Wrist instability

Christian Dumontier
Institut de la Main & hôpital saint-Antoine, Paris
(with courtesy of A. Pagliei & S. Kozin)
The radio-carpal joint
The first row

- Is devoid of any tendinous insertion
- Intercalary segment
- System with “variable” geometry
The midcarpal joint
3 different joints

- The STT joint allows for flexion/extension of the scaphoid
The triquetro-hamate joint is helicoidal and allows for translation and rotation of the triquetrum on the hamate.
The capito-hamate is the central pivot of the wrist.
The first row forms an adaptable acetabulum
Interosseous ligaments serve as to stabilise the form of the first row.
Wrist “instability”

- Ligamentous injuries
- Secondary to bony lesions (i.e. kienböck’s, distal radius malunion,...)
<table>
<thead>
<tr>
<th>Instability I (Sprain)</th>
<th>Instability II (Subluxation)</th>
<th>Instability III (Dislocation)</th>
<th>Instability IV (Fx-Dislocation)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Radiocarpal</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recurrent symptoms with variable clinical findings; assess by dynamic imaging only</td>
<td>CIND-VISI</td>
<td>Dorsal*</td>
<td>Dorsal Barton’s*</td>
</tr>
<tr>
<td></td>
<td>CIND-DISI</td>
<td>Palmar</td>
<td>Palmar Barton’s*</td>
</tr>
<tr>
<td></td>
<td>Ulnar translation*</td>
<td>Ulnar</td>
<td>Radial or ulnar styloid or fossa &amp; carpal translation</td>
</tr>
<tr>
<td><strong>Perilunate</strong></td>
<td>CID-DISI (SLD)*</td>
<td>Perilunate</td>
<td>Transoseosseous PLD tS-pL* &gt; others</td>
</tr>
<tr>
<td>Recurrent symptoms with variable clinical findings; static imaging normal, cinefluoroscopic imaging can be diagnostic</td>
<td>CID-VISI (LT)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Midcarpal</strong></td>
<td>CIND-VISI* &gt; DISI</td>
<td>Triquetrohamate*</td>
<td></td>
</tr>
<tr>
<td>Dynamic instability with variable clinical findings; static imaging normal, fluoroscopic imaging → midcarpal changes ± “catch-up clunk”</td>
<td>Scaphotrapezium trapezoid DISI &gt; VISI capitolunate</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Axial</strong></td>
<td>†</td>
<td>†</td>
<td>†</td>
</tr>
<tr>
<td></td>
<td>Axial-ulnar or axial-radial (or both) fx dislocations</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Carpometacarpal</strong></td>
<td>CMC II &amp; III; tomogram may confirm</td>
<td>CMC II &amp; III Lateral or obliques +; tomogram confirms</td>
<td>CMC I, IV, V most common; special views (Roberts’) confirm</td>
</tr>
<tr>
<td>Recurrent symptoms of painful grip; variable clinical findings; CMC stress test (Linscheid) positive; static fingers; radiographs normal; + bone scan</td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Distal Radioulnar</strong></td>
<td>Distal, dorsal, palmar, ulnar; axial computed tomogram confirms</td>
<td>Distal, dorsal, palmar, ulnar; lateral radiograph confirms</td>
<td>Distal, dorsal, palmar, ulnar styloid, &amp; sigmoid notch</td>
</tr>
<tr>
<td>Recurrent symptoms with forearm rotation; clinical findings with rotation stress; normal or questionable imaging findings</td>
<td></td>
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</tr>
</tbody>
</table>
### Classification according to the type of instability

