PAPER 44

Clinical Paper Session 08: Scapholunate
Saturday, September 12 • 8:45–8:52 AM
Evaluation/Diagnosis, Treatment, Prognosis/Outcomes, Hand and Wrist

Outcomes of Acute versus Subacute Scapholunate Ligament Repair
Level 3 Evidence
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Hypothesis: It is currently unknown whether time from injury affects outcomes following repair of dorsal scapholunate ligament (SLL) tears. We tested the null hypothesis that the outcomes of SLL repair are similar when performed within 6 weeks of injury (acute repair) versus when repaired from 6 to 12 weeks following injury (subacute repair).

Methods: This case-control study examined 22 patients (12 acute repair, 10 sub-acute repair) who underwent dorsal SLL repair for isolated complete tears of the SLL, with or without supplementary capsulodesis. Patients who underwent SLL repair for complete rupture of the dorsal SLL between 1996 and 2012 were identified from an electronic billing database. Demographic data (age, sex, BMI, occupation, tobacco use) was recorded and radiographic measurements (SL angle and SL gap) were determined from preoperative radiographs. All patients returned to clinic for a study-related visit including measurements (SL angle and SL gap) were determined from preoperative radiographs. Analyses were performed on all categorical and continuous standardized questionnaires (Michigan Hand Questionnaire, VAS-function, wrist range of motion, strength testing) and radiographic examination of the injured wrist (PA, lateral, supinated PA grip radiographs.

Results: The median length of follow-up for the acute and sub-acute groups were 5.5 and 6.1 years, respectively (Table 1). There was no significant difference in any of the variables between the two groups. The groups were near identical with regard to final SL angle (acute: 66°, subacute: 65°), final SL gap (3.0 mm, 2.9 mm), and proportion of cases that progressed to scapholunate-advanced collapse (2/12, 2/10). Patient-rated outcomes were not different between patient groups (Table 2). Wrist motion (P = 0.20) and forearm motion (P = 0.21) were also comparable for the acute and subacute repairs. Both acute and subacute repairs demonstrated well-preserved grip strength (98% of unaffected versus 90%) (P = 0.29).

Summary Points:

• At a median follow-up of 5.5 and 6.1 years, respectively, no statistically significant or clinically relevant differences were found when comparing radiographic findings, patient rated outcomes and wrist motion following acute and subacute SLL repair.

• Acute and subacute repairs of the SLL demonstrate similar rates of progression to end-stage arthritis.

• Whether treated within 6 weeks or 12 weeks of injury, SLL repair may produce a similar outcome when reparable ligamentous tissue exists.

PAPER 45

Clinical Paper Session 08: Scapholunate
Saturday, September 12 • 8:52–8:59 AM
Treatment, Surgical Technique, Hand and Wrist

Reconstruction of the Scapholunate Interosseous Ligament Using Bone-capitohamate Ligament-bone
Level 4 Evidence
Toshiyasu Nakamura, MD, PhD
Yukihiko Obara, MD
Takuji Iwamoto, MD, PhD
Kensuke Ochi, MD, PhD
Kazuki Sato, MD, PhD

Hypothesis: The biomechanical property of the capitohamate (CH) ligament is equivalent to the SL ligament. We reconstructed torn SL ligament using the bone-CH ligament-bone substitute.

Methods: Indications of this procedure are unrepairable complete disruption of the SL ligament (Fig 1A). Scapholunate joint was reduced by manual or joystick maneuver, then temporary fixed with 2 K-wires and the scapho- trapezium interval was fixed with 1-2 K-wires. The dorsal portion of the SL ligament was refreshed and the 5 mm×10 mm×5 mm (width, length, depth) cubic gutter was made at the exact position of the dorsal portion of the SL ligament by a chisel. Proximal half of the CH ligament with capitate bone and hamate bone (bone-CH ligament-bone) was harvested as same size as the gutter made at the SL ligament, then grafted, fixed firmly with 1.2 mm diameter titanium screws to the scaphoid and lunate to reconstruct the SL ligament (Fig 1B and C). Since 2008, 15 wrists of 14 patients with an age of 38 years (range 25 to 75) underwent this procedure with at least 1-year follow-up. There were 14 male and 1 female, 11 rights, 2 left and 1 bilateral wrists. Thirteen wrists indicated dissociation of SL joint gap more than 3 mm and 2 indicated complete SL ligament disruption with severe DISI deformity. K-wires were removed 8 weeks after the surgery and active ROM exercise...
began. We evaluated pain (VAS), wrist motion (angle), radiographic characteristics, such as SL gap (mm), SL angle, and modified Mayo wrist score. **Results:** VAS was improved to postoperative 77 from preoperative 12. We obtained average wrist extension/flexion of 74/60 degrees. There was no ossification of reconstructed SL. SL gap was improved average 4.8 mm to 2.1 mm and SL angle was changed from 67 to 55 degrees (Fig. 2). Modified Mayo wrist score was improved to 82 points postoperatively from preoperative 47. Clinical outcome was 8 excellent, 6 good and 1 fair with modified Mayo-wrist score. **Summary:** We obtained excellent radiographic and clinical results of complete disruption of the SL ligament by reconstruction using bone-CH ligament-bone substitute.

