilled. Distances between the pins and the depths of the drilled holes were calculated in conventional computertomographic scans and Iso-C 3D scans in perpendicular, 30 degree and 90 degree position of the gantry and compared to actual distances and depths. There were no significant differences between the actual measured distances and those measured by CT scans and Iso-C 3D scans. Furthermore, gantry position had no significant effect upon the results.

Iso-C 3D scans are as reliable as conventional CT scans for intraoperative controlling of implant positioning.





**P146**

**A radial ridge excision for symptomatic volar tendon subluxation following De Quervain's release**

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**Purpose:** Symptomatic volar tendon subluxation after De Quervain's release is a complication of this common outpatient procedure. We present excision of the radial ridge as an alternative treatment to relieve pain associated with volar tendon subluxation following De Quervain's release.

**Materials & Methods:** Six patients complained of painful volar subluxation of abductor pollicis longus (APL) and extensor pollicis brevis (EPB), following splint removal post dorsal compartment release for DeQuervain's stenosing tenosynovitis. Patients underwent Provocative Testing, resisting thumb extension under their flexed index finger – and wrist flexion and extension. Pain and subluxation was reproduced in all patients. Two patients complained of symptoms indicative of radial sensory branch neuritis and had positive Tinel's sign upon examination. Initially, patients underwent a first dorsal compartment release. During the second procedure, the same incision was opened sharply. Subcutaneous dissection was performed bluntly. The first dorsal compartment tendons were visualized and the wrist was ranged through extension and flexion. Volar subluxation of APL and EPB over a prominent fibro-osseous radial ridge at the most radial aspect of the first dorsal compartment was confirmed. The tendons were retracted dorsally from the radial ridge and a volar-based periosteal flap was elevated. The bony portion of the radial ridge was excised with a rongeur, filed smooth with a rasp, and sutured into place. The APL and EPB tendons were released from dorsal retractors.

**Results:** Patient follow-up revealed no subluxation or snapping. Repeat provocative testing revealed volar tendon translation with pain-free wrist flexion.

**Conclusion:** Following De Quervain's release, the APL and EPB tendons may sublux volarly or dorsally over the bounds of the first dorsal compartment. Painful subluxation occurs when over a sharp, prominent fibro-osseous ridge. Excision of this ridge removes the traumatic irritant to APL and EPB tendons. Without repetitive insult, the tendons glide painlessly over the radial styloid.



**P147**

### **Etiology and treatment of ulnar synovial folds of the wrist**

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**Purpose:** It is not generally known that synovial folds cause dorsal pain of the wrist. The clinical symptoms of ulnar folds resemble those of TFCC injury, and this disorder should be considered for diagnosis. We investigated the pathogenesis and treatment of synovial folds of the wrist.

**Subjects and Methods:** The subjects were 10 patients (7 males, 3 females), with a mean age of 22.3 years (range: 14 to 45 years). In all patients, pain occurred while playing sports. Pain was induced on dorsal flexion, radial flexion ulnar flexion, or supination. MRI confirmed thickening of the folds. Initially, local injection of a steroid and a topical anesthetic was performed several times. In patients in whom injection did not relieve pain, arthroscopic fold resection was performed.

**Results:** Local injection relieved pain in 6 patients, whereas surgery was performed in 4 patients without relief. Of these 4 patients, the folds were present in the ulnar area in 2, and in the ulnar to central areas in 2. The ulnar folds were present between the TFC and the carpus. In patients with folds involving the center, the folds were present between the radius and the lunate. Total resection was performed using a shaver and a punch. In the 4 patients, returning to sports was achieved within 2 months after surgery.

**Discussion:** There are few synovial folds of the wrist. However, repeated stress related to sports activities may cause inflammation on the synovial membrane, resulting in thickening and sclerosis. In various events such as baseball batting, rotation occurs via dorsal flexion of the wrist. This may be because stress is added to the capsula articularis and synovial membrane. As a first treatment, local injection of a steroid is effective. However, when conservative treatment is not effective for sports performance, surgery should be indicated.



**P148**

**Early pain relief after radial shortening osteotomy in Kienbock's disease**

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**Purpose:** While there have been many reports relate to radial shortening osteotomy for Kienbock's disease, it is impossible to eliminate the bias of postoperative immobilization for evaluation of the effect of the procedure. We performed radial shortening osteotomy without postoperative immobilization for patients who had Kienbock's disease and evaluated their early clinical results after surgery.

**Materials And Methods:** Eight patients with stage I to IIIB of Kienbock's disease were included. Chief complaint of all patients was wrist pain. The radius was shortened 2mm and fixed with a locking compression plate. They were allowed to use the affected hand freely without any splint or cast. Their early clinical results including wrist pain evaluated by a visual analogue scale (VAS), range of motion/of the wrist joint (ROM) and grip strength (GS) were assessed for six weeks after surgery. Overall clinical results were assessed according to the Cooney's scoring system.

**Results:** The wrist pain was decreased at the next day of the surgery, and further improvement was recognized. Though the mean VAS value was 7.23 before surgery, it was decreased as 4.45 at one day, 2.83 at one week, 0.68 at three weeks and 0.54 at six weeks after surgery. However the ROM and GS were once decreased after surgery, gained to the level of before surgery in one week and three weeks respectively, and then increased gradually. Mean Cooney's wrist score was 46.9 before surgery and increased to 74.4 at six weeks after surgery.

**Conclusion:** Early pain relief and functional improvement effect of the radial shortening osteotomy was clearly demonstrated in spite of eliminate the bias of postoperative immobilization. This is a notable advantage of radial shortening osteotomy among many treatment options for patients who have stage I to III of Kienbock's disease.



**P149**

### **Shortening osteotomy of forearm bones for treatment of stage III Kienbock disease**

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Shortening osteotomy of forearm bones were performed for 9 cases of stage IIIA and 5 cases of stage IIIB Kienböck disease. The following reports post operative radiological finding with time and clinical outcomes.

**Cases:** In our series, including 8 male and 6 female. Their age at operation ranged from 22 to 65. Shortening osteotomy of both radius and ulna was performed on 7 cases and the remaining cases had received ulnar shortening only. Follow up period ranged 3 to 30 years with average of 9.3 years.

**Results:** radiographic finding of all 14 patients taken within one year after operation showed some improvement of sclerosis, segmentation or flattening. Eight cases had follow at 1 year to 2 years 6 months after operation, 5 of them showed recurrent segmentation and destruction. In 3 out of 5 case follow at 4 to 6 years found progression of staging. Seven cases who had follow up period longer than 10 years were all progressed to stage IV and two of them had osteoarthritic change. As for clinical outcome, tenderness, pain were improved as soon as 5 days after operation, and latest in 4 weeks. They remained well until final follow up except two cases who complained of pain after heavy labor activity. ROM of the affected wrist joint improved from average 63% of healthy side preoperatively to 76% postoperatively. Grip power had improved from average 51% of healthy side to 92.3% postoperatively. Although all 7 cases who had follow up period longer than 10 years, the stage progressed to stage IV, non have expressed inconvenience in ADL, and some still engaged in original job as agriculture or carpenter

**Conclusion:** Shortening osteotomy of forearm bones for stage III Kienböck disease would not prevent progression of disease, but significantly improve patient's functional outcome consecutively.



**P150**

**Slip number of APL in refractory De Quervain's disease and intraoperative pathological findings**

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**Purpose:** To evaluate the results of surgical treatment of de Quervain's disease and correlate the slip number of APL with the refractory de Quervain's disease.

**Methods:** 18 cases of 17 patients (one patient, bilateral) with refractory de Quervain's disease unresponsive to non-operative treatment were managed surgically. Under regional anesthesia 1 st extensor compartment was released as radial-based. Patients were assessed retrospectively at average 12.2months for pain relief, postoperative Finkelstein test, symptom of superficial radial nerve and painful palmar subluxation or adhesion of APL/EPB. The degree of pain relief was evaluated with Visual Analog Scale from no pain 0 to severe pain 10. Intraoperative pathologic findings such as separate septum, slips number of APL and tendon degeneration. We analyzed the association of the slips number of APL with refractory de Quervain's disease .

**Results:** Resting pain disappeared. Mean VAS is 0.7(0~2). Postoperative Finkelstein test was negative in all patients. Tingling sensation along superficial radial nerve was found in one patient but disappeared within 4 weeks. Painful palmar subluxation or adhesion of the released APL/EPB were not identified. The slips number of APL was more than 3 in 17 cases except one case of 2 slips. Separate septum was identified in 9 cases (53%). Statistical analysis demonstrated strong correlation between refractory de Quervain's disease and slips number of APL.

**Conclusion:** The high slips number of APL may increase tendon aberrancy and lead to increased frictional force under extensor restraint. The surgical result of refractory de Quervain's disease is acceptable based on the high patient satisfaction and low complication rate.

**Reference:** Minamikawa et all (1991)



**P151**

**Diagnostic usefulness of ulnocarpal stress test for triangular fibrocartilage lesions**

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**Purpose:** The ulnocarpal stress test has been used widely for evaluation of patients with ulnar-sided wrist pain but its role as a clinical test has not been well established. The purpose s of this study were to define the maneuver of the ulnocarpal stress test and to evaluate its usefulness as a diagnostic test in patients with triangular fibrocartilage (TFC) lesions.

**Methods:** Sixty patients who had been initially diagnosed as TFC lesions base d on the history and physical examination, and subsequently under went arthroscopy were included. For ulnocarpal stress test, both hypersupination and hyperpronation stress were applied, while the patient` s wrist was ulnarly deviated in a position of dorsiflexion, neutral and volar flexion respectively. For six each stress maneuver, evoked pain was rated into four grades. Based on the arthroscopic findings, TFC lesions were classified into a traumatic tear or a degenerative wear, and the results of ulnocarpal stress test were analyzed in each lesion. Generalized Estimating Equations test was used to determine whether the intensity of pain according to the wrist position was significantly different in each lesion ( $p < 0.05$ ).

**Results:** The arthroscopic examinations demonstrated traumatic tears in 32, degenerative wears in 19, and others in 9 patients. In patients with tears, the hypersupination stress evoked greater pain than hyperpronation stress ( $p < 0.01$ ), particularly in dorsiflexed position. In patients with wears, difference in pain degree was not significant with respect to the type of rotational stress ( $p = 0.60$ ), but the pain tended to be aggravated in dorsiflexed position ( $p = 0.03$ ).

**Conclusion:** Ulnocarpal stress test can be used effectively not only as a screening test for patients with ulnar-sided wrist pain but also as a test for predicting the type of TFC lesions.



**P152**

**Comparison between patients with TFCC injury and volunteers by MR imaging with a microscopy coil**

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**Purpose:** Degenerative changes occur with aging in triangular fibrocartilage complex (TFCC). The purpose of this study was to identify the location of TFCC pain by comparing high resolution magnetic resonance ( MR) imaging using a microscopy coil in patients with TFCC pain and normal healthy subjects.

**Materials and methods:** Seventy-five subjects (35 patients with a positive sign during the ulnocarpal stress test and tenderness at the distal end of the ulna and 40 volunteers without symptom), were studied with high-resolution MR imaging using a 47-mm diameter microscopy coil. All subjects were under fifty year old. Six regions of the TFCC were investigated for injury; radial attachment, disc, ulnar triangular ligament , palmar radioulnar ligament (PRUL), and dorsal radio-ulnar ligament (DRUL), ulnolunate, ulnotriquetral, ligament (ULL, UTL). Two observers (one orthopedic surgeon and one radiologist who was a musculoskeletal specialist) were blinded to the subject selection and were also blinded to the results of other examiner. For each of six TFCC structures, the observers assigned either no tear (value=0), or partial or complete tear (value=1).

**Results:** The Kappa values for each region were: radial attachment 0.804, disc proper 0.817, triangular ligament 0.863, DRUL 0.782, PRUL 0.724, and UTL, ULL 0.589. In the volunteer group, both observers identified a positive sign on 4 subjects (triangular ligament 2, and ULL, UTL 2). In the patient group, 34 showed a positive sign ( radial attachment 9, disc 10, triangular ligament 5, DRUL 2, PRUL 4, ULL, UTL 4 ). Both observers identified similar lesions in 21 of the patients. Nine patients had multiple lesions (five patients had 2 lesions, three had 3, and one had 4 lesions).

**Conclusion:** The inter-observer reproducibility of TFCC injury with high-resolution MRI was very good in radial attachment, disc proper, and triangular ligament. The patients with TFCC pain had significantly greater number of lesions than the healthy volunteers.



**P153**

**Effect of radius shortening on lunate decompression. A three-dimensional finite element analysis**

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**Introduction:** Radius shortening is commonly performed for Kienböck's disease in order to reduce mechanical stresses on the lunate. Although lots of biomechanical studies reported the effect of decompression in this procedure, an analysis using: 3-dimensional finite element method (3DFEM) has not been performed. We first reported a preliminary result on postoperative stress changes measured by 3DFEM at the 2005 Meeting of the Japanese Society for Clinical Biomechanics.

**Method:** We built up a three-dimensional wrist joint model based on computed tomogram of a healthy adult male whose UV was 0mm. Then a UV +2mm model was created by moving the radius 2mm proximally, and a UV -2mm model by moving the radius 2mm distally. A shell element was employed for expression of articular cartilage. TFC and intercarpal ligaments were inserted to each model according to their anatomical locations. Using the ANSYS-STRUCTURAL, a 3DFEM software, compressive force was applied on the third metacarpal bone along the long axis of the radius, and the surface and internal stresses of the lunate were calculated.

**Result s:** The maximum stress of the radio-lunate joint was largest in the UV -2mm model, followed by the UV 0mm model and the UV +2mm model in this order. Pressure distribution of a lunate bone was dispersed to the ulnar side in UV +2mm model compared to other models, suggesting the TFC bearing larger mechanical stresses.

**Discussion and conclusion:** In previous biomechanical studies, the effect of radius shortening was investigated using different specimens, one with the radius intact and the other with the radius shortened. In contrast, the current study showed the effect of radius shortening in the same specimen, as in the real surgery. With this method, we may predict the decompression effect before surgery in respective patients with Kienböck's disease, thereby choosing best candidates for radius shortening.





**P154**

**Concomitant avascular necrosis of carpal scaphoid and carpal lunate**

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**Introduction:** Preiser's disease (AVN of carpal scaphoid) and Kienbock's disease (AVN of carpal lunate) is well-known entities. The etiology of them is usually idiopathic and they are uncommon disease. The case which avascular necrosis of carpal scaphoid and carpal lunate occurred concomitantly was reported in a child after distal radius fracture. However, there has not been a report which occurred in an adult. Thus we present the case of an adult with idiopathic concomitant avascular necrosis of carpal scaphoid and carpal lunate.

**Case:** Patient was 65-year old woman. She had had a wrist pain for 10 years without trauma history. The wrist pain and limitation of motion were aggravated at one year ago. In simple X-ray, carpal scaphoid was already collapsed and there was dorsal intercarpal instability between the carpal scaphoid and carpal lunate. MRI showed concomitant avascular necrosis of carpal lunate. We treated the patient with the wrist fusion, because degenerative arthritis of the wrist was already progressed.

**Discussion:** In this case, avascular necrosis of carpal scaphoid is old one, and that of carpal lunate is recently developed. Carpal scaphoid collapsing and scapholunate dissociation increase the load pressure acting on the carpal lunate and these may be a cause of avascular necrosis of carpal lunate. Thus, we could postulate that longstanding Preiser's disease brings about Kienbock's disease.



**P155**

### **Conservative treatment of de Quervain's disease**

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De Quervain's disease is most common tenosynovitis of wrist. There have been many reports on its conservative and surgical treatments. The purpose of this prospective study is to investigate the effects of a single corticosteroid injection into the first compartment of the wrist on this disease.

Between September in 2001 and March in 2004, 5mg triamcinolone acetonide and 0.5ml of 1% lidocaine hydrochloride were combined and injected into EPB tenosynovium of 100 hands of 97 patients (7 men and 90 women) with de Quervain's disease. Their ages ranged from 18 to 73 years (average 54.3 years). The mean duration between the onset of symptoms (including late recurrence) and this injection was 3.5 months (range: 3 days to 41 months). The assessment was performed at one year after the injection.

All 100 hands had satisfactory results by this injection. Forty-three hands (43%) had relief of pain following a single injection for one year or more. Twenty-four hands (24%) had relief of pain for more than 6 months, 28 hands (28%) for more than 3 months and 5 hands (5%) within 3 months. Fifty-seven hands with recurrent pain required the same injection, and no patients required surgical treatment.

The existence of the septum between EPB tendon and APL tendon may not be only easy to occur this disease, but may be also difficult to cure. This anatomical variance is popular to us, so the recovery from this stenosing condition can be made and the recurrence can be prevented only by this injection. This prospective study revealed this injection is the best of the conservative treatments.

There is no absolute indication of surgical treatment for de Quervain's disease.



**P156**

### **Linburg-Comstock syndrome revisited**

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**Introduction:** In 1979 Linburg and Comstock described anomalous tendon slips between flexor pollicis longus and the flexor digitorum profundus in 31% of individuals (Linburg, Comstock; J Hand surg 1997, Jan). The purpose of this study is to find out the incidence of Linburg-Comstock Syndrome in the British population.

**Methods:** A clinical examination of the hands of healthy volunteers, including office workers and medical professionals, was carried out by one person. It was determined if flexion of the thumb causes concomitant flexion of index or/and middle finger. Additionally, pain on passive extension of the fingers was also documented.

**Summary of Results:** 70 volunteers were included, the test for Linburg-Comstock syndrome was positive in 55% of people who had concomitant flexion of the fingers with the thumb and pain in the wrist with passive extension. In 70% of people just concomitant finger flexion was seen. In 10 cadaveric dissections no connecting tendon slips were found but one fibrinous connection between FPL and FDP was noted.

**Conclusion:** Our study shows that the incidence of Linburg -Comstock Syndrome is much higher than previously thought based on the clinical examination. However cadaveric dissections did not confirm a distinct structural connection except in one case where there was a fibrinous connection. It is likely that at least in some cases it is an acquired anomaly in response to repeated use/overuse of thumb and index fingers.



**P157**

**Limited wrist arthrodesis for the advanced Kienböck's disease**

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**Purpose:** To evaluate clinical outcomes of triscaphe (STT), scapho-capitate (SC) and scapho-capito-hamato-triquetral (SCHAT) fusion in the advanced Kienböck's disease.

**Methods:** Thirty patients of the advanced Kienböck's disease (Lichtman stage III and IV) were treated with the limited wrist arthrodesis. STT & SC fusion for stage IIIa and IIIb, and SCHAT fusion for IIIb and IV were done, according to the preoperative radiologic and intraoperative articular surface findings. Mean follow-up period was 30.2 (range 6-108) months and mean age at the time of their operation was 34.8 (range 23-57) years. There were 10 cases of STT fusion, 15 cases of SC fusion and 5 cases of SCHAT fusion. For assessment of treatment results, we measured wrist ROM, grip strength, VAS (visual analog pain score) and checked any radiologic changes of wrists at last follow-up.

**Results:** VAS score was 4.3 for STT, 3.5 for SC, 4.5 for SCHAT, and grip strength, compared to the opposite side, was 71% for STT, 78% for SC, 65% SCHAT. The sum of range of motion of the wrist was 97.5 ° for STT, 113.3 ° for SC, 90 ° for SCHAT. There was no change of carpal height ratio for all cases, but 2 of 10 STT fusions showed degenerative change of radiocarpal joint. All cases except one SC fusion were united.

**Conclusions:** Limited wrist arthrodesis in advanced Kienböck's disease was regarded as a valuable method and showed acceptable clinical results in STT & SC fusion. However, SC fusion was thought as more favorable than STT fusion in respect to pain relief and complication rate. SCHAT fusion was thought to be a possible salvage procedure for Stage IV Kienböck's disease.



**P158**

### **Outcomes of ulnar shortening osteotomy for treatment of ulnar impaction syndrome**

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**Purpose:** To analyze retrospectively the follow-up results of the patients with ulnar impaction syndrome treated by arthroscopic debridement and simultaneous ulnar shortening osteotomy.

**Materials and Methods:** Eleven wrists in ten patients with ulnar impaction syndrome which were diagnosed by history, physical examination, radiological evaluation, and an arthroscopic findings and treated by an arthroscopic debridement and ulnar shortening osteotomy were included. The minimum duration of the follow-up was one year. The ulnar variance was measured using Kreder's method and the follow-up results were clinically analyzed using Chun and Palmer's wrist score as well as radiographically.

**Results:** According to the wrist scoring system, seven wrists were fair and four poor preoperatively, but eight wrists were excellent and three good postoperatively. The average wrist score was increased from 63 preoperatively to 94 at last follow-up. The mean ulnar variance was changed from +3.3 mm (+0.4~+6.4mm) preoperatively to +0.1 mm (-0.8~+1.3mm) at last follow-up. Radiological union of the osteotomy site was achieved at an average of 12 weeks. Non-union or malunion were not founded.

**Conclusion:** When an ulnar impaction syndrome is diagnosed by clinical, radiological, and arthroscopic findings, an arthroscopic debridement and ulnar shortening osteotomy is a useful treatment method for relieving the patient's symptoms.



**P159**

**Kienbock's disease: Vascularized bone graft**

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A There is still no agreement in the treatment for Kienbock's Disease during the stages previous to established osteoarthritis. Lunate collapse leads to disturbance of radiocarpal and mediocarpal joint. Described treatments go from resection, osteotomies, joint replacement, to vascularized bone grafts. Since Roy-Camille, Beck and Saffar's reports, pioneers of the vascularized bone graft, up to those described by Sheetz, who uses the distal radius vascularity, Moran, Cooney and cols. Have used vascularized bone graft from the 4+5 extensor apparatus.

**Materials and methods:** we did the 4+5 dorsal distal radius compartment vascularized bone graft technique, in 12 patients with Kienbock's Disease in stages II and IIIa, 7 men and 5 women, mean age 37 years. 60% involve the dominant limb. Pre-op assessment showed mean VAS 7 with a 40% of morbidity restraint compared to the contralateral limb. Diagnosis was made with simple X-ray plus MRI. In 25% of the cases a carpal arthroscopy was practiced so as to rule out joint involvement. One year follow up period. All the patients underwent a rehabilitation protocol with assessments every 3 months and strict supervision of the indications, with use of thermoplastic brace for at least 3 months.

**Results and conclusions:** VAS (2) decreased significantly in all the patients. 20% of functional increase. 30% of grip strength increase. Only one patient evidenced a progressive lunate collapse or progression to a more advanced stage. 8 of the 12 patients showed an evident vascular recovery as seen by MRI. We had no infections nor major complications.



**P160**

**Real-time dynamic MRI of the wrist: A new imaging tool for standardized motion in vivo**

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**Background:** The combination of static MRI with dynamic MRI of the wrist offers extremely effective diagnostic means of evaluating this joint. In performing kinematic MRI, it is essential to maintain a constant axis of motion with a defined positioning of the wrist during real-time imaging. A MRI actuator, for remote control of the motion and position of the wrist during the non-invasive diagnostic was developed.

**Methods:** The forearm and hand are fixed on the rotary moment arm, a small plate which is connected to a belt-pulley to transfer the motor force to the joint. The MR suitable motor of the system is built of two liquid muscles, which are pneumatic devices. These devices contract asynchronous if they are supplied with compressed air. The motor controller is realized with a microprocessor, a control panel and air valves and is installed in the operator room. It remotes the system with air pressure via two lines and activates the airflow to the pneumatic muscles corresponding to the operating lever for a clockwise or counter clockwise motion. : Dynamic MRI of the wrist was performed using a 1T MRI unit (Gyrosan) with a wrist coil and a software program (Powertrack 3000). Sagittal and coronal T1-weighted sequences of the wrist were performed through 5 cycles of radio-ulnar deviation and flexion-extension of the wrist.

**Results:** Dynamic MRIs using the new actuator allows constant, reproducible motion. It is possible to apply a defined amount of stress to the wrist and the range of motion in both planes could be visualized exactly. Additional functions of the controller allow defining the motion speed, the maximum moment and different setups for standard diagnoses.

**Conclusion:** The actuator is a useful tool to assess pathological wrist conditions or instabilities. Further investigations to calculate the 3D motion of the entire carpus under in vivo dynamic conditions may be possible.



**P161**

## **Functional Outcome of the Physiotherapy Program After Surgical Intervention of Ulnocarpal Abutment Syndrome**

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**Introduction:** Degenerative lesions of the triangular fibrocartilage complex (TFCC) are commonly associated with ulnocarpal abutment syndrome (UCAS) which result from repetitive loading of the TFCC in association with ulnar positive variance. The purpose of this study was to show the effects of the physiotherapy program after surgical intervention of UCAS.

**Methods:** Eight patients (4 male, 4 female) with UCAS who underwent TFCC debridement and wafer procedure participated in the study. Pre and post assessments included pain score, range of motion (ROM) of wrist and forearm, grip strength and The Disabilities of Arm, Shoulder and Hand Questionnaire Turkish Version (DASH-T). Physiotherapy program started by an average of postop 5 days after surgical intervention including cold pack application, retrograde massage, ultrasound application, gentle active ROM exercises of wrist and fingers and forearm supination exercises. Pronation exercises were avoided at the first weeks. Exercises, which were done based on the principle of long duration, low stress application were progressed to the mobilization of carpal bones, passive ROM exercises of wrist and forearm, grip and strengthening exercises respectively. Patients had physiotherapy program three times a week for a total of four months.

**Results:** Grip strength and ROM have increased ( $p < 0.05$ ); DASH-T and pain score have decreased ( $p < 0.05$ ).

**Conclusion:** Early rehabilitation program based on the biomechanical considerations of the wrist and the healing stages of the tissues is crucial to a good outcome of treatment for UCAS.





**P162**

**Spontaneous multiple extensor tendon rupture with advanced Kienböck's disease**

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**Introduction:** We describe a very rare case of spontaneous multiple extensor tendon ruptures that were caused by advanced Kienböck's disease.

**Case Report:** A 64 year-old male complained of spontaneous loss of extension of right 3 rd and 4 th fingers and weakness of 5 th finger extension. Two months ago, he suddenly became unable to extend his 3 rd finger; and 1 month later, he could not extend 4 th finger with weakness of 5 th finger extension. Active extension of the 3 rd, 4 th fingers was impossible and 5 th finger extension was weak. The wrist joint motion was mildly limited without pain. Radiographs and CT demonstrated a collapsed lunate. Two fragments of the lunate were noted and dorsal one had migrated dorsally. An MRI revealed necrosis of the lunate and the ruptured 3 rd, 4 th, and 5 th extensor tendons. The tentative diagnosis was spontaneous 3 rd, 4 th, and 5 th extensor digitorum ruptures that were caused by the chronic irritation of the dorsally displaced fragment of the lunate in Lichtman stage 3B Kienböck's disease. The extensor tendon reconstruction was performed. After a retinacular incision, we noted the dorsal fragment of the lunate had perforated the wrist joint capsule and protruded into the 4 th extensor compartment. The 3 rd, 4 th, and 5 th extensor tendons were completely ruptured, but the extensor digiti minimi was intact. The lunate was excised and a scapho-capitate arthrodesis was performed. The extensor indicis was transferred to the 3 rd extensor tendon and a palmaris longus tendon graft was performed for the 4 th finger. A short arm cast with dynamic finger extension device was applied, and after 2 months the patient achieved full active extension of the fingers.

**Conclusion:** Kienböck's disease has to be considered as a possible cause of spontaneous extensor tendon rupture, especially in old age. Because the symptoms are mild until it develops into an advanced disease, proper treatment in the early stages needs to be provided.



**P163**

**Intrasheath steroid injection for de Quervain's disease -A prospective comparison between triamsinolone and betamethasone-**

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**Introduction:** We have used two types of steroids, namely, triamcinolone (TC), a lyophobic steroid, and BM (Betamethazone), a water-soluble steroid, in turn, for intrasheath injection in the treatment of de Quervain's disease since 1994. A prospective randomized control study of treatment results for the above steroids is reported.

**Materials:** In 75 wrists of 71 patients with de Quervain's disease who had received intrasheath steroid injection and were followed up until the final examination, thirty-eight wrists of 36 patients were assigned to treatment with TC, and 37 wrists of 35 patients were treated with BM. TC at a dose of 10 mg and BM at a dose of 2 mg were used so that both injections would have the same titer. The patients' symptomatic improvement was graded into four groups based on pain and daily activity.

**Results:** There was no significant difference between the two groups in age, gender, laterality, hand dominance, duration of symptom, and duration of final follow-up. Symptomatic improvement were graded as excellent in 31 wrists, good in five and fair in two for Group TC, and excellent in 21, good in 9, fair in five, and poor in two in Group BM. There was significant difference between the two groups. Side effect around the needle-insertion site was observed in seven hands, and at the same site was observed in three; however: whereas no such complications were found in Group BM.

**Conclusion:** We investigated differences in the results of intrasheath injection of those two steroids, TC and BM, in patients with de Quervain's disease, and found that TC was superior to BM in the results of intrasheath injection and in the response rates. On the other hand, however, we should explain adequately to their patients prior to treatment about possible complication in the skin and subcutaneous tissue.



**P163a**

### **Treatment of Scapholunate dissociation**

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**Purpose:** We present the results of operation about 12 patients diagnosed as scapholunate dissociation with journal review.

**Material and method:** This was a retrospective study of 12 cases operated for scapholunate dissociation between May of 1992 and April of 2005. Ten cases had dynamic carpal instability and 3 cases had static carpal instability. The follow-up period averaged 32 months (range, 6-68 months). All patients had surgical treatment by either direct repair in 4 cases or transosseous suture in 12 cases through open dorsal approach. Additionally, modified Blatt's capsulodesis was performed in 3 cases including 2 cases of static scapholunate dissociation. Relief of pain, radiographic finding, range of motion, grip and pinch power were evaluated

**Result:** In 7 cases definite relief of pain were seen and discomfort persisted in the others. Range of motion(flexion, extension) is improved 70% and 60% of uninjured side respectively at last follow-up. Grip and pinch power is also improved slightly. Carpal alignment were good in 10 cases except for 2 cases showing loss of parallel and there were clinical improvement without arthritic changes in all cases

**Conclusion:** Surgical management of chronic scapholunate dissociation is also effective and essential procedure for not only functional improvement but also prevention of degenerative arthritis.



**P163c**

### **Clinical outcome and specific rehabilitation program on wrist arthroscopy**

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2 *Institut De La Main -Paris*

**Purpose:** This study reviews the clinical outcome after a specific rehabilitation program of 100 wrist arthroscopy between 2000 and 2004 in Orthopaedic Clinic of Perugia.

**Methods:** one hundred patients underwent arthroscopy of the wrist for 30 ganglia, 25 Tfcc tears, 20 synovitis, 5 necrosis of proximal pole of the scaphoid, 20 ulnar sided wrist pain, for all patients a specific rehabilitation program was done. All of them were evaluated at a mean of 18 months (range 12 to 30 months) with physical examination and a module outcome assessment questionnaire.

**Result:** average wrist motion was flexion extension 80°, pronation and supination were 65°, the average of grip strength was 90% of the other side.

**Conclusions:** the arthroscopy of the wrist is a good and safe surgical procedure of treatment of wrist pathology associated with a specific rehabilitation program improves the results.



**P163d**

**Effect of Scaphoid and Triquetrum excision on midcarpal Arthrodesis of wrist: A cadaveric study**

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**Purpose:** Limited wrist arthrodesis has been shown to be an effective treatment for the degenerative and unstable wrist, abolishing pain but limiting motion. The aim of the study was to assess the effect of excision of scaphoid and triquetrum on wrist joint motion following limited midcarpal arthrodesis.

**Methodology:** Twelve cadaveric wrists had range of motion measured before and after ulnar four-corner fusion (lunate, capitate, triquetrum and hamate fusion) and after sequential scaphoid and then triquetral resection. The mean and standard deviation of the change in motion were calculated for each step. The two-tailed Student's *t*-test with  $p = 0.05$  was used to determine the statistical significance of the changes.

**Results:** Scaphoid excision after four-corner arthrodesis resulted in 10% ( $p < 0.01$ ) increase in flexion-extension (F-E) arc and 29% ( $p < 0.01$ ) increase in radioulnar (R-U) arc. Subsequent excision of triquetrum further increased F-E arc by 5% ( $p = 0.05$ ) and R-U arc by 13% ( $p < 0.01$ ).

**Conclusion:** In the cadaveric wrists, triquetral excision resulted in significantly improved R-U arc and F-E arc when compared with four-corner fusion. Triquetrum excision should be considered in formal SLAC wrist reconstruction to improve residual wrist motion.



**P163e**

## **Wrist Arthrodesis: Technique and functional evaluation**

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**Background:** Wrist arthrodesis is a reliable procedure that, although it sacrifices motion for stability, provides the patient with relief from pain. In order to ascertain the value and future of wrist arthrodesis we assessed the results of 6 wrist arthrodesis performed at the Department of Trauma Surgery of the Vienna Medical University, Austria.

**Methods:** In a retrospective analysis we examined the patients clinical and radiological records. The mean score on the "Disability of arm, shoulder and hand" (DASH) was evaluated.

**Results:** We reviewed 6 patients using the AO technique, with plate and screw fixation and iliac crest bone graft. The most common diagnosis was posttraumatic arthritis. The evaluation showed a 100% union rate and high patient satisfaction. A better function of the hand was reached in every patient. The majority of the patients had no pain and an acceptable strength. Using the questionnaire, the patients revealed that they adapted to their fused wrists but still had difficulty with some activities, such as heavy lifting and positioning the hand for some specific activities.

**Conclusion:** We conclude that wrist arthrodesis using the AO technique after posttraumatic arthritis gives good long term results and an increase in quality of life.



**P164**

### **Cold sensitivity following operatively treated phalangeal fractures**

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**Introduction:** Cold sensitivity is a very common but often neglected long-term complication after phalangeal fractures. We aim to assess whether this is related to thermoregulatory dysfunction.

**Methods:** We studied twelve subjects who had healed proximal phalangeal fractures one year after operative treatment. All of them complained of cold induced pain. The temperature of the previously injured digit was measured at ambient temperature, volarly and dorsally, using L-308 Perfusion Monitor (Hallcrest Inc.). Similar measurements were carried out on the corresponding digit of the opposite hand as control. Both the hands were kept in a cold box consisting of an insulated outer box, an intermediate layer of slush and an inner box for the hands. After 2 minutes the temperatures were recorded again at the same spots as before.

**Results:** The previously injured finger was always colder than its fellow at room temperature by an average of 0.55 degree (range 0.1 to 0.85, SD=0.28). When the hands were cooled down the temperature of the study fingers fell further in 8 subjects (66.6 %) and went up in 4 (33.3%) compared to controls. The mean difference in the temperature after exposure to cold was 0.99 degree (range 0.1 to 2.85, SD=0.92) compared to controls. Previous studies suggest that a difference of up to 0.3 degree can occur between opposite fingers. The maximum measurement error using the L-308 strips is 0.3 degree. Therefore a difference of 0.6 degree or above is considered significant. In our study 8 subjects (66.6%) had a significant temperature dysregulation.

**Conclusions:** Temperature dysregulation occurs in a significant proportion of patients with phalangeal fractures treated operatively. This may be related to damage to the autonomic nerves by the injury itself and/or iatrogenic damage sustained during operative fixation. It is a distressing long-term complication and deserves further research.



**P165**

### **Plate fixation in closed ipsilateral multiple metacarpal fractures**

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**Purpose:** Although plating of metacarpal fractures is well described there is very little data with respect to plate fixation of closed ipsilateral multiple metacarpal fractures. We analyzed our data for the efficacy of plating in closed ipsilateral multiple metacarpal fractures.

**Methods:** 17 male and 2 female patients averaging 24 years (range 14 to 40 years) with closed ipsilateral multiple metacarpal fractures were treated with plate fixation. Three surgeons plated 40 of 43 the metacarpal fractures at an average of 8 days after the injury.

All fractures that were plated had a 2.0 mm standard plate or LCDC plate with a minimum of two screws on each side of the fracture. Interfragmentary screws alone were placed in three fractures.

**Results:** Fourteen patients were evaluated an average of 5 months (range 1.8 to 7.4 months) after injury. Four patients had full function and no complaints at six weeks and declined further follow-up and one patient was lost to follow-up after two weeks. There were no complications, and 15/16 patients recovered full function within 6 weeks.

Two patients required plate removal; one patient had extensor tenosynovitis at the base of the third metacarpal and the other patient had a plate at the neck of the fifth MC that interfered with MP flexion.

**Conclusion:** Plating of closed ipsilateral multiple MC fractures is a safe, reliable, effective and consistently reproducible procedure with a low risk of complications and uniformly excellent outcomes, provided principles of stable internal fixation are followed. Plates placed on the bases of 2nd and 3rd MC may be a cause of irritation of the wrist extensors, needing plate removal. Plates placed distally on the MC head/neck may interfere with extensor excursion and MP flexion and should be avoided. Routine removal of plates does not appear to be necessary.





**P166**

**Use of the S-Quattro dynamic fixator for complex PIPJ fractures – Medium Term results**

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The S-Quattro fixator is a low-cost, easily applied device allowing distraction, fixation and gentle movement. It is ideally suited to complex fractures around the PIP joint.

Sixteen patients were treated by a single surgeon for unreconstructable intra-articular fractures over a four year period. Outcomes were assessed at a minimum of one year in a dedicated research clinic.

Satisfactory alignment had been maintained and all fingers were functioning with a measurable range of movement and little pain. The outcomes were disappointing in terms of grip strength and range of movement, but better than expected for the severity of injury. No patient had required revision to arthroplasty/arthrodesis at the time of review.

Complex fractures of this type are expected to have a poor outcome and treatment is rarely rewarding for patient or surgeon. Preserving function as much as possible, while allowing soft tissues to remain in the best condition for later revision is the aim. This device allows a better than expected outcome in the short to medium term, while having the benefits of simplicity, low cost and good patient acceptability.

The authors recommend it as a useful and reliable device to salvage unreconstructable PIPJ fractures.



**P167**

**Avulsion fracture of second metacarpal base by extensor carpi radialis longus combined with extensor pollicis longus tendon rupture-Case report**

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The most commonly observed avulsion fracture of the hand region is the mallet finger. Research for treatment has been going forward for the first and the fifth metacarpal base fracture because they are also comparatively often observed. However, report on avulsion fracture of the second metacarpal base due to extensor carpi radialis longus is rare. A theoretical basis on documents about the danger present on rupture of extensor pollicis longus due to bone fragment of avulsed extensor carpi radialis longus exists, but it is difficult to find it from the documents. The authors intend to report on an experience of one example where avulsion fracture of the second metacarpal base due to extensor carpi radialis longus is accompanied by the rupture of extensor pollicis longus.



**P168**

### **Chicken - A new training model for hand trauma**

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**Introduction:** Operation room based training has traditionally been supplemented with laboratory based teaching. Whilst ethical and legal concerns are raised when live animals and cadavers are used, many synthetic models are poor simulators of reality.

**Aim:** To create a simple, easily accessible and inexpensive surgical training model that closely simulates human hand trauma.

**Methods:** Fresh uncooked chickens bought from a local supermarket, were dissected to assess their usefulness as a training model. We measured the length, diaphyseal outer diameter and cortical thickness of chicken femurs. We also assessed the appropriateness of using chicken femurs to practise fracture fixation techniques such as wiring and plating.

**Results:** Chicken thighs with a mean weight of 165g had a mean femoral length, mid-diaphyseal outer diameter and cortical thickness of 78.8mm, 9.4mm and 2.0mm respectively. These dimensions are similar to human adult metacarpals. Chicken soft tissue and bone handling qualities were also comparable to human tissues. The fracture fixation model was simple and straightforward to set up, and easy to use. During fracture fixation, a definite change in resistance between cortical and cancellous bone was noted. This is in complete contrast to the synthetic bone model which is usually solid and thus lacks this differentiation. We found the chicken to be a very useful non-synthetic model to practise existent skills and to learn new techniques in hand surgery.

**Conclusion:** The "off the shelf" chicken is a simple, inexpensive and readily available non-synthetic hand trauma surgery training model that closely simulates reality.



**P169**

**Modified Ishiguro's method (extension block pinning) for large mallet fractures**

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**Purpose:** Ishiguro's method for the mallet fracture is useful and therapeutic. But in some cases with large fragments more than 50% of the joint surface, the proximal bone fragments are not reduced and have the step in the DIP joint. We devised modified Ishiguro's method.

**Surgical Technique:** Under the fluoroscopic observation, the large fragment can be manipulated by pinch between thumb and index finger of the operator and a 0.7mm Kirschner wire can be placed through the fragment from dorsal to volar. After the favorable reduction of the joint surface of the distal phalanx base is showed Ishiguro's method is applied. As compared with original Ishiguro's method, the fixed position of DIP joint is extended position, about 0-10 degree flexion. The postoperative treatment is almost same as Ishiguro's method.

**Clinical Results:** This method was applied to 20 fingers of the fresh fractures, in all cases of which was large fragment involving 50% or more of the joint surface. The average patient age was 30.5 years. We reviewed to determine the results of treatment, union, range of motion, pain, and evaluated by Kanie's criteria. At average 4 months follow up evaluation the average extension loss was 4.3 degree and average flexion was 66.7 degree. All patients had bony union within 5 weeks. There was no patient complained pain and complication, and was shown the arthritis change. According to Kanie's criteria 16 fingers were excellent and 4 fingers were good.

