Tri-plane Osteotomy Correction of Distal Radius Malunion Addresses Shortening, Angular, and Rotational Deformity

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INTRODUCTION: Rotational malalignment following fracture of the distal radius may be under appreciated and contribute to subluxation and dysfunction of the distal radioulnar joint. Rotational malunion is demonstrated by both plain radiographic and CT imaging. METHODS: Eleven patients with shortened, angular and rotational malunion underwent correction by performance of triplane osteotomy. Additional radiographic analysis of both “sawbones” models and cadaver wrists was performed to define the degree of rotational offset required to diagnose this deformity. RESULTS: Healing of the osteotomy of the distal radius was achieved in all 11 patients. Fixation utilized low profile anatomy-specific plates. Preoperative pronation/supination arc was 40° and postoperative arc was 130°. In eight of the 11, pain was rated as 0 on a 10 point scale while the other three ranged between 2 and 5. At two year follow-up, grip strength measured 80% of the contralateral side while total range of motion measured 76% of the contralateral side. All 11 patients were functional at daily household activities, five out of seven previously working patients were back to work, and all patients felt that their postoperative status was a significant improvement over their preoperative status. Plain x-ray evaluation of “sawbones” radius models demonstrated observable cortical offset with as little as 15° malrotation. However visualization of DRUJ subluxation required 30° of malrotation, which was readily demonstrated on CT scan images. DISCUSSION AND CONCLUSION: Triplane osteotomy is effective in restoring pronation and supination, diminishing pain and increasing function. Radiographic evidence of medial and/or lateral cortical “step-off” should raise the suspicion of a rotational component to the fracture deformity. CT imaging is helpful in making a definitive diagnosis. Recognition of this “third” component of distal radius fracture displacement is important in correcting initial displacement as well as late deformity.

Atraumatic Osteonecrosis of the Distal Radius and Ulna: A Case Series and Review

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INTRODUCTION: Atraumatic multifocal osteonecrosis is a relatively rare disease, defined as the occurrence of this entity in three or more discrete anatomic locations. We identified 10 wrists with osteonecrotic lesions in six patients who had this disease. The purpose of this study was to describe its clinical manifestations affecting the long bones of the wrist, identify risk factors for developing the disease in this location, and evaluate the success of percutaneous drilling for its treatment. METHODS: Ten wrists in six patients who had symptomatic osteonecrosis were identified. Their mean age at presentation was 41 years (range, 21 to 61 years) and all were women. Patients were treated by percutaneous drilling when they failed non-operative modalities. Clinical evaluation (including pre- and post-operative MI Hand Questionnaire (MHQ) scores), plain radiographs, and MRI evaluations were performed to assess and characterize the disease, and the incidence of risk factors was recorded. RESULTS: There was disease occurrence in the radius in all 10 wrists, and in the ulna in four wrists. The mean age was 41 years (range, 21 to 61 years), and all patients presented initially with symptomatic osteonecrosis of the large joints (knee or hip) secondary to corticosteroid use. These patients later developed symptomatic wrists, which impaired activities of daily living. Other risk factors included alcohol or tobacco use, blood dyscrasias, and systemic lupus erythematosus. Treatment consisted of percutaneous drilling and all reported improvements as measured by the MHQ. One patient required additional bilateral drillings followed by further improvements in her scores. At a mean followup of 35 months (range, 32 to 84 months), there was no radiographic evidence suggesting disease progression in any wrist. DISCUSSION AND CONCLUSION: The distal radius and ulna are rare sites of osteonecrosis, associated with multifocal disease. The clinical presentation and risk factors are similar to osteonecrosis in the large joints. Magnetic resonance imaging shows evidence of necrotic lesions. The results of the present study suggest that disease in these sites can be safely and effectively treated with percutaneous drilling. Level of Evidence: Level IV Therapeutic Study.

Clinical Outcomes of Total Wrist Arthroplasty for Post-traumatic Arthritis

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INTRODUCTION: Total wrist arthroplasty (TWA) is an evolving procedure. Current indications include symptomatic patients with posttraumatic wrist arthritis, rheumatoid arthritis, and Kienbock’s disease as an alternative to wrist arthrodesis. Patients have shown preference of arthroplasty over arthrodesis given the retained motion that maximizes function, especially in the case of bilateral disease. The purpose of this study is to evaluate the clinical outcomes, complications, and implant longevity of TWA. METHODS: A prospective evaluation was performed on 23 TWA patients. The average age at the time of surgery was 63.1 years (range 49-79). Etiology included post-traumatic arthritis (15), rheumatoid (six) and Kienbock’s disease (two). Pain score, DASH, Mayo wrist scores were collected during follow up. Wrist motion, complications, radiographs were evaluated. RESULTS: At a mean follow-up period of 28 months (4-55), the DASH and MAYO wrist scores were 36.5 and 51.5. Mean followup of 35 months (range, 32 to 84 months), there was no radiographic evidence suggesting disease progression in any wrist. DISCUSSION AND CONCLUSION: Triplane osteotomy is effective in restoring pronation and supination, diminishing pain and increasing function. Radiographic evidence of medial and/or lateral cortical “step-off” should raise the suspicion of a rotational component to the fracture deformity. CT imaging is helpful in making a definitive diagnosis. Recognition of this “third” component of distal radius fracture displacement is important in correcting initial displacement as well as late deformity.
was (flexion 41.3 / extension 50.5 / radial 14.1 / ulnar 31.7) compared to pre-op motion (flexion 45.3 / extension 40.3 / radial 8 / ulnar 27). Radiographs revealed no evidence of loosening at mean follow up. Grip strength averaged 60% the opposite hand. One patient had failure secondary to deep infection and was successfully converted to wrist arthrodesis. DISCUSSION AND CONCLUSION: Posttraumatic wrist arthritis is becoming the most common indication for total wrist arthroplasty with improved implant survival and patient outcomes. Previous reports on total wrist arthroplasty have shown the benefits for bilateral wrist arthroplasty with regard to function and for rheumatoid arthritis with regard to pain. There have been concerns, however, due to relatively high complication rates. Improvements in implant design have been encouraging, although long term data has not yet been presented. Also, with the advances in design over the last 30 years, the indications have been expanded to include intolerable post-traumatic arthritis. More long-term studies are ultimately necessary to prove the benefit of total wrist arthroplasty. Total wrist arthroplasty performed in select patients can yield successful outcomes with low short-term failure rates.

PAPER NO. 109
The Incidence and Clinical Outcomes of Tendon Rupture Following Volar Plating Distal Radius Fractures
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INTRODUCTION: Our hypothesis is that there will be identifiable risk factors related to tendon rupture following distal radius fracture and that patient outcomes will not be adversely affected after undergoing tendon repair. METHODS: A retrospective chart review was performed on patients treated for tendon rupture following distal radius fracture. Charts were examined to determine age, sex, fracture pattern, initial treatment, mechanism of injury, time until tendon rupture, tendon ruptured, and treatment of rupture. Objective and subjective functional results were evaluated by looking at active range of motion (ROM), grip strength, and pain score. Radiographic analysis was performed on patients with tendon rupture to document volar plate prominence, dorsal screw prominence, and fracture union. RESULTS: A total of 2,358 patients between 2002 and 2010 were treated for distal radius fracture at our institution (1,359=cast, 999=ORIF). There were 11 tendon ruptures treated in eight different patients (mean age 64.4 years; seven female) for an incidence of eight/2,358 (0.003%) in all patients. There were two extensor tendon ruptures (EPL, ECRB) and nine flexor tendon ruptures (FPL=5, FDP=3, FCU). All tendons ruptures occurred with volar plate fixation. Patients with tendon rupture were followed for an average of 6.5 months (range 2-16 months) after repair. Injury radiographs demonstrated intra-articular fracture in five of eight (63%) patients. All eight patients underwent primary repair of their tendon ruptures with concomitant volar plate removal at an average time of 19.9 months (range 4-56 months) after initial injury. The mean active wrist ROM was 66.5° of flexion, 69.4° of extension, pronation of 85°, and 82.5° of supination. Mean grip strength was 47.5 kg (range 38-75). Dorsal screw prominence of proximal shaft screws or distal locking screws was seen in seven of eight (88%) patients with tendon rupture. Volar plate prominence, as determined by Soong, et al., was determined to be Grade 0 in two of eight (25%), Grade 1 in two of eight (25%), and Grade 2 in four of eight (50%). Residual pain at final follow up was scored as none in four or eight, mild in three of eight, moderate in one of eight and severe in zero of eight. DISCUSSION AND CONCLUSION: Patients who are treated for tendon rupture following distal radius fracture functionally do very well in regards to active wrist ROM, pain scores, and grip strength. Radiographic evidence demonstrated volar plate prominence in all patients with flexor tendon rupture and dorsal screw prominence in all patients with extensor tendon rupture. Consideration should be given to remove volar distal radius plates with radiographic evidence of volar plate or dorsal screw prominence to reduce risk of tendon rupture.

PAPER NO. 110
Complications of Locked Volar Plating for Distal Radius Fractures
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Alexander Yong Shik Shin, MD, Rochester, MN
INTRODUCTION: The purpose of our study was to evaluate the incidence and characterize the types of complications that occur with locked volar plating of distal radius fractures at one institution. METHODS: We retrospectively reviewed the records of 153 randomly selected adult patients with distal radius fractures treated by volar locked plating at one institution from 2001-2009. We identified those patients with minor or major complications. Major complications included hardware-related problems (intra-articular, loosening, pain), tendon rupture or irritation, carpal tunnel syndrome requiring release, infection requiring reoperation, major medical complications and non-union. We identified all other complications as minor complications. RESULTS: There were 16 major and 27 minor complications for a total of 43 complications (28%). The breakdown of complications is seen in Figure 1. Of the 43 patients with complications, 14 underwent further surgery which included six limited or full hardware removal, one extensor pollicis longus (EPL) reconstruction, one EPL rerouting, one open carpal tunnel release, one trigger finger release, one pin removal. One patient had a Darrach procedure and carpal tunnel release followed by plate removal. Two patients had triangular fibrocartilage complex reconstructions in addition to plate removal. Two patients had intra-articular hardware but declined surgery for removal as they were asymptomatic. DISCUSSION AND CONCLUSION: The incidence of complications...
in this study was 43/153 or 28%. The most common complication seen in our series of patients was sensory disturbances (17/43) followed by hardware-related problems (nine/43). All but two patients had resolution of their sensory disturbances at the time of final follow up. Tendon-related complications accounted for four of 43 of the total complications. While many of the complications we reported were minor, there was still a relatively high rate of secondary operations (14/153 or 9%). Interestingly, there were no flexor tendon ruptures/irritation as has been documented by others as a complication of volar plating.

**Figure 1. Complications by Category**

<table>
<thead>
<tr>
<th>Major Complications = 16</th>
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</thead>
<tbody>
<tr>
<td>Hardware-related</td>
</tr>
<tr>
<td>Intra-articular</td>
</tr>
<tr>
<td>Loosening</td>
</tr>
<tr>
<td>Pain</td>
</tr>
<tr>
<td>Tendon-related</td>
</tr>
<tr>
<td>EPL rupture</td>
</tr>
<tr>
<td>EPL irritation</td>
</tr>
<tr>
<td>Carpal tunnel syndrome requiring surgery</td>
</tr>
<tr>
<td>Nonsuture</td>
</tr>
<tr>
<td>Infection requiring re-operation</td>
</tr>
<tr>
<td>Major medical</td>
</tr>
<tr>
<td>Saddle pulmonary embolism</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minor Complications = 27</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRPS</td>
</tr>
<tr>
<td>Delayed union</td>
</tr>
<tr>
<td>Sensory disturbances</td>
</tr>
<tr>
<td>Median nerve</td>
</tr>
<tr>
<td>Superficial branch radial nerve</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Superficial wound infection treated with antibiotics</td>
</tr>
<tr>
<td>Transient distal radioulnar joint (DRUJ) instability</td>
</tr>
<tr>
<td>Stiffness</td>
</tr>
<tr>
<td>DRUJ pin migration</td>
</tr>
<tr>
<td>Ulnar pnt migration requiring reoperation</td>
</tr>
<tr>
<td>Trigger finger requiring release</td>
</tr>
</tbody>
</table>

**OVERALL COMPARISONS OF ANTIBiotic PROPHYLAXIS**

<table>
<thead>
<tr>
<th>Number of Patients</th>
<th>No FdRpq Antibiotics</th>
<th>FdRpq Antibiotics</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>51.3 (44.9)</td>
<td>55.8 (44.6)</td>
<td>0.79</td>
</tr>
<tr>
<td>Gender (male)</td>
<td>132 (52.8%)</td>
<td>79 (34.1%)</td>
<td>0.2</td>
</tr>
<tr>
<td>Diabetes</td>
<td>87 (21.6%)</td>
<td>61 (26.3%)</td>
<td>0.03</td>
</tr>
<tr>
<td>Smoker</td>
<td>68 (16.9%)</td>
<td>63 (27.2%)</td>
<td>0.03</td>
</tr>
<tr>
<td>CTR</td>
<td>198</td>
<td>100</td>
<td>0.79</td>
</tr>
<tr>
<td>Trigger Release</td>
<td>12</td>
<td>56</td>
<td>0.79</td>
</tr>
<tr>
<td>Excision</td>
<td>43</td>
<td>28</td>
<td>0.79</td>
</tr>
<tr>
<td>DeBreepamian</td>
<td>22</td>
<td>22</td>
<td>0.79</td>
</tr>
<tr>
<td>Tenolysis</td>
<td>15</td>
<td>22</td>
<td>0.79</td>
</tr>
<tr>
<td>Superficial Infecn</td>
<td>3 (0.75%)</td>
<td>3 (1.29%)</td>
<td>0.67</td>
</tr>
<tr>
<td>Deep infection</td>
<td>0</td>
<td>0</td>
<td>0.79</td>
</tr>
</tbody>
</table>

**INFECTION RATES BY PROCEDURE**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number of Procedures</th>
<th>Superficial Infection</th>
<th>Deep Infection</th>
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<tbody>
<tr>
<td>CTR</td>
<td>299</td>
<td>3 (1.00%)</td>
<td>0</td>
</tr>
<tr>
<td>Trigger</td>
<td>173</td>
<td>1 (0.56%)</td>
<td>0</td>
</tr>
<tr>
<td>Excision</td>
<td>44</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tenolysis</td>
<td>37</td>
<td>2 (5.4%)</td>
<td>0</td>
</tr>
<tr>
<td>Totals</td>
<td>635</td>
<td>6 (0.93%)</td>
<td>0</td>
</tr>
</tbody>
</table>

**UNIVARIATE ANALYSIS FOR RISK FACTORS ASSOCIATED WITH SUPERFICIAL INFECN**

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>Odds ratio</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.05</td>
<td>0.95</td>
<td>0.90 – 0.99</td>
</tr>
<tr>
<td>Sex</td>
<td>0.1</td>
<td>4.06</td>
<td>0.74 – 22.3</td>
</tr>
<tr>
<td>BMI</td>
<td>0.7</td>
<td>0.65</td>
<td>0.08 – 5.63</td>
</tr>
<tr>
<td>Smoking</td>
<td>0.4</td>
<td>1.95</td>
<td>0.35 – 10.76</td>
</tr>
<tr>
<td>CTR</td>
<td>0.5</td>
<td>1.12</td>
<td>0.23 – 5.82</td>
</tr>
<tr>
<td>Trigger</td>
<td>0.6</td>
<td>0.53</td>
<td>0.06 – 4.56</td>
</tr>
<tr>
<td>Excision</td>
<td>1.0</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Tenolysis</td>
<td>1.0</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Tendolysis</td>
<td>0.62</td>
<td>0.86</td>
<td>1.50 – 47.77</td>
</tr>
<tr>
<td>Alc</td>
<td>0.5</td>
<td>1.74</td>
<td>0.35 – 8.68</td>
</tr>
<tr>
<td>Ancef</td>
<td>0.4</td>
<td>2.09</td>
<td>0.42 – 10.47</td>
</tr>
<tr>
<td>Vince</td>
<td>3.0</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Umeda</td>
<td>1.0</td>
<td>0.001</td>
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</tbody>
</table>

**PAPER NO. 111**

**Is Antibiotic Prophylaxis Necessary in Clean Soft Tissue Hand Surgery?**

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John R. Fowler, MD, Phoenixville, PA  
Joseph Dwyer, MD, Philadelphia, PA  
Asif M. Ilyas, MD, Wayne, PA  
Joseph J. Thoder, MD, Chalfont, PA

**INTRODUCTION:** Indications for antibiotic prophylaxis in clean soft tissue hand surgery are not well defined. Available evidence for prophylaxis in hand procedures has focused on traumatic hand surgery or carpal tunnel release; a paucity of data exists regarding the necessity of antibiotics in common, elective hand procedures. The purposes of this study were to 1) determine if antibiotic prophylaxis reduced the rate of surgical site infections in elective hand surgery and 2) identify associated risk factors.

