Carpal Instability

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Carpal Instability - Definition

- Inability to maintain normal alignment and distribute load under physiologic conditions.
  - Results from ligamentous and osseous injuries.
  - “Static” pattern: abnormal carpal alignment at rest
  - “Dynamic” pattern: normal carpal alignment at rest but abnormal alignment with movement or stress.

Carpal Instability - Caveats

- Little consensus in literature regarding classification.
- Biomechanics of the many extrinsic and intrinsic ligaments still being investigated.

Diagnosis of carpal disorders

- Start with plain radiographs to assess alignment.
- Articular bones have opposing surfaces 2 mm or less.
- Check Gilulas lines.
- Three smooth arcs. Disruption in the continuity suggests abnormality at site of broken arc.

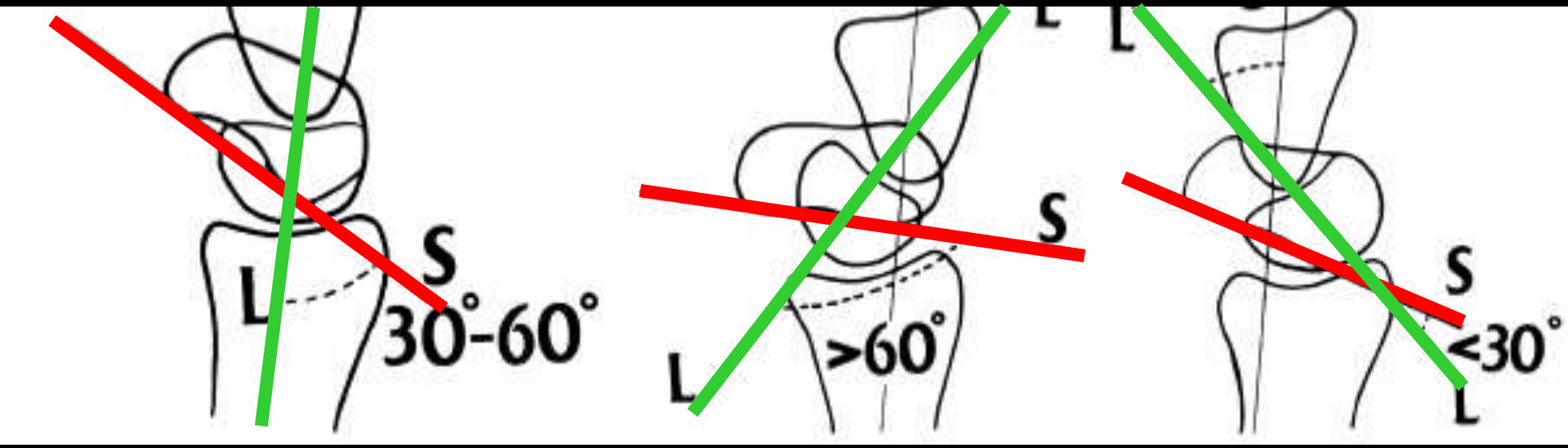
Overview of Patterns of Carpal Instability

- Dissociative
  - Scapholunate dissociation
  - Lunotriquetral dissociation
- Non-dissociative
  - Radiocarpal
  - Midcarpal

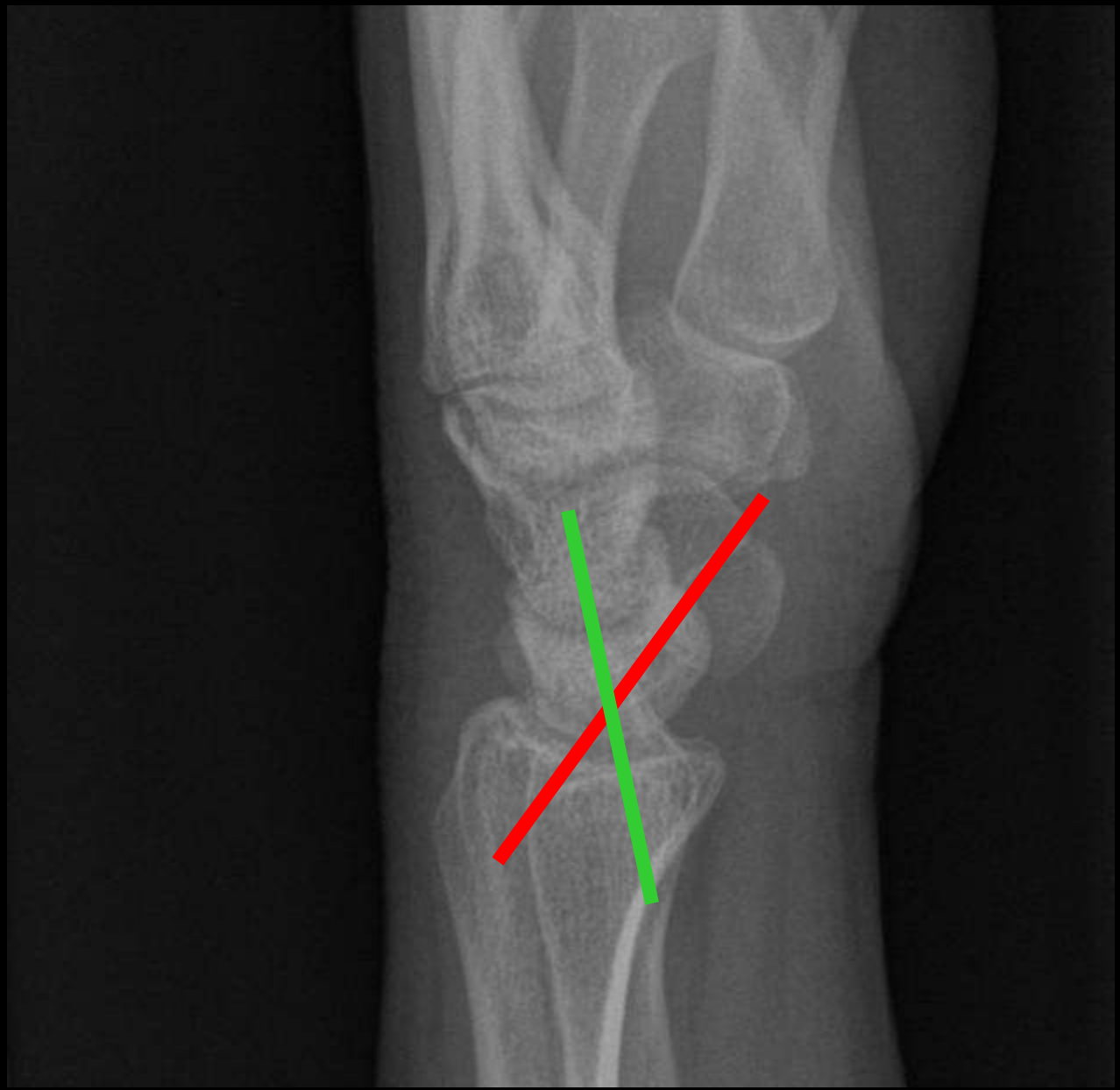
Normal

DISI

VISI

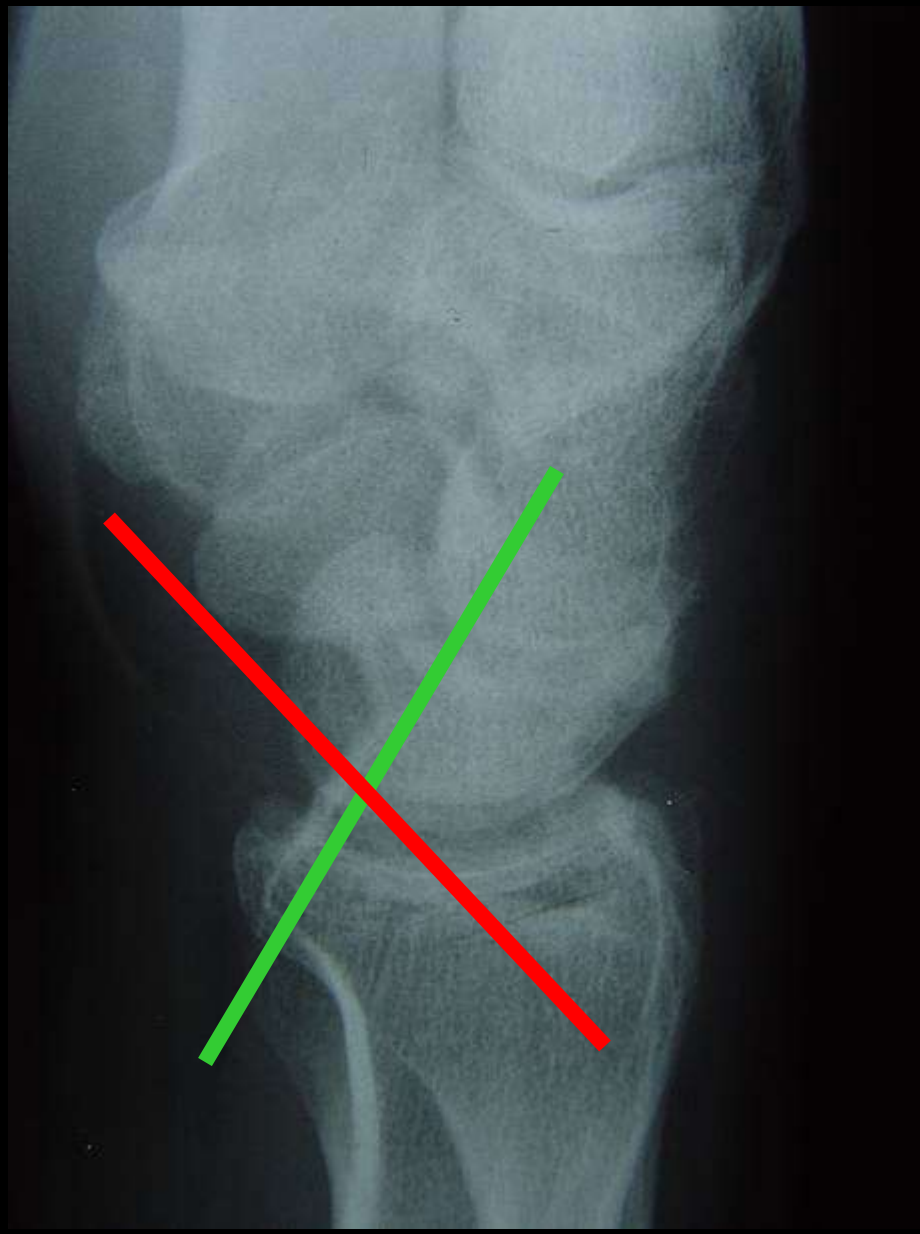


MR imaging of the major carpal stabilizing ligaments: normal anatomy and clinical examples..Radiographics. 1995 May;15(3):575-87