**Discussion :** In Ishiguro method, the cause of poor reduction is that the large fragment is rotated dorsally by the extension block wire. Our method prevents the large fragment from stepping of the joint surface by the manual reduction and the fixation with thin wire. The results showed that this method resulted in anatomical union and has excellent outcomes based on established criteria.



**P170**

**Optimal position for percutaneous K-wire insertion for finger fractures based on skin movement with mobilisation**

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**Introduction and Aims:** Hand fractures comprise a large proportion of acute plastic surgery admissions. Displaced, unstable phalangeal fractures are usually held reduced by K-wires rather than open reduction and internal fixation. Early mobilisation and physiotherapy to avoid stiffness can lead to pin-site infection due to tethering of the skin.

We sought to quantify the extent of skin movement around the joints of the digit with flexion and extension to guide appropriate placement of percutaneous k-wires, fracture configurations permitting.

**Methods:** We devised a non-invasive method using reproducible skin surface markings on the digits to calculate skin stretch and contraction across both metacarpophalangeal and interphalangeal joints. Skin movement was measured in dorsal, midaxial and a longitudinal axis between these landmarks in all five fingers at the extremes of flexion and extension.

**Results:** Skin stretch from extension to flexion was greatest over the dorsum of the joints and actually contracted in the midaxial line during digital flexion. Skin mobility was greatest over the proximal interphalangeal joints (120° flexion), and least so across the distal interphalangeal joints (60° flexion).

**Conclusions:** We present our findings from 20 hands to identify the optimal sites for the insertion of percutaneous k-wires to minimise pin-site complications with mobilisation.



**P171**

### **A novel fixator for finger fractures - Dynamic spring mini external fixator (DySMEF)**

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**Introduction:** A new mini external fixator has been developed for the fixation of metacarpal and phalangeal fractures. This fixator is unique as locking of the fracture can be done in static and dynamic modes. The amount of motion at the fracture site can be configured according to the fracture personality and the time frame during the fracture union process.

**Objectives:** To determine the strength and stiffness of the DySMEF in stabilizing fractures in a rabbit tibial osteotomy model.

**Materials and Methods:** Six rabbit's tibiae were osteotomised at the midshaft and fixed with the DySMEF. The right tibia were all fixed in the static mode and the left tibia in the dynamic mode. The rabbits were allowed to weight bear freely after surgery. Serial radiographs were done at immediate postoperative, 2 weeks, 3 weeks and 4 weeks to determine the amount of callus formation. Quantitative computed tomography scans were performed to determine the amount of callus. Biomechanical testing was done on the tibiae harvested using the Instron mechanical testing machine. Compressive, bending and torsional stresses were conducted to determine the stiffness and strength of the constructs. A comparison was done with the Pennig mini external fixator.

**Results:** Callus formation was greater in size and amount at 2 weeks on the limb in which the dynamic mode of locking was applied. At 4 weeks the amount of callus were similar in both groups. The biomechanical testing revealed better compressive and bending strength compared to the Pennig mini external fixator.

**Conclusion:** The Dynamic Spring Mini External Fixator (DySMEF) can provide both static and dynamic locking options to facilitate fracture union and has been proven to be biomechanically superior.



**P172**

### **Operative treatment of hamate body fractures with ulnar carpometacarpal joint subluxation**

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**Purpose:** Coronal fracture of the body of the hamate with associated dorsal dislocation of the bases of the fourth and fifth metacarpals is rare and the diagnosis is frequently missed. Displaced hamate body fractures require anatomic reduction to restore normal carpal kinematics and obtain good outcome. We present the clinical and radiological results of the open reduction and internal fixation for hamate body fractures with concomitant ring and small finger carpometacarpal joint dislocation.

**Materials and Methods:** From 2003 to 2005, we experienced 12 cases of hamate fractures with ring and small finger carpometacarpal dislocations that underwent the open reduction. Two cases had dorsal capitate and hamate fractures, and ten cases had dorsal hamate fractures. Treatment consisted of open reduction through dorsal approach and internal fixation with mini bone screw followed by splints and immediate range of motion exercises. Bone union was evaluated with X-ray and clinical evaluation was done with grip strength, wrist and finger range of motion, and pain.

**Results:** The mean follow up period was 12.3 months. All cases showed bony union at the average of 7 weeks postoperatively. All cases achieved excellent range of motion. Grip strength were normal compared to the other side. Two cases had intermittent pain as a complication.

**Conclusion:** This diagnosis should be suspected on initial review of plain radiographs in any patient presenting with pain after blunt trauma to the hand. Oblique roentgenographic views, true lateral views and CT were helpful in the assessment of the fracture. The operative treatment was required in cases with difficulty in maintaining closed reduction, open displaced fractures, and delayed diagnosis. Open reduction and internal fixation resulted in good clinical and radiological outcome.



**P173**

**Better initial assessment and diagnosis of Ulnar Collateral Ligament injuries of the thumb Metacarpophalangeal Joint – A nine year experience of a dedicated service**

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Early diagnosis and repair of displaced Ulnar Collateral Ligament (UCL) of the thumb gives better results than delayed repair or ligament reconstruction (1).

In 1998, we noted that the initial assessment and diagnosis of UCL injuries was less than optimal in a large district hospital serving a population of 350,000 -500,000. This was in spite of regular teaching to hospital emergency staff and primary care practitioners.

A weekly specialist follow up clinic, within the Accident and Emergency department, was set up to review and assess all patients with injuries around the MCPJ of the thumb. To assess and screen those patients requiring surgery, ultrasound of the MCPJ was performed.

Initial results were published (2). The difficulty for primary care practitioners and emergency staff in making an early diagnosis was identified; the value of ultrasound in the initial diagnosis and in informing the decision to operate was emphasised.

We now describe a nine-year experience of running such a service with the benefit of a dedicated early ultrasound service, early surgical intervention and aggressive rehabilitation.





**P174**

## **Hand injury in winter sports**

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Hand injury during winter sports are, ski and snow board, frostbite in snow sports and mountain climbing in winter season. Regarding to the ski injury, ulnar collateral ligament rupture of the first carpometacarpal joint is the most well known condition called as skier's thumb. Incidence of the skier's thumb is less than 10% in total number of ski injuries, most of the ski injuries were knee, ankle and tibia in lower extremity. Recently, population of the snow boarder is gradually increased year by year. Distal radius fracture is the most frequent injury in snow boarders.

Now a day, hand and wrist injuries are more important then lower extremity injuries in snow sports.

Author report incidence and its recent trends and treatment options of the snow sports and mountain climbing in cold season.

The trend of the lower extremity injury is decreasing in snow sports, hand and wrist injuries are going to increase because of rapid increasing population of the snow borders. In our twenty year study in the 3 million skiers analysis, number of the injured skier was 8763, the incidence of skier's thumb was 6.5%.

46% of wrist injuries among 67% of upper extremity injury in snow border injury in recent study.

Management of the hand frostbite in 128 cases of deep frostbite patients treated by surgical methods. The indications and results of the surgical management will be report.



**P175**

**Tension band fixation for chronic mallet fractures**

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**Introduction:** As operative procedures for chronic mallet fractures, extension block pinning, internal fixation with screws or K-wires, pull-out suturing and tension band wiring have been introduced, however, selection of the procedures is still controversial. Since 2001, we have performed the tension band technique and obtained bony union and joint congruity in all cases. This study evaluates the clinical and radiographic outcomes of our experiences.

**Surgical technique:** After reduction and fixation of the DIP joint with a K-wire, a steel wire was directed from the palm of the extensor insertion to the dorsum of the fragment. The wire was passed through the distal phalanx to the palmar side. The fracture was reduced and the wire was tied on the palmar surface of the phalanx with an additional small incision in the pulp. When the bone defects were found at the fracture site, cancellous bone was grafted before reduction. The K-wire was removed about 5 weeks after surgery, and active motion of the DIP joint was started.

**Patients and methods:** Twenty patients underwent the tension band technique for treatment of chronic mallet fractures. There were ten men and ten women with an average age of 26 years (range, 11-56 y). The average time from injury to surgery was 56 days and the average follow-up period was 8 months.

**Results:** In all cases, bony union and joint congruity were obtained. The average extension lag at the DIP joint was 5 ° , and the average flexion was 62°. Two patients experienced mild pain on passive flexion and the other two had residual deformity, but numbness in the pulp, skin necrosis and remarkable nail deformity were not encountered. Osteoarthritic changes were seen in two cases.

**Conclusions:** The tension band technique is an effective method of treatment for chronic mallet fractures.



**P176**

**Regional Variations in pull-out strength of screws inserted into proximal phalanges – A cadaveric study**

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**Background:** It is unknown how strong fixation of hand fractures needs to be. General rules in trauma suggest 6 cortices are needed for adequate fixation either side of a fracture. The thickness of cortex in the proximal phalanges varies according to site. We studied the pull-out strength of 1.7 mm cortical screws in different regions of the proximal phalanges. Knowledge about these variations is helpful in selecting optimal methods of fracture fixation.

**Materials And Methods:** 20 cadaveric proximal phalanges were harvested. Dorso-lateral and ventro-medial drill holes using a 1.4 mm drill were made 3 mm from the articular margin proximally and distally and at the midpoint of the shaft. Self tapping 1.7 mm screws (Stryker Osteosynthesis) were inserted. The specimens were then mounted on a custom made jig consisting of a trap to hold the the bone and a bracket going around the head of the screw to pull it out. A universal testing machine (Instron) was used to measure the pull-out strength. The cross-head speed was set at 5mm/min.

**Results:** The average pull-out strength dorso-ventrally at the mid-diaphysis was 333 Newtons compared to 103 Newtons (31% of mid-diaphysis) at the proximal metaphysis and 172 Newtons (52% of mid-diaphysis) over the distal metaphysis. Medio-laterally the average pull-out strength was 236 Newtons at the mid-diaphysis compared to an average of 89 Newtons (38% of mid-diaphysis) at the proximal metaphysis and 155 Newtons distally (66% of mid-diaphysis). All fingers showed similar ratios.

**Conclusions:** Pull -out strength varies in a consistent ratio between the different regions of the proximal phalanx and according to direction of screw insertion. Most proximal phalangeal fractures are in the proximal metaphysis which has one third of the strength of the mid shaft. This may have an effect on the size and type of plate and number of screws in fracture fixation.



**P177**

### **Internal fixation of 5 th metacarpal fractures – A viable option**

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**Introduction:** 5 th metacarpal fractures have traditionally been treated conservatively. There are very few reports showing a favorable outcome following internal fixation of these fractures. We present our results of operative intervention in these injuries.

**Methods:** 53 consecutive patients with 5 th metacarpal fractures treated with internal fixation were evaluated retrospectively. Patient demographics and fracture characteristics were identified. Outcome measures observed were range of movement, complications including deformities and secondary procedures if required. The results were analyzed using simple statistical tools.

**Results:** Injuries of the 5 th metacarpal included intraarticular, metaphyseal and diaphyseal fractures. Anatomical reduction was achieved intra-operatively. Internal fixation devices used were K wires, plates and screws. Full range of movement was observed in 46 patients (87%). This was achieved at an average of 2.5 months (range 1-6 months). 7 patients were left with some degree of terminal stiffness at the metacarpo-phalangeal joint. Complications were seen in 4 patients. These included superficial skin infection (3 patients) and a keloid scar (1 patient). No one required a secondary procedure.

**Conclusion:** Results of internal fixation were found comparable to conservative treatment. There were few complications. We conclude that this is a viable option of treatment in these injuries.



**P178**

### **Treatment of metacarpal and phalangeal fractures with the low profile plate and screw system**

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**Introduction:** Recently, low profile plates were used for the treatment of finger fractures. During the time this system was used, we evaluated the clinical results of the treatment.

**Materials and Methods:** Forty fingers with 33 patients were treated with a low profile plate and screw system. The average age of the patient was 44, and the average follow-up period was 12 months. There were also 10 open fractures. The fractured region was located on the metacarpal in 24 fingers, the proximal and middle phalanx in 16. Bone substitutes were used in 6 fingers, and tendon suture was performed in 4. Basically, active motion began the day after the operation without splint fixation.

**Results:** Bony union was obtained in all of the fingers without any infection. The mean time to achieve bony union was 2.6 months. The breakage screw was observed in 3 fingers, and loosening screw was observed in 1 finger. The TAM of the finger was 230° on average. There was no significant difference between the TAM of the metacarpal bone fracture and that of the phalangeal bone fracture. There was no significant difference between the TAM of the fingers in closed fracture and in open fracture, and between those with plate fixation and with screw fixation. The 242° of the TAM of the fingers subjected to no bone substitution was significantly higher than 179° of the TAM of the fingers subjected to bone substitution.

**Conclusion s:** The low profile plate system is considered to be useful, as patients can use their fingers beginning the day after surgery. And this system also has good clinical results in the treatment of the finger fractures. However, because of the possible breakage of the screw, we have to be careful with post operative treatment especially passive ROM exercise.



**P179**

**A model for teaching the fixation of fractures**

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**Introduction:** We sought to develop a new model for the teaching of hand fracture fixation to trainees.

The fixation of fractures in the hand has traditionally been taught to orthopaedic and plastic surgery trainees in theatre on patients. A reduction in the number of hours worked per week by trainees and an overall shortening of the number of years spent in surgical training have led to a reduction in the experience gained by trainees in basic surgical techniques. A sound grasp of the techniques of hand fracture fixation prior to entry into theatre will help to maximize the training opportunities in theatre.

**Materials & Methods:** We present the use of "Bonio" dog biscuits as a good practical model on which to teach these principles. These biscuits are approximately the size and shape of adult metacarpal bones. They have the advantage of having two 'cortices' and realistically simulate the feel of drilling metacarpals in the clinical situation.

The biscuits can be broken in a variety of ways to mimic transverse, oblique and spiral fractures and can be held reduced with bone holding forceps. A wide variety of methods of fixation can be practiced: K-wire fixation, lag screws, plates, circlage and tension band wiring. The biscuits do not crumble if good surgical techniques are used and the accuracy of the reduction is easily assessed at the end of the session.

**Conclusion:** The model is extremely cheap and widely available. We therefore recommend its use as an introduction into the principles of fracture fixation, especially for those beginning their training.



**P180**

### **Early results of open reduction and lag screw fixation of proximal phalanx fractures**

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**Purpose:** For isolated spiral or long oblique fracture of the proximal phalanges of the fingers, open reduction and lag screw fixation is the treatment preferred by the senior author for the purposes of anatomical reduction and stability. The aim of the study was to assess the results of the surgical treatment of these fractures.

**Methods:** 10 long oblique and spiral fractures were treated using the lag screw technique with a mean follow up of 24 months. An independent observer assessed function, pain, movement, grip strength and intrinsic muscle function. X-rays were assessed for union and malunion.

**Results:** All fractures had an element of rotational deformity though clinically not demonstrated. There was soft tissue interposition at the bony spike in all of these fractures which had to be cleared before adequate reduction was achieved. One patient complained about pain and stiffness. No wound infection was reported. There was no evidence of malunion radiologically and none of the patients required removal of metalwork. The grip strength and intrinsic muscle function was well preserved.

**Conclusion :** Spiral or long oblique fracture of the proximal phalanx has a degree of soft tissue interposition which will obstruct adequate reduction in closed techniques and lead to malunion. The early results of surgical treatment of these fractures using lag screw technique are reassuring.



**P181**

## **Fractures & fracture dislocations of the ulnar carpo-metacarpal joints**

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**Introduction:** 4<sup>th</sup> & 5<sup>th</sup> metacarpal base fractures are debilitating. Conservative & surgical regimes have been suggested with little support in the literature. We report a prospective series of fractures of 4<sup>th</sup> & 5<sup>th</sup> metacarpal bases, with up to 1-year review. Methods: Over 12 months 54 fractures of 4<sup>th</sup> or 5<sup>th</sup> metacarpal base presented with or without associated carpus fractures. AP, lateral, oblique & 60° supinated x-rays were performed. Metacarpal base dislocations or intra-articular steps underwent reduction & instrumented fixation with short arm cast protection. Undisplaced fractures were managed conservatively in a moulded short arm cast for 4 weeks. Review was proposed at 1 & 4 weeks, 3, 6 and 12 months. Wires and casts were removed at 4 weeks.

**Results:** 39 of 54 notes and x-rays available.

- 82% were male; Mean age 31
- 82% right hand dominance; 15% non-dominant hand injury
- 82% punch injuries
- 20 5<sup>th</sup> base fractures, 2 with hamate injury.
- 4 4<sup>th</sup> base fractures, 1 with hamate injury
- 15 fractures of 4<sup>th</sup> & 5<sup>th</sup> bases ( ± carpus injury)
- 16 fractures managed conservatively; 1 displaced at 1 week requiring k-wires
- 23 required fixation; 21 k-wires (2 open). 2 by ORIF; None required revision surgery
- Mean follow up of 7.75 weeks (range 1 - 26 weeks)

19 had telephone follow up at 18 months: 58% had persistent pain, 32% persistent swelling & 63% reduced hand function. Average return to work was 11 weeks (range 1 to 64); 3 patients never returned to work.

**Conclusion:** 4<sup>th</sup> & 5<sup>th</sup> metacarpal base fractures may be more common than current literature suggests. Good imaging can aid diagnosis. Young males sustain most injuries, usually by punching. Follow up is difficult so long-term effects of injury are poorly recognised. Many patients report persistent pain and dysfunction.





**P182**

**Analysis of force in modified Hynes-Giddins dynamic external fixator**

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**Background:** Hynes & Giddins modified the rubber band traction device advocated by Suzuki for management of proximal phalangeal fractures. We present here a modified version of Hynes-Giddins dynamic external fixator (HG-DEF) which allows for adjustment of distracting force by a simple adjustment of the construct.

**Methods:** We used K-wires of 1.1 mm diameter to construct the modified Hynes-Giddins dynamic external fixator. Pin 1 (5 cm length) was positioned proximal to the simulated fracture site and its ends bent backwards. Ideally it should pass through the center of rotation of the phalangeal head. Pin 2 is a 15 cm length of K-wire passed distal to the simulated fracture so that equal lengths are available on either side of the digit. Pin 2 is bent to a right angle on either side of the digit, 1cm away from the surface (point A). It was bent again at point B (hence forming an angle B) to lie in a sagittal plane. Finally the free ends (points E1 & E2) were twisted back. The free ends E1 and E2 were mounted on a force measuring device and a known amount of force applied in axial direction.  $\Delta D$ , the displacement of the free end was noted for various amounts of the applied force (F) for 6 different constructs, each with a different angle B.

**Results:** We plotted  $\Delta D$  against force applied for various values of the angle B. We plotted a graph of  $\Delta D$  vs force applied (F) for all constructs which showed that the distracting force varies in direct proportion to the angle B as well as  $\Delta D$

**References:** Y Suzuki et al 1994, MC Hynes & GE Giddins 2001, EG Keramidas 2005



**P183**

**A study of long term disability following finger injuries, using the DASH assessment**

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The purpose of this study was to assess the pattern of finger injuries admitted to three departments of Hand Surgery over a two year period, and to compare injury types and surgical techniques used to achieve soft tissue cover with long-term disability using the DASH (Disability of the Arm Shoulder and Hand) assessment.

A retrospective review of finger injuries was performed. The medical notes of all adult patients admitted with such injuries over a two year period, to three departments of Hand Surgery in England, were reviewed. Patient demographics, injury types, surgical details and complications were recorded. Patients completed a DASH (Disability of the Arm, Shoulder and Hand) questionnaire to assess long-term disability, at least one year after injury. The results are demonstrated in clear, simple pie charts. Robust statistical analyses were performed to assess these results.

A review of the literature revealed no similar study of finger injuries to which the DASH assessment had been applied.

Statistical analyses confirmed a preponderance of males ( $p < 0.0001$ ) and a prevalence of injuries to the left hand ( $p = 0.01$ ). The thumb was injured with the least frequency ( $p < 0.0001$ ) and the index finger was the most commonly injured digit ( $p < 0.0001$ ). As displayed in coloured dot plot graphs, the DASH assessments revealed poorer long-term function in those patients who underwent more proximal shortenings, in those who injured more than one digit and in those who suffered post-operative complications.



**P184**

**Suitability of tri-cortical graft from proximal ulna for treatment of segmental defects of proximal phalanges. An anatomical and bio-mechanical study**

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**Background:** Segmental or multi-fragmentary phalangeal fractures causing bone loss are rare but difficult injuries to treat. We have evaluated a tricortical graft from the proximal ulna for both suitability of use and donor site morbidity.

**Methods:** The proximal part of the subcutaneous border of ulna was exposed in five cadavers and a 1 cm graft chamfered at either ends was harvested. Thus a crater measuring 2 cm was created in the proximal ulna. The proximal phalanx of one finger (different for each cadaver) was exposed by a dorsal tendon splitting approach. A segment of the midshaft of the proximal phalanx measuring 1 cm was removed and the graft taken from proximal ulna was interposed and checked for size and fit. The ulna was then disarticulated at the elbow and osteotomised proximal to the wrist. Opposite intact ulna was also harvested in the same manner. The ulna were mounted on a materials testing machine (Instron) and subjected to 4 point loading to failure.

**Results:** The shape of the tri-cortical graft was suitable to bridge the segmental defects in all the phalanges except the thumb phalanx where it left a step in the dorso-ventral plane. In all other phalanges the cortex allowed the flexor and extensor tendons to glide smoothly. The mean load to failure of the intact ulna was 1138.35 Newtons (range 1025.7 to 1251, SD=112.65) and the donor ulna failed at an average of 519 Newtons (range 408.25 to 629.75, SD=110.75). Thus the donor ulna had 46% strength compared to the intact ulna.

**Conclusion:** Ulnar tricortical graft provides a good match for segmental defects of proximal phalanges of fingers. The donor bone retains almost half the original strength. This contrasts with studies on the radius for mandibular reconstruction where 82% of the strength was lost resulting in frequent fracture. However, care may need to be taken to protect the donor site.



**P185**

### **The use of plaster cylindrical casting for contracture of the PIP joints**

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**Introduction:** Plaster cylindrical serial casting of interphalangeal joints presented by Paul Brand is not one of progressive stretching but of growth of cells of the contracted tissue. The aim of this study is to evaluate the affect of this method on PIP joints.

**Materials & Methods:** In this survey 28 patients with flexion contracture in PIP joint who were refered to Iran hand rehabilitation center were treated by cylindrical casting. In the beginning of treatment samples were evaluated by T.A.M, flexion contracture, flexion gap. In one month every other day, joints were recasted, and between casting wax bath, oil massage and exercise were used for the patients.

**Findings:** In re evaluating mean of T.A.M was superior than first evaluation (from 88.51 to 130.18) mean of flexion contracture was decreased (from 37.59 to 8.14), mean of flexion gap was decreased too (from 4.37 to 2.37).

**Conclusion:** Findings show that this method is a usefull method for treating flexion contractures of PIP joints without limiting in range of motion.



**P186**

**PIP joint contractures - Hand therapy for successful results**

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**Keywords:** stabilizing, anatomy, planes of movement, intrinsic muscles, hinge, skin tightness, oedema, late presentation, static and dynamic splints.

The anatomical cradle incorporating the volar plate of the pip joint is discussed.

The literature is in agreement that effort in extension mobilization may be quite disappointing when marked contracture is present.

In my protocol different modalities are used with the main aims to reduce pain and oedema, achieve 0° of extension, and functional range of motion.

Modalities used include splinting, pop casting, and dynamic splints are discussed.

Pip joint contractures are difficult to treat and impact negatively on function in ADL.

Once the contracture has resolved it is important to maintain results.

Education is vital, and patients need to be reminded that rehabilitation involves a protracted process. Support needs to be provided, and strict adherence to my protocol has proved very positive results.



**P187**

### **Sport climb and hand therapy**

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Different kinds of grip used in sports climb are able to favour the appearance of different minor pathologies such as: soft tissue injuries, tendon injuries (at flexor muscles level overall), tenosynovitis, carpal tunnel syndrome, contracture.

Other issues, as for example, rupture of pullies, ligament injuries, articular luxation or tendons rupture are generally caused by orthopaedics reasons.

We have carried out a routine survey to a group of 97 climbers from different ages, and sports experience in order to establish what kind of pathologies are most frequent and set out in this way the possibility of establishing a protocol of proceedings.

This form has been carried out by Climbers Asociation from Málaga and in El Torcal (Antequera), El Chorro and La Cala del Moral.

We have taken into account the time (based on weekly hours) they dedicate to climb and the experience of sportsmen/women (number of years that climbers have been practising).

Referred pathologies have been divided into six groups: soft tissue injuries, flexor tendon injuries, rupture of A2 pully, joints and ligaments injuries and nervous compression syndrome.

Those cases in which we could detect after-effect, (57% presented deformity at some of the IFP level), they were explored individually to determine the typology, and to value the current conditions.

In this study are relevant the great percentage of injuries by overload which climbers suffer, permanent after-effect and the non-existence of a detection and an early treatment of such injuries.



**P188**

**Trapezium excision and suture suspensionplasty for the treatment of basilar thumb arthritis**

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**Introduction:** We sought to retrospectively analyze the effectiveness of a new procedure for basilar thumb arthritis that was designed to be simple, low cost, and with minimal patient morbidity.

**Methods:** The "suture suspensionplasty" consisted of trapezium excision, stabilizing the 1<sup>st</sup> and 2<sup>nd</sup> metacarpal bases with a suture anchor, and packing the trapezial space with gelfoam. The follow-up analysis consisted of a DASH survey, a modified outcomes measure, and radiographic evaluation in a 42-patient cohort. Clinical data such as strength, radiographic subsidence, and pain scores were also collected. As well, we analyzed the biomechanical strength of suture suspensionplasty in preventing metacarpal subsidence when compared to no fixation, k-wire fixation, and ligament reconstruction with tendon interposition in a cadaver model.

**Results:** Approximately 90% of patients were satisfied with their results, while 10% were neutral or dissatisfied. Radiographic shortening of the metacarpal-scapoid space occurred at an average of 50% at the immediate (<2 months) post-operative period. The results appeared independent of age, sex or other diagnoses. The biomechanical study showed that cadaveric pinch strength and scaphoid-metacarpal distance was closest to the normal control in suture suspensionplasty.

**Conclusions/Discussion:** While similar to other procedures in its effectiveness, this procedure is extremely simple and cost effective. The results in our cohort of patients show similar satisfactions rates to other more complex procedures. A direct comparison study may be necessary to compare this procedure to simple trapeziectomy and the more elaborate ligament reconstruction, tendon interposition procedures.



**P189**

**Suspensionplasty with APL does not prevent MC 1 subsidence a retrospective cohort study on clinical and radiological results of the suspensionplasty in CMC 1 osteoarthritis**

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**Introduction:** For the treatment of CMC 1 osteoarthritis several surgical procedures are available with varying results mentioned in literature. Few studies involving only suspensionplasty (SP) have been published. In our clinic we used to perform SP because we felt that SP might positively influence clinical results by minimizing subsidence.

**Goal:** Correlation of clinical and radiological results after SP.

**Methods:** 49 suspensionplasties (trapezectomy followed by suspension of the base of MC1 to the base of MC2 with the abductor pollicis longus 1) were performed between 1999 and 2001 in our hospital. Function, pain, satisfaction, grip strength and radiological subsidence determined by scaphoid-metacarpal distance (SMD) and trapezoid-metacarpal distance (TMD) were scored in 40 thumbs of 30 patients.

**Results:** 4 men and 26 women (mean age 62 years) were seen at a mean follow-up of 37 months. VAS score was 1,1 for pain and 7,7 for satisfaction. Results for function and grip strength were equivalent to those mentioned in literature for trapezectomy or LRTI 2. The mean radiological subsidence (pre-operative minus post-operative SMD) was 6,4 mm (range 3-11). The percentage subsidence (subsidence divided by pre-operative SMD) was 46%. The decrease in TMD was 7,0 mm. No correlation was found between subsidence and clinical parameters. 6 patients were treated pharmacologically for intermittent CRPS, in 2 a neuroma was excised and 2 patients suffered from scar problems.

**Conclusion:** Our results with SP are similar to those of LRTI and simple trapezectomy in literature. Subsidence could not be prevented. Although our results are good, we advise to perform a simple trapezectomy instead of a suspensionplasty 3.

**References:** 1. Thompson JS. 1989, 2 Wajon A et al. 2006, 3 Belcher HJCR et al. 2000





**P190**

**Prevalence of osteoarthritis of the scapho trapezio trapezoid joint**

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**Aim of the study:** To assess the prevalence of STT joint osteoarthritis in adults more than 40 years.

**Material & Methods:** Seven hundred and eighty radiographs of the wrist and hand (including the Scapho-trapezio-trapezoid joint) of patients who came in to the Accident & Emergency department during a 6 month period, were reviewed for the evidence of STT osteoarthritis. A simple grading system was used for classifying the severity of the condition.

Grade 0 – No arthrosis

Grade 1 – Early arthrosis (Sclerosis / decreased joint space)

Grade 2 – Severe arthrosis (complete destruction of the joint)

This grading system had a good inter-observer (Kappa value 0.62) and intra-observer (Kappa value 0.74) reliability.

The data was analysed for age and sex variance using suitable statistical analysis.

**Results:** The prevalence of STT osteoarthritis increases significantly with age – 91% of patients over 80 years had arthritic changes. These changes were significantly more in females as compared to males – 92% females over 80 years had OA changes as compared to 85% males. Women had higher odds (Odds ratio 3.45, 95% confidence interval  $\hat{a}$  2.12 – 5.67) at developing grade 2 OA as compared to men. The prevalence of grade 2 OA was higher in females through all age groups; 44.4% females over the age of 80 years had grade 2 changes as compared to 23.8% males.



**P191**

**The gap after trapeziectomy: A prospective study**

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The aim of this study was to investigate the timing of the inevitable collapse of the trapezial space after trapeziectomy alone, radiologically. Thirteen patients with basal joint arthritis of the thumb were treated by simple trapeziectomy. All patients underwent radiological assessment pre-operatively and at 2, 4 and 12 weeks after surgery. Special standardised views were taken to assess changes in the 'trapezial gap'. The progression of trapezial space collapse was remarkably consistent in all of our patients. Collapse of this was noticed up to 4 weeks following surgery but no significant change occurred thereafter. In respect of this collapse, prolonging immobilisation after 4 weeks is probably unnecessary. The timing of reduction in the trapezial gap shown in this study would suggest that any manoeuvre intended to reduce the gap, e.g. K-wiring across the gap or prolonged splinting would only have effect during the first two weeks and should not be prolonged beyond this period, particularly as prolonging immobilisation may reduce the eventual mobility of the thumb base.

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**P192**

**Weight bearing views of the trapezio metacarpal joint-A new diagnostic test**

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**Introduction:** Trapeziometacarpal arthritis of the thumb is a common problem. Routine radiographs in the early stages are usually normal. There is no definitive radiological view for early diagnosis. We describe a new weight bearing view for early diagnosis of this common problem. It is similar to weight bearing views in other joints.

**Methods:** Weight bearing x-rays of the trapezio metacarpal joints are done with a pinch grip of the thumb and the index finger and x-rays are taken in the AP and lateral views with the patient asked to pinch as hard as possible.

The joint space is narrowed in the weight bearing views and these correlate with the level of symptoms. These weight-bearing views are similar to the weight bearing views of other joints.

**Conclusion:** The weight bearing x-rays of the trapezio metacarpal joint give us a good idea of the diagnosis in early stages of arthritis. In more advanced stages it may give us an idea of the severity of the arthritis. These are better than the previous views described in the literature as they give a better idea of the state of the joint and the correlate better with the clinical severity of the disease.



**P193**

### **Early results of our experience with the Elektra Trapezio Metacarpal Joint Replacement**

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**Introduction:** Trapezio metacarpal osteoarthritis is a common problem and over the years trapeziectomy has been the standard treatment of choice. Various types of joint replacements have been tried but they have not had good results. We present a series of 72 patients who have had Elektra Trapezio Metacarpal (TMC) Joint Replacement in the last 4 years.

**Methods:** We have followed up 72 patients who had Elektra TMC joint replacement. The average follow up is 28 months. We have had 94% good results as measured clinically by pain relief, good range of movements, good grip strength and no radiological evidence of loosening.

**Conclusion:** Elektra Trapezio Metacarpal Joint Replacement is better than trapeziectomy because it preserves first column length, provides better opposition of the thumb, produces better thumb digit pinch, offers better range of motion and improves stability. The recovery period is less than trapeziectomy. There is also a satisfactory salvage option in the form of trapeziectomy if the joint fails. From our early results we feel this is a better surgical option of treating trapezio metacarpal joint arthritis than other forms of arthroplasty.



**P194**

**Volar oblique ligament fibroblasts express estrogen, LGR7 receptors**

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**Introduction:** Deterioration of the volar oblique ligament (VOL) precedes the development of basal joint osteoarthritis (BJA) (Pelligrini et al., 1992). BJA predominates in females (Newport, 2000), suggesting a hormonal etiology. While VOL tissue is positive for estrogen and relaxin receptors (Krushinski et al., 2002; Lubahn et al., 2006), little is known about receptor expression in isolated VOL fibroblasts. Therefore, we probed cells obtained from explants to determine whether LGR7, the putative relaxin receptor, and estrogen receptor beta are expressed.

**Methods:** Following patient consent, VOL tissue was obtained as surgical waste from reconstructive surgery, minced, and cultured in serum-supplemented medium. After *seven* days of incubation, adherent cells were transferred to culture flasks, propagated until confluent, and passaged. Cells from P3 through P7 were used for staining. Presumptive fibroblasts were placed on coverslips, fixed, permeabilized, and blocked with 1% *bovine* serum albumin/PBS. Cells were then probed with primary antibodies directed against vimentin, actin, estrogen receptor beta, or LGR7. Fluorescent-labeled secondary antibodies were used to detect primary antibody binding. Photomicrographs were then obtained. Negative controls included either omitting only the primary antibodies or omitting both primary and secondary antibodies.

**Results:** Cells evidenced abundant staining for vimentin and actin, cytoskeletal elements consistent with fibroblast morphology. Additionally, cells stained positively for both LGR7 and estrogen receptor beta. In all cases, control slides exhibited only minimal levels of background fluorescence.

**Conclusions:** The data show that cultured, VOL fibroblasts express sex hormone receptors. Given that ECM may have confounded the staining results of prior histology studies, the present data provides evidence that ligament fibroblasts are competent to respond to relaxin and estradiol. This competence may reflect normal cell biology. It could also contribute to pathologic states. Additional research is warranted to assess these implications.



**P195**

**Arthroplasty of the CMC joint of the thumb in degenerative osteoarthritis: Experience with ARPE prosthesis**

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A variety of treatment options are available for patients with symptomatic carpo-metacarpal osteo-arthritis of the thumb. For osteo-arthritis at other sites, joint replacement is usually the treatment of choice.

Over a period of more than five years (63 months) a total of 48 joint replacements were performed in our department using the ARPE TM prosthesis (Biomet Europe).

The main indication was pain and limitation of function not responding to conservative measures such as injection and splintage. 7 patients underwent bilateral replacement (staged).

45 were female and 3 were males with a mean age of 61 years (age range 42-84 years). 7 patients had Eaton stage II and 41 stage III osteo-arthritis.

Of these patients 41 were completely satisfied and said that they would undergo the procedure again. A total of 11 complications were recorded consisting of 1 superficial infection and 1 dislocation requiring open reduction. 7 patients required subsequent removal of the prosthesis because of cup loosening requiring revision to partial trapezectomy and interposition graft (palmaris longus), at follow up all of these patients had a satisfactory outcome. Two patients have continued to experience some pain although the implant appears satisfactory.

The range of movement and pinch grip in our group are comparable to other published studies using other methods (trapezectomy).

Our early experience with replacement of the thumb carpo-metacarpal joint demonstrates that it is comparable to the other surgical methods available. The key to operation is the bone stock available in the trapezium, and we recommend minimal resection of the trapezium. Where bone stock is poor we recommend reversion to a partial trapezectomy and interposition graft intra-operatively.



**P196**

**Weilby's tendon interposition arthroplasty for osteoarthritis of trapeziometacarpal joint**

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Clinical osteoarthritis is very common in the trapeziometacarpal joint. Weilby's arthroplasty for osteoarthritis of the trapeziometacarpal joint with excision of the trapezium and ligament reconstruction was performed in ten cases. There were six male and four female patients; their average age was sixty nine years old. Ten procedures were undertaken with an average follow-up time of twenty four months. After the excision of the trapezium, the flexor carpi radialis tendon (FCR) was split into two. The distally based FCR slip passed in a figure-of-eight fashion around the abductor pollicis longus (APL) and remaining FCR. Recently, in six cases with a micro quick anchor, the FCR slip was attached to the dorsal base of the first metacarpal to prevent it from displacing dorsally. The end of the FCR slip was secured to the volar base of the first metacarpal with a suture. In five cases, with the scaphoid-trapezium joint intact, the distal region of the trapezium was excised to keep the scaphoid-trapezium joint. During postoperative management a cast was used for four weeks, then gentle range of motion activities were begun. Range of motion, pinch strength, grip strength, and gap after trapeziectomy were examined. Postoperative radial and palmar abduction were performed using fluoroscopy. The angle between the first metacarpal and second metacarpal was measured. During postoperative consultation nine patients reported complete relief of pain. One patient had mild, residual pain. Tip pinch strength was improved from 2.3kg to 4.5kg and grip strength from 14 kg to 20kg. The gap was 4mm. Examination of postoperative range of motion of the trapeziometacarpal joint showed good recovery. Postoperative palmar abduction was 47° and radial abduction was 35° in measurement of radiograph. Overall patient satisfaction was excellent.



**P198**

### **Rehabilitation post thumb basal joint trapezectomy and suspensionplasty**

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For patients suffering for thumb basal joint arthrosis non responding to conservative treatment in Eaton fourth stage trapezectomy is necessary.

After trapezectomy during the years biological methods to substitute the trapezium and to suspend the system are grown up. Now this kind of surgical treatment is very reliable but accurate rehabilitation is very important.

For two weeks after surgery thumb is immobilized with short splint with motion of IP.

After we start with oedema treatment ,ROM long fingers, initial motion of the thumb.

From four weeks to twelve weeks we improve muscle power and power grip: we start treatment of the scar and we work for abduction, extension and opposition of the thumb.

In this period patients worn splint only during night time.

We think that it's important:

- 1) Before 8<sup>^</sup> week avoid adduction of the thumb and use of strong pinch grip;
- 2) Avoid MP and IP iperextension;
- 3) Avoid heavy power on the palm:

We obtain normal ROM about at six months.





**P199**

**Anatomical study investigating thumb interphalangeal joint pronation**

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**Introduction:** Kapandji (1976) demonstrated 5-10° of pronation at the cadaveric thumb interphalangeal joints (IPJ). Thumb IPJ pronation is important in pinch grip, where greater pulp to pulp contact increases overall pinch force and may have functional and surgical implications on thumb movement, biomechanics and grip.

**Methods:** An observational study of 88 asymptomatic volunteers (176 thumbs, mean age 40 years range 21-90) with no history of thumb pathology or surgery was undertaken. Both thumbs were photographed twice using a standardised reproducible protocol with the IPJ at 40° in a splint. All photographs were analysed by three investigators and mean IPJ pronation measured.

**Results:** The male:female ratio was 1:1 and the right to left hand dominance ratio 10:1. IPJ tilt was greater for the left thumb (mean 5° ± 3°) compared to the right (mean 4° ± 2°) (p=0.0001). There was no correlation between IPJ tilt and age (p=0.4). There was no statistical difference between dominant thumb IPJ tilt with regard to gender (p=0.5) or dominance (p=0.2). Occupations were grouped into administrative, fine-dextrous and manual. Significantly less IPJ tilt was found with dominant thumbs of the 'fine-dextrous job' group as compared with administrative or manual jobs (p=0.009).

**Conclusion:** Left thumb IPJ tilt is greater than the right. Fine-dextrous occupations have significantly less IPJ pronation which may be due to the fact that it is mainly used in flexion and stability is achieved from the 1st dorsal interosseous and adductor pollicis muscles. In manual workers and non-dominant thumbs, the IPJ is generally used in extension, and thus increases pronation by gaining more stability from abductor pollicis brevis and longus, flexor pollicis brevis and opponens pollicis. When clinically applied this may improve function and success in fusion of this joint and implies that the thumb IPJ is not a true hinge joint.



**P200**

### **The metacarpo-phalangeal daphne prosthesis**

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The Daphne prosthesis is a monoblock articulated metacarpo-phalangeal prosthesis, made of PMMA, material of proven biocompatibility, elasticity and strength.

The monoblock structure guarantees from possible dislocation of the stems, while the structure of the stems themselves preserves from rotations and ensures an optimal fixation. Articularity is achieved thanks to an elastic rotational joint, within which a Nitinol spring allows to exceed 50 million cycles of flex-extyension ( $0^\circ - 90^\circ$ ) and 15 million cycles in lateral deviation ( $+30/-30^\circ$ ) according to the performed testing plan. The elasticity of the flexible rotational joint favours the extension of the fingers.

Four sizes are available with versatile instruments.

The preliminary presentation consists of 15 treated patients with an arthritic and post-traumatic pathology with a 6-month follow-up in which the results show a correction in those cases of ulnar deviation, where was before present, and an average recovery of  $40^\circ$  in flex-extension with none complication.



**P202**

**DGT prosthesis to treat painful osteoarthritis or posttraumatic changes of the PIP joint**

**Pierre-Jean Regnard**

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The author presents his experience of use of DGT prosthesis to treat osteoarthritis or posttraumatic changes of the PIP joint of the finger.

