

Chapter 17:

Sprains Of The Wrist

Barbra Koczan, PT, CHT, DPT

I. Ligamentous Injuries of the Wrist

Intrinsic/interosseous ligaments–Ligaments that span between individual carpal bones, are contained inside the joint capsule and are bathed in synovial fluid. **Extrinsic/capsular ligaments**–Ligaments that connect the radius to the carpal bones.

A. Carpal ligaments¹

1. Palmar ligaments

- a. Have double V-shape, are thick and strong and intracapsular
- b. Stabilize against hyperextension and ulnar translation of carpus
- c. Include lunotriquetral, deltoid, radiolunate, radioscaphocapitate, radial collateral ligament, ulnotriquetral, ulnolunate, and radioscapholunate

2. Dorsal ligaments

- a. Are thinner, less clearly defined and more likely to be injured
- b. Prevent volar instability
- c. Includes radioscaphoid, radiolunate, radiotriquetral, dorsal intercarpal, trapezium trapezoid, trapezoid capitate, capitate hamate
- d. Typically injured due to a forceful hyperextension injury

B. Carpal instabilities

1. Occur due to direct, blunt trauma; sudden, uncontrolled excessive force or repetitive, controlled force
2. Carpal instability Dissociative(CID)–injury to intrinsic ligaments; involves injury to ligaments between bones in the same carpal row^{2,3,4}

a. Scapholunate (SL) ligament (Fig. 1)

- i. Most common injured ligament at wrist
- ii. Young to middle aged population
- iii. Results from fall on extended wrist or repetitive strong grasp
- iv. Symptoms–acute–painful, swollen and tender wrist; decreased grasp strength
- v. Positive Watson’s test and Scaphoid shift test
- vi. X-Ray
 - a. Clenched fist–loads SL ligament; shows increased gap between SL interval
 - b. AP–“Terry Thomas sign”–widened gap between scaphoid and lunate; may see “cortical ring sign”– fixed flexed posture of scaphoid makes it appear perpendicular to the radius
 - c. Lateral–abnormal SL angle (>60 degrees) SL ligament disruption leads to extension of the lunate relative to the longitudinal axis of the radius and capitate

** Normal SL angle is 30-60 degrees which indicates the angle created by the lunate in relation to the longitudinal axis of the radius and capitate with the wrist in neutral. The scaphoid has the tendency to flex and the triquetrum has a tendency to extend, with the lunate in between; intact SL and LT ligaments in the normal wrist restrain the scaphoid and triquetrum; disruption to the ligaments can lead to an increase or decrease in the SL angle (Fig. 2)^{3,5}*

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- vii. DISI (dorsal intercalated segmental instability) deformity
 - a. Occurs with chronic SL injury
 - b. With SL ligament disruption, scaphoid flexes and lunate and triquetrum extend; SL angle >60 degrees
 - c. Can lead to degenerative arthritis (typically radioscaphoid then capitulunate)
- viii. Further progression can lead to arthritic degeneration of all carpal bones (SLAC–scapholunate advanced collapse)
- ix. Nonoperative management (i.e. casting to correct and maintain SL alignment)
 - a. Casting typically fails—not adequate to maintain reduction
 - b. If closed reduction possible, often K-wires placed with cast immobilization
 - c. If closed reduction possible, immobilization must be maintained for 6 weeks
 - d. Activity modification—patient must avoid loading of wrist (weight bearing; pressure on wrist at end range extension or deviation) and strong grasp
- x. Surgical intervention for SL insufficiency
 - a. Acute
 - 1. Arthroscopic debridement of portions of frayed ligament
 - 2. Direct ligament repair—must reduce scaphoid, directly repair ligament then protect ligament with K-wire fixation
 - 3. Dorsal capsulodesis—reinforcement of the SL ligament using the dorsal capsule or portion of the dorsal retinaculum; done to decrease the palmar flexion and dorsal subluxation of the scaphoid
 - b. Chronic
 - 1. Ligament reconstruction with tendon graft
 - 2. Partial fusions—SL, STT (scaphotrapezium trapezoid), or SC (scaphocapitate) fusions
 - c. Post-op management
 - 1. Cast 6-8 weeks
 - 2. Protected wrist AROM at 6-8 weeks; focus on tenodesis pattern and dart thrower’s motion (DTM—utilizes midcarpal joint motion to a greater degree than radiocarpal motion; is in a plane approximately 30-45 degrees from the sagittal plane and is a combination of wrist flex/ulnar deviation and wrist ext/radial deviation. (Fig. 3)^{6,7,8}
 - 3. Gentle PROM and grip strengthening at 8-12 weeks
 - 4. Passive forceful flexion contraindicated due to overstretching of repaired ligament resulting in instability
 - d. Post-op goals
 - 1. Post-op wrist ROM goals—40 degrees of flexion
 - 2. Stability and pain relief—never compromise stability for mobility

