Carpal Instabilities

Orthopaedic Hand Conference

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Definition by IFSSH

Wrist is unstable only if it exhibits

- symptomatic dysfunction
- inability to bear loads
- abnormal carpal kinematics

Garcia-Elias, JHS 1999

Mayo Classification

Wright, JHS (Br) 1994

- Carpal Instability Dissociative (CID)
- Carpal Instability Non-Dissociative (CIND)
- Carpal Instability Adaptive (CIA)
- Carpal Instability Complex (CIC)

CID - Dissociative

Instability within carpal row usually due to intrinsic ligament injury

- Scapholunate dissociation
- Lunotriquetral dissociation
- Scaphoid fracture
CIND - Nondissociative
Instability between carpal rows due to extrinsic ligament injury

- CIND - Volar Intercalated Segment Instability (VISI)
- CIND - Dorsal Intercalated Segment Instability (DISI)
- Combined CIND

CIA - Adaptive
Extra-carpal derangement causing carpal malalignment

Midcarpal instability caused by malunited fractures of the distal radius
Taleisnik, JHS 1984

CIC - Complex
Instability patterns with qualities of both CID and CIND patterns

- Dorsal perilunate dislocations (lesser arc)
- Dorsal perilunate fracture-dislocations (greater arc injuries)
- Volar perilunate dislocations
- Axial dislocations, fracture-dislocations
Perilunate Dislocations

- Uncommon, 7% of all carpal injuries
- High-energy axial load (MVA, fall from height, contact sports)
- Mechanism - Hyperextension, ulnar deviation, intercarpal supination (Mayfield, 1980)
- Present w/wrist pain, swelling, limited motion
- Dx often missed, radiographs misinterpreted

Mayfield Classification
Progressive Perilunar Instability

- I - Rupture SLIL, RSCL
- II - CL dissociation
- III - Rupture LTIL, dorsal carpal dislocation
- IV - Palmar lunate dislocation (LRL & SRL ligaments intact)

Greater or Lesser Arc Injuries

- Perilunate injuries may involve bones, ligaments or both
- Greater arc injuries include fractures of scaphoid, capitate (slower force application)
- Lesser arc injuries involve ligaments only (more rapid force application)

Imaging

- PA XR - Disruption Gilula’s arcs
- Lateral XR - Loss of carpal colinearity
- CT scan to assess carpal fractures
Immediate Closed Reduction

- Prompt reduction to decompress median nerve in carpal canal
- IV sedation in emergency room setting
- Longitudinal traction for 5-10 minutes
- Dorsal-directed pressure on lunate with wrist palmar flexion

ORIF for Best Result

Volar, Dorsal or Combined Approach

- Volar - release carpal canal, reduce lunate, repair LTIL and volar capsule (space of Poirier)
- Dorsal - restore carpal alignment, repair SLL, address carpal fractures, repair DRCL
- K-wire stabilization of SL, LT and midcarpal reductions
- Suture anchors for capsular repair, capsulodesis

Perilunate Dislocations & Transscaphoid
Perilunate Fx–Disl: 10-Year Follow-Up
Forli et al., JHS 2010 35A: 62-68

- Retrospective review 18 pts, avg 13-yr F/U
- Mayo score - 5 exc, 3 good, 7 fair, 3 poor
- Radiographic arthrosis observed in 12 pts
- Post-traumatic arthrosis well-tolerated
- Therapeutic Level IV study (France)

Perilunate Summary

- Goal is stable wrist, minimal pain, functional arc of motion
- Most patients will not regain normal motion or grip strength
- If diagnosis missed in patient < 30 yrs, ORIF should be attempted
- Older patients more than 4 wks post-injury should have salvage proximal row carpectomy
Scapholunate Instability

- Prime stabilizer SL joint
- C-shaped 3-part ligament
  - Dorsal is thickest, strongest
  - Palmar is thinner, weaker
  - Proximal is thin, weakest
- Secondary stabilizers are RSC, DRC, DIC, ST ligaments

Natural History

- Secondary stabilizers stretch leading to DISI
- Lunate extends, scaphoid flexes with wrist RD
- Abn wrist mechanics over time leads to SLAC
- Radioscaphoid, then capitolunate arthrosis
- Timely rx SL dissociation may prevent SLAC