This prosthesis made by SBI is a metal-metal, cementless but able to be cemented if needed, semi-constrained prosthesis.

The needed resection is only 6 mm of the head of the first phalanx. 2 components for this prosthesis: proximal part the head is fixed to the stem and the head had a guide to the distal part totally deepened in the second phalanx.

Dorsal approach was used, but the extensor system was opened as Flatt's technique between the medial band and the ulnar lateral band.

The results of our series of 51 cases are presented after study of evolution of pain, mobility and in some cases strength (Grasp and pinch).

About pain the results are good for all the patients but 3 who suffer occasionally (2) and always (1). The mobility is often good with 10° of lack of extension, but with possible flexion to 80°. About strength the results were good but we think this criterion need explanation because it's probably not significant for ulnar digits.

Some complications were noticed during this study: lack of extension but this was very moderate, deepening of the proximal part was frequent at the beginning of use of this prosthesis, but this complication is now seen in very few number of cases after revision of the rasps and the implants.

Use of this implant for the Rheumatoïd polyarthritis was tried, but the plasticity of the bone in this disease is so important that the results were fund non satisfactory and finally the results were good to treat osteoarthritis and traumatic changes of the PIP joint



**P203**

**Preliminary results of the hemi-CMC pyrocarbon saddle joint replacement: A multi-center trial**

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**Introduction:** The authors present their results of a multicenter cohort study on the treatment of CMC I-osteoarthritis by a PyroCarbon hemi-prosthesis. This study started in July 2003.

**Objective:** The purpose of this prosthesis is to create an anatomical joint without destabilisation and normalising the hand function.

**Methods:** This prospective study included 22 patients (20 women and 2 men, mean age: 55 years). Evaluation was performed preoperatively and postoperatively at 3, 6, 12 and 24 month. The evaluation included pain score (visual analogue scale); DASH-score, satisfaction (assessed with a questionnaire); grip strength and ROM. Radiographic analysis was performed at the same times.

**Results:** In all cases there was a decrease in pain in rest and during activity (At 1 year follow-up at rest pre-op 6 to post-op 0.5 and in activity pre-op 9.1 to post-op 1.4). In all patients there was an increase in DASH-score. The overall strength measurement showed a slight improvement. In 30% of the cases there were radiolucent lines around the prosthesis. There was no revision-surgery and the only complication was a scar-neuroma. There were no dislocations. The over-all improvement started in most of the cases after 6 month. After 1 year follow-up 90% of the patients had a satisfaction of more than 80%.

**Conclusions:** Improvement of the function of the thumb and satisfaction of the patients starts only after 6 month. Although the radiological appearances show some radiolucent lines, there was no need for revision-surgery. These results are promising, but a longer follow-up will generate a more definitive conclusion.



**P204**

**A new choice to the distal interphalangeal joint arthrodesis - Lateral approach and plate fixation**

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Several fixation techniques for arthrodesis of the distal interphalangeal joint have been described, with good clinical results but complications rate between 10-20%. We propose an alternative fixation approach. From March 2003 to September 2005, 11 patients, total 15 fingers, underwent distal interphalangeal joint arthrodesis using a lateral approach with a 1.3 mm plate and screw fixation. The indications were post-traumatic arthritis in 8 fingers, degenerative arthritis or rheumatoid arthritis in 5 fingers and isolated flexor profundus tendon lesion in 2 fingers. Arthrodesis relieved pain and restored stability with osseous union in all patients, with 12 weeks average interval to fusion. All patients demonstrated total active PIP joint mobility with pulp-palm distance of zero in the same finger at 6 months follow up. There wasn't rotational or angular malalignment, nail bed lesions or skin complications. The lateral approach with plate and screw fixation can be an option for the DIP joint arthrodesis, avoiding the dorsal approach related complications.



**P205**

**Outcome of mucous cysts in the hand**

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**Purpose :** The success of treatment for mucous cysts of the distal interphalangeal joints the fingers has been widely variable. The aim of this study was to evaluate the results of surgical treatment of these cysts in our hand unit.

**Methods:** Eighty one cysts were treated, with a mean follow up of 18 months(6-24 months). Thirty-one patients (25%) had nail ridging or deformity at presentation. All patients had surgical excision and joint debridement through a dorsal Approach.

**Results:** All patients who underwent surgery had evidence of osteoarthritis at surgery with osteophytosis. Nail ridging resolved after surgery in 55 (67%) digits; the remaining digits had partial improvement or persistent ridging. Five (6%) infections occurred and were treated successfully with antibiotics (4 cases) or debridement (1 Case).6 patients had increased stiffness of the joint and occasional pain or swelling noted in 8 (9.8%) cases.

**Conclusions:** Contrary to published literature the recurrence rate following excision and joint debridement is very low. Although some patients have decreased range of motion, pain is usually relieved. Some residual symptoms might be due to pre existing osteoarthritis.



**P205a**

**A novel artificial prosthetic replacement for the proximal interphalangeal joint of the hand**

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Based on the principles of anatomic surface components, macrolocking intramedullary stem, and cobalt-chrome alloy material, a design for an artificial prosthetic replacement of the PIP joint was conceived. With a team of surgeons and engineers, further modification of the surface component to provide some initial stability, enlargement of the backside of the articular surface to strengthen the surface-stem region, and detail dimensions of the stem were worked out. A prototype was eventually produced and a US patent was approved. Further biomechanical testing, wear and tear testing, and animal experiments were being carried out at this moment. Once completed, clinical trial can be started.



**P206**

**Universal total wrist replacement. Is it the answer to difficult wrist problems-Our early results**

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**Introduction:** Total wrist replacement has never been a popular procedure among wrist surgeons mainly because of the good results of wrist fusion and the unavailability of a good prosthesis. We describe our early results of Total wrist Replacements with the Universal 2 Total Wrist Replacement and wonder whether it is the answer to difficult wrist problems.

**Methods:** We describe the results of our first four Total wrist replacements with a follow up of one year. The indications were as varied as post traumatic osteo arthritis, SLE, Rheumatoid Arthritis and non union of distal radius fracture. All of them had prior surgical procedures ranging from proximal row carpectomy, Ulnar head replacements and in the case of non union of the distal radius fractures three attempts at fixation.

**Results:** At the end of year 1 all four of them had good relief of symptoms in the form of pain relief. There was improvement in the range of movements and improvement of DASH scores and no radiological evidence of loosening. The problems encountered were considerable post operative swelling and pain and one case of dorsal subluxation which was corrected with serial casting.

**Conclusion:** Although our numbers are small all four of these patients had difficult problems in which previous surgery had not had a good result and all four of them were against a wrist fusion. So on the evidence of our early results we conclude that a total wrist replacement is another option in the treatment of difficult wrist problems and a viable alternative to wrist fusion if patients are not in favour of it.





**P207**

### **Tenosynovitis and rupture of the flexor tendons in the rheumatoid arthritis**

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The rheumatoid patient with chronic involvement of the flexor tendons usually gives a history of the fingers triggering, and then the tendons no longer slide through the narrow tunnel and tend to bind because of the synovial thickening about the tendons. Prolonged involvement of the digital sheaths with invasion of the tendons gradually tends to the tendon rupture within the sheath between the PIP joint and the palm.

In this study, the authors'll tell how to reconstruct 34 cases, 38 fingers including one FDS with the flexor tendon rupture in rheumatoid hand. 34 cases were 26 females and 8 males, the age distribution was from 38 to 62. Rupture of the FPL was in 11 digits, FDP in 26 and FDS in one. The index finger was in five digits, middle in three, ring in nine, little in 10. The authors analyzed 23 digits in which the period from tenosynovitis to rupture of

the tendons could be clearly recognized, it distributed from two weeks to three and a half months. According to this data, the authors knew that conservative observation for tenosynovitis in rheumatoid hand should be limited within one and two months. All of cases except for a case of the FDS rupture were reconstructed by free tendon graft using the palmaris longus tendon.

The post operative results were good and satisfied. The authors are sure that free tendon graft has some advantages. They are 1) retaining excursion of the original FDP tendons, 2) minimum damages to the pulley and the gliding floor, 3) easy decision of the correct tension, etc.

The authors concluded the followings: 1) It's the most important to prevent tendon rupture in rheumatoid arthritis. 2) Rheumatoid tenosynovitis prolonging for more than 2 months should be progressively removed. 3) For reconstructions, free tendon graft is recommended.



**P208**

### **Our experiences with NEUFLEX metacarpophalangeal arthroplasty**

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**Purpose:** The effects of destructive rheumatoid arthritis (RA) on the joints of the hand can often be seen. There are several surgical treatments for this destructive arthritis of the metacarpophalangeal joint,

One of these is prosthesis. Since 2002 we have been using a silicon prosthesis called NEUFLEX which we have been implanting into the metacarpophalangeal and proximal interphalangeal joint.

**Materials and Methods :** All the arthroplasties which have been done between 2002 and 2006 in our institution, have been done using NEUFLEX prosthesis. We evaluated 110 MP and 4 PIP joint replacements done in 28 patients. 109 cases were primary, 5 cases were revision arthroplasty. The mean patient age at the time of the procedure was 55,9 (31-78) year old; mean postoperative follow-up was 24,2 (2-44) months. Preoperative diagnoses included rheumatoid and other inflammatory arthritises.

**Results:** The results were well and excellent. The patients reported some pain relief, better hand functionality and in addition, it had a positive cosmetic effect.

**Discussion:** On the base of our experience, we recommend the silicon prosthesis as the surgical treatment of choice for the arthrosis of the MP and PIP joint.



**P209**

**The Mathys finger joint replacement – Unacceptable early failure rate**

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The Mathys finger joint replacement system offers a novel fixation system into the medullary canal and a semi-constrained `sloppy hinge` articulation. The theoretical advantages are of radio-ulnar stability preventing ulnar drift in patients with rheumatoid disease and solid bony ingrowth into the implants offering implant longevity.

A series of patients underwent implantation under the care of one surgeon and the results were monitored.

22 devices were implanted, two being thumb CMCJ replacements, the rest finger joints. 18 implants were inserted for Rheumatoid disease. Follow up was for a minimum of three years.

Patients were reviewed regularly and implant performance assessed critically along with survival of the implants to revision, infection or death.

Unacceptable failure rates at the early and medium term stages were identified with >75% of the implants revised by two years. Loosening was the commonest mode of failure.

The authors do not recommend the use of this implant, especially in cases of Rheumatoid arthritis.



**P210**

**The added value of a nurse practitioner in a multidisciplinary setting for patients with hand problems due to rheumatoid arthritis**

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**Introduction:** A multidisciplinary team advising and treating patients with hand problems due to rheumatoid arthritis (RA) aimed at improving the patient's satisfaction and quality of life (QoL), enlarging the team's capacity to see patients at the clinic and working more efficiently.

**Objective:** To reveal whether the contribution of a nurse practitioner (NP) improves the patient's satisfaction and QoL, enlarges the number of patients seen by the team, and improves the efficiency of a multidisciplinary team for RA patients with hand problems.

**Methods:** During 8 months patients visiting the team were included in the *control group*. During the next 10 months patients were included in the *experimental group*. In the latter situation, a NP supported the team. Patient satisfaction, QoL, the number of patients seen by the team and economical aspects were measured by using questionnaires directly after consultation of the team and three and six months later.

**Results:** Patient satisfaction in the experimental group (n=78) was greater compared to the control group (n=69) directly after consultation of the team. During the first three months after consultation of the team the QoL improved in both study groups. The team was able to see 13% more patients in the experimental situation. Taking over tasks by the NP from medical professionals saved € 3.388. Costs related to official home care or informal care did not differ between experimental and control groups (after correction for differences in costs at study onset).

**Conclusion:** An NP has an added value to a multidisciplinary team treating rheumatoid hand problems, since the number of patients seen at the clinic and patient satisfaction improved. Improvements in QoL did not differ between both groups. The team with an NP works more efficiently, although the savings were modest.

**References:** Hill, J 2003, Hill, J 2004, Litaker, D 2003, Mundinger, MO 2000.



**P211**

**Pre-implantation tests and clinical follow-up of a new finger joint implant**

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**Introduction:** Artificial implants must be thoroughly evaluated before they are used in patients. When performing such tests it is important to mimic the environmental conditions in which the device should be implanted. This has been done for a constrained artificial finger joint, designed with two parallel metallic springs as the active element. The joint can be used in a primary procedure in patients with rheumatoid disease and osteoarthritis but also in replacement procedures. The purpose of this study was to verify the results from the in-vitro tests with clinical results.

**Methods:** Endurance tests were performed in test equipment that bends the joint in preset angles (65 degrees) and at preset frequency (2 Hz). The equipment was designed at our laboratories and tests were performed in air and in various solutions. The wear of the joints was measured. Sixteen joints have been implanted into patients after the promising pre-tests. The patients have been evaluated clinically and radiological at 3 months interval.

**Results:** The endurance was measured for 25 millions cycles without any breakage of the joint. Any effect of the wear on the artificial finger joint emerged in various solutions, was not detectable. Patients have been pain free and with good ability to move the fingers. A nine month clinical follow up will be presented at the conference.

**Conclusions:** 1) The endurance was not affected by the solutions. 2) Mechanical wear was not detected. 3) Patients are pain free and have a good range of motion in their fingers.

**References:** Joyce, TJ, Unsworth, A, 2002, A test procedure for artificial finger joints, Proc Instn Mech Engrs, (216) J Engineering in Medicine, 105-110.

Sollerman, C, 2006, How I do it – MP joint arthroplasty, International Congress series 1295, 144 -153. Elsevier, Surgery of the Rheumatoid Hand and Wrist



**P212**

**The diagnosis of distal radioulnar joint subluxation of the rheumatoid wrist using computerized tomography**

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**Purpose:** Subluxation of the distal end of the ulna has been associated with extensor tendon rupture in rheumatoid wrists. Due to sigmoid notch scalloping and a volar shelf in the rheumatoid wrist, the usual criteria used for diagnosing subluxation of the DRUJ by CT are difficult to apply. Using computerized tomography (CT) images, we newly defined the subluxation ratio of rheumatoid wrists and analyzed the correlation between the subluxation ratio and extensor tendon rupture.

**Methods:** 35 wrists of 35 rheumatoid patients undergoing DRUJ surgery and 10 wrists of 10 healthy volunteer were scanned using a multidetector-row CT scanner. The rheumatoid patients were divided into a tendon rupture group (14 hands) and a non tendon rupture group (21 hands). We quantitatively defined the subluxation ratio as the degree of dorsal subluxation of the ulna for the four compartments of the dorsal wrist in maximum pronation. To assess the utility of this method for assessing subluxation of the DRUJ in rheumatoid wrists, the relationship between extensor tendon rupture and the subluxation ratio was analyzed.

**Results:** The subluxation ratio was  $0.440 \pm 0.181$  in the rupture group,  $0.333 \pm 0.222$  in the non rupture group, and  $0.106 \pm 0.072$  in the healthy volunteer group. There was a statistically significant difference in the subluxation ratio among the groups. The subluxation ratio and extensor tendon rupture were closely correlated ( $p=0.02$ ).

**Conclusions:** In this study, this newly defined subluxation ratio was found to be useful in assessing subluxation of the DRUJ in rheumatoid wrists.

**References:** Ryu J 1998, Moore JR 1987, Nakamura R 1996, Flury MP 1999, Ishikawa H 1992, Mino DE 1985, Burk DL 1991



**P213**

### **Total finger arthroplasty with fine total finger joint system in rheumatoid arthritis patients**

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**Introduction:** Total joint arthroplasty using various types of implants have been performed as reconstructive surgery for the deformity of rheumatoid hand. However, Surface type system has the problem of palmar dislocation of basal phalanx. Moreover, the rigid system has a high possibility of causing breakage of implant, and loosening. In order to solve these problems, we developed FINE total finger joint system equipped with the mechanism to control dislocation of basal phalanx to palmar side. Clinical application of this system has been started from April 2004.

**Materials and Results:** The number of cases was eight and all cases were females. Age was an average of 60,1 years old. The stage of RA was Larsen's Grade IV or V. Total finger joint arthroplasty was performed by 37 fingers of eleven cases. The postoperative extension angle of MP joints was an average of - 22.2 degrees and the flexion angle was an average of 71.4 degrees. Severe cases of the ulnar drift deformity and palmar dislocation of MP joints had poor extension of ring finger and little finger. However, all patients were very much satisfied, in order to be able to perform skill movements, such as writing a character and using chopsticks.

**Conclusion:** It is the key feature of this system that proximal phalanx prosthesis has a projection (as following "post"). This post is snapped in the metacarpal prosthesis. The tip section of post moves so that it may always come to the center of rotational movement of MP joint. And this post controls palmar dislocation of a proximal phalanx at the time of a flexion movement. According to this feature, the smooth joint movement became possible. FINE total finger system has given the clinical results which can be satisfied to patients and us.



**P214**

**Moment arm analysis of rheumatoid arthritis simulated finger model with metacarpophalangeal joint volar subluxation**

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The metacarpophalangeal joint (MPJ) is one of the first and most frequently affected joints in rheumatoid arthritis (RA) patients. The laxity of the collateral ligaments (CLL) and the radial sagittal band (RSB) due to synovitis results in volar subluxation of the proximal phalanx at the MPJ in 20% of patients. The purpose of this study was to measure the moment arms (MAs) of both intrinsic and extrinsic muscles of the subluxed MPJ and to compare them to those of the normal MPJ.

A cable was sutured at the end of each extrinsic tendon, and the origin and the insertion of each interossei muscle of the index and middle fingers of 12 fresh cadaver hands. Tendon excursion and MPJ angular excursion data was acquired simultaneously during passive MPJ motion. The MA was calculated throughout the range of motion using tendon excursion- joint rotation method (Buford et al., 2005). After collecting the MA data from the normal joints, the serial sectioning of the CLL and RSB were carried out. The order of the sectioning was randomized, acquiring MA data at each stage.

During flexion-extension, RSB incision reduced the extensor MAs, while CLL incision reduced flexor MAs at more than 60 degrees of flexion. Sectioning both resulted in remarkable reduction of extensor and flexor MAs starting from 20 degrees of flexion. During radial-ulnar deviation, RSB incision increased the radial deviator MA, while CLL incision increased radial deviator MA and decreased ulnar deviator MA. Sectioning both resulted in remarkable reduction of both radial and ulnar deviator.

RSB and CLL had the independent effect on the MAs of the muscles for the MPJ. When both CLL and RSB are elongated by RA synovitis, altered MAs result in aggravating the volar subluxation deformity, and weaken the grip strength and pinch of the RA patients.





**P215**

### **Closed compression wrist fusion in RA**

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**Introduction:** Wrist fusion is a well established procedure in treatment of the painful/stiff wrist in RA. The Mannerfelt technique works well both closed and open but is not suited to a very subluxed carpus, nor does it allow much adjustment of position. We describe a technique of closed compression fusion that accommodates carpal subluxation, allows adjustment of the fusion position for optimal wrist function and leaves useful radial finger CMC joint movement.

**Methods/Materials:** 12 consecutive patients with RA underwent open Darrachs procedures and closed compression wrist fusions. The technique is to align the wrist closed and hold it with K wires passed from the radial side of the distal radius. 3 Accutrak compression screws are passed under image intensification guidance to hold the reduction and compress the bones to optimise the chances of bone union. All patients were further immobilised in POP for 6 weeks and followed clinically and radiologically to bone union. Scoring systems even a pain VAS could not be used because of the confounding of the Darrach's procedure. Rather the outcome is assessed by stable bone union.

**Results:** 11 or 12 patients united. Most united at 6 weeks but 3 required immobilisation for 3 months and one went to non-union due to movement of the proximal ends of the compression screws in the distal radial metaphysis as the standard Accutrak screws only go to 30 mm long. In all cases of union the wrist was immobilised with some extension and some ulnar deviation as planned. Apart from the one painless non-union there were no significant complications.

**Conclusion:** This is a reasonably reliable and flexible closed technique. Recent use of Accutrak Plus screws has ensured the screws are long enough to prevent radial metaphyseal movement and avoid use of a POP beyond the first 10 days.



**P216**

**The MCP-stabilisation splint: A new method to treat the intrinsic plus phenomenon in patients with rheumatoid arthritis**

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**Introduction:** About 7-9 ‰ of the Dutch population suffers from rheumatoid arthritis. About 90 % of these patients have problems with their hands such as; pain, joint swelling, joint destruction, contractures and muscle imbalance. As a result, the function of the hand is often severely deteriorated. One type of muscle imbalance is called '*the intrinsic plus phenomenon*', which is an imbalance between the intrinsic and extrinsic muscles of the hand.

**Treatment:** The occupational therapists of the Groningen University Hospital in the Netherlands provide splint therapy combined with exercises in order to improve the muscle balance in the hand. The aim of the therapy is to reduce the 'intrinsic plus phenomenon'. This splint stimulates the extrinsic muscle activity and enhances a normal movement pattern during function of the hand. In our opinion this treatment postpones deterioration of the function of the hand indefinitely. This could positively affect the experienced well being of the patients.

Therapists and patients experience that the splint is tolerated well and that the treatment has a positive effect on the range of motion, manipulation, grip strength and usability of the hand in daily life in an early phase of RA.

**Study:** In 2003 a pilot-study started to evaluate the effect of the 'MCP-stabilisation splint', combined with exercises on the function of the hand of patients in an early stage of RA. A pretest-posttest design is used. The data are collected and analysed on the levels of the ICF-classification, because this classification offers the possibility to organise and structure the consequences of the chronic progressive disease RA on the different levels of functioning in one's life.



**P217**

**Identification of valuable information by patient and team members at a rheumatoid hand outpatient clinic**

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**Objective:** The purpose of this study was to identify what sort of information the medical team and the patients attending a Rheumatoid Hand Outpatients Clinic expect from an Occupational Therapy Assessment.

**Methods:** The method used had a qualitative semi-structured approach. The ICDH-2 classification was used as a framework for data collection and data analysis. Four team members and four patients at the Rheumatoid Hand Outpatients Clinic at University Hospital Groningen participated in semi-structured interviews in order to obtain information from an Occupational/Hand Therapy Assessment. Content analysis was used to analyse the data.

**Results:** Eight themes emerged after the analysis of the interviews. Three themes were found concerning the levels of bodily functions and structures: 'Pain experienced by the patient', 'General condition of the patient', and 'Anatomical state of the hand'. Three themes were also found concerning the activity levels: 'Using the hand for daily activities', 'Compensating strategies for daily functioning' and 'Accepting or coping with the situation'. The participation level and the contextual factors level each had only one theme: 'Participating in the social environment', and 'Influence of contextual factors experienced by the patient',

**Conclusion:** Patients and the team value the same information, but each from their own perspective. They have different demands and expectations regarding the information they obtain from an Occupational/Hand Therapy Assessment. The biggest differences are concerning the themes 'Pain experienced by the patient', 'General condition of the patient', 'Compensating strategies for daily functioning' and 'Experienced influence of contextual factors'.



**P218**

**Accelerated active mobilization after proximal interphalangeal arthroplasty in rheumatoid arthritis**

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**Introduction:** Post-operative care after surface replacement (SR) arthroplasty in proximal interphalangeal (PIP) joints in patients with rheumatoid arthritis (RA) joints consisted of dynamic splinting and mobilization exercises of the operated finger. However, despite a careful post-operative hand therapy protocol, early joint stiffness was experienced.

**Aim:** The aim of this clinical message is to introduce a modified guideline to treat RA patients who underwent a SR arthroplasty of a PIP joint.

**Methods:** The guideline is based on a short arc active mobilization program after central slip repair of the extensor tendon zones 3 and 4 (Eissens 2006). Furthermore, the guideline is founded on a literature review and clinical experience. The guideline is applicable if a dorsal approach is used by the surgeon. As such, the central extensor tendon slip is bisected and re-attached with a tight suture.

**Results:** A more aggressive mobilization protocol and a simple splinting program were developed. A small dorsal finger splint is provided with the PIP joint in neutral position. At the first day after surgery, 45 to 60 degrees of active flexion and full extension are allowed in the PIP joint with 30 degree palmar wrist flexion. Three weeks post-surgery, 70 tot 80 degrees of flexion is aimed. If an extension-lag occurs, the protocol is decelerated. After application of the guideline in four RA patients an average active range of motion of 80 degrees of flexion was found 3 months after surgery. An extension-lag with an average of 20 degrees was found in three distal interphalangeal joints (DIP).

**Conclusion:** Accelerated active mobilization after SR arthroplasty of the PIP joint of RA patients seem to result in an excellent active range of motion of PIP joints. However, an extension lag of the DIP joint is a concurrent problem which still has to be solved.



**P218a**

**The role of hypoxia in rheumatoid hand disease**

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The factors thought to be responsible for ulnar drift of the digits in patients with Rheumatoid Arthritis (RA) are either external forces applied to the fingers during normal usage of the hand or changes in the internal forces/anatomy of the digits due to alterations in the supporting structures of the joints and/or their control mechanisms. The part played by the intrinsic muscles in the development of ulnar drift is obscure; their tightness may be due to adaptive shortening or a disease process. A consistent feature of the rheumatoid process is hypoxia of the involved joints, tendons and associated synovium. Our hypothesis is that intrinsic muscle hypoxia may also be responsible for the loss of intrinsic function observed in many patients with RA disease, which then contributes to the development of the characteristic deformities of RA hand disease. We have taken measurements of tissue oxygen levels in the intrinsic muscles of the hand of patients with a diagnosis of RA undergoing elective surgery at Mount Vernon Hospital using the microelectrode technique established for measurement of synovial tissue oxygen. Patients undergoing elective hand surgery for conditions other than RA served as matched controls. Results so far suggest that the hand muscles of RA patients are significantly ( $p < 0.05$ ) more hypoxic (mean oxygen tension 6.7%) than the matched controls (mean oxygen tension 10%) and there is a trend of increasing hypoxia with the RA sub-group in the radial-to-ulnar direction. Therefore, it is possible that the weakness and wasting of the intrinsic muscles of the hand observed in RA are not the result of atrophy secondary to joint disease but may be due to primary muscular involvement due to hypoxia.



**P219**

**The treatment of spinal accessory nerve injuries (paralysis of trapezius) and tendon transfers**

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**Purpose:** To demonstrate that very serious injury can be markedly improved by performing the appropriate operation.

**Methods:** Ten cases with paralysis of the trapezius muscle have been treated in the past 25 years. Most cases were the result of accidental injuries. Half were of iatrogenic origin, namely, paralysis followed the removal of small lipomas from the neck area. There were 10 patients, 6 men and 4 women. The right side was involved six times, the left four times. Ages ranged from 28 to 65 years. All patients were handicapped in using their extremities, causing marked weakness in abduction, with difficulty performing activities such as fishing, tennis, golf and other sports, as well as simple tasks like combing their hair, putting and behind neck and elevating the arm. The operation consisted of transferring the insertion of the levator scapulae with a fascial sling through the acromion. The fascial sling was also used to anchor the spinal border of the scapula to the spinous processes of the upper dorsal vertebrae. The lateral transfer of the rhomboid muscle in a double-breasted fashion was added to this procedure.

**Summary:** The results were as follows: Excellent and good 75%, and fair 25%. In this later group, all patients demonstrated much improvement compared with the preoperative status.

**Conclusion:** This method has been found to be satisfactory for correcting the paralysis of the trapezius.



**P221**

### **Asymmetry of fingernails in paretic hands**

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**Introduction:** Nail deformities in paretic hands are frequently seen. In order to investigate the etiology of nail deformities in paretic hands, we focused on morphological changes of fingernails in hemiplegic hands and in hands with ulnar nerve palsy.

**Materials and Methods:** Bilateral fingernails of 20 patients with hemiplegia and those of 20 patients with unilateral ulnar nerve palsy were observed. Several morphometric indices of nails were defined and measured. Pinch power of each finger against the thumb was also measured. Paired t-test was adopted for statistical analysis of difference in the both hands.

**Results:** In both of the groups, pinch power on the paretic side was weaker in all the digits ( $p < 1\%$ ). In the hemiplegic group, all of the fingernails on the paretic side were longer, axially and longitudinally more curled and distally narrower in shape than on the normal side ( $p < 1\% \sim 5\%$ ). On the contrary, in ulnar nerve palsy, only the little fingers showed nail deformities on the affected side ( $p < 1\%$ ).

**Discussion:** The weakness of pinch power reflected that influence of disuse was the same in all the digits on the paretic side of both groups. Hemiplegia is the disorder of central nervous system, and peripheral neurotrophic factors are not impaired among the paretic digits. Therefore the nail deformities are derived from the condition of disuse. In contrast, ulnar nerve palsy is the paresis of peripheral nerve. Paralyzed little fingers and non-paralyzed other digits coexist in the same paretic hands under the same disused condition. However just the nails of little fingers demonstrated the deformities. It was attributed to the impairment of peripheral neurotrophic factors. We concluded that the nail deformities are due to both disuse and the impairment of neurotrophic factors and that the deformities are influenced more by neurotrophic factors than by disuse.



**P222**

**Early results of a prospective randomized study of immediate active mobilization versus immobilization for Zancolli's "Lasso" procedure**

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**Purpose:** Determine the early differences between immediate active mobilization versus Immobilization following Zancolli's 'Lasso' for claw deformity correction.

**Methods:** In a Randomized Prospective Trial 50 mobile claw deformities were (randomized by sealed envelopes) allocated into 2 groups i.e. Immediate Active Mobilization protocol (IAMP) Group A or immobilization Group B. Rehabilitation was begun at 48 hours in the IAMP group on 22 nd post-operative day following immobilization. Hand volume for swelling, pain measured on a visual analogue scale, integration of transfer, time when hand was used in daily living activities and therapist time per patient per day were recorded. Grip and pinch power were recorded at the end of 3 months. Deformity correction, digital flexion and sequence of flexion was assed and all outcomes were compared in both groups.

**Results :** Pain was reduced on an average 2.5 weeks and swelling 2 weeks earlier with IAMP. Integration of transfer and daily living activities occurs 3 weeks earlier with IAMP. There is a significant reduction in the average therapist time (22 min vs 42 min) with IAMP. At 3 months after surgery Grip is stronger by 25% and Pinch stronger by 40% with the group A compared to Group B . At 3 months deformity correction was in Group A: Good 93%, Fair 7% and Group B: Good 77%, Fair 23%. For IAMP morbidity time was reduced by an average of 19 days

**Conclusion:** IAMP reduced costs, restored early hand function without compromising the early results. therapist time was reduced by 40%.





**P223**

**Assessment of upper limb kinematics in treatment of patients with cerebral palsy – Virtual reality and haptic feedback**

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We explore the possibility of using Virtual Reality (VR) and Haptic Feedback (HF) as a means of objectively assessing the quality of upper limb kinematics in patients with cerebral palsy (CP). A common phenomenon in CP is flexion of the elbow, wrist, and fingers, forearm pronation, and 'thumb in palm'. Treatment includes physiotherapy, splinting, botulinum toxin type A injections, and surgery. Our research group has experience of VR and HF in upper limb stroke assessment\*. We have now assessed CP patients with this technology.

The two first subjects in a series of 10-20 were: P1 - 55-year-old adult male with spastic hemiplegia of the right arm. Operated with multiple flexor tendon releases. P2 - 17 year-old male, spastic hemiplegia of the left arm. Treated with botulinum toxin type A injections in affected muscles. We employ a haptic and stereo vision immersive workbench for assessment before and after treatment and at follow up\*. Presently, two phenomena were recorded: i) overall arm/hand trajectory with the aid of a 'point-test' program which gives precise and detailed quantitative kinematic data, this in turn provides 3D graphs for visual analysis. ii) range of motion in wrist and forearm.

So far, the technology has proven successful. The 'point-test' gave detailed recordings for future analyses. The 'range of movement' test is under refinement. (Fuller results will be presented at IFSSH & IFSHT 2007.)

Many of today's methods for assessing upper limb motion contain a subjective element and require the assessor to be skilled. We suggest that VR/haptic technology can be used to assess and possibly train upper limb motion in CP patients. The total procedure is comparatively cheap, fast, and easy to perform.



**P224**

**Early motion following the surgical treatment of upper extremity spasticity: The Leeds regimen**

**Waseem Saeed** , Jonathan Wiper, Koo Chan, Joanna Burdon, Michelle Dolan

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Over a 5.5 year period 48 patients, the majority suffering from cerebral palsy, underwent surgical treatment of elbow, wrist, finger and thumb contractures and deformities.

All operations were performed by the same surgeon and consisted of combinations of tendon lengthening procedures, tendon releases, tendon transfers and soft-tissue joint stabilisation.

All transfers with the exception of biceps lengthening were mobilised using an early motion protocol on the first postoperative day.

There was over 170 transfers carried out and only one case of tendon rupture remote from the site of tenorrhaphy as a result of non-compliance.

We conclude that early mobilisation of tendon transfers is safe in this group of patients and describe our protocol.



**P225**

**Upper limb spasticity surgery and the elbow. A review of results in Leeds UK**

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The Leeds Cerebral Palsy Clinic provides a specialist multidisciplinary team setting for the surgical treatment of elbow flexion contracture from a variety of causes, as part of the treatment plan for the patient's affected upper extremity.

Patients demonstrating attempts at limb use, the need for intervention for personal care or a need for more aesthetic positioning are offered surgery irrespective of traditional exclusion criteria such as age, mental retardation, poor sensation or co-existing severe distal deformity.

All procedures were carried out by the senior author with data collected prospectively, using a pre and post-operative functional assessment independent of the surgeon's assessment. A total of 31 patients (33 elbows) were treated by surgical release. The median age at time of surgery was 17.5 (range 1.8 to 56.8) years. The median duration of follow up was 2.8 (range 0.4 to 4.3) years.

Using the Pinzur Classification there was no deterioration of upper limb placement.

The majority of patients achieved at least one grade improvement on follow up, with a second group showing no change in grading either due to absence of active control or a pre-operative maximum grade. All patients gained a modest increase in the range of elbow movement (median 15° increased resting elbow extension, median 15° and 10° increase in active and passive elbow extension respectively). This did not reflect the improvement in spasticity aesthetics and easier personal care. There was one complication (lymphoedema). These results show that this procedure is safe and produces predictable functional and aesthetic improvement in this group of patients.

We believe that good clinical judgement and comprehensive functional assessment using simple measurements is adequate in deciding whether surgery is beneficial to these groups of patients.



**P226**

### **Flexor Carpi Ulnaris opponenplasty for the thumb in severe carpal tunnel syndrome**

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**Purpose:** There have been several tendon transfers described to restore opposition and mobility to the thumb after severe thenar muscle loss in association with carpal tunnel syndrome. We describe a transfer that provides for both these essential movements.

**Method:** A retrospective review of 6 cases of Flexor Carpi Ulnaris (FCU) opponenplasty was performed for severe carpal tunnel syndrome. The technique involves the use of an intervening Palmaris Longus graft with a proximal FCU attachment and APB insertion. An open carpal tunnel release is also performed. The technique is described in detail.

**Results:** Patients were followed up at 8 weeks and up to 2 years in 1 case. All cases had good to excellent opposition and abduction. All patients were satisfied with the procedure and were able to return back to activities of daily living.

**Discussion & Conclusion:** Severe carpal tunnel syndrome with thenar motor involvement leaves the thumb in a position that incapacitates the hand. The hand is left without the ability to perform many tasks that are taken for granted, i.e. writing, buttoning. Simultaneous tendon transfer together with a carpal tunnel release can be performed (Camitz transfer) 1. Extensor Indicis Propius 2 and Extensor Digiti Quinti transfers provide good opposition. The Camitz transfer (Palmaris Longus transfer) provides good abduction. The FCU opponenplasty offers both opposition and abduction in a single transfer with minimal morbidity.

#### **Reference:**

1. Camitz, Acta Chir Scand, 1929
2. Burkhalter, JBJS, 1973
3. Camitz, Acta Chir Scand, 1929
4. Burkhalter, JBJS, 1973
5. Camitz, Acta Chir Scand, 1929
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**P227**

**Six months follow up of shock wave therapy on upper limb hypertonia in patients affected by stroke**

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**Background and purpose:** Spasticity is a disabling complication of stroke. Different not invasive treatments are used to reduce hypertonia. Extracorporeal Shock waves (ESW) are used in the treatment of tendon diseases and on muscular contractures. Our purpose is to investigate the long term effect of ESW on the muscle hypertonia of the hand and the wrist.

**Methods:** We studied 20 patients affected by stroke associated severe hypertonia in upper limb. An electromagnetic coil lithotripter was used. The pressure pulses were focused in the flexor hypertonic muscles of the forearm and in the interosseus muscles of the hand. A placebo stimulation was performed in each patient. NIH scale, Ashworth scale and a video with digital goniometer were performed before and immediately after the placebo and active stimulation. Needle EMG was recorded after 4 weeks. The patients were monitored after one, four, twelve and twenty-four weeks from the active treatment.

**Results:** After active ESWT the patients had greater improvement in flexor tone of wrist and fingers than after placebo stimulation. At follow up visits at one and four weeks a significant decrease of passive muscle tone was noted on the treated muscles in all patients. After 12 weeks from the therapy ten of the twenty patients showed persistent reduction in muscle tone, none of the patients showed a return to the baseline conditions. After 24 weeks 10 patients (50%) showed a persistent effect over the treated muscles. Four patients (20%) showed a further reduction of hypertonia and 6 patients (30%) patients showed a return to the baseline level of spasticity. No denervation was observed in all patients after 4 weeks. There were no adverse events associated with ESWT.

**Conclusions:** ESWT reduce hypertonia of the wrist and finger muscles in all patients after 12 weeks and in 70% of patients after 24 weeks.



**P228**

### **Surgical restoration of the upper extremity in cerebral palsy**

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**Aim:** To evaluate the outcome of surgical procedures performed between 1998 – 2006 on individuals with spastic type of cerebral palsy

**Material and Method:** 34 surgical operations were carried out on 32 patients between 1998 – 2006 ( 14 males , 18 females ) . Mean age was 15.2. Procedures include release of the elbow contracture by brachialis fractionated lengthening and biceps brachii tendon lengthening; pronator quadratus release and pronator teres release or rerouting and brachioradialis re-routing procedures for forearm pronation deformity; tendon transfers for wrist and finger extension and release of spastic flexor muscles. For the correction of the thumb-in-palm deformity , first web space release by Z plasty of the skin and release of the adductor muscle, EPL re-routing and augmentation of abduction by plication or tenodesis of the APL tendon to the radius were carried out. Physical therapy was applied to all patients in the postoperative period. The patients were evaluated using scales described by Green- Banks / Samilson –Morris and House.

**Results:** Increased use of the affected extremity and improvement of hand function was observed in especially motivated and cooperated patients. Measurement of hand function with House system revealed a mean postoperative improvent of 1.5 points on the scale (range : 0 – 3).

**Discussion:** Cerebral palsy is a nonprogressive central nervous injury with peripheral manifestations dependent on the area of the brain that is affected. Motor, sensorial and intellectual functions have been altered. Muscle spasticity is the most common disorder, leading to the typical spastic extremity of these individuals. Although it is not possible to obtain a normal extremity, surgical procedures in the upper extremity of selected cases of cerebral palsy yield satisfactory functional and cosmetic outcomes. Increased use of the upper extremity in our patients have been encouraging.



**P229**

**The neural group selection theory: understanding and treatment of motor disorders of the hand in children**

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**Introduction:** In literature there is no explanation for the timing of treatment of children with congenital disorders of the upper limb. These disorders consist of neurological, for example cerebral palsy as well as non-neurological disorders like the radial club hand (Gupta 2000). One argument mentioned for early treatment, is the opportunity for the child to incorporate new situations in the formation of body schemes (Bowker 1992). The Neural Group Selection Theory (NGST) explains and implicates why we should start early intervention in children with congenital hand disorders (Hadders-Algra 2002).

**Method:** The NGST is based on the principle that sensorimotor development is a combination of genetic and environmental factors. NGST states that development in the brain starts with primary neuronal repertoires (first stage). It proceeds with adaptation of these repertoires by selection on the basis of afferent information produced by behaviour and experience (second stage).

**Results:** Hand therapy starts in the second stage where you should focus on the provision of variable sensorimotor experiences. Motor strategies can be adapted to specific situations and trial and error is used to select the best strategy. Therapy consists of active training of motor tasks, using variation as well as repetition. All this should be combined with joy and play to constantly stimulate the motivation of the child.

**Conclusion:** NGST provides more insight in evidence based treatment of children with congenital upper limb disorders. Timing of intervention should be based on the moment of selection of motor strategies in the sensorimotor development.



**P230**

### **The bending cock up splint for radial nerve palsy**

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**Background and purpose:** A splint to which a dorsal outrigger is attached that is composed based on a cock-up splint is generally used for a drop hand caused by radial nerve palsy. The splint prevents paralyzed muscles from being overstretched.

Patients put on the splint as a functional compensation until the recovery of muscles and employ it for their daily life and work. Therefore, low profile type traction is used by preference for the extension traction of fingers. We report this time that we have devised and produced more compact and bending cock up splint supported on the palmar side based on a new concept without traction on the dorsal side.

**Method of making:** Neoprene and Aquaplast (Rolyan) were used as materials of the splint.

We made use of the flexure of Aquaplast adding the stretches to it, and modeled the splint in cock up with opponence shape by keeping wrist joint at 35 ° extension, MP joint at 45 ° flexion and thumb in opposition(Fig 1). Neoprene was stuck on the palmar side in order to strengthen the flexure to the adequate extent and fit comfortably.

In order to obtain perceptive feedback from the palmar part, the distal part to DIP joint was not covered and a Velcro strap was attached in order for patients to easily put on the splint by themselves.