<table>
<thead>
<tr>
<th>Type, Site, &amp; Name</th>
<th>Radiographic Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. CID</strong></td>
<td></td>
</tr>
<tr>
<td>1. Proximal carpal row CID</td>
<td></td>
</tr>
<tr>
<td>a. Unstable scaphoid fracture</td>
<td>DISI</td>
</tr>
<tr>
<td>b. Scapholunate dissociation</td>
<td>DISI</td>
</tr>
<tr>
<td>c. Lunotriquetral dissociation</td>
<td>VISI</td>
</tr>
<tr>
<td>1.2 Distal carpal row CID</td>
<td></td>
</tr>
<tr>
<td>a. AR disruption</td>
<td>UT</td>
</tr>
<tr>
<td>b. AU disruption</td>
<td>PT</td>
</tr>
<tr>
<td>c. Combined AR and AU disruption</td>
<td></td>
</tr>
<tr>
<td>1.3 Combined proximal and distal CID</td>
<td></td>
</tr>
<tr>
<td><strong>II. CIND</strong></td>
<td></td>
</tr>
<tr>
<td>2.1 Radiocarpal CIND</td>
<td></td>
</tr>
<tr>
<td>a. Palmar ligament rupture</td>
<td>DISI, UT of entire proximal carpal row</td>
</tr>
<tr>
<td>b. Dorsal ligament rupture</td>
<td>UT with increased SL space; PT (actually is a CIC)</td>
</tr>
<tr>
<td>c. After “radius malunion,” Madelung’s deformity, scaphoid malunion, lunate malunion (see “Adaptive carpus” below)</td>
<td>VISI, DT</td>
</tr>
<tr>
<td>2.2 Midcarpal CIND</td>
<td></td>
</tr>
<tr>
<td>a. Ulnar MCI from palmar ligament damage</td>
<td>VISI</td>
</tr>
<tr>
<td>b. Radial MCI from palmar ligament damage</td>
<td>VISI</td>
</tr>
<tr>
<td>c. Combined UMCI &amp; RMCI, palmar ligament damage</td>
<td>VISI</td>
</tr>
<tr>
<td>d. MCI from dorsal ligament damage</td>
<td>DISI</td>
</tr>
<tr>
<td>2.3 Combined radiocarpal-midcarpal CIND</td>
<td></td>
</tr>
<tr>
<td>a. CLIP</td>
<td>VISI, DISI, alternating</td>
</tr>
<tr>
<td>b. Disruption of radial &amp; central ligaments</td>
<td>UT with or without VISI or DISI</td>
</tr>
<tr>
<td><strong>III. CIC</strong></td>
<td></td>
</tr>
<tr>
<td>a. Perilunate with radiocarpal instability</td>
<td>DISI &amp; UT</td>
</tr>
<tr>
<td>b. Perilunate with axial instability</td>
<td>AxUI &amp; UT</td>
</tr>
<tr>
<td>c. Radiocarpal with axial instability</td>
<td>AxRI &amp; UT</td>
</tr>
<tr>
<td>d. Scapholunate dissociation with UT</td>
<td>DISI &amp; UT</td>
</tr>
<tr>
<td><strong>IV. “Adaptive carpus”</strong></td>
<td></td>
</tr>
<tr>
<td>a. Malposition of carpus with distal radius malunion</td>
<td>DISI or DT</td>
</tr>
<tr>
<td>b. Malposition of carpus with scaphoid nonunion</td>
<td>DISI</td>
</tr>
<tr>
<td>c. Malposition of carpus with lunate malunion</td>
<td>DISI or VISI</td>
</tr>
<tr>
<td>d. Malposition of carpus with Madelung’s deformity</td>
<td>UT, DISI, PT</td>
</tr>
</tbody>
</table>
CID versus CIND

Complex types are the various associations.
Radio-carpal instability

- CIND
- Very (very) rare
- Radio-carpal dislocation
Surgical treatment is recommended

Dumontier et al., JBJS 2001
Proximal CID-Scapholunate
Continuum of lesions
## Scapho-lunate

