Poster 01: Surgical and Conservative Management of Mallet Finger: A Systematic Review

Category: Hand

Treatment; Surgical Technique; Prognosis/Outcomes

Level 4 Evidence

Julie B. Samora, MD, PhD, MPH

Hypothesis

We hypothesize that there is no difference in clinical outcomes between surgical and nonsurgical management for mallet finger injuries. We hypothesize that most surgeons use size of fracture and subluxation as key indications for operative intervention.

Methods

A systematic review of multiple databases was performed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) to if any conclusions can be drawn concerning the indications for surgery in mallet finger injuries; the treatment outcomes of surgical vs nonsurgical management; the most effective methods of surgical and nonsurgical treatment; and the most common treatment complications of mallet finger injuries. English language clinical studies evaluating therapeutic interventions for mallet fingers that reported objective, standardized outcome measures were included. Basic science studies, cadaveric studies, conference abstracts, level V evidence studies, studies lacking statistical data, and tendinous injuries other than mallet fingers were excluded. Salvage procedures and studies evaluating exclusively chronic lesions were also excluded.

Results

Forty-four studies were included that reported clinical outcomes for treatment of mallet finger injuries, 22 evaluating surgical treatments and 17 studies investigating conservative treatments. The average DIPJ extensor lag was 5.7° following surgical treatment and 7.6° following nonsurgical treatment. Complication rates of surgical and nonsurgical interventions were comparable (14.5% and 12.8%, respectively). Five studies directly compared outcomes of surgical to nonsurgical management, with mixed results and recommendations.

Summary Points

• Both surgical and nonsurgical treatment of mallet finger injuries lead to excellent clinical outcomes.
• There is approximately a 2° improvement in DIPJ extensor lag with surgical treatment, but this is not clinically relevant.
• No one specific splint or procedure was found to be superior to others.
• We found similar complication rates between conservative and surgical treatment, with more severe complications occurring with surgery.
• There remains insufficient evidence to determine when surgical intervention is indicated. However, fracture size is the most commonly reported indication (82.6%), followed by subluxation of the distal phalanx (60.9%).
• Based on our literature review, it appears that these treatments are equivalent and treatment should be individualized to the patient.

Bibliography
Poster 02: Minimally Invasive Proximal Interphalangeal Joint Arthrodesis: Surgical Technique

Category: Hand

Surgical Technique
Level 4 Evidence

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HYPOTHESIS
Proximal interphalangeal joint arthrodesis by minimally invasive technique is a viable option.

Methods
Consecutive patients who presented to the senior author with PIP joint arthritis were offered PIP joint arthrodesis by minimally invasive technique. A 1 cm transverse incision is made over the PIP joint, incising the skin, central band, and articular capsule with one cut. The PIP joint is flexed to expose the articular surface. The collateral ligaments can also be transected at their proximal phalangeal insertion if further exposure is needed. The articular surfaces are prepared with a fine tipped rongeur, exposing subchondral bone until flat surfaces are obtained. Under fluoroscopy a guide wire corresponding to the chosen cannulated headless screw (3.0mm, 2.4mm, or 2.0mm) is inserted in an antegrade fashion. It progresses from the center of the proximal phalangeal articular surface until it exits through the dorsal cortex and the distal end lies within the subchondral bone. The angulation of this guide will determine the degree of flexion in which the PIP is fused. This is the most critical step of the procedure as it determines the angle of flexion in which the PIP will be fused. A 5mm incision is made to expose the guide wire and then the wire is advanced through the center of the medullary canal of the middle phalanx. The wire is then overdrilled, length is measured and a headless compression screws is inserted. Reevaluate alignment after insertion of the screws because malrotation may be induced by torque during compression.

Results
Six consecutive patients underwent the procedure by the senior author. All patients healed the arthrodesis without complications and hardware removal was not needed.

Summary Points
- Minimally invasive PIP joint arthrodesis is a safe and viable procedure
• Critical portions of the procedure include 1) placing the wire at the angle of the desired angle of fusion and avoiding malrotation during screw insertion.
Poster 03: Minimally Invasive, Percutaneous Approach to Distal Interphalangeal and Thumb Interphalangeal Arthrodesis

*Category: Hand*

Treatment; Surgical Technique
Level 4 Evidence

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**Hypothesis**
The goal of distal interphalangeal (DIP) and thumb interphalangeal (IP) arthrodesis is to provide a painless, stable, and properly positioned union between juxtaposed phalanges, allowing appropriate function of the postoperative hand. Various pathologies, including degenerative and traumatic conditions, require DIP and thumb IP arthrodesis to provide symptom relief. While many described surgical techniques exist, most require soft tissue violation and bony preparation prior to implant placement. With reported nonunion rates and major complications rates of up to 20%, the authors discuss a minimally invasive alternative that may lower complication rates and still provide painless immobilization.

**Methods**
Operative cases for 9 primary distal interphalangeal and 2 thumb interphalangeal joint arthrodeses were treated by a single, fellowship-trained hand surgeon utilizing the described intervention. In all cases, intramedullary screws were placed percutaneously, in a retrograde fashion, across an appropriately positioned joint. Outcome measures were defined by clinical and radiographic evaluation.

**Results**
8 patients (7 female, 1 male), averaging 72 years at time of surgery, accounted for 11 cases. Indications for operative intervention included primary osteoarthritis (OA) in 8 of 11 joints with the remaining related attributable to known secondary OA pathology. Patients were followed clinically and radiographically for an average of 10.32 months. Painless, clinical arthrodesis was achieved in 10 out of 11 patients (91%) in an average of 1.6 months. Preoperative coronal malalignment averaging 10.4 degrees (range 4 to 16 deg.) was corrected. No major wound complications or nail growth disturbances were observed in this series. One patient requested removal of a symptomatic implant with complete resolution of symptoms. Only one patient in this series required revision arthrodesis secondary to painless nonunion.
Summary Points
• A percutaneous, retrograde approach without traditional joint preparation is a viable option for providing the primary goal of DIP and thumb IP joint arthrodesis: a painless, stable joint.
• Despite the closed nature of this procedure, degenerative angular deformity is effectively addressed and corrected.
• In appropriately selected patients, this approach may substantially decrease major complications without sacrificing stable union.
• The authors highly recommend further investigation comparing the role of percutaneous intervention versus traditional open arthrodesis.

Bibliography

Images
Poster 04: Clinical outcome of digitolateral flap in surgical release for finger flexion contracture

*Category: Hand*

Treatment; Surgical Technique; Prognosis/Outcomes

Level 4 Evidence

Issei Komatsu, MD
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**Hypothesis**

Management of scar contracture on the volar surface of the finger is challenging. Surgical treatment basically consists of scar release and skin grafting or Z-plasty. The ideal procedure uses a local tissue flap to cover the skin defect created by scar release without skin grafting. The purpose of this study is to examine the effectiveness of digitolateral flap as used to cover defects on the volar surface of the finger following contracture release.

**Methods**

From 2004 to 2013, chart reviews were performed to identify patients with finger flexion contracture who subsequently underwent a surgical correction utilizing the digitolateral flap. In each case, a midlateral digital skin flap was elevated and transposed to cover volar skin defect following scar release. (Figure 1A) The flap is versatile in that it can be proximal or distally based, (Figure 1B) and depending on contracture location, it can be used to cover skin defects at either the PIP or MP joint crease. (Figure 1C) Clinical outcome of the procedure was analyzed.

**Results**

A total of 51 fingers in 41 patients were identified. Of the 51 fingers, 39 had isolated skin contracture, 7 also had a joint contracture, 5 were Dupuytren contracture. 29 fingers utilized the digitolateral flap for coverage at the MP joint crease, 14 at the PIP joint crease, 7 fingers at both MP and PIP joint crease. 47 flaps were proximally based while 5 flaps were distally based. Digitolateral flaps which were designed for coverage of a defect at the middle phalanx or distal phalanx needed skin grafting to cover the defect at the donor site. 3 flaps had marginal skin necrosis but eventually healed without leaving skin defect. Mean joint arc of motion of the PIP joint was 41° (Range; -27° - 68°) pre-operatively and 70° (range-14° - 84°) at 6 months post-operatively. Mean joint arc of motion of the MP joint was 69° (range -2° - 71°) pre-operatively and 79° (range-4° - 83°) at 6 months post-operatively.
Summary Points
• Digitolateral flaps are a viable alternative for skin defects created by contracture release on the volar surface of the finger.
• Scar contractures in the finger are usually secondary to burns or trauma and leave the lateral side of the finger uninjured and suitable for donor tissue to cover defects created by contracture release.
• This flap is a random type flap so the digital artery is not sacrificed.

Bibliography
1: Hirase Y., Practical Techniques in Flap Surgery, Springer, Jan 2017
Poster 05: Does Debridement of Dorsal Hand Abscesses in the Operating Room Improve Outcomes?

Category: Hand

Treatment; Prognosis/Outcomes
Level 4 Evidence

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Hypothesis
The most common site for hand infections is over the dorsal surface and is secondary to some traumatic mechanism. There is, however, no evidence to date to support either formal debridement in the operating room or a simple bedside procedure. The benefits of bedside procedures include decreased hospital costs, decreased time and staff required, and, particularly for sick patients, the ability to avoid general anesthesia. We hypothesize that formal debridement in the operating room does not improve patient outcomes and therefore does not justify forgoing the aforementioned benefits of a bedside procedure.

Methods
After obtaining IRB approval, a retrospective chart review was conducted for patients presenting to our level-one trauma center with a dorsal hand abscess. Information obtained included demographics, whether the initial debridement was performed at the bedside or in the operating room, as well as the organism, number of trips to the operating room, and repeat hospitalizations.

Results
During the one-year retrospective collection period 27 patients had a dorsal hand debridement in the operating room whereas 23 patients had undergone bedside debridement as their primary procedure and a paired t-test was used for comparisons. The number of trips to the operating room was significantly less in the bedside debridement group (p=0.03), as was the average length of hospital stay (p=0.04). Staphylococcus aureus was the most common organism in both groups, with no statistical difference in MRSA isolation. There was no difference in hospital readmissions, duration of symptoms prior to debridement, age, gender, or comorbidities. Size of abscess on presentation was not significant, although this was poorly documented in the records.
Summary Points

• Bedside debridement of dorsal hand abscesses may result in less overall trips to the operating room and less overall hospital days.
• While selection bias may influence these results, an initial attempt at bedside debridement may be safe and cost-efficient as a first-line attempt at treating dorsal hand infections.
Poster 06: Outcomes of Scapholunate Injuries With Concomitant Distal Radius Fractures: To Fix or Not to Fix?

Category: Wrist

Treatment; Prognosis/Outcomes

Level 4 Evidence

Nicholas Duethman

Hypothesis

There is a paucity of literature in regards to the treatment of scapholunate (SL) injuries in the setting of acute distal radius fractures (DRF). We hypothesized that concomitant repair of SL injuries in adult patients with operative DRFs leads to improved functional outcomes.

Methods

A retrospective review of 3,246 patient charts with an operative DRF or SL injury was performed of patients 18 years and older between 2005 and 2013. We included only patients with operative DRF and concomitant SL injury (n=42). SL injury was diagnosed by either SL diastasis > 3mm on PA radiographs, magnetic resonance imaging, or with wrist arthroscopy. Subjects were divided into 3 groups: 23 had a SL repair within 21 days of injury (acute), 8 underwent repair greater than 21 days from injury (subacute/chronic), and 11 did not undergo repair (non-operative). Mean time to follow-up was 2.3 years (range, 6 months to 9 years). The mean age at surgery was 42.2 years (19-79). Statistical analysis was performed using ANOVA for multiple group comparisons. Continuous data was reported as means and ranges.

Results

Thirty-nine (92.9%) of the 42 patients suffered an intra-articular DRF and all underwent fixation with radial styloid pins (n=5), volar plate (n=29), fragment specific fixation (n=7), or a bridge plate (n=1). SL injuries were repaired using pin fixation (n=7), pin fixation with suture anchor(s) (n=23), or modified Brunelli procedure (n=1). There was no statistically significant difference in pre-operative SL gap or angle between the 3 groups (p = 0.47 and p = 0.32, respectively). On the initial post-operative radiographs, there was a statistically significant difference between the SL gap in those treated surgically vs. those treated non-operatively with means of 2.5 mm and 3.6 mm, respectively (p = 0.005). This difference was not maintained at final follow-up (p = 0.14). There was no statistically significant difference in clinical outcomes between the 3 groups (p = 0.80). Of patients repaired acutely, 17.3% had good to excellent Mayo Wrist Scores (MWS). Good to excellent MWS were noted in 25% of subjects in the subacute/chronic group and 27% in the non-operative group. One patient in the non-operative group required a radiocarpal fusion for persistent symptoms.
Summary Points

• This study did not demonstrate a functional difference between patients who had their associated SL injury treated acutely, subacutely, or non-operatively.
• Missed SL injuries repaired in a delayed fashion did not demonstrate any significant differences compared to those treated acutely or observed non-operatively.
Poster 07: Carpal Translocation Following Dorsal Bridge Plate Fixation of Distal Radius Fractures: A Cadaveric Study

Category: Wrist

Treatment; Surgical Technique; Prognosis/Outcomes
N/A - not a clinical study

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Hypothesis
Dorsal bridge plate fixation is a technique increasingly utilized to establish and maintain reduction of the distal radius in the setting of complex fracture patterns involving significant comminution, a large zone of injury, or osteopenic bone. Lewis et al. revealed increased incidence of 1st and 3rd extensor compartment entrapment with distal fixation to the 3rd metacarpal. This study seeks to investigate differences in carpal translocation resulting from bridge plate distal fixation to the 2nd vs. 3rd metacarpal.