Chapter 17 Figures

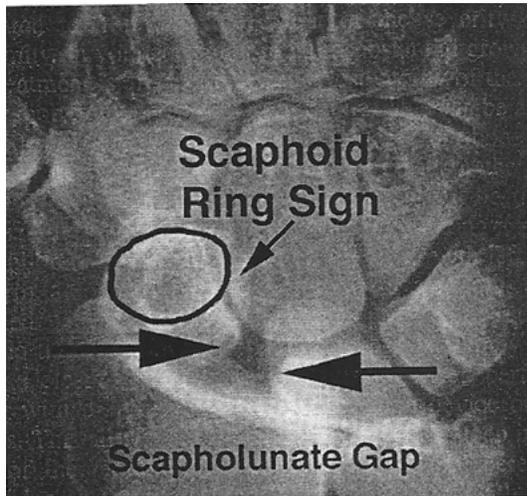


Fig. 1. Scapholunate ligament tear with scaphoid ring sign and a gap between the scaphoid and lunate. Printed with permission: Trumble TE. Principles of Hand Surgery and Therapy, 2nd Ed. Philadelphia, PA: WB Saunders; 2000. (p.108 Figure 5-53).

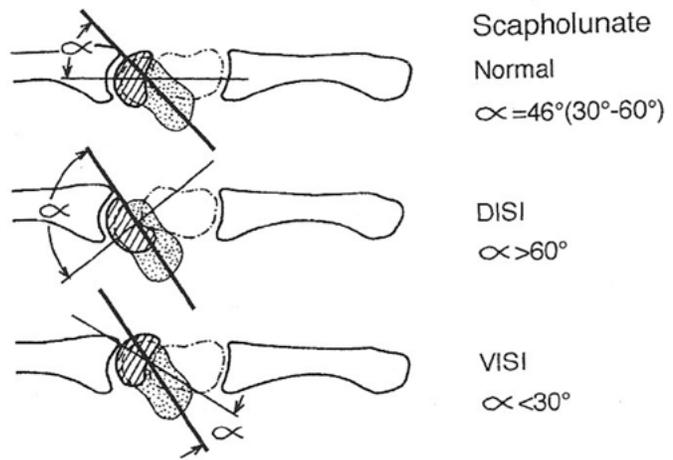


Fig. 2. Scapholunate angle: Volar Intercalated Segmental Instability (VISI); Dorsal intercalated segmental instability (DISI) and normal angles. Printed with permission: Trumble TE. Principles of Hand Surgery and Therapy, 2nd Ed. Philadelphia, PA: WB Saunders; 2000. (p.91, Figure 5-4).