**METHODS:** A multi-center, retrospective review was performed on 635 consecutive elective soft tissue hand procedures. Procedures with concomitant implant or incomplete records were excluded. Antibiotic delivery was given at the discretion of the senior surgeon. Patient co-morbidities were recorded. Outcomes were measured by the presence of deep or superficial infections within 30 days from the operation. A univariate analysis was performed to identify associated risk factors.

**RESULTS:** The five most common procedures were carpal tunnel release, trigger finger release, excision, first dorsal compartment release, and tenolysis. The overall infection rate was 0.9%. All infections were considered superficial. In patients who received antibiotic prophylaxis (n=232), the infection rate was 1.29%. In those who did not receive prophylaxis (n=403), the infection rate was 0.75%. These differences were not statistically significant (p=0.79). Diabetes and smoking were not associated with an increased risk for infection. When compared to other procedures, tenolysis was 8.46 times more likely to result in an infection.

**DISCUSSION AND CONCLUSION:** The overall rates of infection following elective soft tissue hand surgery are very low. Antibiotics did not appear to confer additional protection from surgical site infection, and their routine administration is thus not indicated in these procedures.
fractures using wrist arthroscopy as the reference standard. METHODS: During a six-year period (2004-2010) at two institutions, 44 adult patients with a scaphoid waist fracture elected arthroscopy-assisted operative fracture treatment a mean of nine days after injury (range, two to 22 days). The prospective cohort of operated patients consisted of all radiographically displaced scaphoid fractures and a selection of non-displaced scaphoid fractures (based on preference in order to avoid cast immobilization or randomization as part of another study). In addition to radiographs, all patients had CT with reconstructions in planes defined by the long axis of the scaphoid. RESULTS: The reference standard (arthroscopy) revealed 22 displaced fractures (prevalence, 50%) and 29 unstable fractures of the scaphoid waist (prevalence, 66%). All intra-operatively displaced fractures were unstable as were seven of the 22 non-displaced fractures. Among the 44 patients, radiographs demonstrated displacement in 11 patients (25%) and CT in 20 (45%). The sensitivity, specificity, and accuracy for diagnosing intra-operative displacement were 46%, 96%, and 71%, respectively, for radiographs and 77%, 86%, and 82%, respectively, for CT. The sensitivity, specificity, and accuracy for diagnosing intra-operative instability were 35%, 93%, and 55%, respectively, for radiographs and 62%, 87%, and 71%, respectively, for CT. Assuming a 10% prevalence of fracture displacement and instability among all scaphoid waist fractures, the positive and negative predictive values for displacement were 53% and 16% respectively for radiographs, and 39% and 30% for CT, and for instability were 37% and 14% respectively for radiographs, and 34% and 20% for CT. CT was significantly more accurate than radiographs at determining intra-operative fracture displacement (p<0.05) and instability (p<0.05). DISCUSSION AND CONCLUSION: Radiographs and CT scans are much more specific than they are sensitive. Nonetheless, the positive and negative values of both modalities are poor, primarily because the prevalence of displaced fractures among all scaphoid fractures is low. These low predictive values mean that test results do not provide certainties in clinical practice, and we need to be comfortable discussing the probability rather than the certainty of displacement with our patients. Radiographs and CT scans do not accurately diagnose intra-operative fracture displacement or instability.

PAPER NO. 113
Randomized Trial Comparing Two Fixation Methods for Unstable Fractures of Distal Radius
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INTRODUCTION: Optimal treatment of unstable distal radius fractures is debatable. Intrafocal closed pinning (Kapandji technique) with or without bridging external fixator and locked volar plating are and well studied acceptable methods of fixation, however head-to-head comparison is sparse. We compared the radiological and functional outcome of intrafocal pinning to volar locked plating. We also did a cost-effect analysis with functional outcome as the end-point.

METHODS: Sixty patients with unstable fracture of the distal radius were randomized to two treatment groups and studied over a period of two years (2006 to 2008). In first group fracture was fixed by intrafocal pinning using Kapandji technique but was modified by fixing K wires to external fixator not spanning the radio-carpal joint (group1). The other group underwent locked plating through the volar approach (group2). Functional comparison was done using the DASH score, VAS score was used for pain assessment and acceptability of procedure at minimum follow up of one year. Other variables evaluated for comparison were range of motion at the wrist joint, radial length, radial tilt and radial inclination and grip strength. Time to surgery, duration of surgery, hospital stay, implant cost, complications and number of hospital visits, readmissions, time to union, absence from work were evaluated for cost analysis of the procedure. Levine's test for equality was used to judge uniform distribution. Students t-test was used to compare continuous variables while chi-square for discrete variables. The mean follow-up period was 30 months (24 months to 36 months).

RESULTS: Both the groups were comparable in terms of age, sex distribution and fracture pattern. Mean DASH score in group1 of 14 (SD 5.2; range 9 to 20) was not significantly different (p = 0.93) from group2 of 22 (SD 7.8; range 14 to 31). No significant difference was found in the movements at wrist, grip strength and the various radiological parameters between two groups. The overall cost of procedure was approximately $450 for group1 while $1,250 for group2 which was highly significant (p<0.001).

DISCUSSION AND CONCLUSION: Modified Kapandji procedure and locked volar plating were both found to produce comparable functional and radiological results, however former was significantly more cost effective as compared to latter. We concluded that modified Kapandji technique is a viable cheaper alternative for fixing unstable distal radius fracture compared to locked volar plating.

PAPER NO. 114
Hypovitaminosis D in Postmenopausal Women with a Distal Radius Fracture
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Cheol Ho Song, Seoul, Republic of Korea

INTRODUCTION: Although hypovitaminosis D is reported to be common in the general population, few reports have examined vitamin D levels in patients with a distal radius fracture (DRF). The authors hypothesized that postmenopausal women with a DRF may have depressed vitamin D levels.

METHODS: The data of 104 postmenopausal women treated for a distal radius fracture (DRF group) and 107 age-matched control patients with soft tissue disease, such as tenosynovitis or lateral epicondylitis (control group) were compared. Serum
vitamin D levels (25-hydroxycholecalciferol, 25(OH)D₃) and the levels of several bone metabolism markers including serum parathyroid hormone, osteocalcin, C-telopeptide, and urine N-telopeptide were sampled and compared. RESULTS: The mean 25(OH)D₃ level was significantly lower in the DRF group than in the control group (p < 0.001). In particular, patients in their sixth and seventh decades in the DRF group had significantly lower vitamin D levels than patients in the control group. Twenty-seven patients (26%) and 19 patients (18%) in the DRF group were vitamin D insufficient (defined as a serum level of 20-32ng/mL) or vitamin D deficient (defined as a serum level of < 20ng/mL), respectively, as compared with 12 patients (11%) and two patients (2%) in the control group. The levels of the assessed markers of bone metabolism were similar in the two groups.

DISCUSSION AND CONCLUSION: Postmenopausal women with a DRF were found to have significantly lower serum vitamin D levels than the control. Since vitamin D is required for bone metabolism and musculoskeletal function, further studies are warranted to determine whether hypovitaminosis D is a risk factor for DRF and whether vitamin D supplementation helps rehabilitation and the prevention of future fractures in patients with a DRF.

PAPER NO. 115
Corrective Osteotomy of Post Traumatic Distal Radius Deformity Using Volar Locking Plate
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Sophia Opel, MBBS, Rickmansworth, United Kingdom
Elliott Sorene, FRCS, London, United Kingdom

INTRODUCTION: Post-traumatic distal radial deformity may cause severe morbidity with restriction of wrist mobility and function. Corrective osteotomy is often necessary to realign the functional axis of the wrist to correct symptomatic malunion. The aim of this study was to review the mid-term results of a single surgeon’s series of distal radius corrective osteotomies following distal radius fracture malunion using a fixed angle volar locking plate. METHODS: Seventeen patients underwent corrective osteotomy using a fixed angle volar locking plate for post-traumatic distal radius malunion. The indication for the operation was pain and functional limitation. Fourteen were women and three were men, with an average age of 52 years. Outcome was assessed using radiological and clinical confirmation of union, patient satisfaction and the DASH questionnaire postoperatively. RESULTS: At mid term follow up, no complications were noted in any cases. Radiological union was confirmed in all cases at three months. Patients noticed an improvement in their wrist function. This was objectively confirmed by an average post operative DASH score of 13.48. Wrist alignment significantly improved, as demonstrated by measurements on plain radiographs. DISCUSSION AND CONCLUSION: At mid term follow up, corrective osteotomy of the distal radius for symptomatic post traumatic malunion has excellent functional outcome.

PAPER NO. 116
Isokinetic Evaluation of Pronation After Volar Plating of a Distal Radius Fracture
Hyun S. Gong, MD, Seongnam, Republic of Korea
Jung Kyu Huh, MD, In-Cheon, Republic of Korea

INTRODUCTION: Pronator quadratus (PQ) is an important contributor to forearm pronation, and there is concern that volar plating of a distal radius fracture (DRF) may damage the PQ function. We hypothesized that pronation strength would decrease after volar plating of a DRF, thus we evaluated isokinetic pronation strength in patients with a DRF treated by volar plating. METHODS: Thirty-four patients of mean age of 55 years underwent bilateral isokinetic testing at one year after open reduction and internal fixation using volar plating. Isokinetic pronation and supination strengths were compared between the operated and normal sides. Clinical outcomes such as grip strengths, range of motions, and DASH scores were evaluated and analysed for any associations with isokinetic results. RESULTS: Differences in pronation strength were not statistically significant (p = 0.188 for peak torque and p = 0.190 for total work), while supination torque and total work were significantly lower in the operated sides (p = 0.015 and p = 0.029 respectively). Decreases in pronation strength were found to correlate significantly with decreases in supination strength and grip power. Wrist motion and DASH scores were not found to be correlated with decreases in pronation or supination strengths. DISCUSSION AND CONCLUSION: In patients with a DRF treated by volar plating, pronation strength was not significantly different between the operated and normal sides at one year postoperatively, and decreases in pronation or supination strengths were not found to affect clinical outcomes as assessed by DASH scores. This study suggests that dissection of the PQ may have minimal clinical impact on forearm pronation function.

PAPER NO. 117
Longterm Outcome of Perilunate Fracture Dislocations
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INTRODUCTION: Patients sustaining perilunate dislocations and fracture dislocations experience impaired functional outcome with associated radiographic deterioration over time. METHODS: A retrospective review was conducted analyzing the outcome of all perilunate dislocations and fracture dislocations treated within our institution from 1985 to 2009. Standardized postoperative assessments included wrist range of motion, grip strength and Mayo Wrist Score. Preoperative and postoperative radiographs were examined to ascertain the incidence of post traumatic arthritis. Statistical analyses used included parametric and nonparametric t tests. RESULTS: Ninety-four patients were treated within our institution over the last 25 years. There were 30 perilunate dislocations and 64 fracture dislocations (five open and 89 closed injuries). Complete radiographic records were present in 57 patients and included 20 perilunate dislocations and 37 fracture dislocations (four open and 53 closed injuries). Forty-one patients were treated with combined volar and dorsal approaches, 11 dorsal only and five volar only approaches. There were no statistically significant differences between the pure dislocation versus the fracture dislocation groups with respect to contralateral grip strength (64% versus 68% respectively). The fracture dislocation group tended to have improved flexion to extension arc compared to the purely ligamentous injury patients (86 degrees versus 74 degrees). Thirty-three percent of patients underwent additional secondary procedures. The pure dislocation patients went onto a higher rate of salvage procedures compared to the fracture dislocation patients (35% versus 5%). According to the Mayo wrist scores, 23% of patients had good to excellent results and at final follow up, only 59% of patients returned to work indicating the significant morbidity associated with this injury. Normal scapholunate (SL) angles were achieved intraoperatively in 18 of 20 dislocations and
INTRODUCTION: Scaphoid non-unions continue to be a challenging problem for which the ideal treatment remains controversial. We hypothesize that the modified Russe procedure offers a reliable method to reduce the deformity and fix the construct for predictable healing. METHODS: This was a retrospective review of a subset taken from 21 patients treated for scaphoid fracture non-union. In the subset, a modified Russe procedure was performed for scaphoid waist fracture non-union with humpback deformity and no evidence of avascular necrosis. Bone graft was harvested from the distal radius and a “matchstick” of volar cortex was placed into the nonunion site as a strut. Cancellous bone graft was packed in the remainder of the nonunion site followed by fixation with a headless screw (Figure 1). The cohort was followed for healing rate, range of motion, grip strength, radiographic parameters of scapholunate (SL) and intra-scaphoid angles, pain, return to work status and complications. Statistical analysis was performed by one-way analysis of variance testing with significance set at p<0.05. RESULTS: Eight patients (seven male, one female) met inclusion criteria from the original cohort of 21. The mean ages of the patients was 26 years (range 19-32) and mean follow-up period was 18 weeks (range 8-27). All the patients healed at a mean time of 8.5 weeks (range 7-10). Compared to the contralateral side, mean total wrist range of motion (extension + flexion) was 88% and mean grip strength was 96%. The mean SL angle postoperatively was 39 degrees (range 34-45), which was significantly less than the preoperative angle of 65 degrees (range 50-90)(p<0.001). The mean intra-scaphoid angle postoperatively was 29 degrees (range 25-35), which was significantly less than the preoperative angle of 52 degrees (range 35-70)( p<0.001). The mean visual analog pain scale post-operatively was 1 (range 0-2). All the patients returned to their original work, and there were no reported complications. DISCUSSION AND CONCLUSION: A modification of the Russe technique using the volar cortex of the distal radius as a strut, followed by cancellous bone and headless screw fixation for the treatment of scaphoid non-unions is a reliable method with predictable healing. This modification restores and maintains the scapholunate and intra-scaphoid angles, while avoiding the donor site morbidities associated with iliac crest bone graft harvesting. It also provides excellent radiographic and functional results. We recommend this technique to treat scaphoid fracture waist non-unions.

PAPER NO. 119
Predictors of Secondary Displacement in Operatively and Non-Operatively Managed Distal Radius Fractures
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INTRODUCTION: We hypothesize that certain demographic parameters inherent to each distal radius fracture, initially managed operatively or non-operatively, will reliably predict the likelihood of secondary fracture displacement at a defined healing period. The objective of our study is to assess the predictive value of these presenting demographics by reviewing radiographs for evidence of secondary displacement. METHODS: Radiographic records were retrospectively reviewed for all distal radius fractures seen in the orthopaedic hand clinic between September 2002 and February 2009. A total of 881 cases were reviewed. All patients included in this study received AP and lateral radiographs taken at diagnosis, after fixation, and “at healing” (eight weeks post-presentation). Patients were excluded if younger than 18 years, did not return for follow-up imaging, or displayed ulnar and radial fractures on presentation. A total of 415 cases were included for review (183 operative fixation, 232 non-operative) (Figure 1). The initial reduction was considered preserved if the measured dorsal angulation was less than 10 degrees or the volar angulation was less than 25 degrees on the final radiograph. Additionally, an articular step-off < 2mm, an articular gap < 2mm, or radial shortening < 5mm was used as a baseline for preserved reduction. Each patient was classified according to their age (18-44, 45-64, 65+), gender, A/O classification, presence of dorsal comminution, and the number of fracture parts. The relative rate of secondary fracture displacement was determined for each variable via univariate statistical analysis (Pearson’s Chi-squared or Fisher’s Exact test). The variables were then evaluated via multivariate analysis to elucidate those predictive of secondary displacement without two-way interaction with other variables. RESULTS: The results of the univariate analysis revealed that...
higher rates of displacement are observed in older patients and in fractures displaying A/O class C, dorsal comminution, or 3+ parts. Furthermore, multivariate analysis of these variables show that A/O class C and older patient age are independently predictive of displacement without significant two-way interaction (Figure 2). DISCUSSION AND CONCLUSION: Of the analyzed patient demographics an age of 65+, A/O class C, fractures displaying dorsal comminution, or 3+ parts all displayed a significantly higher rate of secondary fracture displacement when compared within their own classification demographic. Only a patient age of 65+ or A/O class C fractures were independent predictors of secondary fracture displacement without any two-way interactions with other variables. These predictive variables are useful in assessing risk for the overall population presenting with distal radius fracture before treatment is chosen.