Methods
Ten paired cadaveric upper extremities without evidence of gross deformity or prior surgery distal to the elbow were evaluated with 3-view wrist fluoroscopic images were evaluated for baseline radiographic measurements. A 1-cm osteotomy distal radius fracture model was then created via a volar Henry approach. Following fracture creation, a dorsal bridge plate was applied with random fixation to the 2nd or 3rd metacarpal. To control for anatomic variation, each specimen served as an internal control. 3-view wrist fluoroscopic images were repeated and measured for radial inclination, radial height, radiocarpal angle, volar tilt, ulnar variance, radiolunate angle, radioscaphoid angle, radial rotation index, and carpal translocation. Carpal translocation was calculated using Taleisnick’s ulnar translocation index, Chamay’s ulnar translation index, and McMurtry’s carpal translation index.

Results
Distal fixation to the 2nd and 3rd metacarpal occurred evenly with regard to laterality. Radial inclination, radial height, radiocarpal angle, volar tilt, ulnar variance, radiolunate angle, and radioscaphoid angle were not statistically different between pre- and post- fixation to the 2nd and 3rd metacarpal. There was, however, a statistically significant increase in the radial rotation
index following bridge plate application to the 3rd metacarpal. This difference was not seen in the group with 2nd metacarpal fixation. There was no difference in Taleisnick’s ulnar translocation index, Chamay’s ulnar translation index, or McMurtry’s carpal translation index.

Summary Points
- Dorsal bridge plate fixation of distal radius fractures restores preoperative physiologic measures of the radius, ulna, and carpus.
- No significant carpal translocation occurred during dorsal bridge plate fixation to the 2nd or 3rd metacarpal bone.
- Therefore, fixation to the 2nd metacarpal is preferred as it restores pre-operative physiologic measures and has a decreased risk of 1st and 3rd extensor compartment entrapment.

Bibliography
Poster 08: Distal Radius Corrective Osteotomy: A Comparison of Volar and Dorsal Plating

*Category: Wrist*

Treatment; Surgical Technique; Prognosis/Outcomes
Level 4 Evidence

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**Hypothesis**
Symptomatic distal radius fracture malunions (DRFM) in the adult patient may be treated by either a volar or dorsal corrective osteotomy. Our study hypothesis is that malunions of the distal radius treated with dorsal osteotomies have worse clinical outcomes and more complications than those treated with volar osteotomies.

**Methods**
The records for consecutive patients treated with osteotomies for symptomatic dorsally angulated DRFM were retrospectively reviewed and divided into two groups: volar osteotomy (VO) and dorsal osteotomy (DO). Data was collected regarding patient demographics, timing from injury to surgery, clinical and patient-reported outcomes by quickDASH, as well as minor and major complications. Continuous variables were compared using student’s t-test and categorical variables were compared using Fisher’s exact test.

**Results**
Forty-seven patients were identified that met inclusion criteria (VO n=31 and DO n=16). The average time from initial injury to index procedure was 16.1 months (1 month - 17 yrs) and average time of final follow-up was 14 months. Groups were similar in terms of age and fracture severity. Final QuickDASH scores were similar in both groups (VO 21.7 vs. DO 13.9, p=0.51). Minor complications included finger stiffness (VO n=9 vs. DO n=7, p=0.35) and continued pain (VO n=9 vs. DO n=2, p=0.29). Major complications were more common in the VO group and included removal of symptomatic hardware (VO n=3 vs. DO n=2, p=1.0) and revision osteotomy (VO n=2 vs. DO n=0, p=0.54).

**Summary Points**
- Volar and dorsal osteotomies for DRFM result in satisfactory long-term clinical outcomes.
- Both VO and DO are associated with an important number of minor and major complications.
- There was no demonstrable benefit to either the volar or dorsal approach.
Poster 09: Carpometacarpal Arthrodesis for Traumatic Carpal Boss in Professional Fighters

*Category:* Wrist

Evaluation/Diagnosis; Treatment; Surgical Technique

Level 4 Evidence

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**Hypothesis**
Among professional combat athletes, excessive and repetitive trauma to the carpometacarpal (CMC) joints causes instability, arthritis, and the development of a traumatic carpal boss. If non-operative management fails, CMC arthrodesis with iliac crest grafting and Kirschner-wire fixation is a reliable surgical treatment for carpal boss that can result in a pain free and full return to competition.

**Methods**
From 2002 to 2015, 15 professional athletes with 17 symptomatic carpal bosses were treated with CMC joint arthrodesis. All patients had attempted non-operative management including rest, immobilization with splinting, non-steroidal anti-inflammatories, and corticosteroid injections. The operative technique included decortication of the articular surface of the CMC joints, insertion of iliac cancellous and corticocancellous slot grafts, and secure Kirschner wire fixation (Figure 1). Patient charts and post-operative imaging was retrospectively reviewed. Outcome measures included grip strength, pain relief, fusion rate, return to competition, and complications.

**Results**
The average age at the time of surgery was 28.2 years (range, 21 to 39 years). The average time from initial presentation to surgery was 12.5 months. Eight patients had 2 CMC joint arthrodesis, 7 patients had 4 CMC joint arthrodesis and 2 patients had 3 CMC joint arthrodesis. The radiographic fusion rate was 100% and occurred on average at 7.5 weeks (Figure 2). Average return to competition occurred at 6 months. Grip strength at final follow-up increased 32% from pre-operative level and was 90% of the grip strength of the contralateral hand. Post-operatively, 2 patients sustained sagittal band ruptures and 1 patient had a 5th metacarpal fracture. There were no revision surgeries.
Summary Points
- CMC arthrodesis with iliac crest autograft is a safe and effective surgical method for treating symptomatic traumatic carpal boss in professional fighters
- All patients undergoing CMC arthrodesis had a successful fusion without need for revision surgery
- Post-operatively, fighters experience pain relief, re-gain grip strength, and are all able to return to their pre-injury level of competition
- CMC arthrodesis should be considered as an optimal surgical treatment for professional fighters who are seeking complete recovery and return to competition

Bibliography
Poster 10: The Effect of Distal Pole Scaphoid Resection on Wrist Biomechanics

Category: Wrist

Treatment: Basic Science
N/A - not a clinical study

Stephen D. Hioe
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Hypothesis
The purpose of this study is to evaluate the effects of varying levels of scaphoid resection on wrist biomechanics. We hypothesized that increasing levels of scaphoid resection will correlate with worsening radiographic signs of carpal instability.

Methods
Six fresh frozen cadaveric upper extremities were statically affixed to a wooden ballast. A dorsal exposure was used to approach each scaphoid. Three 0.045” Kirchner wires were driven into the radial aspect of the intact scaphoids to mark planned resection levels of 25%, 50%, and 75% of their longitudinal lengths (Figure 1). Wrist radial and ulnar deviation as well as physiologic grip and pinch were simulated with differential weights affixed to the wrist and finger flexor and extensor tendons. For the intact scaphoid and each sequential resection level, the following radiographic parameters were assessed: Radiolunate and capitolunate angles; carpal height and 1st metacarpal subsidence ratios; radial styloid clearance (defined as the distance between the radial styloid tip and trapezium in wrist radial deviation); and, the amount of ulnar carpal translation. Statistical analysis was performed using repeated measures ANOVA at P <0.05 using SPSS version 22 (IBM Aramonk, NY).

Results
Increasing levels of scaphoid resection is associated with a significant linear increase in radiolunate angles with a mean of 15° at 0% resection to a mean of 32° at 75% resection (P = 0.01). The remaining variables did not attain statistical significance and are summarized in Table 1.
Summary Points

• Increasing levels of scaphoid resection demonstrated a trend towards radiographic carpal instability primarily in the form of worsening DISI; however, besides an increase in mean radiolunate angles, the other variables failed to reach any statistical significance in this study.
• Secondarily, there is a consistent decrease in radial styloid clearance for which a concomitant radial stylopectomy should be considered to avoid impingement.
• Overall, increasing levels of scaphoid resection did not lead to intercarpal dislocation or other major instability events; however, it is associated with progressive radiographic signs of subtle intercarpal instability best depicted by changes in radiolunate angle measurements.

Bibliography


Images
Poster 11: Outcomes of Proximal Row Carpectomy for Wrist Arthritis in Smokers

*Category: Wrist*

Treatment;Surgical Technique;Prognosis/Outcomes

Level 4 Evidence

Tyler A. Evans
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**Hypothesis**

It is estimated that 1 in 7 Americans suffer from wrist arthritis leading to chronic wrist pain. Mechanical etiologies often present late, requiring surgical intervention to sacrifice range of motion for pain control. Partial fusion procedures target the dominant site of arthritis, but are often complicated by hardware failure, lack of fusion, and persistent pain. Proximal row carpectomy does not require hardware or bony fusion to succeed, and can reliably provide pain relief without significantly impeding function. Common comorbidities increasing surgical risk, like smoking and diabetes, make this a more desirable approach.

**Methods**

A retrospective review of all patients that underwent a proximal row carpectomy (PRC) at the Richard Roudebush VA medical center by a single surgeon from 2007-2015 was conducted. Data including demographics, co-morbidities, tobacco use, wrist excursion, complications and length of follow up was obtained and analyzed.

**Results**

Thirteen patients were identified with an average of 54.5 years. Of these patients, 46.2% were active smokers and 23.1% had diabetes mellitus. Indications for the procedure were a SLAC wrist in 6 patients, Kienbock’s disease in 3 patients, SNAC wrist in 2 patients, a distal radius malunion patient and a scaphotrapezotrapezoidal (STT) arthritis patient. Average follow up was 29 months. All patients reported pain relief with limited functional deficits, with an exception of one patient who experienced persistent pain and loss of wrist excursion secondary to non-compliance with postoperative care. Average post-operative wrist excursion was 53° and 84.6% of patients returned to full work duty.
Summary Points
Proximal row carpectomy is an effective procedure to reduce pain and maintain functionality in patients with a mechanical cause of arthritis. Unlike fusion procedures, this provides a dependable surgical approach for active smokers. This series demonstrates the utility of PRC for smokers with chronic wrist pain and comorbidities.
Poster 13: How Do Trauma Surgeons Treat Distal Radius Fractures?

Category: Wrist

Evaluation/Diagnosis; Treatment
N/A - not a clinical study

Ugochi Okoroafor, MD

Hypothesis
Orthopedic trauma surgeons generally adhere to the American Academy of Orthopedic Surgeons (AAOS) Clinical Practice Guidelines (CPG) and Appropriate Use Criteria (AUC) for treatment of distal radius fractures.

Methods
An online survey was distributed via the Orthopaedic Trauma Association (OTA) website and email database. Information collected included demographic information, general management questions, and case based questions. For all cases, surgeons were asked to select their treatment of choice given the same fracture in a 25-year-old patient and a 65-year-old patient. Case 1 was an extra-articular distal radius fracture with apex volar angulation. Case 2 was a displaced radial styloid fracture. Case 3 was a comminuted intra-articular distal radius fracture with radiocarpal subluxation. Case 4 was an intra-articular distal radius fracture with dorsal comminution. Case 5 was a die punch intra-articular distal radius fracture. Results were compared between surgeons with 10 years of experience.

Results
There was a total of 51 survey respondents. 45% had 10 years in practice. 41% were employed in an academic setting, 29% were private practice, and 29% were hospital employees. All respondents reported routine use of preoperative radiographs, while 26% reported routine use of preoperative computed tomography (CT) scans. All routinely used postoperative radiographs. 73% reported that they perform operative fixation of associated ligamentous injuries at the time of distal radius fracture fixation. None used wrist arthroscopy or fixed associated ulnar styloid fractures. In the immediate postoperative period, 69% reported no allowance of range of motion. 20% reported routine use of Vitamin C for CRPS prophylaxis postoperatively. 59% reported routine use of physical and/or occupational therapy postoperatively. For case-based scenarios, respondents generally tended towards operative fixation in younger patients compared to older patients with the same fracture type. Surgeons with 10 years in practice varied significantly in terms of preoperative imaging and operative fixation of associated ligamentous injuries.
Summary Points
• Orthopedic trauma surgeons generally followed accepted AAOS treatment guidelines.
• Differing practices between surgeons with 10 years in practice may be reflective of what is currently taught in residency training programs.
• A future direction for this study will be to examine management trends among hand surgeons in comparison to orthopedic trauma surgeons.

