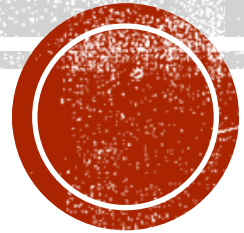
CARPAL INSTABILITY

DR SAAD HADDAD



INTRODUCTION

HISTORY

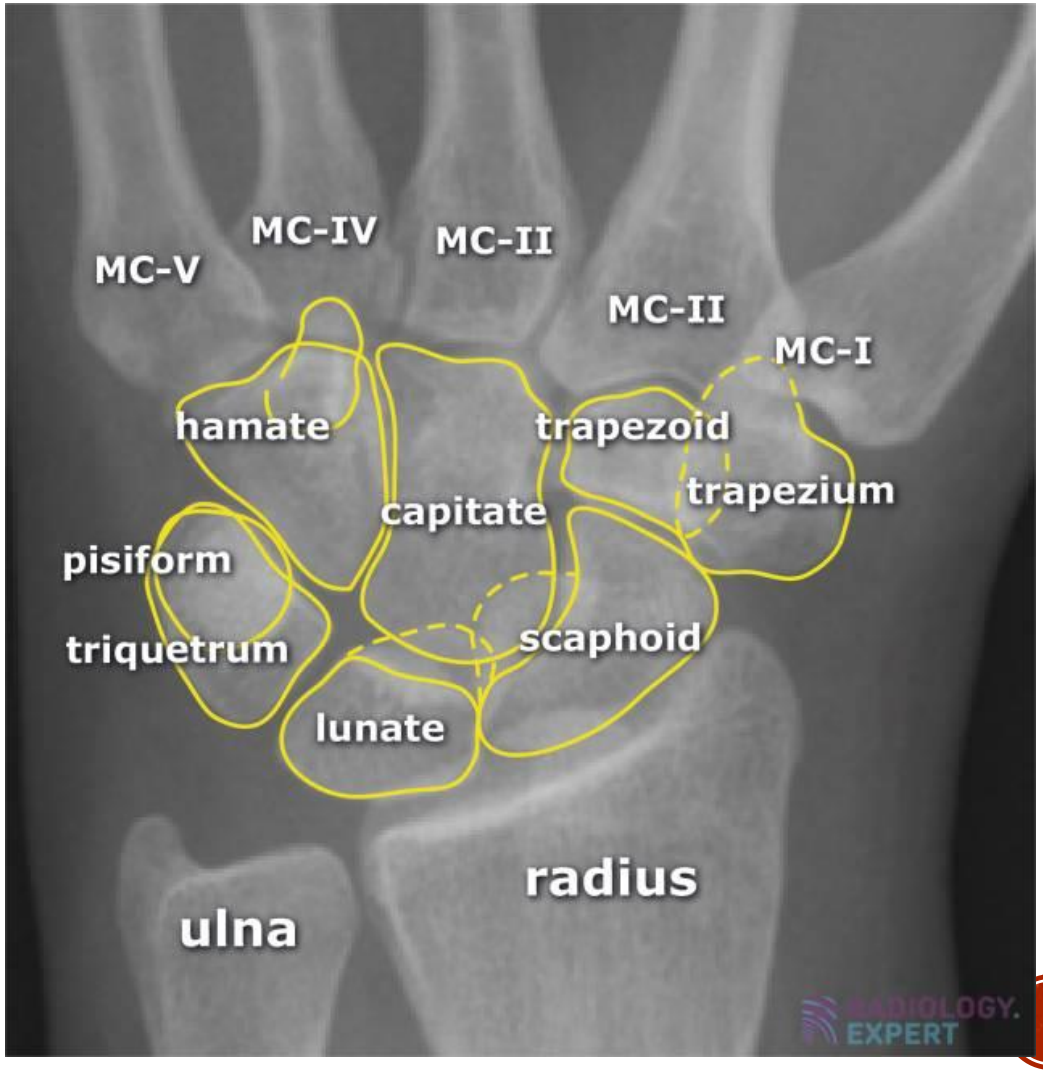
- The concepts of wrist instability and carpal malalignment were first introduced in the 1970s.
- Mayfieled in 1980 described perilunate dislocation
- Concept of DISI and VISI were Introduced by Linscheid in 1982
- The terms carpal instability dissociative (CID) and carpal instability nondissociative (CIND) were first proposed by Dobyns et al in 1985

WRIST ANATOMY

- Complex, composite joint formed by 20 interdependent articulations binding 15 bones

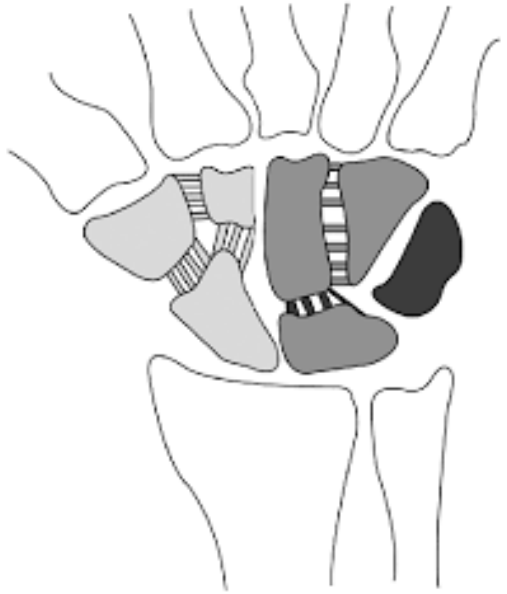
- Two rows (proximal and distal) The distal carpal row consists of 4 tightly bound bones (trapezium, trapezoid, capitate, hamate) with little mobility between them. The proximal carpal row, by contrast, exhibits substantial intercarpal mobility. It consists of three bones (scaphoid, lunate, triquetrum), interconnected by two intercarpal joints: scapholunate and lunotriquetral

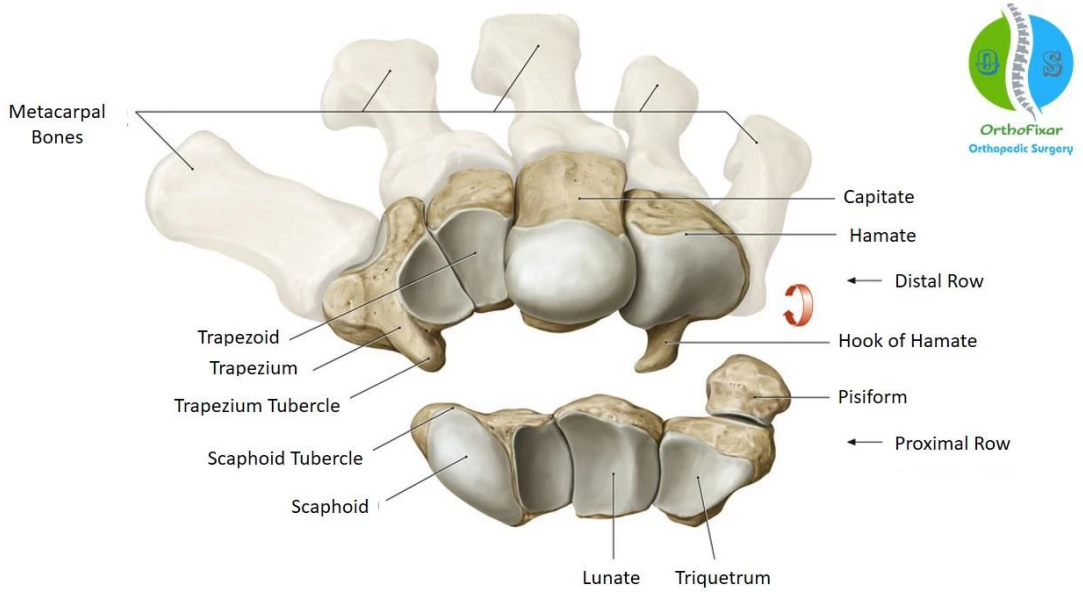
- The pisiform, usually considered a proximal row bone, is actually a sesamoid bone that increases the lever arm of the flexor carpi ulnaris tendon



WRIST ANATOMY

- **The midcarpal joint is a combination of three types of articulations:**
  - On the radial side, the convex distal surface of the scaphoid articulates with the concavity formed by the trapezium and the trapezoid (the scaphotrapeziotrapezoid (STT)) joint **(**the **radial column)**.
  - The central portion of the midcarpal joint is concave proximally and convex distally and has two parts: the scaphocapitate and lunocapitate joints. The column formed by the lunate and capitate is also known as the **central column**.
  - The lunate may have only one distal facet articulating with the capitate (**lunate type** I) or have two distal facets to articulate with the capitate and proximal pole of the hamate (**lunate type II**).
  - On the ulnar side, the triquetrum articulates with the hamate through the helicoidally shaped triquetrohamate joint (the **ulnar column**).





WRIST ANATOMY

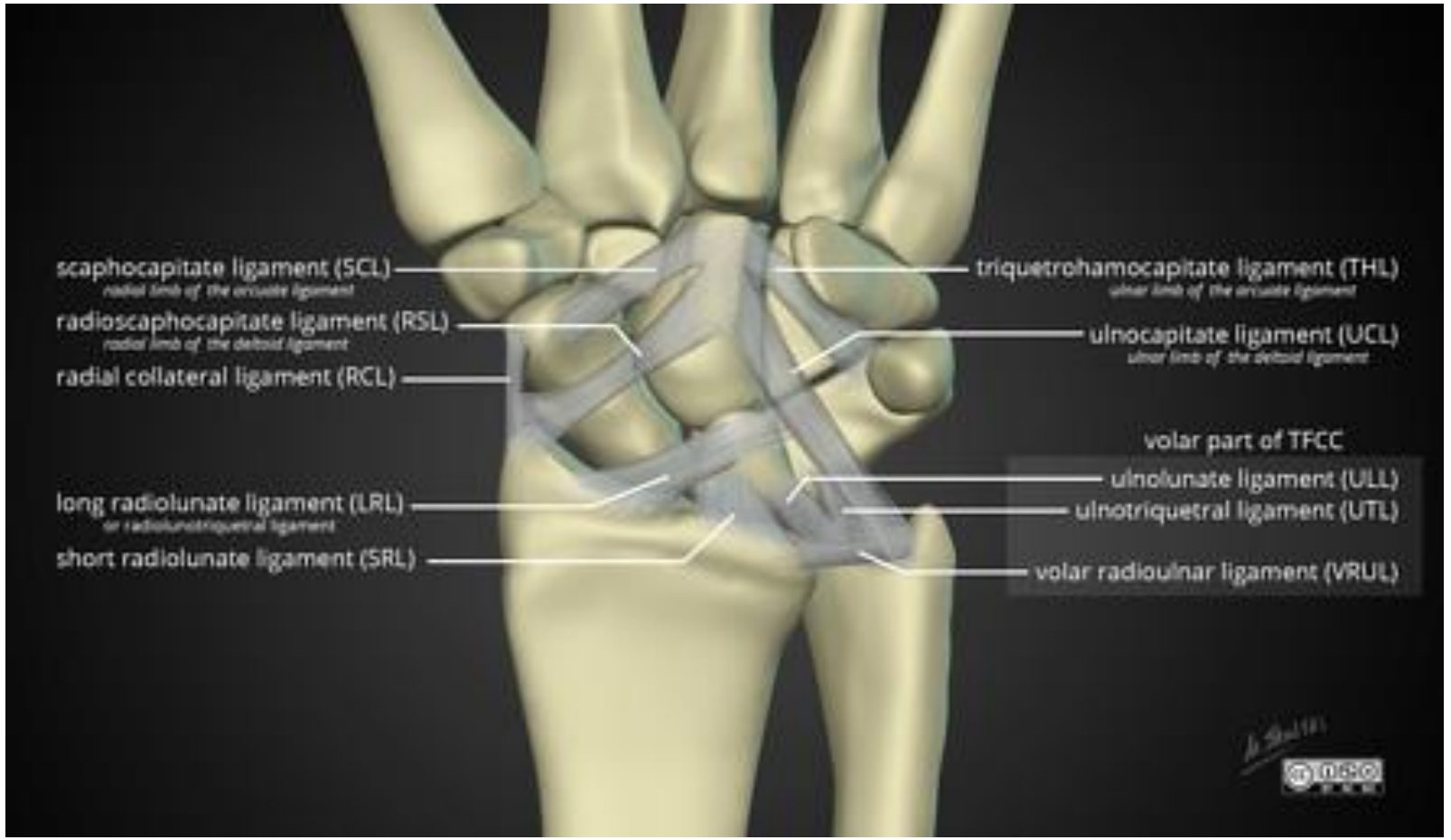
❖ **2 main types of Ligaments :**

- **Extrinsec ligaments :**

Volar:

- Four palmar radiocarpal ligaments
  - Radioscaphoid
  - radioscaphocapitate (RSC)
  - Long radiolunate
  - Short radiolunate ligaments (long RL and short RL)

- Three palmar ulnocarpal ligaments:
  - Ulnocapitate (most superficial)
  - Ulnotriquetral (deep)
  - Ulnolunate (deep)



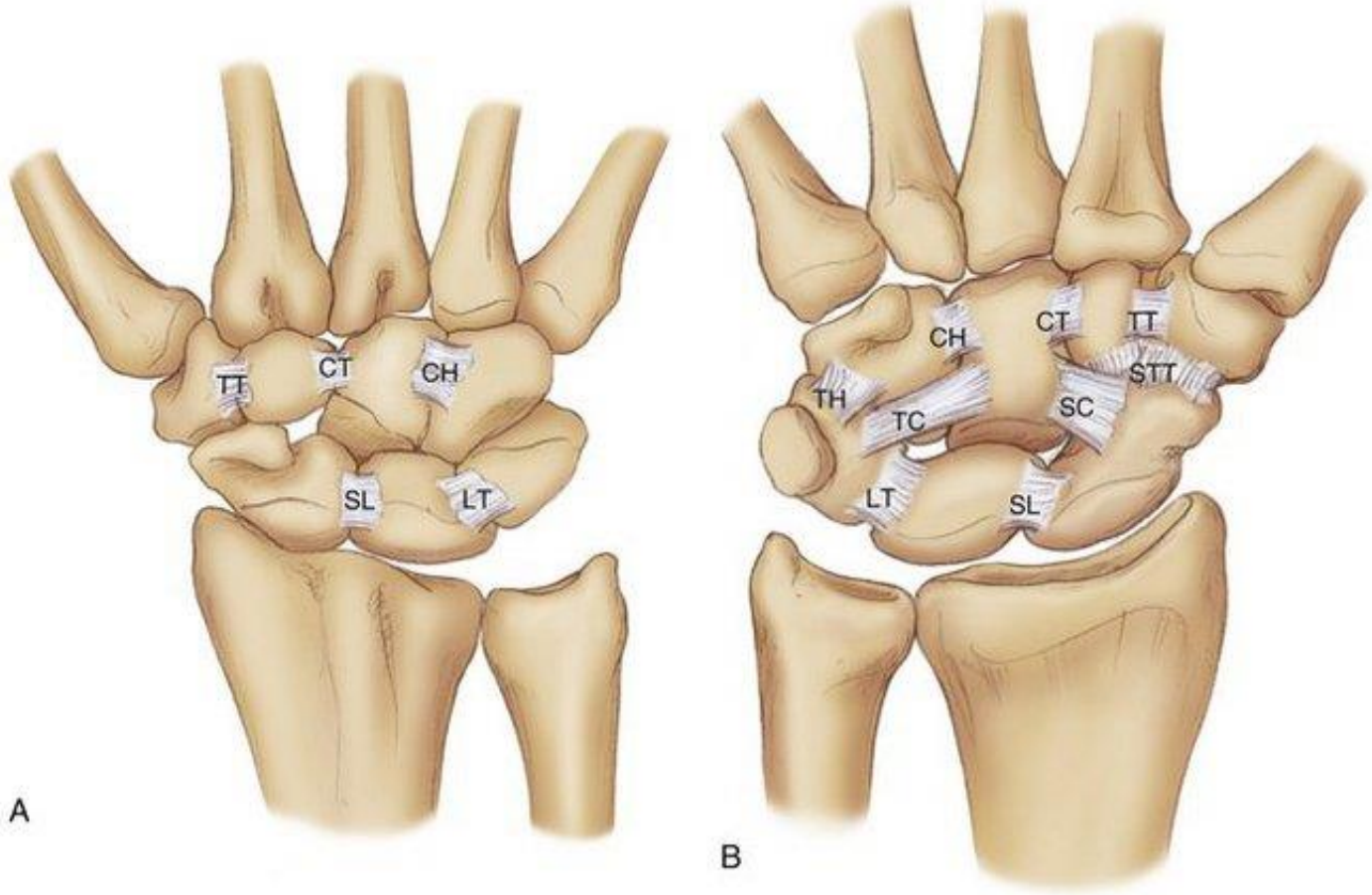
Dorsal:

- Only one dorsal radiocarpal ligament (dorsal Radiotriquetral or dorsal radiocarpal (wide ligament that emerges from the dorsal edge of the distal radius and courses obliquely toward its distal insertion onto the dorsal ridge of the triquetrum)

- No dorsal Ulnocarpal ligaments

WRIST ANATOMY

- Intrinsec ligaments :
  - **Transverse intercarpal (same row)**
    - **Scapholunate ligament**
    - **Lunotriquetral ligament**
    - Trapeziotrapezoid ligament
    - Trapeziocapitate ligament
    - Capitohamate ligament
  - **Midcarpal (across midcarpal joint)**
    - scaphotrapeziotrapezoid
    - scaphocapitate
    - triquetralcapitate
    - triquetralhamate

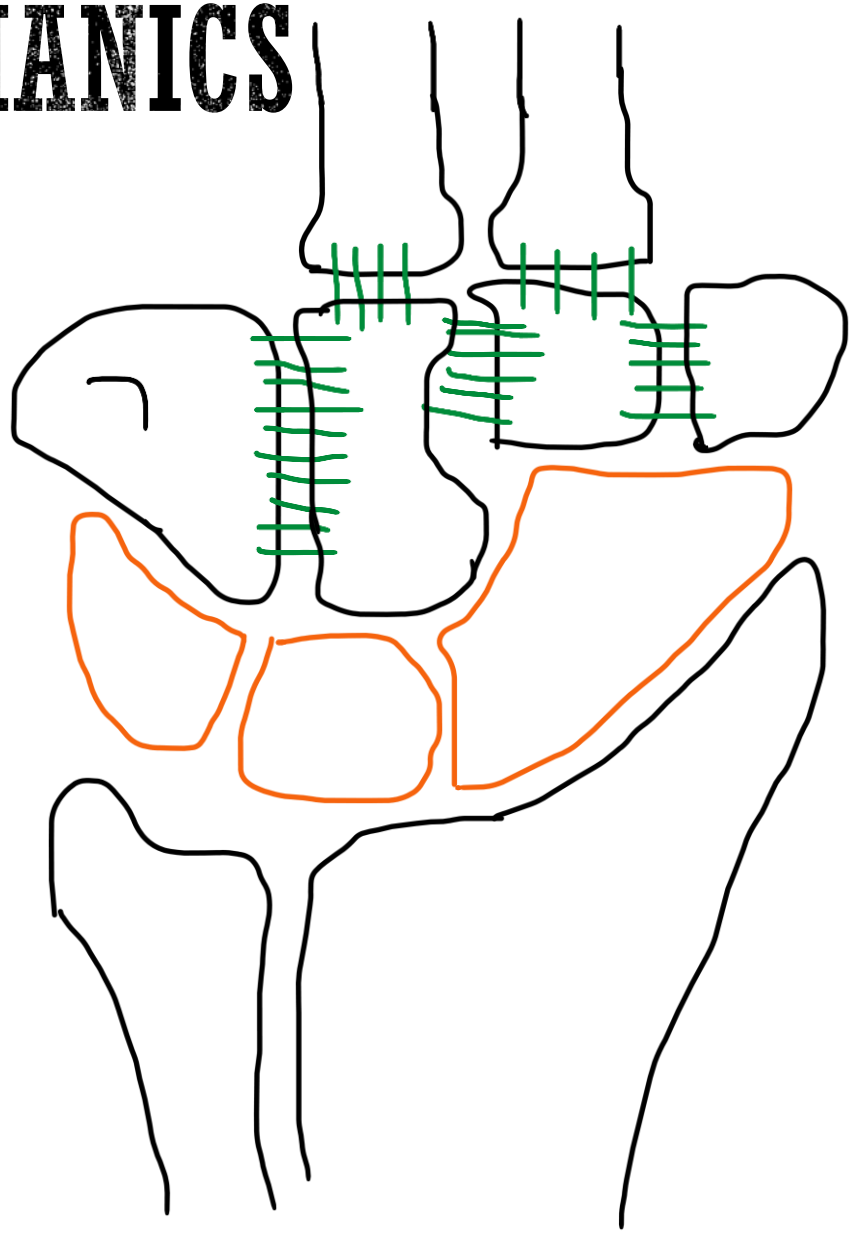


ROLE OF MUSCLES AROUND THE WRIST

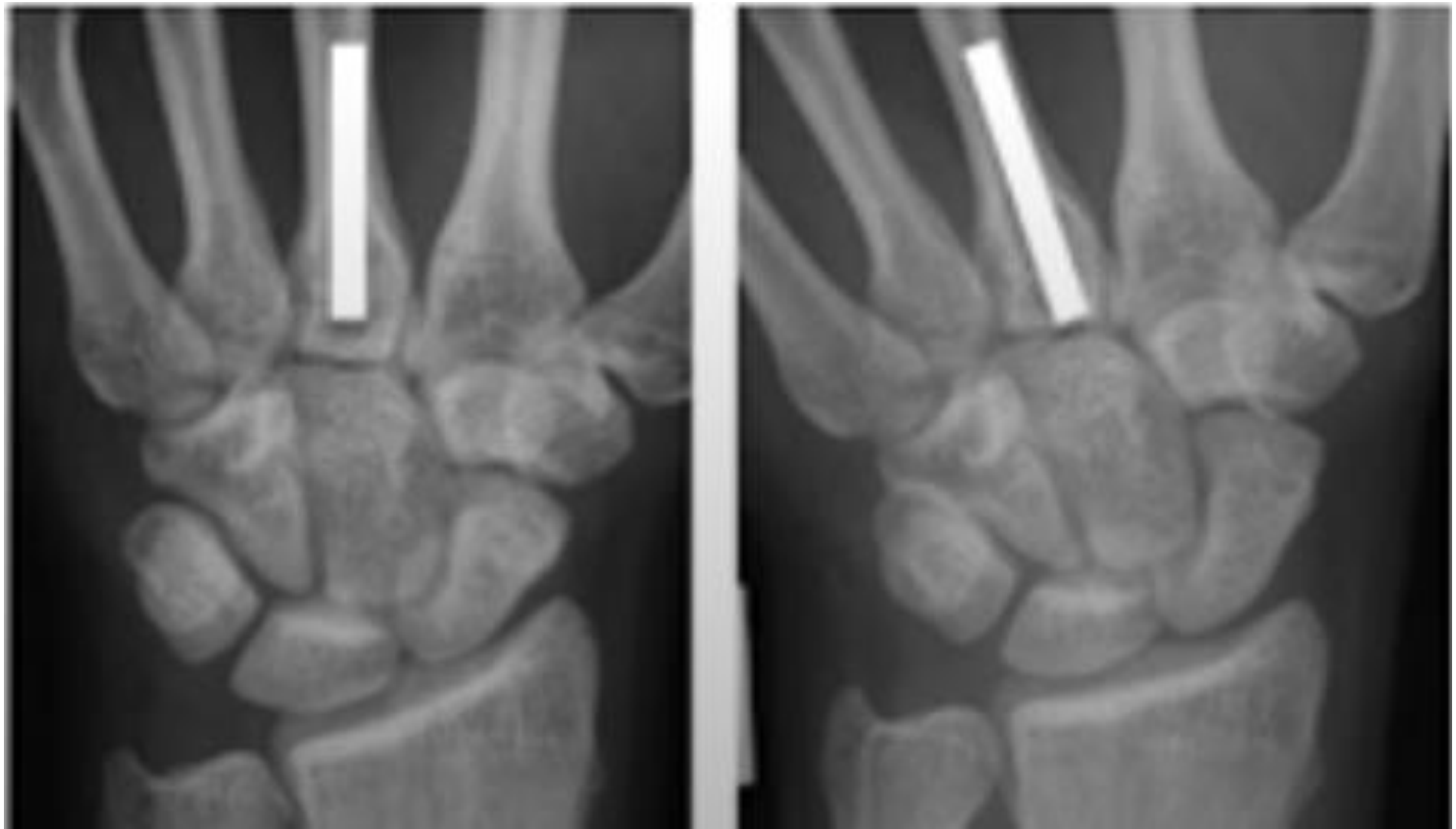
- The mechanisms of muscle stabilization of the wrist are based on the ability of some muscles to pronate or supinate the distal carpal row
- When the intracarpal supinators (ECRL or APL) contract, the trapezium displaces dorsally, causing tightening of the STT ligament.
- If the STT ligament is taut, the scaphoid cannot collapse into flexion and pronation. The intracarpal supinators, therefore, protect against excessive flexion–pronation of the scaphoid.
- In contrast, when the ECU contracts, the distal row pronates, tightening the TqH ligament and preventing the proximal row from collapsing into flexion.
- So, the supinators are useful in the treatment of scaphoid instabilities, and the pronators in the treatment of most ulnar side carpal instabilities.
- muscles are the ultimate carpal stabilizers