![Image](image_url)

**FIGURE 2. Secondary Displacement Rates of the Overall Population by Category (1) Statistically Significant Comparison).** Variables that represented independent predictors of displacement after multivariate analysis are individually labeled “Predictors of Displacement.”

### PAPER NO. 120

**Prospective Randomized Trial of Peri-Operative Ketorolac on Distal Radius Fracture Healing**

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**INTRODUCTION:** The analgesic effects of ketorolac have been well established, however its effect on bone healing is less clear. Basic science studies have suggested a deleterious effect by NSAIDs on bone metabolism and bone healing but a paucity of evidence exists as to whether this translates to clinical relevance. This study aims to prospectively evaluate the effect of ketorolac on healing time for distal radius fractures undergoing volar plate fixation.

**METHODS:** Patients undergoing distal radius fracture volar plate fixation were prospectively randomized to either a single perioperative intravenous 30mg dose of ketorolac or to receive no ketorolac. Fractures were assessed for initial fracture union and defined by the presence of bridging callus on orthogonal radiographic views, or adverse healing events. The remainder of the post-operative protocol including analgesia, immobilization, and rehabilitation were the same for both groups. Patients were evaluated at two, six, 12, and 24 weeks (or until fracture union) following surgery.

**RESULTS:** Forty-two patients were enrolled (15 male, 27 females; mean age 57), with an average follow up of eight months. Thirty patients were randomized to receive ketorolac and 12 to receive no ketorolac. The average time to evidence of healing on orthogonal views measured in days was 43.19 days for the group receiving ketorolac and 42.92 days for the group not receiving ketorolac. There were no cases of delayed unions, nonunions, or adverse reactions.

**DISCUSSION AND CONCLUSION:** All fractures of both groups demonstrated evidence of healing with bridging callus on orthogonal views by the six week exam with the no statistical difference in average days to healing. The use of ketorolac did not result in any delayed unions or nonunions following volar plate fixation of distal radius fractures.

**Nerve Regeneration Using White Adipose Tissue (WAT) Flap and Insulin-like Growth Factor-1 (IGF-1) as a Scaffold**

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**INTRODUCTION:** White adipose tissue (WAT) and insulin-like growth factor-1 (IGF-1) have shown potential to enhance peripheral nerve regeneration. We hypothesized that white adipose tissue flap (WATF) enriched with IGF-1 as an in vivo biologic scaffold would provide functional and histological benefits in a sciatic nerve crush injury model.

**METHODS:** Forty male Sprague-Dawley rats were divided into four arms. All rats underwent a crush injury to one sciatic nerve and received a pedicled WAT flap, while local release of IGF-1, both, or no treatment at the lesion area (experimental control) for four weeks. The WATF was composed of adipose tissue derived from the inguinal region. IGF-1 was delivered from polylactic-co-glycolic acid (PLGA) microspheres embedded in fibrin gel adjacent to the crush injury. Tibialis anterior (TA) muscle weights and maximum isometric tetanic force (ITF) of the TA muscle normalized to crush injury. Tibialis anterior (TA) muscle weights and maximum isometric tetanic force (ITF) of the TA muscle normalized to crush injury. Tibialis anterior (TA) muscle weights and maximum isometric tetanic force (ITF) of the TA muscle normalized to crush injury. Tibialis anterior (TA) muscle weights and maximum isometric tetanic force (ITF) of the TA muscle normalized to crush injury. Tibialis anterior (TA) muscle weights and maximum isometric tetanic force (ITF) of the TA muscle normalized to crush injury. Tibialis anterior (TA) muscle weights and maximum isometric tetanic force (ITF) of the TA muscle normalized to crush injury. Tibialis anterior (TA) muscle weights and maximum isometric tetanic force (ITF) of the TA muscle normalized to crush injury.

**DISCUSSION AND CONCLUSION:** Utilizing a pedicled WAT flap with the addition of IGF-1 showed promise for regenerative peripheral nerve tissue. Further study is needed to elucidate the role of IGF-1 in peripheral nerve regeneration.

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**For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.**

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**PAPERS, POSTERS & SCIENTIFIC EXHIBITS**

**HAND & WRIST**
PAPER NO. 244

Tension Free Post-Operative Immobilization for Dupuytren's Disease

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INTRODUCTION: Open fasciectomy represents a standard treatment of Dupuytren's disease. Although patients are commonly immobilized in extension to prevent post-operative contracture formation, immobilizing the extremity under tension may precipitate a flare reaction and scar related complications. This study explores the incidence of flare reaction and other complications with postoperative tension-free splinting after fasciectomy for Dupuytren's contracture.

METHODS: The study was designed to retrospectively review patients' charts that underwent surgery for Dupuytren's contracture. The 228 procedures in 192 patients identified underwent surgery by the senior author between 2000 and 2010. Postoperative notes were reviewed for wound healing problems, scar appearance, flare reaction and complications. The grading system defined by Evans was used to standardize flare reaction and scar complications.

RESULTS: Using tension free splinting the incidence of flare reaction and other complications with postoperative tension-free splinting after fasciectomy for Dupuytren's contracture was significantly lower than that in the control group. The control group consisted of the patients who were immobilized in extension for postoperative recovery.

DISCUSSION AND CONCLUSION: Tension-free splinting after fasciectomy for Dupuytren's disease is a safe and effective method of postoperative immobilization. It significantly reduces the incidence of flare reaction and other complications compared to traditional methods of postoperative immobilization.

For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
reaction was 3.5% (8/228). The eight patients that had flare reactions had mild involvement, and no severe reaction was observed. Fifteen patients had hypertrophic scars, eight had hypersensitive scars and six had recurrent contractures.

**DISCUSSION AND CONCLUSION:** The incidence of flare reaction using tension free immobilization postoperatively was low in our study. According to our findings, tissue complication and wound healing problems are rare when tensionless splinting is employed.

**PAPER NO. 245**

**The Use of Phenol for Refractory Neuromas of the Hand and Forearm**

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**Matthew M. Malerich, MD, Bakersfield, CA**

**INTRODUCTION:** Refractory neuromas in the hand and forearm can be debilitating. For 4.5 years we have been using aqueous phenol for treatment of these refractory neuromas. The objective of our presentation is to describe the technique and review our series of patients who have undergone this treatment.

**METHODS:** Sixteen patients with refractory neuromas for two to 25 years underwent aqueous phenol injection into a segment of the involved nerve and its neuroma. Patients were followed for an average of 3.4 years and a minimum of two years. Indications for the injection were failed prior neuroma surgery which included multiple resections, rerouting neuromas, multiple failed neurolysis, burying the neuroma into bone and implanted nerve stimulators. The technique requires the nerve to be surgically exposed and isolated from surrounding tissue as the phenol is quite caustic. The phenol is injected into a 0.75-3 cm segment of the involved nerve as well as the resultant neuroma. Eye protection is mandatory.

**RESULTS:** All patients experienced immediate relief of symptoms. There was consistently a flare up seven to 10 days after the injection which resolved in three to seven days. The pain was found to completely resolve in 40% of pre-injection pain level. Repeat injections were performed in several of the patients and were found to have increased efficacy.

**DISCUSSION AND CONCLUSION:** Phenol injection demonstrates significant pain relief for refractory neuromas, warranting further investigation of this technique. We realize that follow up is short, but pain relief in this patient population for two or more years is substantial and gratifying. Many of these patients were in pain management and we were able to eliminate their need for heavy narcotic use. Open phenol injection for refractory neuromas is a treatment option for this unsolved and, in many instances, debilitating condition.

**PAPER NO. 246**

**Complications after Flexor Tendon Repair: A Systematic Review and Meta-regression Analysis**

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**INTRODUCTION:** Although outcomes after flexor tendon repair have reportedly improved with modern treatment, complications are not uncommon. However, the incidence of these complications and the potential contributory factors are not well described.

**METHODS:** We performed a systematic review to identify publications in which patients with flexor tendon ruptures were surgically treated. Demographics, zone of injury, core suture technique (modified Kessler or other), use of epitendinous suture and date of publication (before or after year 2000) were extracted. Articles were excluded if they did not report information on re-operation, re-rupture or adhesions. Unadjusted pooled meta-analysis was used to report the incidence of complications, while meta-regression was used to describe the potential contributory factors for each complication while controlling for age, gender and zone of injury.

**RESULTS:** Unadjusted meta-analysis revealed rates of re-operation of 5.8%, re-rupture of 3.9% and adhesions of 3.9%. Meta-regression analysis of 29 studies showed that re-rupture is not influenced by core suture technique or use of an epitendinous suture. However, the presence of an epitendinous suture decreases re-operation by 84% (OR 0.16; CI 0.06, 0.42). Adhesion development is 134% higher (OR 2.34; CI 1.07, 5.11) if the modified Kessler technique is not used. There is a 3% increase in the likelihood of adhesions with each month of follow up (OR=1.03, CI 1.005, 1.05). Publication date did not influence the incidence of complications.

**DISCUSSION AND CONCLUSION:** The published literature supports use of the modified Kessler repair technique with an epitendinous suture to minimize complications. While complication rates are low, our data suggests that there has been no definitive improvement in reported complications pre and post 2000.

**PAPER NO. 247**

**Is There a Need for Routine Postoperative Follow Up Post Trapeziectomy or Single Digit Dupuytren's Fasciectomy?**

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**Tamer Kamal, Kent, United Kingdom**  
**Andrew Smith, MD, Canterbury, United Kingdom**

**INTRODUCTION:** “No routine post-operative follow up appointments” policy has been implemented in NHS hospitals in different specialties for uncomplicated surgical procedures. In trauma and orthopaedics, few studies to date reviewed this practice and reflected on the patients’ opinions.

**METHODS:** In this study we prospectively surveyed 50 patients post simple trapeziectomy and 71 patients post single digit Dupuytren’s fasciectomy for their opinion of post operative care and whether they would have liked to be reviewed by the surgeon in a routine post operative follow up appointment or not. The total of 121 patients were recruited over two years for this study; each patient had post operative follow up by the hand therapist for three months. All patients included in this study had their operations done by one surgeon in one hospital. All patients were reviewed by a hand therapist within two weeks post operatively and treatment protocols were followed with all the patients. During their final appointment with the hand therapist, all patients completed a questionnaire survey.

**RESULTS:** A total of 116 patients completed the study, five post Dupuytren's fasciectomy patients were lost for follow up. A total of 106 patients (91%) were satisfied with their post operative management and 99 patients (85%) did not want to be reviewed by the surgeon in a post operative outpatient follow up appointment.

**DISCUSSION AND CONCLUSION:** This study reflects the successful application of “hand therapy led follow up and discharge” policy with no routine post operative review by the surgeon in our organization. We succeeded in reducing the waste in the NHS by avoiding at least 215 unnecessary routine follow up appointments over a two-year period. By applying this policy we also succeeded in avoiding the inconvenience to patients having...
multiple trips to the hospital. We advise implementing this practice for other common uncomplicated surgical procedures with the possibility of giving the patient the option to request appointment with the surgeon if needed.

PAPER NO. 248

Flexor Tendon Excursion and Load During Passive and Active Motion: A Cadaver Study
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INTRODUCTION: Early motion protocols after flexor tendon repair of the hand are designed to promote tendon excursion to minimize adhesion formation without placing excessive load on the repair. We hypothesize that there will be differing amounts of tendinous excursion and load with passive and active motion that are quantifiable.

METHODS: Six cadaveric above elbow specimens were mounted to allow for active motion by tendon loading and passive motion. Lateral fluoroscopic images were used to measure FDP and FDS tendon excursions via intra-tendinous metal markers placed at the junction between the A1 and A2 pulleys in the index, middle and ring fingers. Measurements were performed during the following exercises: 1) passive extension to 0°, 2) passive extension to 60°, 3) digital extension with wrist tenodesis, 4) digital flexion with wrist tenodesis, 5) passive flexion, 6) straight fist, 7) block PIP, 8) block DIP, 9) hook, 10) place & hold. The tension on FDP and FDS tendons was recorded for respectively appropriate motions. Data was analyzed by ANOVA and Tukey HSD for pair-wise comparison between the different exercises and Student's t-test was used to compare the tension forces in the active and passive exercises. Significance was set at p<0.05.

RESULTS: Mean tendon forces were higher in all active versus passive movements (p<0.01). The highest forces were during the block PIP for the FDS (6.01N, range 5.75-9.00) and block DIP for the FDP (8.78N, range 8.98-12.05) (Figure 1). Mean FDS tendon excursions during all active movements, except block DIP, were larger than excursions during the passive movements (p<0.01). Mean FDP tendon excursions for the active movements of block PIP, block DIP, hook, and place & hold were larger than excursions during the passive movements of extension to 0°, extension to 60°, digital extension with wrist tenodesis, digital flexion with wrist tenodesis and passive flexion. The hook position had the highest mean excursion (12.8mm, 18.4mm) while the block DIP had the lowest mean excursion (3.4mm, 2.6mm) for the FDS and FDP tendons, respectively. The highest inter-tendinous excursion (between FDS and FDP) was the hook position (5.6mm) and the lowest was the block PIP (0.8mm) (Figure 2).

DISCUSSION AND CONCLUSION: Active motion results in higher tendinous excursion than does passive motion. Hook position exercise results in the highest total tendinous excursion and the highest inter-tendinous excursion (between FDS and FDP tendons). Blocking exercises place the highest loads on the flexor tendons. This knowledge may help optimize the management of the post-operative exercise therapy regimen.

PAPER NO. 249

Percutaneous Needle Fasciotomy vs. Collagenase in the Treatment of Dupuytren’s Disease of the Hand
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INTRODUCTION: Dupuytren’s disease is a progressive genetic disorder of pathologic collagen production and deposition. It begins with palpable nodules in the palm with later development of pathologic collagen cords, which extend longitudinally, thicken and shorten causing flexion contractures of the joints. The purpose of this study is to compare the results of percutaneous needle fasciotomy (PNF) to collagenase injection in the treatment of Dupuytren’s contracture of the hand. Our hypothesis is that both percutaneous fasciotomy and collagenase treatment may yield similar clinical outcomes. We hope to further identify risks,
RESULTS: The age distribution of the patients were 36-58 years (average of 46), four females and two males. Flexiglide was used during the second revision in five patients and during the third revision in one patient. Two patients had an extensive hypertrophic granuloma formation with wound breakdown five to six weeks post operatively. There were no organisms grown on culture from the granulation tissue. The wounds healed completely following the removal of the Flexiglide implant.

DISCUSSION AND CONCLUSION: Flexiglide is manufactured from 100% micro-biologically safe synthetic material. The final degradation products, lactic acid and -hydroxy-hexanoic acid, are resorbed, metabolized and excreted by the body. Our experience denoted that it led to a foreign body granuloma type formation in 33% of the patients. This possible complication should be considered prior to the use of this implant.

PAPER NO. 251
Analysis of the Causes and Outcome After Hypothenar Fat Pad Flap for Recurrent Carpal Tunnel Syndrome
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INTRODUCTION: The hypothenar fat pad flap is used for the treatment of recurrent carpal tunnel syndrome. However there is inadequate evidence in the literature to predict the outcome after this technique.

METHODS: We retrospectively analyzed 25 patients (27 hands) who had both clinical and electrophysiological confirmation of true recurrent carpal tunnel syndrome from January 2004 to December 2009. In all the patients, after releasing the nerve a vascularized fat pad flap was mobilized from hypothenar region and sutured to the lateral cut end of flexor retinaculum. The patient characteristics, co-morbidities, duration of symptom, interval between the surgeries and intra-operative findings were assessed against post-operative relief of pain, recovery of sensory and motor dysfunction.

RESULTS: The average age was 58 years (43-81) and dominant hand involvement of non-dominant hand, recurrence within a year, spine problems and e) recurrence in the non-dominant hand. The patients with delayed recovery had a) early functional return immediately after surgery; the remaining 11 patients had delayed recovery 56 months. Intra-operatively 18 had reformed retinaculum (two partially reformed) and seven had scar tissue between the cut ends overlying the nerve and two had scar tissue and fibrosis around the nerve. All patients had improvement of symptoms post-operatively. Sixteen had complete recovery immediately after surgery; the remaining 11 patients had delayed recovery. The patients with delayed recovery had a) early recurrence, b) diabetes mellitus, c) obese/over-weight, d) cervical spine problems and e) recurrence in the non-dominant hand.