Bibliography

Images
Poster 14: External Fixation for Distal Radius Fractures: Not as Bad as it Looks

Category: Wrist

Treatment;Prognosis/Outcomes;Residents/Fellow/Educator Resources
Level 2 Evidence

Bryan D. Brown

Hypothesis
Operative treatment of distal radius fractures has been trending towards open reduction internal fixation with the advent of volar locked plating promising fewer complications. However, this study aims to compare the clinical and radiographic outcomes of volar locked plating versus external fixation.

Methods
Medline, Scopus and Embase searches were completed using key words “distal radius fracture, volar locked plating, external fixation, and wrist fracture” in solitarily and in combination with appropriate MeSH terms. 1,472 abstracts were produced. Only randomized controlled trials or meta-analysis of randomized controlled trials specifically mentioning volar locked plating were included. Study quality was maintained using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist. Papers were divided into clinical outcome, radiographic outcome, length of follow-up, complications, and sample size. Clinical outcome was further divided into the type of clinical instrument used, range of motion, grip strength, and return to work. Radiographic outcome was divided into volar tilt, radial height, and ulnar variance.

Results
21 papers met the studies conclusion criteria. Clinical outcome measures at 3-6 months post-operatively more often favor volar locked plating with stronger grip strength, higher Mayo wrist scores and self-reported mental physical and social health on SF-36 questionnaires. After 12 months the clinical differences in most studies were insignificant. Current studies report contradictory results in regard to radiographic outcomes, ranging from superior radiographic outcomes in volar locked plating to no difference between treatment. Higher incidence of superficial infections and superficial radial nerve injury in external fixation group. High incidence of re-operation rate and median nerve injury in volar locked plating.
Summary Points
• Clinical outcome measures suggests that while patients may benefit from volar locked plating in the short term recovery phase of treatment, there may be no clinically relevant difference in the long term.
• Radiographic outcomes and loss of reduction were similar in both groups in most studies.
• Complications of either treatment method were often equal in frequency; however, variable in nature.

Bibliography
Poster 15: Incidence of Distal Radioulnar Joint Malreduction Following Operative Fixation of Distal Radius Fractures: Are We Missing Something?

Category: Wrist

Evaluation/Diagnosis; Surgical Technique; Anatomy

Level 4 Evidence

James Eric Neal, MD
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Hypothesis

Open reduction and internal fixation of distal radius fractures is one of the most common procedures performed in orthopedics. Universally, great care is taken to obtain anatomic reduction of the radiocarpal joint in order to prevent intraarticular incongruities and subsequent postoperative pain or disability. However, reduction of the sigmoid notch is not typically given the same degree of scrutiny intraoperatively. This study aims to determine the incidence of distal radioulnar joint malreduction after fixation of intraarticular distal radius fractures and if imperfect reduction of the sigmoid notch be detected on routine intraoperative fluoroscopy.

Methods

Using a database of 37 wrist fractures collected at a level 1 trauma center between 2013-2014, two examiners compared intraoperative fluoroscopic images to postoperative CT studies to determine if radiographic signs of sigmoid notch malreduction could be discovered during surgery.

Results

Of 37 wrist fractures reviewed, 5 (13%) revealed sigmoid notch malreduction or intraarticular stepoff, defined as greater than or equal to one millimeter on CT scan, that were not readily apparent on intraoperative fluoroscopy. An additional 7 cases (19%) were noted to have sigmoid notch incongruity both on intraoperative fluoroscopy and postoperative CT. A total of 12/37 (32%) cases had malreduction of the DRUJ.

Summary Points

- Routine fluoroscopy during ORIF of distal radius fractures can detect a significant number, but not all DRUJ malreductions.
• Increased attention should be paid to the anatomic, concentric reduction of the DRUJ during distal radius ORIF.
• Clinical correlation however, still is required to assess true impact on quality of life.
Poster 16: Proximal row carpectomy versus standard operative treatment of acute perilunate dislocations and fracture dislocations: A Systematic Review

Category: Wrist

Treatment; Prognosis/Outcomes
Level 4 Evidence

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Barry Claman
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Hypothesis
Perilunate dislocations (PLD) and perilunate fracture dislocations (PLFD) are high-force injuries that frequently result in chronic pain and reduced motion despite prompt treatment. These sequelae of PLD/PLFD may necessitate a salvage procedure like proximal row carpectomy (PRC). We hypothesize that range of motion outcomes from standard treatment of PLD/PLFD are equivalent to outcomes from PRC. It may be reasonable to treat selected patients with PLD/PLFD with PRC in the acute setting in lieu of standard open reduction techniques.

Methods
Three systematic reviews were conducted. The first was designed to characterize range of motion outcomes after standard operative treatment of acute PLD/PLFD. A second review characterized outcomes after PRC done for any reason. Finally, a third review identified reports of PRC performed acutely as treatment for PLD/PLFD. For each review, a meta-analysis was attempted to obtain pooled estimates of average postoperative wrist flexion/extension arc. Flexion/extension arcs were compared between study groups using meta-regression.

Results
Our review of standard operative treatment of PLD/PLFD identified 179 articles. Of these, 8 met inclusion criteria for our quantitative analysis. Pooled average postoperative flexion/extension arc across these studies was 104 degrees (range 89-125, 95% CI 101-107). I2 analysis revealed significant heterogeneity among the studies.
Our review of studies reporting outcomes of PRC done for any reason identified 135 articles. Of these, 24 met inclusion criteria for our quantitative analysis. Pooled average postoperative flexion/extension arc across these studies was 74 degrees (range 50-109, 95% CI: 73 – 76). I2 analysis again revealed significant heterogeneity among these studies.
Meta regression showed no significant difference in wrist flexion/extension arc between the treatment groups, standard treatment of PLD/PLFD versus PRC done for any reason (104 degrees v. 74 degrees, p=0.13) though the significant heterogeneity within each group made this comparison uninterpretable.

Our review of studies reporting PRC used as acute treatment for PLD/PLFD identified 28 studies. Of these, 13 met criteria for inclusion in our qualitative analysis. Four were case reports, and 9 studies were case series. These studies reported a total of 38 patients undergoing PRC in the acute setting. Followup in these reports was generally poor with little data on complications and outcomes.

**Summary Points**
- Studies reporting outcomes from both standard treatment of PLD/PLFD and PRC are mostly case series
- These studies are heterogenous, making a comparison of outcomes difficult
- PRC has been reported as a treatment method for PLD/PLFD, though outcomes data and follow up in these studies are lacking
Poster 17: Management of Forearm Fractures Secondary to Civilian Low Velocity Gun Shot Injuries: Locked Bridge Plating with Limited Debridement

Category: Elbow/Forearm/Shoulder

Prognosis/Outcomes
Level 4 Evidence

Ryan Kozlowski, MD
Petra Gheraibeh
Rahul Vaidya

Hypothesis
Open forearm fractures secondary to civilian gun shot wounds treated locked bridge plating and local wound care and intravenous antibiotics leads to similar outcomes compared to those treated with more extensive irrigation and debridement with internal fixation.

Methods
A retrospective review of 65 consecutive patients with displaced and/or comminuted fractures of the forearm secondary to gunshot injuries was conducted. There were 62 males and 3 females with an average age of 27.7 years. There were 31 radius fractures, 28 ulna fractures and 6 both bone forearm fractures. Treatment included 48 hours of prophylactic intravenous antibiotics in all patients. Thirty patients had fracture stabilization using a locked bridge plate and minimal local debridement of the wounds consisting only of excision of visible necrotic tissue. The remaining 35 patients had formal irrigation and debridement of skin, subcutaneous tissue, muscle, and bone followed by open reduction and internal fixation of the fracture.

Results
Fifty-eight patients managed operatively required one surgery while seven patients required multiple surgeries for soft tissue management. Twenty-nine patients treated with locked bridge plating displayed fracture healing at last follow up. One patient required revision surgery for delayed union. All thirty five patients with formal irrigation and debridement and plating showed evidence of healing at final follow up. There were no signs of infection or osteomyelitis in any patient at final follow up.

Summary Points
• Forearm fractures caused by low velocity civilian gunshot wounds are usually comminuted single bone injuries
• Treatment with locked bridge plating and minimal debridement resulted in a high rate of union and low infection rate
• Extensive open debridement to bone may not be necessary in order to achieve union and prevent infection for open forearm fractures secondary to low velocity gun shot wounds
• This largest reported case series confirms that locked bridge plating with minimal debridement and intravenous antibiotics is a suitable option for the treatment of forearm fractures following low velocity gun shot injuries

Bibliography

Images
Poster 18: Analysis of Factors Associated with Failed Treatment of Lateral Epicondylitis in a Referral Hand Surgery Practice

Category: Elbow/Forearm/Shoulder

Evaluation/Diagnosis; Prognosis/Outcomes
Level 4 Evidence

James Deal, MD
Gary Lourie, MD

Hypothesis
Lateral epicondylitis is a common malady seen with nonoperative, and if needed, operative, treatment successful over 90% of the time. However, a number of patients continue to have symptoms with referral to a hand surgeon’s practice a necessity. We hypothesize that failure of both nonoperative and operative treatment is most commonly due to inability to identify coexisting pathologies. Recognition and treatment of these diagnoses is essential to achieve satisfactory outcomes in failed lateral epicondylitis.

Methods
Twenty-five consecutive patients referred to a single hand surgeon’s practice with a diagnosis of failed treatment of lateral epicondylitis (nonoperative and operative) comprise the data base in this study. Age, side involved, inciting activity, concomitant diagnoses, particular treatment, reason for referral, and pertinent findings in coexisting conditions form the basis of the analysis. Ultimate surgical findings to explain failure in all 25 cases is presented. Long-term results of surgery is part of a separate study.

Results
Average age was 43.1 yr, male/female ratio 0.8, with the dominant extremity involved 79% of the time. Of the 25 referred patients, 21 (84%) were referred due to failed conservative treatment and/or confounding diagnoses. Four (16%) were referred due to failed primary surgery. Of the 21 (84%) failed nonoperative patients, 10/21 (48%) were ultimately diagnosed by the senior author to have coexisting radial tunnel syndrome. Diagnosis was confirmed with dedicated attention to physical exam along with diagnostic selective injections and monitored patient response. Nerve studies were not confirmatory, being normal in 9/10 cases used. Of these 21 referred patients, surgical relief was achieved with primary surgical debridement of the ECRB (Nirschl) in 11 (52%), while 10 (48%) required combined debridement of the ECRB and radial tunnel release.

Of the 4 failed operative patients referred (16%), 2 were found to have inadequate debridement, 1 failed radiofrequency ablation with need for anconeus arthroplasty, and 1 failed
epicondylectomy resulting in posterolateral instability and synovial fistula requiring reconstruction.

Summary Points
• Lateral Epicondylitis seen in a hand surgeon referral practice presents with distinct and important differences
• While reported coexistence of lateral epicondylitis and radial tunnel syndrome is 5%, in this series it was as high as 48% and even higher when failed operative cases were included
• Failure to identify this in nonoperative cases will lead to failure. Attention to exam, selective injections, and history of worsening symptoms with use of counterforce bracing are key

Bibliography

Images
Poster 19: Outcome Measures Utilized in Capitellum and Trochlea Fracture Literature: A Systematic Review

Category: Elbow/Forearm/Shoulder

Prognosis/Outcomes
N/A - not a clinical study

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Kelly Mamelson, BS
Bradley Schoch, MD
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Joseph John King, MD

Hypothesis
We hypothesize that there is limited reporting of outcome measures used to evaluate the management of capitellum and trochlea fractures in the current literature. Secondly, we hypothesize that higher-level journals will report higher number of outcome measures compared to lower-level journals.

Methods
A systematic review of capitellum and trochlear fractures was performed to identify all English language articles assessing capitellum and trochlea fractures published since 01/01/2006 in PubMed and World of Science databases. Exclusion criteria included: review articles, meta-analyses, surgical technique articles, and biomechanic/anatomic studies. Included studies were reviewed for patient demographics and reports of range of motion, outcome measures utilized, satisfaction rate, return to previous level of activity, complication rates, and reoperation rates. Different outcome measures used were reviewed and compared to journal rank, number of fractures, and continent of study. Statistical analysis was performed with an unpaired t-test for continuous variables and Fisher exact test for dichotomous variables.

Results
The initial search identified 285 articles, with 46 meeting inclusion criteria. The mean number of capitellum and/or trochlea fractures per study was 11.2 with mean patient age of 34.8 years. Average follow-up per study was 29.8 months (range 3-59 months). Eight different outcome measures were used with the most commonly reported being MEPS (50% of studies), DASH (17%), and ASES (15%) scores. An average of 1.09 outcome measures were reported per study. Fourteen studies (30%) reported no outcome scores; eight of these were case reports. Satisfaction rate was reported in only 15% of studies. Larger studies (=5 elbows) were associated with an increased number of outcome measures used compared to smaller studies with =1 had
more patients (14 vs 7.5, p=0.04), higher number of reported outcome scores (1.4 vs 0.8, p=0.04), higher use of the MEPS (66% vs 33%, p=0.04), and slightly higher reporting of satisfaction and complication rates (not statistically significant) compared to studies with a journal ranking ≥5 fractures reported a higher number of outcome scores.
**Hypothesis**

The ExploR™ Modular Radial Head Arthroplasty system by Biomet provides short and mid-term results comparable to other previously described systems.