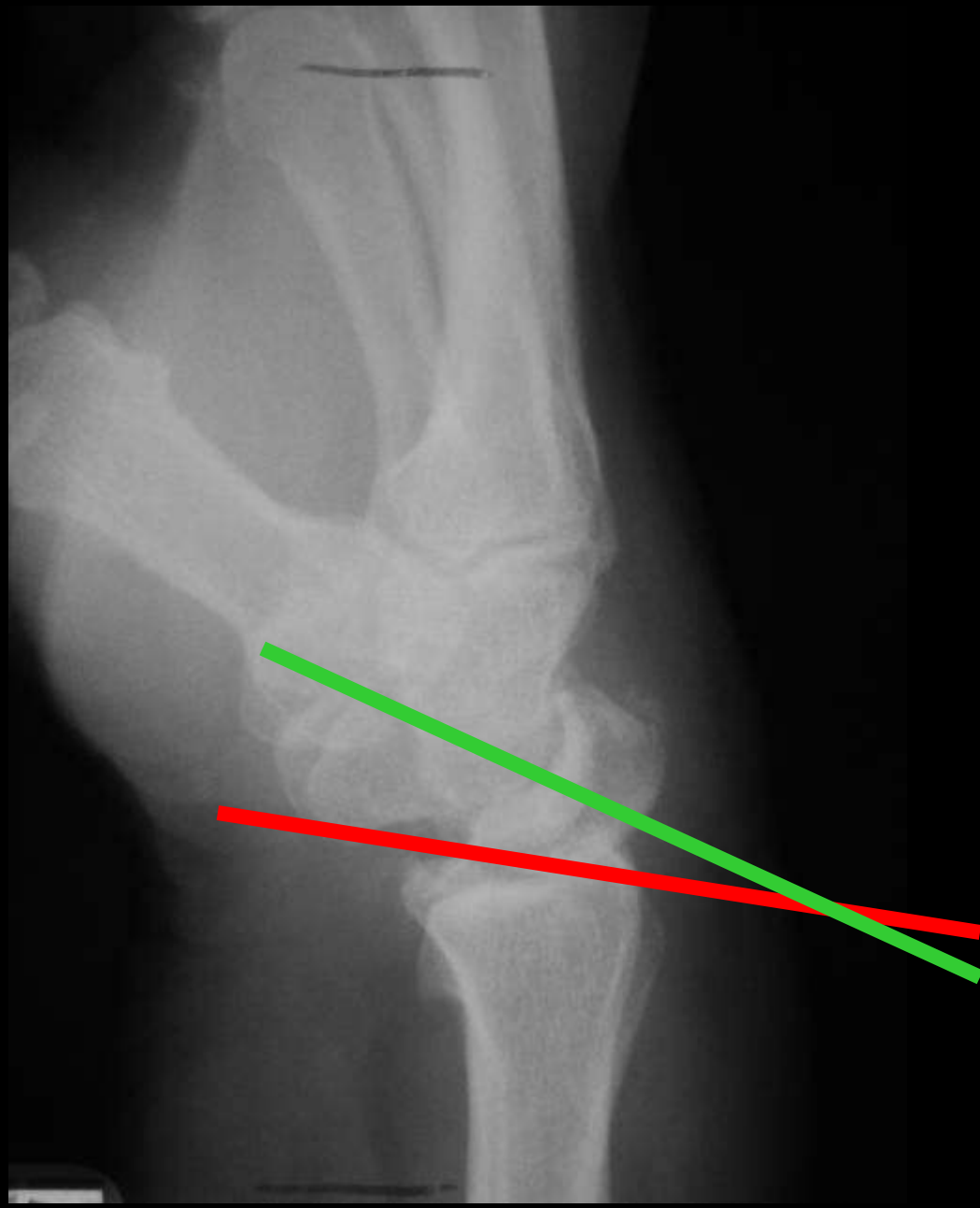


Normal

DISI:
SCAPHOLUNATE
ANGLE > 60

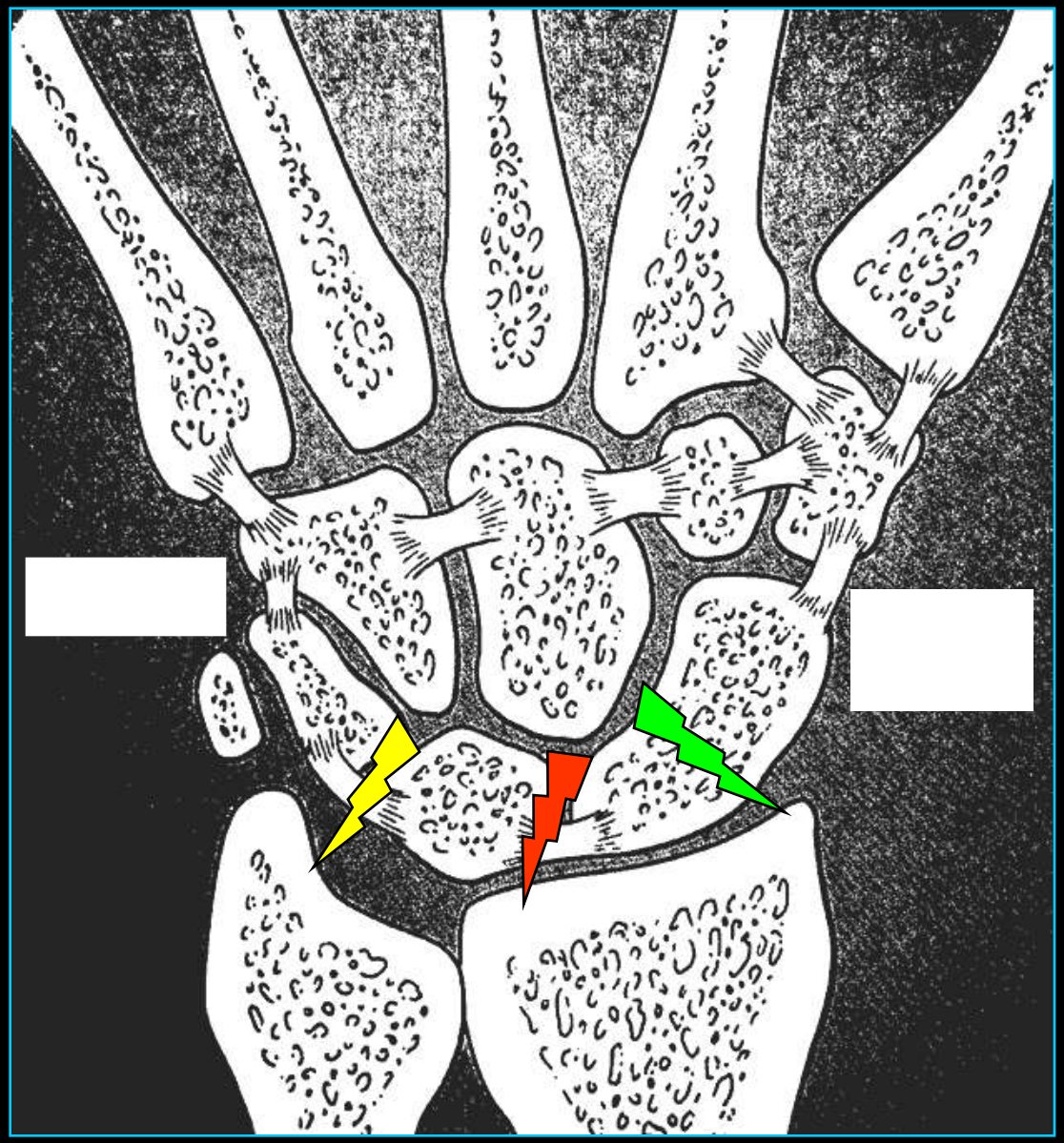


VISI SCAPHOLUNATE ANGLE < 30



Normal Carpal Kinematics

- At the carpus, OPPOSING torques are always acting:
  - Under axial load or radial deviation, the scaphoid flexes and the triquetrum extends.
  - With ulnar deviation, the scaphoid extends and the triquetrum flexes.
- Lunate is the intercalated segment b/n these opposing forces of the scaphoid and triquetrum.
- Forces are balanced by a ligamentous ring.



DISI PATTERN

DISI PATTERN

VISI PATTERN

LUNATE is the intercalated element

Overview of Patterns of Carpal Instability

- Dissociative
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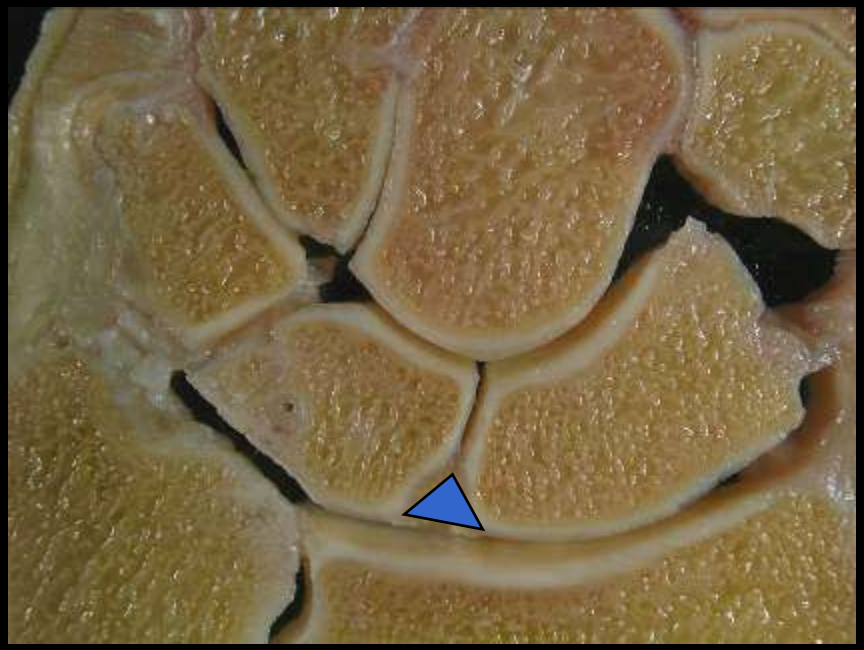
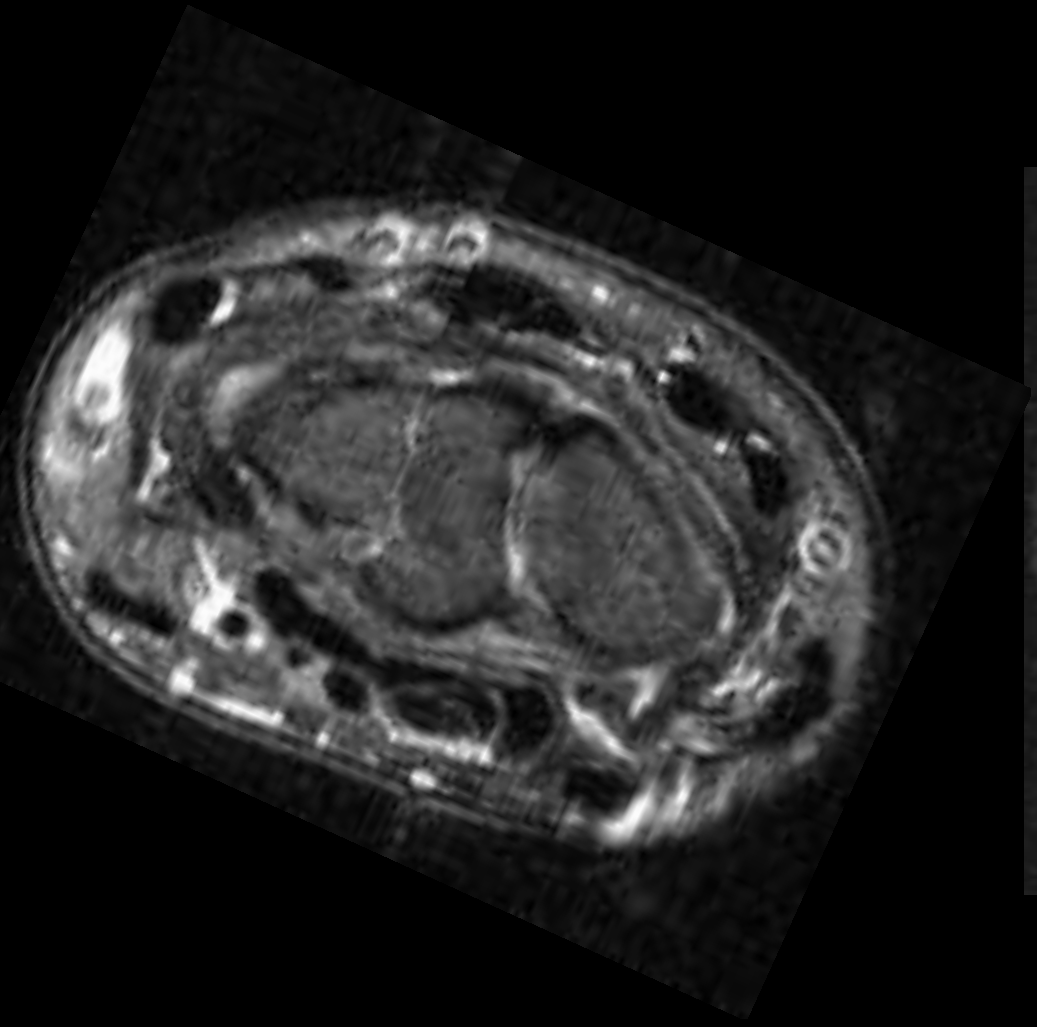
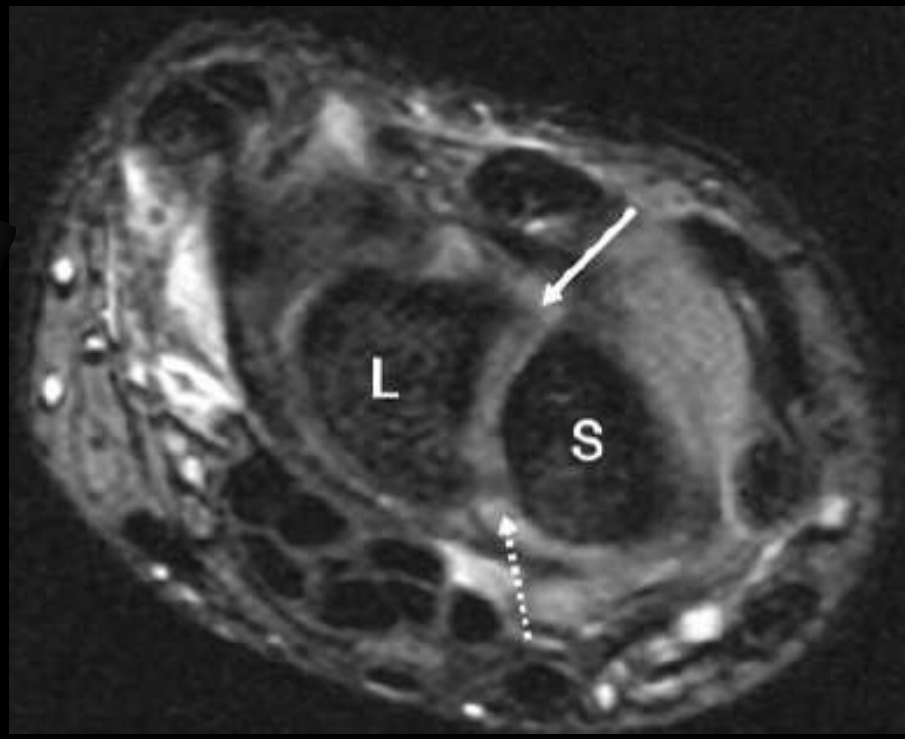
Scapholunate dissociation

- Scapholunate interosseous ligament is the strongest and stiffest of the interosseous ligaments.
- Occurs as an isolated injury or with distal radius or scaphoid fractures.
- Tenderness in the anatomic snuffbox.
- Rupture site most often at scaphoid attachment sites because fibers less dense.
- Tears traumatic and degenerative.

