Carpal Instability

• What is it?
• Incidence
• Anatomy
• Normal Wrist Biomechanics
• Classification
• Examples
Carpal Instability - Definition

• “Carpal injury in which a loss of normal alignment of the carpal bones develops early or late” (Stanley & Trail 1994)
• “A disturbance of the normal balance of the carpal joints caused by fracture or ligament damage” (Larson 1995)
• Carpal Malalignment (Ruby 1996)
• “Disturbance of normal kinematics of the wrist” (Short 1998)
Incidence

- Dobyns (1975): 10% of all carpal injuries resulted in instability
- Jones (1998): 5% of non fracture wrist injuries have scapholunate instability
- Tang (1993): Xray evidence of instability seen in 30% of wrist fractures
Anatomy 1

- Carpus includes 4 sets of joints
  - Distal Radial Ulnar Joint
  - Radio-carpal Joint
  - Midcarpal Joint
  - Carpal-Metacarpal Joints

- Carpus lies in 2 rows
  - Proximal – Scaphoid, Lunate, Triquetral, (Pisiform)
  - Distal – Trapezium, Trapezoid, Capitate, Hamate
Anatomy 2

- Stability of the wrist due to:
  - Shape of the articular surfaces
  - Ligamentous constraints
  - Oblique position of the scaphoid
    - Crossing from the PCR to Midcarpal joint
  - Tendons passing over the carpus
  - Soft tissue investments
  - Opposing torques on the PCR
    - As scaphoid flexes the triquetral extends
Anatomy 3

- **Wrist Ligaments:**
  - **Intrinsic:**
    - Have their origin and insertion within the same carpal row
    - Each bone in each row is bound to its neighbour
    - Proximal Row
      - Scapholunate interosseous ligament
      - Triquetrolunate interosseous ligament
    - Distal Row
      - Bind all the distal carpal bones together
  - **Extrinsic Ligaments:**
    - Origin and insertion on different carpal rows
    - Dorsal and Volar
    - Thickenings in the capsule
Volar Extrinsic Ligaments

1. Radioscaphocapitate
2. Radiolunate
3. Radioscapholunate
4. Ulnalunate
5. Ulnatriquetral
6. Scaphocapitate
7. Triquetral capitate
8. Lunotriquetral
Dorsal Extrinsic Ligaments

1. Dorsal Radiotriquetral
2. Dorsal Intercarpal
Normal Wrist Biomechanics

• Normal Wrist Motion totals 150 degrees
  – 70 degrees Extension
    • 66% RC Jt, 33% Midcarpal Jt
  – 80 degrees Flexion
    • 60% Midcarpal Jt, 40% RC Jt

• Radial – Ulna Deviation totals 50 degrees
  – 20 degrees Radial
  – 30 degrees Ulna
    • 60% Midcarpal Jt, 40% RC Jt
Flexion/Extension Views

MRI Flexion and extension views of the wrist joint in the sagittal plane
Radial/Ulna Deviation Views

MRI Ulna and Radial deviated positions of the wrist joint in the coronal plane.
Normal Carpal Kinematics
Normal Carpal Angles

- Scapholunate angle 30-70 degrees
- Capitolunate angle -6 to 30 degrees
- Radioscaphoid angle 55-70 degrees
Classification

• Mayo
  – Static
    • loss of normal alignment on Xray
  – Dynamic
    • Xray within normal limits with instability produced by voluntary movement or manipulation
Classification

- Dissociative
  - Relating to instability between individual carpal bones of the same row

- Non Dissociative
  - Relating to instability between carpal row or transverse osseous segments
  - Can be caused by ligament injury or fracture or both
Classification

Carpal Instability
Dissociative

Carpal Instability Non Dissociative
Types of Carpal Instability - DISI

- Dorsal Intercalated Segment Instability – DISI
  - Most common
  - Dorsiflexion abnormality
  - Lunate rotates into dorsiflexion
  - Zig-zag alignment of the radiolunatocapitate alignment
  - Capitate displaces dorsally to the long axis of the radius