WRIST BIOMECHANICS

- Central fixed functional unit of the hand
- Intercalated row
- Extension and flexion occurs 60% at the radiocarpal Joint and 40% at the midcarpal
- Radial Ulnar deviation occurs 60% at the midcarpal And 40% at the radiocarpal



WRIST BIOMECHANICS



WRIST DISORDERS CAUSES

- Bones geometry changes.
- Ligaments injury or insufficiency.
- Loss of some muscles stabilizing effects.
- **most of the consequent wrist disorders evolve carpal misalignment.**
- **In theory, the most misaligned wrists should all be unstable. In practice, this is not always true.**
- **Instability is a multifactorial phenomenon that may or may not be associated with an alteration of the carpal alignment.**

INSTABILITY
VS CARPAL MISALIGNMENT

- No good answers to this question till now
- Further research is needed.
- Not every unstable wrist is malaligned and not every malaligned wrist is unstable

INSTABILITY
VS CARPAL MISALIGNMENT?

- example is the constitutional hyperlax wrist: It may appear misaligned, yet it frequently remains asymptomatic, able to handle most activities of daily living, and seldom requires treatment.

- Another example of malalgined but not unstable wrist is some chronic unreduced perilunate dislocations .. It starts with instability but then becomes stiff (opposite of being unstable)

CARPAL INSTABILITY

- A multifactorial phenomenon.
- Difficult diagnosis and treatment
- Each case needs to be individualized
- stability can be defined as the ability of a joint to avoid subluxations or dislocations under physiologic loads in all wrist positions.
- Not always symptomatic, asymptomatic instabilities are frequent and many do not require treatment

CARPAL INSTABILITY

TABLE 13.2 Analysis of Carpal Instability

Category I: Chronicity	Category II: Constancy	Category III: Etiology	Category IV: Location	Category V: Direction
Acute, >1 week (maximum primary healing potential)	Occult	Congenital	Radiocarpal	VISI rotation
Subacute, 1–6 weeks (some healing potential)	Dynamic	Traumatic	Proximal intercarpal	DISI rotation
Chronic, >6 weeks (little healing potential)	Static reducible	Inflammatory	Midcarpal	Ulnar translation
	Static irreducible	Neoplastic Iatrogenic	Distal intercarpal	Dorsal translation
		Miscellaneous	CMC	Other
			Specific bones	

analytical scheme developed by Larsen et al

CLASSIFICATION OF CARPAL INSTABILITY

- **No system is complete, easy enough or clinically easily applicable to all types**

- **However, Mayo Clinic classification is the most commonly used by the majority of wrist specialists and therefore, it is recommended** :

Type	Classification	Description	Example
I	Carpal instability dissociative (CID)	Instability within a carpal row caused by intrinsic ligament injuries	Scapholunate ligament disruption Lunotriquetral ligament disruption
II	Non-dissociative carpal instability (CIND)	Instability between carpal rows caused by extrinsic ligament injuries	Midcarpal instability: palmar, dorsal or mixed
III	Complex carpal instability (CIC)	Combination of the above two	Combination of CID and CIND
IV	Adaptive carpal instability (CIA)	Abnormal carpal kinematics caused by a change in direction of forces acting on the carpus	Distal radial malunion

CARPAL INSTABILITY DISSOCIATIVE (CID)

- Usually between two bones of the proximal carpal row, such as between scaphoid and lunate or between the lunate and triquetrum.

- Dissociative instabilities between bones of the distal carpal row are rare , due to little mobility between them

CARPAL INSTABILITY DISSOCIATIVE (CID)

SCAPHOLUNATE DISSOCIATION & DISI

- Is the most common carpal instability
- Isolated or associated with other injuries (distal radius fractures, perlunate injuries , scaphoid …)
- Usually caused by FDOOH with ulnar inclination
- SL is a C shaped ligament that has 3 components (Dorsal, Volar and proximal)
- Dorsal part is the strongest and proximal fibres have minimal role
- Untreated → DISI and then SLAC

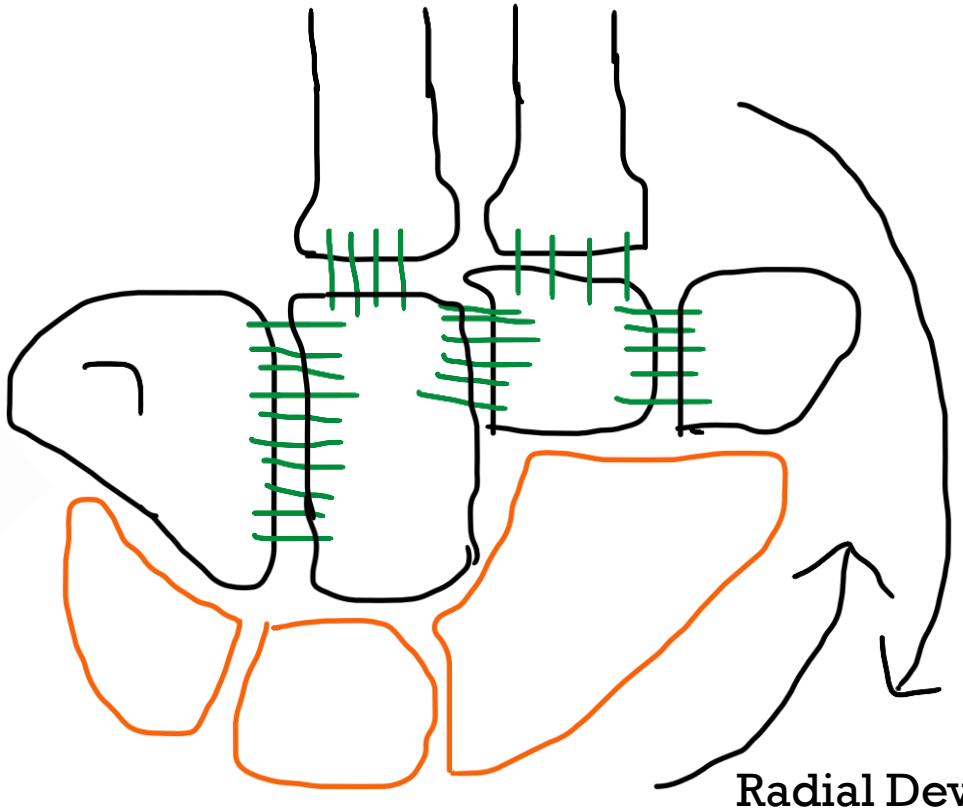
CARPAL INSTABILITY DISSOCIATIVE (CID)
SCAPHOLUNATE DISSOCIATION & DISI

- Presentation :
  - Acute FDOOH vs Degenerative
  - Dorsal radial sided wrist pain increasing with wrist loading
  - Clicking or catching in the wrist
  - Sometimes weakness or instability
  - Snuffbox tenderness on physical exam
  - Pain increases with extreme wrist extension and radial deviation
  - Painfull clunck during Watson test (deviation from ulnar to radial with pressure over scaphoid to sublax it dorsally, the clunck is palpated when scaphoid reduces back

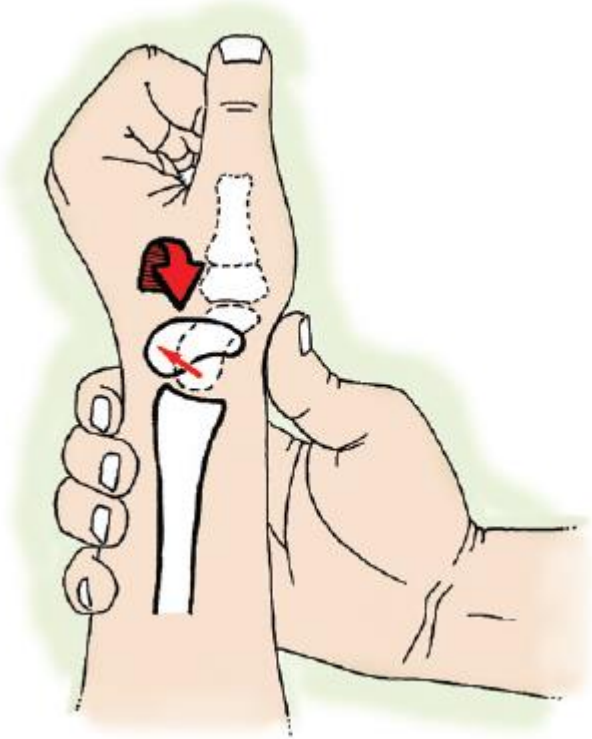
CARPAL INSTABILITY DISSOCIATIVE (CID)

SCAPHOLUNATE DISSOCIATION & DISI

Watson Test



Radial Deviation



CARPAL INSTABILITY DISSOCIATIVE (CID)
SCAPHOLUNATE DISSOCIATION & DISI

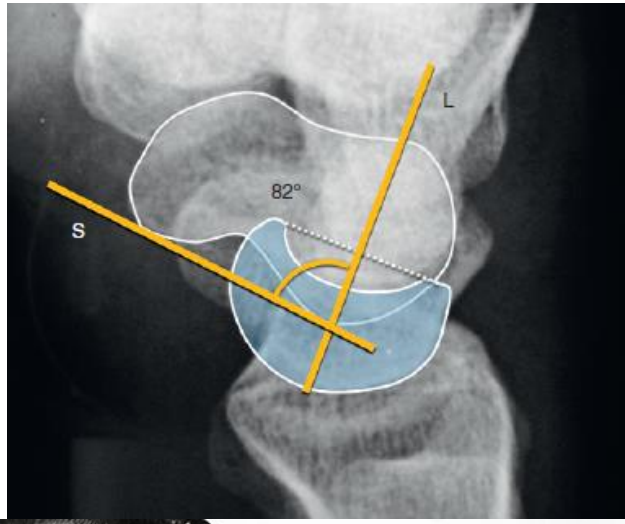
Resisted finger extension test:

The ability of the proximal pole of the scaphoid to carry a load without producing pain can be explored by asking the patient to extend the index and middle fingers fully against resistance with the wrist partially flexed.

In the presence of an injury or insufficiency of the dorsal SL ligament, a sharp pain is elicited in the SL area, probably due to the presence of synovitis at the RS joint. This maneuver is very sensitive but not specific for this pathology.

CARPAL INSTABILITY DISSOCIATIVE (CID)

SCAPHOLUNATE DISSOCIATION



RADIOLOGY :

- Increased SL joint space (Terry Thomas Sign)
- Scaphoid Ring Sign
- Increased SL angle (Greater than the usual 45-60)

CARPAL INSTABILITY DISSOCIATIVE (CID)

SCAPHOLUNATE DISSOCIATION

RADIOLOGY :

Advanced imaging.