**Discussion:** Aquaplast with the material's elasticity. We think we could make the support on the palmar side lighter and reproduce the functional compensation compactly.

The splint is also comfortable to wear. In the future, we would like to examine the extent of Aquaplast's stretch and the method of making the splint.





**P231**

**Direct measurements on intrinsic hand muscles in patients with charcot-marie-tooth disease using the rotterdam intrinsic hand myometer (RIHM)**

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**Introduction:** Manual muscle strength testing (MRC scale, grades 0-5) and pinch and grip dynamometry are standard instruments to quantify muscle weakness in the hand of patients with Charcot-Marie-Tooth (CMT) disease. However, manual muscle testing is not very sensitive in detecting change in muscle strength in the 3-5 grades, while pinch and grip strength dynamometry can only assess the combined action of intrinsic and extrinsic hand muscles. This study evaluates the efficacy of the Rotterdam Intrinsic Hand Myometer (RIHM) to directly measure intrinsic hand muscle strength in patients with CMT.

**Methods:** Intra- and interobserver reliability of the RIHM was assessed in 15 CMT patients. In a separate session, muscle strength of 41 CMT patients was evaluated using the RIHM, manual muscle testing, and dynamometry of pinch, grip, and wrist strength. In addition, hand function was measured using a selection of the Sollerman test and the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire.

**Results:** RIHM measurement of intrinsic strength had excellent intra- and interobserver reliability. We found much overlap between the strength measured with the RIHM in the MRC grades 3 to 5. A relatively high grip and pinch strength was found in a number of patients with severe intrinsic muscle weakness. The RIHM measurements of the intrinsic muscles were more strongly correlated with selected items of the Sollerman test than with the grip, pinch and wrist strength values.

**Conclusion:** The present results indicate that the RIHM can reliably measure the intrinsic hand muscles, as in manual muscle testing, while having the advantage of being more sensitive to detect change in MRC grades 3-5. Thus, to assess muscle weakness in CMT patient, the RIHM seems to be a valuable addition to the commonly used instruments.



**P231a**

**Spastic flexor carpi ulnaris function for tendon transfer surgery**

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To optimize tendon transfer, functional characteristics of the donor muscles are needed. These characteristics are often predicted from generic muscle models. The purpose was to study the variability force, functional range and the relation between active and passive force of the spastic flexor carpi ulnaris (FCU) to evaluate the usefulness of such predictions.

Active and passive length-force curves of muscles were intra-operatively measured in ten patients with cerebral palsy using supra-maximal electrical stimulation, and a custom developed set-up<sup>1</sup>.

FCU length at neutral position of the wrist varied considerably among patients between 18.5 cm and 26.8 cm, and maximum active force varied between 41 N and 135 N. Passive forces averaged 9.6 N (S.D. 9.1 N) at maximum extension, and varied between 0 N and 7 N at maximum active force. The potential active excursion varied between 4 cm and 7 cm, while patients used different parts of the active length-force curve when moving the wrist from flexion to extension. The maximum active force was in general situated near the neutral position of the wrist.

The large inter-individual variety demands the assessment of muscle specific data of each individual patient for "tailoring" the capacity for the new function after transfer.

<sup>1</sup> Smeulders MJ, et al Clin Orthop 2004



**P232**

**MRSA – Nuisance or silent killer?**

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**Introduction and Aims:** Methicillin-resistant *Staphylococcus aureus* is a nosocomial pathogen prevalent worldwide which imposes huge financial burdens on health systems.

In the light of current media “scrutiny” regarding “the silent killer”, we sought to ascertain the level of patient knowledge about MRSA in our department of Plastic Surgery and Hand Trauma.

**Methods:** A multiple choice questionnaire was given to patients enquiring about the nature, source, spread, effects, prophylaxis and treatment of MRSA infection.

**Results:** Of 203 respondents, 74% knew MRSA was a bacteria. Patients knew it was present on skin (58%) and in the nose (23%), that it spreads through direct person-person contact (70%), mostly in hospitals (93%) but also in offices, nurseries and schools (20%). Hand washing was recognised as the best method to prevent spread (84%). Patients believed MRSA infection causes high temperature (47%), blood poisoning (41%) and chest infection (39%), the most susceptible groups being those with open wounds (63%) or concurrent illnesses (41%). Fifty-eight patients (29%) predicted death as the likely outcome despite the fact that complete recovery (57%) was correctly identified as result of treating the infection with stronger antibiotics.

**Conclusions:** Public awareness of MRSA as a health risk is high. However, patients overestimate the dangers of infection, possibly due to exaggerated media cover.



**P233**

**Diagnostic significance between tuberculous and chronic non-specific tenosynovitis around the wrist and hand**

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**Purpose:** The treatment modalities are quite different between tuberculous and chronic non-specific tenosynovitis. Hence, we consider the diagnostic differentiation of tuberculous tenosynovitis from chronic non-specific tenosynovitis is very important. The purpose of this study is to identify the diagnostic significance between tuberculous and chronic non-specific tenosynovitis around the wrist and hand, which have similar clinical, laboratory, histopathological, and radiological patterns.

**Methods:** A retrospective review was performed on 25 cases of chronic tenosynovitis around the wrist and hand, which were divided into two groups; 10 cases of tuberculous and 15 cases of chronic non-specific tenosynovitis. Tuberculous tenosynovitis was confirmedly diagnosed by pathological biopsy and polymerase chain reaction (PCR), and culture. Differential diagnoses were made using clinical, laboratory, histopathological and imaging studies. All patients did not respond to conservative treatment for at least 3 months, and received tenosynovectomy. To differentiate tuberculous tenosynovitis from chronic non-specific tenosynovitis, we evaluate the twelve preoperative clinical and laboratory factors (age, gender, symptom duration prior to surgery, size of lesion involvement, the presence of edema, localized warmness, neurologic deficit, leukocytes count, neutrophil ratio, lymphocyte ratio, erythrocyte sedimentation rate, complement reactive protein).

**Results:** Three factors were found to be statistically significant for the diagnosis of tuberculous tenosynovitis; a localized warmness, a wide lesion involvement and an increased complement reactive protein (CRP).

**Conclusions:** We suggest that tuberculous tenosynovitis should be considered than chronic non-specific tenosynovitis if the patient shows unresponsiveness to conservative measures, wide lesion involvement, localized warmness, and elevated CRP level.



**P234**

**Mycobacterium intracellulare infections of the hand: Two case studies**

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**Introduction:** Mycobacterium intracellulare, an atypical mycobacterium, is a rare cause of localized soft tissue infection. Once infection of tenosynovium and/or wrist joints develops, treatment often becomes increasingly difficult because of resistance to most antimycobacterial drugs. Here, we present two cases of mycobacterium intracellulare infection of the wrist and hand.

**Case 1:** A 59-year-old woman consulted our hospital due to prolonged swelling of her left wrist. She had been treated for systemic lupus erythematosus with steroids for over 15 years. X-ray of the wrist revealed articular destruction and mycobacterium intracellulare was detected in a biopsy specimen. Total resection of the carpal bones, articular surface of the radius and ulna was performed and antimycobacterium chemotherapy was administered for three months. After subsidence of the local infection was confirmed, a vascularized fibular graft was applied for wrist arthrodesis.

**Case 2:** A 47-year-old male was evaluated at our institution because of gradual developmental swelling of his right index finger and palm for six months. He underwent flexor tenosynovectomy and bacteriologic culture examination but the cultures showed no growth. Three months after surgery, swelling from the palm to volar side of his forearm reappeared. Re-tenosynovectomy was performed and mycobacterium intracellulare was identified. He was treated with a combination of CAM, RFP and EB resulting in improvement of his hand and fingers. However, recurrence was observed after a lapse of three years. Extensive resection of the tenosynovium was performed again and administration of six kinds of drug was necessary for effective chemotherapy.

**Conclusion:** The findings suggest that early diagnosis obtained by culture of synovium for detection of mycobacteria contributes to early initiation of treatment and improved outcome. Extensive resection of the affected site as well as multi-drug chemotherapy is the only effective approach for treatment of mycobacterium intracellulare infection.



**P235**

### **Comparison of return to work: endoscopic versus open cubital tunnel release**

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*Orthopaedic Specialists, P.C.*

Endoscopic cubital tunnel release (ECTR) is an emerging technique with speculated advantage of smaller incision and earlier return to activity. However, early return to activity has not been previously demonstrated. The purpose of the study was to compare the return to work time for patients undergoing ECTR versus anterior subcutaneous transposition of the ulnar nerve (ASTUN).

**Methods:** Thirty consecutive cases were reviewed, 15 (11 W/C, 4 Pvt) by ECTR and 15 (12 W/C, 3 Pvt) by ASTUN. All patients had preoperative electrical studies. Severity was rated using Dellon's classification. Postoperative results were graded using Bishop's 12 point rating. Sex, age, length of preoperative symptoms, percentage of positive electrical studies, Dellon's classification and percentage of work comp cases were similar in the two groups. The average follow up time was one year for both groups.

#### **Results:**

**ECTR:** The average return to work for the ECTR group was 2 days (range 1 to 3) for modified work and 7 days (range 5 to 9) for regular duty. Results were 10 Excellent (68%), 3 Good (20%), 1 Fair (6%) and 1 Poor (6%) using the Bishop12 point rating system.

**ASTUN:** The average return to work for the ASTUN group was 17 days for modified work (range 12 to 22) and 70 days (range 60 to 80) for regular duty. There were 2 Excellent (13%), 10 Good (68%), 2 Fair (13%) and 1 Poor (6%) using the Bishop's rating scale.

There were no re-operations or complications in either group. All returned to their usual occupation.

**Conclusion:** ECTR release provides good to excellent symptom relief in most cases with earlier return to work compared to ASTUN. The differences in recurrence, complications, and long-term outcome require additional study.



**P236**

**Radial nerve compression between the brachialis and brachioradialis muscles in a manual worker: A case report**

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In previously reported cases, high radial nerve palsy occurred by compression of the lateral head of the triceps following muscular effort.

A 44-year-old manual worker was admitted due to right radial nerve palsy. The clinical symptoms and signs of high radial nerve palsy occurred 2 month ago abruptly. He had been treated physical therapy in other clinic after onset of the symptoms, but there was no clinical recovery of symptoms. He had no specific episode of trauma and no evidence of systemic disease. Electrodiagnostic examination showed right radial neuropathy around spiral groove area with active nerve degeneration. Surgery revealed the right radial nerve to be compressed in the interval between the brachialis and the brachioradialis muscles, a previously unreported location. The patient's normal radial nerve functions returned 24 weeks after surgery.

We stress the need for exploration between the brachialis and brachioradialis muscles. If compression of the radial nerve is not found in the spiral groove of the humerus and at the lateral head of the triceps.

Manske PR 1977

Lussiez B 2004



**P237**

### **Meralgia Paresthetica Caused by Hip-Huggers**

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Meralgia paresthetica (MP) is an entrapment neuropathy of the lateral femoral cutaneous nerve (LFCN), which is characterized by localized paresthesia and numbness on the anterolateral aspect of the thigh. The MP may result from a variety of causes at the various sites along the course of LFCN.

Hip-huggers which are widely liked in young women may be a precipitating factor to cause MP, especially, in the thin person with an aberrant pathway of LFCN. We present a 25-year-old woman with a long-standing history of MP caused by an abnormal course of LFCN and tight trousers such as hip-huggers. Sonography was very useful for detecting the lesion site and an abnormal pathway of LFCN. Patient was treated with neurectomy, resulting in complete relief.

This case demonstrates that clinical significance of hip-huggers in lean persons with an aberrant pathway of the LFCN and the usefulness of sonography in the diagnosis of MP and detection of an abnormal course around the ASIS





**P238**

**Action on plastic surgery – Our experience following the introduction of a 'fast-track' carpal tunnel clinic**

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**Introduction:** 'Action On' programs represent projects within the United Kingdom set up to initiate fast-track services for patients across a variety of healthcare settings. They constitute an integral part of the government's modernization agenda for the National Health Service.

The Hull and East Yorkshire Hospitals NHS Trust was successful in securing funding for a 'fast-track' carpal tunnel clinic in 2003.

**Method:** The trust was awarded £95,000 to provide a rapid assessment and investigative clinic. Whilst there patients were examined by a Consultant Plastic Surgeon, underwent nerve conduction studies by a neurophysiologist, had their fitness for surgery assessed by a nurse, before being given a date for surgery within 6 weeks on protected designated day-case theatre lists.

**Results:** The service has been operational since January 2004. During the first 12 months only 221 patients of 681 referrals were able to be seen in the monthly clinics. Of those, 143 (65%) required nerve conduction studies where diagnosis was questionable. 138 (62%) proceeding to surgical decompression.

**Conclusions:** Our new 'Action On' pathway for patients with suspected carpal tunnel syndrome has dramatically reduced waiting times for surgery. It has increased patient satisfaction and reduced potentially harmful delays for unnecessary investigations. We present the benefits and drawbacks of our fast-track service.



**P239**

**A prospective clinical study of the efficacy of low level laser therapy (LLLT) in the treatment of carpal tunnel syndrome**

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**Purpose:** Low Level Laser Therapy (LLLT) may provide an energy source to cells that are treated, helping patients suffering from Carpal Tunnel Syndrome (CTS). Though no scientific research or technology to study the efficacy of LLLT in treating CTS currently exists, it is possible to conduct empirical tests. This study evaluates the safety and efficacy of LLLT in the treatment of CTS.

**Materials & Methods:** Forty-two male and female CTS patients (ages 18 to 80) were physically examined and questioned. Those meeting the inclusion criteria were randomized into two groups – active laser and identical placebo laser. A MicroLight 830 infrared laser was used in active treatment. Four treatment points on the volar side of the hand were treated for 90 seconds each with 3 joules of energy – 3 times per week for 5 consecutive weeks. Upon completion, patients were re-evaluated at 1, 6, and 12 weeks.

**Results:** At 1 week and 6 weeks post treatment, the mean VAS score for Group 1 decreased by 29% then 31%, compared to pretreatment scores. There was a 13% improvement in the mean grip strength value (MGSV). The mean VAS score for Group 2 decreased by 9% at 1-week post treatment, and 12% at 6 weeks. And MGSV improved by 14% compared to pretreatment. In later follow-up, MGSV for Group 1 maintained its percentage of improvement at 16%. However, Group 2 returned to pretreatment values – at 0% improvement.

**Conclusion:** Subjective data for the control and treatment groups showed improvement at 1 and 6 weeks post treatment. However, objective data, such as grip strength, maintained improvement in only Group 1. Overall, the data suggests that there is some role for this type of electromagnetic treatment in those patients who have mild to moderate CTS on EMGs, and that it may provide short-term benefit.



**P240**

**An imaging and anatomic study of Pisiform/Ulnar Nerve relationship in determining the best surgical approach for Pisiform Excision**

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**Purpose:** Pisotriquetral arthritis is the second most frequent degenerative arthritis of the wrist, causing pain, ulnar nerve compression and degenerative changes in the pisotriquetral joint. This study examines the relationship between the Pisiform and Ulnar Nerve using a series of excisions at the flexor carpi ulnaris (FCU) and MRI imaging to determine the best excision in avoiding nerve damage during pisiform procedures.

**Materials & Methods:** Ten volunteer wrists were selected for the MRI portion of this study and 10 cadavers were used for the excision. A MRI produced spin echo T1-weighted axial images with 3.0 mm slices every 0.2 mm for three positions – extension, neutral, and flexion/radial deviation. Palmar dissection was used from the mid-forearm to the distal hamate - categorized Cut I, II, and III. Measurements were made with electric calipers under magnification. Subcutaneous tissues were removed to expose the FCU. It was then transected in the mid-forearm and freed from adhesions down to the pisiform bone. The portion of the pisiform covered by the FCU tendon, periosteum, transverse carpal ligament, and pisohamate ligament was estimated at Cut II and Cut III, using analogue clock values in the axial plan. Measurements of the pisiform dimensions and width, depth and length at each cut were recorded.

**Results:** Average pisiform length was 13.7 mm – an average of 8.8 mm, or 64.1% of the length involved in the FCU tendon insertion. Average depth was 10.03 mm and width at both Cut II and III showed averages of 9.995 mm and 10.27 mm. The relationship of the pisiform and ulnar nerve varied between proximal and distal aspects of the pisiform.

**Conclusion:** Data combined with measurements from Cut I, II, and III indicates that the Volar approach through Canal de Guyon, releasing the ulnar nerve, is a safe excision and preserves soft tissue continuity.



**P241**

**Comparison between young and elderly patients with carpal tunnel syndrome  
-From the standpoint of heat shock protein 70 of intracarpal canal synovium**

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**Purpose:** Heat shock protein 70 (HSP-70) is a stress-inducible protein that protects against cellular injury; as a molecular chaperone, it plays an essential role in mediating protein folding, assembly, transport, and degeneration. The purpose of this study was to monitor the level of HSP-70 in the synovium of young and elderly patients with carpal tunnel syndrome (CTS).

**Methods:** We evaluated 9 female patients with idiopathic CTS, ranging in age from 34 to 64 years (young group), and 6 females with idiopathic CTS, ranging in age from 65 to 76 years (elderly group). The synovium of the superficial flexor tendon (IV) was excised during open carpal tunnel release. HSP-70 in the specimen was measured. One sample was taken from the intracarpal canal (I-HSP) and another from the extracarpal [M1] canal (E-HSP). HSP-70 (ng/g tissue) was measured with an enzyme-linked immunosorbent assay (ELISA) kit (Stressgen, Canada) using a monoclonal antibody against inducible HSP-70. Carpal canal pressure (mmHg) was measured with the wick catheter technique during the surgery.

**Results:** In the young group, I-HSP ( $838 \pm 376$  ng/g) was significantly lower than E-HSP ( $1442 \pm 867$  ng/g) ( $p=0.047$ ). There was a significant positive correlation (0.782) between the remainder of the subtraction of I-HSP from E-HSP and carpal canal pressure. In the elderly group, there was no significant difference between I-HSP ( $1715 \pm 491$  ng/g) and E-HSP ( $2202 \pm 1261$  ng/g), and no significant correlation between the remainder of the subtraction of I-HSP from E-HSP and carpal canal pressure.

**Discussion:** In the young group, it appears that I-HSP was consumed in order to protect the synovium against high carpal canal pressure. Hence, geranylgeranylacetone, which is known to increase HSP-70, might improve the symptom of younger CTS patients. According to our results, the pathogenesis of CTS might be different between young and elderly patients.



**P242**

### **Knifelight instrument in the surgical treatment of carpal tunnel syndrome**

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Carpal tunnel syndrome (CTS) is the most common of all the nerve entrapment syndromes. Various authors have recommended blind division of flexor retinaculum by a short longitudinal incision in the palm with specially developed instruments.

Knifelight (Stryker) is a disposable carpal tunnel release instrument with a cutting knife sandwiched between two plastic transparent skids. It has its own light and battery source. Knifelight leaves the skin and subcutaneous tissue intact over the flexor retinaculum.

In this study 54 patients between 1999 and 2005 operated with knifelight instrument were examined and compared with another 54 patient operated by open technique. Their preoperative and postoperative status was measured with Boston questionnaire. Their both hands were examined by sensorial tests and their grip and pinch strenghts were measured. Their anterior carpal pain and time to return to work were recorded.

Knifelight group had faster return to work, less scar pain, more esthetic scar as less damage to skin and subcutaneous tissue compared to open release group.

Knifelight technique is more simple and easier to learn than endoscopic technique and combines advantages of open and endoscopic technique. It should be first choice for idiopathic CTS treatment.



**P243**

### **Vein wrapping for recurrent carpal tunnel syndrome**

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**Introduction:** In spite of surgical technique it is possible to recurrence of CTS and regression of symptoms and signs.

One of the causes of this problem is nerve adhesion to soft tissue

**Method:** 34 cases with paresthesia, pain and weakness after CTS surgery (open technique) was checked by clinical and Paraclinical methods methods.mean duration after surgery

Was 6 mo(8mo-24mo).revision surgery was performed with classic approach. .in 28 patient nerve adhesion was seen ,that after nerve release ,dorsal vein of forearm was used for separation of nerve from scar tissue and prevention of new scar.

Mean followup after revision surgery was 11 mo (8-36mo)

Except 2 cases (because of CRPS) 26 patients completely relieved Signs and symptoms.

**Conclusion:** in recurrent CTS vein wrapping seem to be a simple and benefit method.



**P244**

**Median nerve excursion in response to wrist movements after endoscopic and open carpal tunnel release**

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**Purpose:** The purpose of this study was to compare the peroperative effect of endoscopic carpal tunnel release and open carpal tunnel release on median nerve excursion and bowstring at wrist region.

**Methods:** 16 hands of 13 patients with idiopathic primary carpal tunnel syndrome in were randomly assigned to two groups (Group 1 endoscopic and Group 2 open). Symptoms and functional status were evaluated by the Symptom Severity Scale and the Functional Status Scale, respectively. For the measument of the median nevre gliding and bowstring a metallic marker was used. P rior and after the division of the transverse carpal ligament, longitudinal gliding and volar displacements of the median nerve were calculated based on the fluoroscopy imaging for each wrist. It was analyzed using software developed for measurements of the marker locations in the frames from the wrist extension of 20° to flexion of 70° position .

**Results:** All the patients were evaluated a median of seventeen months postoperatively, the mean symptom-severity score improved from 3.2 points preoperatively to 1.9 points at the latest follow-up examination. Improvements in the symptoms, signs, and functional status of the patients were statistically significant in both treatment groups ( $p < 0.05$ ). The median nerve excursion was measured preoperatively in Group 1 and Group 2 up to 28 mm and 30.7 mm respectively in a proximal direction with wrist movements. Preoperative and postoperative longitudinal sliding values were similar with either Group 1 and Group 2 ( $p = ,753$ ). The mean distance was 19.5 mm in Group 1, contrasted with 20.8 mm in Group 2 preoperatively ( $p = ,372$  and  $p = ,103$ ).

**Conclusion:** This study supports the endoscopic carpal tunnel release is not favored over the open carpal tunnel release in terms of longitudinal nerve sliding and bowstring.



**P245**

**Effects of repetitive compression on the rabbit sciatic nerve in view of nerve conduction and blood flow**

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The objective of this study is to clarify the physiological changes in response to the repetitive compression of the nerves in a rabbit experimental model. We invented a novel compression apparatus. Fifteen adult male Japanese white rabbits were used. Under anesthesia, compression apparatus was set around the sciatic nerve. We selected 80 mmHg as the compression force, in which nerve conduction and blood flow recovered rapidly after 30 minutes of compression in a previous study. Three conditions of compression, namely, continuous compression (CC), low frequent release compression (LFR, 1 second release time every 30 seconds), high frequent release compression (HFR, 1 second release time every 10 seconds), were each applied for 90 minutes to the sciatic nerve. Each group consisted of five rabbits. Compound nerve action potential (CNAP) and nerve blood flow (NBF) were evaluated from the beginning of compression to 90 minutes after compression release. NBF was recorded using a laser Doppler flowmeter at the compression site. The ratio with respect to the initial state was compared among the groups. Endoneurial microvascular permeability was evaluated with intravenous administration of Evans blue albumin (EBA). NBF decreased with compression immediately in all groups and the averages during compression were 48.4, 56.3, and 69.4% in the CC, LFR, and HFR groups, respectively. CNAP amplitudes gradually decreased with compression and were 62.5, 73.7, and 81.1% at 90 minutes of compression in the CC, LFR, and HFR groups, respectively. After release, although the CC group showed rapid recoveries of CNAP amplitude and blood flow, the repetitive groups did not show full recovery. Moreover, EBA leakage was observed in the repetitive groups. Therefore, we conclude that repetitive stress induces collapse of the blood-nerve barrier rapidly and leads to the delay of normal physiological recovery. Thus repetitive compression can be a harmful source of entrapment neuropathy.

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**P246**

**Clinical feature of multiple entrapment neuropathy of upper extremity**

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**Purpose:** Multiple entrapment neuropathy means significant nerve compression on two or three separate nerves in the ipsilateral extremity. Some entrapment neuropathy which involve varying degrees of compression at multiple sites and levels, are more difficult to diagnose and treat. The purpose of this study was determined the frequency of multiple entrapment neuropathy and the participation of associated metabolic disease or cervical lesion.

**Materials and methods:** 226 patients received operations of anterior transposition of the ulnar nerve between six years from January 2000 through December 2005. Combination of carpal tunnel release, posterior interosseous nerve release and pronator release operation on ipsilateral extremity were eligible. A total of 29 patients had combined surgery during this time period. Clinical records of these patients were reviewed.

**Results :** 24 cases combined of carpal tunnel release, 4 cases of posterior interosseous release, one case of pronator release. Three cases were associated with diabetes mellitus, two cases were renal failure, three cases were cervical vertebrae lesion, three cases were OA elbow, for each one case hyperlipidemia, alcoholic hepatopathy, asthma steroid taking. Two cases were workers compensation related (medialepicondylitis and finger trauma injury). One case was doubt of anomalous connection between the median nerve and ulnar nerve.

**Conclusions:** Metabolic disease and cervical lesion were the most frequent combined disease. OA elbow combined cases would have a relation of over use of the upper extremity. These associated diseases would have an influence on the results. There were 11 cases that did not complaint subjective symptoms of carpal tunnel syndrome at first consultation. We are in danger of overlooking of combined entrapment neuropathies. Thus, careful and detailed clinical examination will be required to localize the significant levels of nerve compression of upper extremity necessitates both median, ulnar or radial nerve study. We recommend neurophysiologic study and sensory evaluation.the choices to solve the problem of DRUJ.



**P247**

### **Hour glass constriction in advances carpal tunnel Syndrome**

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*University of Medical Sciences, Isfahan, Iran*

The purpose of this paper is to show morphologic changes of median nerve in advances CTS.

80 patient with thenar atrophy, anesthesia and paresthesia of first, second and third finger and severe changes in EMG-NCV was chosen for surgery.

All of cases was operated by classic approach.

At 10 cases nerve is constricted in point (point hourglass constriction) and in 6 patients area constriction (area hourglass) was seen.

In all of cases internal and external neurolysis was performed, in 2 cases because of wide area resection and nerve repair is performed .

Mean followup was 12 mo (8-40 mo).

In 15 cases return of sensation and in 13 cases recovery of opposition power was seen.



**P248**

### **Unusual causes of carpal tunnel syndrome**

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*2 Department of Orthopedic Surgery, Yonsei University Medical Center , Seoul, Korea*

**Purpose:** Carpal tunnel syndrome is a compression neuropathy wherein the median nerve is compressed inside of the carpal canal. Although almost 50% of cases of carpal tunnel syndrome are idiopathic in nature, CTS can be caused by a pathological increase in the contents of the carpal canal , such as rheumatoid arthritis, endocrine disorders, local trauma, amyloidosis, hemophilia, local tumors and anatomical variations. We describe unusual cases of compression of median nerve at the wrist.

**Patients And Methods:** Retrospective study reviewed the 202 cases of clinically diagnosed and electrophysiologically confirmed carpal tunnel syndrome that underwent release of the transverse carpal ligament. We experienced 12 unusual cases (5.9%) that underwent open release in order to free the median nerve . The patients presented with classical symptoms and tenderness by pressing over the carpal tunnel region. We performed a simple excision of the space occupying lesion combined with a release of the transverse carpal ligament and a tenosynovectomy.

**Results:** Recognized unusual causes of the syndrome are 3 Kienbock's disease, 2 Tuberculous tenosynovitis, 2 giant cell tumor of a superficial flexor tendon sheath, 3 Non-specific flexor tenosynovitis, 1 lunate palmar dislocation, and 1 Schwannoma of the median nerve. The mean follow up period was 12.3 months. All cases showed a slow, but uneventful recovery.

**Conclusion:** Consideration should be given to the use of magnetic resonance imaging or ultrasound imaging when there is a suspicion of a space occupying lesion in the carpal canal, especially if endoscopic surgery is contemplated. Familiarity with this entity and its imaging characteristics may prove helpful in diagnosis and preoperative planning.



**P249**

**Correlation between the Carpal Tunnel Syndrome Instrument (CTSI) and the Disabilities of the Arm, Shoulder and Hand Disability/symptom score (DASH-DS) in the general population**

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**Objective:** The purpose of this study was to examine correlation between the Carpal Tunnel Syndrome Instrument (CTSI) and the Disabilities of the Arm, Shoulder and Hand Disability/Symptom score (DASH-DS) in the general population.

**Methods:** The subjects were 291 nurses of our hospital who agreed to respond to CTSI and DASH-DS. Pearson's correlation was applied to analyze correlation between CTSI Symptom Severity Scale (CTSI-SS) and CTSI Functional Status Scale (CTSI-FS), between age and CTSI, between age and DASH, and between CTSI and DASH. Welch's *t*-test was applied to investigate the differences of CTSI between the two generations.

**Results:** The average of CTSI-SS was 11.7 (range, 11-34 ) and that of CTSI-FS was 8.2 (range, 8 -16). There was slight correlation between CTSI-SS and CTSI-FS ( $r = 0.22$ ). There was no correlation between age and CTSI – SS, although there was moderate correlation between age and CTS-FS ( $r = 0.46$ ). CTSI-SS score was significantly worse in the group over 50 years old than in that of 50 years old or less ( $p < 0.05$ ). The average of DASH-DS was 1.6 (0-33.3). There was strong correlation between age and DASH-DS ( $r = 0.78$ ). Although there was no correlation between CTS-SS and DASH-DS , there was strong correlation between CTSI-FS and DASH-DS ( $r = 0.89$  ).

**Conclusions:** Both of CTSI-FS and DASH-DS significantly declined with age. CTSI-SS was significantly worse in the group over 50 years old. These results were consistent with the fact that CTS was common among that group. The validity of CTSI remained unknown in this study because we have not revealed the presence or not of CTS.



**P250**

**Usefulness of magnetic resonance imaging in carpal tunnel syndrome**

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Electrodiagnostic studies are highly sensitive and specific for diagnosis of CTS. However, conduction velocities correlate with neither symptom severity nor treatment outcomes. MRI demonstrated that the most constant finding in CTS is tenosynovial thickening within the carpal tunnel . The purpose of the present study is to analyze relationship between subjective symptoms and findings of MRI and to identify clinical evaluations which reflect subjective symptom severity. Subjects comprised 48 females with CTS. Patients were divided into 4groups based on the symptom duration (A: 0-3 months, B: 4-6 months, C: 7-12 months, D: >1 2months). All patients were assessed regarding subjective symptom severity with Likert scale, SCV and CMAP, preoperatively. In addition, all patients took MRI to evaluate flexor tenosynovial swelling represented by palmar bowing of the flexor retinaculum (PBFR). Fourteen healthy females with comparable demographics served as controls. Relationships were estimated using Spearman rank score or Mann-Whitney's U test. Regarding subjective symptoms, pain severity decreased significantly in the order groups A, B, and C except D., while paresthesia did not show any significant difference among groups. PBFR was significantly higher in all groups compared to the control, PBFR, similar to pain severity, decreased significantly in the order group A, B, and C except D. Statistical analysis demonstrated that there is a close correlation between pain severity and PBFR. However pain severity did not show any correlation either with electrophysiology or with functional status. In contrast to electrophysiology or objective functional status assessment, flexor tenosynovial swelling shows close correlation with pain severity in CTS. This study suggests that subjective symptoms relate to problems with the connective tissue rather than pathology of the nerve fiber itself in the majority of patients with CTS, and MRI is a useful tool to objectively evaluate subjective pain severity.



**P251**

**Carpal tunnel release does not have a bowstring effect of the flexor tendons**

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The association between carpal tunnel syndrome and stenosing tenosynovitis is not rare. Previous reports said that in some of the patient affected CTS, the onset of the stenosing tenosynovitis occurred within few months of open carpal tunnel release. Hombal et al. stated that on division of this restraining band (transverse carpal ligament), due to possible bowstring effect of flexor tendons, more tension is exerted at the proximal pulley, especially in a situation when the fingers are functioning with the wrist in flexion. The propose of this paper is to prove if carpal tunnel release has a bowstring effect of the flexor tendons as Hombal said.

Prospective study was carried out. Ten patients underwent open carpal tunnel release by the incidence of carpal tunnel syndrome. MRI was performed at two times, before the operation, and three months after the operation. In saggital view, we check the position of the flexor tendons. And we followed up for one year to determine the exact incidence of trigger digits. We have two patients with trigger digits (thumb: 1, index: 1, long: 1, ring: 1). In MRI assessment, there is no apparent bowstring of flexor tendons after the surgery. In conclusion, bowstring of the flexor tendons after carpal tunnel release does not affect occurrence of trigger digits.



**P252**

### **Transverse Carpal Muscle During Surgery for Carpal Tunnel Syndrome**

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**Introduction:** We studied the frequency of transverse muscle fibers between thenar and hypothenar, to explore their possible role in carpal tunnel syndrome (CTS).

**Methods:** During surgery for CTS, we looked for the presence of transverse muscle fibers on the palmar side of the transverse carpal ligament in 143 consecutive hands. We simultaneously looked for these fibers in 50 cadaver hands.

**Results:** In 71 operated hands (50%) no transverse muscle was found, in 56 hands (39%) we cut transverse muscle fibers between 2 and 10 mm wide and in 16 hands (11%) we found a transverse muscle 11 to 35 mm wide.

In 29 cadaver hands (58%) there were no transverse muscle fibers, small transverse muscle fibers were found in 15 hands (30%) and in 6 hands (12%) a wide muscular band was present. In 2 cases the wide transverse muscle was an aberrant insertion of abductor digiti minimi muscle, in 1 specimen it was a hypertrophic palmaris brevis muscle and in 3 cases there was a muscular connection between thenar and hypothenar.

**Discussion and conclusion:** A transverse carpal muscle is sometimes held responsible for CTS (Tuncali et al. Clinical Anatomy, 2005). In our study the frequency of transverse muscle fibers was not significantly higher in patients when compared to anatomical specimens. Transverse carpal muscle may not be a predisposing or causative factor for development of CTS.



**P253**

**Ulnar nerve palsy due to the anconeus epitrochlearis muscle: Two case reports**

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*4 Juntendo University, Tokyo, Japan*

The anconeus epitrochlearis muscle has been rarely reported to cause ulnar nerve palsy. We describe two patients who were diagnosed as cubital tunnel syndrome due to ulnar nerve compression by the anconeus epitrochlearis muscle. Their complaints were weakness and tingling in the ring and small fingers of the hand. In both cases, patients noticed claw hand deformity following elbow pain and paresthesia in the ulnar nerve distribution. Radiographs showed osteoarthritis of the elbow in one case. Electrophysiology tests revealed a reduction in the nerve conduction velocity of ulnar nerve throughout the elbow and suggested cubital tunnel syndrome in both cases. Operations were done in two cases. Surgical examination showed aberrant muscle originated from the medial epicondyle and inserted into the olecranon, so called anconeus epitrochlearis. Ulnar nerve was significantly compressed by the muscle in both cases. Both patients were performed excision of the muscle and cubital tunnel release with anterior subcutaneous transposition of ulnar nerve. Weakness and tingling in the ring and small fingers of the hand has been improved, but unfortunately the claw hand deformity has not been restored on a recent medical consultation. Although the anconeus epitrochlearis muscle is not a rare anatomical variant, this muscle has been reported rarely to cause ulnar nerve palsy. In our cases, the anconeus epitrochlearis muscle significantly compressed the ulnar nerve and ulnar nerve palsy has improved after operative decompression.





**P254**

**Carpal tunnel syndrome caused by space occupying lesions**

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**Purpose:** To evaluate the diagnosis and treatment of the carpal tunnel syndrome due to space occupying lesions.

**Materials and Methods:** 11 patients and 12 cases that underwent surgery from January 1992 to December 2001 at Yongdong Severance Hospital for carpal tunnel syndrome due to space occupying lesion were studied. We excluded space-occupying lesions caused by bony lesions, such as malunion of distal radius fracture, volar lunate dislocation, carpal bone fracture, etc. The average age was 51 years (range, 24 to 78 years). There were 4 men and 7 women. Follow up period was 12 to 40 months, an average of 15.6 months. The diagnosis of carpal tunnel syndrome was made clinically and eletrophysiologically. In patients with swelling or tenderness on the area of wrist flexion creases, Magnetic Resonance Imaging (MRI) and/or Computed Tomogram (CT) were additionally taken as well as the carpal tunnel view. We performed open transverse carpal ligament release and removal of space occupying lesion.

**Results:** The types of lesion confirmed by pathologic examination were, in three cases tuberculosis tenosynovitis, nonspecific tenosynovitis in two cases, gout in one case. Other space occupying lesions were tumor in five cases, and abnormal palmaris longus hypertrophy in one case. Tumors were due to calcifying mass in four cases and ganglion in one case. Following surgery, all cases showed alleviation of symptom without recurrence or complications.

**Conclusion:** In cases with swelling or tenderness on the area of wrist flexion creases, it is important to obtain a carpal tunnel view, and if necessary, MRI and/or CT should be supplemented in order to rule out space occupying lesions around the carpal tunnel and to establish a treatment plan.



**P255**

**Carpal tunnel release using hook-knife through a small transverse carpal incision**

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**Introduction:** To avoid prolonged recovery time and scar tenderness, various carpal tunnel releases using minimal invasive techniques have been performed. However, incomplete release and possible major neurovascular injury are still remained concerns. We tried to release the transverse carpal ligament using a hook-knife through a small transverse carpal incision and evaluate the reliability of our method.

**Materials and methods:** Since November 1, 2003, one hundred and twenty-eight carpal tunnel releases in 88 patients were performed using simple curved hemostat and meniscectomy hook-knife through a small transverse incision at the proximal carpal crease. 42 cases were excluded due to insufficient follow up(24 cases), combined other regional problems(9 cases), medical diseases(3 cases), conversion to open procedure(2 cases) etc. and 86 cases in 59 patients were evaluated retrospectively. The outcomes were analyzed according to the Cseuz's criteria and in terms of symptomatic resolution and functional status using Boston questionnaire. The mean follow up period was 18.2months with range of 6-31 months.

**Results:** All 86 cases revealed complete or marked symptomatic resolution and all but one patients graded their outcome satisfactory. 17 of 23 cases with subjective initial motor weakness experienced completely recovered motor function. The mean time interval between surgeries to return to ADL was 6.9 weeks. 9 of 27 cases with less than one year follow up showed mild to moderate tenderness over the released transverse carpal ligament. The overall symptomatic severity score was 1.1 and the overall functional status was 1.04. There was one superficial palmar arch injury as a complication.

**Conclusion:** Our method of carpal tunnel release using hook-knife through a small transverse carpal incision was simple and reliable with high rate of symptomatic resolution and patient satisfaction.



**P256**

**A scheme for assessment of patients for carpal tunnel release by postal questionnaire**

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A scheme for assessment of patients for carpal tunnel release (CTR) by postal questionnaire had been established to address limitations in outpatient clinic capacity. Described as a Direct Access to Carpal Tunnel Surgery (DACTS) scheme, patients could be listed for surgery on the basis of responses in questionnaires, and avoid an initial outpatient appointment. The aim of this study was to evaluate satisfaction and outcomes associated with the DACTS scheme. Patient satisfaction with the new DACTS scheme was compared to that associated with standard initial assessment in clinic.

**Methods:** Over a 6 month period, a consecutive series of 75 patients undergoing CTR included 42 patients listed for surgery after returning questionnaires (DACTS patients), and 33 patients initially assessed in clinic (non-DACTS patients).

All patients were contacted by telephone 3 – 6 months post operatively, and responses to a questionnaire compared. For DACTS patients, response to treatment was measured using Boston (Levine) scores.

**Results:** During the study period no DACTS patients were considered to have been listed for surgery inappropriately. Overall patient satisfaction was similar in the two groups, (94% DACTS, 96% non-DACTS patients satisfied / very satisfied; 92% and 87% respectively would recommend their treatment). Some shortcomings were identified in the DACTS process: e.g., clear pre-operative understanding - 47 % DACTS, 71% non-DACTS patients; preference for their system of pre-operative assessment - 27% DACTS, 64% non-DACTS. Improvements in Boston scores were significant among DACTS patients.

**Conclusion:** Preoperative evaluation by postal questionnaire can be successful and satisfactory to patients. There is scope for improvement in some aspects of this scheme found to be less satisfactory. Such schemes may ease strain on outpatient resources.



**P257**

## **Nerve conduction studies and carpal tunnel syndrome - A diagnostic tool or a medicolegal move?**

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**Introduction:** Nerve conduction studies are sensitive tools in determining nerve entrapment disorders. Although used for various pathologies, its commonly used to help in the diagnosis of CTS. However CTS presents quite frequently with clinical signs which in itself are specific to its presence. We therefore wanted to see if requesting the study aided establishing the diagnosis.

**Methods:** At our unit, there are 3 surgeons with an upper limb interest and a senior physiotherapist who tend to patients with the above problem. 80 case notes were retrieved who had a decompression(20 from each responsible health professional) and an analysis of the patients presenting symptoms and clinical findings were documented. This was then correlated with the findings of the nerve conduction study and their functional outcome subsequently.

**Findings:** 68% of the patients had strong evidence for isolated CTS based history and examination alone and a further 18% were convincing. Only 14% had symptoms that were equivocal and possibly had symptoms originating more proximally which the nerve conduction study helped in discriminating site of compression. Nevertheless, in that 18%, some resolution of their symptoms became evident after decompression. 2% had complications including minor wound infection and a persistent painful scar.