Acute Scapholunate Injury

- FOOSH mechanism with wrist in extension, ulnar deviation, supination
- Rarely present acutely < 6 weeks from injury
- Pain with wrist loading such as push-ups
- Focal swelling, tenderness at SL interval
- Positive scaphoid shift test (if tolerated)
Scaphoid Shift Test

- Apply pressure to scaphoid tuberosity as wrist is moved from ulnar to radial deviation
- SLIL tear allows scaphoid proximal pole to subluxate dorsally wrt scaphoid fossa
- Release pressure, scaphoid reduces into scaphoid fossa with reduction “clunk”

Kinematics of the Scaphoid Shift Test
Wolfe et al., JHS 1997; 22A: 801-06

- 25 uninjured subjects (50 wrists) examined
- 36% subjects had positive scaphoid shift test
- Dorsal and axial displacement correlated with positive test
- Positive test results should be confirmed by fluoroscopic exam

Imaging

- XR - PA, lateral, scaphoid views (UD)
- XR - bilateral clenched pencil views
- MRI - high-resolution, small-field technique

Radiographic Findings

- PA projection
  - SL interval widened
  - SL asymmetry
  - Triangle lunate
  - Scaphoid ring sign
- Lateral projection
  - Increased SL angle
  >70 degrees
Carpal Instability

Wrist Arthroscopy

- Gold standard for diagnosing SLIL injury
- Better sensitivity & specificity vs MRI, MRA
- Permits injury classification (Geissler)
- Allows diagnosis concomitant pathology
- Able to treat partial SLIL arthroscopically

Geissler Classification

- I - redundant ligament, no tear, occult instability
- II - partial tear (proximal, volar), minimal gap, predynamic
- III - partial tear, articular incongruence, moderate gap, dynamic instability
- IV - complete tear/dissociation, gross static instability

Geissler, JBJS 1996

Carpal Instability

Treatment Considerations

Age of Patient
- Young - > 30 yrs
- Middle - 30-60 yrs
- Older - > 60 yrs

Age of Injury
- Acute - < 3 wks
- Subacute - 3-6 wks
- Chronic - > 6 wks

Stage of Injury
- Predynamic
- Dynamic
  - Repairable
  - Not repairable
- Static
  - Reducible
  - Not reducible
- Arthrosis

Carpal Instability

Prognostic Factors

- Is the dorsal SLIL intact?
- If dorsal SLIL disrupted, can it be repaired? (mid-substance vs avulsion)
- Are the secondary scaphoid stabilizers intact? (rotatory subluxation)
- Is the carpal malalignment easily reduced?
- What is the status of the articular cartilage? (radiocarpal and midcarpal joints)

Garcia-Elias, JHS 2006
### Basis for Treatment

- Symptom severity
- Degree of instability (predynamic, dynamic, static)
- Chronicity (acute, subacute, chronic)
- Arthroscopic findings (Geissler grade)

### Treatment Options

- Benign neglect
- Intermittent splinting
- Arthroscopic debridement
- Arthroscopic thermal annealing
- Arthroscopic reduction & pinning
- Open reduction & repair
- Open reduction & capsulodesis
- Open reduction & association
- Open reduction & reconstruction
- Combined procedures

### ARIF: Arthroscopic Reduction Internal Fixation

- **Group I** - < 3 months sx, < 3 mm increase in SL interval - 83% improved
- **Group II** - > 3 months sx, > 3 mm increase in SL interval - 53% improved
- Worse prognosis for older injury, wider gap
- ARIF recommended for Group I patients

  *Whipple, Hand Clinics 1995*

### Arthroscopic Debridement Alone for Intercarpal Ligament Tears

- Weiss et al., JHS 1997; 22A: 344-49
- 127 pts w/wrist pain had arthroscopic debridement of ICL tears, early wrist motion
- 85% w/partial SLIL tears improved, 66% with complete tears improved
- For LTIL, 100% w/partial, 78% w/complete tears improved
- Majority pts improve w/debridement alone

*Whipple, Hand Clinics 1995*
Partial SLIL Injuries Rx With Arthroscopic Debridement and Thermal Shrinkage
Darlis et al., JHS 2005; 30A: 908-14
- 16 pts (mean age 34 yrs) w/partial SLIL tears
- Rx arthroscopic thermal shrinkage volar & proximal portions of ligament, early motion
- Mean F/U 19 months, 14 pts good pain relief, 2 were unchanged
- Longer follow-up needed to establish efficacy