**Methods**

Between 2008 and 2016, thirty-seven patients were treated with the ExploR™ system for unreconstructable radial head fractures, thirty-four of which met criteria for inclusion in our prospective cohort study. Functional and radiographic outcomes were obtained up to a mean follow-up of 20 months (range, 3 – 94 months), with eleven patients having follow-up ≥2-years (mean, 44 months; range, 26 – 94 months).

**Results**

For the eleven patients with greater than 2-years of follow up, the mean DASH score was 15.6 (range, 0 – 56.8), and the mean Mayo Elbow Performance Score was 88.6 (range, 70 – 100), with 5 excellent results, 5 good, and 1 fair. Mean results for flexion were 132 degrees (range, 115 – 140 degrees), extension deficit of 20 degrees (range, 0 – 40), pronation of 72 degrees (range, 50 - 85), and supination of 73 degrees (range, 30 - 90). Outcomes for the eleven patients with ≥2 years follow-up were not statistically different than the outcomes for all patients. Four patients needed revision surgeries: one seroma evacuation, one revision ulna fixation, and two capsular releases. Radiographic abnormalities were not associated with clinical outcomes.

**Summary Points**

- The ExploR™ Modular Radial Head Arthroplasty system by Biomet is a frequently used system, yet clinical outcomes have never been reported.
- DASH scores and Mayo Elbow Performance scores were comparable to previously described results for other radial head arthroplasty systems.
- Complications and need for revision was rare, and not associated with any patient, injury, or radiographic factors.
Poster 22: Development of Bilaterality in Pediatric Trigger Thumb

Category: Pediatrics/Congenital/Nerve

Evaluation/Diagnosis; Treatment; Prognosis/Outcomes
Level 4 Evidence

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Hypothesis
Pediatric trigger thumb is a common condition that can occur bilaterally; we hypothesized that the majority of patients with bilateral trigger thumbs would initially present to the pediatric hand clinic with bilateral involvement. Of those patients who subsequently develop bilateral trigger thumb, we hypothesized that they would develop bilateral involvement within 6 months after initial presentation.

Methods
This was a retrospective chart review of patients diagnosed with pediatric trigger thumb from 2008 to 2016 at a large pediatric hospital. The primary objective was to determine the timing of development of contralateral trigger thumb. The secondary objective was to determine if there were any risk factors for bilateral involvement. Data collected included age at presentation and onset, laterality, age and timing of onset of contralateral symptoms, time of index procedure and subsequent procedure (if any), severity of symptoms, previous treatments, range of motion, and birth history. Inclusion criteria were patients diagnosed with pediatric trigger thumb(s). Exclusion criteria were prior injuries to, or surgeries involving, the thumb; severe medical co-morbidities; and incomplete data.

Results
There were 198 cases of trigger thumb identified with 50 patients (25.25%) having bilateral involvement. Of the patients with bilateral trigger thumbs, 94% presented to the pediatric hand clinic with bilateral involvement. Three (1.52%) total patients were diagnosed with contralateral trigger thumb after initial presentation to the hand surgeons with unilateral trigger thumb. The average time to contralateral trigger thumb development was 13.7 months after presentation with unilateral trigger thumb. Two of these patients developed contralateral symptoms in less than 9 months. Of the 3 patients that developed contralateral trigger thumbs, 1 required a second surgery after the index procedure was performed on the contralateral hand. Nearly all patients presented with a locked flexion contracture with a palpable Notta’s nodule. Surgery
universally resulted in resolution of the trigger thumbs symptoms. No risk factors for bilaterality were identified.

Summary Points
• 25% of pediatric patients with trigger thumb had bilateral involvement
• The vast majority (94%) of patients with bilateral trigger thumbs presented to the pediatric hand surgeon with bilateral involvement
• Only 1.52% of patients developed bilateral trigger thumb after initial presentation with unilateral trigger thumb
• Patients that developed contralateral trigger thumb after initial presentation did so on average of 13.7 months

Bibliography
Images
**Poster 23: Anesthetic Neurotoxicity in Congenital Hand Surgery: What Do We Know and How Do We Counsel Parents?**

*Category: Pediatrics/Congenital/Nerve*

Michael Steven Gart, MD  
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Joshua M. Adkinson, MD

**Hypothesis**

Children with congenital hand differences (CHD) often require one or more surgical interventions at an early age to optimize upper extremity function. In light of a growing body of evidence suggesting potential detrimental effects of general anesthesia exposure in developing children, we sought to determine whether changes in the surgical timing of CHD correction might be warranted and review the available evidence for anesthetic neurotoxicity to guide discussions with caregivers.

**Methods**

A literature review was conducted to determine the following: (1) Are the currently practiced surgical timelines for reconstruction of CHD developmentally appropriate? (2) What is the available evidence regarding the safety of general anesthesia in developing children? (3) What can we tell caregivers when recommending surgery for correction of CHD? Motor developmental timelines and recommended stages of CHD reconstruction were compared for congruency and considered in the context of the available anesthetic neurotoxicity evidence.

**Results**

(1) Current clinical practice aims to intervene early to reconstruct CHDs that will significantly alter anatomy or leave lasting or irreversible deformity and delay reconstruction when possible. The timelines appropriately incorporate motor developmental milestones in surgical planning. (2) Multiple animal studies have demonstrated widespread neurotoxicity following administration of common general anesthesia medications. Much of the literature in humans is limited to observational or cohort studies. The PANDA study and the interim analysis from the GAS trial have both failed to find a correlation between general anesthesia exposure in developing children and cognitive function later in life. Final results from the GAS and MASK studies have yet to be published. (3) Resources are available for parents seeking additional information about the potential deleterious effects of general anesthesia in children.
Summary Points
- The currently accepted timelines for reconstruction of CHD are developmentally appropriate and do not warrant change based on the available evidence.
- Despite a large body of evidence documenting neurotoxicity and adverse neurodevelopmental outcomes in multiple animal models, the relationship between anesthesia exposure and cognitive function in humans remains unknown.
- Several trials are underway that should better inform discussions with caregivers when recommending surgical correction of CHD.

Bibliography
Poster 24: Incidence and Surgical Management of Syndactyly

Category: Pediatrics/Congenital/Nerve

Evaluation/Diagnosis; Treatment
Level 4 Evidence

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Hypothesis
Although syndactyly is considered to be the most common congenital limb anomaly, there is a paucity of epidemiologic studies focusing on its incidence and surgical management. In this study, we describe the incidence of syndactyly using a population-based database, and we describe the surgical management of these children.

Methods
A retrospective study was conducted using the Statewide Planning and Research Cooperative System (SPARCS). We identified all patients born between 1997 and 2014 in the state of New York with an ICD-9 code for the diagnosis of syndactyly. We compared these totals to the total number of births in New York State for each year in order to determine annual incidence. Patients with syndactyly were followed longitudinally to determine the age at the time of surgical correction, gender, institution where surgery was performed (teaching versus non-teaching), surgeon specialty, and insurance status. Descriptive statistics and univariate analyses were used.

Results
There were 3417 reported patients with syndactyly between 1997 and 2014 in New York State. The mean annual incidence was 0.081%, which equates to 2 cases per 2500 live births. Of these patients, only 203 (6%) patients had surgical management in New York State, and 82% of patients were under the age of two at the time of surgery. Approximately 72% of surgeries were performed at teaching hospitals, and 54% of procedures were performed by orthopaedic surgeons. Female patients were more likely to have surgery in New York state compared to male patients (p = 0.02). Similarly, patients from more deprived communities and patients with state insurance were more likely to have surgery in New York State compared to patients from less deprived communities and patients with private insurance, respectively (p < 0.05).
**Summary Points**

- The incidence of syndactyly is relatively high for congenital limb anomalies.
- The majority of patients that undergo surgical management are under the age of 2.
- There are several barriers to care including the availability of orthopaedic surgeons, access to teaching hospitals, patient gender, socioeconomic background, and insurance status.
- The low number of patients treated in New York State raises concerns regarding adequate access to care for this common condition.

**Bibliography**

Poster 25: Use of BMP/Allograft Reconstruction in Hypoplastic Digits

Category: Pediatrics/Genital/Nerve

Treatment; Surgical Technique
Level 4 Evidence

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Gary Lourie, MD

Hypothesis
Patients with unstable hypoplastic digits, as seen in symbrachydactyly and congenital band syndrome, can have poor function of the involved digits because of instability with pinch and manipulation of objects from the unstable soft tissue elements. We hypothesize that reconstruction with allograft bone (Plexur ®) augmented with BMP-2 (Infuse ®) for unstable fingertips with good soft tissue envelopes provides a stable base for prehensile activities and avoids donor site morbidity of autograft harvest.

Methods
We outline the technique used to reconstruct unstable fingertips in pediatric patients with adequate soft tissue but inadequate bone stock for stable prehensile activities. Outcomes, complications, incorporation of the graft, and manual ability scales were retrospectively reviewed.

Results
To date ten procedures have been performed in eight thumbs and 2 index fingers. There have been no major complications. One finger had a transient inflammatory reaction consisting of hyperemia and edema. All patients developed clinically stable digits for use in prehensile activities after placement of allograft augmented with BMP-2. Improvements were seen in post-operative ABILHAND-Kids questionnaire.

Summary Points
• Though not all of the digits have shown incorporation of the BMP/Plexur construct, all have resulted in improved pinch mechanism and maintained pulp stability
• It is hoped that with refinement of the technique as seen in later cases, the allograft construct will be replaced by host bone and create a platform that could be lengthened
• Allograft augmented with BMP-2 avoids donor site morbidity associated with autograft use
• Allograft augmented with BMP-2 is a surgical option for stabilization of unstable hypoplastic digits seen in symbrachydactyly and constriction band syndrome
• Use of BMP-2 in pediatric patients is off-label and contraindicated according to the manufacturer, and parents must be disclosed of its use

Bibliography
Images
Poster 26: Global brachial plexus birth palsy, a cohort analysis

Category: Pediatrics/Congenital/Nerve

Evaluation/Diagnosis; Treatment; Prognosis/Outcomes
Level 4 Evidence

Katherine Celeste Faust, MD
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Hypothesis
Children born with global brachial plexus birth palsy (BPBP) are generally held to have a poor prognosis. The problems that these children face are distinct compared to Erb’s (C5-6) palsy, and previous publications recommend early operative intervention.

Methods
Practice records were audited for pediatric patients with an ICD-9 of 767.6. Only patients with a global BPBP with greater than 12 months of follow-up are included. In addition to serial examination, these babies underwent chest fluoroscopy to evaluate the phrenic nerve. Active movement scales were available at intermittent therapy visits.

Results
Eleven patients, five females and six males, met inclusion criteria. Average age at presentation was 81 days with gestational age at birth from 32 to 41 weeks. Nine of eleven were reported to have difficult deliveries, with two humeral fractures diagnosed shortly after birth and three requiring NICU stays. Four patients had Horner’s syndrome; none had evidence of ipsilateral hemidiaphragmatic paralysis or paradoxical diaphragmatic motion. All children presented with supple arms, but no active motion. Two patients did not have nerve exploration: one recovered to an Erb’s palsy appearance by age of four months and one showed 90 degrees active elbow flexion by six months of age. Nine patients underwent microsurgical exploration at an average of 5.7 months of age (range 2.9-9.1 months) with an average of 6.5 cm of allograft nerve used per case. One case was aborted intraoperatively after a subclavian vein injury. Three patients underwent nerve transfers at a second procedure. Two patients had modified Hoffer transfers as toddlers. Four of the surgical patients showed self-mutilating tendencies as toddlers with two also demonstrating learned disuse. Active motion scales showed a significant drop from preoperative to immediately postoperatively, both in the nerve root distributions that were grafted and those that were not explored, but some recovery was seen long term, suggesting the reconstructions healed. The best outcomes were seen in patients who underwent nerve
transfers. Despite full passive motion at presentation, elbow flexion contractures developed as biceps function returned. One patient developed posterior subluxation of the glenohumeral joint, diagnosed 1 year after surgery.

**Summary Points**
- Full passive shoulder motion at presentation, self mutilation, and learned disuse are unique characteristics we have seen in our global brachial plexus palsy patients.
- Families of global brachial plexus patients should be counseled that the affected extremity might require multiple surgeries

**Bibliography**

Images
Poster 27: Treatment of Madelung’s Disease with Vicker’s Ligament Release: A Case Series

Category: Pediatrics/Congenital/Nerve

Treatment; Surgical Technique; Prognosis/Outcomes

Level 4 Evidence

Jeffrey E. Otte, MD
James E. Popp
Julie Samora, MD

Hypothesis
We hypothesize that early treatment of Madelung’s deformity with Vicker’s ligament release minimizes progression of deformity and may prevent the need for future surgeries.