When the patient's history, clinical examination,and radiographs are inconclusive, magnetic resonance imaging, computed arthrotomography, or diagnostic arthroscopy may be helpful to assess the degree of injury to the intercarpal ligaments, the secondary supporting ligaments, and the articular cartilage

CARPAL INSTABILITY DISSOCIATIVE (CID)

SCAPHOLUNATE DISSOCIATION

- When SL ligament is injured lunate will go with triquetral movement

CARPAL INSTABILITY DISSOCIATIVE (CID)

SCAPHOLUNATE DISSOCIATION

- Conservative (NSAIDs and rest +- immobilization)
  - Acute non displaced
  - Chronic asymptomatic
- Usually insufficient
- May be effective when tears are incomplete

CARPAL INSTABILITY DISSOCIATIVE (CID)

SCAPHOLUNATE DISSOCIATION

Treatment:

- Numerous factors and difficult and not always predictable treatment
- injury is frequently missed at presentation specially when partial
- Even if diagnosed early, the ligament remnants are short and difficult to repair.

CRITICAL POINTS *Six Questions to Consider When Evaluating an SL Injury*

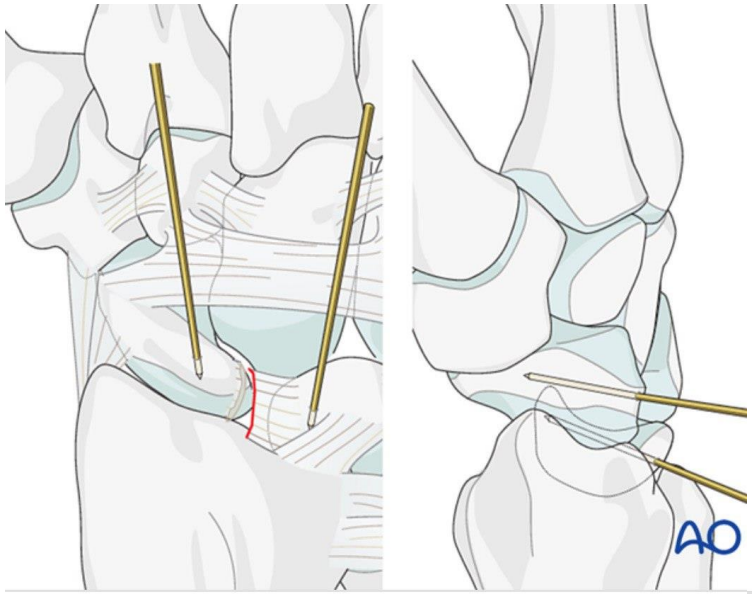
- Is the dorsal SL ligament intact and functional?
- If the ligament has ruptured, does it have good integrity for repair?
- Is the scaphoid alignment normal?
- Is radiolunate alignment still retained?
- Are abnormal carpal alignments easily reducible?
- Is the articular cartilage normal?

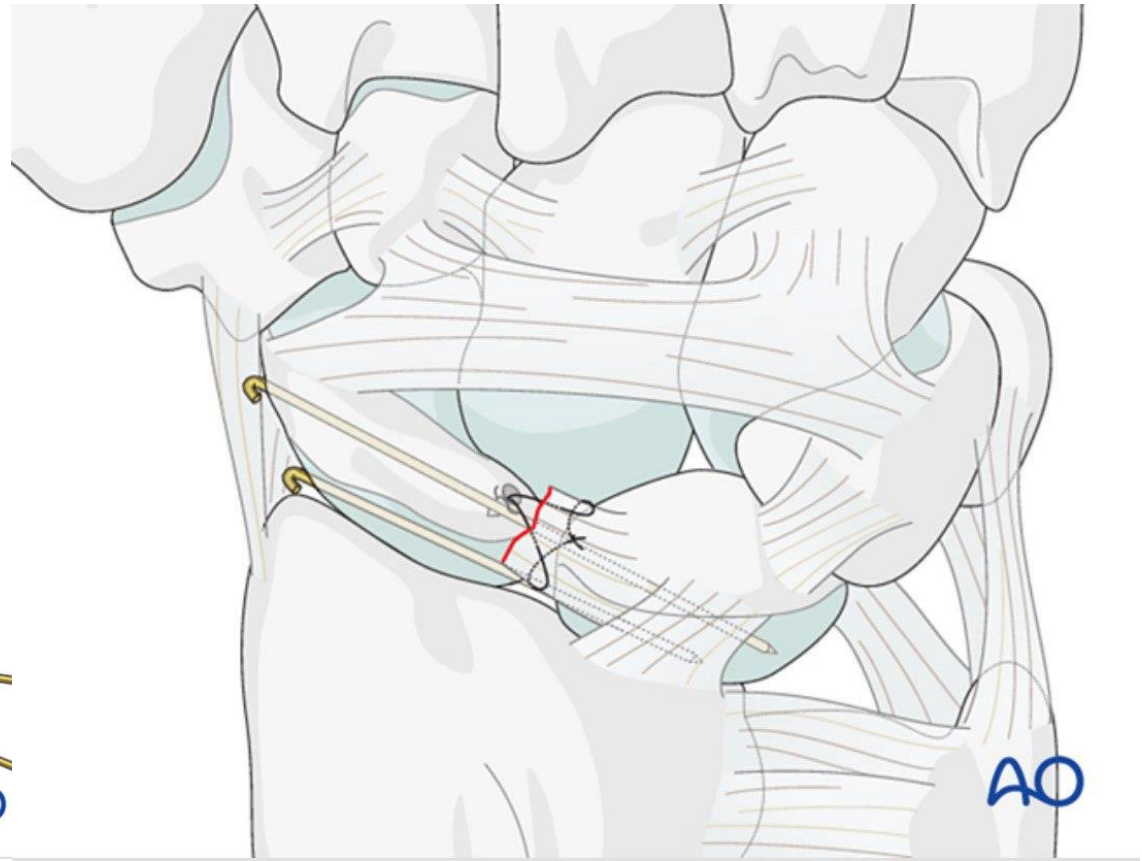
	Stage I	Stage II	Stage III	Stage IV	Stage V	Stage VI	Stage VII
Partial injury	Yes	No	No	No	No	No	No
Repairable	Yes	Yes	No	No	No	No	No
Normal RS angle	Yes	Yes	Yes	No	No	No	No
Lunate aligned	Yes	Yes	Yes	Yes	No	No	No
Reducible	Yes	Yes	Yes	Yes	Yes	No	No
Normal cartilage	Yes	Yes	Yes	Yes	Yes	Yes	No

CARPAL INSTABILITY DISSOCIATIVE (CID)

SCAPHOLUNATE DISSOCIATION

- **Treatment** :
  - Direct repair when acute (less than 18 months if reducible)





CARPAL INSTABILITY DISSOCIATIVE (CID)

SCAPHOLUNATE DISSOCIATION

Post repair :

- The wrist is immobilized in a below-elbow cast for 8 to 10 weeks, at which time the K-wires are removed. Physical therapy with ROM exercises of the fingers is initiated immediately.
- The wrist is protected with a removable splint for an additional 4 weeks. ROM and grip strength exercises of the wrist are begun at 3 months.
- Heavy activities are discouraged for 6 months.
- Reeducation of wrist proprioception
- Muscles with positive effect on SL ligament : ECRL and APL and FCR (carpal supinators)
- Muscles with negative effect on SL ligament : ECU (carpal pronator) → avoid isometric contraction

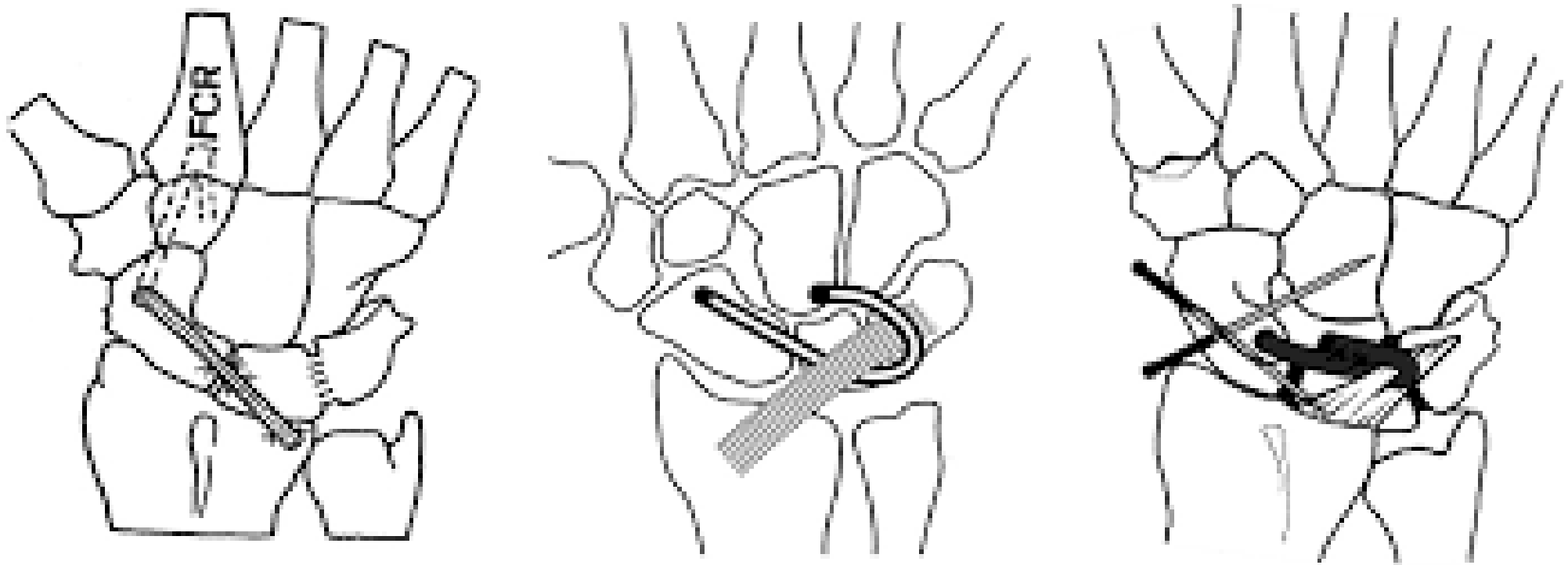
CARPAL INSTABILITY DISSOCIATIVE (CID)

SCAPHOLUNATE DISSOCIATION

- **Treatment** :
  - Ligament Reconstruction When acute and not repairable or when chronic and reducible(more than 18 months)
  - Graft from FCR or ECRB

CARPAL INSTABILITY DISSOCIATIVE (CID)

SCAPHOLUNATE DISSOCIATION

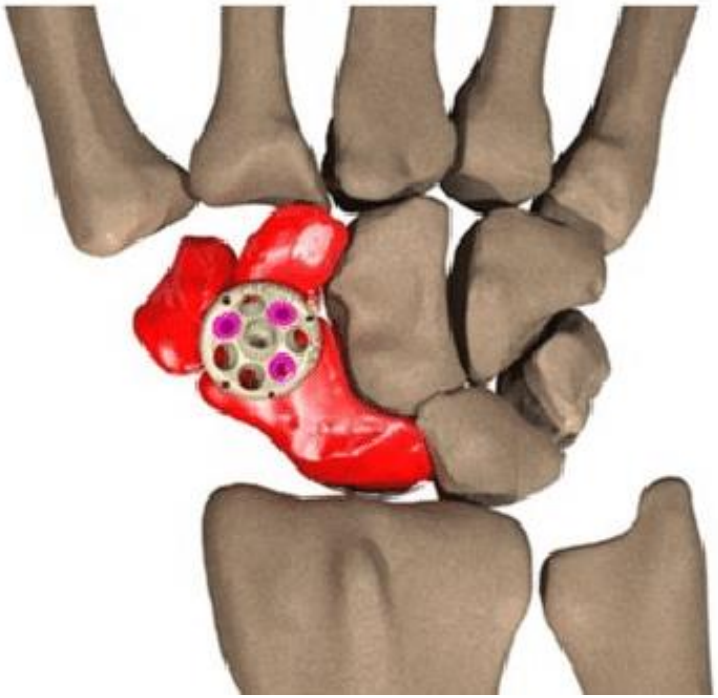


CARPAL INSTABILITY DISSOCIATIVE (CID)