**REFERENCES**


**PAPER 46**

Clinical Paper Session 08: Scapholunate Saturday, September 12 • 8:59—9:06 AM 
Anatomy, Basic Science, Hand and Wrist

**Biomechanical Analysis of Articulating Intercarpal Screw Fixation After Scapholunate Ligament Division**

N/A - Not a clinical study
REFERENCES


PAPER 47
Clinical Paper Session 08: Scapholunate Saturday, September 12 ● 9:06—9:13 AM
Patient Education, Hand and Wrist

Wrist Biomechanics In Yoga
Level 4 Evidence

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Anthony Sapienza, MD
Smita Rao, PT, PhD
Martin Posner, MD

Hypothesis: In a survey of yoga professionals, the wrist accounted for 11.5% of reported injuries. The purpose of this study was to evaluate how modifications may decrease strain and prevent injury in three common yoga positions—downward dog (DD), chaturanga (Ch), and side plank (SP).

Methods: The participants were 43 healthy volunteers, 23 females and 20 males. Mean age was 27 years. Peak pressure, maximum force and load distribution were measured in standard and modified positions in DD, Ch, and SP using a pressure-measuring device. Wrist extension was also measured in these same positions. Modification to the DD position consisted of placing the palms on an elevated platform. Ch and SP were modified by permitting the participants to have their knees on the floor rather than balance on their toes. Modified positions shifted the center of gravity further toward the lower torso, decreasing both load forces on the wrist and degree of wrist extension. A two-way ANOVA was performed to assess the effect of standard and modified positions on peak pressures.

Results: Peak pressures decreased from 379.4 to 308 kPa and 483.1 to 401.9 kPa in the modified Ch and SP positions, respectively ($P < .001$). The modifications in DD did not significantly affect maximum force ($P = 0.518$). Analysis of load distribution mapping showed that peak pressure and maximum force were highest in the thenar area in the palms in DD and SP positions. In Ch, peak pressure and maximum force were highest in the hypothenar area. The angle of wrist extension increased in Ch and SP from 70.3 to 70.7 and 82.3 and 83.3. Wrist extension decreased in the DD position from 57.5 to 52.0.

Summary Points:
• Modified SP and CH yoga positions resulted in a significant decrease in peak pressure and maximum forces by shifting the center of gravity toward the lower torso.
• Modifications to the DD pose resulted in a significant decrease in wrist extension angle potentially adding protective benefits.

REFERENCES


PAPER 48
Clinical Paper Session 08: Scapholunate Saturday, September 12 ● 9:13—9:20 AM
Evaluation/Diagnosis, Treatment, Prognosis/Outcomes, Hand and Wrist, Nerve, Diseases and Disorders

Buying Time: Long-term Results of Wrist Denervation and Need for Revision Surgery
Level 4 Evidence
Maureen A. O’Shaughnessy, MD
Sanjeev Kakar, MD, MBA
Richard Berger, MD

Royalty: Skeletal Dynamics (Kakar)
Consulting Fee: Arthrex, Skeletal Dynamics (Kakar)

Hypothesis: Wrist denervation has been shown to be a good option for patients with chronic wrist pain related to articular degeneration or chronic instability. Removal of the sensory innervation to the wrist joint provides relief of pain; however denervation does not address the underlying pathology. Patients continue to undergo degenerative changes and may need revision procedures. This study reviews the 20 year long term outcomes of patients treated with partial wrist (anterior and posterior interosseous nerve) denervation focusing on need for and time to salvage procedure.