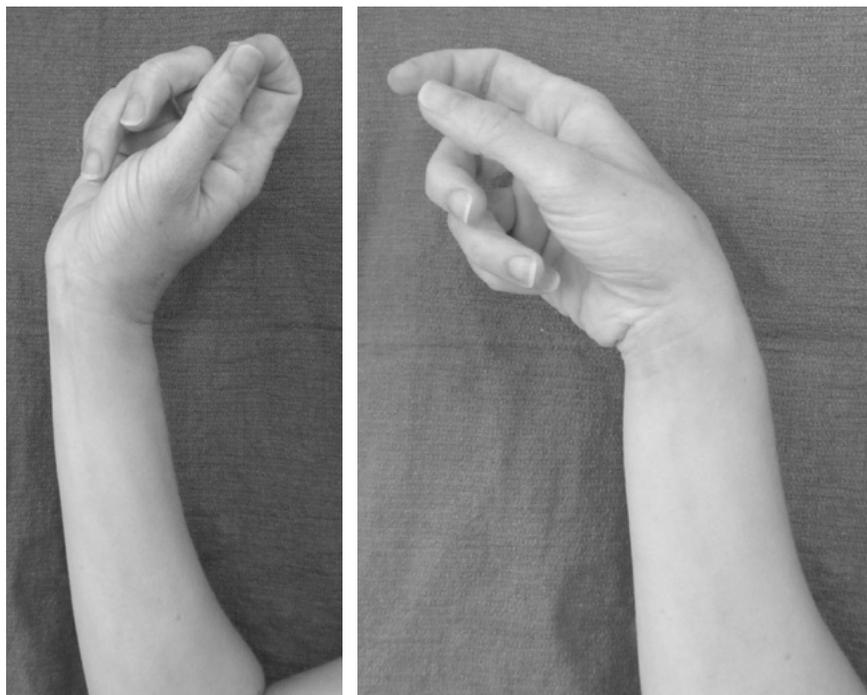


Fig. 3. Dart Thrower's Motion utilized with SL injury.

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3. Activity modification—help patient realize that normal wrist biomechanics have changed, thus, certain activities stressing end range flexion should be avoided
- xi. Surgical intervention for SLAC wrist^{4,9}
 - a. STT fusion with partial radial styloidectomy—not done if radioscaphoid arthritis is present
 - b. Dorsal capsulodesis
 - c. 4 corner fusion—capitate wedges between scaphoid and lunate; lunate, triquetrum, hamate, capitate fused; scaphoid excised; wrist maintains about 50% motion
 - a. Immobilize for 6-7 weeks
 - d. Proximal row carpectomy (PRC)—scaphoid, lunate and triquetrum and tip of radial styloid are removed
 - a. Goal—pain relief, functional ROM, functional grip strength
 - b. Wrist maintains about 50% motion; grasp maintains about 75% of contralateral hand
 - c. Management
 - i. 2-4 weeks—wrist immobilized in cast or orthosis
 - ii. 4 weeks—AROM
 - iii. 6 weeks—strengthening
 - iv. Digital flexion may be decreased due to altered biomechanics and tension of flexor tendons
 - e. Wrist fusion—if longstanding diffuse degeneration, all motion is sacrificed for stability and pain relief; Scapholunate, scaphocapitate, lunocapitate, radioscaphoid, and capitate and 3rd metacarpal are fused, typically using a plate
 - a. 6-8 weeks casted
 - b. Wrist cock-up orthosis for 8-12 weeks
 - c. 10-12 weeks—strengthening
 - d. Complications
 - i. Decreased MP joint flexion due to plate
 - ii. Extensor tendinitis due to tendons rubbing on plate

**Surgical interventions for SLAC wrist are typically salvage-type procedures. A significant decrease (or absence) of wrist ROM should be expected, thus a decline in functional usage of the wrist should be anticipated.*

- b. LT (lunotriquetral) ligament^{2,4,9,10,11}
 1. Less common than SL injury
 2. Usually occurs due to injury to ulnar wrist, i.e. fall on extended and radially deviated wrist
 3. Ulnar wrist pain with grip and ulnar deviation, tender LT joint, weak grasp
 4. Positive Ballotement test—stress LT ligament
 5. X-Ray—either normal or will show VISI (see description below) on lateral view
 6. Arthrogram—positive
 7. MRI—useful in ruling out other wrist pathologies