Scapholunate ligament







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Classification of Scapholunate Dissociation

Table 3 The stages of scapholunate instability (scapholunate dissociation) in the modified classification of Watson et al. [33]

Stage	Description	Ligamentary status	Carpal function
I	Pre-dynamic	Partial tear of the SL ligament	Normal at rest, normal under load
II	Dynamic	Complete tear of the SL ligament	Normal at rest, SL instability under load
III	Static	Complete tears of the SL ligament and the secondary stabilizers	SL instability at rest
IV	Osteoarthrotic	Complete tears of the SL ligament and the secondary stabilizers	Osteoarthritis secondary to SLD

Stage I identified with MRI. Stage II diagnosed with stress views with a clenched hand. Stage III and IV demonstrates DISI pattern.

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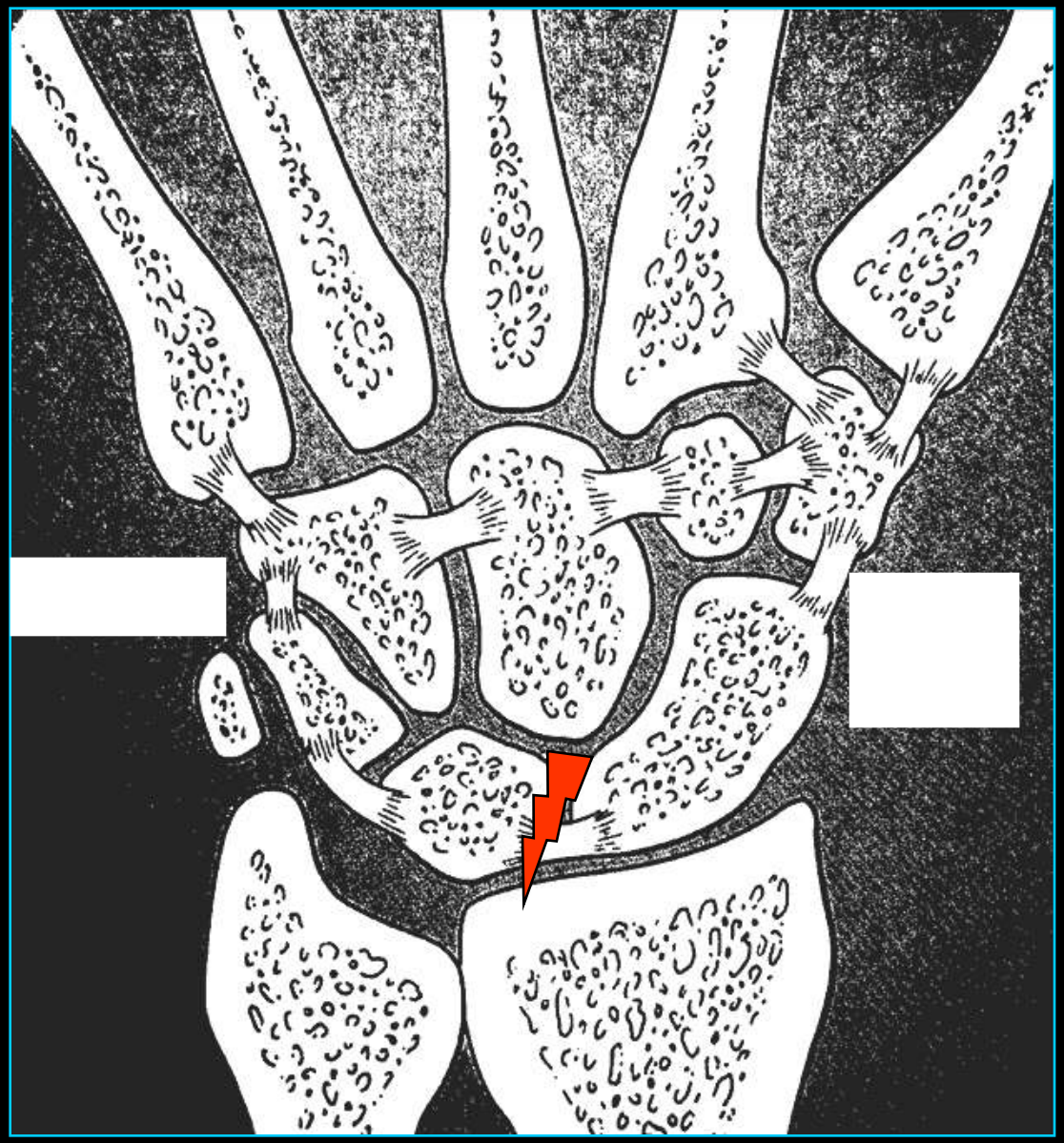
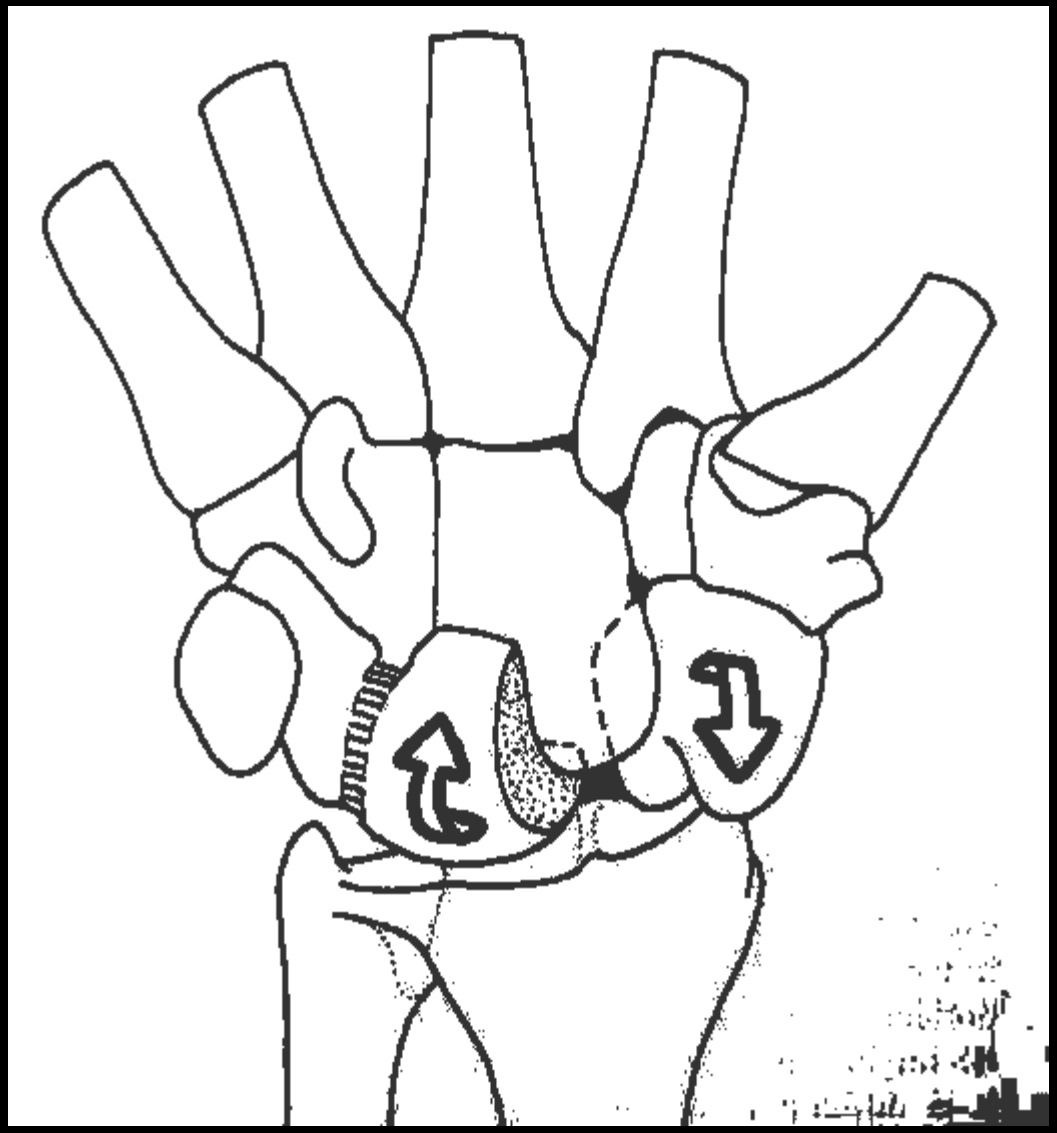
Scapholunate dissociation



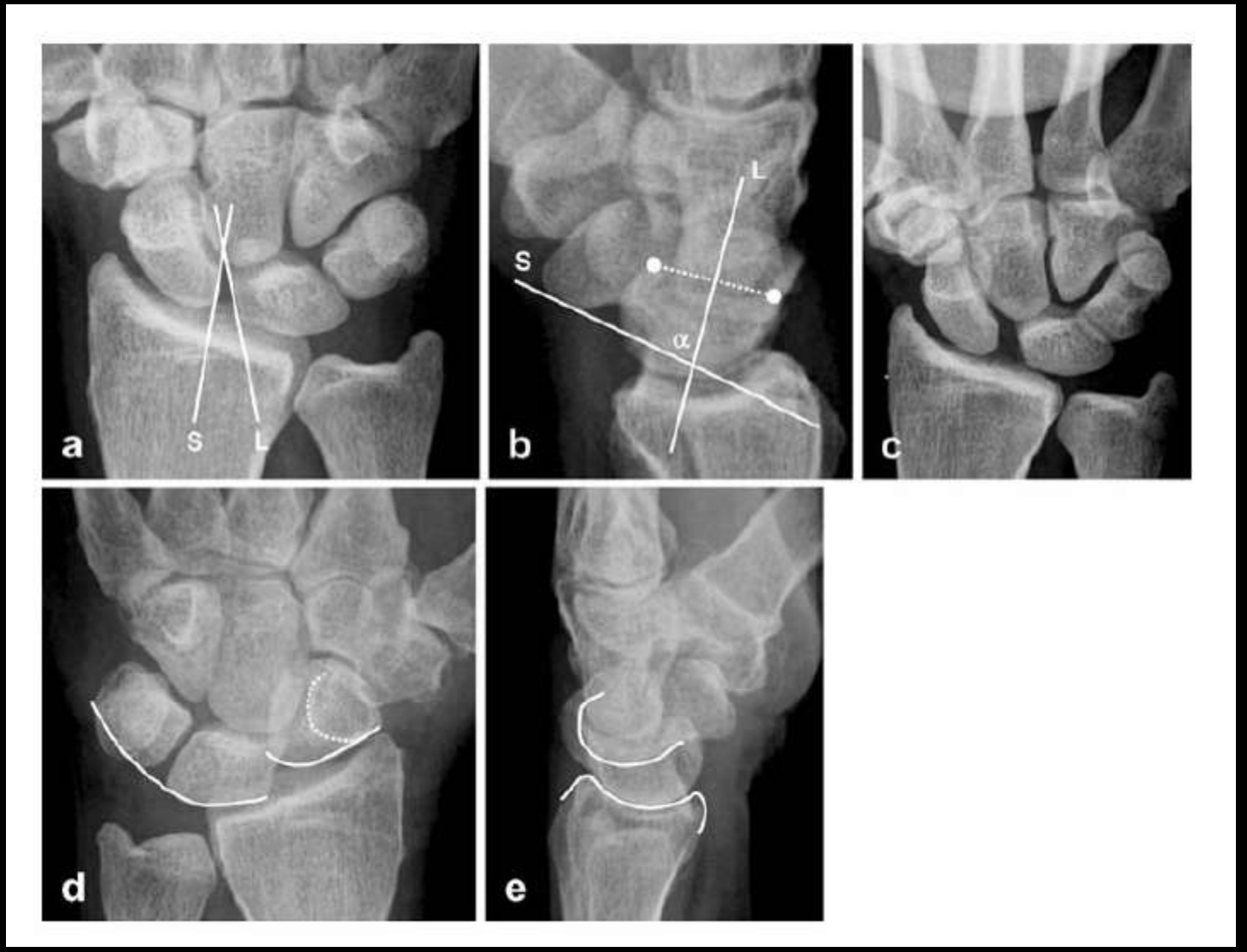
DISI PATTERN

LUNATE is the intercalated element



S/L Dissociation, Scaphoid Rotary Subluxation

DISI



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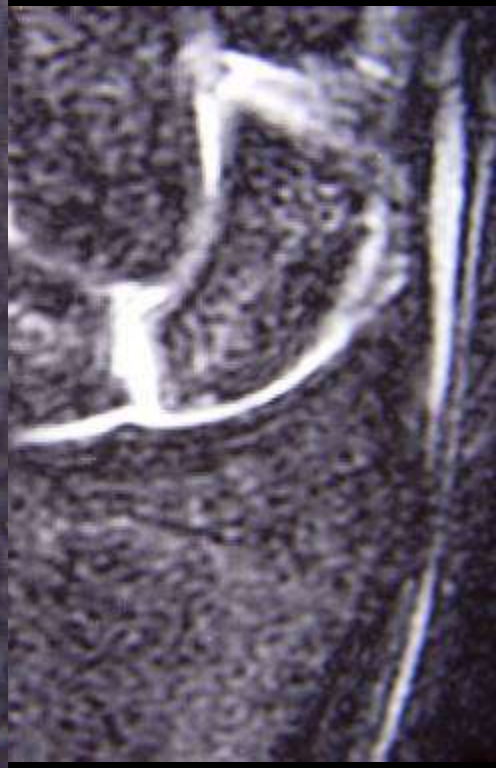