Methods: We conducted an IRB approved retrospective study over a 20 year period of all patients undergoing wrist denervation by the lead authors between 1994 and 2014. At latest follow up, data including range of motion, grip strength, radiographic degeneration and need for revision surgery were recorded.

Results: The series includes 106 patients (68 male, 38 female) with an average age at surgery of 52 (range 14 to 80). Average follow up was 78 months (range 3 to 212). The main diagnoses in this series were SLAC degenerative arthritis (43%) and radiocarpal arthritis (40%). Average flexion to extension arc was 93 degrees on the affected extremity (76% of the contralateral) and average grip strength was 83% of unaffected extremity.

Seventy one percent of patients (75/106) had satisfactory outcomes and did not require revision procedures at average follow up of 78 months (range 3 to 212). Twenty nine percent (31/106) of patients underwent revision surgery including four corner fusion (11), total wrist fusion (6), proximal row carpectomy (4), radiocarpalunate fusion (3), total wrist arthroplasty (1), Sauve-Kapandji (1), ulnar shortening procedure (1), Darrah (1), radial styloidectomy (1) and ulnar head hemiresection interposition arthroplasty (1). Twenty nine percent of patients ultimately underwent salvage procedure.

Summary Points:
- Partial wrist denervation is a reliable motion preserving procedure for patients with chronic wrist pain. In this series, 71% of patients experienced pain relief and did not require further salvage procedures at an average of 78 months of follow up.
- Twenty nine percent of patients ultimately underwent salvage procedure. On average, the patients experienced pain relief for 25 months after denervation (range 2 to 165).
- The significance of these results better enable surgeons to give time estimates and expectations regarding pain control following wrist denervation in the patient with chronic wrist pain.

Figure 1. Isolation of posterior interosseous nerve an floor of fourth dorsal compartment through dorsal midline approach (proximal to the right; distal left).

Figure 2. Isolation of anterior interosseous nerve immediately ulnar to interosseous septum.

PAPER 49
Clinical Paper Session 09: Basic Nerve
Saturday, September 12 ● 8:45—8:52 AM
Basic Science, Hand and Wrist, Elbow and Forearm and Arm, Nerve

Hydrophilic Polymers Immediately Restore Axonal Continuity as Assessed by Retrograde Tracer

David C. Riley, BS

Hypothesis: Polyethylene glycol (PEG) immediately restores axonal continuity using an in-vivo rat sciatic nerve injury model.

Methods: Female Spraque-Dawley rats were anesthetized with inhaled 2% isoflurane. The left sciatic nerve was exposed by making a clean 25 mm transection through the biceps femoris. Pre-injury compound action potentials (CAPs) were recorded. The nerve was transected and repaired using standard microsurgical techniques. Polyethylene glycol (PEG) was delivered into the neurorrhaphy using a novel application device. Post-repair compound action potentials were recorded immediately following repair. The sciatic nerve was then cut 4-5 mm distal the repair site. The proximal stump was exposed to 5 µL of 2% fast blue tracer for 1 hour. The biceps femoris was sutured using horizontal mattress sutures and the skin reaproximated using a running subcuticular suture. Animals were sacrificed on post-operative day 7 by perfusion fixation. Thirty evenly spaced cross-sections of the lumbar spinal cord were taken from L2-L4. Experimental animals were treated with Plasmalyte A, 1% methylene blue, 50% by weight solution of polyethylene glycol (PEG), and Lactated Ringers; control animals did not receive PEG.

Results: We found that PEG rapidly restores axonal continuity as assessed by compound action potential conduction and intracellular retrograde tracer across the injury site. In our study, we found that 83.33% (5/6) of PEG fused animals had restored CAP function immediately following repair while 0% (0/6) of control animals had any signs of CAP recovery. Additionally, PEG treated animals were associated with a statistically significant increase in the number of fluorescently labeled motor neurons from L2-L4 of the spinal cord compared to negative control animals. Finally, we found a significant decrease in the number of fluorescently labeled cells for PEG vs positive control which indicates that not all axons are being fused in PEG treated animals.

Summary Points:
- We believe PEG fusion techniques may drastically improve the long-term recovery of more proximal nerve injuries where poor outcomes are more common.
- The ability to record through conduction action potentials following repair in PEG treated animals suggest that axonal continuity is immediately restored following application of PEG.