8. VISI (volar intercalated segmental instability) deformity—with disruption of LT ligament, scaphoid flexes and pulls lunate into flexion as well; SL angle <30 degrees (Fig. 2)^{3,4,5}
9. Conservative management
 - a. Cast or wrist orthosis for 6-8 weeks
 - b. Begin AROM of wrist at 6-8 weeks
 - c. Begin gentle grip strengthening 2-4 weeks after cast/wrist orthosis removed
10. Surgical intervention^{5,11}
 - a. Acute injury
 - i. Direct ligament repair—reduction of carpals, ligament repair with capsulodesis to tighten dorsal structures, percutaneous pinning
 - b. Chronic
 - i. LT fusion
 - ii. 4 corner fusion-capitate, lunate, hamate, triquetum—chronic LT injury
 - iii. Total wrist fusion—if diffuse carpal osteoarthritis (OA)
 - c. Post-op management
 - i. Cast for 6-8 weeks
 - ii. Orthosis usage for an additional 4 weeks
 - iii. Begin AROM at 6-8 weeks
 - iv. Add gentle resistive exercises at 10-12 weeks
- A. CIND—Carpal instability nondissociative—instability within extrinsic ligaments; abnormal motion of the entire proximal carpal row at radiocarpal or midcarpal joint^{2,3,4}
 - a. Symptoms
 - i. Generalized pain and clunk with deviation of wrist
 - ii. No swelling typically
 - iii. Depression at midcarpal joint when wrist is flexed
 - b. Causes
 - i. Typically due to ligament laxity
 - ii. Can be caused by distal radius fracture malunion
 - c. Typically occurs at midcarpal joint (capitate and lunate instability)
 - d. Usually young women with minor trauma to wrist; ligament laxity present throughout body
 - e. Diagnostic tests
 - i. Exam under fluoroscopy—best diagnostic test
 - ii. CT Scan—useful to show distal radius malunion
 - f. Non-operative management—NSAIDS, wrist cock up orthosis or ulnar boost orthosis to support midcarpal joint,¹² activity modification (avoidance of ulnar deviation)
 - g. Surgical management
 - i. Soft tissue reconstruction (capsule or ligament tightening)
 - ii. Bony reconstruction (triquetral hamate fusion, 4 corner fusion, total wrist

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- fusion, ulnar shortening, distal radius osteotomy)
- h. Post-op goals
 - i. Create stability of proximal row
 - ii. Educate patient on permanent alteration of wrist biomechanics and on activity modifications to accommodate decreased wrist ROM and strength
- E. CIC—Carpal instability combined—occurs when both intrinsic and extrinsic ligaments in the wrist are unstable; combination of CID and CIND^{2,3,4}
 - a. Cause—high impact injury; forceful extension, resulting in dislocation of capitate on lunate
 - b. SL, LT and radiocarpal ligaments are disrupted
 - c. Usually young men
 - d. X-Ray
 - i. Lateral—complete dislocation of capitate on lunate
 - ii. AP—lunate flexed; carpals appear shortened
 - e. Management
 - i. Acute cases
 - 1. Closed reduction with traction and K-wire fixation of scaphoid to lunate and scaphoid to capitate to hold reduced position
 - 2. Open reduction with K-wire fixation and SL, LT and radiocarpal ligament repair
 - 3. Post-op therapy—immobilize 6-8 weeks followed by pin removal and remobilization
 - 4. Goals—functional wrist, decreased pain, ROM 50% of contralateral wrist
 - ii. Chronic perilunate dislocation—severe injury associated with a major trauma; the lunate remains in its normal position while the remaining carpal bones and hand dislocate dorsally to it; can be caused by a scaphoid fracture or major disruption to the stabilizing ligaments of the wrist; reduction no longer possible. Procedures are done to limit motion between carpal rows so anticipated motion is less than procedures done to limit motion within carpal rows¹³
 - 1. PRC
 - 2. Total wrist fusion
- F. TFCC—(Triangular Fibrocartilage Complex) (see Figure 4)^{2,3,4,5}
 - 1. Major stabilizer of the distal radioulnar joint (DRUJ)
 - 2. Composed of ulnocarpal ligaments, triangular fibrocartilage, meniscal structure, articular disc
 - 3. Articulates with lunate and triquetrum on ulnar side of wrist
 - 4. Suspends distal radius and ulnar carpus from distal ulna
 - 5. Accounts for approximately 20% of the load applied across the wrist
 - a. Distal radius absorbs 80% of axial load
 - b. Changes in forearm-wrist unit significantly affect radial load transmission (i.e. in the normal wrist, the distal articular surface of the ulna is even with the distal radius)