- Most common example is: Scapho-lunate dissociation
  - Capitate is forced between the scaphoid & lunate to create a gap
  - Scaphoid flexes
  - Lunate extends
  - Leads to:
    - Increase in capito-lunate angle
    - Dorsal translation of the distal carpal row
    - Proximal pole of the scaphoid extends into the dorsal rim of the radius
    - Ulnar translation of the luno-triquetral block
Types of Carpal Instability

Schematic Diagram of DISI and VISI

NB: Increased S-L angle in DISI and decreased in VISI
Specific signs on x-ray:

- Increased S-L gap,
- Ring Sign,
- Scaphoid short <7mm,
- Dorsiflexed lunate,
- Triquetrum dorsiflexed
Types of Carpal Instability - VISI

- Palmar Flexion
  - Volar Intercalated Segment Instability VISI
    - Radiocarpal flexion
    - Intercarpal extension
  - Scaphoid and Lunate in palmar flexion
  - Most common
    - Lunotriquetral dissociation
      - Failure at L-T ligament
      - Loss of triquetral extending force on the lunate
    - Carpal instability non dissociative (CIND)
      - Midcarpal instability (Ligamentous laxity)
Types of Carpal Instability - VISI

Ring sign, Scaphoid short, Lunate volar flexed. Triquetrum distal in relate to hamate Ulnar head & Triquetrum reduced, Convex outline of proximal carpal row is interrupted.
Types of Carpal Instability - 3

- Ulnar Translocation
  - Abnormal translocation of the lunate ulnarward
    - Type 1 – the entire carpus is translocated ulnarward
    - Type 2 – the relationship between the radius and scaphoid is normal but the scapholunate gap is wide
      - Commonly seen in Rheumatoid Arthritis
Types of Carpal Instability - 4

- Dorsal Subluxation
  - Malunion fracture distal radius with reversal of the normal palmar tilt
Examples of DISI

• Dissociative Injuries:
  – Displaced Scaphoid Fracture
  – Scapho-lunate Dissociation
  – Perilunate Dissociation
  – Perilunate Fracture Subluxation

• Non Dissociative Injuries
  – Colles Fracture
  – Dorsal Barton’s Fracture
Examples of VISI

• Dissociative Injuries
  – Displaced Triquetral Fracture
  – Lunotriquetral Dissociation
  – Perilunate Fracture Dislocation

• Non Dissociative Injuries
  – Smith’s Fracture
  – Volar Barton’s Fracture
Outcome

• If left untreated generally result in arthritis of the wrist
  – Scapholunate advanced collapse (SLAC)
    • 2ndy to ligamentous injury
    • Radioscaphoid jt
    • 3 stages
  – Scapho Non Union Advanced Collapse (SNAC)
    • 2ndy to fracture
    • 2 stages
  – Scapho trapezo- trapezodial arthritis (STT)
Treatment

• Carpal Instability Dissociative
  – Scaphoid #/Non Union
    • Treat # or Malunion
  – Scapholunate Ligament Injury
    • Acute
      – Early open repair + K wire fixation
      – Delayed open repair performed up to 6 months
      – Repair by direct suture or pull through sutures
    • Chronic
      – Scapho-trapezio-trapezoid fusion
      – Dorsal capusulodesis
Treatment

• Carpal Instability Dissociative
  – Established SLAC
    • Scaphoid Excision and 4 corner fusion (C-H-L-T)
    • Proximal Row Carpectomy
    • Radial Styloidectomy
    • Wrist Denervation (division of anterior and posterior interosseous nerves at the wrist)
Treatment

- Carpal Instability Dissociative Lunotriquetral Ligament Injury
  - Rarely recognised acutely – but if achieved then acute ligament repair
  - Lunotriquetral fusion
  - FCU tenodesis

- Acute Perilunate Dislocation
  - Immediate closed reduction & open repair of the ligaments
Scapholunate Dissociation
Perilunate Dislocation
Scapholunate collapse
Thank You