SCAPHOLUNATE DISSOCIATION

- **Treatment :**

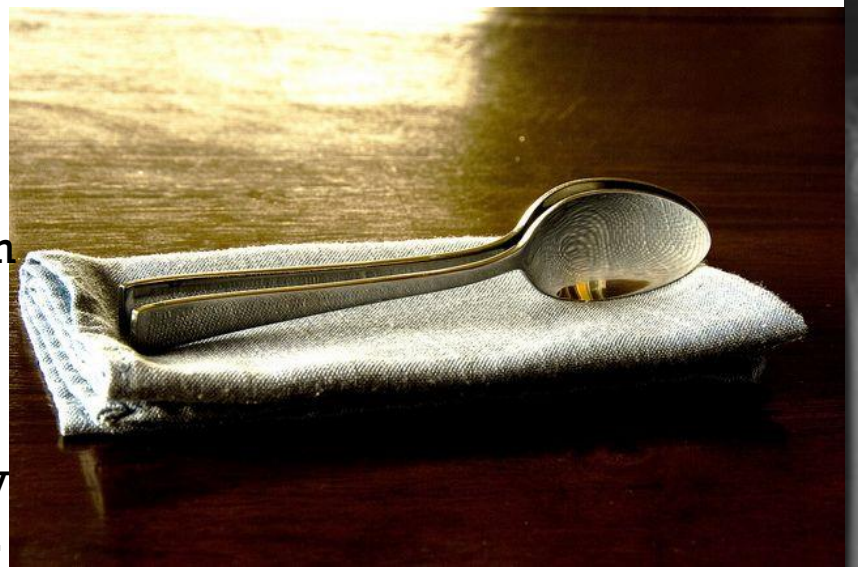
Stabilization with wrist fusion (STT or SLC) when rigid and unreducible



SCAPHOID LUNATE ADVANCED COLLAPSE SLAC

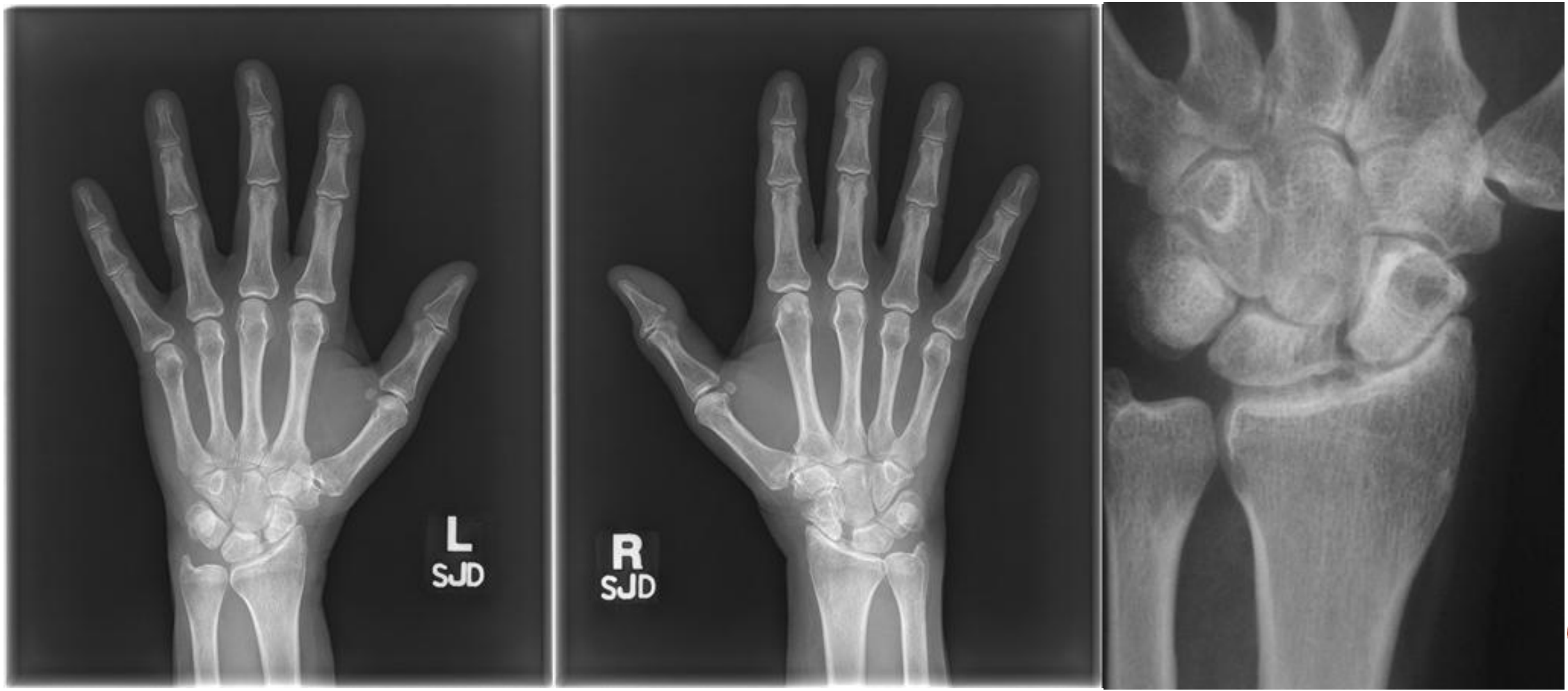
- Specific pattern of degenerative arthritis seen after chronic Scapholunate injury
- Clinical diagnosis (progressive wrist pain and wrist instability with xrays showing arthritis of the radiocarpal and midcarpal joints)

- Chronic SL injury and DISI creates a condition that Watson compared to **2 spoons sitting on top of each other** with the handles out of alignment peripheral contact may explain the frequent development of degenerative changes at the **dorsolateral corner of the RS fossa**. lunate extends but remains stable with the radius because both opposing articular surfaces have the same radius of curvature. This explains why the RL joint is rarely affected by the degenerative process.



SCAPHOID LUNATE ADVANCED COLLAPSE SLAC

Watson Classification :



SCAPHOID LUNATE ADVANCED COLLAPSE SLAC

- **TREATMENT :**
  - CONSERVATIVE IN MILD CASES
  - SURGICAL IN OPTIONS VARIES FROM SIMOLE RADIAL STYLOIDECTOMY, PRC, 4 CONRNER FUSION AND WRIST ARTHRODESIS
  - DEPENDS ON THE STAGE OF THE ARTHRITIS

CARPAL INSTABILITY DISSOCIATIVE (CID)

LUNOTRIQUETRAL DISSOCIATION & VISI

- FDOOH with the arm externally rotated the forearm supinated, and the wrist extended and radially inclined.
- Impact is concentrated on the hypothenar area, and particularly on the pisiform, which acts as a punch against the extended triquetrum
- Three **components** of the lunotriquetral ligaments (**volar**, dorsal, and proximal).
- Association with TFCC tear and distal avulsion of ulnotriquetral ligament
- In some cases, a perilunate injury process, may lead to lunotriquetral instability.

CARPAL INSTABILITY DISSOCIATIVE (CID)

LUNOTRIQUETRAL DISSOCIATION & VISI

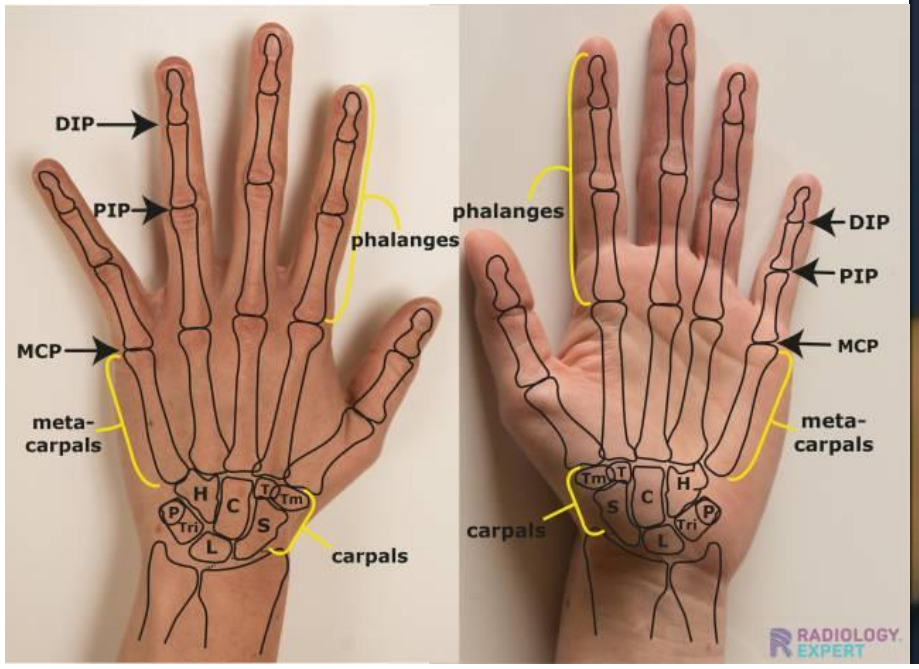
- .

CARPAL INSTABILITY DISSOCIATIVE (CID)

LUNOTRIQUETRAL DISSOCIATION & VISI

- Physical examination :
  - LT shuck test (Ballottement test)→
  - Lunotriquetral Compression test

  (ulnar displacement of the triquetrum During radioulnar deviation)



CARPAL INSTABILITY DISSOCIATIVE (CID)
LUNOTRIQUETRAL DISSOCIATION & VISI

- Physical examination :
  - Most of the mentioned tests has poor specificity and there are many other conditions that may cause ulnar sided pain during them such as :
    - LTq synchondrosis
    - fracture of an incomplete congenital coalition.
    - Triquetrum hamate impingement and degeneration.
    - Avulsion fractures of the dorsal triquetrum.
    - Pisotriquetral arthropathy.
    - Traumatic or degenerative TFCC tears.
    - Ulnocarpal impaction syndrome.
    - ECU tenosynovitis
    - Entrapment of the dorsal branch of the ulnar nerve.

CARPAL INSTABILITY DISSOCIATIVE (CID)

LUNOTRIQUETRAL DISSOCIATION & VISI

- **Imaging:**

- Xrays :
  - SL angle less than 30
  - Break in Gilula's arc
  - Proximal translation of triquetrum and or LT overlap

•Arthroscopy

Helpful in making diagnosis, as xrays may be normal

CARPAL INSTABILITY DISSOCIATIVE (CID)

LUNOTRIQUETRAL DISSOCIATION & VISI

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Helpful in making diagnosis, as xrays may be normal

CARPAL INSTABILITY DISSOCIATIVE (CID)
LUNOTRIQUETRAL DISSOCIATION & VISI

- **Treatment :**
  - Individualized according to the patient's age, occupation, recreational demands, and intensity of symptoms.
  - Many clinical conditions in which there is damage to the LTq supporting ligaments, each having its own