**Discussion:** In the UK, pressure on waiting lists are enormous. The utilisation of the study in this series certainly aided confirming diagnosis but it is the opinion of the authors that sufficient evidence was present in a significant majority of the patients to proceed straight to a decompression. Clinical acumen is so heavily impressed on in medical schools and surgical training units that determining the diagnosis, certainly in the hands of the experienced surgeon is rarely suspect. We are not advocating excluding the study and am aware of the legal implications in doing so but are asking if the move is purely medicolegal based. If so, it is unfortunate and we value input from other centres on their experience with this.



**P258**

**Endoscopic carpal tunnel release in long-term hemodialysis patients: detection rate of amyloid and beta 2 microglobulin deposits**

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**Introduction:** Carpal tunnel syndrome in long-term hemodialysis (HD-CTS) is a major complication of hemodialysis-related amyloidosis. Good results have been reported with both endoscopic carpal tunnel release (ECTR) and open carpal tunnel release (OCTR). However, from the point of view of treatment of hemodialysis related amyloidosis, it is important to prove the presence of amyloid and beta 2 microglobulin( $\beta$ 2m) . It is thought that one disadvantage of ECTR is the limited amount of biopsy tissue able to be obtained. The purpose of this study is to review the positivity rates of amyloid and  $\beta$ 2m from the biopsy tissue to be obtained in ECTR and to evaluate the availability of ECTR.

**Patients and Methods:** Since 2000, 62 wrists (44 patients) with HD-CTS were treated by the first author using USE system one portal ECTR (Okutsu) and obtained flexor tendon synovium from skin incision. There were 20 men 31 wrists and 24 women 31 wrists, The mean age was 59 years old (range 44-75 years old) and the mean time between start of hemodialysis and surgery was 18.9 years (range 9-27 years). Preoperative seriousness was grade one: 13 wrists, grade two: 24 wrists, grade three: 25 wrists by Hamada's classification. Deposits of amyloid and  $\beta$ 2m in those specimens were examined by microscopy.

**Results and Conclusions:** The positivity rates for amyloids and  $\beta$ 2m were 92% (57/62 wrists). In comparison with previous reports, the findings are similar to those obtained in OCTR .



**P259**

**High-resolution MRI of carpal tunnel syndrome with a microscopy coil; The morphological change in the carpal tunnel by the finger motion**

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Thickening of the synovium around the flexor tendons have been considered the cause of idiopathic carpal tunnel syndrome but the pathogenesis has not been clarified. We investigated the morphological change in the carpal tunnel during finger motion using high-resolution MRI with a microscopy coil. Thirteen wrists were examined in twelve patients. They were diagnosed as idiopathic carpal tunnel syndrome on clinical symptoms and electrophysiological examination and finally underwent carpal tunnel release. They were all female and the mean age was 55.6 years old. As a control group, 10 wrists were also examined in 10 people without symptoms. They were seven male and three female and the mean age was 33.1 years old. A 1.5 T MR system (Philips) and a 47-mm microscopy surface coil were used. Coronal sections with 2.0 mm thickness with spacing of 0.2 mm were obtained by T1-weighted and T2-weighted fast spin echo and T2-weighted fast field echo. The F.O.V was 50 mm. We evaluated the cross-sectional area of the flexor tendons including their surrounding synovium and the median nerve in both finger extended and flexed positions. The structures in the carpal tunnel were clearly shown on the MR images. In patients, the cross-sectional area of the flexor tendons including synovium significantly enlarged in finger flexed position compared with finger extended position. In that position, the median nerve was compressed toward radioulnar direction by the enlarged synovium around FDP tendons which filled the ulnar side of central carpal tunnel. Significant enlargement of the diameter of the median nerve was observed at the more proximal level. On the other hand, in controls, these changes by the finger motion were a little observed. Therefore, we conclude that repeated mechanical stress by the flexor tendons with thickening of the synovium can result in pseudoneuroma of the median nerve neuropathy.



**P260**

### **Carpal Tunnel Syndrome and the UK workforce**

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**Introduction:** Little is known about the effect of Carpal Tunnel Syndrome (CTS) on different sections of the workforce.

**Methods:** We distributed a short questionnaire to 500 consecutive patients undergoing Carpal Tunnel Decompression (CTD), of which 204 were useable.

**Results:** Mean time off work pre-CTD was 0.95 weeks for the non-manual group (n=55) and 3.88 weeks for those in manual work (n=120), and mean times off work post-CTD were 4.62 and 9.64 weeks respectively.

53 patients (26%) changed job following their CTD, 13 non-manual workers (24%) and 40 manual workers (33%). Two (4%) from the non-manual group compared with 14 (12%) of the manual group attributed their job change to CTS. Two (4%) of non-manual workers compared with 15 (13%) of manual workers described their symptoms as the same or worse following CTD. Two (4%) of non-manual workers compared with 10 (12%) of manual workers were involved in compensation claims related to their CTS.

**Conclusions:** Based on these statistically significant differences, we conclude that life with CTS and after CTD is more challenging for manual compared with non-manual workers.



**P262**

**Endoscopic carpal tunnel release in the elderly**

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The present study aimed to clarify postoperative outcomes for endoscopic carpal tunnel release in elderly patients with carpal tunnel syndrome. Endoscopic carpal tunnel release was performed on 37 hands of 27 patients (2 men, 25 women) who were aged 70 years or older and clinically and electrophysiologically diagnosed with carpal tunnel syndrome. Mean age at the time of surgery was 74.5 years (range, 70-85 years). Mean postoperative follow-up was 35.5 months (range, 12-114 months). Pain was present preoperatively in 20 hands, but quickly resolved postoperatively in all cases. Numbness completely disappeared in 13 of 37 hands (35.1%), but some degree of numbness remained in the remaining cases. Preoperative severity of thenar muscle atrophy was none in 4 hands, mild in 7 hands, moderate in 12 hands and severe in 14 hands. Postoperative severity of thenar muscle atrophy at final follow up was none in 13 hands, mild in 16 hands, moderate in 2 hands and severe in 6 hands, confirming that thenar muscle atrophy improves even in elderly patients. However, moderate or severe thenar muscle atrophy remained in 8 hands (21.6%). Endoscopic carpal tunnel release should be considered in the elderly, even though clinical symptoms may not improve substantially in advanced cases.





**P263**

**Guyon's canal- A human design fault?**

**Cathryn Gray**

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An ulnar motor nerve palsy results from compression at Guyon's Canal. Unlike compression at the carpal tunnel, symptoms may be identified late due to a lack of sensory disturbance. Hence, repetitive compression at Guyon's Canal which result in an ulnar nerve palsy could be prevented if this design fault was highlighted. Our poster highlights the case of a 32 year old female who sustained an ulnar palsy from compression at Guyon's Canal following repetitive sport.



**P264**

**Sites of ulnar nerve compression at the elbow: Anatomic study**

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Five potential sites of ulnar nerve compression at the elbow were described: the arcade of Struthers, the medial intermuscular septa, the medial head of the triceps, Osborne's ligament and the flexor pronator aponeurosis.

Thirty five cadaver elbows were dissected to study this potential sites of static or dynamic compression and the possibility of secondary compression after anterior transposition.

An arcade of Struthers was present in 24 specimens. There is variation of length, position and structure. This arcade not appears compressive originally. Osborne's ligament, with a variable thickness, was present in all cases. The flexor pronator aponeurosis originated an average 5 cm distal to the medial epicondyle. In the 35 specimens there was not anconeus epitrochlearis muscle.

After transposition there was a possible conflict when the arcade of Struthers was less than 6 cm proximal to the medial epicondyle and when there was a flexor carpi ulnaris aponeurosis less than 5 cm distal to the medial epicondyle.

So when a transposition is necessary, a secondary compression can be prevent by an 11 cm incision with the cheking of all the potential sites of ulnar nerve compression.



**P265**

**Endoscopic carpal tunnel release by single portal: Pitfalls and technical tips**

**Stefan Bande**

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The author presents his personal experience in a large series of Endoscopically treated Carpal Tunnel Syndromes. From February 1994 till August 2006, 949 single portal ECTR were performed using the Concept Carpal Tunnel relief kit. Emphasis is put on the practical details of the intervention. The author concludes that with proper technique, this intervention is safe and leads to a high degree of patient satisfaction.



**P266**

### **Tensile properties of peripheral nerves differ at joint and non-joint areas**

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**Introduction:** Peripheral nerves in the limbs stretch to accommodate changes in length during normal movement. The upper limit to which nerves can be stretched before their function is compromised, has been subject of various experimental and clinical studies. However, literature lacks knowledge of the physiological tensile properties of peripheral nerves. The aim of this study was to examine the tensile properties of peripheral nerves relative to the position of the joint.

**Materials and methods:** Median and sciatic nerves of Wistar rats were examined. In situ deformation (strain) in joint and non-joint regions, caused by physiological joint movement, was examined using optical image analysis. The ex vivo stiffness of isolated samples of joint and non-joint regions was determined in a tensile testing machine. In addition, the histological fascicular/non-fascicular tissue architecture was compared between the two nerve regions.

**Results:** In each nerve the strain was significantly greater in the joint rather than the non-joint regions (2-fold in the median nerve, 5- to 10-fold in the sciatic). Tensile testing of isolated samples of joint and non-joint regions of both nerves showed that joint regions were less stiff (more compliant) than their non-joint counterparts with joint: non-joint stiffness ratios of  $0.5 \pm 0.07$  in the median nerve, and  $0.8 \pm 0.02$  in the sciatic. The fascicular/non-fascicular tissue architecture could not explain the observed tensile heterogeneity.

**Conclusion:** This study identified differences in tensile properties of peripheral nerves between joint and non-joint regions (increased strain and decreased stiffness at articulations) . This is important in understanding normal dynamic nerve physiology. Furthermore, it puts new perspective on experimental and clinical aspects of surgical nerve repair under tension.



**P267**

**The treatment of compression of the ulnar nerve at the elbow by V-Y anterior transposition**

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**Purpose:** To show a new technique by the author that can improve function of the hand and wrist caused by compression of the ulnar nerve.

**Methods:** A new procedure was developed, performed the usual manner, a medial incision over the elbow, the ulnar nerve is exposed, freed at the ulnar groove and neurolysis is performed if indicated. The medial intermuscular septum is excised and the nerve is mobilized proximally. The nerve branches of the ulnar nerve supplying the flexor carpi ulnaris and flexor profundi of the ring and little fingers are mobilized, dissected, and retracted. The origin of the flexor muscles are dissected and V-Y plasty performed. The incision is made like a V shape and closed like a Y shape. With this method, the nerve is transposed in the new created bed, there is approximately 5 to 6 cm of lengthening of the flexor muscles, and a wide space is created for the ulnar nerve. This space is much larger compared with the previous method.

**Summary:** Results: Excellent 75%, and Good 25%. No fair results and no failures.

**Conclusion:** This method has less recurrences of compression than previous methods.



**P267b**

## **Reproducibility of three tests for the evaluation of hand sensibility in Asymptomatic individuals**

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**Objective:** Sensibility is a conscious interpretation of sensorial stimuli from the environment and its loss or alteration causes significant functional losses. This fact reveals the complexity involved in the measurement of a system that is not completely defined yet. Many tests have become popular regarding the evaluation of hand sensibility. Other several tests have been described, although none of them has been accepted as gold standard for the evaluation of hand sensibility. The objective of this cross-sectional study is to assess the interobserver reproducibility of the Semmes-Weinstein monofilaments test and the two-point discrimination test: Statistics and Dynamics.

**Material and Methods:** In order to accomplish that goal, 80 healthy subjects with mean age of 20.8 years old (standard deviation = 3.5) were selected and accepted to take part in the study.

**Results:** Two different researchers administered the tests to these subjects. Kappa coefficient was used to evaluate the agreement between the researchers for each test. The two-point discrimination test (statistics and dynamics) did not present a statistically significant agreement ( $p > 0.05$ ), and in the monofilament test, even though there was a high percentage of agreement between the observers, the statistical calculation of kappa coefficient was negatively influenced by the lack of data variability.

**Conclusions:** It is possible to conclude that most of the tests did not present agreement between the researchers, and further studies are necessary to confirm these findings.



**P267c**

**Endoscopic carpal tunnel release using modified Chow's extrabursal dual portal technique: Clinical results of 957 patients**

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**Introduction:** The purpose of this study is to evaluate the clinical results of endoscopic carpal tunnel release using modified Chow's extrabursal dual portal technique in 1120 wrists in a single center.

**Material and Method:** A total of 1120 wrists in 957 patients were collected during 10-year period. All operations were performed under local anaesthesia. A 1-cm incision was marked 1 - 2 cm proximal to the distal wrist crease, in the midline, ulnar to the palmaris longus. A distal portal was established along a line bisecting an angle created by the intersection of the ulnar border of the abducted thumb and the third web space. An obturator and cannula assembly was inserted under the, and three blades were used to cut the under endoscopic vision.

**Results:** Subjective results showed that 1008 hands (90%) had a reduction in the severity of pain after carpal tunnel release, 1008 hands (90%) had a reduction in the severity of paraesthesia and 1041 hands (93%) had a reduction in the severity of numbness. Nocturnal pain and paresthesia were relieved in 1065 cases (95%).

**Discussion:** Conventional open carpal tunnel release, limited open carpal tunnel release, and endoscopic carpal tunnel release (single or dual portals) are available. Less postoperative pain and faster recovery has been reported following endoscopic carpal tunnel release when compared top conventional open carpal tunnel release.

**Conclusions:** This study suggests extrabursal dual portal technique is a safe and reliable treatment option for carpal tunnel syndrome with high success rate.



**P267d**

### **Double crush syndrome in upper extremity**

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**Purpose:** To evaluate the incidence and the treatment of the double crush syndrome of the upper extremities occurring among the nerve entrapment syndrome patients.

**Patients And Methods:** A total of 75 nerve entrapment syndrome patients, who had visited the hospital between March 2004 and December 2005 were included in the study. The incidence of the double crush syndrome was investigated, and the diagnosis was made clinically based on the patients' symptom, physical examination and electromyographic results. The subjective symptoms were evaluated using Cseuz criteria, and the alleviation of the pain and tingling sensation using Visual Analogue Scale (VAS).

**Results:** Among 75 Nerve Entrapment Syndrome cases, 49 were single nerve entrapment syndrome and 26(34%) were double crush syndrome. For the treatment of the last 26 cases, simultaneous multiple decompression surgery was given to the other 5 cases (Group A), and injection therapy and step-by-step decompression surgery were given to 6 cases (Group B), and conservative therapy including injection was given to 15 cases(Group C). The improvement of subjective symptoms better than 'good' of the Cseuz criteria was observed in 75% of the A group and in 60% of the B group and in 50% of the C group. The pain sensation decreased after the surgery from VAS 8 to 3.3 in the A group, and from VAS 7 to 4.3 in the B group, and from VAS 8.3 to 4.6 in the C group. The tingling sensation decreased after the surgery from VAS 7 to 2.7 in the A group, and from VAS 6.6 to 4 in the B group, and from VAS 7.2 to 4.6 in the C group.

**Conclusion:** Since the double crush syndrome frequently occurs in the nerve entrapment syndrome patients, it will be helpful for the patient treatment to check the presence of the double crash syndrome before the surgery and need multiple decompression surgery to double cr ush syndrome.





**P267F**

### **Cortical plasticity in response to peripheral nerve trauma in children**

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**Background:** Recovery from peripheral nerve injury in adults results in profound abnormalities in sensory perception. Superior peripheral nerve regeneration in children could be inferred. We have previously shown that the cortical representation area for the median nerve is changed in adults after median nerve trauma and surgery. The aim of this study was to evaluate young persons injured in childhood.

**Material:** Eight patients (6 men and 2 women) aged 12-24 with a total unilateral median nerve injury at the wrist level were examined. Six of the patients were injured before the age of 16, the remaining two at 18 and 21 respectively.

**Method:** The cortical activity was mapped with functional magnetic resonance. The activation was produced by stimulation of digits II and III of the injured and uninjured hand separately. Tactile gnosis was tested with static 2-point-test and Semmes-Weinstein filaments.

**Results:** The tactile gnosis measurements showed normal two-point discrimination in 3 patients, fair in two, poor in one and protective in two. The Semmes Weinstein monofilament test revealed three patients with only diminished light touch and five with diminished or lost protective sensation. The activated area in response to stimulation of the injured hand did not differ significantly in size compared to the activated area when the uninjured hand was stimulated. In contrast, in a similar study of adults with median nerve damage, stimulation of the injured hand was found to produce a larger area of activation.

**Conclusion:** These results support the concept of plasticity as the important mechanism for the superior functional recovery in the young.



**P267g**

**Endoscopic carpal tunnel decompression – Ten years experience with the uniportal technique**

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**Purpose:** The author reviewed 474, out of a group of 815 cases, operated upon by the Agee uniportal endoscopic technique over a ten year period ending July, 2004, to analyze the effectiveness and safety of endoscopic carpal tunnel decompression.

**Methods:** Endoscopic carpal tunnel releases were all performed by the author using the Agee uniportal endoscopic technique. The study group had an average 4.5 year follow-up, range 1 to 10 years. An analysis was made of complications, late symptoms, time off work, and patient satisfaction. Females predominated by a nearly two to one ratio. 235 received Worker's Compensation insurance, and 239 did not. Nine per cent (n=42) had diabetes mellitus. Cortisone injections, as conservative treatment preoperatively, had been given twice in 98%, and three times in 82%. Severity was determined through an analysis of symptoms, provocative tests, thenar atrophy, and electrophysiologic testing. Patients were placed in one of four severity grades, minimal, mild, moderate or severe. Seventy three percent were either moderate or severe.

**Results:** Complications were analyzed. There were no lacerations of tendon, nerve or artery. There was 1 neuropraxia of the common digital nerve to the third web space, which spontaneously cleared over a four month period. Two patients had symptoms of very mild chronic regional pain syndrome, which again cleared. There were no repeat carpal tunnel operations. Those not receiving Worker's Compensation were off work 5.2 weeks, compared to 8.2 weeks for those who did not. This difference remained true for both manual workers (6 vs. 8.8 weeks), and for sedentary occupations (4.4 vs. 7.6 weeks). Symptoms persistent more than 4 months postoperative were present in 21% of Worker's Compensation recipients, vs. 7% in non-Workers' Compensation patients.

**Conclusion:** The Agee Uniportal Endoscopic Method for the treatment of carpal tunnel syndrome is safe, and gives excellent functional results and patient satisfaction.



**P268**

**Comprehensive study of bridging 10-20mms long nerve defects with autologous vein and PGA tubes**

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**Introduction:** Nerve defects were bridged with autologous saphenous vein (AVSM) and polyglycolic acid tubes (PGA) in animal experiments. We compared the regeneration in cases of 10 and 20mms gaps.

**Methods and materials:** We used the sciatic nerves of canadian white rabbits. In the first group 20mms segment of the sciatic nerve of 10-10 rabbits were resected. The nerve-stumps were inserted 2-3mms into the lumen of the AVSM and PGA tubes and fixed with 10/0 thread with a gap between the ends of 10mms. In the second group we used 10-10 rabbits with a nerve defect of 20mms. EMG examinations were done at 1,2,3,6,9 and 12 months after the operation. The animals were sacrificed 2-12 months after the procedure. The nerves were resected 5-5mms proximally and distally from the grafts. Slide-series were made from the graft. The regeneration was evaluated with qualitative and quantitative methods.

**Results:** We examined the surrounding tissue-reaction. The number of white blood cells were counted at 450x magnification. These numbers were significantly higher in the cases of the PGA tubes. The fibrosis was also greater in these cases. Two months after the operation only few myelinisated fibers reached the distals stumps. The nerve fibers at the periferic areas did not grow paralelly, they showed a great turbulence and many neuromas were seen. After 6 months only segments of the PGA tubes were present, but the elastic fiber of the veins were well detectable. Any time we examined the number of the myelinisated fibers, it was significantly higher in the cases of the 10mms long defects than in the cases of the 20mms gaps. We examined the myelinisated axon numbers and the fiber diameter.

**Conclusion:** In both groups bridging the nerve defects with PGA tubes showed better results. The 20mms long gap can be considered as a critical distance for the regenerating fibers in both cases.



**P269**

**The effect of proteasome inhibition in peripheral nerve reperfusion injury**

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**Introduction:** The proteasome is known to play an important role in the regulation of proteins that control cell-cycle progression and apoptosis . It also regulates the N F- kB that has been known as an important transcriptional factor to mediate the inflammatory pathway involved in the tissue reperfusion injury. This study was designed to assess whether the proteasome inhibitor, bortezomib ( a dipeptide boronic acid derivative, Velcade™, Millennium Pharmaceuticals, Cambridge, MA) can attenuate the peripheral nerve ischemia/reperfusion ( I/R) injury and consequently promote motor functional recovery .

**Materials & Methods:** The rat sciatic nerve was exposed 2 h of ischemia and followed by various period of reperfusion. The rat received either 0. 3mg/kg of bortezomib or the same amount of phosphate buffered saline (PBS) intraperitoneally at 30 min before the start of reperfusion. The results were evaluated using a walking track test, isolated muscle contraction test, muscle weight, and histology.

**Results:** The bortezomib treatment revealed significantly earlier improvement in sciatic functional index (SFI) and induced faster restoration of the contractile force and muscle weight of the extensor digitorum longus (EDL) muscle. Histology showed that the bortezomib treatment reduced axonal degeneration and promoted earlier regeneration compared to PBS-treated group.

**Conclusion:** This study indicates proteasome inhibition is effective in promoting functional recovery of the reperfused peripheral nerve and can be a potential strategy in attenuating peripheral nerve I/R injury.



**P270**

### **The inhibitory effects of rat spinal cord chip on peripheral nerve regeneration**

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**Introduction:** The fact that nerve regeneration is strongly suppressed after spinal cord injury is common knowledge. And, it is known that the neuronal growth inhibitory factors such as Nogo, MAG (myelin-associated glycoprotein), and CSPG (Chondroitin sulfate proteoglycan) are included in the spinal cord. However, little is known about the effects on peripheral nerves by neuronal growth inhibitory factors in the spinal cord. The purpose of this study is to clarify the effects of spinal cord chip on peripheral nerve regeneration.

**Materials and methods:** A silicone tube was implanted between the severed rat's sciatic nerve gap of 10 mm. The silicone tubes, which included spinal cord chip, boiled spinal cord chip, frozen and thawed spinal cord chip, sciatic nerve chip or a piece of adipose tissue from another SD rat, were grafted. Histological examinations were done with a light microscope 4 weeks after the operation. In addition, neurofilaments, macrophages and Schwann cells were examined immunocytochemically using anti-neurofilament antibody, anti-macrophage ED1 antibody and anti S100 protein antibody.

**Results:** No regenerated nerves were seen in the spinal cord chip grafted groups, the boiled spinal cord chip grafted group or the frozen and thawed spinal cord chip grafted group. In contrast, regenerating nerve bridges were seen in the sciatic nerve chip grafted group, the adipose tissue grafted group and control group. These results indicated that a spinal cord chip suppressed peripheral nerve regeneration.

**Conclusion:** An allografted spinal cord chip suppressed peripheral nerve regeneration.



**P271**

### **The "bioartificial living nerve graft"**

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**Introduction:** Since our first description intramuscular application of 25 -50 mouse units (DYSPORE, R) botulinum toxin type A at two sites of the target muscle is a useful tool in the treatment of brachial plexus in many centers.

**Patients and Methods:** 42 patients have been treated in our institutions. Some patients had injection on more than one site. This technique is used in our institution for 1) prevention of internal rotation deformity at the shoulder (n = 6), 2) muscular co-contraction treatment at the biceps/triceps (n = 32) and deltoideus/teres major (n = 12).

**Results:** For prevention of internal rotation deformity at the shoulder Botulinum toxin is injected only one time intraoperatively into the subscapular muscle the the time of early microsurgical revision of the brachial plexus in 6 patients. In every patient passiv extenal rotation could be maintained > 40° during the postoperative course and after nerve regeneration this range of motion could be used actively. 32 children (1 - 4 years) presenting severe biceps-triceps co-contractions after nerve regeneration of an obstetrical brachial plexus lesion were treated with local injections. Botulinum toxin injections were monitored by EMG recordings. Clinical testing (muscle power graded by the British Medical Research Council classification and measurement of the active range of motion using the Neutral-0-Method) and EMG studies were performed prior and after injections. Follow-up was at least 24 months. Mean active elbow flexion prior to application was about 50° (range: 20 - 60°) and muscle power was graded M2 (6 cases) to M3 (26 cases). 24 months after injection mean elbow flexion is about 100° (range: 80 - 120°) and muscle power is graded M4 in all cases. There was no recurrence of co-contraction in any of the patients after an 18 months follow-up.

**Discussion:** The effect of local injetion of the teres major muscle are less spectacular that in the triceps. At least 3 injections and a heavy physical therapy programme are necessary. After the first injection a "softening" of the scapulo-humeral contraction can be seen. An increase of the active range of motion in abduction and flexion will result after 2 injection (n = 4) or most often after 3 injecions (n =8). Local injections of botulinum toxin type A represents a new effective non-operative adjuvant tool for treatment in obstetrical brachial plexus lesions. Especially its potential in prevention of deformities by early application should be more investigated in the future.



**P272**

**Delayed radial nerve laceration due to repeated trauma by sharp blade of a K-wire pin**

**Mohammad Javad Fatemi**, Maryam Mansoori, Hamid Malekan

*Hazrat Fatemeh, Iran Medical Science University, Tehran, Iran*

Neurovascular complications associated with supracondylar fracture of humerus are well recognized but delayed radial nerve laceration due to repeated trauma by sharp blade of a K-wire pin has not been previously reported. Usage of a proper length K-wire pin without a sharp blade is critical to minimize this rare unusual complication.



**P273**

**Presentation of a technique for peripheral nerve grafting in severe scar tissue: two stage nerve graft**

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**Introduction:** Although several techniques exist for treatment of large peripheral nerve gaps in scarred tissue, none have resulted in uniformly satisfactory outcome. Two stage graft techniques have been previously used in tendon and bone injuries. In this study, we used "two stage nerve graft" for sciatic nerve injuries with large gaps in scar bed in rats.

**Material and Method:** 17 mm of right sciatic nerve was resected in 20 female Wistar rats (200-250 gr). Scar formation was induced by local administration of tetracycline powder in nerve gap bed. Animals were divided into two groups. In group 1, a 20mm silicon tube was sutured to free nerve ends, but in group 2 nerve ends were left free. After four weeks, at second operation, nerve defects in both groups were grafted by using median nerves of each animal as donor. In group 1 nerve graft was performed without causing any disturbance to the membrane that was formed around the silicon tube. 16 weeks after second operation; functional, morphometric and immunohistochemical assessments were performed in both groups in order to evaluate the outcome of the graft.

**Results:** Motor and sensory functional recoveries were measured by "Extensor Postural Trust"(EPT) and "Withdrawal Reflex Latency"(WRL) respectively. Both measures showed significantly greater degree of recovery in group 1 ( $p < 0.05$ ). Same results were observed on morphometric and immunohistochemistry tests.

**Conclusion:** The results of this study suggest that Two Stage Nerve Graft in severely scarred bed tissue can significantly improve graft outcome.





**P274**

**NGF S7 promoting factor administration combined with an epineural conduit for bridging short nerve defects in the rabbits sciatic nerve. Experimental study- Early results**

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**Aim:** Peripheral nerve regeneration through an epineural flap conduit in which NGF-S7 promoting factor was daily administrated was examined in this experimental protocol.

**Material-Methods:** Two groups including 48 New Zealand rabbits were used. There were 2 study groups (A and C), A consisting of 36 animals and C called and control group consisting of 12 animals.

A 10-mm long sciatic nerve defect was bridged either with a specially designed advancement epineural flap (Group A) or with a classical nerve graft (Group C). NGF-S7 promoting factor was daily, locally administrated by a specially installed subcutaneous pomp, for 20 days.

Animals from all groups were examined 21, 42 and 91 days postoperatively to evaluate nerve regeneration employing light microscopy and immunocytochemistry. Nerve regeneration was studied in transverse sections at 3, 6 and 9 mm from the proximal stump. Using electromyography the gastrocnemius muscle contractility was also examined prior to euthanasia at 91 days post surgery in all groups.

**Results:** Immunohistochemical, histochemical and functional evaluation showed nerve control group.

**Conclusion:** An epineural flap can be used to bridge a nerve defect with success, especially when an NGF S7 promoting factor is locally administrated.



**P275**

**RGTA, a synthetic glycosaminoglycan mimetic, significantly reduces neural adhesions after peripheral nerve injury in rats**

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**Object:** Extra- and intraneural scar formation after peripheral nerve injury frequently causes tethering and compression of the nerve as well as inhibition of axonal regeneration. ReGeneraTing Agents (RGTA) mimic the stabilizing and protective properties of sulphated glycosaminoglycan (GAG) towards heparin-binding growth factors (HBGFs). The aim of this study was to assess the effect of a RGTA, on extraneural fibrosis and axonal regeneration after crush injury in a rat sciatic nerve model.

**Methods:** Thirty-two female Wistar rats underwent a standardized crush injury of the sciatic nerve. The animals were randomly allocated to RGTA treatment or sham treatment in a blinded design. To score neural adhesions, the force required to break the adhesions between the nerve and its surrounding tissue was measured 6 weeks after nerve crush injury. To assess axonal regeneration, magnetoneurographic (MNG) measurements were carried out after 5 weeks. Static footprint analysis was performed preoperatively and 1, 7, 14, 17, 21, 24, 28, 35, and 42 days postoperatively.

**Results:** MNG data show no significant difference in conduction capacity between the RGTA and the control group. In addition, results of the static footprint analysis demonstrate no improved or accelerated recovery pattern. However, the mean pull-out force of the RGTA group (67 g; SEM 9 g) was significantly ( $p < 0.01$ ) lower than that of the control group (207 g; SEM 14 g).

**Conclusion:** RGTAs strongly reduce nerve adherence to surrounding tissue after nerve crush injury.



**P276**

**Experimental study of novel biodegradable polymer conduit filled with gelatin incorporating FGF-2 for peripheral nerve defect**

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Recently, various biodegradable polymer tubes have been reported. However those results were not satisfying enough for clinical use. The purpose of this study is to introduce our novel biodegradable polymer tube filled with gelatin incorporating FGF-2 as drug delivery system (DDS) and to report its effect on peripheral nerve regeneration and angiogenesis.

**Materials and methods** Study #1; DDS of gelatin incorporating FGF-2 in vivo> we prepared 125I FGF-2 solution and gelatin microsphere in 125I FGF-2 solution for 10 min. They were implanted into subcutaneous tissue of Wistar rat and measured the residual 125I FGF-2 at 1h, 1D, 7D and 14D post implantation. Study #2; effects of DDS of gelatin incorporating FGF-2 on peripheral nerve regeneration and angiogenesis> we implanted biodegradable polymer conduit filled gelatin with or without incorporating FGF-2 into 12 mm sciatic nerve gaps in Wistar rats. At 12 weeks after implantation, number of regenerating nerves and vessels at mid-conduit were observed histologically.

**Results:** Study #1 injected 125I FGF-2 solution was soon absorbed in a couple of days. However 80% incorporated FGF-2 could remain at 1h after implantation, 60% at 1D, 40% at 7D, and 20% at 14D. After all 40% FGF-2 had been gradually released during 2 weeks. Study #2 concerning FGF-2, the results of nerve regeneration at 12 weeks obviously showed the advantage of DDS with FGF-2. And the number of vessels and total area of vessels in conduit significantly increased with FGF-2, too.

**Conclusion:** this study shows our conduit filled with gelatin incorporating FGF-2 is a reliable DDS and it is very useful for tissue engineering methods in peripheral nerve repair. And this DDS using gelatin could have a significant effect on peripheral nerve regeneration and angiogenesis



**P277**

**Functional evaluation of cold stored versus cryopreserved allogenic epineural sheath grafts for repair of 25mm rat sciatic nerve gap**

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**Introduction:** Epineural sheath (ES) allotransplantation provides unlimited amount of grafting material, but immunosuppression may be necessary. ES allotransplantation outcome may be improved by cold storage or cryopreservation by decreasing immunogenicity.

**Purpose:** To compare functional results of rat sciatic nerve gap repair using cryopreserved (CRESa) and cold stored (CSESa) ES allografts.

**Material And Methods:** 12 Lewis rat recipients were divided into 2 groups of 6 animals each. ES were harvested from BN rats and each one was divided into two strips. CRESa were stored in liquid nitrogen for 3 days. CSESa were stored in +4C. A 25mm gap was created in recipient's sciatic nerve and defect was bridged with CRESa in group 1, CSESa in group 2. All recipients received 7 days protocol of  $\alpha\beta$ TCR and CsA. Nerve regeneration was evaluated by pin prick and toe spread at 3, 6, 12, 24 weeks and by somatosensory evoked potentials examination (SSEP) at 12, 24 weeks. At 24 week gastrocnemius muscle index was evaluated.

**Results:** Average pin prick score (3, 6, 12, 24weeks): CRESa (0.8, 2.4, 3, 3), CSESa (1, 1.8, 3, 3). Average toe spread score (3, 6, 12, 24weeks): CRESa (0, 0.8, 1, 1.4), CSESa (0.2, 0.5, 1, 1). SSEP (p1, n2 latencies; p1, n2, % of normal values) at 12 week: CRESa (17.6, 24.9; 82%, 84%), CSESa (17.0, 23.8; 84%, 80%), at 24weeks: CRESa (18.3, 24.0; 89%, 85%), CSESa (17.9, 24.0; 80%, 79%). Gastrocnemius muscle index in CRESa group was 18.2%, in CSESa group it was 18.4%.

**Conclusions:** Recovery of sensory function evaluated by SSEP and pin prick, and motor function measured by toe spread and gastrocnemius muscle index is similar in both groups. CRESa seem to have better clinical application because is more feasible to store for long time periods giving similar functional results.



**P279**

**Efficacy of an isolated nerve segment for nerve regeneration through nerve conduit using autogenous vein**

**Lee J** , Lee D

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**Purposes:** Alternative sources for nerve grafts have included: veins, muscles, and bioabsorbable tubes. Despite some encouraging studies, their functional results remain unclear. The purpose of this study was to assess the effect of different sized nerve segments which were excised from a proximal nerve stump and inserted through autogenous vein grafts on peripheral nerve regeneration.

**Materials and methods:** In group I of the rats studied, 10mm of sciatic nerve was removed unilaterally, and a gap was bridged with the jugular vein taken from the neck. In group II, 12mm of sciatic nerve was removed, and a 2mm nerve segment was introduced to the center of a bridging vein. In group III, 14mm of nerve was removed and a 4mm nerve segment was inserted at the center of the bridging vein.

**Results:** Histological and electrophysiologic examination was performed four months after surgery. Quantitative analysis of myelinated nerve fibers showed that both the total number and fiber diameters of myelinated fibers were significantly greater in group II than in group I or group III there was no statistical difference between group I and group III. Electrophysiologic examination showed that there was no statistical difference in the Compound Muscle Action Potential (CMAP) and Nerve Conduction Velocity (NCV) in the three groups.

**Conclusions:** This study shows that a short nerve segment, which is excised from a proximal or distal nerve stump and inserted at the center of the bridging vein for nerve reconstruction of the sciatic nerve in the rat is less influenced by the size of the nerve defect, and can stimulate regeneration by preventing collapse of the bridging vein. However, a long isolated nerve segment inserted at a bridging vein has the same efficacy as an autogenous vein graft alone for nerve regeneration. Our findings suggest that inserting a proper length of the nerve segment at a bridging vein is an effective method that is an alternative to the autogenous vein graft.



**P279**

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**P280**

**An investigation about the effect of mild ethanol alcohol consumption on peripheral nerve healing**

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**Introduction:** In this study, we aimed to determine the effect of ethanol intake on peripheral nerve healing in rats.

**Material and Method:** Thirty two adult, male, healthy, Wistar Albino rats were randomly assigned to four groups. Group 1 (n=9), consist of without nerve repair and taking non-alcoholic modified liquid diet as control group; Group 2 (n=9), nerve repair without taking non-alcoholic modified liquid diet; Group 3 (n=6), taking 7.2% alcohol containing modified liquid diet without nerve repair and, Group 4 (n=8), taking 7.2% alcohol containing modified liquid diet with nerve repair. The animals were sacrificed after post operative 2 month and nerve (posterior tibial nerve) and muscle (gastrocnemius muscle) samples from the operated right extremities were obtained for histological analysis.

**Results:** On histological analysis, the axonal degeneration were found as severe in group 4, moderate in group 2 and mild in group 3. The analysis of muscle specimens showed that there was a considerable atrophy of type II fibers in group 3, neurogenic atrophy and atrophy of type II fibers in group 4, neurogenic atrophy only in group 2. The counted number of myelinated axons in Group1-4 was shown on table 1 and there was a significant difference at the comparison of the groups according to the number of myelinated axons (Table 2).

**Conclusion:** Our study showed that even mild alcohol intake contribute significant myopathy and deteriorates the peripheral nerve healing.

**Table 1.** The comparison of the groups according to the number of myelinated axons.

	p value			
	Group 1	Group 2	Group 3	Group 4
Group 1		<0.001	<0.001	<0.001
Group 2	<0.001		<0.01	<0.001
Group 3	<0.001	<0.01		=0.001
Group 4	<0.001	<0.001	=0.001	



**P281**

### **Outcomes of median and ulnar nerves in repair of spaghetti wrist injuries**

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**Objective:** The aim of this survey is to determine the sensory motor recovery of median and ulnar nerves in repair of spaghetti wrist injuries.

**Materials & Methods:** 33 Patients (31 male, 2 female) with Spaghetti wrist due to sharp injuries who were operated by one surgeon, presented early after surgery to hand Rehabilitation center with early rehabilitation programs by one hand therapist for 10 weeks include early mobilization and early sensory re-education , and then sensory evaluation were assessed with mono semmes- weinstein mono filament and power and pinch were assessed by jammam dynamometer , range of motion were assessed by flexion gap evaluation. The effects of sex, age, time of surgery, difference of power and pinch between injured and intact hand due to kind of injury and sensory recovery were assessed.

**Results:** Thirty-three Patients were included in this survey. In evaluation of median nerve in the given time, all of them had diminished of light and protective touch in pulp of index finger. In ulnar nerve 44.4% had diminished protective and light touch and 55.6% had absent of protective sensation in pulp of little finger. In evaluation of pinch and grip, difference of them with intact hand with  $p\text{-value}=0$  had better recovery in median nerve .In combined median and ulnar nerve injuries, power grip and pinch were less to individual injuries. Age and sex had not any effect in outcomes (correlation =0.99). Flexion gap in all patients were zero after given time. Delay time between injury and surgery had positive effect on outcomes.

**Conclusion:** Early surgery and intervention have the best effects on spaghetti wrist Motor and sensory recovery although results were better in median nerve injuries versus ulnar nerve ones.





**P281b**

### **Zachary transposition technique for radial nerve palsy**

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Radial nerve palsy is a common nervous lesion in which tendinous transposition techniques may play an important role. It consists of diverting the original insertion of a tendon to another. These techniques are destined to motivated patients, since it is important that in the immediate pos op there isn't a loss of range of motion. They are surgically demanding because a full knowledge of anatomic, functional, and biomechanical knowledge of the hand is needed.

Tendinous transfer may rehabilitate lost of wrist and finger extension due to radial palsy. The authors revised 9 patients submitted to the Zachary technique and compared it with other techniques. There is a risk of radial deviation, but Zachary technique had good functional results with a high degree of patient satisfaction.

All the patients submitted to tendinous transposition by this procedure from January 1991 to December 2000 were selected. All patients were submitted to an EMG and the paralyse classified as high radial palsy or low radial palsy accordingly to the involvement of wrist extension. We used the Zachary tendinous transfer technique, with immobilization in a plaster splint for 3 weeks. The follow-up consultations were at 3 weeks, 3 months, 6 months, 1 year and once a year. The physical evaluation involved range of motion.

9 patients were submitted: 7 men, 2 women; 43 years of age average. The aetiology of the radial palsy was traumatic in all patients. Mean evolution time of palsy was of 8 months. Mean follow up of 48 months. There were no infectious complications.

There are more than 60 surgical procedures for Radial nerve palsy correction. Nowadays we are still discussing the muscles to transpose. The tendinous transfers still are an up to date technique. The Zachary transposition technique showed good results in our study.



## P281c

### **Mixed nerve repair by means of biological conduits: Results of 23 consecutive cases treated with muscle-vein-combined grafts**

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Although autogenous nerve grafting is still considered the best method for bridging nerve defects, several alternative types of conduits (biological and synthetic) have been studied. We have demonstrated in previous experimental research that a graft made using a vein (providing a guide for nerve regeneration) filled with fresh skeletal muscle (to prevent vein collapse and support axon regeneration) gave similar results to traditional nerve grafts, in the rat. On this basis, we decided to use the muscle-vein-combined grafts in clinical cases not only for sensory nerves but also for mixed nerves.