<table>
<thead>
<tr>
<th>Stage</th>
<th>Occult</th>
<th>Dynamic</th>
<th>Scapholunate dissociation</th>
<th>DISI</th>
<th>SLAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injured Igts</td>
<td>Partial SLIL</td>
<td>Torn SLIL, partial palmar extrinsics</td>
<td>Complete SLIL, volar or dorsal extrinsics</td>
<td>SLIL+extrinsics +2ary lesions</td>
<td>idem</td>
</tr>
<tr>
<td>Xrays</td>
<td>normal</td>
<td>usually normal</td>
<td>SL gap &gt; 3mm +/- SLΔ &gt; 70°</td>
<td>SL gap &gt; 3mm +/- SLΔ &gt; 70°, RLΔ&gt; 15°, CLΔ &lt; 15°</td>
<td>I styloid DJD II RS DJD III CL DJD IV Pan-carpal</td>
</tr>
<tr>
<td>Stress Xrays</td>
<td>normal</td>
<td>abnormal</td>
<td>grossly abnormal</td>
<td>unnecessary</td>
<td>unnecessary</td>
</tr>
</tbody>
</table>

Xrays: normal

SLAC: unnecessary
Direct repair

- Only the dorsal part of the SL ligament can heal
Treatment
Dorsal capsulodesis

- Usually associated with ligamentous repair

Capsulodesis modifications

Szabo (JHS 1999)

Kleinman (ASSH 2000)

Viegas (JHS 1999)
FUNCTION

PAIN

*Taleisnik, 21 pts, 3 yrs FU*
Saffar AOB 1999

37 Patients
Motion - 82%
Pain Relief - 83%
Gap = 4.2 mm

Wyrick JHS 1998

17 Patients (< 3 months after injury, f/u 30 months)
Motion - 60%
Recurrent SL gap
15/17 - Fair/Poor
Bone-ligament-bone

Extensor Retinaculum
- same stress/strain properties as SLI
- 1/3 cross sectional area as SLI
- 1/3 ultimate strength
- “toothpick vs 2X4”


1st cuneiform-navicular ligament
- excellent strength (479 N)
- articular surface interface
- remote donor site

Davis, Culp, Hume, Osterman J Hand Surg 1998
Hofstede, Ritt, Bos J Hand Surg 1999
.062 K wire into scaphoid and lunate as joysticks

manually reduce SL joint
Stabilize with 2 0.045 K wires in palmar 1/2 of scaphoid and lunate
Inset graft into SL channel

Scaphoid

Lunate

Osteotomize dorsal scaphoid and lunate

Plan osteotomy for CH BLT

Secure graft with 1.3 mm screws into scaphoid and lunate

Inset graft into SL channel
<table>
<thead>
<tr>
<th>arthrodesis</th>
<th>Type</th>
<th>Ext / flex (%)</th>
<th>RD/UD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STT</td>
<td>Clinical Simulated</td>
<td>62-80</td>
<td>52-64</td>
</tr>
<tr>
<td></td>
<td></td>
<td>73-88</td>
<td>68-83</td>
</tr>
<tr>
<td>SC</td>
<td>Clinical Simulated</td>
<td>47</td>
<td>79-81</td>
</tr>
<tr>
<td></td>
<td></td>
<td>81-82</td>
<td>52-64</td>
</tr>
<tr>
<td>SCL</td>
<td>Clinical Simulated</td>
<td>47</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td></td>
<td>59-66</td>
<td>64-91</td>
</tr>
</tbody>
</table>
Scapholunate Az

- Motion in flexion and extension goes through the SL joint
- There is no report of a congenital scapholunate fusion
- Fusion difficult to achieve
  - Considerable loads
  - Small surface area
  - About 50% nonunion

“incomplete” SL fusion

- The RASL procedure allows for correction of radiological parameters and improvement of symptoms
- However, radiolucency around the Herbert screw raises concern about the future
STT arthrodesis