- c. Ulnar (+) wrist (ulna is distal in relation to the radius) has increased force absorbed by distal ulna; may lead to ulnocarpal impingement
 - d. Ulnar (-) wrist (ulna is proximal in relation to the radius) has decreased force absorbed by distal ulna; may lead to Kienbock's disease
6. Causes of TFCC injury
- a. Degenerative changes due to Ulna (+) variance (ulnocarpal impingement)
 - b. S/P distal radius fracture
 - c. Twisting motion of loaded wrist
7. Central 80-85% of articular disc is avascular does not have potential to heal
8. Peripheral vascular portion has potential to heal
9. Symptoms
- a. Ulnar side wrist pain
 - b. Instability of DRUJ
 - c. Pain worsens with ulnar deviation, grasp, forearm rotation
 - d. TFCC Shear test (+)
10. Conservative management^{2,4,9}
- a. Immobilize about 6 weeks in long arm orthosis with forearm and wrist in neutral; gentle painfree AROM of wrist and forearm may be done but no physical activity out of orthosis; educate in risk factors
 - b. At 6 weeks initiate gentle AROM and PROM as tolerated
 - c. At 8 weeks, if symptoms have subsided, add gentle progressive strengthening with forearm in neutral, avoiding weight bearing and rotation
 - d. At 10-12 weeks, if symptoms continues to be asymptomatic, add progressive weight bearing (Fig. 4), wrist deviation and forearm rotation strengthening
11. Surgical management^{2,9,10}
- a. Central debridement—debridement of avascular central portion of TFCC
 - i. Treatment—wrist is immobilized in wrist cock up orthosis for 1-2 weeks; at 1-2 weeks add AROM wrist/forearm; at 4-6 weeks add AAROM/PROM and gentle strengthening in neutral rotation; progress strengthening in deviation and rotational motions and weight bearing as tolerated
 - ii. Goal is to eliminate pain so educate patient on risk factors
 - iii. May need to have ulnar shortening procedure (ulnar osteotomy, Suave-Kapandji) if positive ulnar variance
 - iv. With debridement there is nothing to protect so treatment progresses quicker than with peripheral repair
 - b. Peripheral Repair—Direct repair of the peripheral (vascular) portion of the TFCC^{2,10,14}
 - i. Immobilization in long arm orthosis or muenster orthosis (Fig. 5) for 6-8 weeks with forearm and wrist in neutral; initiate gentle wrist AROM at 3-4 weeks; educate on avoidance of weight bearing, grasp, rotational motions

Chapter 17 Figures



Fig. 4. Progressive weight bearing (WB into therapy putty) utilized after TFCC injury.



Fig. 5. Muenster orthosis used after TFCC peripheral repair.