Methods
A retrospective review was performed at a single large pediatric institution from 2013 to 2016 for patients with a diagnosis of Madelung’s deformity treated with Vicker’s ligament release. The inclusion criteria included skeletally immature patients with Madelung’s deformity who underwent Vicker’s ligament release by one of two fellowship-trained hand surgeons. Exclusion criteria included patients who were skeletally mature, underwent osteotomy procedures, or had incomplete follow-up. Patient demographics were collected, concomitant surgeries were recorded, and outcomes including range of motion (ROM) and pain were documented. Standard anterior-posterior and lateral radiographs were studied pre- and post-operatively to monitor radiographic deformity and progression.

Surgical technique included a volar wrist approach with elevation of the pronator quadratus muscle. The thickened Vicker’s ligament was identified, elevated, and completely resected from proximal to distal. If a physiolysis was performed, intraoperative fluoroscopy was utilized to aid in the identification of the abnormal physis. Resection proceeded until normal physis was encountered clinically, and then local fat graft was interposed.

Results
Retrospective review identified six female patients with bilateral Madelung’s deformity who underwent bilateral Vicker’s ligament resection (12 total wrists). The average age of presentation was 7.5 years, with an average follow-up of 22 months. Only one patient had a family history. Reasons for presentation included sports injuries (2), ulnar-sided wrist pain (2), and mild deformity (2). Radial physiolysis was performed in 10 wrists, radial epiphysiodesis was performed in two wrists, and ulnar epiphysiodesis was performed in two wrists.
All patients were immobilized for four weeks post-operatively. There were no intraoperative complications. Pain resolved within the first one month after surgery for all patients, and all patients returned to their pre-surgery activities. There was no loss of ROM, and four wrists with pre-operative supination deficits improved by an average of 17 degrees. Radiographic measurements were used to objectively monitor progression or improvement of the deformity following surgery. Minimal to moderate improvement in the radial physeal angle was seen in all patients. No patients displayed significant progression of the deformity. Two patients underwent subsequent procedures to supplement the benefit of the initial procedures.

Summary Points
- In patients with early Madelung’s deformity, Vicker’s ligament release is a safe treatment option that may minimize progression of deformity.
- This technique may lead to future research in preventing future surgeries for this patient population.

Bibliography

Images
Poster 28: Identifying Patients with Concomitant Cubital Tunnel Syndrome and Carpal Tunnel Syndrome

Category: Pediatrics/Congenital/Nerve

Evaluation/Diagnosis
Level 4 Evidence

Brandon S. Shulman
Siddharth Mahure
Lorraine Hutzler
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Hypothesis
The incidence of concomitant Carpal Tunnel Syndrome (CTS) and Cubital Tunnel Syndrome (CuTS) has not been clearly defined. Our hypothesis is that patients with CuTS commonly also have CTS. Lack of awareness of this association increases the risk of missing a concomitant CTS. The aim of this study was to determine the incidence of concomitantly treated cubital and carpal tunnel syndromes by retrospectively reviewing patients from a large academic medical center and the New York Statewide Planning and Research Cooperative System (SPARCS) patient database.

Methods
We retrospectively reviewed 3052 consecutive patients who underwent surgical treatment for CTS or CuTS at our tertiary care institution over a 5-year period. We then used the SPARCS database to search for every patient that underwent operative treatment for CuTS or CTS from 2003 – 2014 (84,829 patients) in New York State. Statistical analysis was performed to determine how many individual patients with CuTS were also treated for CTS per year for both our institution and on a statewide level. Subgroup analyses for age and gender were performed.

Results
21% of patients surgically treated for CuTS at our institution from 2011-2016 also underwent concurrent ipsilateral carpal tunnel release (range 16-28%). In New York State, the number of patients receiving surgical treatment for CTS and CuTS ranged from 23% in 2003 to 45% in 2014 - an increase of 700% (p=<0.001). Patients treated surgically for concomitant CuTS and CTS were significantly older than patients treated for isolated CuTS (54.8 years old versus 46.4 years old, p=<0.001). Males were more likely to have either surgically treated CuTS (54.7%, p=<0.001) or concomitant CuTS and CTS (55.3 %, p=<0.001) but consisted of only 33.3% of those surgically treated for CTS alone.
Summary Points

• Approximately one quarter of patients requiring surgical treatment for cubital tunnel syndrome undergo concomitant carpal tunnel release.
• Possible explanations for this include: improved diagnosis, over-diagnosis/treatment, or increased willingness to perform concurrent releases.
• While all patients with CuTS should be screened carefully for CTS, male patients over age 50 presenting with symptoms of CuTS have the highest risk of concomitant CTS and should be examined with extra vigilance.
Hypothesis
Mechanical finger injuries are a common reason for pediatric acute care evaluation. Only a portion of injuries are fractures or need surgery. Previous studies have reported the epidemiology of fractures specifically, or injuries requiring surgery, while larger studies rely on primary providers to accurately code injury patterns. The average fracture rate and distributions across the hand using the denominator of all mechanical finger injuries on initial presentation have not been previously well-described.

Methods
We performed a retrospective chart review of all emergency and urgent care visits from 2013 at a major US pediatric tertiary referral hospital and satellite clinics. We reviewed all visits with hand or finger injuries recorded in the chief complaint, or by ICD code. Age, gender, injury laterality, finger segment, mechanism, delays in presentation and rates of correct ICD coding were recorded in addition to other variables. We excluded simple lacerations, cellulitis, non-pediatric patients and visits for other primary complaints.

Results
Nearly 1% of all visits were for mechanical hand trauma. 41% were female, 59% male. Average age was 9.1 (8.5 female / 9.5 male; 35% 0-6, 39% 7-12 and 26% 13-18 years old). Injury mechanism was not correlated with gender and was distributed as: 42% crush, 19% jammed, 11% impact, 10% fall on outstretched hand, 7% hyperextension, 1% twisting, 10% other/unclear. Notably, crush resulted in fractures only 25% of the time, independently of age, while other mechanisms were higher at 51%. Crush was responsible for 75% of injuries age 0-6, but only 14% of age 13-18. Average delay from injury to presentation was 1.26 days and was not correlated with age or fracture presence. Ulnar digits were more likely to be fractured after injury (59% vs 40%). Border digits (Th and SF) were injured more often than others(26% vs 14-18%). For border digits, most fractures were in the proximal phalanx (60% vs 23% for nonborder digits). Providers correctly coded 96.2% of fractures, but only 34% of injury codes and 14% of fracture codes were digit-specific.
Summary Points

Pediatric finger injuries frequently utilize emergency care. Injuries occur more often in males and in the border digits while injury mechanism and finger injured affect fracture rates. ICD coding is often nonspecific for injury patterns. Understanding the basic epidemiology of pediatric finger injuries can guide resource utilization and set the groundwork for future studies on optimal treatment algorithms in the urgent and primary care setting.
Poster 30: Pediatric Upper Extremity Holiday Related Injuries: Patterns of Injury at a Level 1 Trauma Center

*Category: Pediatrics/Congenital/Nerve*

Evaluation/Diagnosis; Patient Education
Level 3 Evidence

Simon Ivey
Eric Wenzinger
Fernando A. Herrera, Jr.

**Hypothesis**
The purpose of this study was to review a single Level 1 Trauma center’s experience of pediatric upper extremity holiday related injuries, and to identify the specific patterns of injury and etiologies.

**Methods**
A retrospective chart review of all pediatric patients presenting to a Level 1 pediatric emergency room with upper extremity injuries sustained during major and minor holidays were identified. ICD-9 codes specific to the upper extremity were used to identify these injuries. All patients younger than 19 years-old were included in the study. Patients presenting on major and minor holidays, including the day before or after, and any associated weekend were identified. Major holidays included as New Year’s Eve, New Year’s Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving, Christmas Eve, and Christmas Day. Minor holidays included Easter, St. Patrick’s Day, Mother’s Day, Father’s Day, and Halloween. The patient demographics, mechanism of injury, level of injury, length of hospital stay, surgeries, day of injury, time of injury, associated injuries, and insurance status were recorded and analyzed.

**Results**
All pediatric emergency room visits from January 2004 to January 2014 presenting to a Level 1 Trauma Center were reviewed. Of the 1, 680 patients identified, 128 patients were noted to have sustained upper extremity injuries associated with a major or minor holiday. There were 76 males and 52 females identified. African-American males and Caucasian males were tied for the most common populations to present with a holiday related injury (30%). The most common injuries sustained were fracture (46%), infection (17%), and contusion (12%). The most common etiologies of injury were fracture of the distal radius with ulna or wrist involvement and infection of the nail or hand. Most upper extremity related injuries occurred over the Labor Day holiday (19%) with the Memorial Day holiday as the second most common (11%). There were 6 cases of amputation of the finger related to an injury sustained during a major or minor holiday.
Summary: The incidence of pediatric upper extremity holiday related injuries were 7.6%. The majority of injuries occurred in males. Fractures to the radius, ulna or wrist were the most common injuries followed by infection of nail or finger. The most frequently involved holiday was Labor day. For pediatric patients, the holiday season can be a significant catalyst for injury and education on safety can be an important method of prevention.

Bibliography
Hypothesis
Treatment of neuromas of the hand is important, as they can be painful and lead to inability of patients being able to perform activities of daily living. Traditionally if the nerve cannot be repaired, the neuroma is resected and the proximal stump is transposed into muscle or under fascia. We present our case series of neuroma transpositions into muscle and bone.

Methods
Patients who had undergone neuroma transposition were identified from a senior hand surgeon’s logbook and data was collected using the Electronic Document Management System (EDMS). Data collected included patient demographics, hand dominance, occupation, aetiology, symptoms, procedure performed and post-operative outcome.
Transposition of proximal nerve end into muscle involved burying the nerve end directly into a muscle pocket and securing with 8-0 Ethilon. Coverage with tissue and skin closure was performed using 5-0 Vicryl rapide.
Transposition of proximal nerve end into bone involved using a burr of size 2-2.5mm and burring into the medulla of the phalanx, insetting the nerve end into the recess under no tension and securing it with 8-0 Ethilon suture. Coverage with tissue and skin closure was performed using 5-0 Vicryl rapide.

Results
Nine patients underwent neuroma transposition from February 2012 to September 2016. Four patients suffered with amputations/terminalisations and 5 patients with lacerations. All suffered with trigger points of pain. Three neuromas were transposed into muscle, 1 patient required a posterior interosseous nerve graft and 5 neuroma’s were transposed into bone. Two patients from the muscle transposition group required a re-exploration + further transposition. One patient from the bone group required re-exploration and re-inset of the neuroma end into the bone. Three patients (2 from muscle group and 1 from bone group) remained sensitive but improved with post-operative desensitisation exercises. All patients remained pain-free post-operatively and returned to work.
Summary Points
We have found that transposition of neuromas into bone have had a lower re-operation rate and sensitivity post-operatively. All patients remained pain-free post-operatively.
**Poster 32: The Frequency of Carpal Tunnel Syndrome in Hurler Syndrome is Unaffected by Peri-Transplant Enzyme Replacement Therapy: A Retrospective Comparison**

*Category: Pediatrics/Congenital/Nerve*

Evaluation/Diagnosis; Treatment; Prognosis/Outcomes

Level 3 Evidence

Mitchell Wyffels, MD

**Hypothesis**

Children with Hurler syndrome (HS) develop carpal tunnel syndrome (CTS) from glycosaminoglycan deposition due to enzyme deficiency while an advancement in treatment of the underlying enzyme deficiency now commonly includes peri-transplant intravenous enzyme replacement therapy (ERT). The primary objective of this study is to determine if the use of limited ERT in addition to hematopoietic stem cell transplantation (HCT) for the treatment of children with HS would reduce the incidence of surgical intervention for CTS when compared to a cohort of historical controls treated with HCT alone.

**Methods**

- Medical records for a historical group of 43 HS patients who underwent HCT alone were compared to 31 HS patients who underwent HCT+ERT.
- Both Groups were compared for genotype, age at transplant, gender, transplant graft source, median/ulnar nerve conduction study (NCS) parameters, as well as incidence and treatment of CTS.
- Pre- and post-operative nerve conduction studies were compared for children treated surgically for CTS.
- A positive exam for carpal tunnel syndrome would typically be concluded if the median/ulnar peak latency (sensory or motor) constituted a 200% increase or the corresponding median/ulnar conduction velocity was slowed to 70% or less.

**Results**

- The cumulative incidence of CTS at five years for HS children treated with HCT+ERT was 51% as compared with 47% for HS children treated with HCT alone.
- The incidence of CTS did not depend upon graft source, age at transplant, or gender.
- The preoperative median nerve conduction velocity and motor latency did not significantly differ between the treatment groups.
• The median nerve conduction velocity and motor latency did demonstrate statistically significant improvement (p<0.05) for both treatment groups after surgical carpal tunnel release.