- Alters carpal kinematics
- All loads transfer to scaphoid fossa

Sutro Surgery 1946
Peterson & Lipscomb Arch Surg 1967
798 STT arthrodesis

- 543 “rotatory” subluxation
- Union rate 96%
- 86% “better or much better”
- 80% returned to original employment
- Flexion/extension & RD/UD 75%
- Grip strength 80%

STT fusion

• Complications
  • Nonunion 4-24%
  • Radial styloid scaphoid arthritis
  • Progressive carpal arthrosis (may be related to scaphoid reduction)

Fortin & Lewis. J Hand Surg 1990
Kleinman & Carroll. J Hand Surg 1990
McAullife et al. J Hand Surg 1993
SC fusion

- 17 patients (4 rotatory subluxation, 9 Kienbock’s, 3 scaphoid nonunion, 1 lunate nonunion)
- Primary union 15/17 ROM averaged 42° extension, 32 ° flexion
- easier to fuse than STT, but gives more stiffness

Douglas, Peimer et al. JBJS 1987
Garcia-Elias et al. J Hand Surg 1989
SLAC wrist

- I. Radial styloid- scaphoid distal pole
- II. Radius- proximal pole (ovoid anatomy, load change)
- III. Capitohamate joint
- IV. Radiolunate usually spared (spherical)
SLAC wrist

- SLAC treatment options
  - Wrist denervation
  - Radioscapholunate fusion
  - Proximal row carpectomy (PRC)
  - Scaphoid excision & 4-corner fusion
4-corner fusion

- Outcome- multiple studies
- Expected 50-70° (60-70%) flexion-extension and 40-50° (50-70%) radial-ulnar deviation, grip strength 70-80%
- Reliably decreases pain
Must correct the DISI pattern to maximize wrist extension

Proximal row carpectomy

- In stages I & II
- Intact capitolunate joint?
- Volar or dorsal incision
Proximal row carpectomy

- Expected 50-70° (60-70%) flexion-extension and 20-40° (40-50%) radial-ulnar deviation, grip strength 70-80%
- Little to no radial deviation
- Mild x-ray changes over time, clinical results preserved
4-corner vs PRC

Temple University
19 Patients
Mean - 48 years
Follow-up - 17 months

Rush Medical Center
19 Patients
Mean - 47 years
Follow-up - 28 months
Wrist denervation
Wrist arthrodesis

Hastings H et al. Arthrodesis of the wrist for traumatic disorders
<table>
<thead>
<tr>
<th>Partial</th>
<th>YES</th>
<th>YES</th>
<th>YES</th>
<th>YES</th>
<th>YES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic</td>
<td>no</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>2ary stabilizers</td>
<td>no</td>
<td>no</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Irreducible</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>YES</td>
</tr>
<tr>
<td>Cartilaginous lesions</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>YES</td>
</tr>
</tbody>
</table>

- K-Wires
- Bone-lgt
- Suture
- Bone-lgt
- Suture
- Ligamento
- Pasty
- 4-corner, PRC
- Fusion
Lunotriquetral instability

- Less symptomatic
- Do not evolve to a VISI type deformity, unless the dorsal radiotriquetral ligament is also torn
Lunotriquetral instability treatment

- Ligamentoplasty
- Lunotriquetral fusion
K wires at 45° drill into triquetrum and lunate

Lunate
Scaphoid
Triquetrum
Extensor carpi ulnaris
Ulna
Radius
Suture
Split tendon graft
Extensor carpi ulnaris
Although logical, up to 25% non-union rate has been reported.
Midcarpal instability

- The less understood carpal instability
- 2 types (at least)
  - Radial type (STT instability)
  - Ulnar type
Conclusion (1)

- Wrist instability is a wild and mostly unknown world.
- The scapholunate instability is the most frequent and most debilitating carpal instability.
- Diagnosis is difficult in early stages and requires sophisticated imaging techniques and/or arthroscopic evaluation.
• Many techniques have been developed but their indications should be discussed according to the extent of the lesions and patient’s expectations