We reviewed 23 patients operated from 1993 to 2004 with this technique. The mean follow up was 26 months (minimum 14 months – maximum 58 months). The mean length of conduits was 2.5 cm (0.5 to 6 cm). Case series: 4 radial nerve at the elbow level, 9 median nerve at the distal third of the forearm, 6 ulnar nerve at the forearm, 1 ulnar nerve at the wrist, 1 ulnar nerve at the arm, 2 proximal cord of the brachial plexus. We evaluated our results by the criteria of the Nerve Injuries Committee of the BMRC modified by Mackinnon-Dellon. We classified the results in three groups with the grading system proposed by Sakellarides. Very Good:  $\geq$  M4 /  $\geq$  S3+; Good: M3 / S3-S2+; Poor: < M2 / < S2+. In 12 (52%) cases we had a good and very good results. In 6 cases (26%) a good sensory restoration has been not accompanied by a good motor recovery. In 2 cases (8.5%) we had a good motor recovery and a fair sensory recovery. In the last 3 cases (13%), in gap longer than 3 cm, we had a fair results both for sensory and motor recovery. *Conclusions:* The clinical employment of tubes as an alternative to autogenous nerve grafts is mainly justified by the limited availability of donor tissue for nerve autograft and its related morbidity. Indication, in this little series of patients operated in ten years, had been very restricted : treatment in emergency, not enough nerve graft, no will of the patient on harvesting a healthy nerve.



**P282**

### **A Care plan model for treatment of complex regional pain syndrome I (CRPS Type I)**

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**Purpose:** The aim of this work was to design a standard care plan for early treatment of patients showing pathological post-traumatic signs to increase the chance of avoiding development of Complex Regional Pain Syndrome (CRPS).

**Methods :** A review of the literature of existing therapies for CRPS from 1990 to 2001 was conducted from Medline and Pubmed. Based on these findings and the experience of our clinic and the department of Anaesthesiology, we designed a care plan for CRPS. We decided to focus the treatment on a multidisciplinary team effort. NSAID and Paracetamol were prescribed to all patients treated for hand/arm injuries or elective surgery showing oedema, pain, disturbed sensibility, dystonic or dystrophic signs from two weeks after injury/surgery. They were also referred to occupational-and physiotherapists for daily hand/arm therapy. If symptoms remained after three to four weeks the treatment intensified if necessary with mild opioids , Tricyclic antidepressant and referral to the team anaesthesiologist.

**Conclusion :** Diagnosis is often delayed due to the resemblance of normal post-traumatic signs in the early stages of CRPS and CRPS can lead to lifelong suffering and functional debility resulting in financial loss for patients and society.

Various treatment modalities of CRPS are described in the literature. Hand therapy is often the only treatment in simple cases. Pharmacological agents and sympathetic blocks may be needed for pain . With a standard care plan, patients with abnormal post-traumatic symptoms may be diagnosed and treated early.



**P283**

### **Arthroplasty of CMC joint of thumb**

**Balakrishnan Govindasamy**

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Osteoarthritis of carpo metacarpal joint of thumb is a disabling degenerative disease. The individual is crippled with pain and poor hand function. It leads to restriction of professional and social activities. Persistent pain, progressive handicap and failure of conservative management are indications for surgical management of CMC joint arthritis. The various options available are gap arthroplasty, interpositional arthroplasty and replacement arthroplasty. In this paper, we review our technique of interpositional arthroplasty. Gap arthroplasty is technically easier, but leads to shortening of thumb and instability of basal joint. Replacement arthroplasty is costlier and the complication rate is more. Interpositional arthroplasty gives good stability of basal joint. There is no shortening and mobility is restored faster. Over the last 3 years 5 patients with CMC arthritis underwent this procedure. The diseased trapezium is excised and half of flexor carpi radialis tendon was used to fill up the gap. All the patients had improvement in the range of movement and pain relief. This is one of the most rewarding and satisfying surgeries in hand surgery. We present our experience with this technique and the results.



**P284**

### **Unusually large wrist glomus tumour**

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*3 Department of Radiology, Tan Tock Seng Hospital, Singapore*

Wrist glomus tumours are extremely rare, with only 7 cases reported in the literature. Here we report a case of unusually large wrist glomus tumour with atypical presentation. MRI findings correlated well to those previously described for digital glomus tumours. This rare differential should be considered when evaluating lesions around the wrist.

A 29-year-old Indonesian lady presented with an 8 year history of a lump over the volar-ulnar aspect of her right wrist, slowly increasing in size. There was also paraesthesia along the ulnar nerve distribution. In addition she complained of increasing localized pain over the preceding months. Physical examination revealed a 5 cm diameter mass of soft consistency in the subcutaneous tissue plane, which was not compressible or pulsatile. The mass, however, did not demonstrate local tenderness or cold sensitivity. Tinel's sign was negative, and there was no numbness or weakness elicited in the hand. MRI showed a well defined homogenous lesion between the palmaris longus and flexor digitorum superficialis muscles showing intermediate signal intensity on T1 weighted images with a hyperintense signal on T2 weighted images. The median nerve was also displaced laterally by the mass. Based on the findings on physical examination and MRI, the initial diagnosis was of a hemangioma or neurogenic tumour causing symptoms by compression of the adjacent median nerve.

Surgical exploration and excision was carried out under general anaesthesia and tourniquet control, and demonstrated a large reddish blue mass adjacent to the ulnar neurovascular structures with multiple feeding vessels and the appearance of a venous haemangioma. Histological examination revealed the diagnosis of a glomus tumour. The patient subsequently made an uneventful postoperative recovery with complete resolution of symptoms.



**P285**

**Synovial osteochondromatosis at the triangular fibrocartilage complex (TFCC)**

**Naoko Nishiyama** , Toshiyasu Nakamura , Noriko Okuyama, Hiroyasu Ikegami , Kazuki Sato , Yoshiyuki Toyama

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Synovial osteochondromatosis in the triangular fibrocartilage complex (TFCC).

We report an extremely rare case of synovial osteochondromatosis in the triangular fibrocartilage complex (TFCC), Radiocarpal joint (RCJ), and distal radioulnar joint (DRUJ).

A 36-year-old woman presented with a 6-month history of pain at the ulna side of her right wrist. She complained of pain when she exercised in the gymnasium, although there was no history of trauma on her wrist and forearm. On physical examination, there were tenderness and motion pain at the TFCC area without any swelling on the wrist and any instability at the DRUJ. Supination of the right forearm was slightly restricted. Radiogram indicated the small fragment at the ulnar side area of the wrist. Arthrogram demonstrated massive TFCC tear. MRI revealed partial tear of the TFC and several low signal intensity area inside the TFCC, where the osteochondromatoses were seen. Arthroscopic and open removal of the osteochondromata in the radiocarpal joint, the distal radioulnar joint and the TFCC was carried out. Although some of osteochondromata were free in the joints, most was invaginated into the TFCC. After the removal of the osteochondromata, repair of the TFCC was needed to re-stabilize the DRUJ. There was no recurrence 4 months after the surgery. A synovial tissue, which was histologically seen around the prestyloid recess of the TFCC, may proliferate and metastasis to the osteochondromata.



**P286**

### **Transformation of synovial chondromatosis of the third metacarpal to chondrosarcoma**

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**Introduction:** Chondrosarcoma of the hand, although rare, typically evolves from an enchondroma. Transformation of monostotic enchondroma to chondrosarcoma is extremely rare (<1%). Synovial chondromatosis is a rare, benign condition characterized by nodular proliferation and metaplasia of the synovial membrane where the fragmented synovium may subsequently grow, calcify, or ossify. The condition predominantly involves the knee, hip, shoulder or elbow. Malignant degeneration of synovial chondromatosis to chondrosarcoma in the hand is, we believe, unknown.. We present the development of such a chondrosarcoma of the distal 3 rd left metacarpal 37 years following synovial chondromatosis in the same area and review the literature.

**Method:** A 33 year old woman presented with 11-year old swelling over the dorsum of the 3 rd MCPJ. Plain X-ray demonstrated spotted calcification in the soft tissues adjacent to the MCPJ. She underwent excision of histopathology-confirmed synovial chondromatosis. She presented 26 years later (age 59) with a large, slow growing lesion overlying mainly the palmar and also dorsal surface of distal part of 3rd metacarpal. There was no tendon or neurovascular involvement. Plain X-ray showed spotted calcification and severe bony erosion. MRI demonstrated a large lobulated mass centred on the head and neck of the 3rd metacarpal. PET scan showed no metastases. Following biopsy and imaging the patient underwent wide clearance involving ray amputation, excision of 2nd and 3rd neurovascular bundles and reconstruction with index ray transposition.

**Results:** The histopathology demonstrated chondrosarcoma grade 2/3 superimposed on pre-existing synovial chondromatosis. Ten months post reconstruction there was very good function and an aesthetically pleasing result. There has been no clinical or MRI evidence of local or distant recurrence (10 month follow-up).

**Conclusion:** The present case demonstrates the rare presentation of synovial chondromatosis with malignant transformation to chondrosarcoma over a period of 37 years. Wide local excision is treatment of choice.



**P287**

**Simple curettage with restoration of bone lid for enchondroma of the hand**

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**Introduction:** Enchondromata are treated by curettage with or without bone grafting. Since 1990 many good clinical results have been reported with simple curettage without bone grafting. We have treated enchondroma of the hand by simple curettage with return of the bone lid.

**Patients:** Between 2001 and 2005, we treated eight patients (8 bones) with enchondromata of the hand. All patients were treated with simple curettage of the tumor and putting back the bone lid without bone grafting. Mean age was 35 years (range 22-52). The diagnosis of enchondroma was done by histological examination in each patient. In cases of pathological fractures, operations were not undertaken until they had healed.

**Surgical procedure:** Surgery was performed using air tourniquet under brachial plexus block or general anesthesia. The cortical bone at the tumor area was fenestrated into rectangular shape after punching holes with Kirschner's wire. Tumor was curetted, followed by the cavity was rinsed with saline solution and one or two holes were punched in both the wall near the window and bone lid. Tourniquet was down and the cavity was filled with blood. Few minutes later with wiping blood on the outside of the cavity the blood in the cavity clotted. The bone lid was put on the clotted blood and tied with absorbable thread. After the surgery, splints were applied to some patients for few days. Active motion exercise of the fingers was started as soon as possible.

**Results:** There were no fracture, infection or other complications after operation. There was no case of restriction of joint movement at the last follow-up examination. Radiographs showed sclerotic change around 6 weeks after the operation.

**Conclusion:** We have gotten good results about the treatment of enchondroma of the hand by simple curettage with restoration of the bone lid without bone grafting.





**P288**

**Surgical treatment of fibrolipomatous hamartoma generated in the median nerve. Complete Resection of the tumor and nerve transplantation, opponensplasty .**

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**Purpose:** Fibrolipomatous hamartoma is a rare benign neoplasm. Except for the cases of macrodactyly, it is often generated in the median nerve. There are a lot of reports of less growth of the tumor in adults. Carpal tunnel release only is recommended in the cases of the adults with fibrolipomatous hamartoma generated in the median nerve. We report a case of fibrolipomatous hamartoma surgically treated by complete tumor resection, free sural nerve transplantation and opponensplasty.

**Case:** A 36-year old man had had a tumor on his left wrist since infancy, and it increased gradually. He hoped to have it removed at another hospital, but it was impossible to separate the tumor from the median nerve, and only carpal tunnel release was performed. But he complained strongly of discomfort, and so our hospital was consulted. We recommend him not to remove it, but his desire for complete resection was strong. We explained that his hand might have complete median nerve palsy after complete tumor resection but he was unable to endure the pressure feeling from the tumor. We therefore acceded to his wish for complete excision.

At the operation, we first removed the swollen median nerve completely, and harvested the bilateral sural nerve, then we performed cable grafting of the nerve. Moreover, because the thenar muscle branch of the median nerve was also removed, we added Bunnell method opponensplasty.

**Results:** After one year, the sensory disorder remains, but the patient's satisfaction is great because it has become easy to grasp after the operation. There is no recurrence of the tumor.

**Conclusion:** In our case the tumor was too large to tolerate, even though the carpal tunnel syndrome symptoms were improved. It seems complete tumor resection and nerve graft is a good option for treatment in such a case.



**P289**

**Flexor tendon sheath ganglion mimicking as the cause of trigger thumb - Case report -**

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Flexor tendon sheath ganglion is the third most common ganglion of the hand and wrist. This ganglion can cause triggering of the finger.

We have experienced a case of flexor tendon sheath ganglion on the A1 pulley, mimicking as the cause of trigger thumb.

Three and half year old child visited our department for the mass at the volar surface of first metacarpo-phalangeal joint of left hand. This mass was recognized by his mother 3 days prior to visit. At examination, bean-sized and firm mass was palpated and the mass didn't move with flexor tendon excursion. Also, the passive extension of thumb was limited. We regarded this flexor tendon sheath ganglion as the cause of trigger thumb.

At operation, we excised the ganglion attached to the A1 pulley and then passively extend the thumb, but full extension was not possible. We carefully examined the flexor tendon and found the intratendinous node (Notta's node) which blocked sliding of flexor tendon. In the end, we released the A1 pulley and passive the full extension of thumb was obtained.



**P290**

### **Glomus tumor in finger**

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**Introduction :** We reviewed 23 cases of glomus tumor in fingers operated between 1991 and 2005, and report representative clinical cases.

**Materials and methods :** There were 23 patients consist of the eleven males and twelve females, and 24 tumors.

All cases were operated with local anesthesia and were diagnosed as a glomus tumor by pathological examination.

**Results :** The operated age ranged from 21 to 70 years old with a mean of 42.3 years old. Five cases were in thumbs and five cases in index fingers, four cases in middle fingers, six cases in ring fingers and four cases in little fingers. The 23 tumors in 22 cases occurred at subungual region, and other two cases occurred at pulp region. Three cases were examined with enhanced MRI ( magnetic resonance imaging ), and the T2 contrasted films showed high intensity area in all cases. The mean operated age of cases occurred at pulp region was higher than at subungual region(47.5 years old v.s 41.7 years old).But, we were not able to prove significant difference.

**Discussion :** The glomus tumor occurred at subungual region is characterized by drastic pain and tenderness, but there was comparatively little pain and tenderness in the glomus tumor at finger pulp region.

**Conclusion :** We think that a subungual glomus tumor is more painful than a pulp glomus tumor because of small subungual space .

MRI was useful diagnostic tool in the cases of non-typical clinical symptom.



**P291**

### **Paediatric hand tumours**

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**Introduction:** Hand tumours are a common reason for referral to hand surgery services. A previous review of 349 cases identified ganglion cysts, foreign bodies and vascular malformations as the most common causes of a palpable swelling in a paediatric hand. We aimed to investigate the paediatric population referred to our hand surgery service with tumours of the hand and wrist.

**Methods:** A retrospective case note review of patients referred to our hand surgery service with hand tumours over a five-year period. Data was collected on: patient demographics, referral pattern, investigation, treatment and outcome.

**Results:** Data was collected on a total of ninety-five patients, some with multiple lesions. Eight diagnostic categories were identified: ganglia (n=45), nerve lesions (n=2), vascular lesions (n=13), soft tissue tumours (n=14), skin lesions (n=2), bone tumours (n=8), foreign bodies (n=7) and other lesions (n=4). There was incomplete data for 12 patients. Age at referral ranged from 3 months to 16 years. Most patients were referred by their General Practitioner. In total 41 patients were male and 54 female. No imaging was required in 34% of patients. Of those imaged 4% underwent MRI, 19% ultrasound, 24% x-ray and 19% both ultrasound and x-ray. 23% of patients underwent surgical excision with histological confirmation of diagnosis. No malignant tumours were identified.

**Conclusions:** Ganglion cysts were the most commonly made diagnosis, followed by soft tissue tumours then vascular lesions. A female preponderance was noted in the ganglion cyst and vascular groups. A male preponderance was noted in the bone, soft tissue and foreign body groups. Patient numbers were very small in the other diagnostic groups. Lesions were usually referred from Primary Care and often undiagnosed prior to review. Ultrasound was a useful diagnostic tool. Often these lesions require no surgical intervention. All referred lesions were benign.

**References:** Colon F 1995, Nahara ME 2004.



**P292**

**Augmentation of interosseous cyst of lunate with injectable calcium phosphate cement, A case report**

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Interosseous bone cysts are rare lesions which even more rarely involve the bones of the hand. We report a case of a cyst involving the lunate who was a pain and limited wrist motion. Under the fluoroscopy we treated by curettage and filling of the defect with Norian SRS cement. After 3 days we removed the dressing and allowed early ROM. The radiological and CT appearances of the cement were unchanged at follow-up. The injectable bone cement can easily be handled surgically under fluoroscopic control and has proved to be remodelable.



**P293**

**Vascular leiomyoma in the hand: The characteristics of MR images**

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Vascular leiomyoma in the hand is a comparatively rare soft tissue tumor which is reported sporadically in the literature. We experienced eleven cases of vascular

leiomyoma and could realize the unique findings of MR images, which have not been reported previously.

The patients comprised 6 males and 5 females with a mean age of 57 years (range; 27-

77 years). MRI was taken in all cases with T1 and T2 weighed images in 2 planes. As a result, the signal intensity showed equal to the muscle with uniformity inside the tumor in all cases in T1 weighed images. T2 weighed images showed the unique mixture of high and low intensity, in which one radiated in the other, and were similar to, but quite different from other common vascular tumors in 9 cases out of 11. The diagnosis were made pathologically as vascular leiomyomas and classified to 3 types, those were capillary, venous and cavernous type, according to Morimoto ' s classification. Among the 9 cases with this MR findings in T2 weighed image, there were 4 cases in capillary type, 2 in venous and 3 in cavernous. Each of these histological types could present the same T2 weighed MR findings.

The high and low intensity areas in T2 weighed image are considered to represent vessels filled with blood and smooth muscles respectively. The unique pattern of mixture of the high and low intensity areas is supposed to be dependent on the site and the proportion of vessels and muscles inside the tumor. Pre-operative diagnosis of this tumor is generally thought to be difficult, but it is very possible with this T2 weighed MR finding which is supposed to characterize this tumor.



**P294**

### **Upper Extremity Esquemia Due to Persistent Arterioveous Fistula**

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**Introduction :** Arterioveous fistulae (AVF) used for haemodialysis, if realised on arteries of a high blood flow, may produce isquemia distally, as blood flow tends to run to the less pressure territory.

**Clinical case:** a39 y.o. lady with diabetes and cronic renal insuficiency that 7 years before, and after a haemodialysis programme, underwent a reno-pancreatic transplantation.

She complained of an injury of the skin at the dorsum of the proximal interphalangeal (PIP) joint of the middle finger that did not close after 6 months of evolution.

Initially the patient was treated with a local debridment and two Hueston flaps (distal and proximal). Flaps became necrotic and an osseous infection developed in the finger. Then middle ray amputation was realized. Two weeks later, skin necrosis of the borders and suppuration appeared. Then, a groin fasciocutaneous pedicled flap (Mc Gregor), was carried out and autonomized in the third week. Donor site evolution was good, but the flap became necrotic after sectioning its pedicle.

An arteriography showed no radial or ulnar flow distal to an arteriovenous fistula situated in the anterior aspect of the elbow. Fistula was dissected and found to communicate the humeral artery and the cephalic vein. The fistula was eliminated as it was supposed to provoke the blood flow theft phenomenon distally.

At the level of the hand, we resected the osteo-tendinous structures of the index finger and used the skind as a flap to cover the cutaneous defect.

Evolution was satisfactory after the last surgery and in the arteriography don 2 months after, showing permeability of the palmar arch, from the ulnar and interosseous arteries.

**Conclusions:** It is important to consider closing an arterioveous fistula in the presence of an infection in extremity with a proximal fistula, in order to avoid the theft of the blood flow phenomenon.



**P295**

**Two case reports: Long term rehabilitation results of giant cell tumor after surgery**

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Giant cell tumor of the distal radius is rare neoplasm that affects the peri-articular metaphysical region of the bone. Free vascularized fibula transfer is an established method for reconstruction of the wrist following tumor resection. Our purpose is to present the physical and occupational therapy results of two cases with giant cell tumor on radius after wide tumor resection and vascularized fibula transfer with complete wrist fusion (Muramatsu et al., 2005).

Our patients were both female, was working and had one child. Their ages were 34 and 35. After 1.5 month casting DASH (Disabilities of Arm Shoulder and Hand), Lawton Activities of Daily Living Index, Jebsen hand Function Test was used and range of motion, muscle strength and hand strength was measured for rehabilitation process and assessments were repeated on 6,12 and 24 months after surgery.

A satisfactory range of motion of all upper extremity was maintained. In the first case grip strength increased from 2 kg. to 8 kg., while the opposite arm strength was 10 kg.; second case increased from 3 kg to 24 kg, while the opposite's was 17 kg. In both cases they only have problem with hard work. DASH score was decreased from %62.4 to %12.3 in the first case and from %50.8 to %6.6 in the second one. Repetition and metastasis has not been seen in both cases.

Psychological status and adaptation is an important factor while treating patients with tumor. We gained good functional results for both of our patients. They were first very afraid to use the hand and had anxiety based on a fear of recurrence. We did not have to get psychological support from department but we had to encourage them to go on their lives. They both carry on their occupations at job and daily life.





**P296**

**Composite tissue allografts models on the rat**

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The aim of this work was primary to familiarize with some experimental animal models used in the research field of Composite Tissue Allografts (CTAs) and secondary to develop advanced microsurgical skills. All these animal models are vascularized allotransplants from Brown Norway to Lewis rats. A total 97 procedures were done: orthotopic (n = 60) and heterotopic (n = 5) limb transplantation, femur transplantation (n = 5), limb and contralateral femur transplantation (n = 5), knee transplantation (n = 5), tail transplantation (n = 5), sternum transplantation (n = 2), hemiface transplantation (n=5), and toe-to-thumb allotransplant (n = 5). All animals received drug therapy (FK506, MMF and Prednisone) for 8 weeks, then treatment was ceased entirely. The average success rate of transplantation was 84.57%. This study demonstrated that the composite tissue transplantation could be a reliable new method to solve the difficult problem of Plastic Surgery – the reconstruction of extensive soft tissue defects or mutilations. In the same time we improved our rate of success performing a nastomoses of vessels of less than 0.8 - 0.5 mm in diameter. Clinically such anastomoses are necessary for replantation of the distal digits in adults and whole digits in children, and for the new direction of perforators' free flaps. With this techniques practiced, there will be more ease, confidence and success when doing small tissue transplantations or replantation in humans, even in infants.



**P297**

**Toe to thumb allotransplant in rats**

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Anastomoses of vessels of less than 0.5 mm in diameter remain a challenge from the technical point of view. Clinically such anastomoses are necessary for replantation of the distal digits in adults and whole digits in children, and for the new direction of perforators' free flaps. Five big toes harvested from Brown Norway hind foot were successfully allotransplanted to the Lewis thumb position, based on a modified technique described by Bao for toe-to-thumb autotransplantation. All animals received drug therapy (FK506, MMF and Prednisone) for 8 weeks, then treatment was ceased entirely. After our knowledge this is the first to-to-thumb allotransplantation performed in rats. With this technique practiced, there will be more ease, confidence and success when doing toe-to-hand or small tissue transplantations or replantation in humans, even in infants.



**P298**

**A new model of composite tissue allotransplantation: Femur-thigh flap**

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**Purpose:** To study the immunologic problems including rejection, tolerance induction, microchimerism, and graft versus host disease in limb allotransplantation, a simpler and non-functional model that includes all the tissue components of the whole limb is warranted.

**Materials and Methods:** Adult male inbred Wistar rats (WF, RT1Au) weighing 250 to 300 gm were used as isogenic donors and recipients of a new experimental mode for composite tissue allotransplantation. The femur-thigh transplantation is an osteomyocutaneous flap of bone (2/3 femur), muscle (thigh), and skin (groin) based on the femoral vessels and the superficial epigastric vessels. Daily observation for gross appearances was recorded and the transplant tissues were analyzed for the histological findings after 14 days of survival.

**Results:** All the flaps were successful and the histology confirmed vessel patency. The total time from the skin incision to skin closure was reduced compared with the standard hindlimb model.

**Conclusion :** Advantages of the new model include its simplicity, relative purity, and the fact that it does not cause deformity to the animals as does limb transplantation.



**P299**

**Significance of clinical path in replantation of crush-avulsion fingertip amputation: New surgical classification and postoperative management**

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**Objective:** The purpose of this study were to present a new surgical classification, based on types of injuries, and to evaluate significance of our post-operative protocol for fingertip replantation, especially crush-avulsion cases.

**Methods:** Twenty fingertip amputations in 20 consecutive patients were replanted at our institute for recent 5 years. There were 17 male patients and 3 female patients, ranging in age from 19 to 62 years (mean, 45.3 years). There were 13 amputations in Zone I and 7 in Zone II according to Tamai's classification for the level of amputation. Also, we classified our cases based on the type of injury. [New Classification]

Type IA: Distal transverse palm arterial arch (DTPA) is remained in the proximal part Type IB: DTPA is remained in the amputated part

Type II: Loss of DTPA

There were 4 cases in Type IA, 4 in Type IB, and 12 in Type II.

Postoperatively, 12000-24000U of urokinase and 500 ml of low molecular-weight dextran were given intravenously for 7 consecutive days.

**Results:** The overall survival rate of the 20 replantations was 90.0%. The survival rate was 100% in type IA, 100% in type IB, and 83.3% in type II. For arterial repair, vein graft were necessary in 1 of 4 type IA (25%), 1 of 4 type IB (25%), and 11 of 12 type II (91.7%). In 3 of 4 type IA, end to end anastomosis were possible. In 3 of 4 type IB, end to end anastomosis were done. Regarding functional outcomes, excellent cases were 87%, and no poor cases.

**Conclusions:** Our new classification of fingertip amputation based on DTPA was available for strategy of arterial repair. Also, in crush/avulsion fingertip amputation, our clinical protocol and path was very useful and raised success rate of fingertip replantation (90.0%) for crush-avulsion cases.

**Reference:** Hattori, PRS 2003



**P300**

**Successful digital replantation and microsurgical digital transposition after segmental palm defects and severe trauma to digits in a 17-month-old child: A case report**

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**Purpose:** Serious trauma to the entire hand with complete severance of all digits and segmental tissue loss still presents a challenge to microsurgeons. We report a case of successful digital replantation and microsurgical digital transposition after segmental palm defects and severe trauma to digits in a 17 month child.

**Methods:** The rightarm and hand of a 17 years old boy was severely traumatized and entrapped by a meat processing machine on August 31, 2004, and was brought in with the hand in a part of machine. The 5 digits were seen on one side of a machine tube and the arm in the opposite outlet. There was a segmental defect in the palm due to crush by machine and severe trauma to the proximal part of the digits with defects of vascular structures. These amputated digits were carefully debrided and thumb was replanted. There was a segmental loss of the distal palm. The ring finger was of better vascular structures and an appropriate length and was transplanted to the position of the index, with vessels anatomized to the branch of the radial artery and the subcutaneous veins. The flexor and extensor tendons and digital nerves were also repaired.

**Results:** The replantated thumb and the transplanted ring finger survived. Appropriate pinch and grasp function of the hand was restored and there was distinctive restoration of touch, pain, and two-point discrimination of the replanted fingers a year later.

**Conclusions:** We present a unique case of severe trauma to the hand in a 17-month-old boy. Simultaneous digital replantation with one-stage transpositional transplantation to a palm with a segmental defect in a very young child has been few. Despite remarkable great technical difficulty, we feel this kind of surgery is possible and acceptable function can be expected in such difficult cases.



**P301**

**Technical consideration and functional outcome of replantations and revascularization in trans metacarpal crush amputation**

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**Purpose:** To highlight the technical refinements in Transmetacarpal Replantations and Revascularization and to assess their functional outcome.

**Methods:** A series of 14 Transmetacarpal crush amputations which include 9 Replantation and 5 critical Revascularization were followed up for a period ranging 1-8 years. All amputations survived and were analysed by Chen's criteria .The range of motion, grip and pinch strength, job status and duration for maximum recovery were also studied and is presented. Anatomical variation of the palmar arch requiring different strategies of reconstruction and the need of separate inflow into the thumb is highlighted.

**Result:** Outcome based on Chen's Criteria.

Chen's Grade	Replantation		Revascularisation	
	Zone A	Zone B	Zone A	Zone B
<b>I</b>	1	1		4
<b>II</b>	2		2	
<b>III</b>	1		3	
<b>IV</b>				
Total	4	1	5	4

Average range of movement (TAM) - 150, all the 61 metacarpal went on to primary union, 5 patients required soft tissue cover for the dorsum 2 were done immediately

**Conclusion:** We consider identification of structures prior to debridement, 10-20 mm of metacarpal shortening and repair of as many vessels are important technical factors for success. When analysed by Chen's criteria, 10 patients were grade I and II and none belonged to grade IV. Allpatients wentback to work by nine months.



**P302**

### **Primary microsurgical management of degloving injuries of digits**

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**Background:** Wound coverage after a complete degloving injury of the fingers is one of the most difficult problems in hand surgery. Bones, tendons, nerves are exposed and will necrose if not covered adequately. The goal of treatment should be coverage with a thin, sensitive, and cosmetically similar tissue that will allow early mobilization. The main problem in degloving injury is the extensive damage to long segments of vessels which makes direct suture of the structures difficult.

**Methods:** The authors adopt the following general guidelines in these situations: revascularization and replantation of the avulsed structures whenever possible; early transfer of a conventional or free flaps. If the PIP joint was damaged, completion of amputation was the treatment of choice. Between 1997 and 2006, 18 patients were treated for degloving injuries of the fingers.

**Results:** Six partial degloving fingers were successfully microsurgical revascularized (100%). Seven from 11 patients (64%) with ring avulsion amputation injuries (Carroll type IV or Urbaniak type III) were successfully replanted. At one patient with degloving injury in whom replantation was not possible, the finger was covered using an anterolateral thigh fascial free flap with skin graft. Sensibility was protective in all cases and good in 6 cases and a functional range of motion obtained. No patient has requested its amputation because of appearance, painful neuromas, stiffness, or cold intolerance.

**Conclusions:** Although the data show that degloving injuries can be treated successfully by microsurgical techniques in selected cases, functional results are not as successful. However, the decision for surgery at times is determined by nonmedical factors such as the patient's age, occupation, economic situation, and level of motivation.



**P303**

### **Intensive rehabilitation of 8-year old child after upper extremity replantation above the elbow**

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**Introduction:** Case study of intensive rehabilitation of 8-year old left handed boy after replantation of left arm above the elbow after amputation by heavy workshop machinery.

**Methods:** Intensive dynamic rehabilitation program for pain, edema and function. Initial 6 week therapy extended over 1 year period based on continued improvement:

- assessments of ROM and muscle testing used to define and modify kinesiotherapy
- passive motion: different manual techniques including joint mobilization
- active motion: various exercises, hydrotherapy
- pain: low frequency magnetic field, laser
- edema: manual lymph drainage, compressive elastic gloves (entire hand)
- scar: laser, friction massage with anti-scar cream and olive oil
- support: static (night) and dynamic (day) splints
- sensory motor re-education: surface EMG biofeedback
- occupational therapy: sensory stimulation, exercises for daily activities + hand function

**Results:** After surgery replanted arm plegic, afunctional, no active motion, no sensibility, pain and edema distal of injury. Passive elbow ROM flexion 20° - 25°, pronation

15° - 50°. Other arm joint ROM reduced about 30% distal and proximal of injury due to immobilization. Intensive rehabilitation over 1 year (3 hrs PT, 2 hrs hydrotherapy,

1 hr OT daily) gave following results. Passive elbow ROM flexion 10° - 115°, pronation 70°, supination 20°. Active elbow and wrist flexion and extension, finger flexion, thumb flexion and opposition. No active finger and thumb abduction and adduction and no distal finger extension. Sensibility normal except in ulnar nerve innervation region. No pain, no edema, scar tissue softened. Can perform rough grasp and pinch grip.

**Conclusion:** After 1 year of intensive rehabilitation replanted arm is functional and is spontaneously used in daily and sports activities.





**P304**

### **Investigation of IES-R and SF-36 in posttraumatic injury**

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**Background and purpose:** As a result of advances in microsurgery, a finger survival rate of 81% has been reported in cases of finger plantation. However, there have been few reports of changes in patients psychological after the traumatic injury. In this report, we assess and compare IES-R and SF-36 after fingers replantation.

**Methods:** We conducted a questionnaire survey with 50 patients who had undergoes rehabilitation after replantation of a digit. Patients were treated at the emergency department of the Sapporo Medical University hospital. The questionnaire was about whether or not they had experienced any psychological changes after the digit replantation. The patients were assessed by SF-36 and IES-R. We made twice examination after the operation within one week and 50 months later. Mann-Whitney U test and Pearson Correlation Coefficient were used to analyze statistical difference.

**Result :** Investigation were done over a two weeks period and valid answers were obtained from 44% of the patients(22 out of 50).They consisted of 18 men and 4 women, whose average age when they received the wound was 51. 68 percent of all the accidents were industrial. IES-R score was 22.9(16.6) immediately after operation and it had dropped to 7.2(9.2) at 50 months after injury, but there were three patients whose score was above the cut off value.

**Discussion:** Our result shows that there were some patients who were suffering from mental stress right after injury. It also reveals the importance of psychological care in the field of hand therapy after external injury.



**P305**

### **One year rehabilitation results of a case with upper extremity replantation**

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**Aim:** The aim of our study is to give the one year rehabilitation results of a case with upper extremity replantation.

**Method:** Mr K, a 29 year of old righthanded manual worker was admitted to the Orthopaedics and Traumatology Department at Hacettepe University in 23 February following avulsion amputation of forearm level result of a work accident.

Rehabilitation program is began in post-op 2.nd day and 4 times in a week.

In the acute phase the exercise program includes protected passive flexion and extension joint motion of phalanxes and stretching of intrinsic muscles (everyday 30 minutes). After the operation there is extension limitation in both elbow joint so stretching, strengthening and mobilization is added to the acute rehabilitation program. Massage, sensory re-education program and active assistive exercise program is added to the rehabilitation program in 2nd month. He was also advised to use the hand for light functional activities in 5th month. Gross grasping exercise and further functional exercises and work re-training is added to the treatment program in 6th month.

**Results:** Even After 1 year rehabilitation program the results are as follows.

Active Motion: Full motion in elbow and full passive motion in digits, active flexion limitation in 1st and second digit. Muscle strength: except FDP all muscles are 5 according to Dr. Lowett manual muscle test

Sensory evaluation: Sensory loss just only in the dermatome of median nerve Grasping: Active grasping is begin in 6th month

**Table 1. Evaluation results**

	1 month	7 month	1 year
Lawton ADL test	50/72	59/72	62/72
DASH	83	61	43
Jebsen 4 block location	-	14 sn.	4.55 sn.
Jebsen page turn	-	-	15 sn.
Visual analog scale	8	4	2

After one year rehabilitation program joint stiffness is prevented and functional independence level in activities of daily living and work has achieved



**P306**

### **The training of myoelectric prosthetic arms in our hospital in Japan**

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**Introduction:** Myoelectric prosthetic arms more often have been provided for upper extremity amputee in the world. In Japan, they were provided in very few hospitals. The reasons 1 ) problems in the staff to know them well, 2 ) problems in the hospital has a training system, 3 ) problems in the public benefit system, 4 ) problems in the maintenance .The training system of myoelectric prosthetic arms since 2002 was introduced to solve these problems in our hospital located at the northern area of Kyushu in Japan.

**Materials and Methods:** The system for training myoelectric prosthetic arms is prepared. This system consists of a Myoboy, a dynamic mode control hand, a digital twin control hand, a wrist rotator, a 4 channel processor, an elbow forearm assembly, a Myobock electrode, battery chargers and energy packs, and is useful for right arm as well as left arm. This system cost our hospital 3 million yen. Six patients were examined. They were 3 males and 3 females, and average age was 39.7yrs ( range 15 to 52 )

**Results:** This system was useful for simultaneous smooth training in all 6 cases , and helped the application

**Conclusion:** This system was useful to develop myoelectric prosthetic arms in our area for public benefit system. Their ADL and social life were improved by using myoelectric prosthetic arms.

**Reference s:** H.Otuka, et al, 1999



**P307**

### **The Mole Gun Injury of the Hand**

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In rural areas, mole guns causing frequently hand injuries (a kind of weapon to shoot the moles) have been used during the summer by the farmers. It is a primitive weapon produced by the farmers and has not a considerable safety system. It fires lead shot and scattering in the tissue, the shots cause diffuse damage. The farmers set it up, taping their palms on its barrel, just like the moles before smashing to smithereens. Submitting the surgically treated six cases in the recent two years, our aim is to define its characteristic features especially with respect to clinical findings and management options. All the patients were middle aged male farmers. Typical findings of this injury were palmar skin defect greater than dorsal, distal avulsion of flexor tendons, great damage of intrinsic muscles and communitated defective metacarpal and metacarpophalangeal fractures. Following a few debridman and irrigation steps the metacarpals were osteosynthesed with bone graft and plate, external fixator or K wire. Volar palmar defect was covered by the first metacarpal arterial flap in two cases and full-thickness skin graft in four. Avulsed flexor tendons were repaired at their insertions. Revascularization was not required. All the patients underwent the tendon release operations because of severe adhesions and intensive physical therapy due to intrinsic contractures. Bony union was maintained in all cases. All the patients were satisfied with the result. The mole gun hand injury carries typical features such as palmar skin defect and distal flexor avulsions. We found to be useful the first metacarpal arterial flap to cover the volarly skin defect. Intensive physical therapy indispensable because of tendon adhesion and intrinsic contractures in the early postoperative period.



**P308**

**Thumb reconstruction with distraction osteogenesis: Report of 8 cases.**

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**Objective:** Assessment results of the patients with thumb amputation related to gunshot wounds who had basic hand after metacarpus lengthening by callus distraction.

**Material and methods:** Nine metacarpals of 8 patients (aged between 20-27 with a mean age of 24) who had amputation due to gunshot wound. First metacarpals were lengthened. Callus distraction was performed with the use of mini Ilizarov type of external fixator at four cases and uniplanar dynamic mini external fixator at four cases. The distraction rate was 0,25x4 mm/day. The mean follow-up period was 34 months (range from 24 to 44 months).

**Results:** The average lengthening was 28mm (range from 25 to 40 mm), average healing index was 0,75 month/cm (range from 0,65 to 0,88 month/cm).

**Conclusions:** Metacarpus lengthening by callus distraction is an effective reconstruction method for thumb traumatic amputations.



**P309**

### **Concept of on arrival block in the management of major injuries of upper limb**

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**Purpose:** In the management of major mutilating injuries, rapid assessment, early decision making and prompt surgical intervention is essential. The concept of giving brachial plexus block on arrival for a major mutilating upper limb injury even before removing dressings has been practiced and has been found to be useful.

**Methods:** Patients with mutilating injuries are received in the ante room of the operating theatre. Brachial Plexus Block is given using the subclavian perivascular approach. Dressings are opened only after pain relief has been obtained. Radiographs are done. A plan of treatment is made and explained to the patient and relatives

**Result:** This concept of on arrival block has been used in 210 patients over the past 10 years. We have not had any complications attributable to the brachial plexus block. The pain relief boosts the morale and the confidence of the patient. Taking Radiographs after the block helps to obtain better pictures without overlapping of the bones which occurs when the limb is bandaged in the presence of multiple fractures.

Examination of the injuries after pain relief allows better assessment and more meaningful explanation of treatment options. The anesthesia obtained is used to carry on with definitive surgery. The only requirement is availability of a dedicated operating room, skilled anesthesiologist and surgical team for taking care of hand injuries.

**Conclusion:** This technique provides excellent pain relief during the preoperative period and shortens the time the patient takes to go on to the operating table.



**P310**

## **The quantification of the thumb reconstruction necessity by the "TROS" original scale**

**Dan G rigorescu**

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**Introduction:** The necessity of thumb reconstruction is appreciated on clinical basis related to the level of amputation that determines the choice of the best reconstruction method.

**Aims:** To find functional deficit criteria to indicate the relative or absolute reconstruction necessity.

**Materials and method:** A mathematical, cybernetic analysis was applied to the three elements of the functional composition of the thumb, each one being made of other two components: 1. Destot functional column: osteo-articular and musculotendinous; 2. Innervating: motor and sensitive; 3. Coverage: subcutaneous and tegument.

Corresponding elements of every component were assigned a value representing the highest functional deficit in case of its total disabling.

As the defects within each component have a different importance within the global functional loss, I decided to grant them importance indices. The global thumb deficit were determined as  $20\% \text{ OA} + 20\% \text{ MT} + 40\% \text{ MI} + 10\% \text{ SI} + 8\% \text{ SC} + 2\% \text{ TC} = \text{global \% deficit}$ .

**Discussion:** The results can be obtained using a cybernetic programming, named TROS, which overcome the calculation difficulties and are contained in a scale that quantifies the reconstruction necessity:

Obtained values	0-20%	21-40%	41-100%
Global deficit	low	middle	major
Reconstruction necessity	Low	Relative, but necessary	Absolute

**Conclusion:** This method allow to determine quickly and exactly the thumb global deficit and the reconstruction necessity.



**P311**

**Casereport Elisa - Functional reconstruction of left thumb after burn trauma with severe hand deformity in a today four year old girl from Angola**

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Today Elisa is a four year old girl from Angola. During a mining accident at the age of one she suffered from severe burns leading to a deformity of the left hand. Her fingers were amputated on level of the proximal phalanxes. The carpal as well as the metacarpal bones were fixed on the distal dorsal forearm in a 180 ° rotated malposition.

Initially we brought the hand into a physiologic position. In a second procedure we performed a pollicization through transfer of the second metacarpal bone on the first ray. We also deepened the interdigital web spaces.

The functional result is good. Elisa uses her reconstructed thumb in everyday life to grasp and hold on to varying objects.