DISCUSSION AND CONCLUSION: The hypothenar fat pad flap transposition flap provides a reliable source of vascularized local tissue that prevents scar formation and helps nerve gliding. The factors that were associated with poorer/delayed recovery were involvement of non-dominant hand, recurrence within a year from the previous surgery, intra-operatively scar tissue in the carpal tunnel and associated co-morbidities like obesity, diabetes mellitus and cervical spine problems.
Delayed Treatment of Type I and Type II Jersey Finger with Primary Flexor Tendon Grafting

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INTRODUCTION: Rupture of the flexor digitorum profundus tendon is one of the few closed injuries in the hand for which the timing of the presentation has previously been felt to affect the outcome. Our aim was to demonstrate that primary flexor tendon grafting can successfully achieve functional range of motion without jeopardizing superficialis function four or more months after injury.

METHODS: Eighteen ruptured profundus tendons were treated by author MM between 1990 and 2005 with primary flexor tendon grafting through the intact superficialis tendon. Thirty percent of the tendons retracted into the palm and the remaining retracted to the level of the proximal interphalangeal (PIP) joint. Tendon grafting was performed utilizing the technique described by J. William Littler, MD. The profundus tendon was not amenable to primary repair secondary to its distortion. The palmaris longus tendon was used as the graft in all cases. The A4 pulley and/or the chiasm of Camper were dilated with a silastic tendon prosthesis, depending on the level of retraction.

RESULTS: No loss of superficialis function was encountered in the 18 cases. An average of 60% of active distal interphalangeal (DIP) joint flexion was restored and the quadriga effect did not occur to the adjacent fingers.

DISCUSSION AND CONCLUSION: Type I and Type II ruptures of the profundus tendon, which often present with delayed diagnosis or treatment, can be treated successfully with primary tendon grafting. Primary flexor tendon grafting is a successful treatment modality for closed Type I and Type II profundus ruptures with delayed presentation.

Hydrogel-Mediated Delivery of Nerve Growth Factor to Improve Peripheral Nerve Repair

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INTRODUCTION: No treatment, even the gold standard of nerve autograft, reliably restores function after segmental peripheral nerve injuries. The use of synthetic tubular conduits avoids the morbidity of autograft, but conduits are inferior for long gaps. We hypothesize that nerve regeneration across conduits can be improved by the delivery of growth factors within hydrogels. In this study we tested whether nerve growth factor (NGF) delivery within a collagen/hyaluronan hydrogel promotes neurite outgrowth in an in vitro model.

METHODS: We evaluated neurite outgrowth from dorsal root ganglia (DRG) explants of three to four day old CD1 mice. Two type I collagen hydrogels [2 mg/ml (2C) and 4 mg/ml (4C)] and two hyaluronan and collagen hydrogels [2 mg/ml each (2C2H) and 4 mg/ml each (4C4H)] were tested. Varying concentrations of NGF (10, 20, 50, 100, and 500 ng/ml) were then tested in media or in the 4C4H hydrogel. DRGs were placed on poly (l-lactide-co-caprolactone) scaffolds and cultured in media (control) or embedded in hydrogel. After 72 hours, immunofluorescence staining was performed using a neuronal-specific anti-β-III tubulin antibody. Neurite growth was measured as the mean length of the 10 longest neurites growing from each DRG body. Thirty DRGs were evaluated per condition. All conditions were replicated three times, except NGF in media. We used the restricted maximum likelihood approach with treatment as a fixed factor and replicates as a random factor to obtain least squares means. Tukey’s HSD test was used for pair-wise comparisons. Results are reported as mean±SEM.

RESULTS: All hydrogels produced significantly longer neurite growth than media alone (media 411±77 μm; 2C 820±27 μm; 4C 769±27 μm; 2C2H 881±26 μm; 4C4H 912±27 μm, p<0.001). Both hyaluronan-containing hydrogels did better than collagen alone, with a trend toward 4C4H being best (p<0.001 vs. 4C, p=0.03 vs. 2C, p=0.86 vs. 2C2H). We selected 4C4H for NGF delivery because of this trend and its superior handling characteristics (higher viscosity). Addition of NGF to 4C4H hydrogel produced dose-dependent increases in neurite growth, with 100 ng/ml as the optimal dose (Figure 1; p<0.001 vs. all others): 0NGF 905±77 μm; 10NGF 1028±76 μm; 20NGF 1154±78 μm; 50NGF 1345±78 μm; 100NGF 1527±76 μm; and 500NGF 1201±78 μm. A similar trend was seen with NGF in media, but neurite growth was lower at all concentrations compared to NGF in 4C4H (0NGF 378±28 μm; 10NGF 539±28 μm; 20NGF 685±31 μm; 50NGF 688±21 μm; 100NGF 718±21 μm; and 500NGF 482±22 μm, p<0.001). DISCUSSION AND CONCLUSION: Hydrogels made of collagen with and without hyaluronan significantly improve the amount of neurite extension from DRG explants cultured on a synthetic scaffold. When delivered within a collagen/hyaluronan hydrogel, NGF further promotes neurite extension in a dose-dependent manner. Delivery of NGF in hydrogel is more effective than NGF delivered in media. Collagen/hyaluronan hydrogels that contain NGF may enhance peripheral nerve regeneration when delivered inside of tubular conduits and should be investigated in vivo.

Glomus Tumors of the Hand - A Report of 66 Cases

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INTRODUCTION: Glomus tumors are benign small hematomas, but symptoms such as pain, tenderness and temperature sensitivity can cause the patients distress. Moreover, a misdiagnosis and improper treatment are common and so the patients suffer for...
several years without improving their symptoms. We investigate the characteristic signs and symptoms of glomus tumor and the outcomes after surgical operation. We tested the hypothesis that (1) our indications for surgical excision are reliable and (2) our surgical technique is efficient and less harmful to the nail root.

METHODS: We reviewed 66 cases of the glomus tumor in the hand. The clinical diagnosis was made and surgical operations were done according to our indications for an operation. Patients with electrical shock-like pain elicited by touch (the essential symptom) and at least two of four clinical signs and symptoms (cold hypersensitivity, paroxysmal pain that radiated proximally, blue discoloration, nail deformity for dorsal tumor or a palpable nodule for pulp tumor) underwent surgical excision.

RESULTS: The duration of symptoms at our clinic was about five years and the average patient age was 36.5 years (range: 22-62 years). Most patients had a single lesion but two patients had two independent lesions. No difference of prevalence was found in both hands, but the thumb and the middle finger were more affected than the other fingers. All the patients complained of electrical shock pain and the second most common symptom was cold hypersensitivity for the subungal tumors and a palpable nodule for the volar pulp tumors. We used the direct transungal approach with incomplete detachment of the nail plate for the subungal tumors. After meticulous dissection and excision, no recurrence was noticed.

DISCUSSION AND CONCLUSION: To the best of our knowledge, this report is the largest case series about glomus tumors in the finger tip. The clinical signs and symptoms are essential findings and they are sufficient to diagnose glomus tumors, and surgical excision is the only treatment for these tumors. In many cases, arriving at the correct clinical diagnosis by clinicians was delayed and conservative treatment was done for many years before surgery. We introduce simple indications for the surgical excision of digital tumors because an early diagnosis and surgical excision are essential for the treatment of digital glomus tumors reported complications. There were 823 digits released in 566 patients (246 male, 320 female). Average age at surgery was 64 years (14-92). Part 2: Cases complicated by deep infection were further analyzed to identify potential risk factors.

RESULTS: Part 1: There were 89 documented complications among 823 digits (11%). The most common complications involved persistent pain, stiffness, or swelling (39), recurrent triggering (22), or superficial infection (10). Most were treated nonoperatively with injection (34) or oral antibiotics (11). Twenty-one complications were treated operatively: revision release (eight), tenosynovectomy (eight), irrigation and debridement (four), pulley reconstruction (one). The reoperation rate was 3%. Part 2: Deep infection was found in five digits (0.6%), resulting in nine total I&D procedures. Four cases involved the right middle finger (the most common digit in the series). Four did not receive prophylactic antibiotics. Two patients were diabetic. Two were smokers. Three had received a steroid injection in the infected digit within two months of surgery, and two had injections in other sites at the time of surgery. Three grew MSSA, two CNS. All five had additional procedures at the time of the initial surgery.

DISCUSSION AND CONCLUSION: Open trigger finger release is a low-risk procedure, although perhaps of greater risk than appreciated (complications 11%, reoperations 3%). Considering potential reporting bias against minor complications, the actual rate of complications may still be underestimated. Surgeons should be careful to thoroughly discuss the risk of both major and minor complications when counseling patients. Further studies with larger numbers may be necessary to identify risk factors for deep infection.

PAPER NO. 391
Sensory Innervation of the Triangular Fibrocartilage Complex (TFCC)

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INTRODUCTION: An understanding of the sensory innervation of the triangular fibrocartilage complex (TFCC) may introduce selective denervation as a viable treatment alternative for stable TFCC IA injuries. The purpose of this study is to define the sensory innervations of the TFCC using fresh cadaver arms.

METHODS: Ten fresh cadaveric wrists are dissected with 3.2 x loupe magnification in a proximal to distal manner. The cadidate nerves include the dorsal sensory ulnar nerve, volar branch of the ulnar nerve, anterior interosseous nerve, posterior interosseous nerve, median antebrachial cutaneous and palmar branch of the median nerve. Inclusion criteria are identification of neural continuity to the TFCC with histologic confirmation.

RESULTS: From initial two cadaveric dissections, the TFCC was innervated by the dorsal sensory ulnar nerve, posterior interosseous nerve and the anterior interosseous nerves.

DISCUSSION AND CONCLUSION: Since 1958, joint denervation has been performed to alleviate wrist pain by disrupting the neural pathways that transmit the pain message from the joint to the brain. Although Palmer and Werner described the major stabilizer to the ulnar carpus and distal radioulnar joint, the triangular fibrocartilage complex (TFCC), in 1981, the sensory innervations to the TFCC have not been well described. Detailed understanding of the neural anatomy at the TFCC can offer patients a precise denervation procedure for TFCC IA injuries.
Total Wrist Replacement: Current Analysis

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INTRODUCTION: Total wrist replacement is an evolving procedure for the treatment of arthritis of the wrist joint. The purpose of this study is to report our experience with three different total wrist implants (one resectional wrist arthroplasty implant and two resurfacing wrist implants) and to report future directions for total wrist replacement. This is the first comparative study that we are aware of to examine outcomes from total wrist replacement.

METHODS: A review of 47 total wrist replacements was performed at a minimum of 3.5 years with a range 3.5-15 years after surgery to determine the clinical outcome, radiographic appearance and prosthesis survivorship or success. The three different total wrist implants included the Biaxial total wrist, Universal II total wrist and ReMotion total wrist. Review included clinical assessment, radiographic analysis, review of complications (incidence and type) and conversion to wrist fusion. Patient function was assessed pre and post operatively by the Mayo wrist score and the Patient Related Wrist Score and DASH.

RESULTS: Forty-seven wrist implants were performed in 39 patients. There were 37 rheumatoid and 10 post traumatic cases. The total wrist inserted included Biaxial (N=16), Universal II (N=9) and ReMotion (N=22) designs. The later two wrists represent a new concept of joint resurfacing with minimal resection of the distal radius with preservation of the distal radioulnar joint and radiocarpal ligaments, while the Biaxial design is a standard type of arthroplasty with resection of the distal radius and entire proximal carpal row. Success was achieved in 21/22 ReMotion, 8/9 Universal and 10/16 Biaxial wrists, 80% of cases. Two cases were successfully revised previous total wrist replacements. The failed cases were primarily due to implant loosening (distal component - eight) or wrist instability -two). The distal loosening could be salvaged by revision of the distal component (N=2) or wrist fusion (N=6). In the successful cases there was a functional range of wrist motion of 45° extension and 40° flexion and improved grip strength by 15% (mean 12.5 kg). Mayo wrist scores increased from 40 points prior to surgery to 76 points after surgery, while wrist fusion had an average Mayo Wrist Score of 45 points. Mayo Wrist scores for post-traumatic conditions averaged 86.6 points versus 72 points for rheumatoid arthritis. The DASH score measured was Universal II 20.2, Re-Motion 36.6 and Biaxial 47.8. The PRWE score was Universal II (25.8), Re-Motion (32.9) and Biaxial wrist (39.6).

DISCUSSION AND CONCLUSION: Total wrist replacement was successful in 80% of all cases and in 93% of resurfacing implants (Universal II and Re-Motion) at average follow-up of 6.2 years. Better results were correlated with improved distal component fixation and minimal resection of the distal radius. These results are distinctly superior to previous reports on total wrist replacement.

A Biomechanical Comparison of the Hemi-Hamate Arthroplasty and Volar Plate Arthroplasty

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INTRODUCTION: Proximal interphalangeal (PIP) joint fracture-dislocations are difficult problems for the patient and surgeon. There are several described treatment options for this complex problem. The purpose of this study was to compare the biomechanical properties of the hemi-hamate arthroplasty (HHA) to the volar plate arthroplasty (VPA) at varying amounts of articular joint involvement.

METHODS: Middle and ring finger PIP joint implants from six fresh frozen cadaveric hand specimens were used for the study. Three groups were compared. The first group consisted of six HHAs for PIP joints with 50% articular bone loss. The second and third group each consisted of six VPAs performed on PIP joints representing 30% and 50% articular bone loss. Using fluoroscopy, radiographic pre-operative and post-operative range of motion was obtained for each group. Motion at the PIP joint was elicited by applying traction forces through the flexor and extensor tendons of the digit. Biomechanical stability was then tested by applying a dorsally directed force centered over the middle phalanx with the PIP joint in extension. We recorded the force needed to dorsally subluxate the PIP joint > 25%. The measurements were taken radiographically using fluoroscopy. The force applied was measured using a hand held tensiometer. The collected data from 30% and 50% articular bone loss was compared across both groups. Statistical analysis using a Student’s t-test was performed to compare the calculated mean values.

RESULTS: Load to 25% dorsal subluxation demonstrated that the HHA at 50% articular bone loss provided significantly stronger resistance when compared to the VPA at both 30% and 50% articular bone loss (p=0.013, p<0.001 respectively). In addition, the VPA at both 30% and 50% articular bone loss demonstrated significantly more loss of motion than the HHA at 50% articular bone loss (p=0.025).

DISCUSSION AND CONCLUSION: Currently, there are no definitive treatment guidelines for PIP fracture-dislocations that have 30% to 50% articular bone loss from the middle phalanx. Some surgeons prefer the VPA treatment for these injuries when there is less articular bone loss. This biomechanical study demonstrates that HHA provides better results with regards to stability and range-of-motion than VPA at both 30% and 50% articular bone loss.
PAPER NO. 394

Preliminary Results of a Prospective Multi-center Series of 147 Last Generation Total Wrist Arthroplasties
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INTRODUCTION: The use of total wrist arthroplasty (TWA) in rheumatoid and non-rheumatoid arthritis is still very controversial. There is currently no evidence to favor TWA over total wrist fusion when treating advanced wrist destruction. One of the reasons is the limited number of available series. The purpose of this paper was to present the preliminary results of a large multi-center study of one last generation TWA (Remotion).

METHODS: A web-based registry was built. Five orthopaedic centers specialized in wrist surgery prospectively included patients operated on with Remotion TWA. Classic clinical (pain, motion, function, grip strength, quick DASH) and radiological criteria were defined. Operative data and complications were recorded. Pre- and post-operative data were collected at six weeks, six months and every year following the operation. Tables for implant survival and follow-up results were automatically generated.

RESULTS: At the date of abstract submission, 147 Remotion TWA arthroplasties have been included in the database (73% women). The average follow up was 28 months, with a maximum of 83 months. The average age was 62 years (minimum 32, maximum 85). The etiology was rheumatoid arthritis in 67% of the wrists. Van Swol pain improved from 64/100 to 17/100. Quick Dash improved from 55 to 33. Post-operative wrist flexion-extension arc was 60° compared with 64° pre-operatively indicating that almost no active motion was lost. Nine wrists (6%) had revision surgery. The radiological results were optimal in 115, sub-optimal in 12 and poor in four cases. The current survival rate of our series was 95%.