Radiofrequency Thermal Shrinkage
- Thermal probe denatures collagen at 70°C
- Effective for rx Geissler I and II
- Long-term effect on instability unknown
- Outflow portal avoids thermal necrosis
- Contraindicated for pts w/pacemakers
  Sotereanos, JHS 2009

Open Treatment of Acute SLIL Tear
- Dorsal approach, PIN neurectomy
- Plan for dorsal capsulodesis
- Create bed for SLIL repair on lunate
- Carpal reduction, K-wire stabilization
- SLIL repair, dorsal capsulodesis

Postoperative Protocol
- Short-arm splint/cast immobilization x 6 wks
- Removable short-arm orthosis x 6 wks
- Remove K-wires and allow motion at 12 wks
- Strengthening initiated at 4 to 4.5 months
- Unrestricted activity allowed at 6 months
RASL: Long-term Follow-up of Recon Technique for Chronic SL Dissociation
White et al., ASSH 2010

- 36 pts (1991-2008), avg age 50 yrs, F/U 6.4 yrs
- Majority reported improved pain, function
- Flexion-extension arc 80% preserved
- Grip & pinch strength comparable other side
- XR - decreased SL gap and SL angle vs preop

Contraindications

- SL subluxation NOT easily reduced
- Lunate is NOT stable (carpal ulnar translocation)
- Cartilage is NOT normal
- Surgeon is NOT experienced
- Patient is manual laborer

Treatment Algorithm

- I - Thermal annealing or shrinkage
- II - Debridement, thermal shrinkage
- III acute - Arthroscopic debridement, pinning
- III chronic - Capsulodesis vs reconstruction
- IV acute - Open reduction, pinning, repair
- IV chronic - Reconstruction vs arthrodesis

SLIL Tears and DRFx

- Isolated SLIL tears rarely present < 6 wks
- Prevalence of SLIL tears assoc w/DRFx = 40%
- Radial styloid or lunate facet fx should raise suspicion for SLIL tear
- High-grade SLIL tears are problematic
- Operative treatment of both DRFx and SLIL tear should be considered
Intracarpal Soft Tissue Lesions Associated with Intra-Articular Distal Radius Fractures
Geissler et al., JBJS 1996; 78A: 357-65

- Multi-center study 60 DRFx rx w/manipulation, redux, fixation w/fluoro & arthroscopic control
- 26 pts (43%) had TFC tears, 19 pts (32%) had SLIL tears, 9 pts (15%) had LTIL tears
- Soft tissue injuries were most often associated w/lunate facet DRFx

Can Cast Immobilization Successfully Treat SL Dissociation Associated with DRFx?
Tang et al., JHS 1996; 21A: 583-90

- Answer is NO! Consider early operative rx.
- 20 of 424 consecutive pts w/DRFx had SL dissociation on traction flouroscopy
- At 1-yr F/U, study group had worse function than control group w/mean SL gap = 3.8 mm
- 8 of 20 pts required operation for SL symptoms

Intracarpal Ligament Injuries Associated with Distal Radius Fractures
Forward et al., JBJS 2007; 89A: 2334-40

- Prospective study 51 pts w/displaced DRFx who had standard rx & wrist arthroscopy, 1-yr F/U
- Radial shortening >2mm = 4x increase SLIL tear
- Geissler grade III pts had greater likelihood of wrist pain, wider SL dissociation, higher SL angle
- Prognostic Level I study (UK)
Carpal Instability

**Lunotriquetral Interosseous Ligament**
- Primary stabilizer of the LT joint
- C-shaped, 3-part ligament
  - Palmar is strongest vs translation
  - Dorsal is strongest vs rotation
  - Proximal is thin membraneous part
- Secondary LT stabilizers are ulnar volar arcuate ligament, DRC, DIC

**Acute LTIL Injuries**
- Trauma in contact sport athletes
- Ulnar-sided wrist pain, grasp weakness
- Prominent distal ulna, volar ulnar carpal sag, LT tenderness, positive ballottement test
- With LTIL tear, lunate flexes with intact SLIL
- Attenuation secondary stabilizers leads to VISI

**Clinical Findings**
- Ulnar wrist zig-zag deformity
- Limited wrist range of motion
- Decreased grip strength
- Tenderness at ulnar snuff box