**P312**

**Reconstruction of gunshot injuries of the hand by means of a double skin paddle reverse-flow forearm radial flap. Two case report.**

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**Indication, subject:** Since its introduction in 1982, the extreme versatility of the distally based forearm island flap for hand reconstruction has been demonstrated by numerous publications. Its vascular reliability allows several modifications in flap harvesting. We report two cases of hand gunshot wounds treated with a double skin paddle reverse-flow forearm flap

**Material and methods:** The two cases were ballistic trauma of the hand secondary to a self-inflicted rifle injury of a men and a women. Wounds were severe and massive with full-thickness palmar and dorsal skin, tendons, muscles, bone, vascular and nerve destruction and losses. Lesions repair has been performed in one stage with skeletal stabilization and bone grafting, nerve and tendons reconstruction. The double palmar and dorsal skin defect was reconstructed with a a double skin paddle reverse-flow forearm flap which was routed through the hand wound.

**Results:** In the male case, a secondary flap defatting was necessary and he retrieved a good hand function with return to work 8 months later. The female case died unfortunately later, following her brain contusion.

**Conclusion:** Thanks to this flap raising adaptation, the forearm flap is the sole way, excepted free flaps, to achieve a reliable hand dorsal and palmar coverage in a single stage. In addition, this technique simplifies the reconstruction by using a local flap and allows a better and easier management as for healing than for rehabilitation compare to a multiple flap procedure.



**P313**

**The use of ultrasound as an aid for the insertion of brachial plexus blocks and in the diagnosis of hand injuries.**

**Dan Thornton** ,Frank Conroy, Muhammed Riaz, Paul Stanley

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**Introduction:** Hand injuries comprise a large proportion of the acute workload of both Plastic and Orthopaedic units. Definitive surgical treatment may be delayed for further investigation or because of limited anaesthetic availability.

Ultrasound can be a useful diagnostic tool in the assessment of hand injuries involving bone, tendon or neurovascular structures. Additionally, ultrasound also provides a means of safely giving regional anaesthetic blocks without subjecting patients to unnecessary general anaesthetic.

**Method:** In January 2004, our department purchased an ultrasound machine.

This was used both diagnostically and to increase safety and scope for the performance of regional anaesthetic blocks.

**Results:** We found the applications of the ultrasound machine to be exceptionally varied with respect to the assessment of hand trauma cases. The accurate placement of brachial plexus blocks facilitated by the use of real-time ultrasound images to minimize risk to deep structures allowed us to avoid the risks of general anaesthetic and operate outside the constraints of anaesthetic cover.

**Conclusions:** We present our first 20 ultrasound-assisted brachial plexus blocks, and also the value and versatility of ultrasound in the diagnosis of underlying hand trauma.



**P314**

**Extensor tenolysis combined with adipofascial flap for PIP joint contracture with extensor adhesion after crush injury at proximal segment of finger**

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**Purpose:** The crush injuries with the phalangeal fracture and the extensor tendons damage including the broad expansion hood at zone IV may lead to the formation of adhesions with markedly limited motion of PIP joint and the extensor tenolysis is still challenge to surgeons. Transfer of the adipofascial flap with successful results underneath the extensor tendon with purpose of protecting the tenolysed tendons from the adhesion formation over time is reported.

**Materials:** Since 1997, the surgery was performed on 8 fingers, 8 cases of proximal phalangeal fracture (open fracture in 7 cases) associated with complex crush injury of extensor tendons. The average age of patients was 35 years, ranging from 25 to 60 years of age. The injured digits were index finger (2), long finger (3), ring finger (1), and little finger (2). The site of proximal phalangeal fracture was shaft in 7 cases, and head in 1. The type of extensor tendon injury was complete laceration in 4 cases and incomplete laceration with crush injury in 4. The adipofascial flap s used were local flap s (3), venous pedicle adipofascial flaps from the dorsal aspect of the hand (4), and reversed vascular pedicle adipofascial flap using dorsal metacarpal artery (1). The average follow-up period was 4.6 months, ranging from 2.5 to 8 months.

**Results and Discussion:** The extension lag of PIP joint, and active ROM of PIP and DIP joints got better after operation ( $P < 0.05$ ). Because the transferred adipose tissue is rich in blood flow, postoperative tendon gliding should be better even if the adhesion may occur. Moreover, it is hypothesized that as the transferred adipose tissue underneath the tendon is voluminous the extensor tendon becomes tense facilitating the mobility of the digit.



**P315**

### **Late clinical and radiological findings of grease gun injury of the hand**

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**Introduction:** Grease gun injury is high pressure injection injury which can affect upper extremities. Grease oil can spread rapidly along fascia, tendons, skeletal muscle, and neurovascular bundle in the penetration area, and cause severe soft tissue reactions including tissue necrosis. The severity of these injuries is related to the nature, pressure, volume and toxicity of the injected substance. In this report, we present a case of hand high pressure grease gun injury with the description of late clinical and MRI findings.

**Case report:** A 27 year-old man admitted to hospital with the complaint of right hand swelling and pain. He had a penetrating grease gun injury 3 months ago. For initial wound care simple wound dressings were used and the wound healed after a short time. On physical examination, there were palpable subcutaneous multiple nodules the largest being 2 cm in diameter. There were limited thumb adduction and opposition. MRI revealed dispersed, multiple, slightly hyperintense lesions with hypointense peripheral rim in the subcutaneous soft tissues, and in the adductor pollicis muscle. The patient underwent surgery and the skin consisting multiple cystic lesions in the granulomatous lesion was elliptically excised. There were also cystic lesions with the oil inbetween the muscle fibers, all of which were excised removing cyst walls. Microscopic examination revealed granulomatous reaction suggesting marked foreign body reaction and diffuse oil loculations in various sizes Postoperative period was eventful and the patient had normal adduction and opposition of the thumb.

**Discussion:** This case is the first that describes late MRI findings of grease gun injury in hand grease gun injuries. Treatment of choice for such injuries is immediate removal of the foreign material and the surrounding necrotic tissues, irrigation, intravenous antibiotics and, in selected cases, high-dose systemic corticosteroids. Stiffness, chronic pain, infection, and even amputation can occur, if not appropriately managed.



**P316**

**A comparison of upper limb amputees and patients with upper limb injuries using the disability of the arm, shoulder and hand (DASH)**

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**Background:** There are few recognised instruments to measure the a variety of diagnoses affecting the upper limb that takes accounts of functional skills, pain and psychosocial status. The DASH measures disability and allows comparison between different conditions in terms of health burden.

**Method:** All 308 musculo-skeletal outpatients over the age of 16 years presenting to this Occupational Therapist at Prince Henry and Prince of Wales Hospital in Sydney over a 4 year time frame were given the DASH assessment tool and asked to complete it under supervision.

**Results:** Patients with brachial plexus injuries, Complex Regional Pain Syndrome and partial hand amputations demonstrated significantly higher levels of disability to patients with major unilateral upper limb amputations. Patients with compensable injuries demonstrated higher levels of disability than non-compensable injuries.

**Conclusions:** The DASH does not measure the success of prosthetic fitting for adult acquired upper limb amputations. However, amputees enter treatment with much lower levels of perceived disability than other diagnostic categories. What affects a patient's perceived level of disability? What impact does the mental health of the patient have on their perceived outcome? Perhaps the definitive nature of an amputation, and the immediate involvement of highly skilled health professionals serves to assist patients to accept their injury and therefore minimises the level of disability.



**P317a**

**Treatment of severe posttraumatic extension contracture of MP joints of the hand by Arthrolysis**

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**Introduction:** Arthrolysis has been used to mobilize stiff MP joint, but the result is not usually successful. The aim of this paper is to report our experience with arthrolysis for extension contracture of the MP joints in fingers and discuss what makes the result to be successful.

**Materials and Methods:** We performed arthrolysis in 25 extension contracted MP joints of 5 males and 2 females aged 31-68 years. The etiology was electrical burn in 3 patients, flame burn in one, Colles' fracture in one, hot press injury in one, multiple metacarpal fracture in one patient. Among the 7 patients, all MP joints was involved in 4 patients, and two MP joints was involved in 3 patients. We performed arthrolysis by dorsal approach to MP joint, longitudinal incision on extensor tendon, dorsal capsule release, articular surface release up to volar pouch, and collateral ligament release or extensor tenolysis if necessary. After 3 days of postoperative immobilization, the patients was encouraged to flex the fingers with night time splintage for three months.

**Result:** Active range of motion was increased from preoperative average 23 ° to postoperative average 59.7 ° . In 5 successful patients, the increased range of motion was average 44.5 ° . In 2 failed patients, the gain in range of motion was average 12.7 ° . The failed group had many problems that deteorate the hand function, such as, severely damaged muscle and tendon, poor skin coverage and destroyed joint.

**Conclusion:** Arthrolysis procedure requires good skin coverage, structural continuity and functional capacity of flexor and extensor tendons, and preserved joints. If the prerequisite is prepared, then good functional result can be achieved.

Reference: V. Leroy Young, 1978.



**P317b**

**Combined approach in salvage of severely injured hands in children. The role of Hyperbaric oxygen therapy**

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Massive blunt trauma to a hand ,even in young children, lead severely the function.A combined of open fracture with vascular,crush,and avulsion injury resulting in acute peripheral ischemia may place the hand at risk of necrosis and imminent amputation.We suggest a combined,multidisciplinary approach that include initial vascular and tissue repair,fractures fixation,with early institution of hyperbaric therapy.Our series is short include three childrens under 10 years old, four hands treated with a severe blunt trauma ,treated with combined approach surgical and hyperbaric therapy with recovery after four mounths .

Conclusion the combined approach of these type of injury it's a good procedure ,safe,and reduce timing of recovery.



P317c

**Digital replantation & revascularization: A review of 159 digits**

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Digital replantations & revascularizations are highly complex & extremely expensive operative procedures. It is usually performed under general anaesthesia with contributions & efforts from various staff & highly specialized equipments. In Selayang, under the guidance of a consultant hand surgeon, these procedures are done under local anaesthesia & in the ward environment. In a retrospective analysis from 1st January 2003 to 31st December 2003, there were 91 patients operated upon for digital replantations or revascularizations. Accordingly, 159 digits were operated upon, 94 digits were replanted or revascularized under local anaesthesia in the ward procedure room. It is concluded that these procedures can be performed in the ward & under local anaesthesia.





**P317d**

**Delayed microsurgical reconstruction of the upper limbs for complex soft tissue injuries**

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The treatment of severe wounds of the upper extremities characterized by large post traumatic tissue loss represents a clinical problem difficult to resolve, especially when the lesion is surrounded by large areas of ischemic dystrophic tissue which progressively aggravate and extend the initial lesion with frequent exposure of bone and joint structures making the amputation of the limb an inevitable outcome.

The authors present their experience based on a combined treatment by medical support methods like Hyperbaric Oxygen (HBO) and Vacuum Assisted Closure Therapy (VAC) and microsurgical reconstruction of the upper limbs, within a precise therapeutical protocol. From 2000 to 2005, 8 patients were treated, suffering from severe large lesions of the skin and the soft tissue of the upper limbs, with exposure of bone and joint structures in consequence of serious crush injury. Whatever the origin the treatment consisted of a combination, at different pre-fixed stages, of debridement surgical procedures, medical support methods and definitive surgery by microsurgical free-tissue transfer. The average age of the patients (6 men and 2 women) was 23.25 years ranging from 8 to 58. The follow up period ranging from 6 to 36 months.

All patients were considered for a three-phase protocol: debridement, Medical Support Methods and microsurgical procedures.

The use of this protocol in the appropriate times and ways has allowed to successfully treat severe post-traumatic sequelae of the upper limbs, avoiding delayed healing typical of these pathologies, both on the donor site of the flap and on the repaired area, or an unsuitable microsurgical reconstruction for the limbs, allowing a satisfactory morpho-functional restoration and a reduction of the hospitalization period.



**P318**

**The use of cutaneous dorsal metacarpal artery flap for the treatment of contractures of the first web space**

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The authors evaluate the outcome of employing the cutaneous flap that utilizes the second dorsal metacarpal artery with anterograde flow in the treatment of contractures of the first web space in nine operated cases. In three patients, besides contracture of the web space there was also contracture of the volar thenar area in the palm of the hand. The flap is nourished by distal cutaneous branches arising from the second radial metacarpal artery and emerging, in average, 1.2 cm proximal to the metacarpophalangeal joint. Morbidity of the donor site was low, given the high elasticity of the dorsal hand skin, which allows for the donor site's primary closing. The flap survival rate was 100%, although in three cases partial suffering occurred. The length and width of the flaps were enough for a good covering. The flap was shown to be advisable and a good option for the cutaneous covering of the first web space and volar thenar area of the hand.



**P319**

**Staged upper extremity reconstruction with a pedicled parascapular flap and massive bone graft after a devastating airplane propeller accident**

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The pedicled parascapular flap has been known to be a reliable source for soft-tissue coverage in the management of scar contractures in the axilla<sup>1</sup> ,<sup>2</sup>. However, only few authors has reported its use for the soft-tissue reconstruction around the shoulder and upper arm 3.

A 21-year-old patient was hit the at his left upper arm and shoulder by an airplane propeller resulting in a massive soft tissue injury, including nerves and shoulder girdle muscles and a segmental comminuted fracture of the humerus.

The soft-tissue loss extended from the anterior aspect of the shoulder through the anterior aspect of the middle arm. Nine months after injury, the patient presented with an unstable pseudoarthrosis of the humerus with poor soft tissue coverage. There was a 5 cm bone gap between the proximal and middle thirds of the humerus and only a fragile bone bridge connecting the middle and distal thirds. We decided to perform a pedicled paraescapular flap prior to the bone procedure in order to provide a more reliable soft-tissue coverage. The flap was elevated in the same way as it is in a free flap procedure. It was transposed to the anterior aspect of the humerus, between the teres major and teres minor. Six months later, we performed the secondary bone procedure. Cortico-cancellous bone graft was harvested from the iliac crest to fill the bone defects and a long LCP plate was used for fixation. A custom made thoraco-brachial orthosis was used to protect the osteosynthesis. Eight months after the bone grafting, the x-rays shows a solid consolidation of the pseudoarthrosis with bone graft integration.

We present a case that illustrates the potential of the pedicled parascapular flap for local soft-tissue reconstruction around the shoulder and upper arm prior to a bone graft and plating procedure

**References:** Kim, PS 1985; Yanai, A 1982; Vasconez, HC 1993.



**P320**

**Evaluation of moving and static two point discrimination of volar forearm skin before and after transferring as a sensate radial forearm island flap in reconstruction of degloving injury of the thumb**

**Mohammad Javad Fatemi**, Kammal Frootan, Mohammad Jalilimanesh, Mohammad Taghi Dini

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In degloving injury of the thumb a large size defect exists which needs coverage with a sensate, glabrous and pliable skin. Although coverage of this defect with a sensate free flap from the foot is the best choice yet most of the time a non-sensate distant pedicle flap have been used. Between 2001 and 2003, eight patients with degloving injuries of the thumb were treated by using sensate radial forearm flap with the lateral ante-brachial nerve of the forearm for coverage. Re-innervations of the flaps were undertaken by anastomosing lateral ante-brachial nerve of the forearm nerve to the digital nerve of the thumb (6 cases) or a branch of the sensory radial nerve (2cases). Follow up period ranged from 17 to 41 months. (Mean: 29.9 months). Sensory evaluation was performed using the moving two point discrimination (M-2PD) and static two point discrimination (S-2PD) of the volar forearm skin were changed significantly and their measurements were approximated to that of the contra-lateral thumb but never reached the normal sensation ( $P<0.01$ ). Sensate radial forearm island flap is a reliable option to cover a large defect of the thumb such as degloving injury and the sensation produced is near normal



**P321**

**A novel method of rapid nailbed repair using 2-octyl cyanoacrylate (Dermabond)**

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**Introduction and Aims:** Nailbed repair using fine 6-0 or 7-0 absorbable sutures can be technically demanding and time-consuming. We describe a simpler method of nailbed repair using 2-octyl cyanoacrylate (Dermabond) topical adhesive.

**Methods:** 10 consecutive patients with nailbed injuries not involving the germinal matrix were repaired with Dermabond. There were 5 simple lacerations, 4 stellate lacerations and 1 severe crush injury according to Zook's classification. Digital photos taken 6 months following the repair were reviewed by 4 separate hand surgeons who were not otherwise involved in this study. The appearance of the nail at six months was graded according to a new scoring system developed for this study. This system takes into account lifting, ridging, splitting, deformity, and sheen of the nail.

**Results:** Nailbed repairs using Dermabond took on average 4.2 minutes to complete. 4 patients had excellent aesthetic results, 5 had good results, and one patient with a crush injury had a fair result. There were no complications.

**Conclusions:** Dermabond is a useful tool for rapidly repairing acute nailbed injuries. The outcome of repairing injuries not involving the germinal matrix is similar to that expected for suture repairs of similar injuries.



**P322**

### **A standardized approach to defect coverage at the elbow**

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**Background:** Large defects at the elbow region often lead to significant impairment of function.

**Patients and Methods:** In a retrospective clinical study 151 patients (82 male, 59 female) who underwent flap surgery for defect reconstruction at the elbow were reviewed. The age ranged from 7 – 82 (average 39,4) years. The defect was located in 49 cases at the fossa cubitalis, in 15 cases at the medial epicondyle region, in 29 cases at the lateral epicondyle region and in the remaining 61 cases at the dorsal region or involved multiple regions. Etiology of defect was trauma (n = 95), impaired wound healing and infections (n= 27), extravasation injuries (n = 12), unstable scars after multiple previous surgeries (n = 8) and revision after ulnar nerve decompression at the elbow. Defect coverage was done using local flaps (n = 71), pedicled flaps (n = 41) and free microvascular flaps (n = 39). Study criteria were successful defect coverage and active and passive ROM pre- and postoperatively.

**Results:** Successful primary reconstruction could be achieved in 142 cases (93,6%). There were 2 complete and 4 partial flap necrosis after local flap transfer. And 3 after free microvascular transfer. There were no changes in ROM depending on the flap reconstruction unless a scar release had been carried out.

**Conclusions:** Reconstruction of large defects at the elbow do require a multidisciplinary approach. For the treatment of large soft tissue defects we are using a standardized diagnostic and therapeutic schedule. We distinguish 4 functional units (fossa cubitalis, lateral epicondyle unit, dorsal unit (regio olecrani) and medial epicondyle unit, thus defects can be classified into monoregional and polyregional defects. Adequate debridement, early soft tissue coverage, and adequate postoperative care are necessary to achieve a good result. By combining different orthopedic and plastic surgical techniques in combination with adequate postoperative care, will lead to a significant improvement of results and diminish the number of amputations.



**P323**

### **Management and results of tissue extravasation of cytotoxic agents at the upper extremity**

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**Introduction:** Extravasation of cytotoxic agents in subcutaneous tissue during peripheral intravenous administration may either cause local area of self resolving inflammation, or progress to full thickness loss of skin and eventually underlying structures.

**Patients and method:** We report on 20 patients with a infected full thickness skin necrosis at the upper extremity after extravasation of cytotoxic agents, treated 1996 and 2000. Mean age of the patients was 58 years with a range of 52 - 74. In all cases epirubicin or adriamycin were given. The mean time between extravasation injury and onset of surgical treatment was 22 days with a range of 6 to 47 days. A standardized surgical protocol was used: In a first step all necrotic and infected tissue was removed. Whenever possible soft tissue reconstruction was done at the same operation. If there was any doubt about the wound quality, artificial skin substitutes were applied, and a second look within the next 24 to 48 hours was carried out. For definitive soft tissue reconstruction either skin grafting or flaps were used. In a retrospective clinical study the following criteria were evaluated; 1) functional/esthetic result, 2) complications and 3) healing time.

**Results:** Skin grafting was done in 8 patients with either good wound quality (n = 5) or as simple defect closure in old patients with reduced general health status (n = 3). In 12 patients primary defect coverage was done using local flaps. For moderate sized defects at the cubital fossa region the Limberg flap is a good option especially in elder women with skin laxity of the upper arm. Large defects at the dorsum of the hand were reconstructed with a distally based radial forearm flap, either as a fascio-cutaneous or as a fascial flap. Complete wound healing within three weeks was achieved in 17 out of 20 patients. Significant wound healing problems, requiring re-operation, occurred in two patients, one after skin grafting and two after flap coverage.

**Discussion:** Depending on the patient's defect and the possibilities of defect coverage even in the late presented cases an acceptable functional and aesthetic result can be achieved. For patients with reduced general health at least wound closure to prevent further infection can be achieved. The treatment of extravasation injuries requires a multidisciplinary treatment team. In the acute phase, after aspiration of the extravasate, cooling and elevation, a plastic surgeon should immediately see the patient. Whether conventional or early surgical treatment is chosen mainly depends on; 1) Type of extravasated substance, 2) volume of extravasated substance, 3) time between extravasation and onset of adequate treatment, and 4) clinical presentation. We consider skin involvement with ulceration and/or therapy resistant pain an absolute indication for immediate surgery.



**P324**

**Use of thoracodorsal artery perforator flap in children**

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Perforator free flap (PFF) is now performed with increasing frequency for soft tissue reconstruction in adults. When compared to conventional free skin flaps, PFFs are thinner and have less donor site morbidity because only the skin is harvested. The advancement of PFF design has spurred the identification of many skin flaps based on the perforator principle. Although PFFs are used in adults, most reconstructive surgeons still hesitate to perform PFFs in children. The main cause of concern is the perceived high failure rate related to the small diameter of children's perforator vessels. Four consecutive cases of thoracodorsal artery (TDA) perforator flap in children were successfully transferred by author. An acoustic Doppler sonography was used to identify the perforator. Most perforators were larger than 0.5 mm in external diameter and were identified within 6cm from the axillary fossa. Because of thinner latissimus dorsi in children, harvesting thoracodorsal artery perforator flap in children is easier than in adult. This presentation introduces techniques and characteristics of TDA perforator flap in children.





**P325**

### **The versatile second dorsal metacarpal artery flap for hand reconstruction**

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**Purpose:** To demonstrate an option for coverage of difficult hand wounds.

**Introduction:** Exposed tendons, joint spaces, or bony elements of the hand require flap coverage. This is due to the complex anatomy and function of the hand and fingers. The natural contour of the skin and soft tissues of the hand limit the availability of flap coverage which provides for good function. Options for coverage include local flaps (adjacent tissue), reverse flaps (arterialized proximal tissue), pedicled flaps (thoracoabdominal tissue) and free flaps (moved from a distant site). Reverse dorsal metatarsal artery flaps are raised proximally on the second dorsal metacarpal artery and transposed to provide coverage to a digit. This flap is raised proximal to the second dorsal intermetacarpal space, and provides skin, fascia and tendon alone or in combination. This tissue composition is ideal for the reconstruction of digital soft tissue defects.

**Method:** Five patients with traumatic tissue loss to the proximal digit were treated with reverse dorsal metacarpal artery flaps. Mode of injury includes two electrical burns, one blast injury, one saw injury and one complication from soft tissue infection. Flap coverage was provided to the proximal phalanx of the index finger (4/5) and middle finger (1/5). All flaps healed without complication.

**Conclusion:** The reverse dorsal metacarpal artery flap provides reliable digital coverage with minimal donor site morbidity



**P326**

**Skin grafting by axial flaps for the treatment of patients with combined hand injuries**

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**Aim:** The proof of different methods of vascularised skin grafting by axial flaps depending on the type, localization and functional features of skin defects on the hand.

**Methods:** 151 patients with traumatic soft tissue defects of hands and fingers were treated from 1996 to 2005. New methods of repair of soft tissue defects replacement were based on the results of anatomic, pathology and histological investigations.

In the cases of finger avulsion-type injuries (n=8) a double flap method was used. The finger dorsal surface was covered by a dorsal metacarpal artery flap and the palmar surface was treated by a palmar digital artery flap from the adjacent finger.

For the thumb injuries (n=4) a dorsal forearm flap lengthening was offered for reconstruction of major soft tissue defects.

Outcomes were evaluated by studying transplants surviving, recovery of skin sensibility, hand function and necessity

**Results:** Patients were followed up for 0.5-6 years postoperatively. Good results occurred in 49 cases (69%). Satisfactory function recovery was observed in 19 patients (26. 8%). However, unsatisfactory results were found in 3 patients (4. 2%).

**Conclusion:** Vascularised skin grafting using axial flaps provides good functional results in most cases and should be used depending on the size and localization of soft tissues defects.



**P327**

**Reconstruction of fingertip defect with great toe pulp graft**

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**Purpose:** In case of fingertip defect without amputated distal part, healing by secondary intention or surgical treatment including wound closure after shortening of the bone, skin graft, local flap, distant flap, and free flap has been used. These methods, however, have caused functional and aesthetic problems including hypesthesia, paresthesia, pain and nail deformity. The authors have achieved satisfactory results, using pulp graft which was harvested from lateral aspect of great toe.

**Methods:** After minimal debridement of the stump, composite tissue (pulp) harvested from lateral aspect of great toe was grafted on the stump under local anesthesia. Moisture dressing with ointment and foam dressing material was performed. Stratum corneum of the graft got stripped off in two to four weeks after pulp graft. Color of the pulp graft was slightly reddish initially, then it became similar to adjacent tissue.

**Results:** There was complete take in 13 of 16 patients who were treated with pulp graft. There was partial necrosis in 2 patients, and total necrosis in 1 patient. Partial or total necrosis of pulp graft occurred in smokers. Pulp graft was painless and the color and texture of graft was similar to adjacent skin. Sensory was restored in all patients. Though nail shortening was developed, there was no hook nail deformity.

**Conclusion:** Great toe pulp graft has several advantages. The advantages are relatively high rate of graft take, short operating time, painless fingertip, similar color and texture of graft to adjacent skin, less visible donor scar, sufficient soft tissue for padding, and good sensory recovery.

Great toe pulp graft can provide sufficient soft tissue for padding and sensory recovery in the case of fingertip defect without amputated distal part, thereby resulting in good aesthetic and functional satisfaction.



**P328**

**Fascial vascular island flap: Greater reach, less morbidity**

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**Background:** Many of the loco-regional flaps described for skin cover in the finger are associated with significant donor site morbidity in terms of cosmesis or function. These flaps may also have inadequate reach, particularly to the dorsum of the finger distal to the proximal interphalangeal joint.

**Methods:** We describe a heterodigital vascular island fascial flap, which has several advantages over these flaps. The heterodigital fascial flap is a hybrid born of two existing flap concepts, namely the heterodigital island flap 1 and reverse dermal fat flap 2.

It is completely fascial, thus limiting donor site morbidity, and has good reach, which makes it suitable for to cover dorsal defects distal to the proximal interphalangeal joint. Three clinical cases out of a series of seven are described to illustrate the indications and technique.

**Results:** All flaps survived with minimal donor morbidity. There is good preservation of range-of-motion in both donor and recipient fingers.

**Conclusions:** The fascial vascular island flap provides coverage for moderate size finger defects while providing for distal reach, wide coverage and like-for-like resurfacing. In addition it minimizes donor morbidity in the hand.

**Reference:**

1. Littler, PRS, 1953
2. Clodius, PRS, 1973



**P329**

**The use of full thickness skin of abdominoplasty material as a salvage procedure for scalp replantation;  
Late result of a case**

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A 35 years old women who had complete scalp avulsion due to farm machine accident, admitted to our clinic 8 hours after the accident. Reimplantation was not possible due to long warm ischemia time, mutilation of the avulsed scalp due to high speed machine and very distal rupture of the avulsed vessels. We tried to preserve all of the avulsed tissues of the scalp. Inadequate perfusion had detected for more than a week (11-13 days) after anastomosing an arterial supply of this tissue with a territory of occipital artery. During this phase, deep layer of the replanted scalp had gained some viability and it provided us a vascular thinny tissue layer which is nourishing from the vascular tissue just over the non exposed bone of calvarium. By time, with conservation of the escarotomised superficial necrotic skin until spontaneous necrolysis had completed, a vascular tissue coverage of exposed bone of calvarium had obtained. Finally a vascular bed covering all of the calvarium had obtained. So we didn't need to use free or pedicled flaps actually it was necessary for the exposed areas of the calvarium. However, the patient was requiring an abdominoplasty due to multiparity. And so, a large full thickness skin graft had harvested without donor site morbidity. Skin of the lower abdomen prepared as a large full thickness skin graft wrapped around both temporal, parietal and frontal area with upper part of the eyelids and nose in enblock fashion, except occipital area which had covered split thickness skin graft . Later it is recommended to the patient to change this thin epithelialised area with full thickness skin graft and also hair implantation for eyebrows. But the patient refused this operation because of acceptable appearance, and no need more complex operations. This salvage procedure can be thought as an optimal solution for this kind of severe cases.



**P330**

**Dorsal skin flaps in the hand and digits - A review of the vascular architecture**

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Over the past fifty years cadaveric and clinical studies have provided descriptions of the cutaneous supply to the hand and digits. A varied, contradictory and confusing terminology has been developed by various workers.

The dorsal carpal arch is formed by contributions from the radial and ulnar arteries and gives rise to dorsal metacarpal arteries on the dorsum of the hand. Distally, dorsal digital arteries take over the supply. Both systems intercommunicate and receive numerous perforating links with the palmar system, providing scope for distally based forms of reconstruction. The first and second dorsal metacarpal arteries, as well as the occasional intermetacarpal artery have been the subject of confused nomenclature, which would benefit from rationalisation.

This vascular architecture has formed the basis of innovative flap design, providing cover for dorsal defects which would otherwise be difficult to reconstruct. These flaps allow for little margin of error, particularly when distally based. It is essential that the vascular basis of these reconstructions be clearly delineated if such designs are to be undertaken.

The various descriptions of the dorsal vasculature will be critically reviewed.

A simplified terminology, based on the guidelines of the 'Terminologia Anatomica', will be outlined.



**P331**

### **Pedicle flap procedures for sensory restoration of hand and long term results**

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Sensibility of hand is crucial in normal functioning hand and loss of sensibility results in loss of function. Patients operated for soft tissue and sensory restoration are presented with their long term results. Pedicle flaps as radial innervated cross finger flap and neurovascular island flap are the operative procedures applied. 30 patients are presented and sensory restorations of 24 thumbs, 3 index fingers, 3 fifth fingers are performed. 27 neurovascular island flap and 3 radial innervated cross finger flap are performed. Disconnection-reconnection of nerve is performed in 11 of 27 neurovascular island flaps. Mean follow up is 29.2 months (range 5-44 months). Semmes Weinstein Monofilament test and two point discrimination test are applied for sensory evaluation. No flap losses are observed. Contractures of donor digits are seen in 4 (%13) of 27 neurovascular island flaps. Neuroma formations are noted in 2 (%18) of 11 patients who had disconnection-reconnection of nerve. Static and moving two point discrimination test results were 9.1mm and 7.4mm respectively in patients with disconnection-reconnection of nerve. Static and moving two point discrimination test results were 8.25 mm and 7 mm respectively in patients operated with original technique. Static and moving two point discrimination test results were 10.3 mm and 8.6 mm respectively in radial innervated cross finger flap group. All patients with disconnection-reconnection of nerve localized sensation in the recipient site. Of the 16 patients without disconnection-reconnection of nerve, 9 patients (%56) localized sensation in the recipient site, 3 patients (%19) localized sensation in the donor site, and 4 patients (% 25) showed cross sensitivity.

Pedicle flaps are reliable and satisfactory alternatives both for soft tissue and sensory restoration of injured hand and disconnection-reconnection of nerve is found to be successful for prevention of cross sensibility.



**P332**

**Retrograde neurocutaneous metacarpal island flap**

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The neurocutaneous flap is an axial flap, containing both nerve and vein. Its arterial supply is carried out by a vascular net around and inside the nerve. Retrograde flaps that rely on this can be developed from the dorsum of the hand in order to cover complex defects of the fingers. Depending on the affected finger a radial or ulnar sensory branch could be used. The paraneural vascular net gives perforative branches to the skin. In palmar aspect it is also connected with vessels which enter the metacarpal periosteum.

A case with complex defect of the index is presented where such a reconstruction is undertaken. We used a neurocutaneous flap, pedicled on a sensory radial branch. This is a single stage operative technique that allows bone and soft tissue coverage without sacrificing one of the main metacarpal arteries.





**P333**

### **The monodigital superposed cross-finger plasty**

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**Introduction:** The impossibility to perform the cross-finger plasty in the palmar digital defect situated at the level of the PIP joint of the donor finger (because of the joint function impairment) and the limited dimensions of the digital defect to be covered (especially its length which must not be bigger than the width of the donor interarticular space) are two of the limits of using this method in the reconstruction of important supratendinous palmar soft tissue defects at the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> PIP and the 5<sup>th</sup> DIP joint level.

**Material:** Because all other currently used methods have disadvantages, the paper proposes a new, more efficient reconstruction method: *the monodigital superposed cross-finger plasty*. This method is characterized by two superposed flaps devised on the dorsal face of the donor finger (one on the proximal phalanx and another on the medial phalanx), separated by the PIP joint juxtaposed skin. The flaps are cut obliquely diverging from the base toward the top (parallelogram shaped) so that we can obtain by median suture a wider flap (trapezium shaped), the divergence at the base becoming convergence at the top. The newly created single flap has the following main qualities: a) the placement at the palmar face of the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> PIP or the 5<sup>th</sup> DIP joints level; b) double width in comparison with any other classic heterodigital flap, allowing the palmar interphalangeal soft tissues big defects reconstruction. The technique had been conceived and applied in a patient with palmar soft tissue defects of the right hand at the level of the 3<sup>rd</sup>, 4<sup>th</sup> PIP and the 5<sup>th</sup> DIP joints. The case had been solved by using multiple monodigital superposed cross-finger plasty from the 3<sup>rd</sup> finger to the 4<sup>th</sup> and from the 4<sup>th</sup> finger to the 5<sup>th</sup>. It was demonstrated that in this type of plasty each finger can be the donor and that the method can be performed in multiple injuries.

**Results:** Excellent reconstruction of the defect is provided by this method. The final result is discussed both from the point of view of the donor finger and from that of the reconstructed finger.

**Conclusion:** The monodigital superposed cross-finger plasty is elective in palmar juxtaarticular digital defects, even when these are multiple, leading to excellent structural and functional results.



**P333a**

**Use of the reverse posterior interosseous (R-PIA) flap to cover the volar wrist defects by electrical arc injuries**

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There are conditions of electrical arc burn that preclude the use of regional or free flaps for reconstruction of the volar wrist defects. Based on a series of 14 cases, alternative solutions are discussed.

The management of the volar wrist defects by electrical arc burn still represents a challenge. There are various approaches to this problem including local or regional flaps as well as distant flaps and free flaps. There is, however, concern about the state of defect and vasculature when the extremity involved is already compromised. In these cases, local or regional flaps such as the radial and ulnar forearm flaps are not useful. Distant flaps produce low patient comfort, long immobilization of the injured hand, and two stage procedures. Microsurgical procedures are time consuming and microanastomoses can cause complications in vascular compromised extremity. Fortunately, the dorsal aspect of the wrist and forearm frequently spared in electrical arc injury. For these reasons, the reverse posterior interosseous flap can be chosen in management of the volar wrist defects by electrical arc injury.

In the author's series of the patients, the range of exposure was 11,450 to 22,900 volts. All patients was injured by contact the line source or ground(exit). They sustained a significant cutaneous burn of the volar wrist in association with a palmar burn.

The reverse posterior interosseous (R-PIA) flap is useful for reconstruction of the volar wrist defects. The principal advantages are minimal donor site morbidity, minimal vascular compromise, one stage operation. This flap also offers the advantages of ideal color match and composition.



**P334**

**Flow-through arterialized venous free flap using the great saphenous vein for upper extremity salvage**

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**Purpose:** When the survival of upper extremity is doubtful with major arteries damaged while bones and muscles are exposed at the same time, treatment is very difficult. The author performed flow-through arterialized venous free flap transfer not performed previously to reconstruct major arteries as well as the injured skin and soft tissues in the upper extremity.

**Method:** Flow-through arterialized venous free flap was performed using the great saphenous vein to reconstruct major arteries, skin and soft tissues in 2 patients who were involved in auto accidents.

**Results:** The upper extremities were salvaged in both patients with well reconstructed major arteries. Severely damaged skin and soft tissues were also well reconstructed with an arterialized venous free flap.

**Conclusions:** With the method used in this study, surgery time was decreased, only one donor site was used, and reconstruction was possible when long arterial defects, such as 24-25 cm defects in the patients, were present.

**References:** Kevin F. Ciresi 1993, Isao Kosima 1995



**P335**

**Impact of fibrin glue application in free flaps' microvascular anastomosis: Comparative clinical study**

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**Background:** Since the first reports of fibrin glue application in microvascular anastomosis in 1977, by Matras, encouraging results have been achieved by other experimental studies. In spite of that, clinical experience has been limited to two series of fingers replantations and neurosurgical cases, with good results. The aim of this study was to evaluate the impact of fibrin adhesive application in free flaps' microvascular anastomosis.

**Methods:** From March 2005 to June 2006, 24 free flaps were performed in 24 patients. Twenty of them were included in this study. All cases but one were indicated for soft tissue coverage in open fractures in the lower or upper extremities. They were divided into two groups according to the anastomosis technique: conventional anastomosis group (7 patients) and fibrin glue anastomosis group (13 patients). In each case, parameters such as total ischemic time of the flap, arterial and venous anastomosis time, number of sutures stitches per anastomosis, external diameter of the vessels and survival rate of the flap were recorded for comparison between the two groups.

**Results:** The application of fibrin glue significantly reduced the number of sutures and the time taken to perform both arterial and venous anastomosis. The mean ischemic time of the flaps was 70 min in the fibrin glue anastomosis group compared to 83 min in the conventional anastomosis group ( $p= 0.263$ ). The survival rates of the flaps were 92.30% (12/13) in the fibrin glue anastomosis group and 85.71% (6/7) in the conventional anastomosis group ( $p= 1.0$ ).

**New and Unpublished data:** The current study is the only one to evaluate the impact of fibrin glue application in free flaps' microvascular anastomosis in the clinical setting.

**Conclusions:** The clinical application of fibrin glue in free flaps was safe and effective.

**References:** Matras, H 1977; Aksik, IA 1986; Isogai, N 1996; Han, SK 1998.



**P336**

### **Defect elbow-fractures with severe soft tissue damage: The ortho-plastic team approach**

**Robert Hierner** ,Stefaan Nijs, Eric van den Kerkhove

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**Introduction:** Complex fractures of the elbow are difficult to treat, especially when bone defects are combined with severe soft tissue damage.

**Patients and Method:** Between august 2001 and May 2005 we did treat 7 patients because of combined articular bone loss of the elbow and severe soft tissue defect. All patients were polytraumatized. There are 4 female and 3 male patients. Mean age is 30 years. In 6 patients a total elbow arthroplasty has been performed. In 3 of them the arthroplasty has been augmented with the use of an allograft. In the 7 th patient we did reconstruct the joint using an allograft alone. Because of the large soft tissue defect, a free myo-cutaneous latissimus dorsi flap was used. In two patient vascular reconstruction of the brachial artery was necessary. In 4 patients nerve reconstructions have been performed. In a retrospective clinical study the following criteria were evaluated: 1) active Range of motion (Neutral-0-Methode), 2) Power (Elbow flexion, power grip), 3) Functional Scores (DASH, SF 36, HSS, Morrey Score), 4) subjective judgment of the result by the patient (very good, good, moderate, fair) and 5) Complications.

**Results:** Mean active ROM was 0-58-128° for Extension/Flexion and 40-0-50° for Pronosupination. Mean power in comparison with the contralateral side was 64% for elbow flexion and 30% for power grip. Mean values for the DASH sore were 50, HSS Score 75,8, Morrey Score 72%. Subjective Judgement of the results by the patient showed 1x very good, 2x good, 4 x moderate. The was one loss of a pedicled LD flap, which had to be replaced by a contralateral free LD flap. We did see heterotopic ossifications in two patients, necessitating an arthrolysis. In two patients a dislocation of the elbow occurred. There was one post-operative infection, which could be cured by repeated irrigation and antibiotics. All patients do score their results subjectively as good or satisfying.

**Conclusion:** Defect fractures of the elbow with severe soft tissue damage remain challenging to treat. With a patient tailored, multidisciplinary approach however, acceptable functional results cab be obtained, avoiding arthrodesis or even amputation.



**P337**

**Use of triple free flaps and reverse sural island flap to reconstruct the foot defect by electrical burn**

**Jang-hyu Ko** , Jong-wook Lee, Dong-kook Seo , Suk-joon Oh , Young-chul Jang

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**Objectives:** Wide or multiple soft tissue defects by electrical burn may not facilitate single flap reconstruction. In that case, several flaps may be necessary.

**Methods:** A 37-year-old male was admitted with a work-related 22,900V electrical burn resulting in multiple soft tissue defects on the foot including the right 2, 3 and 4 toes, the heel and the ankle. On angiography imaging, the anterior tibialis artery had a normal circulation only up to the area 2cm proximal to the affected area near the ankle joint while the posterior tibialis artery was confirmed to have normal circulatory flow. The radial forearm flaps from both forearm and the anterolateral thigh flap from the left thigh were harvested to cover multiple soft tissue defects of the foot. First, proximal pedicle of the right radial forearm flap was anastomosed to the anterior tibialis artery. Then, the distal pedicle of the radial forearm flap was anastomosed to one side of the T-form pedicle of the anterolateral thigh flap. The other side of the T-form pedicle was anastomosed to the pedicle of the left radial forearm flap, simultaneously performing three free-flap procedures. Donor defects of the radial forearm flaps were covered with Terudermis ®. Donor defect of the anterolateral thigh flap was closed primarily. The rear part of the ankle joint was resurfaced with a reverse sural island flap.