DISCUSSION AND CONCLUSION: Our preliminary results (to be updated) suggest that one last generation TWA may have better results than those reported on more limited numbers of patients and old-generation TWA. Despite the limitations of any multi-center study, the authors think that it was worthwhile to build a prospective study about a significant number of TWA. This is the first large scale study on TWA. The preliminary results of this series may help decision making between total wrist fusion and TWA when a patient presents with complete destruction of the wrist.

PAPER NO. 395

Is There a Need for a Two Year Hand and Upper Extremity Fellowship?
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INTRODUCTION: One year of hand fellowship education is inadequate based on the experiences of fellows having completed a fellowship.

METHODS: Electronic surveys were sent to surgeons who had completed a hand surgery fellowship from 2008-2010. The survey was structured to ascertain whether there was a need for expanded education encompassing the entire upper extremity. Four separate mailings were conducted to increase the response rate.

RESULTS: A total of 166 surgeons responded to our survey. Fifty-nine percent were in private practice. Seventy-three percent were orthopaedically trained, 17% from plastics, 9% general surgery and 1% from neurosurgery. Thirteen percent of candidates felt that one year of specialty training was insufficient. Forty-seven percent of trainees were seeking shoulder and elbow training in their fellowship. Forty-six percent of candidates did not have dedicated plastic surgery rotations and 42% were devoid of any shoulder and elbow training during their fellowship. Microsurgical experience was lacking, with 10% of trainees not having performed a replantation, 21% not being involved in a free flap, 34% not participating in brachial plexus surgery and 19% not having done a vascularized bone graft. Forty-one percent of orthopaedically trained surgeons stated they did not feel competent in performing a replant as opposed to 15% of plastic surgeons. In contradistinction, 94% of orthopaedic trainees felt comfortable treating both a bone forearm fracture compared to 42% of plastic surgeons. Fifty-one percent of candidates did not have any time set aside for research during their fellowship. Twenty percent of trainees were enrolled in additional training after their fellowship including shoulder and elbow, microsurgery, pediatrics and peripheral nerve surgery. When specifically asked if they would have applied to a two-year hand and upper extremity fellowship, 60% of candidates were supportive of the additional training.

DISCUSSION AND CONCLUSION: Based on the results of this survey, one year of hand fellowship training has been perceived as inadequate in 60% of respondents, with focus lacking in shoulder and elbow, microsurgery, pediatrics and clinical research. Further critical review and consideration of extended training should be considered.

PAPER NO. 396

Isolated Lunotriquetral Ligament Tears Treated with Ulnar Shortening Osteotomy
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INTRODUCTION: This study examines the outcome of isolated lunotriquetral ligament (LTL) tears treated with ulnar shortening osteotomy (USO).

METHODS: This retrospective study included 61 cases of isolated LTL tears of traumatic etiology treated with USO between October 1992 and June 2009. All cases had arthroscopically confirmed LTL tears. Patients were excluded on the basis of any concurrent triangular fibrocartilage complex (TFCC) damage or indication of ulnar impaction syndrome. The modified Gartland and Werley wrist grading system was used to assess surgical outcomes.

RESULTS: Grip strength increased from a mean value of 22% to 52% at latest follow-up. VAS pain improved from 64/100 to 17/100. Quick Dash improved from 85 to 20. The aetiology was rheumatoid arthritis in 67% of the wrists. The modified Gartland and Werley wrist grading system was used to assess surgical outcomes. The average follow up was 28 months, with a maximum of 83 months. The average age was 62 years (minimum 32, maximum 85). The etiology was rheumatoid arthritis in 67% of the wrists.
7.4 kg before to 31.3 kg after surgery, representing a 48% increase. The majority of patients exhibited excellent (57.2%, n=24) or good (32.6%, n=15) scores post-surgery (84.8%, n=39 combined) with only minimal fair (15.2%, n=7) and zero poor scores. All objective and subjective scores within the Modified Garland and Werley wrist grading system significantly increased following surgery. Mean bone healing time was 18 weeks. There were no non-union or complications.

DISCUSSION AND CONCLUSION: Patients with isolated LTI tears of traumatic etiology reported significant improvement in objective and subjective outcomes following USO. Regardless of preoperative ulnar variance, isolated LTI tears can be successfully treated by performing a USO.

PAPER NO. 397

Percutaneous (“in Situ”) vs. Open Arthrodesis of the Distal Interphalangeal Joint
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INTRODUCTION: This study compares fusion rates and outcomes of a percutaneous (“in-situ”) to a traditional open arthrodesis of the distal-interphalangeal joint (DIPJ) with a headless compression screw. METHODS: From June 1999 through May 2010, 20 digits (17 patients) underwent an open arthrodesis with preparation of the joint surfaces and a headless compression screw. Seventeen digits (12 patients) had an in-situ arthrodesis, where the headless screw was inserted percutaneously across the unprepared joint in a compressive mode via a stab incision at the fingertip. All procedures were performed by a single surgeon, who began performing the percutaneous fusions in March 2003. After this time, patients with involvement of the thumb interphalangeal joint, an angular deformity that could not be passively corrected, or accompanying mucous cysts or large osteophytes, which the patient desired to have removed, continued to receive an open arthrodesis. All patients in both groups had osteoarthritis with accompanying pain, except two patients in the open group: one with psoriatic arthritis, another with gouty arthritis, and one patient in the in-situ group with a chronic flexible swan-neck deformity. A semiconstrained, surface replacement proximal interphalangeal joint arthroplasty was performed in the same digit in three patients in the in-situ group.

RESULTS: In the open group, radiographic fusion was documented in 14/20 digits - 70%. Eleven/14 had regular post-operative radiographs, and fusion was documented at an average of 3.3 months (range 1-8). Three/14 did not return for radiographs until 32, 84 months post-operatively - all were radiographically fused. Two/20 did not return for follow-up radiographs, but were contacted by phone and reported no pain or tenderness after 10 and 29 months. One patient did not have an obvious radiographic fusion 12 months post-operatively, but reported no pain, tenderness, or deformity at 72 months when contacted by phone. One patient had four digits fused (thumb IP, IF/LF/RF) simultaneously. Three of four digits developed an infected non-union as the likely consequence of a severe maxillary abscess which developed during the perioperative period. In the in-situ fusion group, 10/17 had radiographically confirmed fusions - 59%. Five/17 did not exhibit clear radiographic union at an average of 8.2 (range 3-17) months post-operatively. Two of these five digits (bilateral long fingers in same patient) had residual angular deformities of 18° and 20°. When contacted by phone at an average of 16.7 (range 13-24) months post-operatively, none of these five patients reported pain nor tenderness of the involved joint. Another patient (one/17) did not return for post-operative radiographs, but reported no pain, tenderness or any problems at 63 months. One digit (index finger) failed to unite and developed recurrent pain and deformity with loosening of the implant and required revision fusion with K-wires.

DISCUSSION AND CONCLUSION: Percutaneous “in situ” arthrodesis of the distal interphalangeal joint with a headless compression screw results in a lower rate of radiographically confirmed union (59 vs. 70%). Whether done by open or percutaneous means, however, radiographic union does not seem to be necessary to achieve long term good results with respect to relief of pain and tenderness. Percutaneous in situ arthrodesis offers the advantages of avoiding wound healing complications over the dorsum of the digit, a shorter operative time and maintaining anatomic rotational alignment of the arthrodesed joint. Open arthrodesis with formal joint preparation seems to produce a faster and more predictable radiographic fusion and correction of angular deformity.

PAPER NO. 398

Cadaveric Dissections and Radiographic Findings Regarding Thumb Carpometacarpal Joint Osteophytes
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INTRODUCTION: Recent trends in management of thumb carpometacarpal joint osteoarthritis include hemi-trapeziectomy, joint replacement and interposition arthroplasty. Preoperative knowledge of the precise location of osteophytes is important to plan the approach for adequate joint clearance. Residual osteophytes may be the cause of persistent or residual pain and possibly instability. Limitation of deep surgical exposure due to partial excision of the trapezium may lead to inability to visualize deeper osteophytes in the region of the beak ligament. We hypothesized that preoperative radiographs may not give adequate information on the extent of wear as well as size and position of osteophytes. METHODS: We performed 45 cadaveric thumb base radiographs on 15 thumbs followed by dissection of the thumb carpometacarpal joint to correlate the location of osteophytes and wear within the joint. The radiographic views taken were oblique and lateral views of the thumb base, more specifically the carpometacarpal joint. A Roberts view was also taken in full pronation with the thumbnail resting directly on the cassette, felt to better reflect the true AP view. On dissection of the cadaveric thumbs by clinicians other than those involved in the radiographic phase of the study, the depth and pattern of wear on both the metacarpal and trapezial articular surfaces was observed, taking the 12 o’clock position as the highest point on the dorsum of the thumbnail in line with the midpoint of the metacarpal base. An accurate and reproducible assessment of osteophyte location and size was then made and recorded in a standardized fashion for all dissections. RESULTS: The initial analysis of the thumb carpometacarpal joint radiographs showed good views of the osteophytes, with their location being variable. The beak ligament on the volar and ulnar aspect of the joint was thought to be main focus of the osteophytes radiologically. It was found that there was correlation between the location of the osteophytes clinically and radiologically. Wear patterns are difficult to visualize radiographically and showed little correlation with dissection findings. DISCUSSION AND CONCLUSION: Successful surgery involves removal of all osteophytes to reduce pain and therefore re-operation rates. Osteophyte location may help with understanding the pathogenesis of thumb carpometacarpal osteoarthritis. We suggest that a series of correctly taken radiographs do correlate with dissection findings in terms of osteophyte location, making...
PAPER NO. 399

Rate of Clinically Significant Post-traumatic Arthritis following Small Finger CMC Fracture-Dislocations

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INTRODUCTION: Although small finger carpometacarpal (CMC) joint fracture-dislocations are relatively common hand injuries, there are few studies in the orthopaedic literature focusing on their clinical outcomes. The goal of this study was to analyze the rate of clinically significant post-traumatic arthritis following small finger CMC joint fracture-dislocations treated with either cast immobilization alone or open reduction and internal fixation.

METHODS: We performed a retrospective chart review of 91 consecutive patients treated for a small finger CMC fracture-dislocation by a single fellowship-trained hand surgeon over a five-year period. Operative indications included irreducible small finger CMC fracture-dislocations and recurrent small finger CMC joint instability after attempted reduction. Group I included 72 patients with small finger CMC fracture-dislocations who were treated with cast immobilization alone for six weeks, while Group II included 16 patients treated surgically and followed by six weeks of cast immobilization. Clinical outcome parameters included post-treatment serial radiographs, subjective pain scores and need for subsequent small finger CMC arthrodesis.

RESULTS: Patients in both groups were followed for a minimum of 12 months. In Group I (casting alone), six of the 72 patients (8.3%) developed clinically significant post-traumatic arthritis and required a subsequent small finger CMC arthrodesis. In Group II (surgical), none of the patients developed clinically significant post-traumatic arthritis or required an arthrodesis.

DISCUSSION AND CONCLUSION: Small finger CMC fracture-dislocations treated with casting alone are more prone to developing post-traumatic arthritis and require subsequent arthrodesis than those treated with open reduction and internal fixation.

PAPER NO. 400

Diagnostic Accuracy of Clinical Examination and Magnetic Resonance Imaging for Common Articular Wrist Pathology

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INTRODUCTION: Our aim was to compare the diagnostic accuracy of clinical examination and magnetic resonance imaging (MRI) for intra articular wrist pathology, using wrist arthroscopy as the gold standard.

METHODS: Patients undergoing wrist arthroscopy for triangular fibrocartilage complex (TFCC), scapholunate (S-L) and lunotriquetral (L-T) ligament injury were selected for the study. There were 66 patients with ages ranging from 10 to 68 years. All patients had clinical examination and arthroscopy, while 38 had also undergone an MRI scan.

RESULTS: Using arthroscopy as gold standard, clinical examination of the wrist was noted to have sensitivity of 67.6%, specificity of 43.8%, PPV of 56.1%, NPV of 56% and accuracy of 56.1%. The corresponding values for MRI were 47.6%, 64.7%, 62.5%, 50% and 55.3% respectively. Of the 38 patients who had both clinical examination and MRI before arthroscopy, 17 of the patients had consistent findings across examination and MRI (44.7%). The accuracies of clinical examination for detecting specific pathology were 72.7% (TFCC), 78.8% (L-T) and 60.6% (S-L). For MRI scans the accuracies were 71.1%, 84.2% and 65.8% respectively.

DISCUSSION AND CONCLUSION: There is no statistically significant difference in the accuracy of MRI and clinical examination for diagnosis of common wrist pathology. However, MRI was significantly more specific than examination, while clinical examination was significantly more sensitive. Clinical examination and MRI were not significantly different for detection of the individual pathologies, though examination detected TFCC injuries more accurately and MRI detected better the L-T and S-L injuries.
Two and three bone fusions with the triquetrum excised may allow for better preservation of wrist ROM than four-corner fusion.

PAPER NO. 402
Treatment of Failed FCR LRTI Arthroplasty Using Extensor Carpi Radialis Longus Tendon
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INTRODUCTION: Persistent symptoms following flexor carpi radialis (FCR) trapeziometacarpal arthroplasty is a challenging problem. The purpose of this study was to review our experience with the use of extensor carpi radialis longus (ECRL) tendon for revision of failed FCR trapeziometacarpal arthroplasty. METHODS: Between 1992 and 2008, 23 patients underwent revision arthroplasty of the trapeziometacarpal joint using the ECRL tendon following failed FCR ligament reconstruction tendon interposition (LRTI) arthroplasty. There were 16 females and seven males ranging in age from 52 to 76 years. All patients had persistent pain that did not improve with conservative treatment. Time from the original surgery to the revision surgery averaged 36 months. A distally based strip of ECRL tendon was used for suspension arthroplasty of the CMC joint. The joint was pinned for five weeks. Postoperative follow up averaged 59 months (range 24-96 months).

RESULTS: Pain improved in all patients. Average Visual Analog Scale improved from 6.5 preoperatively to 2 postoperatively. There was no change in the grip strength. Pinch strength improved from an average of 8 lb to 14 lb postoperatively. DASH Score improved from preoperative average value of 44 to 14 postoperatively. Scaphoid to first metacarpal distance increased from an average of 2 mm preoperatively to 9.2 mm postoperatively. Some recession occurred gradually but it became constant after three years. All patients returned to their regular work activities and 60% returned to vigorous recreational activities. Twenty-one of the 23 patients were very satisfied with the procedure.

DISCUSSION AND CONCLUSION: ECRL tendon interposition arthroplasty could be a viable alternative in treating patients with failed FCR trapeziometacarpal arthroplasty.

PAPER NO. 403
Proximal Trapeziectomy after Trapeziectomy Leads to Carpal Instability: A Preliminary Study
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INTRODUCTION: A recent study reported that patients with stage IV carpometacarpal (CMC) arthritis have a higher incidence of non-dissociative dorsal intercalated segmental instability (CIND-DISI) both preoperatively and following trapeziectomy. This has been hypothesized to be secondary to an imbalance between the flexion moment arm of the scaphotrapezoidal (STT) joint, and the extension moment arm of the triquetrum-hamate joint. Additionally, the dorsal intercarpal (DIC) ligament has been suggested to support the dorsal lunocapitate joint to prevent lunate extension. We questioned whether proximal trapeziectomy would lead to CIND-DISI after trapeziectomy with or without DIC ligament excision. METHODS: Six cadaver specimens (four male and two females), average age 52, were prepared and placed vertically in a custom jig with the wrist placed in neutral but axial compression was allowed. Extension of the lunate was recorded using a four-camera system. The wrist was loaded with 100N with the wrist intact, after trapeziectomy, and after excision of about 2 mm of the proximal trapezoid. Three of the specimens had DIC excision completed first, and then proximal trapeziectomy. The effects of loading and treatment were determined using repeated measures ANOVA with a Holm-Sidak post hoc comparison procedure. RESULTS: Average lunate extension in the control wrist during load was -0.2 ± 6.7°. There was no significant difference in lunate extension after trapeziectomy (p=0.48). In the three specimens that had DIC excision after trapeziectomy, average lunate extension was 0.82 ± 8.2°. Because these changes were small, specimens both with and without DIC excision after proximal trapeziectomy were pooled. Following proximal trapeziectomy, the lunate extended 9.0 ± 10.2° (p< 0.01).