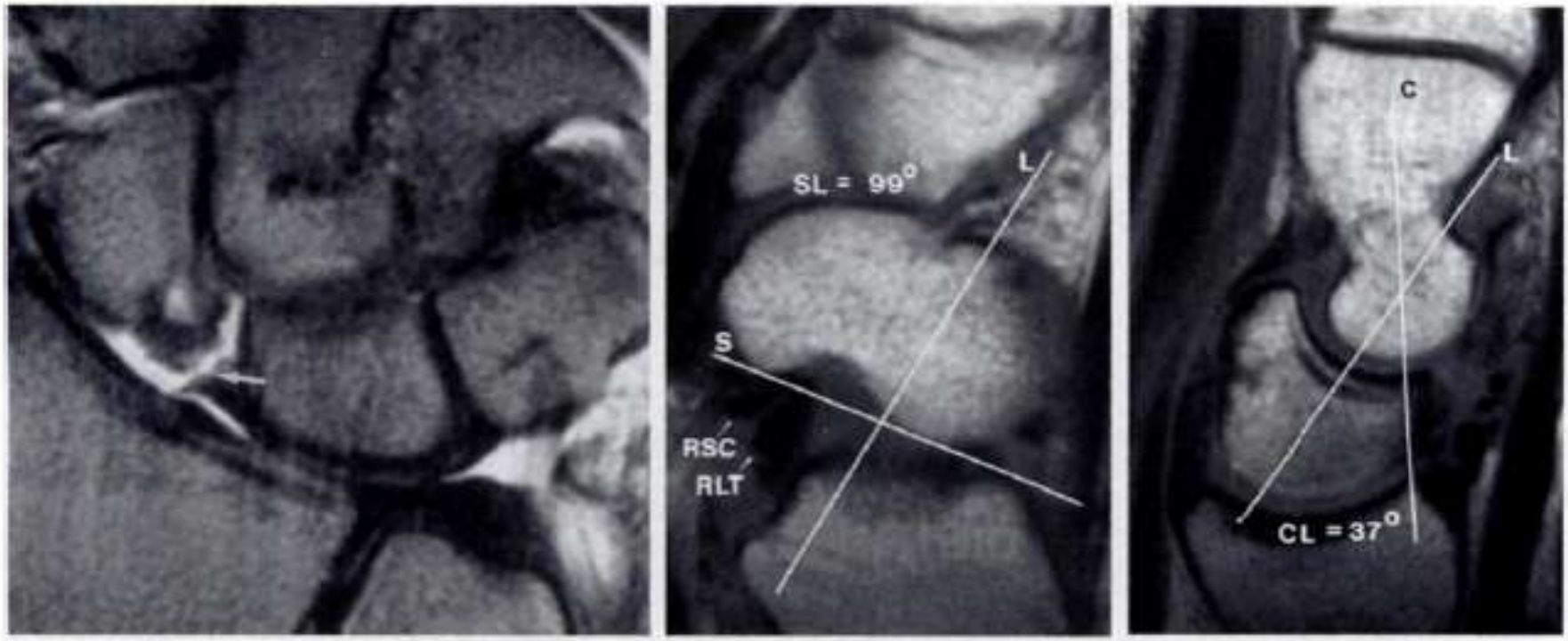
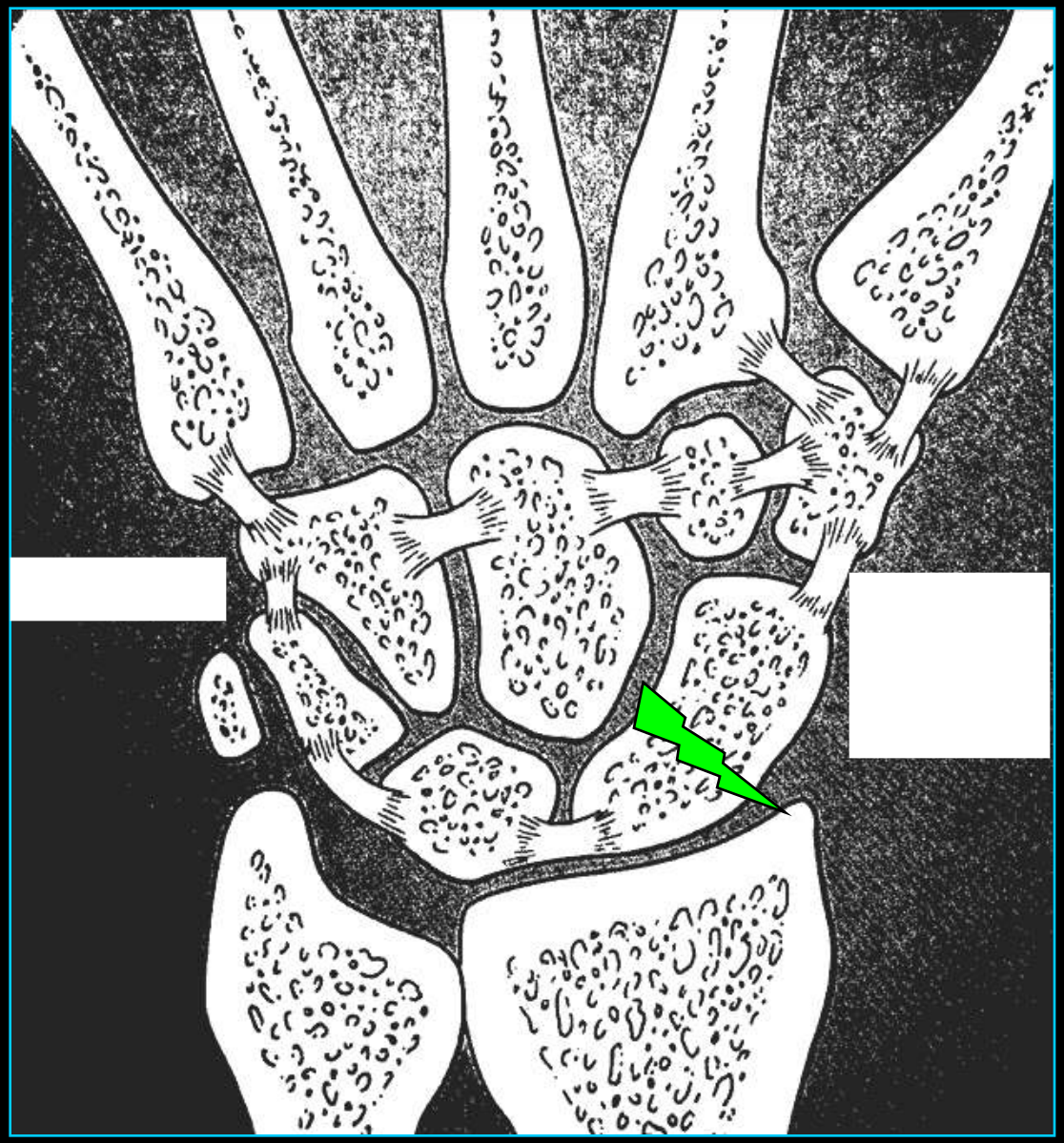


Figure 16. Tear of the scapholunate ligament with DISI. *C* = axis of capitate, *L* = axis of lunate, *S* = axis of scaphoid. **(a)** Coronal T2-weighted MR image shows a scapholunate ligament tear (arrow) with wide separation of the scaphoid and lunate. **(b, c)** Sagittal T1-weighted MR images at the levels of the scaphoid **(b)** and the lunate **(c)** show an abnormal scapholunate angle (*SL*) and capitate-lunate angle (*CL*), indicating DISI. The radioscaphocapitate ligament (*RSC*) and radiolunotriquetral ligament (*RLT*) are displaced volar to the waist of the scaphoid but are still intact.

Radiographics. 1995 May;15(3):575-87.