**Results:** Three free-flaps and a reverse sural island flap survived completely. The flap donor area also healed without any complication. At the six-month follow-up, no complications were seen in the reconstructed area. Ankle joint movement and ambulation were acceptable.

**Conclusion:** We underwent simultaneously triple free flaps and a reverse sural island flap for coverage of multiple soft tissue defects of the foot. A patient had limb salvage and early rehabilitation by one stage operation, ultimately satisfactory functional outcome.



**P338**

**Management of infected non union of the radius in a sportsman**

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Infected non-union of the radius is a difficult and challenging clinical problem. When associated with a large segmental loss of bone in a young sportsman, particular attention needs to be paid to the method of reconstruction to allow for maximum function of the limb. We present the successful management of such an injury in a professional motorcross rider.

Following a compound fracture of the radius and ulna with initial plate osteosynthesis, the patient developed secondary osteomyelitis of the radius requiring radical debridement of bone leading to a segmental defect of 5.5 cm. An osteoseptocutaneous fibula free graft was harvested from the contralateral leg by a combined maxillo facial and orthopaedic team in a district general hospital. The maxillo facial team were required due to their experience in harvesting the graft. This was then used to reconstruct the radius.

There are multiple options available to the surgeon in the reconstruction of such defects in the forearm. Small defects can be shortened with minimal loss of function. Larger defects require grafting techniques, such as, conventional bone grafts, allografts. Bone transport can also be employed. However, integration of such grafts is poor due to a hypo-vascular necrotic tissue bed from prior infection. Prolonged immobilisation is required and is therefore associated with a high rate of failure.

In infected non-unions with secondary bone loss, using an osteoseptocutaneous fibula free graft is an excellent method of re-constructing the radius. It provides a stable construct with minimal loss of function. It allows definitive management sooner and a rapid return to normal life. In our patient bony union had occurred at 3 months and the patient was eventually able to return to the full professional level of the sport.



**P339**

**Free vascularized composite transfer from non-replantable fingers as a free flap for proximal interphalangeal joint primary reconstruction in acute complex hand injuries**

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In mutilating multidigital injuries, nonreplantable parts of amputated fingers may serve well as donor sites for reconstruction of another severely damaged finger. The results of treatment of severe injuries to the proximal interphalangeal (PIP) joint are unsatisfactory. Simultaneous reconstruction of the soft tissue, extensor mechanism, joint, and flexor tendon in a complex hand injury is difficult and challenging. Six heterodigital composite vascularized joints from non-replantable fingers were transferred in 6 patients for PIP joint reconstruction: 3 PIP, 2 distal interphalangeal (DIP) and 1 metacarpophalangeal joint (MCP). The flaps contained a neurovascular bundle and a dorsal island skin flap which were sutured to the corresponding palmar artery and nerve of the finger by microsurgical technique. Two flaps include a segmental extensor tendon.

**Results:** Two years after surgery average active range of motion of the reconstructed PIP joint following transfer of a PIP was 30 degrees extension to 43 degrees flexion; DIP to PIP transfer was 22 degrees/33 degrees and MCP to PIP transfer was 37 degrees/49 degrees. Bony union as well as full radiographic preservation of the articular space, no instability or pain has occurred in each case.

**Conclusion:** In multidigital mutilating injuries the immediate use of a microvascular composite flap from a nonreplantable part is recommended to improve healing and later use of the remaining digits. These flaps allowed for a one-stage procedure avoiding donor site morbidity or need for additional reconstructive surgery. The main advantages of these techniques are a compound tissue transfer, rapid bone healing, good lateral stability, and long-term cartilage preservation





**P340**

**The treatment of hand disorders with vascularized radial bone grafting**

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**Purpose:** Vascularized living bone grafting from the radius were performed to the hand disorders with avascular necrosis. The purpose of this study was to evaluate the outcome of the treatment of hand disorders with vascularized radial bone graft.

**Methods:** From January 2004 through April 2006, 6 hand disorders with avascular necrosis were treated with vascularized radial bone grafts: scaphoid non-union(n=1), Preiser Disease(n=1), idiopathic avascular necrosis of the capitate(n=1) and Kienb Ö ck Disease(n=3). The cases of the scaphoid non-union and Preiser Disease were treated with 1, 2-ICSRA-based vascularized bone grafts. A case of the idiopathic avascular necrosis of the capitate were treated with 2, 3-ICSRA-based ones. The other 3 cases were treated with 4, 5-ECA-based ones. A retrospective review of the clinical and radiographic information was performed.

**Results:** All cases went on to union at an average of 15.4 weeks after surgery. The results were evaluated based on the Mayo Wrist Score. In Mayo Wrist Score, 3 cases were excellent, 3 cases were good.

**Conclusion:** Vascularized bone grafts were efficacious in the treatment of the hand disorders with avascular necrosis. 1, 2-ICSRA, 2,3-ICSRA and 4,5-ECA pedicle vascularized bone grafting are technically easy to perform. It should be choice which arterial pedicle to use according to the cases.



**P341**

**Free tissue transfer and ancillary procedures for the wrist and hand reconstruction after severe burn injury**

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The wrist and hand reconstruction after severe burn injury is a great challenge because it often causes a complex soft tissue defect including skin, tendons, nerves. When reconstruction is planned, we must take not only an adequate resurfacing but also functional restoration into account. After rapid wound healing and early rehabilitation by free tissue transfer, secondary ancillary procedures were done.

From 1998 to 2004, 38 cases underwent the hand and/or wrist reconstruction using free flaps from various sites < 12 latissimus dorsi, 8 scapular, 7 radial forearm, 3 temporal fascia, 2 compound(latissimus dorsi+scapular), 2 dosalis pedis, 3 lateral arm, 1 anterolateral thigh >. Male was 35, female was 3. Patients age was between 22 and 53 years of age. Causes of injuries were electrical burn in 25 cases, contact thermal burn in 9 cases, flame burn in 3 cases, chemical burn in 1 case.

Flaps were successful in all cases except 2 cases. Secondary ancillary procedures were as follows.

11 tendon grafts(7 cases for flexor, 4 cases for extensor),

9 tendon transfers(6 cases for median nerve, 3 cases for ulnar nerve)

4 sural nerve grafts for sensory restoration of the hand

Wide defect throughout the hand and wrist was resurfaced with latissimus dorsi muscle flap and skin graft. The others were covered with flaps from various sites adequately according to patient condition.

Wide defect including deep structure in the hand and/or wrist was promptly covered with an adequate free flap which was able to get a rapid wound healing and early rehabilitation and then we got a satisfactory result from ancillary procedures in function.



**P341a**

**The vascular bone grafts at the wrist: Our surgical experience**

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**Introduction:** The vascular bone graft, free or pedicled, is a surgical procedure well known in the common practice, specially for the treatment of vascular necrosis of the carpal bones. The Authors expose their surgical experience about the Mathoulin's graft and propose any experimental new pedicled bone graft.

**Materials and methods:** Between 2003 and 2005 have been treated in Our Center 19 patients for an avascular necrosis of the carpal bones: between them there was 12 scaphoid non-union (stade 1-2A by Alnot), 1 capitatum bone necrosis, 6 Kienböck diseases (stade 2-3 by Lichtmann). In all these patients a pedicled bone graft from the distal radial epiphysis, like described by Kuhlmann and Mathoulin, was put in place after necrotic bone removal.

**Discussion and conclusion:** In 17 patients we could appreciate a complete restoration of the receiving site of the graft and of the ROM of the wrist; in 2 cases of scaphoid non-union the graft failed.



**P342**

**A new initiative in hand therapy - An Irish experience**

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Providing patient centered care and quality timely intervention is vital to maximise functional outcomes and patient satisfaction.

To meet this challenge the Occupational Therapy dept Beaumont Hospital Dublin responded with the development of new model of practice. In January 2006 an OT led hand therapy service for "minor" hand trauma was initiated in the Emergency Department. Research indicates that referral of patients with specific hand injuries directly to therapy service provides a more holistic approach to patient care. It ensures less waiting times for patients, more continuity of care, better use of staff resources and prevents re-occurrence of injuries, (Blake, 2000).

The goal was to create a more time efficient and patient centred service as compared with traditional management of such "minor" hand injuries. It was anticipated that this would provide an efficient service which ensures the very best of care for these injuries in order to optimise outcomes and improve patient satisfaction

This Poster presentation focuses on the experience of implementing a new model of practice. The benefits to the stakeholders, challenges that arouse and potential future developments will be discussed

**Conclusion:** An OT led Hand Therapy service in the Emergency Department meets the Irish Government health strategy of quality and fairness by providing direct access, efficiency and value for money.



**P343**

**Grip strength testing to differentiate sincere from insincere weakness**

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The use of grip strength testing as an objective assessment of disability is often necessary in both the rehabilitation and medico-legal setting. This testing is susceptible to manipulation from subjects for financial, social or psychological reasons. Previous attempts at identifying a means to reliably distinguish feigned from genuine weakness have produced poor results.

We present the results of a prospective, randomized, partially blinded study to assess the test sensitivity and specificity achievable through multi-variant analysis of both previously defined testing parameters and novel analytical criteria.

Three patient cohorts were recruited: 50 patients with genuine hand weakness following trauma or surgery, 50 healthy volunteers functioning at full strength and 50 volunteers feigning a grip weakness. Using a calibrated Jamar dynamometer linked to a computer the subjects were tested with a combination of Rapid Exchange Testing and Sustained Grip Force Time Curve Analysis.

Experimental data was analyzed through ANOVA testing and the multi-variant analysis was modeled with logistic regression. Results confirmed that on an individual basis no one test, or previously described combination of tests, reached sufficient sensitivity and specificity to be clinically useful. Accuracy and reliability of testing regimes could be significantly improved, however, through the combination of multiple variables from different testing protocols achieving a maximum sensitivity of 86.3% and a specificity of 90%.

We conclude that reliable identification of feigned weakness is possible through isometric grip strength testing and multi-variant analysis of a combination of testing parameters.



**P344**

### **Measurement of muscle strength of the thumb with a three-dimensional analysis system**

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We developed a three-dimensional analysis system to measure muscle strength of the thumb. Using this analysis system, we measured the pushing force and the joint torque at the carpometacarpal joint in thumb movements of flexion, extension, abduction, and adduction. Also this study was performed to review the influence of differences in radial abduction angle of the thumb carpometacarpal joint .

A total of thirty thumbs of fifteen healthy women with an average age of 21.2 were examined. In the muscle strength measurement system, a three -component force transducer was fixed to our custom-built sensor. This unit, which is connected to three strain gauge amplifiers, transmits the data to an A/D conversion analyzer for recording on a personal computer. The distal phalanx was pressed onto the prescribed position of the sensor.

The mean values of flexion, extension, abduction, and adduction in pushing force were 29.5N, 9. 6N, 13.6N, and 3 5.9N, respectively. The mean values of flexion, extension, abduction, and adduction in joint torque were 2. 07Nm, 0. 67Nm, 0. 88Nm, and 2. 31Nm, respectively. In the pushing force and the joint torque, the adduction and flexion values were significantly greater than those of extension and abduction.

In extension, t he average force at the radial abduction angle of the thumb carpometacarpal joint of 0 degrees was significantly greater than at 10, 20, and 30 degrees. For adduction, the average force at 0 degrees was significantly greater than for 30 degrees. With the radial abduction angle of 0 degrees, it was suggested that the action efficiency of extensor pollicis longus, extensor pollicis brevis and adductor pollicis were greater than for the other angles. Furthermore, this analysis system will be necessary to review the influence of wrist and forearm position for standardization. This method can be expected to be used for clinical applications.



**P345**

**Mallet injury. A comparative study of two non-surgical treatment models.**

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*4 Malmö University Hospital, Department of Health and Surgery, Sweden*

Mallet injury is a lesion of the terminal extensor tendon or its insertion at the distal phalanx, with or without a fragment of bone. This common hand injury results in a flexion distortion of the distal finger joint and may lead to an inequity between flexion and extension forces more proximally in the digit, resulting in a proposed mixture of treatment protocols. This study analyses the results of non-surgical treatment for closed and displaced mallet finger injury.

The patients above the age of 15 with a mallet injury degree I-III and without additional complications who consulted a physician within three months after injury were included in the study (n=30). The patients were reviewed to compare the results of occupational therapy and traditional treatment protocols. The results of the treatment were documented using the standardized measurement battery such as Grippit, DASH, and COPM semi-structured interviews.

Statistical analysis revealed that the patients treated according to the occupational therapy treatment regime had significantly better functional results concerning finger mobility, treatment satisfaction, activity ability, and fewer complications in the form of swan-neck deformity.

It is concluded that recognizing the complications, following-up of the treatment protocols and correct immobilization are necessary treatment procedures to promote excellent functional outcome.



**P346**

**The effect of upper extremity posture variation on extensor carpi radialis brevis force**

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**Purpose:** The purpose of this study was to determine the effect of posture variation on extensor carpi radialis brevis (ECRB) forces during lifting and reaching tasks.

**Methods:** Eight nonsymptomatic male maintenance workers (ages 35 to 48 y) were recruited to serve as subjects in this study (approved by PSU IRB). Clusters of reflective markers were applied to the arm, forearm, and hand of the dominant upper extremity of each subject; these markers were tracked using an 6-camera motion analysis system to determine the three-dimensional upper extremity motions during each trial. Activity in ECRB was recorded using surface electrodes and a telemetered EMG system. Subjects were asked to perform three tasks: an overhead drilling task and lifting and lowering 10% of the body weight. Two postural variations were assessed for each task. A three-dimensional musculoskeletal model of the upper extremity [1] was used to compute ECRB force from measured EMG activity and elbow and wrist position throughout each trial. Differences in ECRB force and activation resulting from posture variation were tested using repeated-measures ANOVAs followed by Tukey mean comparisons.

**Results:** Significant differences in average force and activation were detected between elbow-flexed and elbow-extended conditions for the lifting task ( $p = 0.030$  and  $p = 0.031$ ). Nearly significant differences ( $0.05 < p < 0.20$ ) were found for the lowering task and no significant differences were found for the drilling task.

**Conclusions:** Few studies have been done to establish the biomechanical determinants of lateral elbow pain or the effects of posture on ECRB activity. The results of this study can be used to establish guidelines both for prevention for workers at risk and for returning to work for symptomatic patients.

**References:** [1] Holzbaur et al., 2005.





**P347**

**“I built a boat in hand therapy”**

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The Wessex Rehabilitation Centre provides intensive multidisciplinary treatment to patients with major hand trauma. Late stage hand therapy is offered through the use of woodwork and engineering tasks in our fully equipped Industrial Workshop, which is staffed by qualified technical staff and occupational therapists.

In the summer of 2006, the patients completed a project to build a hand made wooden boat – a 19 foot, two-mast Caledonian Yawl. The Wessex Rehabilitation Centre patients achieved their hand therapy goals, whilst building a boat to be used by the patients from the Duke of Cornwall Spinal Injuries Centre, also based at Salisbury District Hospital. This complex project was funded by charitable organisations and private donations.

The project captured the imagination of the patients and the public, provided purposeful hand therapy for patients preparing to return to work and resulted in the fabrication of a beautiful and rare hand built wooden boat. The boat was launched by Shirley Robertson, double Olympic gold medal yachtswoman, from the Isle of Wight in May 2006. This paper outlines the therapeutic and organisational considerations of this unique project.



**P349**

### **Escalators eat hands**

**Pamela Hewitt**

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On 25 th May 2005, a 2-year-old boy sustained significant soft tissue trauma to the palm of his hand when it was caught between the steps of an escalator. A year later, I was referred a 6 year old boy who had sustained an entrapment injury to his little, ring and middle fingers when they were caught between the top step and comb plate of an escalator.

As a hand therapist and mother, I was alarmed at the thought that an escalator, so common in our shopping malls today could cause such an injury. The parents of these 2 children were not aware of this danger, and nor was I. Having treated 2 such injuries within a 12 month period, I also wondered if the incidence of these injuries was more common than I had expected.

Enquiries lodged with appropriate authorities indicated that at least 10 children annually suffer hand injuries requiring medical attention as a result of escalator accidents in New Zealand.

I will present the results from a survey of parents of young children regarding escalator safety and discuss appropriate ways to raise public awareness of the risks involved when riding on escalators.



**P351**

**Comparison of past pinch strength norms to new norms with a cross-cultural influence in normal adults**

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The purpose of this study is to compare past pinch strength norms (Mathiowetz, 1985) to present accumulated norms to see if there is a significant difference in pinch strength in the normal adult population.

The study based on an experimental design collected data through a varied sample population (from 18 years onward and free from an upper extremity injury) in America and Switzerland using a validated instrument (B&L Pinch Gauge) in various settings. Three types of pinch (lateral, 3-point, tip-to-tip) were measured using a standardized procedure, and relevant information pertaining to the participant was recorded for statistical and demographic purposes.

The data was put into different tables: pinch strength, comparison of right and left hands, correlation coefficients, occupations, and demographics, which was then statistically analyzed by using the ANOVA two factor test.

The new data will then be compared to Mathiowetz's data in his study from 1985 to conclude if there was a significant change in American pinch strength, and if there was a difference when comparing pinch strength to that of the Swiss data.

**References:** Mathiowetz, V., 1984, 1985, 1990; McDermid, J., 2001



**P352**

**The validity and reliability of the biometrics upper limb exerciser: grip strength**

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**Objective:** In 2001 the Centre for Rehabilitation of the University Medical Centre Groningen (UMCG) purchased the Biometrics Upper Limb Exerciser (BULE), which can directly and digitally restore measurements (grip strength, range of motion, and sensibility). The aim of the present study was to examine the validity and inter- and intraobserver reliability of the BULE, with respect to grip strength.

**Methods:** 31 healthy female nurses (20- 45 years), working in the UMCG were recruited by mail. Exclusion criteria were a history of neuromuscular or orthopaedic dysfunction. To examine inter- and intraobserver reliability, the measurements with the BULE and the Jamar dynamometer were performed by two observers on two different occasions per observer. The Jamar dynamometer was used as the gold standard. Statistics: paired t-tests, ICC, and limits of agreement (LOA).

**Results:** The results of this study showed a good agreement between the BULE and the Jamar. No statistical significant differences were found between the occasions per observer, or between the observers. The LOA's found in the present study point at a minimal difference to detect of 5.8 to 8.3 kg, indicating that clinical evaluation with the BULE should overcome at least a difference of 6 to 8.3 kg prior to establish clinical relevant improvement.

**Discussion & Conclusion:** Computerised systems such as the BULE are introduced to measure grip strength, and have many advantages, like storage data and graphic potentials. The present study showed a good validity, and a high intra- and interobserver reliability of the BULE. However, measurements using the BULE reveal considerable LOA's. As such, our results imply that that measurement of grip strength with the BULE seems to be valid and reliable, but should take into account a minimal difference to detect of 6 to 8.3 kg.



**P353**

**Patient specific expectations of result after elective handsurgery**

**Karin Lind**

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In evaluating outcome of treatment different perspectives can be focused on and patient expectations have received a growing interest when evaluating with a patient specific approach. The close relationship between expectations and satisfaction with result emphasizes the importance to identify the patient´s pretreatment expectations. The patients expectations could be distinctly different from those of the surgeon or therapist and have a great influence on the satisfaction.

The purpose of this study was to preoperatively identify expectations of the result after hand surgery in different diagnosis and to use these expectations to postoperatively assess the fulfillment of expectations.

Further aim was to classify the expectations in accordance to the ICF (International Classification of Functioning).

A selfadministered questionnaire was preoperatively distributed to patients waiting for surgery. The questionnaire has earlier been tested in a study in orthopedic patients for validity and reliability.

The patients specified a maximum of five expectations which the patients are expected to estimate the fulfillment of after the surgery.

The results will be presented as expectations for the different diagnosis and as categorized in accordance to ICF.



**P354**

### **Grip strength measurement: Why?**

**Lynne Pringle**

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**Aim:** ascertaining how the results of grip strength testing, is implemented in rehabilitation, and ultimate function. Do therapists interpret readings correctly?

Is grip strength testing utilized in order to assess the extent and detail of limitation and functional deficit, and then to set, evaluate and modify goals in treatment? When using results for research purposes, statements are often made such as: "good grip strength and therefore good functional outcome".

Different methods, techniques and instruments in measuring grip strength are researched. Norms, reliability and validity is discussed.

A large volume of everyday, functional activities using grip strength is documented. These include samples from factory workers, clerical, technical, medical, administrative, manual labour, domestic workers and selfcare and leisure activities.

**Conclusion:** Norms are merely a guideline. Any calibrated dynamometer is as good as another. A bell curve is mandatory. Each of the 5 settings indicates information regarding function and/or limitation. Using only setting 2, or the mean, or the highest setting result, is of no functional value, and does not indicate functional outcome.

When correctly applied and interpreted, grip strength testing is a valuable tool in assessment prior to, and during rehabilitation, and as a measurement for functional outcome.



**P355**

**Survey of practice of elective hand surgery on smokers**

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We conducted a survey of the members of British society for the surgery of hand. The list was compiled for the web site of the organization and postal questionnaire were sent out. The members were broadly divided into members in UK and members abroad. The members were asked about their clinical practice of elective hand surgery for patients who smoke. To the best of our knowledge there exist no national or regional guidelines or recommendations for performing elective hand procedures on patient who smoke, there is lack of consensus among surgeons and no baseline data is available. 77% of respondents agreed with us that there is delayed healing and more complications in smokers. 32% of respondent have personnel policy regarding hand surgery procedures on patients who smoke. Only 1% of the units have written policy for surgery on smokers. Majority of surgeons are happy to operate on smokers, bit cautious with free or pedicle tissue transfer and bony non-union. There are is total lack of consensus. Guidelines are needed in the selection of and guidance given to patient who smoke and request elective surgery



**P356**

**Adequacy of surgical consent - In a busy tertiary referral hand centre**

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**Introduction:** Despite the government's strict guidelines on consent, it has been documented that majority of consent is taken by junior doctors, who lack the knowledge base to obtain comprehensive informed consent. We assessed the consent practices in a busy tertiary referral hand surgical centre.

**Methods:** 65 consecutive records of surgically managed hand injuries were assessed from February 2006. A consensus was reached by senior surgeons in the unit for adequacy of consent for various structural injuries. This was used as a tool to measure adequacy of the consent forms with operative notes.

**Results:** 87% of patients were consented by junior trainees. In 3 % of cases the wrong hand was consented for and 10% the incorrect digit. General complications including bleeding, infection, nerve injury and pain were consented for in greater than 60% of patients. Specific complications for bone, tendon, soft tissue, nerve and vascular injury were consented for in 21% of the cases. Not a single patient had all the required specific complications documented and 12% of the procedures undertaken did not match the consent.

**Conclusion:** Our study shows consent is inadequate in a majority of cases which has serious medico-legal implications. We propose a robust system of a generic knowledge based information document to assist in the comprehensive consent of hand injury patients to maintain a uniform quality.





**P357**

### **The operative treatment for osteochondritis dissecans of the humeral capitellum**

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*2 Saga Insurance Hospital, Saga, Japan*

**Purpose:** We performed the two kind of operation for osteochondritis dissecans (OCD) of humeral capitellum in teenaged baseball players. In this presentation we compared of the results between the two kinds of operation.

**Operative procedures:** One is osteo-chondrosynthesis with iliac bone graft by mini screw after curettage of necrotic subchondral bone for early stage of OCD. Another is osteochondral autograft transplantation (mosaic plasty) from knee joint for unstable stage of OCD.

**Materials and Methods:** Since 2000 osteo-chondrosynthesis with bone graft was performed on 28 elbows (mean age 14.1 y.o.). On the other side, osteochondral autograft transplantation was performed on 10 elbows (mean age 13.7 y.o.) since 2004. At mean follow up of 24 months, all patients were evaluated with clinical rating system (by Timmerman and Andrews) and radiographs and ability of sports activity.

**Results:** In early stage group, the mean clinical score significantly improved from 128.6 points to 154.8 points post operatively. Radiographically, bony union after the osteo-chondrosynthesis was completed in all patients. Two of 28 patients were decreased slightly in sports activity. 26 patients were able to return to sports activity completely. In unstable stage group, the mean clinical score significantly improved from 133 points to 160 points post operatively. Radiographically, the graft incorporation and a normal contour of the subchondral cortex were found in all patients (N=10). One of 10 patients was decreased relatively in sports activity. Nine patients were able to return to sports activity completely.

**Conclusion:** Both operation (osteo-chondrosynthesis and mosaic plasty) in teenaged baseball players can provide satisfactory clinical and radiographic results. Both operative procedures don't change the alignment which load to humeral capitellum in throwing phase. So the most important point not to recur is improving the throwing form.



**P358**

### **Corticosteroid injection for lateral elbow: A randomized placebo controlled clinical trial**

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**Background:** Lateral epicondylitis is a very common tendinosis that occurs during middle age. Corticosteroid injection is often used for treatment although it's poorly supported by scientific data. We performed a randomized clinical trial comparing dexamethasone injection with injection of lidocaine alone (placebo).

**Methods:** At the initial we evaluated depression, pain catastrophizing, and patient rated arm function (DASH). At one and six months we recorded pain and satisfaction using visual analogue scales (p-VAS and s-VAS), DASH score, and grip strength.

**Results:** 58 patients enrolled in the protocol (26 men and 32 women): 29 dexamethasone and 29 placebo. This abstract is based on preliminary data from 38 patients (19 dexamethasone and 19 placebo) that have completed the protocol. From the initial visit to the last visit the mean DASH score improved from 28.1 to 28.0 to 16.7 in the placebo-group and from 30.9 to 20.8 to 13.8 in the dexamethasone-group. The mean p-VAS score improved from 5.9 to 3.4 to 1.9 in de dexamethasone-group and from 4.6 to 4.1 to 1.7 in the placebo-group. The mean s-VAS improved from 5.5 to 8.6 in the placebo-group and from 5.1 to 8.2 in the dexamethasone-group. The improvements within each cohort were statistically significant, but the differences between groups were not. A positive correlation between DASH-scores and depression and poor coping was found at all visits (depression:  $p < 0.01$ , r-value 0.70 and pain catastrophizing:  $p < 0.05$ , r-value 0.70).

**Discussion:** Lateral epicondylitis is a self-limiting tendinosis of middle age. Self-assessed disability from this condition is strongly related to depression and poor coping mechanisms. Although there was a trend towards earlier recovery in patients receiving dexamethasone, the difference was not statistically significant with the numbers available, which we interpret as indicating that the difference was not large enough to be clinically important based upon our power analysis.



**P359**

**Resection of radial head in an icehockey-player**

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*Medical University of Vienna, Austria*

The resection of radial head following isolated comminuted fractures is a differently discussed method. We report of a 34 year old icehockey player who developed major problems within weeks.

The patient was treated in a regional trauma center and allowed to restart loading of his right elbow after six weeks. Two weeks later he complained of problems in the right wrist during loading. He was treated for tendinitis of the flexors. Progressively the patient developed permanent pain and loss of strength.

After six months he presented himself with severe pain in the wrist, mainly the TFCC, and a ROM of S 30-0-40. The elbow was only little painful, ROM S 0-0-110. The radiographs showed a shortening of the distal radius of 1cm, the MRI proved the compression of the TFCC and showed an edema of the lunate.

A bipolar radial head prothesis was implanted and a shortening correction osteotomy of the ulnar was performed and fixed with a compression plate. Postoperatively ROM in the elbow was S 0-0-150. Free rotation of the forearm was reached after 2 months of physical therapy, in the wrist a ROM of S 50-0-80 could be reached. The strength measured was 1.0bar right vs. 1.4bar left (normal: >0.6bar). Six months after the revision surgery the patient could play again.

Resection of the radial head following isolated fracture comminution should be well-considered regarding age, activity level and profession.



**P360**

### **Experience in floating elbow treatment**

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**Introduction:** Simultaneous ipsilateral fractures of humerus and forearm are not common injuries, and were titled "floating elbow" in 1980 by Stanitski and Micheli. As these fractures are usually high impact, there are often associated injuries, and numerous hurdles encountered during treatment from primary care to rehabilitation. We have treated 12 floating elbow cases from the period July 1, 2004 to June 30, 2006. Following, is an overview of treatment and outcomes.

**Materials and Methods:** Twelve patients comprising 8 men and 4 women, with mean age, 33.6. Seven cases were caused by traffic accidents, 3 were ground impact from significant heights, and 2, others. Associated injuries were sustained in ten cases, and we evaluated these using Injuries Severity Scores. All cases except two children were treated surgically. The method of treatment was determined by each individual patient's condition. Fractures were classified according to Roger's classification and the criteria of A.O. Each case was evaluated with standardized elbow evaluation according to Khalfayan et al.

**Results and conclusions:** According to Roger's classification, 5 cases were group I, and 7 group II. Open fractures occurred in four cases, one humerus, two forearm and one with both humerus and forearm. The Injury Severity Scores were between 4 and 25. Three cases had nerve injuries, one had brachial plexus injury, and there was one compartment syndrome. In all open fracture cases we performed emergency irrigation and debridement. The period from injury to surgical treatment was zero to fourteen days. All fractures healed, but infection occurred in two with open injuries, they needed debridement in conjunction with antibiotics. The functional outcomes did not have the any specific relation to the length of time before the operation was performed or the Injuries Severity Score, but were mostly determined by the severity of nerve injuries.



**P361**

**Comminuted intercondylar fracture of the distal humerus in adults**

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**Purpose:** The purpose is to evaluate the therapeutic results of comminuted intercondylar fractures of the distal humerus in view points of plating methods and surgical approaches.

**Materials and Methods:** From January 1998 to December 2004, we reviewed fifteen cases of intercondylar fracture of the distal humerus, which were surgically treated. The follow-up period ranged from six month to 5 years. The functional results were evaluated using Broberg and Morrey's functional scale according to surgical approach, type of plate and location of plating.

**Results:** The functional results were as follows; seven excellent, six good, one fair and one poor. The mean range of motion in elbow joint was 7°~106°. The mean functional score was 86.6 points through olecranon osteotomy, 90.5 points through Campbell's posterior approach. The mean functional score was 91.6 points in cases using 2 reconstruction plate, 78 points in cases using 1 reconstruction plate and 1/3 semitubular plate, and 86 points in case using 1 reconstruction plate and lag screws. The mean functional score was 88.9 points in cases by posterior and lateral fixation, 86 points in cases by both posterior fixation and 97 points in case by both lateral fixation.

**Conclusion:** There are no significant differences in treatment outcome according to surgical approach, different plate and location of plating.



**P362**

**A study of safety and efficacy of a pneumatic finger tourniquet**

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**Background:** Finger tourniquets are widely used to achieve a bloodless field. However the common designs have no means of quantifying or changing the amount of exerted pressure and run the risk of being forgotten in situ.

**Methods:** 50 adult patients undergoing operation distal to PIPj were included. The pneumatic tourniquet was used according to protocol after ethics committee approval. A 5ml syringe was used to inject the desired amount of air into the tourniquet to achieve the required pressure for the procedure. Patients with vascular injury, sickle cell disease and those taking warfarin were excluded. Both the surgeon and the patient filled in questionnaires looking at safety, efficacy, ease of use and patient comfort of the device.

**Results:** The device had a low failure rate, was considered easy to use and was comfortable for the patient population.

**References:** Avner Karev 1979, Andrew Barnett 1982, Sarah Tucker 2001, IM Smith et al 2002



**P363**

**A clinical study of the Healthtronics OssaTron Extracorporeal Shock Waves for treatment of Chronic Lateral Epicondylitis**

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**Purpose:** This clinical study was conducted to determine the safety and effectiveness of Extracorporeal Shock Waves (ESW) using the HealthTronics OssaTron system to treat Chronic Lateral Epicondylitis.

**Materials & Methods:** This randomized, placebo-controlled clinical trial involved seven test sites and 225 patients evenly divided between male and female with a mean age of 45.7 years. Test patients had a history of Chronic Lateral Epicondylitis, who were under the care of a physician and failed to respond to both physical therapy and minimally two pharmacological treatments. Patients received 90 placebo and 273 active ESW treatments with the OssaTron ESW system - utilizing electrohydraulic technology to generate shock waves. An 8-week follow-up determined baseline results of success criteria of investigator assessments (minimum 50% improvement and VAS score of 4.0 or less), subject self-assessments, and pain medication use.

**Results:** Investigator assessments showed that subjects randomized to active ESW treatment improved from a mean baseline VAS score of 7.73 to 3.64 at 8 weeks, with a median VAS score of 3.35. Forty-three of the 82 subjects (52.4%) met the success criteria for this parameter. The subjects randomized to placebo treatment improved from a mean baseline VAS score of 7.81 to 5.17 at 8 weeks, with a median VAS score of 5.5. Twenty-six of the 83 subjects (31.3%) met the success criteria for this parameter. No unanticipated or serious adverse event has occurred to date in any test patient.

**Conclusion:** Analysis showed that a single OssaTron ESW treatment is effective in treating Chronic Lateral Epicondylitis, when compared to placebo treatment at 8 weeks. Of the 82 active treatment subjects, 33 (40%) met all success criteria, compared to 20 of the 83 placebo treated (24%) – a difference that is significant at a  $p$  level of 0.018.



**P364**

**Corrective osteotomy of the ulna using temporary external fixation for chronic Monteggia lesions in children**

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**Purpose:** In chronic Monteggia lesions in children, the aim of the surgical treatment is reduction of the radial head. In this study, we treated 12 chronic Monteggia lesions using corrective osteotomy and investigated the clinical outcomes.

**Methods:** The average patient age was 8 years old. There were 8 males and 4 females. Lesions were on the right in 5 and on the left in 7. According to Bado's classification, 8 patients were categorized as type 1, 3 as type 3. The average duration before surgery was 3 months. Twelve corrective osteotomies of the ulna were performed. Six cases of the 12 osteotomies underwent corrective osteotomies of the ulna alone. Repair and reconstruction of the annular ligament were performed in 3 and 2 patients, respectively. One patient underwent resection of the radial head. Especially, temporary external fixation was applied to 8 cases at the time of osteotomy of the ulna.

**Results:** The average follow-up period was 28 months. In all patients, the postoperative range of motion of the elbow was increased or unchanged. However, limitations of pronation were present in 3 cases that underwent repair or reconstruction of the annular ligament. One patient had recurrent dislocation of radial head and underwent the radial shortening.

**Conclusions:** Persistent dislocation of the radial head may lead to elbow instability and limitation of elbow motion in children. We treated chronic Monteggia lesion using reconstructive relocation of the radial head. It is important to correct ulnar malalignment to achieve stable reduction of the radial head. Surgery was technically difficult. We used temporary external fixation at the osteotomy to gain correct alignment of the osteotomy site. Temporary external fixation was useful for preservation of the position at the time of osteotomy.





**P365**

**Wear in radial head implant materials in contact with cortical bone**

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Wear behaviors for two materials: CoCrMo alloy and pyrolytic carbon (PyC), used as articulating surfaces in hemi-arthroplasty radial head implants were compared using an *in vitro* joint simulator.

**Methods:** Five PyC and one CoCrMo radial head implants were loaded to 180 N against fresh bovine cortical bone and cycled through an angle of approximately 45 degrees for 5 million cycles at a rate of 4 cycles/second. Bovine serum was used as a lubricant. Two additional PyC specimens were tested with the lubricant doped by additional bone particles generated using a burr and Stryker saw. Wear appearance and wear mark depths were evaluated at set cyclic increments. Wear debris in the lubricant were isolated by centrifugation and digestion to eliminate bone particles. Particle counts were then performed on the resulting supernatant and pellet solutions using a Spectrex PC-2000 laser particle counter.

**Results:** It was necessary to abort the CoCrMo/bone specimen at 500,000 cycles because available bone had worn away. All PyC/bone specimens survived to 5 million cycles.

Result Summary	CoCrMo	PyC	PyC-doped
Final Cycle	500,000	5,000,000	5,000,000
Bone loss mm	2.5	0.18	1.8
Final Roughness (nm)	2,000	40	50
Max Wear depth (nm)	10,000	900	2,000
Debris count increase	100 X	None	None
Surface appearance	Severely plowed	polished	polished

**Conclusion:** Wear occurred by an abrasive mechanism and was exaggerated by the presence of 3 rd body particles. Fewer 3 rd body particles were generated by PyC/bone than by CoCrMo/bone, hence lower wear losses occurred for PyC/bone.



**P366**

## **Performance Requirements for Radial Head Prostheses**

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A three-dimensional musculoskeletal computer model of the upper limb was used to calculate the maximum force transmitted by the radial head during voluntary muscular activity. The model calculations were used to establish performance requirements for radial head prostheses.

**Methods:** Muscle and bone geometry in the model was based on the Visible Human Male dataset. The elbow was modeled as a two degree-of-freedom joint, with flexion-extension and pronation-supination occurring about two non-perpendicular axes; the carrying angle was 14.8° when the elbow was fully extended. The model was actuated by 7 muscles. Optimization theory was used to determine muscle and joint contact loading during maximum isometric elbow flexion and extension exercises.

**Results:** Maximum forces were transmitted by the radial head during maximum isometric contractions of the elbow flexor muscles. The peak resultant force applied to the radial head was 12.0 N per unit of external force applied at the hand, which occurred when the elbow was flexed to 10° and the forearm was pronated to 20°. The compressive force was the most significant: 11.8 N per unit of external hand force acted to press the radial head and capitulum together during maximum isometric flexion. The corresponding shear forces were 3.4 N/hand force and 1.1 N/hand force in the sagittal and transverse planes, respectively. The maximum force transmitted by the radial head during maximum isometric flexion was 6 times greater than that transmitted during maximum isometric extension.

**Discussion and Conclusion:** Joint contact forces determined by the model are expected to be greater than the forces applied to the radial head during activities of daily living, and thus represent demanding performance requirements for radial head implants. Implant durability can be optimized by designing for strength based on the results obtained in this study.



**P367**

**Clinical anatomical study of pedicled vascularized scapular bone graft using the angular branch**

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The angular branch of the thoracodorsal artery supplies blood to the entire lateral margin of the scapula from the inferior angle of the scapula. This study is an anatomical investigation of the angular branch, and examines the possible range of clinical targets for pedicled vascularized scapular bone graft using the angular branch. Forty-six fresh frozen cadavers involving 88 sides were studied utilizing Shimizu's classification and Seitz et al.'s classification. The blood vessel length of the angular branch and thoracodorsal artery was measured. The blood vessel length was calculated, and the distance required to reach the distal humerus from the lower end of the articular surface of the humeral head as reference point was compared with bone length. The angular branch was present in all cadavers. Bifurcation of angular branch was present in a 17.8mm site on average around bifurcation of the main serratus anterior branch and latissimus dorsi branch. The length from the axillary artery was 100 – 190mm (mean 138.8mm). The length from reference point was 84 – 180mm (mean 121.7mm). The lateral margin of scapula length was 108-153mm (mean 124.6mm). It was thought that the maximum distance to arrive in reference point to the distal humerus was a total of blood vessel length and transplantation bone length, which was an average of 246.3mm. This was longer than the average of 240.8mm of bone length from reference point to humeral medial condyle. This study confirms that a pedicled vascularized scapular bone graft using the angular branch could be transplanted to the distal humerus. We considered that this operation became possible without the technique of microvascular anastomosis, and there was wide adaptation for the non-union of the humerus.



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### **Ungueal complex trauma**

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**Objectives:** The aim of this study was to analyze the results of the surgical intervention in 80 consecutive cases of ungueal apparatus trauma

**Methods:** In 22 patients we performed simple suture of the ungueal bed. In 18 patients we performed nail bed suturing followed by distal phalanx osteosynthesis. In 8 patients, we performed microsurgical reconstruction of the ungueal complex. In ten, conventional composite graft of the ungueal apparatus. In 12, immediate nail bed grafting while in 10 delayed nail bed grafting.

**Results:** We considered the nail growth (0 = no growth; 1 = partial growth with arrest, and 2 = normal growth); the nail size (0 = lower than 50%; 1 = between 25 and 50% and 2 = up to 25% of the opposite nail size); and the nail shape (0 = important deformity at the vertical plane; 1 = minor deformity at the vertical plane, and 2 = no deformity) compared to the opposite side. Results were obtained by adding scores and classified as Good (5-6), Regular (3-4) and Poor (inferior to 3). Results were judged as Good in the patients who underwent suture of the nail bed followed by distal phalanx osteosynthesis and microsurgical reconstruction of the ungueal complex. Results were judged as Regular in four conventional composite grafts, in four patients with immediate nail bed grafting and in delayed nail bed grafting. Poor results were verified in two patients who underwent immediate and delayed nail bed grafting.

**Conclusions:** After analyzing the present series of 80 cases, we could attest ( $p < 0,05$ ) that ungueal trauma with no loss of substance at the level of the nail bed showed the better results after reconstruction.



**P369**

## **Handsurgery on out-patients 14 years of experiences**

**Klaus Lowka**

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Report about the experiences in a center for out-patient surgery over a period of 14 years.

1993 two anaesthesiologists and four surgeons decided to open their own center for out-patient surgery.

The main specialities of our center are:

- Handsurgery
- Plastic surgery
- Pediatric surgery
- General surgery
- Minimal invasive surgery

The increasing number of operations achieved an average of 5.000 per year.

Problems and challenges with the administration, the insurances, the organization, the quality control, the medical technology, the medical teaching and the medical research will be described.

In conclusion and in spite of all the problems we had and we will have we are satisfied with the work and the success during the last 14 years.