DISCUSSION AND CONCLUSION: In grip, the wrist is hypothesized to remain stable through a balance of the flexion moment of the STT joint, and the extension moment of the triquetrum-hamate joint. Our study confirms that trapeziectomy alone does not lead to CIND-DISI, but proximal trapeziectomy after trapeziectomy leads to an imbalance in this equilibrium, and causes CIND-DISI in cadavers. Shortening of the scaphotrapezoid joint in CMC arthritis (stage IV) may predispose patients to CIND-DISI after trapeziectomy.

PAPER NO. 404
Divergent Patterns of Trapezial Articular Degeneration in Thumb Carpometacarpal (CMC-I) Arthritis
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INTRODUCTION: The normal trapezium is ‘saddle-shaped’: a biconcave-convex configuration.1 Contradictory reports of articular wear in thumb carpometacarpal (CMC-I) arthritis include preferential volar wear2, radial wear3, and dorsal-ulnar sparing.4 The volar wear pattern reported in 27 specimens is often cited, which supports the hypothesis that volar ligament laxity contributes to the etiology of CMC-I arthritis.4 METHODS: A single surgeon excised 39 trapeziae from 37 patients for CMC arthroplasty procedures over 1.5 years, with radiographic Eaton stage 2-4 disease.5 Explanted specimens represented 27 female (69%), 12 male (31%); average age at surgery was 62 (30-76). These included 25 right trapeziae and 14 left. Specimens were stored in formalin; the CMC-I articular surfaces of the trapezium were carefully inspected, photographed and our research team collectively identified three discrete but consistent patterns of wear: 1) retained saddle, 2) dish shape and 3) ‘seagull’ shape. The dish shape resembles a mortar and pestle pattern of degeneration, with the trapezium as the recipient mortar. A ‘seagull’ shape was defined as preferential pattern of volar wear, creating a separate concave facet of the volar half with a superior ridge running ulnar to radial, similar to the tibial condyles. Subsequently, two independent experts evaluated and classified each specimen twice, while blinded to patient identity and the other’s categorization. Percentage of eburnation of other trapezial articular surfaces (scaphoid, trapezoid, and second metacarpal) were reported. Preferential wear pattern and location of osteophytes was documented. Intra-rater and inter-rater reliability were calculated. RESULTS: The 39 classified trapezial specimens fell into three discrete patterns: 20 (51%) retained saddle, 12 (31%) dish and seven (18%) seagull. Intra-rater reliability was 0.96 and inter-rater reliability of the second round of classification was 0.94. Full eburnation (Outerbridge grade 4) was found in 15 (43%).6

*The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e. the drug or medical device is being discussed for an off label use). For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
Eleven (31%) had no eburnation of the scaphoid, lunate, or second metacarpal articulations. Volar osteophyte formation at the metacarpal beak articulation was identified in all cases of the seagull pattern; the osteophyte location and extent was variable.

**DISCUSSION AND CONCLUSION:** Surgically excised trapeziae demonstrate three distinct patterns of wear; we hypothesize the dish and seagull represent divergent patterns from the original saddle shape, rather than a progression of severity. This refined characterization addresses the discrepancy in the literature and may provide new insight of the role of abnormal mechanical forces in thumb CMC arthritis.

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**PAPER NO. 405**

**A Retrospective Review of Patients Treated for Ulnar-Sided Wrist Pain: Diagnosis, Treatment and Outcome**

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Mary Kate Reinhart, CNP, Smithtown, NY

**INTRODUCTION:** Ulnar sided wrist pain (USWP) has been coined the lower back pain of the wrist and the differential diagnosis can be a daunting task even for the seasoned physician. The purpose of this retrospective study is to evaluate the diagnostic tests for USWP and then to examine the efficacy of ulnar shortening osteotomy (USO) as treatment for triangular fibrocartilage complex (TFCC) tears, lunotriquetral ligament (LT) tears and ulnocarpal impaction syndrome (UIS).

**METHODS:** A total of 40 patients diagnosed with USWP were studied retrospectively; their complaints, history, mechanism of injury, physical findings and x-rays were reviewed. Those who failed to respond to conservative management underwent bone scans and arthrograms. Patients who continued to have USWP and positive findings on bone scans and arthrograms underwent arthroscopy and further treatment was dictated by the arthroscopic findings. Statistical analysis was performed on each diagnostic test to evaluate its efficacy. Outcomes were evaluated based on the modified Gartland and Werley score.

**RESULTS:** Overall, a total of 61 LT tears, 39 TFCC tears and 15 SL tears were confirmed by arthroscopy. The mean ulnar variance on gripping PA view was significantly higher than that seen on standard PA view (p<0.05). TC-99m bone scans exhibited high sensitivity (0.83 @ 95% CI), but low specificity (0.21 @ 95% CI). The radiocarpal arthrogram exhibited high sensitivity (0.93 @ 95% CI) and specificity (0.94 @ 95% CI) for diagnosing TFCC tears, while the midcarpal arthrogram exhibited high sensitivity (0.86 @ 95% CI) and specificity (0.81 @ 95% CI) for diagnosing LT tears. Only 20% of MRI findings were confirmed by arthroscopy, which resulted in low sensitivity (0.50 @ 95% CI) and specificity (0.0 @ 95% CI). For those patients who had USO performed, there was a mean G & W score of 93.4 ± 6.2 with 33 excellent, 15 good, five fair and four poor at final follow up. In these patients, the mean G & W score, mean grip strength and mean ulnar variance all increased significantly from pre-operative values (p<0.05).

**DISCUSSION AND CONCLUSION:** The diagnostic algorithm for USWP includes history, physical examination, a period of conservative management, diagnostic tests and, eventually, arthroscopy. The combination of TC-99m bone scan and arthrogram may provide more accurate diagnostic information than MRI in cases of USWP. USO is an effective treatment for USWP with tears of the TFCC and LT.
INTRODUCTION: Carpal tunnel syndrome (CTS) is the most common peripheral neuropathy and affects four to five times more women than men. A genome-wide analysis was conducted to determine if gene-level differences exist in the transverse carpal ligament (TCL) and tenosynovium (TS) in females versus males with CTS.

METHODS: Under an IRB-approved protocol, TCL and TS tissues were collected from 22 patients (15 female, seven male) with CTS that failed conservative management. The tissues were immediately immersed in an RNA-preserving solution and incubated overnight. Samples were stored until analysis at -80°C. For analysis, tissue was mechanically homogenized separately (as TS vs. TCL) in a urea buffer. RNA from tissue homogenates was utilized for hybridization to arrays, which measures the expression of approximately 22,000 genes. Differentially expressed genes were determined by applying a two-way analysis of variance test. The list of differentially expressed genes was ranked in order of statistical significance (p < 0.05).

RESULTS: In comparing both TCL and TS in males and females, 107 genes were upregulated and 326 were downregulated in female ligaments, while 67 genes were upregulated and 331 downregulated in female synovium. Further investigation of the differentially expressed genes using gene ontology categories showed that the most significant differences between males and females, regardless of tissue type, were in genes belonging to the inflammatory response, cell surface receptor-linked signal transduction, and MHC class II-related complexes. These included genes encoding for chemokines (CXCL11, CXCL10) and human leukocyte antigen (HLA) complexes (HLA-DPB1, HLA-DOA). These findings are significant, as no patient was found to have a history of autoimmune processes, including rheumatoid arthritis or systemic lupus erythematosus.

DISCUSSION AND CONCLUSION: Significant variation in gene expression exists in transverse carpal ligament and tenosynovium in patients with idiopathic carpal tunnel as a function of gender. The biologic process categories that showed the most significant variation between males and females were the inflammatory response, cell surface receptor-linked signal transduction, and MHC class II-related complexes. Expanding on the results of this study may lead to an increased understanding of the higher prevalence of CTS in females and may yield potential therapeutic targets for novel intervention strategies.

POSTER NO. P228

Does Carpal Tunnel Release Guarantee Long-term Relief of Symptoms in Patients with Long-term Hemodialysis?
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Dae-Young Lee, MD, Seodaemungu, Republic of Korea
Yun-rak Choi, MD, PhD, Seoul, Republic of Korea

INTRODUCTION: Surgical release of the transverse carpal ligament is common in patients suffering severe symptoms of HD-associated carpal tunnel syndrome (CTS). Several studies showed that HD-associated CTS patients have less favorable clinical results after surgical release than idiopathic CTS patients and that their symptoms recur frequently. However, these results are largely based on assessments by tools that have not been standardized, proven reproducible, validated, or shown to be responsive to clinical changes, and the studies reported clinical outcomes at variable follow-up periods. Hence, even though CTS is highly prevalent in long-term HD patients, we have insufficient information on the outcomes of carpal tunnel release in HD-associated CTS patients. We compared the clinical outcomes of carpal tunnel release in patients with hemodialysis (HD)-associated carpal tunnel syndrome (CTS) and those with idiopathic CTS.

METHODS: We retrospectively compared 18 patients (22 wrists) with carpal tunnel syndrome who were undergoing HD to manage end-stage renal disease with 18 patients (22 wrists) with idiopathic CTS who did not have HD (control group). Controls were matched for age, gender, involved side, and severity. All patients were followed for at least two years post-surgery. Clinical outcomes were measured preoperatively and at each follow up by the visual analogue scale (VAS) pain and numbness rating (0-10) and the Boston Carpal Tunnel Questionnaire (BCTQ).

RESULTS: The mean duration of hemodialysis in HD-associated patients was 15.5 years. The preoperative mean VAS pain and numbness scores and BCTQ scores were significantly higher in HD-associated patients than in idiopathic CTS patients. Both groups showed significant improvement in symptoms and function at the last follow up after carpal tunnel release. However, HD-associated patients had higher VAS numbness scores and BCTQ symptom and function scores than idiopathic CTS patients.

DISCUSSION AND CONCLUSION: The majority of our patients with long-term HD associated CTS had significant symptomatic and functional impairment at more than two years after carpal tunnel release, while the patients with idiopathic carpal tunnel syndrome did not. The recurrent CTS symptoms were of much lesser severity than the patients’ preoperative symptomatic and functional symptoms. Interestingly, HD-CTS and I-CTS patients showed a comparable degree of improvement in both CTS symptoms and function. In sum, even though carpal tunnel release did not completely resolve the symptoms in the majority of cases, we think that it should be a highly recommended procedure for HD-associated CTS patients.
TCL as seen through the third web space incision of 3cm length. These muscles when present were also incised layer by layer in line with division of the TCL with special care to the motor branch. Patients were divided into three groups according to the extent of the muscles covering the TCL. The three groups were compared for outcomes of surgery at six months in terms of the Boston and DASH scores, grip and pinch powers, and scar pain.

RESULTS: Seventy-five patients (49%) had a purely ligamentous TCL (group I). 52 patients (34%) had muscle fibers covering less than 50% of the incision length (group II), and 25 (16%) had muscle fibers covering more than 50% of the incision length (group III). There were no differences in the postoperative Boston symptom and function scores and the DASH scores among the groups. In addition, there were no differences in the grip and pinch strengths and scar pain. There was no case of motor branch injury.

DISCUSSION AND CONCLUSION: Division of the muscles overlying or within the TCL in line with the third web space incision does not affect postoperative outcomes after carpal tunnel release in terms of the Boston and DASH scores, grip and pinch powers, and scar pain.

POSTER NO. P230
Evaluation of the Blood Supply of the Interosseous Ligament Complex in the Forearm
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INTRODUCTION: Treatment of longitudinal radio-ulnar dissociation, also known as an Essex-Lopresti injury, involves radial head arthroplasty, fixation of the distal radio-ulnar joint and immobilization of the forearm to allow the native interosseous ligament complex (IOLC) to heal. The literature has provided little evidence that the IOLC can reliably heal even with appropriate treatment; recent case reports have attributed failure to its incompetent healing capacity (Gong et al 2010). We hypothesize that the blood supply to the IOLC is limited and may contribute to its tenuous ability to heal.

METHODS: The arterial anatomy of four cadaveric upper extremities was studied with a technique of combined India ink and latex injection, as described by Yamaguchi et al (1997). The axillary artery was identified and cannulated using a 16-french Foley catheter. After flushing the vasculature with normal saline solution, filtered India ink solution was injected into the artery under firm manual pressure. This was followed by injection of red Ward’s latex. Arms were then frozen at -20°C for 48 hours to allow the latex to consolidate. After consolidation, arms were meticulously dissected with emphasis on preservation of the arterial anatomy.

RESULTS: Using a volar injection technique, the needle pierced the ulnar nerve in five specimens and the shortest distance from the needle to each structure was measured using electronic calipers. Instances when the needle was inserted into the IOLC were noted. In one specimen, an “accessory” anterior interosseous artery was identified traveling along the ulnar aspect of the IOLC. A smaller posterior interosseous artery was identified traveling along the ulnar aspect of the forearm and 6.1 cm respectively. In one specimen, an “accessory” anterior interosseous artery was identified traveling along the ulnar aspect of the IOLC. A smaller posterior interosseous artery was identified traveling along the ulnar aspect of the forearm and 6.1 cm respectively. In one specimen, an “accessory” anterior interosseous artery was identified traveling along the ulnar aspect of the first to second branch, at 3.3 cm, third at 7.4 cm, and fourth at 9.0 cm. The largest span without any small branches was from the first to second branch, at 3.3 and 6.1 cm respectively. In one specimen, an “accessory” anterior interosseous artery was identified traveling along the ulnar aspect of the IOLC. A smaller posterior interosseous artery was identified supplying the posterior compartment muscles of the forearm with contributions from branches of the anterior interosseous artery perforating through the IOLC to join the posterior vascular network. After the forearm was de-bulked of soft tissue, backlit images demonstrated sparse vessels within the IOLC itself (Fig 1).

DISCUSSION AND CONCLUSION: Findings suggest that the IOLC derives its blood supply primarily from arteries supplying the surrounding soft tissues with a limited arterial network to the ligament complex itself. There is a particularly large watershed area between the first and second branches of the anterior interosseous artery, which closely corresponds with the location of the central band. Backlit images reveal that the central band has no significant intra-ligamentous blood supply. Present studies demonstrate that the vascularity to the IOLC is limited, further contributing to the debate on whether the IOLC is able to adequately heal after injury.
and the ulnar artery in four specimens. The mean distance from the needle to the ulnar nerve and artery was 1.02 and 0.75 mm respectively. Utilizing a transtendinous volar injection, the ulnar nerve was pierced in one specimen and the ulnar artery was never pierced. The mean distance from the needle to the ulnar nerve and artery was 1.51 and 4.45 respectively. There was a statistically significant difference in the distance of the needle to the ulnar nerve when comparing transtendinous volar and volar techniques. There was also a statistically significant difference in distance of the needle to the ulnar nerve when comparing the transtendinous volar injection to both the volar and medial approaches.

**DISCUSSION AND CONCLUSION:** The ulnar nerve and artery are at risk of injury during ulnar nerve blocks at the wrist. Physicians must be cautious to avoid intraneural or intravascular injections as this can cause pain and permanent damage. Traditionally, ulnar nerve blocks at the wrist have been described as injections placed adjacent to the FCU from either a volar or medial direction. In our study, a transtendinous volar injection had a decreased incidence of piercing the ulnar nerve and artery when compared to the volar and medial injection techniques. There was also a statistically significant difference in distance from the needle to the ulnar nerve when using the transtendinous volar injection compared to the other methods. This suggests that a transtendinous volar injection for ulnar nerve blocks at the wrist may be a safer alternative to traditionally described volar and medial injection techniques.

**POSTER NO. P232**

**ALTERNATE PAPER: HAND AND WRIST I**

**Randomized Comparison of Volar Plates and Intramedullary Nails for Distal Radius Fractures**

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Jonathan C. Barnwell, MD, Kernersville, NC
Beth P. Smith, PhD, Winston-Salem, NC
Ethan R. Wiesler, MD, Winston-Salem, NC
L. Andrew A. Koman, MD, Winston-Salem, NC
Zhongyu J. Li, MD, Winston-Salem, NC

**INTRODUCTION:** Distal radius fractures have a high prevalence in the general population and may be managed either conservatively with cast/splint immobilization or operatively by open reduction and internal fixation utilizing volar plates for unstable fractures. Recently, minimally invasive intramedullary (IM) nails have become available for the treatment of unstable distal radius fractures, possibly leading to decreased intraoperative tissue disruption and reduced postoperative pain. The purpose of this study was to compare the safety and efficacy of IM nails and volar plates for distal radius fracture management by evaluating post-operative subjective and functional outcomes.