Endstage: SLAC Wrist

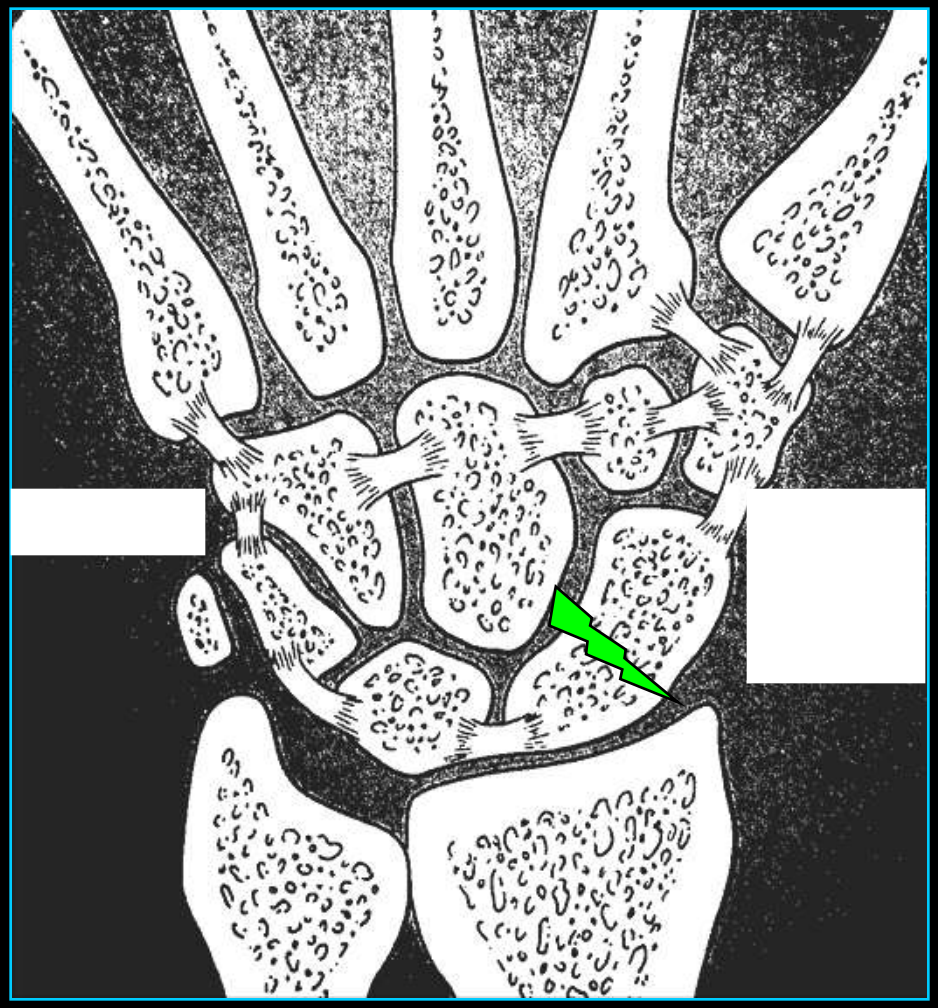


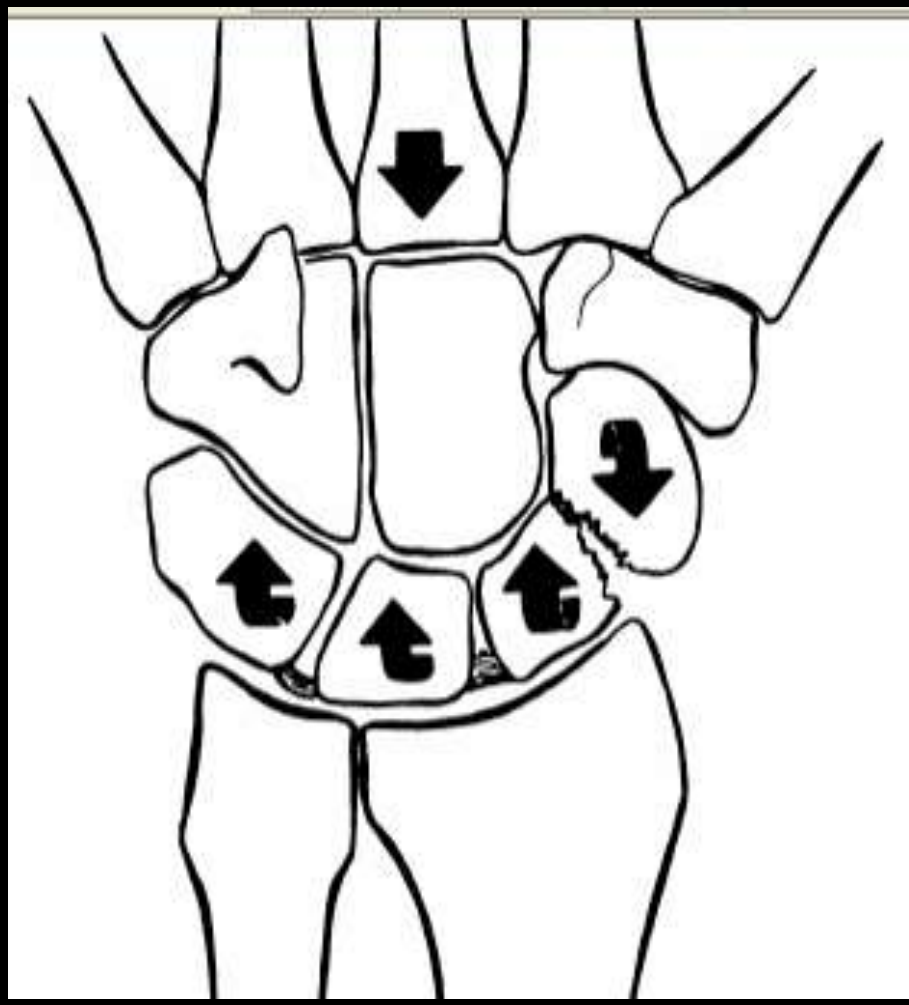
Scaphoid Fracture

DISI PATTERN

LUNATE is the intercalated element

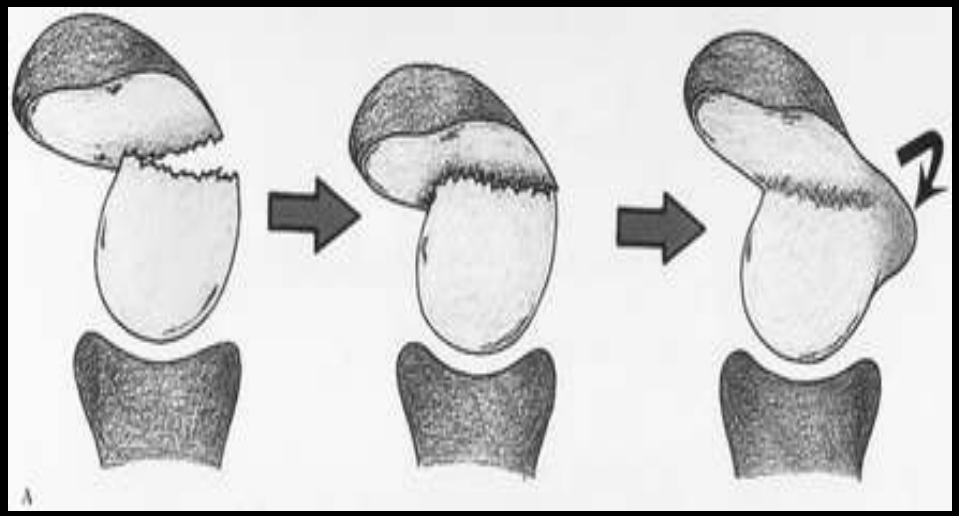
Scaphoid Fracture



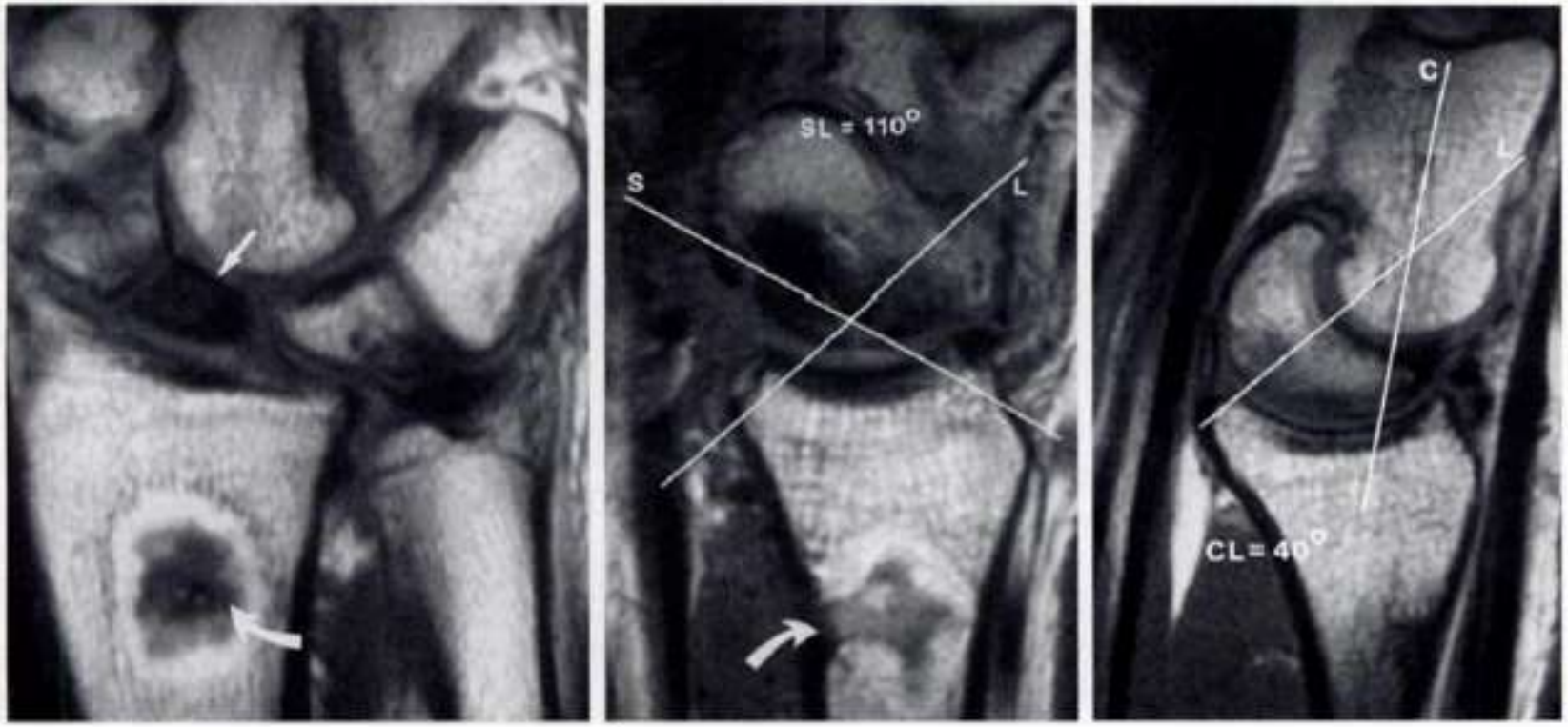


Radiographics. 1995 May;15(3):575-87.

Humpback Deformity



Wrist fractures: what the clinician wants to know. Radiology. 2001 Apr;219(1):11-28



a. b. c.

Figure 13. Unstable fracture of the scaphoid. *C* = axis of capitate, *L* = axis of lunate, *S* = axis of scaphoid. Coronal T1-weighted MR image **(a)** and sagittal T1-weighted MR images at the levels of the scaphoid **(b)** and the lunate **(c)** show an unstable scaphoid fracture with avascularity of the proximal pole. Note the low signal intensity of the proximal pole of the scaphoid (straight arrow in **a**) and the graft harvest site on the volar aspect of the radius (curved arrow in **a** and **b**). The scapholunate angle (*SL*) is greater than 60°, and the capitate-lunate angle (*CL*) is greater than 30°; these measurements are consistent with DISI.

Radiographics. 1995 May;15(3):575-87.

Overview of Patterns of Carpal Instability

- Dissociative
  - Scapholunate dissociation
  - **Lunotriquetral dissociation**
- Non-dissociative
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Lunotriquetral Dissociation

- Like the scapholunate interosseous ligament, disruption may be either traumatic or degenerative.
- Many tears associated with Palmer II TFCC tears.
- Studies and literature regarding this ligament is scarce and controversial.
- Occur both in isolation or part of the perilunate instability.

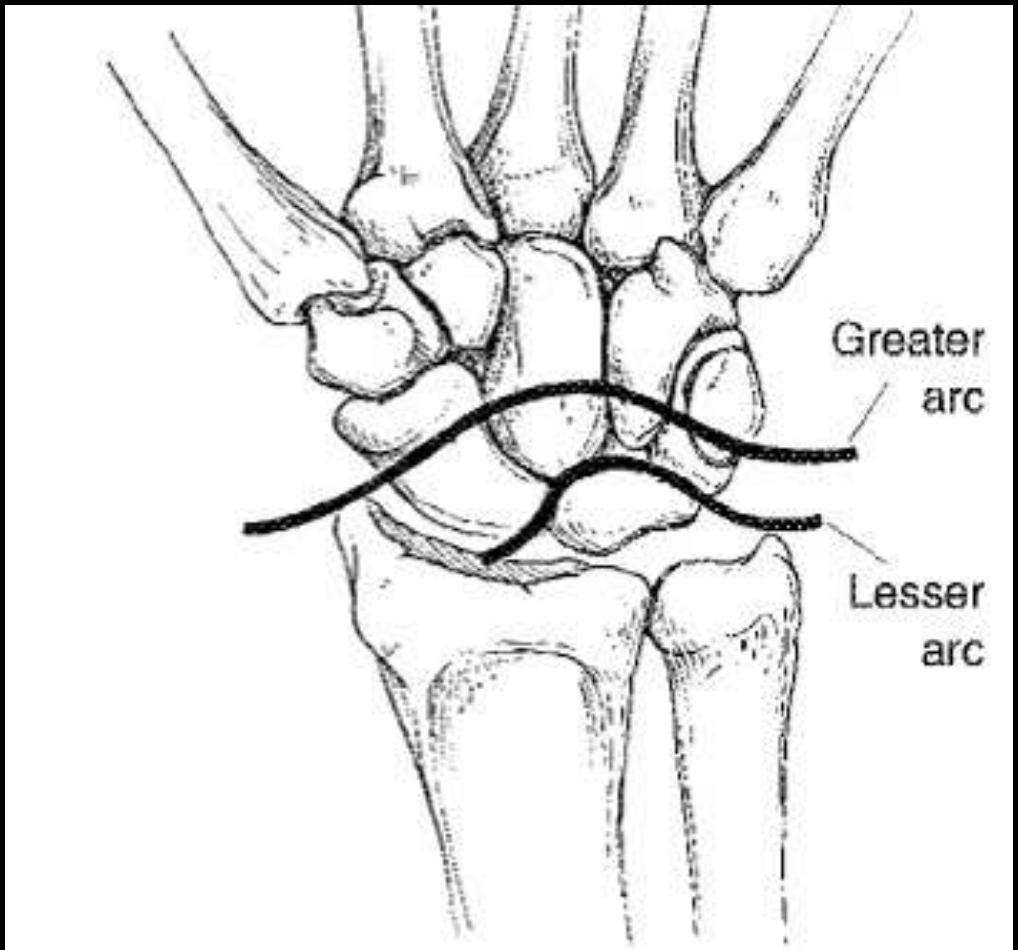


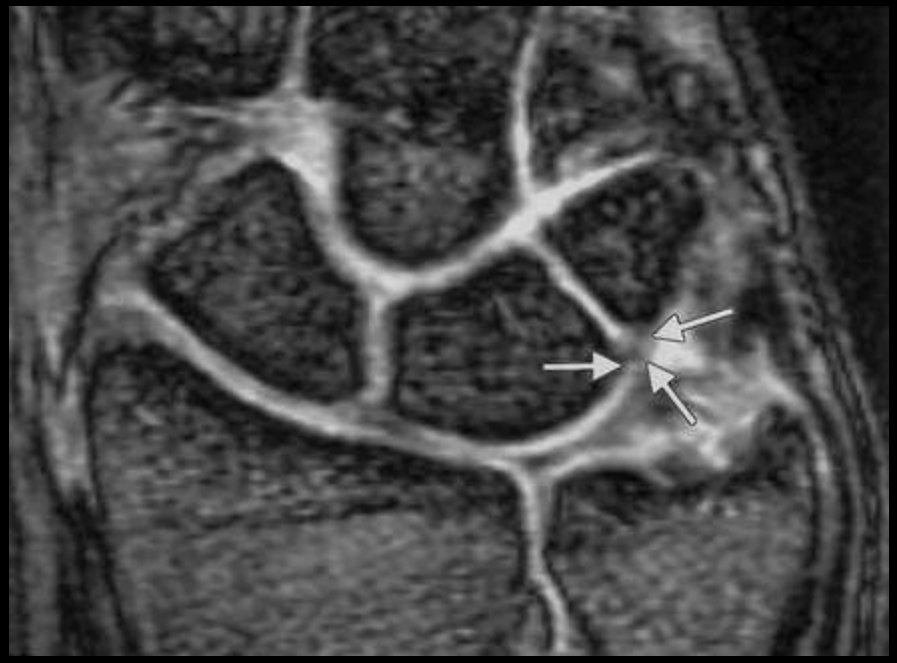
Fig. 2 The lesser and greater carpal arcs of perilunate instability.