**LT Ballottement Test**
- Stabilize lunate between thumb, index finger
- With other hand, translate triquetrum & pisiform dorsal & volar
- Pain on shear stress indicates LTL tear
**Reverse Perilunate Mechanism of Injury**

- Fall onto hypothenar eminence
- Wrist DF, RD, pronated
- LT, then LC, then SL dissociation

**Imaging**

- PA XR - Break in Gilula’s arcs, LT overlap, no gap
- Lateral XR - VISI deformity (late)
- Arthrography - 13% normal wrists have LTIL tear

**Other Diagnostics**

- Fluoroscopy - may see abnormal carpal motion
- MRI - unreliable unless done with contrast
- Arthroscopy is gold standard for dx LTIL tear

**Treatment Algorithm for Acute LTIL Injuries**

- Geissler I - Arthroscopic debridement
- II & III - Debridement, closed pinning, 8 wks wrist immobilization
- IV - Open repair, pinning, capsulodesis, LAC 6-8 wks, pins removed at 10 wks
Treatment of isolated LT injuries ligament:
Arthrodesis, ligament repair or reconstruction
Shin et al., JBJS 2001; 83B: 1023-28

- Outcomes of 57 pts w/LT injuries, F/U 9.5 yrs
- Mean age 30.7 yrs, 98% subacute or chronic
- 27 repairs, 22 arthrodeses, 8 reconstructions
- LT fusions - 41% nonunions, 23% UC impaction
- Pain relief, satisfaction, motion, strength all better for repair or recon than for fusion

Midcarpal Instability

- Proximal carpal row instability under load
- Typical patient is 20-30 yrs c/o clunking with wrist twisting, at extremes of motion
- Post-traumatic or congenital ligamentous laxity
- Proximal row sags into volar flexion due to volar arcuate, DRC ligament incompetence

Physical Exam

- Volar sag ulnar carpus
- Ulnar-sided tenderness
- Audible clunk w/ulnar deviation reduces volar sag
- Positive midcarpal shift test reproduces wrist pain
- Dorsal pressure on pisiform eliminates the clunk
“Catch-Up Clunk”

- Extrinsic ligament (THCL, STL) attenuation leads to CIND-VISI
- Proximal row remains volar-flexed during ulnar deviation
- Hamate abuts triquetrum & proximal row abruptly extends with clunk

Diagnosis

- History & exam - raise suspicion
- XR - may be normal or show VISI
- Videofluoroscopy - diagnostic
- Lateral view - VISI to DISI jump with wrist ulnar deviation

Nonsurgical Treatment

- NSAIDs
- Activity modification
- 3-point dynamic orthosis loading pisiform dorsally
- Proprioceptive training

Surgical Options

- Thermal capsulorrhaphy
- Reefing or reconstruction of volar arcuate, DRC ligaments
- Midcarpal arthrodesis (CL, TH or four-corner)
Arthroscopic Thermal Capsulorrhaphy for Palmar Midcarpal Instability
Mason et al., JHS 2007; 32E: 411-16

- 13 pts, 15 wrists had thermal rx w/monopolar radiofrequency probe for PMCI
- Mean F/U 42 months (range 14 to 67)
- All pts improved (4 resolved, 11 near complete)
- DASH scores improved from 38 to 17
- Thermal capsulorrhaphy is effective w/short F/U

Palmar Midcarpal Instability: Results of Treatment With 4-Corner Arthrodesis
Goldfarb et al., JHS 2004; 29A: 258-63

- 8 pts w/PMCI over 10 yrs rx w/4-corner fusion
- 7 pts were satisfied, 6 had no pain or mild pain
- Flex-ext arc decreased to 75° from 135°
- Grip strength increased from 20 kg to 32 kg
- Four-corner arthrodesis reasonable option

Carpal Instability Summary Comments

- Injuries resulting in carpal instability are rare
- Acute injuries may be missed, so be vigilant. Reduction, pinning, ligament repair indicated.
- Chronic injuries are difficult to classify, treat. Outcome comparisons may not be valid.

Carpal Instability Summary Comments

- Conservative treatment, benign neglect, arthroscopic options are preferred
- Be aware of narrow surgical indications for soft tissue procedures
- Limited intercarpal arthrodeses may be most reliable method to achieve stability