Summary Points
• While the administration of ERT prior to and for several months post-HCT has become routine treatment, our findings do not suggest this combined therapy is sufficient to decrease the high incidence of CTS in children with HS.
• Surgical intervention for median nerve compression remains an effective treatment for CTS in HS children.
• The use of a NCS is recommended to screen for CTS in children with HS.
• The incidence of CTS in untreated HS patients has historically been shown to occur early in life for up to 73% of patients.2,3 We identified that 50% of patients remain at risk after treatment with HST and ERT.
• No known patient factors have been identified to predict the development of CTS in HS patients.

Bibliography
Poster 34: Cross-Sectional Area of the Median Nerve in Severe Carpal Tunnel Syndrome

Category: Pediatrics/Congenital/Nerve

Evaluation/Diagnosis;Anatomy

Level 4

Grant Received from: ASSH Clinical Grant/AFSH

Alan R, Blackburn, II, MD, MS
Cathy Naccarelli
Robert J. Goitz, MD
John Fowler, MD

Hypothesis

Previous studies have suggested that in up to 30% of patients with carpal tunnel syndrome (CTS), supported by both clinical findings and electrophysiologic confirmatory tests, the ultrasound (US) measured cross-sectional area (CSA) of the median nerve is not enlarged. We hypothesize that the CSA area of the median nerve, as measured by US, may be reduced because of secondary atrophy of the median nerve due to severe axonal damage, leading to these false negative results.

Methods

322 wrists (238 patients) with clinical signs and symptoms of CTS underwent US measurement of the CSA of the median nerve at the carpal tunnel inlet by a fellowship trained hand surgeon. Following US examination, a certified electrodiagnostic technician who was blinded to the results of the ultrasound examination performed nerve conduction studies (NCS) according to the guidelines of the American Association of Neuromuscular and Electrodiagnostic Medicine. CTS was defined by using the following cutoffs: 4.2ms for distal motor latency and 3.5ms for distal sensory latency. Severe CTS was defined by no response on either distal sensory or distal motor latencies. Statistical analysis consisted of an unpaired t-test, using Welch’s correction.

Results

23 wrists were identified in this patient population that met NCS criteria for inclusion in the severe CTS cohort. 64 wrists did not meet criteria for CTS on nerve conduction studies. The mean CSA of the severe CTS cohort was 11.73 +/- 0.48 (n=23), whereas the comparison group without CTS was 8.48 +/- 0.28 (n=64), (P<0.0001). The mean age of the severe CTS group was 57.4 +/- 3.5, whereas the comparison group without CTS was 45.6 +/- 1.6 (P<0.004).
Summary Points

• In severe CTS, the CSA of the median nerve was significantly enlarged in all patients of the cohort, and not diminished, despite the severe axonal damage that is present.
• Axonal damage in severe CTS does not explain why some patients with CTS do not have an enlarged CSA of the median nerve on ultrasound.
• The comparatively older age in the severe CTS cohort is remarkable as electrodiagnostic abnormalities and more advanced presentations with thenar atrophy are more common in the elderly. This study documents that in this patient cohort, ultrasound findings are preserved and the median nerve remains enlarged.

Bibliography


Images
Poster 35: Disparities in Digit Revision Amputation and Digit Replantation following Pediatric Traumatic Amputations: Analysis of 3,090 patients.

*Category: Pediatrics/Congenital/Nerve*

Evaluation/Diagnosis; Treatment; Prognosis/Outcomes
Level 4 Evidence

Neill Li, MD
Justin Kleiner
Andrew P. Harris, MD
Avi D. Goodman, MD
Julia A. Katarincic

**Hypothesis**
Indications for replantation following pediatric traumatic digit amputations are more liberal than adults, given the benefit of providing return of function and psychosocial health in an overall healthy patient population with high healing potential. Despite these benefits, age, insurance status, and digit amputated play a significant role in deciding upon replantation versus revision amputation.

**Methods**
The Kid’s Inpatient Database (KID) from the Healthcare Cost and Utilization Project (HCUP) for 2000, 2003, 2006, 2009, and 2012 were queried for traumatic amputations of the thumb or finger (ICD-9: 885.0, 885.1, 886.0, 886.1). Subjects were then separated amongst those who underwent replantation (ICD-9-CM: 84.21, 84.22) and those who underwent amputation (ICD-9-CM: 84.01, 84.02). Patient age, sex, insurance status, and digit(s) affected were recorded. National estimates of incidence were calculated using discharge weighting. Fisher’s exact tests and multivariable regressions were utilized with p values < 0.05 determined to be significant a priori.

**Results**
Between 2000-2012, 3,090 patients suffered traumatic digit amputations. In this group, 1950 (63.1%) patients underwent revision amputation. Of these patients, 1,477 (75.7%) were male, mean age of 12.4 years, and 839 (43%) had private insurance. Among these patients, there were 2023 digits amputated with 1,681 (83.1%) fingers and 342 (16.9%) thumbs. Patients undergoing replantation numbered 1,140 (36.9%), of which 828 (72.6%) were male, mean age of 10.4 years, and 577 (50.6%) had private insurance. Of digits replanted, 884 (75.9%) were fingers and 281 (24.1%) were thumbs. Fisher’s exact test revealed that insurance status, digit amputated, age,
and sex varied significantly in patients undergoing replantation. However, treatment patterns over this time period did not change. With multivariable regression analyses, young patients had an increased likelihood for replantation (OR = 0.955 for each additional year, 95% CI: 0.935-0.975, p<0.0001), thumb injuries were more likely to undergo replantation than finger injuries, (OR = 1.831, 95% CI: 1.382-2.426, p<0.0001), females underwent replantation more than males (OR = 1.375, 95% CI: 1.053-1.795, p<0.05), and private insurance patients were more likely to receive replantation (OR = 1.266, 95% CI: 1.024 – 1.564, p<0.05).

**Summary Points**
- The period between 2000 to 2012 had no change in treatment patterns following pediatric traumatic digit amputations.
- Patients who were younger, female, had thumb injuries, and had private insurance were significantly more likely to undergo replantation.
- These findings support trials of replantation are being done in those who may benefit the most: young patients with greater healing potential and thumb injuries that provide maximum return of function.

**Bibliography**
Poster 36: The Relationship of Postoperative Blood Transfusions to Number of Veins Repaired in Replanted Digits

Hypothesis
Increased number of veins repaired per replanted digit is directly correlated to lower postoperative blood transfusion requirements.

Methods
A retrospective review of all replanted digits in patients >18 years of age from 2007 to 2015 was performed. Demographic data, mechanism of injury, level of injury, digits(s) requiring replantation, length of stay, total number of blood transfusions, preoperative and discharge hemoglobin and hematocrit (H&H), number of veins repaired per digit, and total number of veins repaired was collected. Statistical analysis was performed to determine relationship of number of blood transfusions to number of veins repaired and survival.

Results
Twenty-five patients and 38 digits requiring replantation (9 thumb; 3 index; 9 middle; 9 ring; 8 small) met the inclusion criteria. The mean length of stay was 12 days (range 4-28). The mean number of blood transfusions was 2.7 (range 0-9). Preoperative H&H was 14.6/39.8 whereas discharge H&H was 10.4/28.4. The mean number of veins repaired per digit was 1.34 (range 0-3) whereas total number of veins repaired was 2.47 (range 0-6). The mean transfusion requirement was 2.1 for digits with 0-1 veins repaired (N=24) and 3.8 for digits with 2 or more veins repaired (N=14). The number of transfusions was positively correlated with the total number of veins repaired (R=.42, p=.009) as well as the number of total digits replanted (R=.38, p=.02). The overall survival rate of replanted digits was 42%. There was no relationship between replant survival rate and number of transfusions (p=0.071) or total number of vein repairs (p=0.502).
Summary Points
• The number of transfusions was mildly positively correlated with the total number of veins repaired as well as the number of total digits replanted.
• There was no relationship between replant survival rate and number of transfusions or total number of vein repairs.
• Increased number of veins repaired does not appear to be protective on blood transfusion requirements.
• Survival and number of blood transfusions is likely more dependent on other factors such as mechanism of injury, level of injury, and postoperative anticoagulation therapy.

Bibliography
Images
Poster 38: Physician Payment Sunshine Act: Relationships Between Hand Surgeons and Industry

Category: Miscellaneous

Patient Education; Billing/Coding; Ethics/Professionalism
N/A - not a clinical study

Rizwan Ahmed
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Hypothesis
The Physician Payment Sunshine Act (PPSA) is a government initiative mandating the public reporting of physician payments by biomedical companies, creating improved transparency for potential financial conflicts-of-interests (COI) between surgeons and industry. As many relationships involve product development, research, education, and consulting by physicians that may ultimately benefit patient outcomes, the accurate presentation and interpretation of these data are critical for preserving the public trust. The goal of this study is to provide a comprehensive overview of the PPSA related to the field of hand surgery.

Methods
Using the initial release of PPSA data (August 2013-December 2013), we studied the national distribution of non-research industry payments to hand surgeons. Companies that did not manufacture devices used for hand surgery were excluded. We explored whether payments varied among academic versus non-academic hand surgeons and whether academic productivity, as measured by one’s h-index influenced payments.

Results
Hand surgeons (N=983) received a total of $2,151,260. The median (IQR) was $117 ($39-388); mean (SD) $2,188 (+/- 14,297). The 4 highest payments were: $306,947, $210,687, $113,959 and $95,975. The largest payment categories were: royalty and licensing fees ($1,001,610); speaker fees ($344,529); followed by consulting fees ($284,644). Hand surgeons in academic practice received higher payments [median (IQR) $269 ($120-$2,284)] compared to those in private practice [median (IQR) $125 ($41-$373)] (log-rank p<0.001). Among academic hand surgeons, an increase of 10 units of h-index was associated with 34% higher chance of receiving at least $1000 in total payments (Poisson regression RR=1.141.341.57, p<0.001).
Summary Points
• The PPSA data demonstrated that 50% of hand surgeons received payments less than $117. Royalty and licensing fees comprised of 47% of all payments.
• Academic surgeons received greater industry payments than those in private practice. Among academic hand surgeons an increase in one’s h-index was associated with greater industry payments.
• Understanding and interpreting the PPSA data relative to the potential influence of COI on medical decision making and patient care, both real and perceived, are critical issues for hand surgeons.
Poster 39: Outpatient Hand Surgery is Safe in Patients with High BMI

Category: Miscellaneous

Evaluation/Diagnosis; Surgical Technique; Prognosis/Outcomes
Level 4 Evidence

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Kevin Lutsky, MD
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Christopher M. Jones, MD

Hypothesis
Based on a perceived increased surgical risk, many outpatient surgery centers uniformly decline to schedule procedures for patients with high body mass index (BMI) regardless of age, procedure or overall health. Our goal was to quantify perioperative anesthetic and surgical complications in a cohort of outpatient hand surgery patients with a high BMI. Our hypothesis is that patients with a high BMI can safely have upper extremity surgery at an outpatient surgery center.

Methods
We performed a retrospective, cohort study examining patients with a BMI greater than 40 kg/m² that underwent outpatient upper extremity surgery by four fellowship trained hand surgeons. We performed a chart review of the surgery center electronic medical record (EMR) and recorded any perioperative anesthetic complications. Demographic information, American Society of Anesthesiologists physical status classification (ASA), presence of obstructive sleep apnea (OSA) and anesthetic medication amounts were recorded.

Results
Surgery center EMR query of over 2,000 patients revealed 217 patients with a BMI greater than 40 kg/m² that had undergone outpatient upper extremity surgery. The average age of patients was 50 years old (range, 16-77) and the average BMI was 44 kg/m² (range, 40-61). Thirty-four percent of the patients carried a diagnosis of OSA. There was an average of 203mg (range, 0-700mg) of propofol, 102mcg of fentanyl (range, 0-500mcg) and 2mg of midazolam (range, 0-8mg) administered. Forty-two percent of the patients had an ASA score of 2 and 58% of patients had an ASA score of 3. There were no acute perioperative surgical or anesthetic complications in the studied patient cohort.
Summary Points

• Outpatient upper extremity surgery is safe in patients with a BMI greater than 40.
• Arbitrary cutoffs based on weight are not appropriate for outpatient hand surgery at this time.
Poster 40: Curtis Simple Hand Score

Category: Miscellaneous

Evaluation/Diagnosis; Prognosis/Outcomes
Level 4 Evidence

Katherine A. Butler, MD

Hypothesis
Single assessment numeric equivalent (SANE) scores have been shown to correlate with validated outcome scores for the shoulder. We hypothesize that single assessment numeric outcome scores used for hand and wrist pathologies will correlate with more detailed validated patient outcome scoring systems.