J Am Acad Orthop Surg. 1998 Mar-Apr;6(2):114-20

Lunotriquetral Dissociation

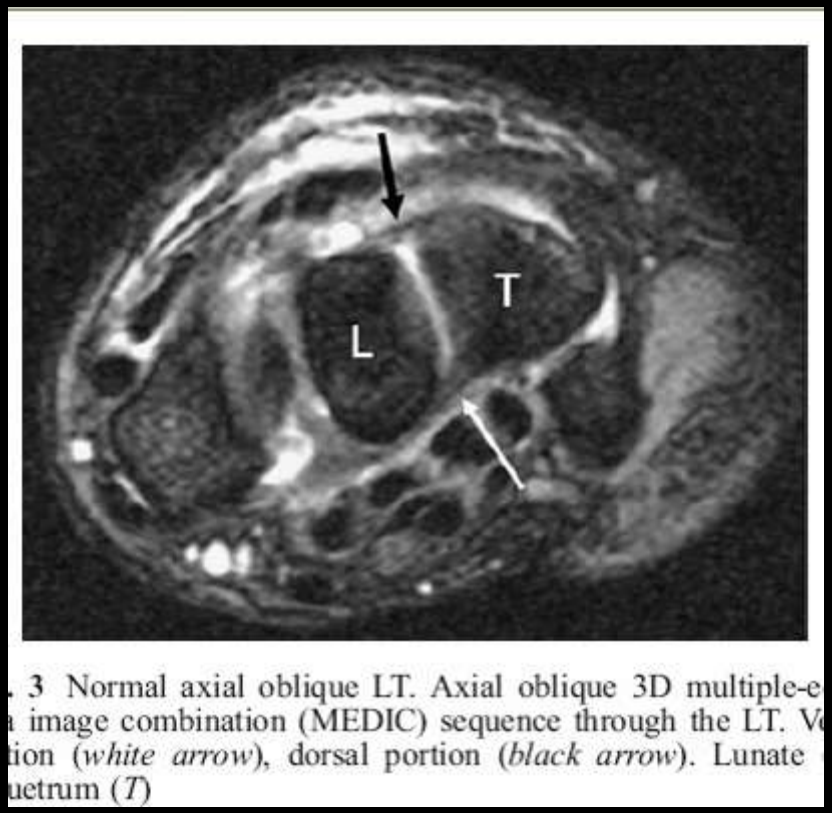
- Heterogeneity of clinical symptoms from asymptomatic tears to collapse of the carpus with a fork-like deformity of the wrist.
- Generally pain aggavated with ulnar deviation.
- Sensation of weakness or instability.

Normal Lunotriquetral Ligament



Radiology. 2003 Jun;227(3):701-7.

Normal Lunotriquetral Ligament



. 3 Normal axial oblique LT. Axial oblique 3D multiple-e
a image combination (MEDIC) sequence through the LT. Ve
tion (*white arrow*), dorsal portion (*black arrow*). Lunate
uetrum (*T*)

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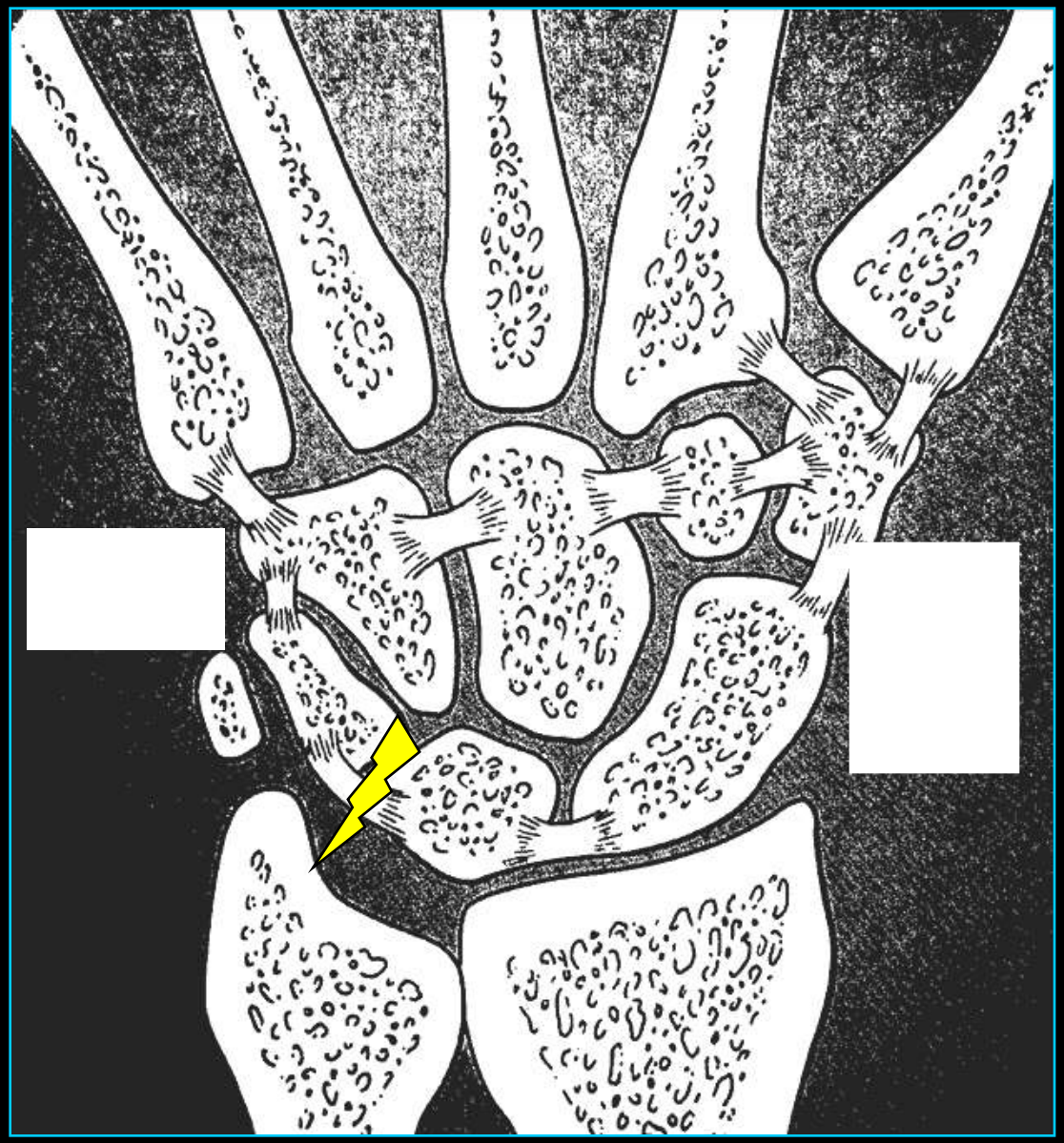
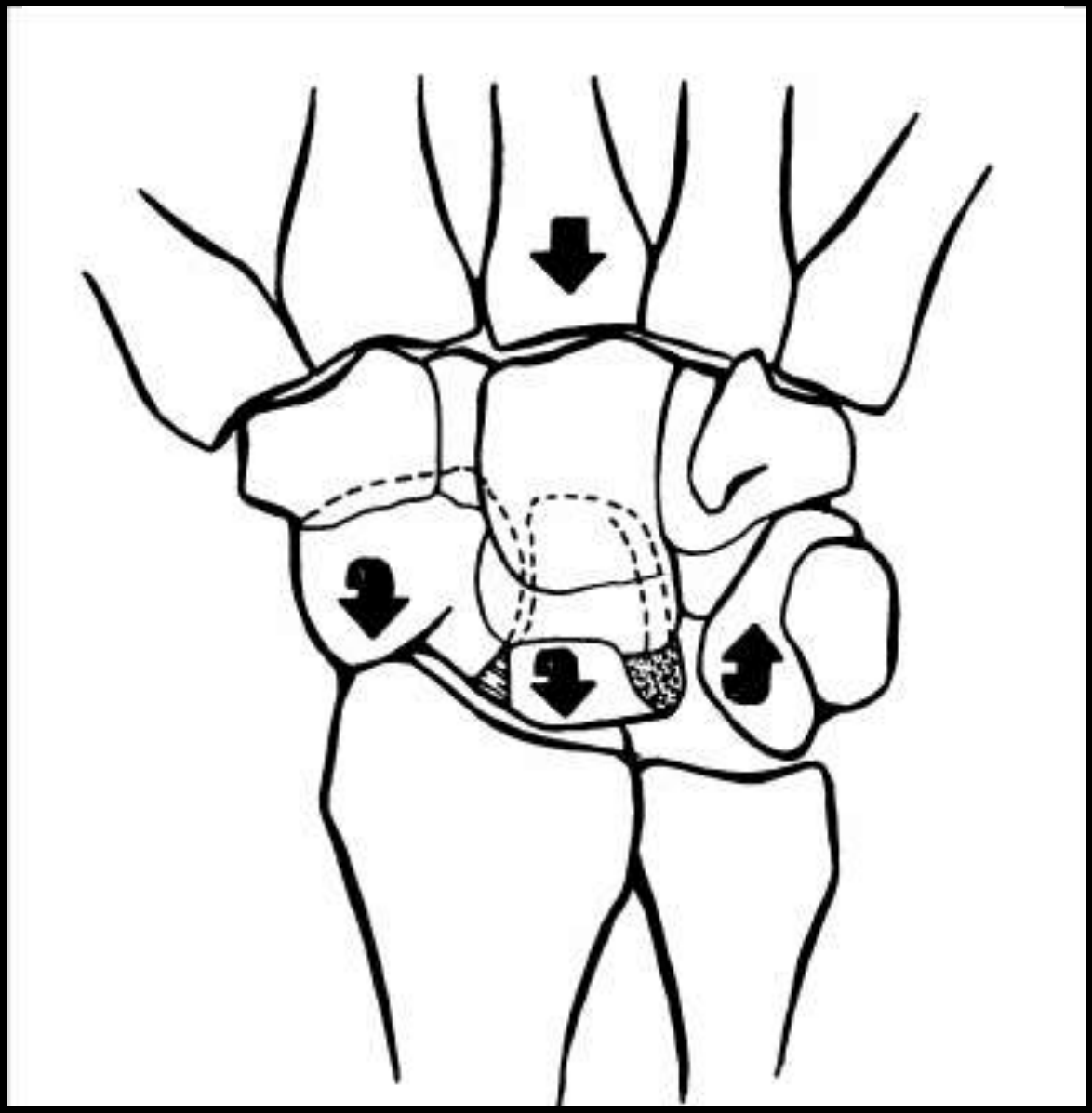