**METHODS:** Fifty-two patients who sustained a closed, displaced, unstable, metaphyseal fracture of the distal radius were randomized to receive either a volar plate or an IM nail for internal fracture fixation. Functional scores (QuickDash) and pain scores on a visual analogue scale (McGill) were assessed pre- and postoperatively after two, six and 12 weeks, six, 12, and 24 months. The use of narcotics for pain management was documented for the first five weeks following surgery.

**RESULTS:** IM nailing was performed in 26 patients (21 females, five males, mean age of 56 years, range 18 to 79) and the other 26 patients (16 females, 10 males, mean age of 53 years, range 19 to 80 years) received a volar plate. Six weeks following surgery, all patients had healed fractures sites on radiographic exam. In both groups, there was similar improvement in post-operative functional and pain scores (QuickDash and McGill), range of motion, pinch and grip strength. In the first three weeks following surgery, narcotic use was similar in both the IM nail and volar plate groups (38.1% versus 41.6%). Four and five weeks after surgery, there was less narcotics use amongst patients treated with IM nailing compared to patients treated with volar plates (14.3% versus 45.8, p<0.05 and 9.5% versus 40.0%, p<0.05).

**DISCUSSION AND CONCLUSION:** The less-invasive IM nail technique used for the operative management of distal radius fractures may reduce postoperative pain and decrease the amount of narcotic pain medication patients need after surgery. Compared to volar plating, IM nails provide similar improvement in functional and radiographic outcomes among a comparable cohort of patients treated with standard open reduction and internal fixation.

**POSTER NO. P233**

**Complications in Open Trigger Finger Release**

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Valentin Neuhaus, MD, Boston, MA
Sigrid Fostvedt, BA, Ketchum, Idaho
Stephanie J.E. J. Becker, MD, Boston, MA
Jesse B. Jupiter, MD, Boston, MA
Chaitanya S. Mudgal, MD, Boston, MA
David C. Ring, MD, Boston, MA

**INTRODUCTION:** The rate of adverse events after open release of the A1-pulley vary widely in published studies. The purpose of this study was to classify and report adverse events of trigger finger release in a large cohort of patients.

**METHODS:** Adverse events of 1,598 trigger finger releases in 984 patients were classified based on a system derived from Center for Disease Control (CDC) criteria and clinical experience. Risk factors for various adverse events were sought in bivariate and multivariable statistical analysis.

**RESULTS:** At latest follow up, we found that 7.3% of the patients, or 6% of the operated trigger digits experienced a documented adverse event. The most common adverse events were recovery issues (2.9%; concern, slow recovery, and severe stiffness), wound problems (1.9%; suture abscess, infection, and wound separation), dissatisfaction (0.9%), persistent post-operative triggering (0.6%), and recurrent triggering (0.3%). Diabetes mellitus was associated with wound problems, severe stiffness, and recurrence. Concomitant carpal tunnel release on the same side was associated with slow recovery. Recovery issues and dissatisfaction were more likely to be documented by one of the surgeons, reflecting the subjective nature and variable documentation of many of these adverse events. All of the adverse events resolved with treatment.

**DISCUSSION AND CONCLUSION:** Open trigger release was not associated with any major adverse events such as nerve injury or deep infection, but at least one in 13.7 patients experienced a minor transient or treatable adverse event, with diabetics at greater risk. Minor adverse events are likely under-documented in the medical record. Level of Evidence: Therapeutic IV
Hand and Wrist Research Productivity: A Twenty Year Analysis

Richard Li, Dublin, CA
Christine Ahn, BA, Boston, MA
Phoebe Kuo, BA, Belle Mead, NJ
Brian Ahn, BA, Boston, MA
Jessica Bryant, BA, Ann Arbor, MI
Charles S. Day, MD, MBA, Boston, MA

INTRODUCTION: Bibliometric analyses examining trends in research productivity have been performed in various fields of medical research but have not been applied to hand and wrist research. This study presents the first bibliometric analysis of hand and wrist research, evaluating temporal and geographic trends in literature contributions.

METHODS: Original hand and wrist scientific articles were collected from seven peer-reviewed journals from 1988-2007. Journals were selected by impact factor. Publications were classified by world region, level of evidence, and study design. Total research volume, research productivity (a measure of quantity and journal impact factor), and research quality (defined by level of evidence) were determined for each global region. Linear regression analysis was performed to identify changes in relative production share over time by region and country.

RESULTS: A total of 3,457 articles were collected from seven journals. Twenty-six percent of studies were basic science, 41% of publications were level IV, and 14%, 9% and 9% were level III, II, and I evidence studies respectively. No significant increase in hand and wrist research volume was observed since 1988 globally or regionally, but productivity increased due to rising impact factors. Western Europe contributed more high-quality (Level I and II) studies than the United States. Overall, The United States and Western Europe contributed 39% and 37% to total research productivity, respectively, followed by Asia (excluding Japan) and Japan (both 8%). Over the 20-year period, research production shifted toward developing regions. The share of research productivity contributed by the United States declined as the share contributed by Western Europe, Latin America, Asia (excluding Japan), and Eastern Europe increased.

DISCUSSION AND CONCLUSION: Western Europe has significantly higher clinical research quality than the United States based on levels of evidence. Research productivity has significantly increased in the past 20 years primarily due to an increase in journal impact factors over time. Hand and wrist research displays a global distribution similar to other fields, with the United States and Western Europe as primary contributors. However, over the 20-year period, research production underwent a relative shift away from the United States toward Western Europe, Latin America, Asia, and Eastern Europe.

ALT. PAPER: HAND AND WRIST III
Poly-L/D-Lactic Acid Interposition Implant and Bone Packing in Revision Metacarpophalangeal Arthroplasty

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Raine P. Tiihonen, MD, Lahti, Finland

INTRODUCTION: Metacarpophalangeal (MCP) arthroplasties using a silicone implant provide pain relief, improve ROM and correct deformity, though the results deteriorate over time. In long-term follow-up studies, osteolysis, subsidence and fracture of the implants frequently occur. Revision MCP arthroplasty after silicone implants is challenging because of severe bone loss and soft tissue deficiencies. The use of a silicone implant in revision MCP arthroplasty is limited by poor survival and bone loss is difficult to address. A disciform, porous, bioabsorbable poly-L/D-lactic acid (PLDLA) interposition implant is designed to retain its shape long enough to allow the ingrowth of host tissue and then gradually be replaced with fibrous tissue in approximately two years, and has yielded promising early results in both primary and revision MCP arthroplasties.

Purpose of this study was to report the seven-year follow-up results of revision MCP arthroplasty using PLDLA interposition implants and morcelised allograft or autograft bone packing in patients with failed MCP arthroplasties and severe osteolysis.

METHODS: Eighteen women with chronic inflammatory arthritis, failed MCP arthroplasty and severe osteolysis, were recruited to this prospective, non-randomized study. The preoperative X-rays of the MCP joints showed cortical bone thinning to less than fifty percent of the original thickness of either the metacarpal or
the proximal phalangeal bone, or both in all but one joint. The majority of the implants removed were broken. Two patients were lost to follow-up, leaving 16 patients (16 hands; 37 joints) to assess. The mean follow-up time was seven years. Clinical assessments included measurements of active ROM, pain and deformity of the MCP joints and assessment of grip power and functional tip pinch, precision and power grips. Radiological assessment included palmar subluxation of the MCP joints and incorporation of the bone grafts. RESULTS: Limited flexion at average seven years after MCP revision arthroplasty was the most common clinical finding. All the patients had very limited grip strength at average seven years follow up, both on the operated and non-operated side. The mean grip strength was 4.2kg (range: 0-14) on the operated side (14 right and two left hands) and 6.0kg (range: 0-26) on the non-operated side. Furthermore, only three (20%), five (33%) and two (13%) patients could perform the power grip jug test, the power grip glass test or the precision grip test, with a normal grip, respectively. The presence of self-reported pain was moderately low and the pain was usually rated mild with mean pain VAS 14.0 (range: 0-53). Initially, the overall patient satisfaction was good with 94% and 90% good or satisfactory results at three months and one year, respectively. However at mean seven years after revision, subjective outcome was excellent in only one patient, good in three, satisfactory in seven and poor in five. Radiographic analysis showed complete incorporation of the grafted bone to the diaphyseal portion of the host metacarpal and phalangeal bones in 31 of the 37 joints. Volar displacement of the proximal phalanges occurred in 25 of the 37 joints (68%), including eight complete dislocations. DISCUSSION AND CONCLUSION: Revision MCP arthroplasty using Poly-L/D-lactic acid interposition implant and bone packing after failed silicone MCP arthroplasty and severe osteolysis can reconstruct bone stock and relieve pain. Bone graft incorporation was achieved in most of the cases but volar displacement recurred frequently. Pain relief continues to be satisfactory for years after revision but the initially acceptable patient satisfaction and functional results have a tendency to deteriorate coinciding with the recurring volar displacement.

POSTER NO. P236
Comparison of Cortisone Injection and Percutaneous Trigger Finger Release in Diabetics
Kevin Kang, MD, Brooklyn, NY
Archit Patel, MD, Brooklyn, NY
Mukund R. Patel, MD, Brooklyn, NY

INTRODUCTION: Trigger finger poses an interesting problem in diabetics due to its relative frequency and inferior response to cortisone injections compared to non-diabetics. Percutaneous release has been shown to be efficacious, but no study has compared the two in the diabetic population in order to help establish a preferred office procedure. METHODS: Two cohorts of patients with 60 receiving a cortisone injection and 60 undergoing percutaneous release were identified and followed until at least one year after initial procedure. All patients were treated by a single physician. Age, sex, laterality, grade, duration of symptoms, severity of pain, and specific finger involved were recorded prior to treatment. Statistical analysis was performed using Student’s t test as well as Chi square with significance set at p < 0.05. Criteria for inclusion in the study were diabetic patients that exhibited clinical triggering on active flexion and extension (grade II - mechanical clicking, grade III - locking, but can be unlocked). Those with painful fingers with tenosynovitis (tenderness at the distal palmar crease without triggering), fingers locked in flexion or extension, previous treatment with splinting, injection, surgery, or a history of trauma or inflammatory joint diseases were excluded. RESULTS: Patient characteristics were similar in both groups with some statistical differences (Table 1). Seven patients were lost to follow up in the injection group and three in the percutaneous release group which left 53 and 57 patients respectively for analysis. Results were graded by the criteria described in Table 2. In the injection group, 39/53 (74%) patients had a successful result while the percutaneous release group had significantly better results with 54/57 (95%) being successful (p = 0.005). There were no cases of infection or nerve damage in either group. Twelve patients were referred to a hand therapist for stiffness of the proximal interphalangeal (PIP) joint and eight patients developed a flexion contracture of the PIP joint that needed treatment with a reverse knuckle bender in the percutaneous release group. In the injection group, two experienced prolonged pain and erythema at the injection site which resolved with hand therapy. DISCUSSION AND CONCLUSION: Diabetic patients received superior and more predictable results with percutaneous release of trigger finger when compared to cortisone injection. Percutaneous release is a safe and effective alternative to cortisone injection as an office procedure for trigger finger in diabetics.

Table 1. Patient Demographics

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Sex (M:F)</th>
<th>Laterality (left:right)</th>
<th>Grade (II:III)</th>
</tr>
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<tbody>
<tr>
<td>Mean (SD)</td>
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Table 2. Results of treatment (1 year)

<table>
<thead>
<tr>
<th>Successful</th>
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<th>Complications</th>
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<tbody>
<tr>
<td>Cortisone Injection</td>
<td>Percutaneous Release</td>
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<tr>
<td>PIP flexion</td>
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<tr>
<td>Release</td>
<td>90</td>
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<tr>
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*Statistically significant

POSTER NO. P237
The Intrasheath Ultrasound Guided A1 Pulley Release (USGAR) for Trigger Digits
Jose M. Rojo-Manaute, MD, PhD, Madrid, Spain
Guillermo Rodriguez-Maruri, SR, MD, PhD, Madrid, Spain
Alberto Capa-Grasa, MD, Madrid, Spain
Francisco Sobron-Caminero, MD, Madrid, Spain
Manuel Villanueva, MD, PhD, Madrid, Spain
Carlos Rodriguez Conde, SR, MD, Madrid, Spain
Antonio Rios-Luna, MD, PhD, El Ejido, Almeria, Spain
Miguel del Cerro, MD, Madrid, Spain
Javier Vaquero Martin, MD, PhD, Madrid, Spain

INTRODUCTION: For trigger digits, the intrasheath ultrasound guided A1 pulley release (USGAR) has previously been shown to be safe and effective in cadavers. This study describes our intrasheath USGAR clinical results in terms of efficacy, safety and functional recovery. METHODS: USGAR was used in 48 digits in 48 patients prospectively followed up for 11.29 months on average and examined one, three years later. RESULTS: Patient characteristics were similar in both groups with some statistical differences (Table 1). Seven patients were lost to follow up in the injection group and three in the percutaneous release group which left 53 and 57 patients respectively for analysis. Results were graded by the criteria described in Table 2. In the injection group, 39/53 (74%) patients had a successful result while the percutaneous release group had significantly better results with 54/57 (95%) being successful (p = 0.005). There were no cases of infection or nerve damage in either group. Twelve patients were referred to a hand therapist for stiffness of the proximal interphalangeal (PIP) joint and eight patients developed a flexion contracture of the PIP joint that needed treatment with a reverse knuckle bender in the percutaneous release group. In the injection group, two experienced prolonged pain and erythema at the injection site which resolved with hand therapy. DISCUSSION AND CONCLUSION: Diabetic patients received superior and more predictable results with percutaneous release of trigger finger when compared to cortisone injection. Percutaneous release is a safe and effective alternative to cortisone injection as an office procedure for trigger finger in diabetics.

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*Statistically significant

For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
and six weeks, three and six months and one year after surgery. Time taking postoperative pain-kilers, range of motion recovery, grip strength, Quick Dash, return to normal activities (including work), cosmetic result, satisfaction and complications were assessed. RESULTS: Success rate was 100% and none recurred. Mean time was 1.9 days taking pain-kilers, 6.6 days for returning to normal activities and 9.9 and 3.8 days for complete extension and flexion recovery, respectively. Mean Quick Dash was 39.8 preoperatively and 7.8, 1.7 and zero after six weeks, six months and one year postoperatively, respectively. Grip strength reached over 90% of the individual’s normal grip strength on the sixth week in males and on the third month in women (p<0.001). One third finger developed radial digital nerve numbness that disappeared on the third week. No other complications were noted. All wounds were cosmetically excellent and final satisfaction was excellent or good in 98%.

DISCUSSION AND CONCLUSION: With the adequate technical knowledge, an intrasheath USGAR can be performed safely and successfully for trigger digits, offering an interesting alternative to the classic open approach in the ambulatory setting.

POSTER NO. P238
Evaluation of Flexor Tendon and A1 Pulley using Ultrasonography in Trigger Finger
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INTRODUCTION: Although trigger finger is a common disease seen in the out-patient clinic, there is no established method for its assessment. Ultra-sonography provides noninvasive visualization of the soft tissues. The purpose of this study was to use ultrasonography to evaluate trigger finger and analyze its characteristics. METHODS: Fifty-three consecutive patients (17 male and 36 female) clinically diagnosed with trigger finger or a condition related to trigger finger were recruited. In total, 67 affected fingers were studied sonographically at the level of the metacarphophalangeal (MP) joint by an experienced hand surgeon. Examined digits included 26 thumbs, four index, 25 middle, and 12 ring fingers. Each finger was graded into one of four groups according to clinical findings (Table 1).

Table 1. Grade of affected finger

<table>
<thead>
<tr>
<th>Grade (thumb: others)</th>
<th>Triggering</th>
<th>Interphalangeal joint contracture</th>
<th>Other findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (3:10)</td>
<td>No</td>
<td>No</td>
<td>Vague sense of tightness around MP joint</td>
</tr>
<tr>
<td>II (10:19)</td>
<td>Intermittent No</td>
<td>No</td>
<td>-</td>
</tr>
<tr>
<td>III (6:7)</td>
<td>Continuous</td>
<td>Yes or no</td>
<td>Can reduce with active extension</td>
</tr>
<tr>
<td>IV (7:5)</td>
<td>Continuous</td>
<td>Mild/severe</td>
<td>Cannot reduce without passive extension/cannot flex</td>
</tr>
</tbody>
</table>

Longitudinal axis of flexor tendon was measured on sagittal and axial planes (Figure 1). Transverse axis of the tendon and low echo area including the A1 pulley were measured only on the axial plane. We also analyzed tissue thickness of the contralateral side on 50 fingers judged to be clinically normal. Tendon thickness was analyzed separately in thumbs and in other digits considering anatomical differences. The maximum intra-observer error was 0.3 mm for all analyses.