Methods
All patients seen at the Curtis National Hand Center for wrist and hand complaints were asked to complete the Quick Dash questionnaire. The patients were also asked to rate their hand/wrist function on a scale of 0-100 with 100 being completely normal. The patients were also asked to score their ipsilateral shoulder and elbow using the same scale. Patients with a unilateral hand/wrist complaint, who completed both the DASH and SANE questions and whose SANE scores for their ipsilateral shoulder and elbow were 100 were included in the study.

Results
Data from 196 patients were collected and analyzed. The mean Curtis Simple Hand score was 56.2 +/- 29.6 and the mean DASH score was 42.8 +/- 26.3. Pearson correlation test was used to examine the relationship between simple score (the single numerical assessment) and the quick dash score. The Pearson correlation coefficient was -0.75, which is statistically significant (p<0.0001).

Summary Points
• There is a strong correlation between a detailed, validated outcome score for hand/wrist pathologies and the Curtis Simple Hand Score, a single numerical assessment
• A single assessment numeric equivalent for hand and wrist pathology may be useful in assessing patient dysfunction and outcomes both in the clinical and research settings.

Bibliography


Poster 42: An Analysis of Hand Surgery Questions on the Orthopaedic In-Training Examination

Category: Miscellaneous

Residents/Fellow/Educator Resources
N/A - not a clinical study

Adam Martin, MD
Hisham M. Awan, MD

Hypothesis
The Orthopaedic In-Training Examination (OITE) was established to assess resident knowledge and education in a standardized fashion. This study will provide a detailed analysis of the hand surgery section from 2009-2015.

Methods
The total number of OITE questions was recorded for each year. Each question categorized as hand surgery by AAOS examination committee from 2009-2015 was then evaluated. The authors then calculated the percentage of total OITE questions labeled as hand surgery. Hand surgery related questions were further analyzed for category and subcategory of content, the categories of which were selected by the authors as general hand teaching topics. The 9 proposed teaching topics were tendon/ligament, fracture/dislocation, amputation, degenerative, wound, congenital, tumor/cyst, vascular, and nerve. The citations provided for each question by the AAOS were recorded.

Results
The citations utilized more than twice from 2009-2015 are listed in TABLE 1. The approximate percentage of the total citations from journals and textbooks was 90% and 10%, respectively. 73.7% of journal citations were from the following 5 journals: JHS Am Vol (33.3%), JAAOS (11%), JBJS Am Vol (10.2%), JHS Br Vol (9.8%), and Hand Clinics (9.4%). 74.2% of textbook citations were from the following 2 textbooks: OKU (38.7%) and Green’s Operative Hand Surgery (35.5%). During the 7 years of OITE exams reviewed, 286 total references in 47 different sources were cited in the hand questions.

TABLE 2 displays the breakdown of hand topics tested from 2009 to 2015. After review of the total 151 hand questions, the top 5 categories include: fracture/dislocation, tendon/ligament, nerve, congenital, and amputation. Further analysis demonstrated that the top 5 most tested individual topics were flexor pulley system, peripheral nerve injury, forearm fracture/dislocation, carpal/cubital tunnel syndrome, and distal radius fractures. These 5 individual topics account for 36.4% of the hand questions.
Summary Points

- The purpose of this study was to analyze the hand surgery section of the OITE to aid both residents and residency programs in preparation for the exam.
- Top 3 journals were JHS Am Vol, JAAOS, and JBJS Am Vol and accounted for ~ 55% of journal citations.
- Provided that ~ 90% of total citations were from journals, residents who are preparing for the OITE would benefit from reading up-to-date literature.
- Knowing the top 5 most frequently tested topics can guide orthopaedic residencies in the development of program and rotation specific educational conferences.
Poster 43: Spread of Collagenase clostridium histolyticum injections out of the pretendinous cord for Dupuytren Contractures

Category: Miscellaneous

Treatment; Surgical Technique; Prognosis/Outcomes
Level 4 Evidence

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Shigeharu Uchiyama, MD

Hypothesis
For collagenase clostridium histolyticum (CCH: Xiaflex®) injections for Dupuytren contracture, securing the needle point within the contracture cord is considered important for the prevention of complications. However, there are no reports on the area of CCH diffusion immediately after administration. We evaluated the effects of diffusion and their surrounding tissues by obtaining simple MRI images immediately after the injection of CCH.

Methods
The subjects were five male patients, age 67-79, with Dupuytren contracture of the MP joints. The joints that underwent treatment were as follows: ring finger, three cases; middle finger, one case; little finger, one case. Flexion contracture angles were as follows: MP joint, 20-40 degrees (mean, 30); PIP joint, 0-60 degrees (mean, 42.5). All patients underwent evaluation prior to injection. Simple MRI imaging was performed within 15 minutes of CCH injection. Stretching maneuvers were performed at 24 hours after injection.

Results
In the MRI immediately after injection, the T2 STIR high-signal area extended outside of the contracture line in all five cases. Continuity from the insertion site was observed in the high-signal area, and the area was in contact with the anterior flexor tendon and neurovascular bundle. No signal change was observed for the flexor tendon. In four of five cases, a signal change was observed within the contracture line.
In all cases, the ROM improved to 0 degree extension for the MP joint and 0-15 degrees extension for the PIP joint after one week and three months of injection. There was no nerve damage or tendon rupture in all cases.
Summary Points
• This is the first report, which analyzed MRI findings immediately after injection of CCH.
• MRI after CCH injection revealed a high-signal area outside of the contracture line in all cases even with correct injection technique.
• Leakage of the drug outside of the contracture was strongly suspected, suggesting a swelling that extends not only to the surroundings of the contracture but also to its dorsal side, in addition to the presence of subcutaneous hemorrhage.
Poster 44: Pull-out Strength of K-wires with Multiple Redirection Attempts

Category: Miscellaneous

Surgical Technique; Basic Science
N/A - not a clinical study

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Hypothesis
Kirchner wires (K-wires) and other forms of smooth pins require friction for biomechanical strength. We hypothesize that redirecting the K-wire through the same proximal hole will weaken the pullout strength both initially and following repeated redirection attempts.

Methods
Using an angle guide, 0.062 K-wires were directed at 10 degrees from a perpendicular angle through a bicortical sawbones substrate. An Instron was then used to test the pullout strength of the K-wires using the peak initial failure load strength in Newtons as a presumed highest possible strength of the construct. Trials were divided into seven groups of 10 samples per group. In group one through six the K-wires were placed into the sawbones by drilling through both cortices. In the non redirect group the K-wires were placed and then tested without redirection. In the one redirects group the K-wires were placed followed by partial withdrawal through the distal cortex only with redirection into a new distal cortex hole. In the two redirects group, the K-wires were placed followed by partial withdrawal through the distal cortex only with two subsequent redirections into new distal cortex holes. This continued for up to five redirections. A unicortical control group was also performed. K-wire pull out strength was tested following each. ANOVA was then performed with post hoc Tukey testing to evaluate the differences between the groups.

Results
The strength of the control group was 72.7 ± 19.6 N, one redirect was 35.2 ± 13.0 N, two redirects were 37.2 ± 14.4 N, three redirects were 32.2 ± 10.0 N, four redirects were 40.6 ± 12.0 N, five redirects were 37.9 ± 8.0, and the unicortical group was 40.4 ± 7.4 N. Post hoc Tukey tests indicated a significantly increased pullout strength for the control compared to any redirect group and the unicortical group (p<0.05),
Summary Points

- K wires placed without redirection have greater pull out strength when compared to K wires placed with subsequent withdrawal and redirection
- There is no difference in pullout strength between multiple redirection attempts
- Any redirection weakens pullout strength similar to a unicortical wire
- Correct initial pin placement is advantageous for optimizing pull out strength.

Bibliography

Poster 45: Accuracy and reliability of finger joint flexion angles using smartphone applications

Category: Miscellaneous

Evaluation/Diagnosis;Anatomy
N/A - not a clinical study

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John Fowler, MD

Hypothesis
Measurement of finger range of motion (ROM) is critical in clinical settings, especially for outcome analysis, clinical decision making, and rehabilitation/disability assessment. Goniometer measurement and visual inspections were traditionally the two most widespread tools for this purpose (1). We compared different smartphone applications and visual inspection measurements of the finger joints to the goniometer measurement standard and to determine inter-rater reliability for these measurement tools.

Methods
Finger joint flexion angles were independently measured by three observers. An independent observer measured each joint flexion angle using a universal hand-held goniometer and was used as the reference standard. Three different smartphone applications were used to measure the flexion angles of the finger: Goniometer (Jinfra), iPhone Compass (Apple), and PT-Tools (PT Tools suite). In addition, visual inspection was used to estimate the flexion angles of finger joints.

Results
The results of our study suggest that all three smartphone measurement tools, as well as visual inspection, correlate well with the reference standard XR measurement. The strongest correlations were between visual inspection and the XR reference standard. (Table 1). The mean correlation coefficients for each smartphone applications exceeded 0.7. Overall inter-rater reliability was similar, with ICC greater than 0.9 for all the measurement tools (Table 2). Visual inspection and the Goniometer application have highest correlation coefficients.

Summary Points
- Our data suggest that new smartphone applications are promising means to provide accurate and reliable measures of ROM.
Bibliography
Images
Hypothesis
Critical evaluation of implant costs and careful implant selection helps to mitigate those costs while providing appropriate care for the patient. In an effort to decrease the cost burden of distal radius implants, a preset shelf price was established by a large orthopedic practice for all distal radius implants, regardless of company and affiliation. We hypothesized that as a result of negotiating a set reduced cost, the total number of screws per implant, the number of locked screws per implant, and the number of wasted screws per implant would be unchanged and implant utilization would not change.

Methods
This was a retrospective evaluation on the impact of standardized shelf pricing for distal radius fracture implants. The total number of screws, as well as the number of screws wasted during each procedure were reviewed. We analyzed number of screw implants used 3 months before and 3 months after the standardized shelf pricing went into effect. This information was compared for 3 fellowship trained hand surgeons operating at a single outpatient urban surgical center. Additionally, we surveyed 10 fellowship-trained hand surgeons in a large private practice regarding changes in operating procedure and perceived changes in the attendance and utility of the surgical representative. A two-sample T test was used to compare the results for statistically significant differences.

Results
We retrospectively reviewed 30 patients that underwent open reduction internal fixation for distal radius fracture 3 month before and 28 patients 3 months after implementation of shelf pricing. On average, there was a 17% reduction in total implant costs after the shelf price agreement was implemented. There was no statistically significant difference in any of the non-financially related (clinical) variables. Negligible change was noted in the surgeon experience in representative availability, surgery related attributes on the survey.
Summary Points

• Despite a set price for distal radius implants, we found that there was no significant difference in the number of screws utilized or wasted after the standardized shelf price was established.
• Additionally, despite a 17% reduction in cost, the level of representative attendance and utility was subjectively similar before and after the change.
Poster 47: Does Esmarch Application Cause Inter-Compartmental Transfer Of Fluid?

Category: Miscellaneous

Surgical Technique
N/A - not a clinical study

Scott Farner
Laxminarayan Bhandari
David Tate

Hypothesis
Esmarch tourniquet application causes transfer of fluid from one compartment to another.

Methods
The study was conducted in freshly prepared cadaver hands. Thenar spaces (4 specimens) and mid-palmar (4 specimens) spaces were selected, as these have well described anatomic boundaries. Control radiographs were taken of all hand specimens with an image intensifier prior to injection. Radioopaque contrast fluid (Cysto-Conray II, 17.2% w/v iothalamate meglumine, Mallinckrodt Inc., St. Louis, Mo.) was injected with a hypodermic needle into selected deep spaces of the hand to simulate collections of purulent material found in infection. Thenar space injections (4 specimens) were performed by direct injection of 15-30 ml of contrast at a point between the 2nd and 3rd metacarpal, deep to the flexor tendons at the level of the distal palmar crease. Midpalmar space injections (4 specimens) were performed by direct injection of 15-30 ml of contrast at a point between the 3rd and 4th metacarpal, deep to the flexor tendons at the level of the distal palmar crease. The image intensifier was used to obtain images just after injection. An Esmarch tourniquet was applied from the fingers distally to the elbow, simulating exsanguination as would be performed for a surgical procedure. Post exsanguination images were taken after removal of the Esmarch to assess the extent of spread, if any, of the contrast material.

Results
Injection into the mid-palmar space and application of the Esmarch tourniquet did not demonstrate any appreciable pattern of spread. However injections in thenar space and application the Esmarch tourniquet demonstrated a radiographic pattern of spread in 2 of 4 specimens. The radioopaque material was noted to have migrated from its initial position to the level of the radial styloid proximally and radial to the first metacarpal laterally.
Summary Points

• Application of Esmarch tourniquet is avoided in cases of infections or abscesses, due to the possibility of spread of organisms. However there are no studies in literature to either support or refute this hypothesis.

• We noticed spread in 2 out of 8 cadaver specimens—this may be due to anatomical variations, or due to the pressure of Esmarch itself.