VISI PATTERN

LUNATE is the intercalated element



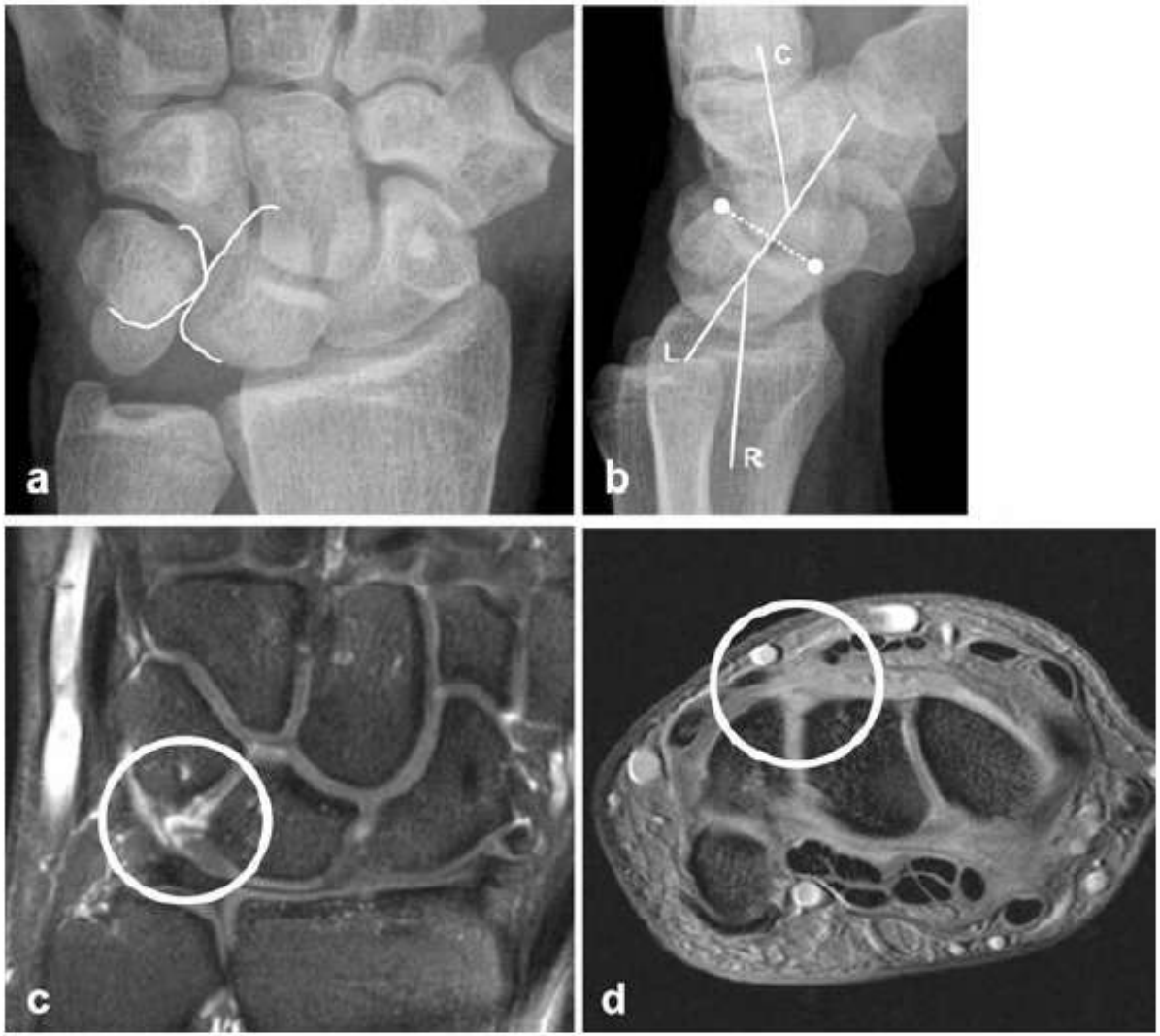


Fig. 6a–d Posttraumatic instability pattern of LTD in a patient suffering from pain and tenderness at the ulnar side of the wrist. **a** On the dorsovolar view, the lunate is not trapezoid, but moon-shaped. The lunotriquetral joint space is abnormal with nonparallel borders of the articulating partners (contours are *outlined*). **b** In the lateral view, a VISI (volar intercalated segment instability) configuration of the middle carpal column is present with increased radiolunate (*RL*) and capitatolunate (*CL*) angles over 15 degrees. **c** Contrast-enhanced MRI depicts the disruptured LTL (*circle*) due to focal hyperemia at the synovial and fibrovascular reparation tissue (T1-weighted SE sequence with fat-saturation). **d** The dorsal tear of the LTL (*circle*) is also visualized on the transaxial image of a plain T2*-weighted GRE sequence

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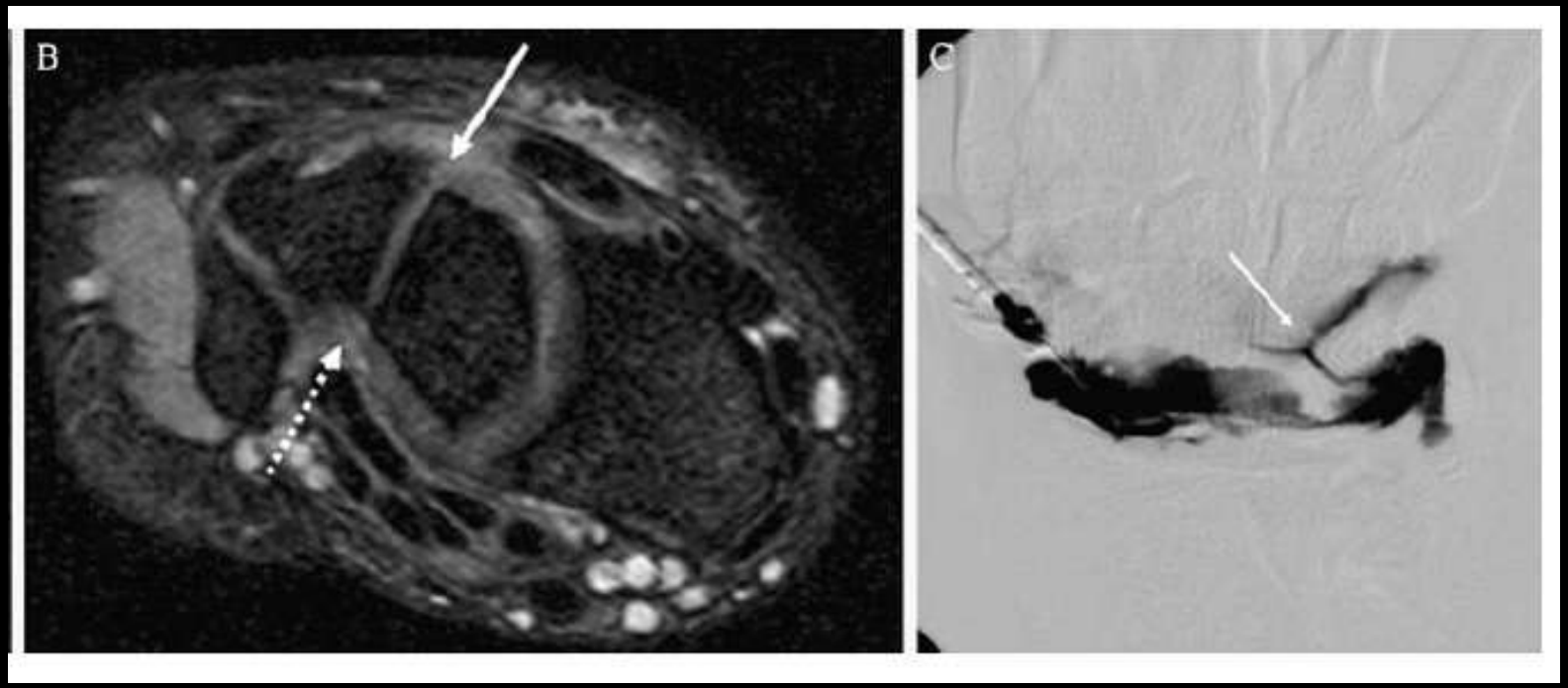

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Overview of Patterns of Carpal Instability

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- Non-dissociative
  - **Radiocarpal**
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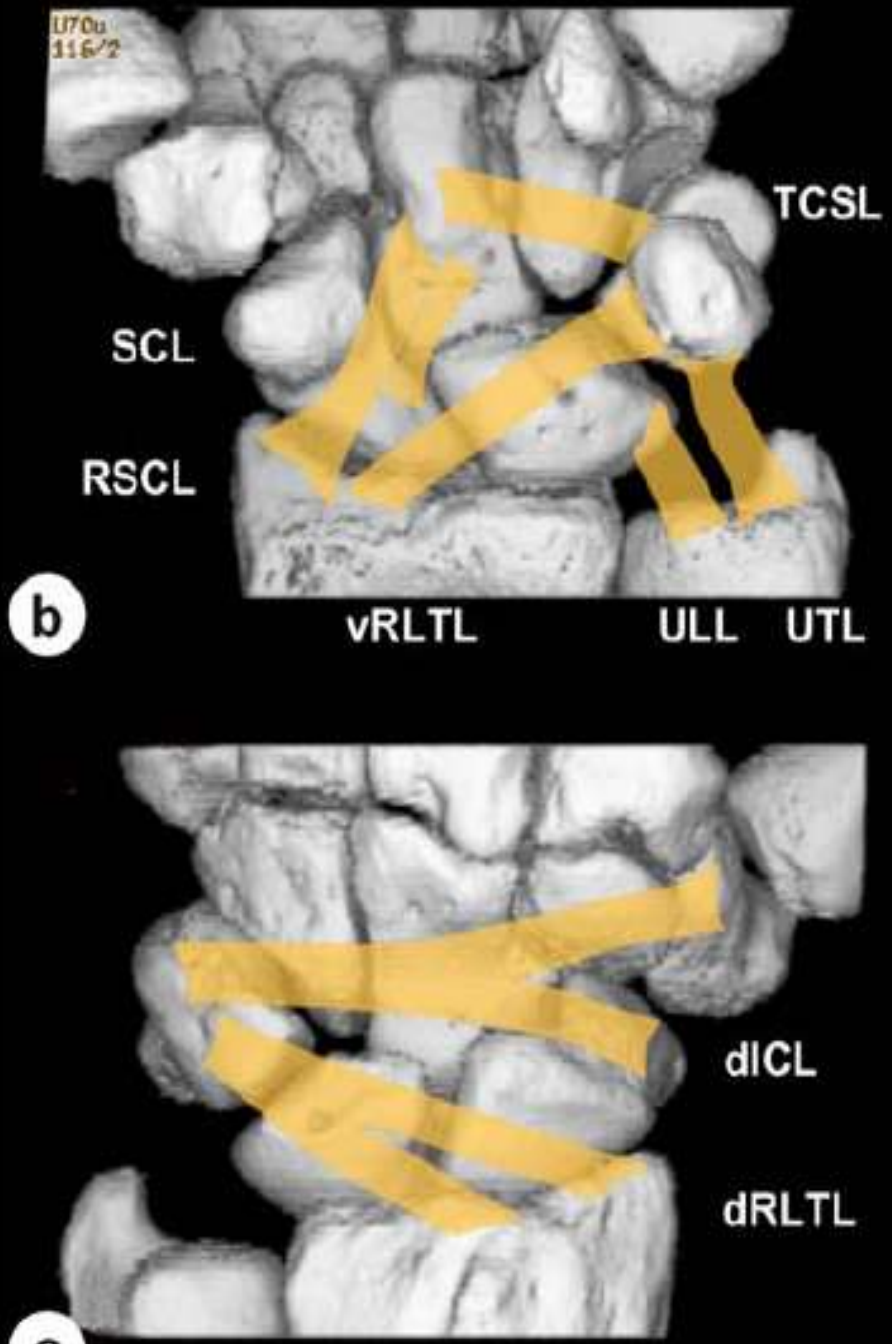
Radiocarpal Instability

- Results in shift of the entire carpus.
- Palmar, dorsal, radial, or ulnar translocation.
- Dorsal and volar translocations with Barton or reverse Barton fractures.
- Ulnocarpal translocations more frequently occur with RA, CPPD.

Normal. Inclination of the radial articulating surface



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TRAUMA

CPPD ARTHROPATHY

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Overview of Patterns of Carpal Instability