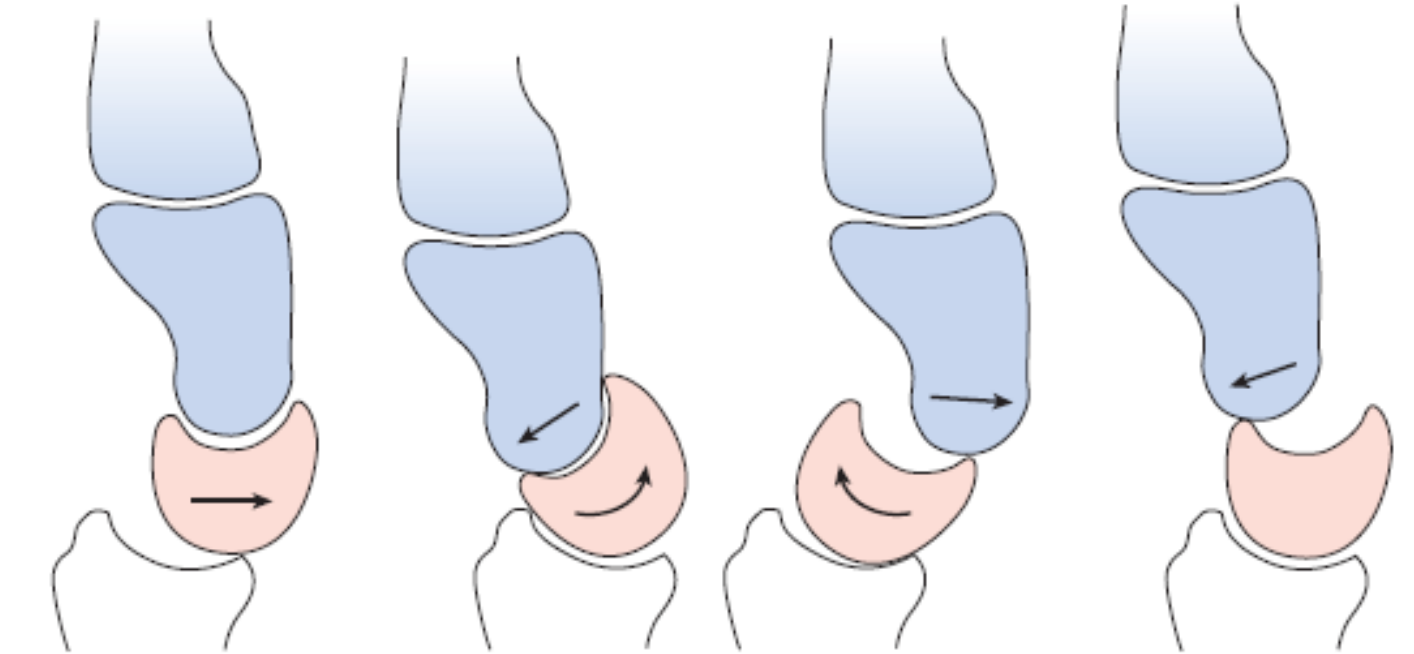
CARPAL INSTABILITY DISSOCIATIVE (CID)

LUNOTRIQUETRAL DISSOCIATION & VISI

- **Some clinical conditions:**
  - **Acute LTq injury without carpal collapse** (Dynamic or occult LTq instability), usually diagnosed by arthroscopy
    - In the past treated believed that should be treated conservatively (In this case above elbow cast should be used with a pad beneath the pisiform to preventthe huge amount of micromotion in this area
    - introduction of arthroscopy as a routine exploration in wrist trauma allowed earlier recognition of the extent of these lesions, and an increased awareness of their potential risk.
    - Pinning with multiple wires and acute ligament repair can be used in some cases
  - **Chronic LTq injury without carpal collapse**
    - Treatment varies from repair and reconstruction using graft to LT fusion(high non union rate)
  - **Chronic LTq dissociation with carpal collapse**
  - **Acute perilunate instability (combined SL and LTq instability)**
  - **Chronic perilunate instability (SL plus LTq instability).**
    - little information in the literature about this specific problem. Generally, when the proximal row presents with a combined SL and LTq dissociation, most authors recommend a proximal row carpectomy

CARPAL INSTABILITY NONDISSOCIATIVE CIND

- **Is characterized by dysfunction of the entire proximal carpal row, manifested at either the radiocarpal joint, the midcarpal joint, or both.**
- **Can be further subdivided into radiocarpal, midcarpal, and combined radiocarpal–midcarpal**



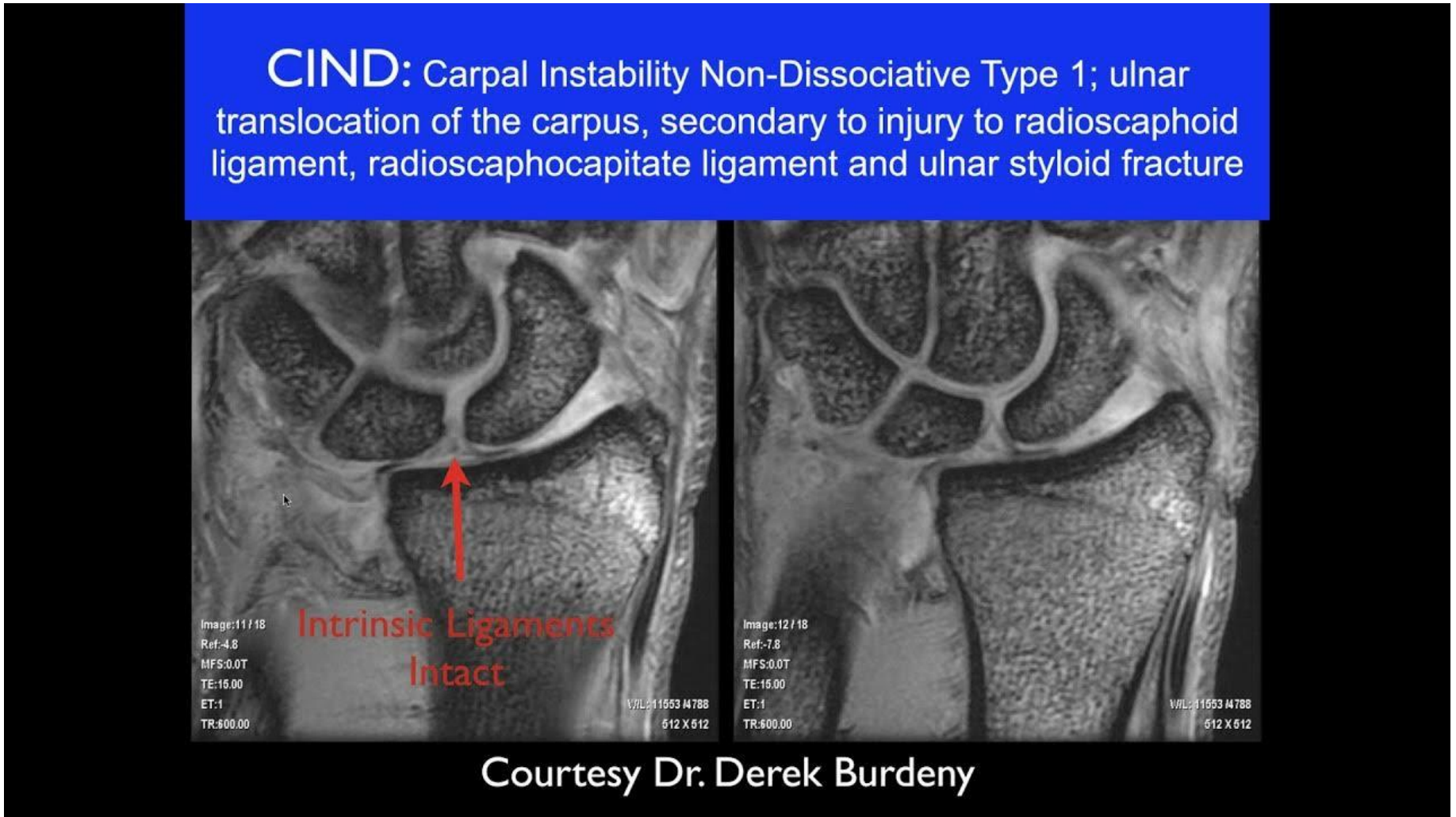
CARPAL INSTABILITY NONDISSOCIATIVE CIND

- **Radiocarpal Instability:**
  - **In patients with excessive laxity or insufficiency of radiocarpal ligaments such as RA and madelung deformity**
  - **Less frequently post traumatic (Distal radial malunion/ pure radiocarpal dislocation)**
  - **The most common form of radiocarpal CIND, is ulnar translocation**
  - **2 types :**

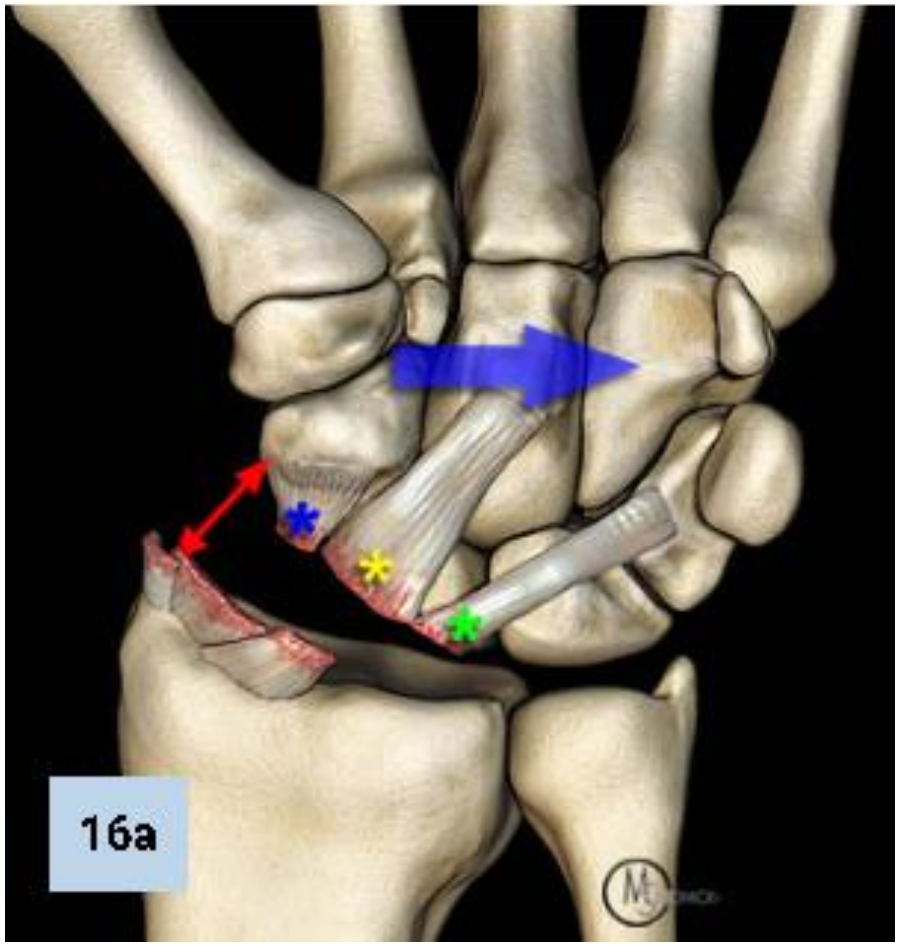
    Type 1 : Involves displacement of the entire carpus, including the scaphoid, and the distance between the radial styloid process and the scaphoid is widened

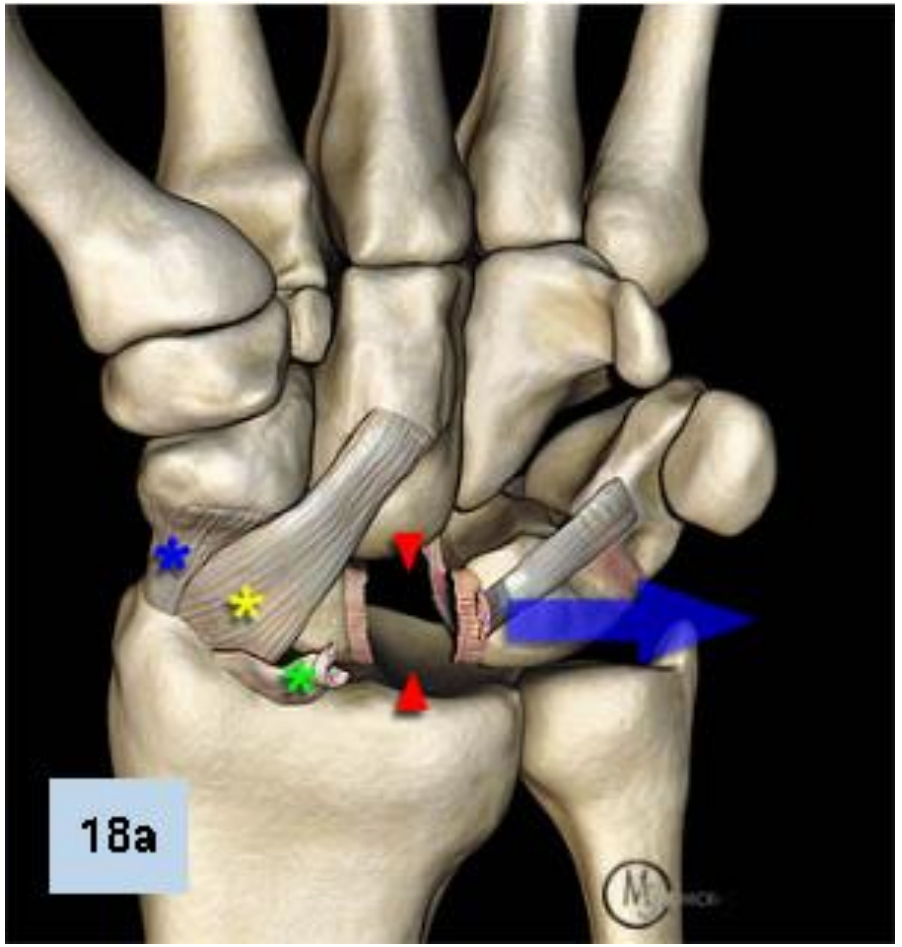
    Type 2 :the relationship between the distal row, the scaphoid, and the radius remains normal. The SL space is widened and the LTq complex is ulnarly translocated **(SL AND RL ARE DISRUPTED)=STAGE 4 SL DISSOCIATION**