• In clinical surgery, it is not possible to predict the possibility of spread of fluid after esmarch tourniquet application. Thus we recommend to avoid esmarch tourniquet in hand infections.

Bibliography


Images
Poster 48: Peripheral Microvascular Effects of Electronic Cigarettes: Preliminary Results of a Controlled Exposure Study by the UCSF Cardiovascular Research Institute

Category: Miscellaneous

Evaluation/Diagnosis; Prognosis/Outcomes; Patient Education
Level 2

Grant Received from: American Foundation for Surgery of the Hand Residents and Fellows Fast Track Grant, National Cancer Institute (NCI) grants #CA-113710

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Background
Cigarette smokers undergoing hand and upper extremity surgery have impaired peripheral microvascular circulation on laser doppler imaging correlating with increased perioperative complications. Yet, 9/10 of plastic surgeons report routinely operating on current smokers. The use of electronic cigarettes (e-cigarettes) or “vape” products (a novel nicotine product) is escalating (Fig 1). Patients report using e-cigarettes perioperatively but physician opinion on e-cigarettes vary widely. Preliminary cardiovascular studies indicate e-cigarettes may reduce harm from combustible cigarettes, but yield equivalent nicotine levels and contain novel, and potentially toxic, components. However there is a lack of published evidence on the peripheral vascular effects e-cigarettes. We performed a direct measure of acute peripheral microvascular effects (peripheral arterial tonometry or PAT). Because PAT is noninvasive, portable, and can be used intraoperatively these measurements also contribute to the body of work on perioperative monitoring of peripheral vascular status.

Hypothesis
We hypothesized that we would detect acute, significant impairment of peripheral microvascular function after use of e-cigarettes and cigarettes using peripheral arterial tonometry.

Methods
We used a crossover study design. Smokers of traditional cigarettes (n=8) had two exposures: cigarettes or sham puffing. Users of e-cigarettes (n=10) had three exposures: e-cigarette with/without nicotine or sham. We measured peripheral volume in the index finger using an FDA-approved peripheral arterial tonometer (EndoPAT-2000, Itamar Medical LTD) which yielded
the natural log of the reactive hyperemic index (lnRHI) during serial arterial occlusions induced by pneumatic cuff at baseline, and 10, 60, and 180 minutes post-exposure. Occlusions were distal to the antecubital fossa. We calculated intrasubject response pre/post exposure, and pooled intergroup comparison by exposure.

**Results**
We did not detect a significant peripheral vascular response to either tobacco or e-cigarette exposures using peripheral arterial tonometry. Our study was limited by dual-use of cigarettes and e-cigarettes among the e-cigarette respondents. While we are underpowered to conclude that there was no peripheral vascular response, previous studies using laser doppler have shown effects of cigarettes with smaller sample sizes.

**Summary Points**
- Patients report perioperative e-cigarette use.
- Surgeons need evidence-based guidelines on e-cigarettes
- Well-designed medical studies on e-cigarettes are difficult to execute because of low recruitment, dual-use with tobacco, and heterogenous e-cigarette products.
Poster 50: Objective Applicant Factors Predict Receiving an Interview and Successfully Matching to a Hand Fellowship Program

Category: Miscellaneous

Residents/Fellow/Educator Resources
N/A - not a clinical study

Katherine A. Butler, MD
Kenneth Means

Hypothesis
There are identifiable objective criteria that correlate with successfully matching into a hand fellowship.

Methods
Our internal fellowship program database of applications was utilized to collect data from applicants for the 2014/2015 and 2015/2016 academic years. The following data elements were collected from the applications: status of foreign or US medical graduate, gender, USMLE 1, 2, and 3 step scores, medical school rank according to US News and World Report, Alpha Omega Alpha honor society membership status, medical school degree (MD or DO), residency type (orthopaedic, general surgery, or plastic surgery), completion of a prior fellowship, completion of multiple residency programs, and residency rank according to Doximity.com. The following data on research experience of the applicants was also collected: total number of poster or podium presentations at a regional or national level by the applicant, total number of scientific publications by the applicant, number of first author publications by the applicant, number of publications on topics related to hand/upper extremity, number of letters of recommendations from hand surgeons, whether or not the applicant’s residency program had an associated hand surgery fellowship. Bivariate and multivariate logistic regression analyses were preformed to identify which factors had a significant impact the two primary outcomes: an interview offer at our institution and successful match into an accredited hand fellowship program.

Results
A total of 233 hand fellowship applications for the 2015 and 2016 academic years were analyzed. Applicants with more scientific presentations, publications and publications in hand journals were more likely to receive an interview at our institution. Residency rank and USMLe scores also had a significant impact on receiving an interview offer. US medical graduates and orthopedic residents were significantly more likely to successfully match into a hand fellowship than foreign medical graduates and applicants from general or plastic surgery residencies. Applicants who
had completed a prior fellowship were significantly less likely to complete a successful match than candidates who had not completed a prior fellowship.

Summary Points
• The type of residency program seems to be the strongest predictor of successful match into a hand fellowship.
• Research experience is valued at our institutions and is an objective criteria used to select candidates for an interview.
• There are identifiable objective criteria that correlate with successfully matching into a hand fellowship.

Bibliography

Images
Poster 51: Comparison of Pulse Oximetry and Handheld Doppler for Assessing Digital Perfusion

Category: Miscellaneous

Evaluation/Diagnosis
Level 4 Evidence

Megan L. Jimenez
Kevin Lutsky, MD
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Hypothesis
Fingertip pulse oximeters are readily available, easy to use, provide an objective measure, and are familiar to most medical professionals. Utility of pulse oximetry for evaluating the perfusion of an injured digit is not well established. The goal of our study was to compare the use of Doppler flow to pulse oximetry measurements in the digits of healthy volunteers.

Methods
Ten healthy volunteers were asked to participate in our study. All digits of both hands were assessed, for a total of 100 digits. For each digit, baseline measurements were performed for both the Doppler and pulse oximeter. These were obtained by first placing the Doppler on the pulp of each digit and confirming flow. Then, a pulse oximeter was placed on each digit for 1 minute, with the recordings taken from each digit at the end of the time. To simulate vascular injury, a penrose drain was used to occlude each digit until Doppler signal disappeared. Once perfusion was absent, the pulse oximeter was placed on the digit. Pulse oximeter readings were recorded for 1 minute. Two types of pulse oximeter were used.

Results
The mean baseline pulse oximeter reading for all 100 digits was 98.9% (range: 96-100). For the first pulse oximeter, no readout was obtained while the digit was unperfused. Using the second pulse oximeter, the mean unperfused readings dropped to 85.0% (range: 71-98). The difference between baseline and the second pulse oximeter used was significant (p< .01)

Summary Points
• Our study supports the use of pulse oximeter in the assessment of fingertip perfusion.
• Depending on the model of pulse oximeter used, results may be binary (signal or no signal) or show a drop in reading compared to a perfumed digit.
• Pulse oximetry is a simple tool that can be used in the emergency department or outpatient clinic as an adjunct to assess finger perfusion.
• Further study would be beneficial to confirm its utility in digits with traumatic vascular compromise.

Bibliography

Images
Poster 52: En Mass Excision and Curettage for Gouty Tophi of the Hands

Category: Miscellaneous

Treatment; Surgical Technique; Prognosis/Outcomes

Level 4 Evidence

Matthew Doscher, MD
Andrew Lovy, MD
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Charles P. Melone, Jr., MD

Hypothesis
Despite increasing disease prevalence there remains a paucity of data examining surgical treatments for gouty tophi. A prevailing reluctance for surgery exists due to generally suboptimal wound conditions with a compromised healing capacity. This paper assesses the authors’ experience with en masse excision and curettage of articular tophi involving the hands.

Methods
A retrospective review was conducted of 12 consecutive patients with 24 tophaceous deposits excised from the metacarpal and interphalangeal joints. Two deposits were also concomitantly excised from the wrist and two from the elbow. All patients had an established diagnosis of gout and had been treated with urate lowering medication. The group included 8 men and 4 women, with an average age of 73.5 years (range, 28-85 yrs). All tophi were substantive in size and were causing major digital joint dysfunction with variable skin ulcerations. The tophi were also a source of considerable disfigurement.

Results
Follow up evaluation ranged 1-15 years (average, 4.25 yrs.) and included pain, mobility, strength, function and patient satisfaction. All patients underwent successful tophus excision with restoration of tendon excursion and joint mobility and without wound complications. All regained high levels of function and all reported satisfaction with their outcome. On follow up as long as 15 years recurrence has not been observed and secondary surgery has not proved necessary.

Summary Points
Surgical excision of gouty tophi of the hands provides long-term relief for patients. With careful technique, wound healing and tendon function can be maximized allowing for improvement in function and aesthetics. There have been no tophi recurrences.
Bibliography
Poster 53: Pediatric and Adolescent Patients with Kienbock Disease: Outcomes of Surgical Intervention

Category: Miscellaneous

Treatment; Surgical Technique; Prognosis/Outcomes
Level 4 Evidence

Elissa S. Davis
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Hypothesis
Surgical intervention in a pediatric and adolescent population with Kienbock disease will result in improved wrist range of motion and decreased pain.

Methods
We utilized a retrospective chart review of pediatric and adolescent patients undergoing surgical intervention for Kienbock disease from 2006-2015. Patient charts were identified by CPT code (25390, 25035, 25365, 25393 and 25430) and only patients 18 years or younger at time of initial presentation were included in this study. The following information was extracted from each chart: patient demographics, wrist range of motion, presenting symptoms, Lichtman classification, and treatment. Only patients with pre-operative and post-operative wrist range of motion as well as pre- and post-operative pain assessment were included in this study. Six patients met the above criteria and were included in the analysis.

Results
The average age of patients at onset of symptoms was 15 years (13-17) and average age at time of surgery was 16 years (14-19). Males were more commonly affected (2:1) and equally affected the left versus right hand (1:1) with a slight predominance for the non-dominant hand (3:2). Four patients had Lichtman IIIA disease, while one patient had Lichtman I disease and one patient had Lichtman Type II disease. All patient presented with pain and negative ulnar variance and 5 out of 6 presented with loss of motion. All patients underwent radial shortening osteoplasty/osteotomy and were followed for an average of 29 months (5-72 months). Pre-operative radial and ulnar deviation were measured at a mean of 22 degrees (5-55) and 18 degrees (5-30), respectively. Post-operatively 5 of 6 patients had complete resolution of pain. Flexion and extension of the wrist post-operatively was found to be significantly improved. Results of paired t test demonstrate flexion post-operatively improved from a mean of 46
degrees to 63 degrees (p=0.0392) and extension improved from a mean of 40 degrees to 65 degrees (p= 0.0017).

Summary Points
- The majority of pediatric and adolescent patients with Kienbock disease present with pain and decrease wrist range of motion.
- Pediatric and adolescent patients undergoing surgical intervention for Kienbock disease have significant improvement in wrist flexion and extension.
- The majority of pediatric and adolescent patients undergoing surgical intervention have complete resolution of pain.
Poster 55: The Direct and Indirect Costs to Society of Carpal Tunnel Release

*Category: Miscellaneous*

**Treatment**
N/A - not a clinical study

**Alex C. Lesiak, MD, MS**
**John R. Fowler, MD**
**Edgar Siyakurima**

**Hypothesis**
Surgical treatment of carpal tunnel syndrome (CTS) has more societal and economic value than conservative treatment.

**Methods**
A Monte Carlo Simulation Model was constructed to estimate the lifetime direct and indirect costs associate with surgical and conservative treatment of CTS. Direct costs include all medical costs for surgical and conservative treatment of CTS. Indirect costs include lost wages due to inability to work, lower earnings, or receipt of disability payments. Direct and indirect cost were incorporated into the Monte Carlo Simulation Model to estimate the impact of CTS surgery over a patients’ lifetime. The utility is presented as an average utility for a given year of an individual’s life with a healthy individual’s utility having a score of 7.8. The utility for each individual varied following a Gamma distribution with the means and standard deviations provided. The Monte Carlo Simulations consisted of 100,000 individual trials. The assumptions made in the model were developed with use of claims and survey data, Medicare reimbursement rates from 2016, median United States Salary data, as well as clinical expert opinion and the peer-reviewed literature.

**Results**
Surgical treatment of CTS had a lower total cost and a higher utility when compared to conservative treatment. Mean total cost of surgical treatment of CTS was $3,536.59 +/- $7,155.66 with a mean utility of 7.8 +/- 1.42. Mean total cost of conservative treatment was $95,735.65 +/- $92,841.14 with a mean utility of 7.1 +/- 1.79. The cost of successful surgical treatment of CTS was $3,068.00 compared to the cost of asymptomatic/recovery treatment, which accounts for 15% of the conservative arm, was $2,322.00.
Summary Points
Surgical treatment for CTS had a much smaller cost as well as a higher utility when compared to conservative treatment. While this is not to say everyone with carpal tunnel syndrome should undergo surgical treatment, it is clearly a cost effective treatment strategy that should be included in the societal perspective of the evolving costs and savings in health care.