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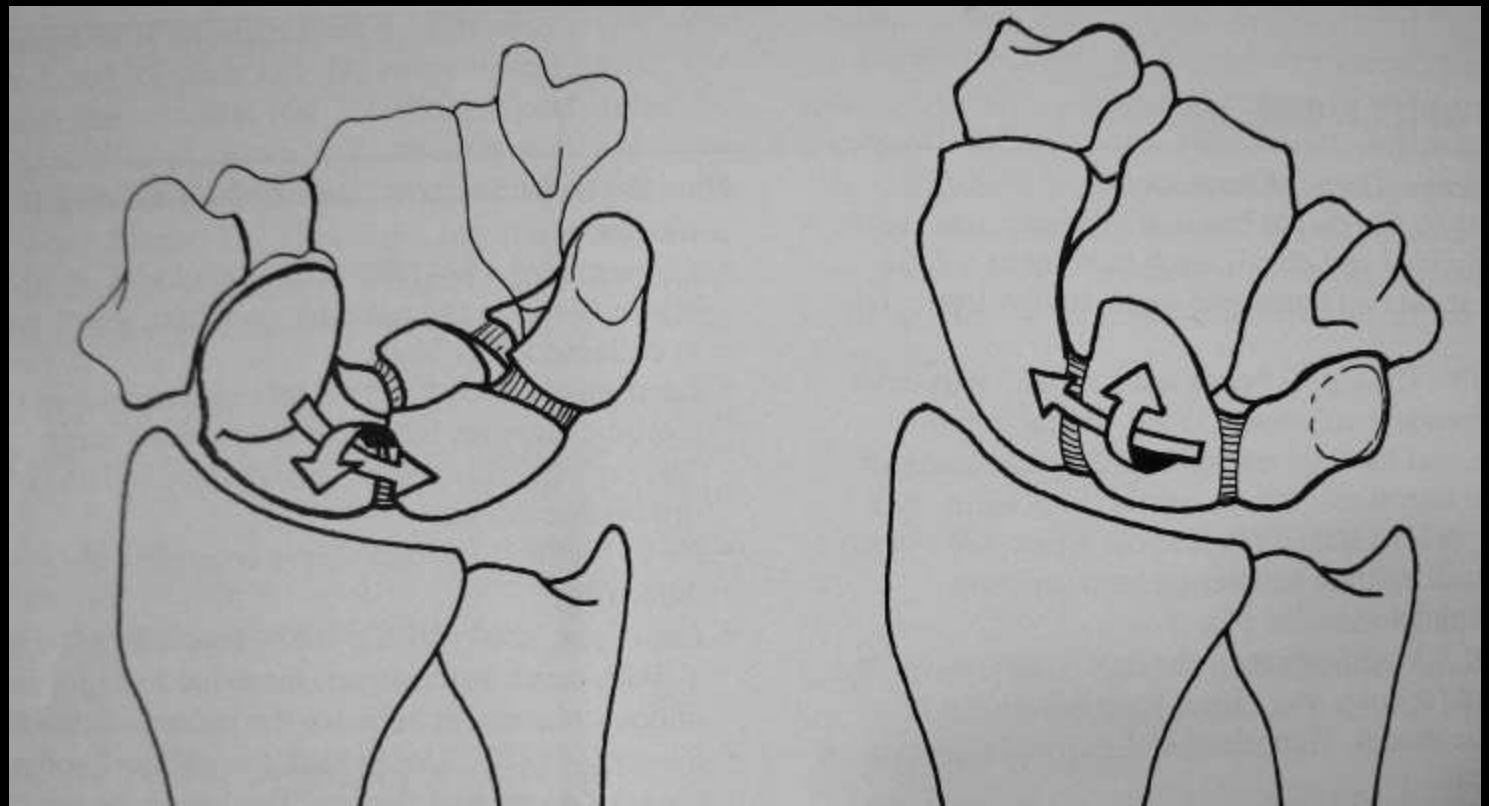
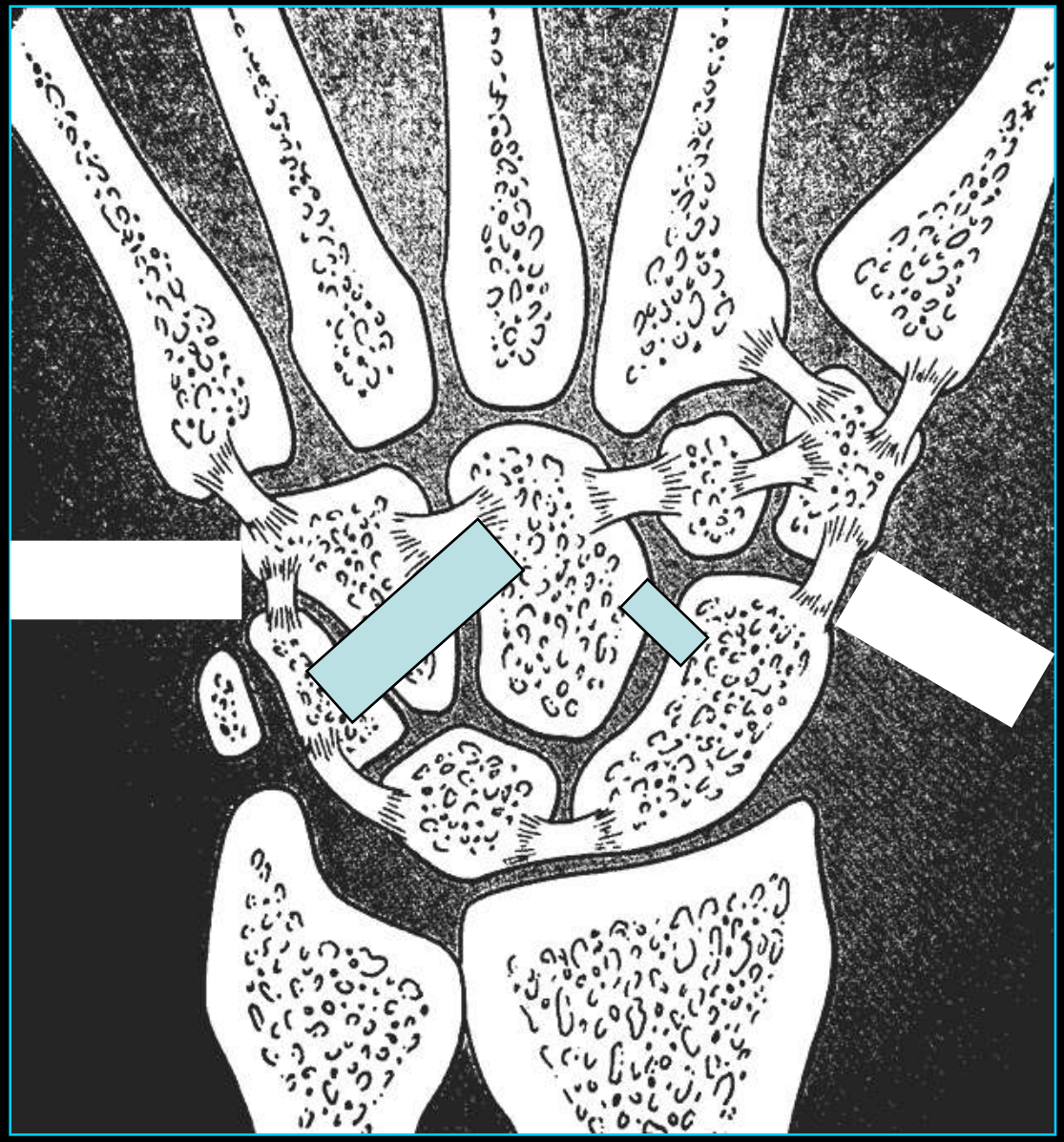
Midcarpal Instability

- Disruption of normal smooth motion of the proximal carpal row.

Normal carpal kinematics



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Midcarpal Instability

- Occurs from repetitive stress in young patients.
- Grip strength can be reduced by 50%
- Painful and audible “snapping” caused by *en bloc* extension of the proximal carpal row during ulnar deviation.

Dynamic Midcarpal instability

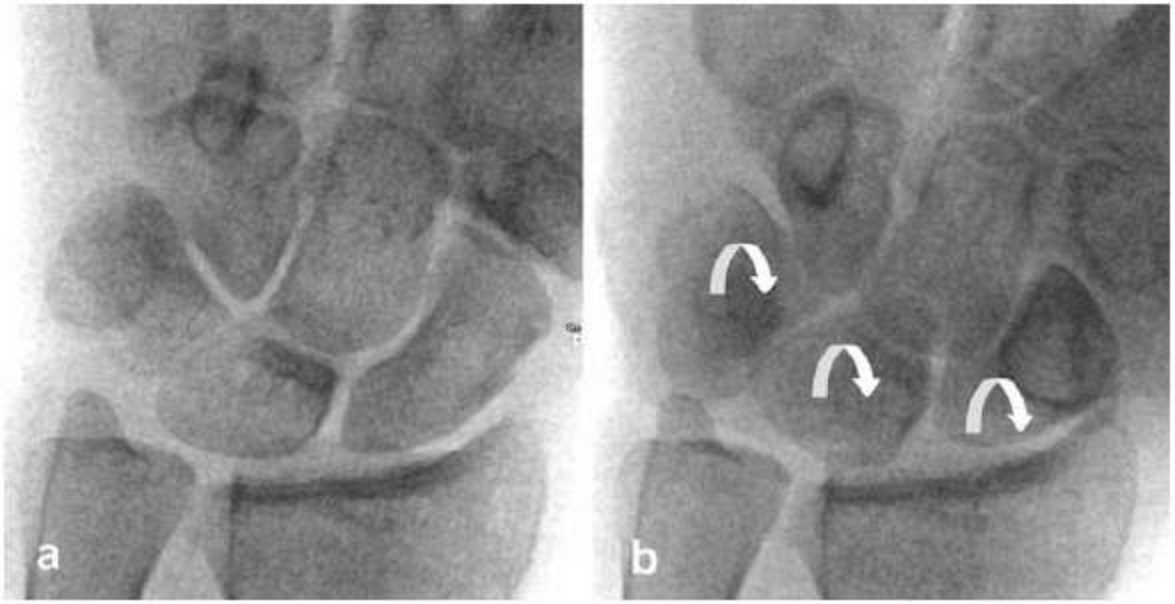

Fig. 11a, b Kinematography in dynamic midcarpal instability. Two snapshots are displayed from a pulsed fluoroscopic scene (15 images/s). While progressively moving the wrist from ulnar deviation to radial deviation, the entire proximal carpal row remains iniatially in an extended position (**a**), before it suddenly "jumps" into a flexed rotation (**b**) accompanied by a painful click. The curved arrows indicate the typical signs of flexion (ring sign of the scaphoid, moon-shape of the lunate, low position of the triquetrum)

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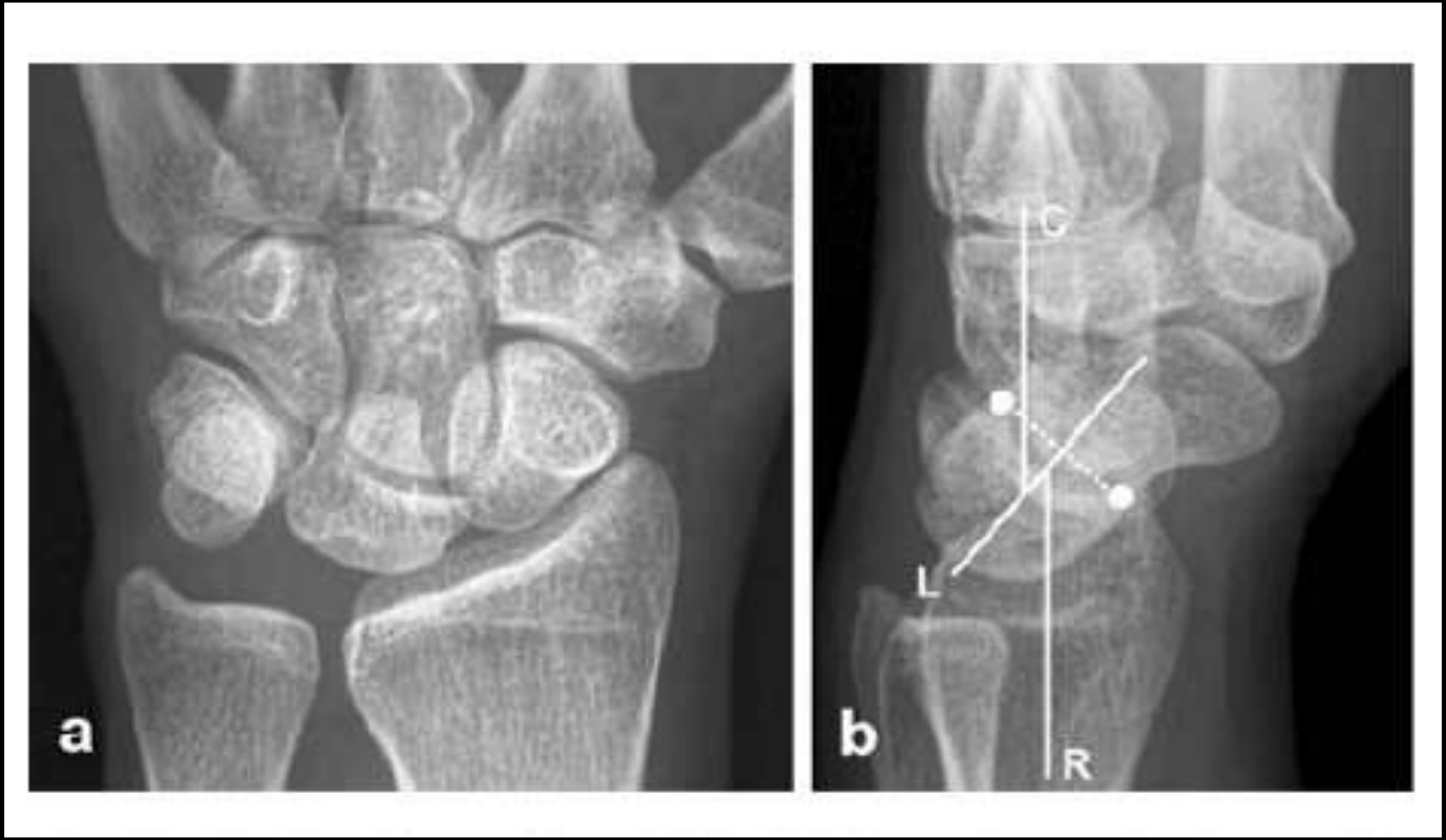
Static Midcarpal Instability

- Static MCI results in flexion of the proximal carpal row and VISI



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Conclusion

- Dissociative
  - Scapholunate dissociation
  - Lunotriquetral dissociation
- Non-dissociative
  - Radiocarpal
  - Midcarpal