CARPAL INSTABILITY NONDISSOCIATIVE CIND



CARPAL INSTABILITY NONDISSOCIATIVE CIND





Type 1 **Radiocarpal Instability** Type 2

CARPAL INSTABILITY NONDISSOCIATIVE CIND

Isolated Midcarpal Instability:

- Rare and most midcarpal instabilities are associated with some degree of radiocaral instability

Volar Instability of the Proximal Row (CIND–VISI):

- The most common type of CIND is the palmar type, or CIND-VISI.
- Described as palmar (or anterior) midcarpal instability
- Usually seen in patients with attenuation or rupture of the palmar midcarpal ligaments associated with insufficiency of the dorsal radiocarpal ligament.
- Midcarpal ligaments(specially Tqh,TqC,STT and SC) have 2 functions : to prevent midcarpal collapse and to ensure smooth progressive transition of the proximal row from extension to flexion during ulnar deviation

CARPAL INSTABILITY NONDISSOCIATIVE CIND

- Patients with symptomatic palmar CIND typically report a painful clunk while performing activities that require ulnar deviation, such as pouring liquids.

- Often bilateral

- Persons with congenital ligamentous laxity(most frequently women, children, and adolescents) or with pathologic ligament laxity(eg, Ehlers-Danlos syndrome) commonly have asymptomatic or minimally symptomatic palmar CIND

CARPAL INSTABILITY NONDISSOCIATIVE CIND

- Conditions that causes injury or increased laxity in these ligaments cause :
  - Collapse during axial load
  - Sudden, sometimes painfull and not smooth transitionfrom extension to flexion of the proximal row

- little is known about what causes these ligaments to fail.

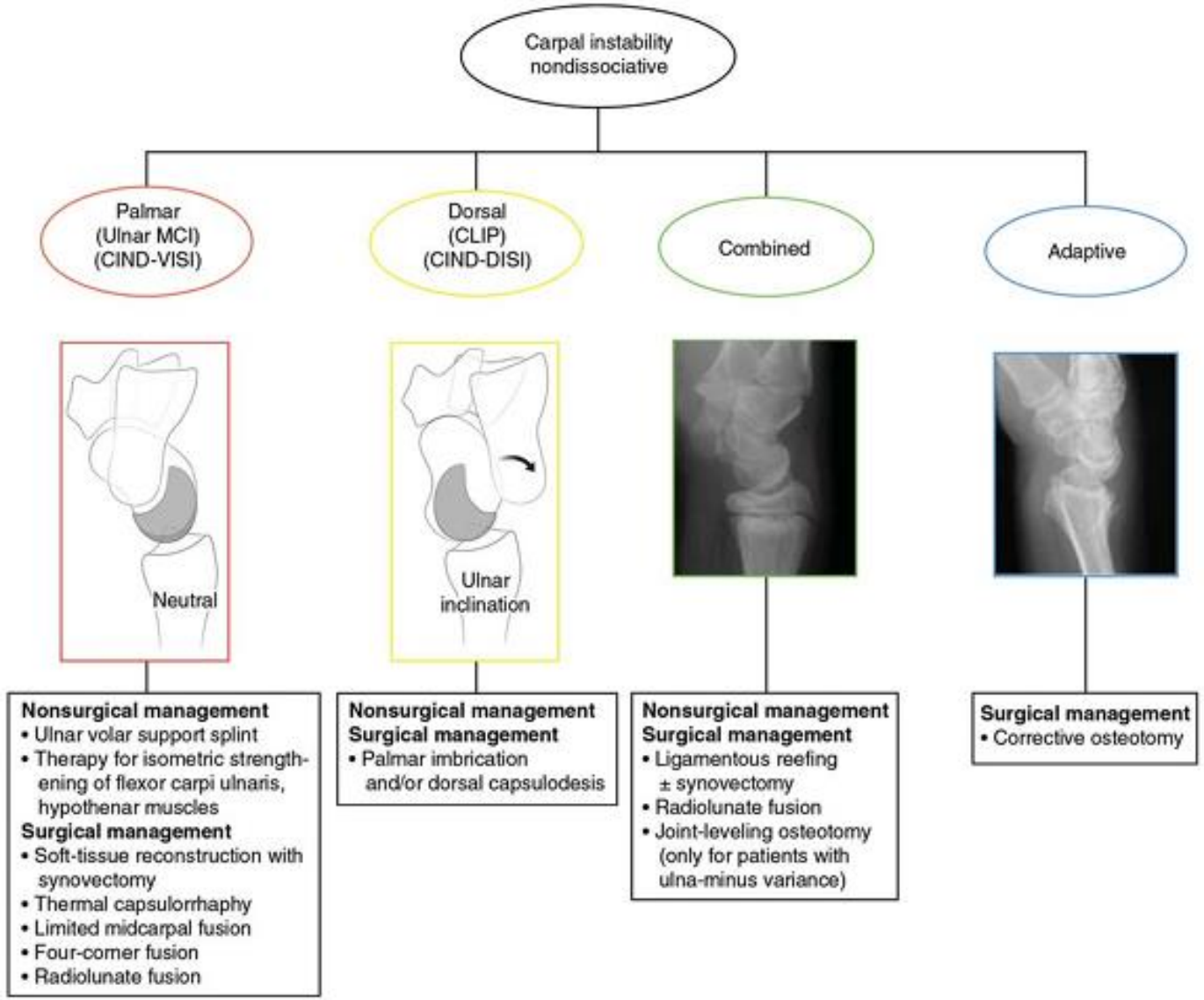
- Proximal row instability rarely results from injury of one specific ligament. Most have congenital laxity with poor neuromuscular control
- Treatment first is usually conservative

- Surgical treatment for refractory cases :
  - Capsular Shrinkage
  - Soft tissue reconstruction of the midcarpal ligaments
  - Limited intercarpal arthrodesis (mostly triquitrohamate fusion)

CARPAL INSTABILITY NONDISSOCIATIVE CIND

- **Dorsal Instability of the Proximal Row (CIND-DISI):**
    - In this condition the wrist appears normally aligned except in ulnar inclination, where a dorsal subluxation of the capitate may appear, often with a clunk.
    - Less common
    - Patients with dorsal CIND typically report pain and clicking while grasping objects with the forearm supinated
    - The pain and clicking are accompanied by weakness in chronic cases

CARPAL INSTABILITY NONDISSOCIATIVE CIND



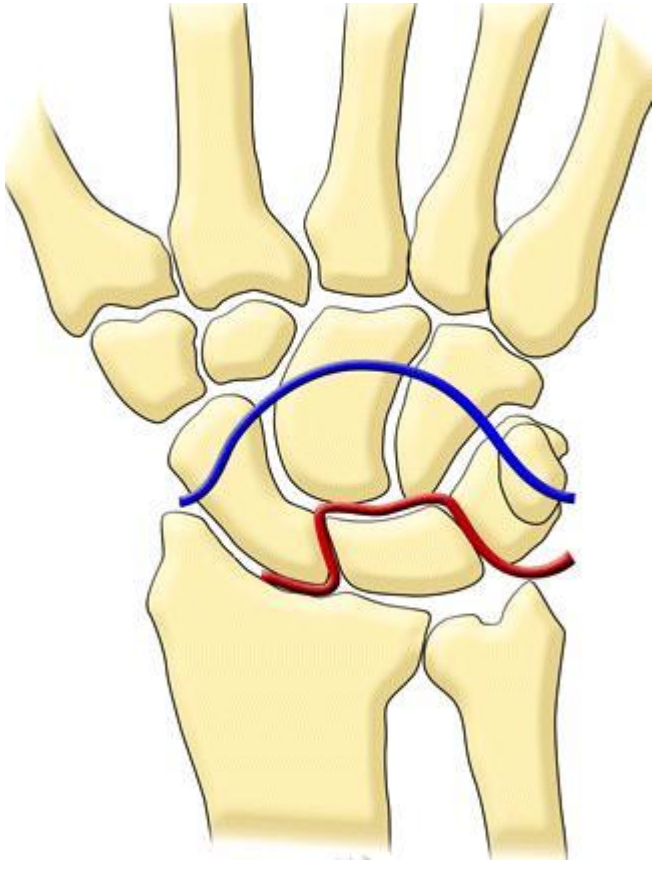
CARPAL INSTABILITY COMPLEX
CIC

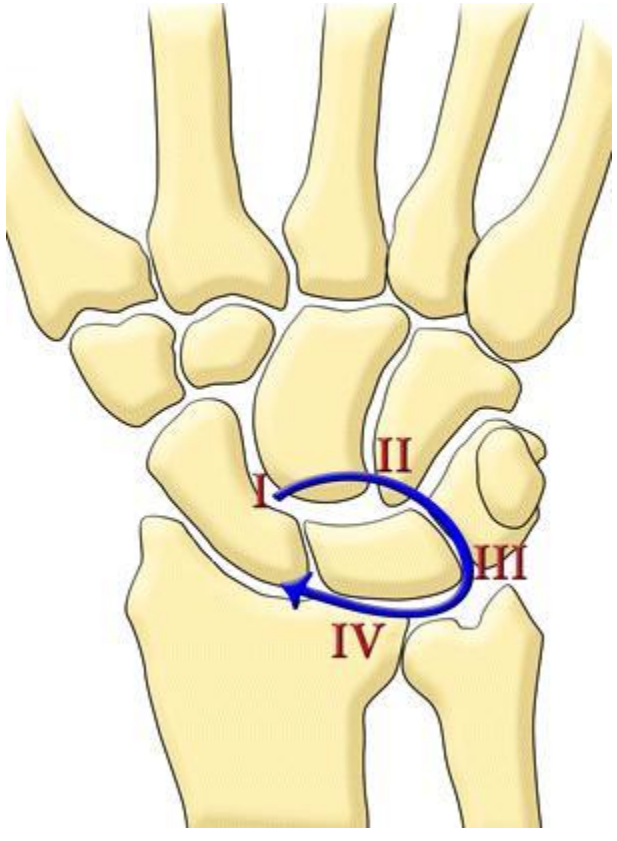
- Combination between CID and CIND, Five groups of CIC have been identified:

- Dorsal perilunate dislocation (lesser arc injury)
- Dorsal perilunate fracture-dislocation (greater arc injury)
- Palmar perilunate dislocation (lesser or greater arc injury)
- Axial dislocation
- Isolated carpal bone dislocation

CARPAL INSTABILITY COMPLEX
CIC

- Dorsal perilunate dislocation (lesser arc injury)