RESULTS: Table 2 summarizes study results. With regards to tendon thickness in the thumb, there were significant differences in longitudinal axis both on sagittal (p=0.039) and transverse plane (p=0.046) between grades. In other fingers, there were also significant differences in longitudinal axis both on sagittal and axial plane (p<0.001) according to grade. Tendon thickness was significantly increased even in grade I lesions as measured at the longitudinal axis on the sagittal and axial planes of other fingers except thumb (p=0.038) compared to controls. In addition, there were significant differences between grades in A1 pulley thickness (thumb: p=0.022, others: p<0.001).

Table 2. Mean value of each tissue thickness *( )*=number of fingers

<table>
<thead>
<tr>
<th>Flexor Tendon</th>
<th>Control</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thumb longitudinal sagittal/axial plane</td>
<td>2.9/2.8</td>
<td>2.8/2.7</td>
<td>3.6/3.5</td>
<td>3.5/3.3</td>
<td>3.6/3.5</td>
</tr>
<tr>
<td>(21)</td>
<td>(3)</td>
<td>(10)</td>
<td>(6)</td>
<td>(7)</td>
<td></td>
</tr>
<tr>
<td>Thumb transverse</td>
<td>4.3</td>
<td>4.8</td>
<td>4.8</td>
<td>4.7</td>
<td>4.7</td>
</tr>
<tr>
<td>(21)</td>
<td>(3)</td>
<td>(10)</td>
<td>(6)</td>
<td>(7)</td>
<td></td>
</tr>
<tr>
<td>Other digits longitudinal sagittal/axial plane</td>
<td>3.6/3.4</td>
<td>4.0/3.7</td>
<td>4.4/3.7</td>
<td>4.9/4.6</td>
<td>4.8/3.9</td>
</tr>
<tr>
<td>(29)</td>
<td>(10)</td>
<td>(19)</td>
<td>(7)</td>
<td>(5)</td>
<td></td>
</tr>
<tr>
<td>Other digits transverse</td>
<td>6.1</td>
<td>6.3</td>
<td>6.6</td>
<td>6.5</td>
<td>6.6</td>
</tr>
<tr>
<td>(29)</td>
<td>(10)</td>
<td>(19)</td>
<td>(7)</td>
<td>(5)</td>
<td></td>
</tr>
<tr>
<td>A1 pulley</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thumb</td>
<td>0.5</td>
<td>0.5</td>
<td>0.9</td>
<td>1.3</td>
<td>1.0</td>
</tr>
<tr>
<td>(21)</td>
<td>(5)</td>
<td>(19)</td>
<td>(7)</td>
<td>(5)</td>
<td></td>
</tr>
</tbody>
</table>

DISCUSSION AND CONCLUSION: Important findings of this study are as follows: 1) The flexor tendon might begin to thicken before showing triggering or A1 pulley thickening except thumb. 2) The longitudinal thickening of the flexor tendon showed fingerspecific patterns. In the thumb, they showed equivalent thickness but a prominently lower value for grade I, whereas they increased gradually with increasing grade in other fingers. 3) The A1 pulley showed greater thickness in grade III than grade IV, which seems to be a more immobile condition. Sonographical measurement of the longitudinal axis of tendon and pulley might be useful for objectively investigating the etiology and mechanism of the trigger fingers.
Hand Surgery After Axillary Lymph Node Dissection for Cancer

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INTRODUCTION: Axillary lymph node dissection can be a part of the treatment regimen for breast cancer, melanoma, and other cancers of the extremities or the trunk. After axillary lymph node dissection, patients are cautioned to avoid interventional procedures on the ipsilateral upper extremity to avoid what is thought to be an increased risk of wound and healing complications, in particular lymphedema. Lymphedema can become a lifelong issue for the patient, as treatments are frequently ineffective. Thus cancer patients often choose to forego procedures for other conditions affecting the extremity. However there is little data in the literature and no consensus in regards to recommendations about hand surgery in patients who have had lymph node dissection. The purpose of this study is to evaluate if this group of patients has an increased incidence of postoperative complications, including lymphedema and infection.

METHODS: A review of all patients presenting to our hand clinic for two senior surgeons over the previous 13 year period was performed (1998-2011). All notes were reviewed, and patients with the diagnosis of breast cancer or melanoma, or a history of prior axillary lymph node dissection were selected. Operative and clinic notes were reviewed. Patients who were treated without surgical intervention and those who had elective hand surgery contralateral to their lymph node dissection were excluded. All patients who fit inclusion criteria were contacted if clarification was required in regards to their medical history.

RESULTS: A total of 147 patients were identified with a history of breast or skin cancer. Fifty-two patients were treated for various hand issues, and of this group, 20 patients (19 females with breast cancer, one male with melanoma) had axillary lymph node dissection on the ipsilateral extremity. Procedures included seven carpal tunnel releases, six trigger finger releases, four soft tissue lesion excisions, and one each of Dupuytren’s release, CMC arthroplasty, scar revision, flexor tendon repair, and foreign object removal. Two patients had concomitant procedures. The average age at the time of lymph node dissection was 55.1 years (range 37.5-73.6); average age at the time of hand surgery was 64.5 years (range 41.6-83.5). The time interval between surgeries averaged 8.2 years (range 7 days-37.3 years). Four of these patients had pre-existing lymphedema. Post operatively there was no lymphedema exacerbation and no new cases of lymphedema. Four patients had pericircumcision erythema, requiring oral antibiotics for presumed superficial infection. All patients recovered without further intervention. Two patients had issues with incisional pain and scarring, each resolving after corticosteroid treatment. No patients required a return to the operating room.

DISCUSSION AND CONCLUSION: Axillary lymph node dissection can be part of the routine care of breast and other lymphatically metastasizing cancers. Patients are traditionally advised after these treatments to avoid any and all procedures to their ipsilateral extremity due to concern over increased risk of complications. With breast cancer alone diagnosed at a rate of more than 200,000 per year in the United States, there are likely many such patients with a history of lymph node dissection, who choose not to seek surgical management for otherwise common upper extremity issues. We have shown, in our limited number of patients, that routine minor hand surgery does not result in lymphedema and did not increase existing lymphedema in patients who had a previous ipsilateral axillary lymph node dissection. This study suggests ipsilateral upper extremity surgery may be pursued safely. A large scale, prospective study is necessary before a culture change may be achieved.

PAPER NO. P240

Why Do Corticosteroids Help in Stenosing Tenosynovitis? A Histologic Examination of the Tenosynovium

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Asif M. Ilyas, MD, Wayne, PA

INTRODUCTION: Trigger fingers and DeQuervain’s disease represent a stenosing tenosynovitis that is readily treated with corticosteroid injections. However, previous histological studies in patients with these pathologies have identified non-inflammatory fibrocartilaginous metaplasia of the tendon sheaths, putting into question the mechanism of symptom improvement following corticosteroid injections. Although previous studies have examined the histology of tendon sheaths, to the best of our knowledge, no study has examined the histology of the surrounding tenosynovium of the involved tendon to better understand the positive response to corticosteroids.

METHODS: The enveloping tenosynovium of 20 consecutive patients with the diagnosis of either a trigger finger or DeQuervain’s disease undergoing surgical release were debrided during surgery and sent to the lab for histopathologic examination. As a control, 11 cadaveric specimens consisting of 1 cm flexor tendon segments taken at the A1 pulley level were excised and similarly examined. All samples were graded on a scale of 0-3 to the amount of inflammation, myxoid changes, and neovascularization by histologic examination.

RESULTS: Of the 20 initial patients whose cases were reviewed, a total 15 patients were included in the study with a total of 16 specimens (one patient had surgical release of both a trigger finger and DeQuervain’s synovitis). Five patients were excluded because of insufficient samples for histological analysis. In the surgical group, the mean grade for inflammation, myxoid and neovascularization was 1.31, 1.06, and 1.94 respectively versus 0.09, 1.82, and 0.00 respectively for the cadaveric control group. Using the Wilcoxon Rank Sum Test, the data was found to be statistically significant with p-values of p<0.0001, p<0.05, and p<0.0001 for inflammation, myxoid, and vascularity. There was no statistical difference in histologic findings between the tenosynovium of the trigger fingers versus DeQuervain’s disease.

DISCUSSION AND CONCLUSION: Previous studies examining the histopathology of patients with stenosing tenosynovitis describe a mucoid degeneration with fibrovascular changes involving the A1 pulley and tendon sheath without evidence of inflammation. Our study of the tenosynovium in patients with stenosing tenosynovitis indicates that there is indeed a degree of inflammation present in these patients. This finding helps to explain why many patients might respond positively to corticosteroid injections.
**Introduction and Purpose of Study:**
Total wrist replacement is an evolving procedure for the treatment of arthritis of the wrist joint. The purpose of this study is to report our experience with three different total wrist implants (one resectional wrist arthroplasty implant and two resurfacing wrist implants) and to report future directions for total wrist replacement. Details related to total wrist replacement, wrist biomechanics, concept of resurfacing of the distal radius with minimal carpal bone resection, allowing preservation of the distal radioulnar joint and intercarpal ligaments will be presented.

**Methods:** A review of 47 total wrist replacements was performed at a minimum of 3.5 with a range of 3.5-15 years after surgery to determine the clinical outcome, radiographic appearance and prosthesis survivorship or success. The three different total wrist implants included the Biaxial total wrist, Universal II total wrist and ReMotion total wrist. Review included clinical assessment, radiographic analysis, review of complications (incidence and type) and conversion to wrist fusion. Concomitant replacement of the distal ulna combined with total wrist replacement will be presented. Patient function was assessed pre and post operatively by the Mayo wrist score and the Patient Related Wrist Score and DASH.

**Results:** Forty seven wrist implants were performed in 39 patients. There were 37 rheumatoid and 10 post traumatic cases. The total wrist inserted included Biaxial (N=16), Universal II (N = 9) and ReMotion (N = 22) designs. The later two wrists represent a new joint resurfacing concept, while the Biaxial design is a standard type of resectional implant. Success was achieved in 21/22 ReMotion, 8/9 Universal and 10/16 Biaxial wrists, 80% of cases. Two cases were successfully revised previous total wrist replacements. The failed cases were due to implant loosening (distal component-8) or wrist instability-2. The distal loosening were salvaged by revision distal wrist surgery (N=2) or wrist fusion (N=6). In the successful cases there was a functional range of motion of 45° extension and 40° flexion and improved grip strength by 15%. Mayo wrist scores increased from 40 points prior to surgery to 76 points after surgery. Fusion had an average Mayo Wrist Score of 45 points. Mayo Wrist scores - post-traumatic conditions averaged 86.6 points versus 72 points for rheumatoid arthritis. The DASH score measured was Universal II 20.2, Re-Motion 36.6 and Biaxial 47.8. The PRWE score was Universal II (25.8), Re-Motion (32.9) and Biaxial (39.6).

**Conclusion:** Total wrist replacement was successful in 80 percent of all cases and in 96% of resurfacing implants (Universal II and Re-Motion) at average follow-up of 6.2 years. Better results were correlated with improved distal component fixation and minimal resection of the distal radius, allowing preservation of dorsal and volar carpal ligaments. Prosthetic loosening was not observed when these biomechanical principles were followed.

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**SCIENTIFIC EXHIBIT NO. SE47**

**Complex Carpal Lesions: Perilunate Dislocations and Fracture Dislocations: Diagnosis, Treatment and Results**

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Federico Dettoni, MD, Torino, Italy
Francesco Giacalone, MD, Torino, Italy
Matteo Ferrero, MD, Chieri, Italy
Maddalena Bertolini, Turin, Italy
Arianna Bernardi, Riva Presso Chieri (TO), Italy
Giulia Colzani, Bra, Italy
Arman Sard, MD, Torino, Italy
Italo Pontini, Torino, Italy

**Introduction:** Complex carpal lesions are rare pathologies involving carpal bones fractures associated with ligament lesions and/or dislocation. Usually these lesions can occur after high energy traumatic injuries, mostly as a result of an impact of the wrist with an outstretched hand. The most frequent injuries are perilunate dislocations, and 65% of these are dorsal trans-scaphoid perilunate fracture-dislocations. The purpose of this study was: 1) to retrospectively review the outcomes of all perilunate fracture-dislocations treated in our Hand Surgery Division, with a mean 3 years follow-up, and compare these results with those reported in the Literature; and 2) to analyze the most recent up-to-date Literature regarding complex carpal lesions, their incidence, classification, treatment, surgical techniques and outcomes.

**Methods:** Between 2002 and 2008 we treated 32 patients affected by complex carpal lesions, with a mean follow-up of 3 years. The lesions were classified into five groups according to the presence of ligament lesions and dislocation: A) Perilunate dislocation without ligament lesion; B) Perilunate dislocation with ligament lesions but no dislocation; C) Dorsal trans-scaphoid perilunate fracture-dislocation with ligament lesions and dislocation; D) Complex carpal lesion without dislocation; and E) Complex carpal lesion with dislocation. The treatment was surgical in all cases, with a mean operation time of 125 minutes. The postoperative rehabilitation was individualized, with a mean duration of 5 weeks. The results were assessed using the Mayo Wrist Score, the DASH score, and the Patient Related Wrist Score. The follow-up was conducted by telephone interview at a mean of 3 years after surgery. The results were excellent in 14% of cases, good in 44%, fair in 28%, and poor in 14%.

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**SCIENTIFIC EXHIBITS**

**SCIENTIFIC EXHIBIT NO. SE46**

**Total Wrist Arthroplasty: New Directions and Outcomes**

William P. Cooney, III, MD, Vero Beach, FL
Marco Rizzo, MD, Rochester, MN

**Introduction and Purpose of Study:** Total wrist replacement is an evolving procedure for the treatment of arthritis of the wrist joint. The purpose of this study is to report our experience with three different total wrist implants (one resectional wrist arthroplasty implant and two resurfacing wrist implants) and to report future directions for total wrist replacement. Details related to total wrist replacement, wrist biomechanics, concept of resurfacing of the distal radius with minimal carpal bone resection, allowing preservation of the distal radioulnar joint and intercarpal ligaments will be presented.

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**Conclusion:** Total wrist replacement was successful in 80 percent of all cases and in 96% of resurfacing implants (Universal II and Re-Motion) at average follow-up of 6.2 years. Better results were correlated with improved distal component fixation and minimal resection of the distal radius, allowing preservation of dorsal and volar carpal ligaments. Prosthetic loosening was not observed when these biomechanical principles were followed.
by complex carpal lesions, including 21 trans-scaphoid perilunate fracture-dislocations (13 “pure” and 8 associated with other anatomical carpal structures lesions). The data collection was performed retrospectively; all patients were evaluated by the same examiner, with a medium follow-up of 36.18 months (min 11, max 84), using the Mayo Wrist Score and the Clinical Scoring Chart. The DASH quality of life questionnaire was submitted to all patients. A statistical analysis of the results was performed, comparing them to the most recent Literature. A thorough search of the Literature was performed, with the purpose of designing an algorithm for diagnosis, classification and treatment of perilunate fracture-dislocations; and determining the main factors associated to the outcomes of surgical treatment. Results: all patients in our case series obtained objective good results, and returned to an acceptable hand function, with a subjective satisfaction. The mean final score obtained with the Mayo Wrist Score was 74.6/100, the mean Clinical Scoring Chart was 80/100 and the mean DASH was 14.5/100. These results are comparable to those reported in the Literature. Discussion and Conclusion: The main factors influencing the outcomes are the type of lesion (trans-scaphoid perilunate fracture-dislocations associated with other bony or ligamentous lesions showed worse outcomes compared to “pure” lesions, even if the difference was not statistically significant) and the timing for surgery (patients undergoing surgery within 7 days from the time of the injury had better outcomes compared to those operated more than a week later). An acute non-surgical reduction is mandatory in order to restore the normal anatomical connections as soon as possible, but it is not adequate as a definitive treatment. Treatment should always involve an open reduction and possibly an internal fixation.