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- ii. At 6-8 weeks add forearm rotation AROM; wrist orthosis worn for additional 2-4 weeks
- iii. At 8 weeks initiate gentle PROM forearm and wrist
- iv. At 10-12 weeks gentle strengthening initiated with forearm in neutral
- v. At 12+ weeks initiate strengthening with rotational motions and weight bearing activities

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Multiple Choice Questions

1. Post-operative treatment following SL insufficiency focuses on all of the following except:
 - A. Not compromising stability for mobility
 - B. Educating patient on how biomechanics of the wrist have changed
 - C. Early mobilization
 - D. Avoidance of end range flexion stress
2. Your patient wants to know why they are able to still move their wrist despite their 4 corner “fusion” at their wrist. What would you tell them?
 - A. Explain that the fusion must not have worked or that they began moving too soon
 - B. Explain the mechanics of motion occurring at the radiocarpal joint which is not disturbed but the midcarpal motion was “fused” thus leaving 50% ROM
 - C. Explain that the motion at the midcarpal joint was not disturbed but the radiocarpal joint was “fused” thus leaving 50% ROM
 - D. Explain that the motion between the scaphoid and distal carpal row was altered thus significantly limiting ROM
3. A 15-year-old girl presents to clinic after a fall with tenderness at the radial wrist and pain with movement. XRays negative for scaphoid or distal radius fracture. Diagnosis: wrist sprain. What diagnostic test would you want to do?
 - A. Ballottement test
 - B. Watson’s
 - C. TFCC shear test
 - D. Piano Key test
4. When shadowing your hand surgeon you look at an XRay of a patient with SL insufficiency. What would you not potentially expect to see?
 - A. Abnormal SL angle less than 30 degrees
 - B. “Terry Thomas” sign
 - C. Cortical ring sign
 - D. Abnormal SL angle greater than 60 degrees
5. What would you not expect to see with a patient with a DISI deformity?
 - A. Chronic SL injury
 - B. SL angle 30 degrees
 - C. Flexed Scaphoid
 - D. Lunate extended
6. Six weeks after SL repair patient has questions regarding return to golf. What would your instructions be?
 - A. Typically, return to sports does not occur until at least 8 weeks post op
 - B. Typically, return to sports can begin at 6 weeks post op, as long as he is careful
 - C. Typically, patients should not expect to return to impact sports after SL repair
 - D. Typically, return to sports does not occur until at least 12 weeks post op

Multiple Choice Questions

7. Patient is a 25-year-old woman who presents with a generalized clunk and pain with wrist deviation and you note laxity of all upper extremity joints. What would you suspect?
 - A. SL injury
 - B. CIND
 - C. CID
 - D. LT injury

8. How would you best treat the woman in the above question?
 - A. Ulnar boost orthosis and pain and activity modification
 - B. Thumb spica orthosis and pain and activity modification
 - C. Long arm orthosis and pain and activity modification
 - D. No orthosis necessary; strengthen wrist and hand

9. Following chronic perilunate dislocation which surgery would you expect your patient to have?
 - A. SL repair
 - B. LT repair
 - C. PRC
 - D. Ulnar shortening osteotomy

10. What would not be an expected cause of TFCC injury?
 - A. Ulna positive variance
 - B. Kienbock's disease
 - C. Distal radius fracture
 - D. Twisting motion of a loaded wrist

11. Patient is status post TFCC sprain. To decrease load on TFCC what would you do?
 - A. Have patient perform wrist extension exercises in pronation
 - B. Have patient practice opening a jar
 - C. Have patient squeeze putty for 50 repetitions each therapy session
 - D. Have patient do all gripping in supination

12. Which is the correct pair
 - A. Ulnar negative: ulnocarpal impingement
 - B. Ulnar negative: Presser's disease
 - C. Ulnar negative: Kienbock's disease
 - D. Ulnar negative: Increased axial load on ulna

13. Following TFCC central repair what is the appropriate orthosis?
 - A. Muenster orthosis 2 weeks; begin AROM exercises
 - B. Muenster orthosis 6-8 weeks; wrist orthosis an additional 2-4 weeks
 - C. Wrist orthosis 12 weeks
 - D. Muenster orthosis 6-8 weeks; wrist orthosis an additional 6-8 weeks

Multiple Choice Questions

**Multiple Choice Question Answer Key
Chapter 17**

1-C, 2-B, 3-B, 4-A, 5-B, 6-D, 7-B,
8-A, 9-C, 10-B, 11-D, 12-C, 13-B

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