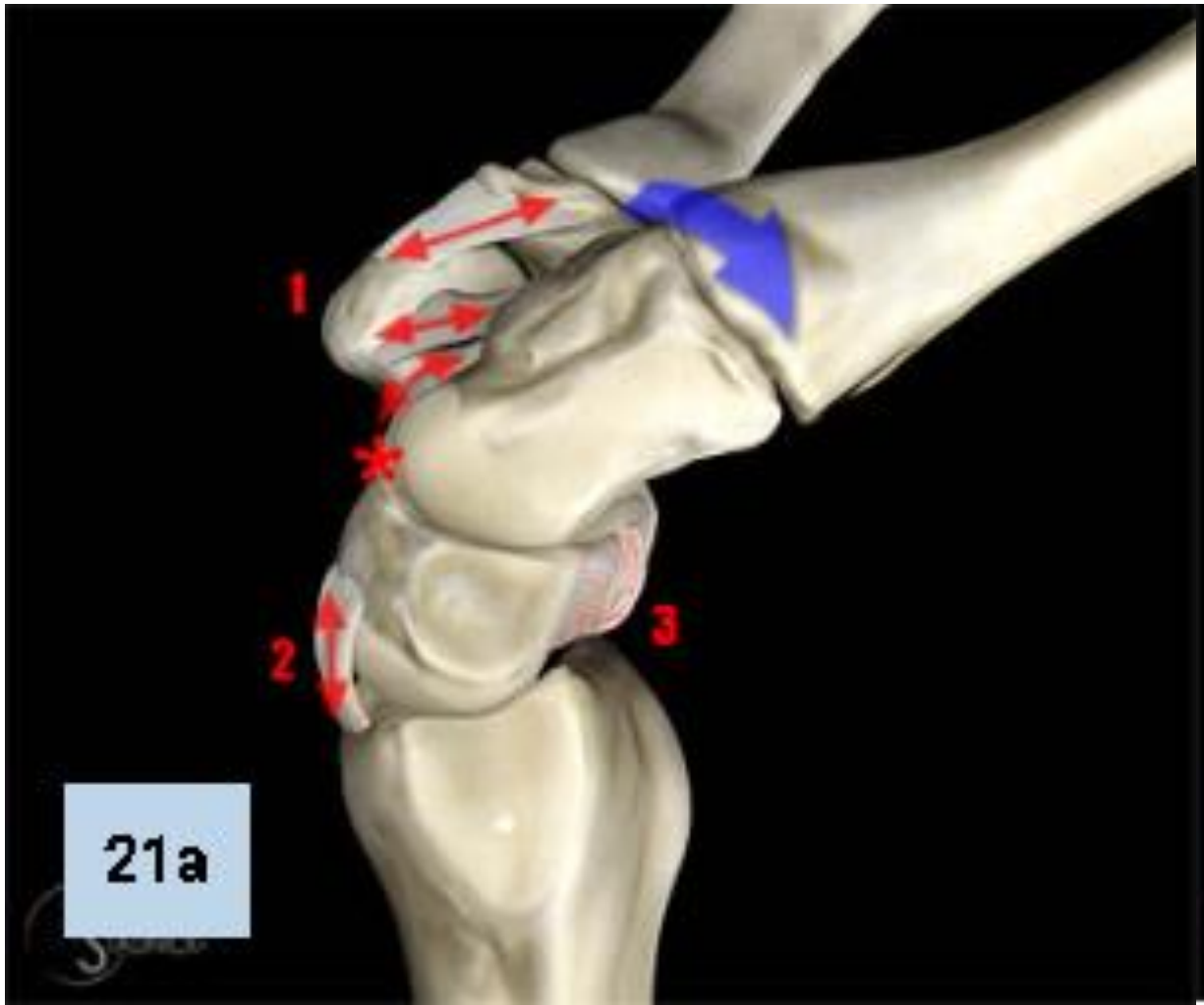


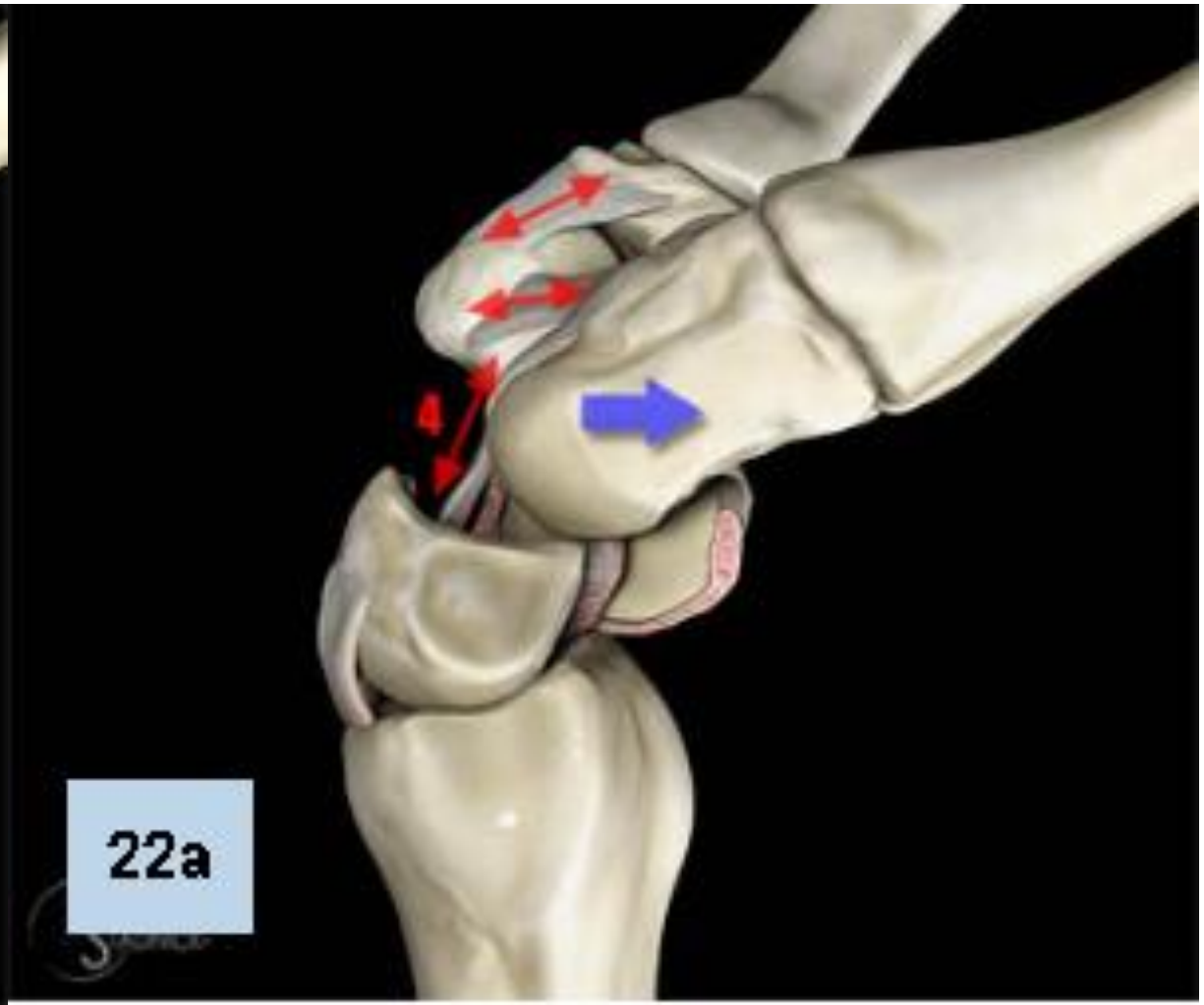
CARPAL INSTABILITY COMPLEX
CIC

- Dorsal perilunate dislocation (lesser arc injury)

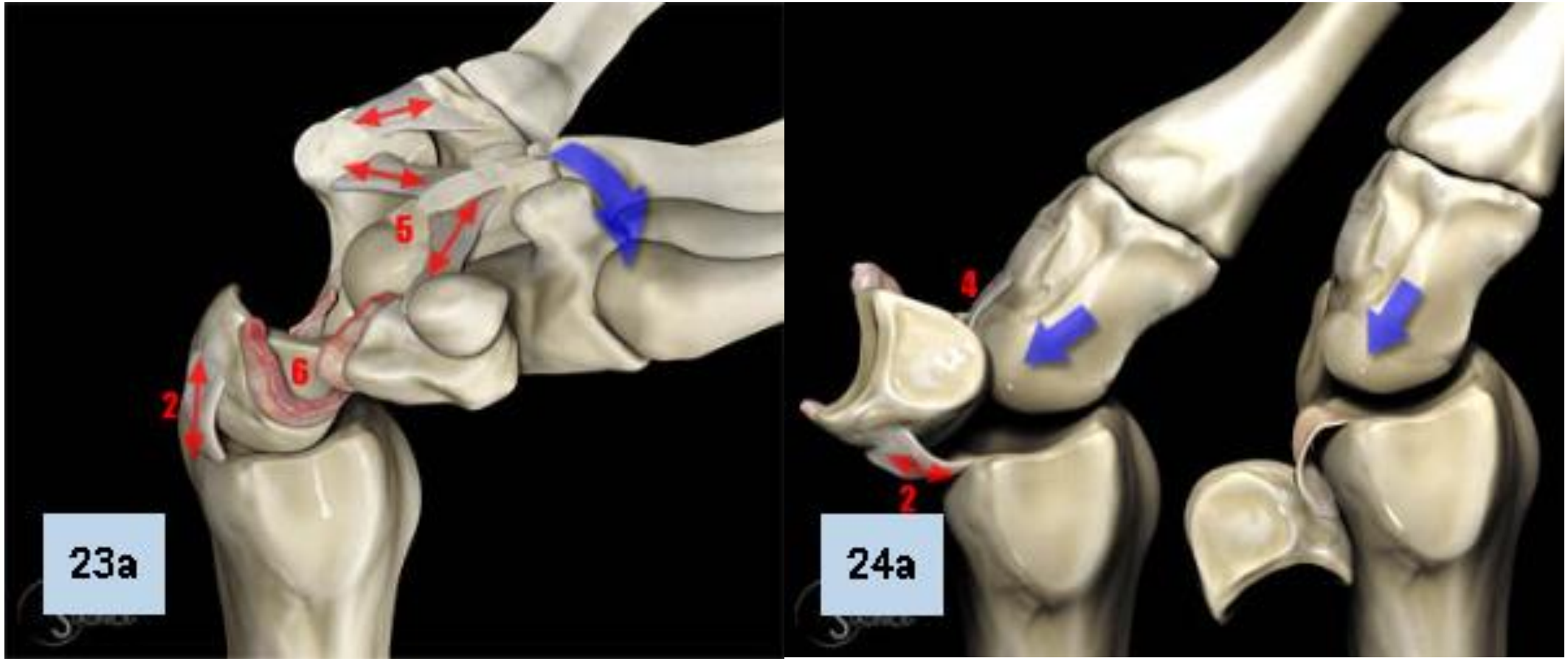
Mayfield Classification	Level of carpal instability
Stage I: scapholunate dissociation	Disruption of scapholunate ligament with +Terry Thomas sign; exacerbated in clenched fist view
Stage II: perilunate dislocation	+Disruption of capitolunate joint; high association with scaphoid fractures
Stage III: midcarpal dislocation	+Disruption of triquetrolunate joint; neither capitate or lunate is aligned with distal radius
Stage IV: lunate dislocation	+Disruption of radiolunate joint

CARPAL INSTABILITY COMPLEX
CIC





CARPAL INSTABILITY COMPLEX
CIC



CARPAL INSTABILITY ADAPTIVE CIA

- Carpal instability adaptive is carpal malalignment due to extrinsic non carpal deformity (fracture or malunion of the dista radius and can mimic features of midcarpal CIND)

- the most frequent involves radial shortening plus extension, radial deviation, and supination misalignment of the distal fragment relative to the radial shaft. No matter how inclined the distal radial surface is, patients always try to realign the hand along the longitudinal axis of the forearm. Obviously, this implies forcing the wrist into considerable misalignment

- Excessive dorsal tilt may cause prolonged flexion and distend the dorsal capsule.
- Important to differentiate with CIND-VISI → treatment (osteotomy vs soft tissue repair)

THANK YOU