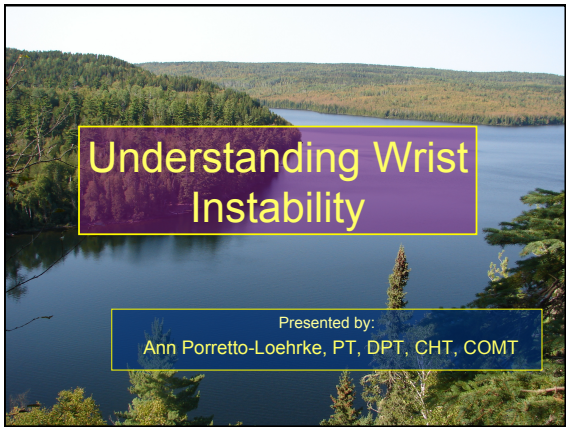



## The Wrist

•Bony Anatomy of the wrist

## Bony Anatomy: distal radius

RADIAL DECLINATION

Neumann D. Kinesiology of the musculoskeletal system: foundations for rehabilitation. 2nd ed. St. Louis: Mosby 2010.

Schuind FA, Linscheid RL, An K-N, Chao EYS. A normal database of posteroanterior measurements of the wrist. J Bone Joint Surg. 1992; 74A: 1418-1429.

## Bony Anatomy: distal radius

VOLAR DECLINATION

Neumann D. Kinesiology of the musculoskeletal system: foundations for rehabilitation. 2nd ed. St. Louis: Mosby 2010.

Taleisnik J, Watson HK. Midcarpal instability caused by malunited fractures of the distal radius. J Hand Surg. 1984; 9A:350-357.

## Bony Anatomy of the Wrist

## Cross section of the Wrist

## Osteology-Carpal bones

### Scaphoid

- articulates with the distal radius proximally, and trapezium and trapezoid distally;
- most frequently fractured carpal bone!

## Osteology-Carpal bones

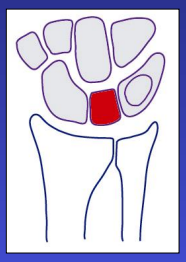
### Scaphoid

- Scaphoid fractures can present as tenderness in the snuff box and at the scaphoid tubercle
- Sometimes misdiagnosed as a "wrist sprain"

Parvizi J, Wayman J, Kelly P, Morgan CG. Combining the clinical signs improves diagnosis of scaphoid fractures. A prospective study with follow up. J Hand Surg Br. 1998 Jun;23(3)324-7.

Dell P. Dell R. Management of carpal fractures and dislocations. Rehabilitation of the Hand the Upper Extremity, 2002,1171-1173.

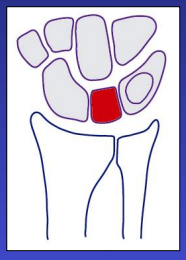
## Osteology-Carpal bones



### Lunate

- articulates with the distal radius proximally and capitate distally
- the most commonly dislocated carpal bone
- prone to avascular necrosis (AVN)

## Osteology-Carpal bones



- Majority of lunates have dorsal and palmar vessels with rich anastomotic network.
- In<20% of patients: a single vessel enters palmar surface; more susceptible to disruption of palmar nutrient supply with hyperextension and dislocation injuries.

Wheeless' Textbook of Orthopaedics. WheelessOnline.com. Duke University Medical Center's Division of Orthopaedic Surgery, in conjunction with Data Trace Internet Publishing, LLC .

## Osteology-Carpal bones

27%-34.5% | Lunate: 2 types | 65.5%-73%

**Type 1: One distal facet (Capitate)** | **Type 2: Two distal facets (Capitate and hamate)**

Viegas SF. Variations in the skeletal morphologic features of the wrist. *Clinical Orthopaedics And Related Research*. 2001;383:21-31.

## Osteology-Carpal bones

**Type 1** | **Type 2**

DISI | No DISI

**Type II Lunate: Theory**

Morphology protective against **Dorsal Intercalated Segmental Instability**

Added articulation= additional stability that resists abnormal ext

Haase SC, Berger RA, Shin AY. Association between lunate morphology and carpal collapse patterns in scaphoid nonunions. J Hand Surg 2007; 32A: 1009-1012.

## Osteology-Carpal bones

### Triquetrum

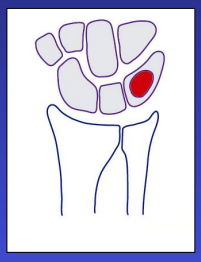
- articulates with the articular disc proximally and hamate distally;
- in direct contact with the pisiform via a synovial planar joint;
- irritation to this joint may mimic FCU tendinitis;

## Osteology-Carpal bones

### Triquetrum

- likes to extend;
- Attachment for ulnar collateral ligament (ulnotriquetral ligament) and triangular fibrocartilage homologue tissue.

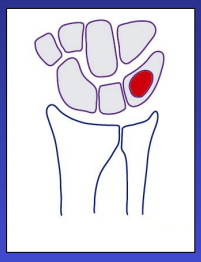
## Osteology-Carpal bones



### Pisiform

- acts as a sesamoid bone for the FCU;
- does not play a direct role in wrist arthrokinematics at the radiocarpal and midcarpal joints;

## Osteology-Carpal bones



### Pisiform

- attachment of transverse carpal ligament;
- extension of the transverse arch of the proximal carpal row in a volar-ulnar direction.

## Osteology-Carpal bones

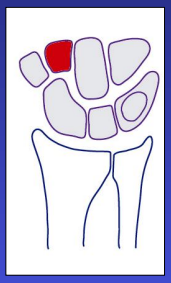
### Trapezium

- articulates with the scaphoid proximally and the 1st metacarpal distally (sellar joint);
- carpal bone most often afflicted with degenerative changes.

## Osteology-Carpal bones

### Trapezoid

- Biconcave in shape
- Forms one functional unit together with trapezium and capitate
- Trapezo-scaphoid joint limit can decrease thumb retroposition



## Scaphotrapezio-trapezoidal joint

**Scaphoid axial plane:**
-Includes the interfacet ridge of the distal scaphoid;
-Is oriented in approximately 45° supination from coronal plane (Radiodorsal to ulnopalmar)

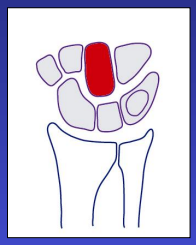
Moritomo H, Viegas SF, Nakamura K, DaSilva MF, Patterson RM. The Scaphotrapezio-trapezoidal joint. Part 1: An anatomic and radiographic study. J Hand Surg 2000; 25A: 899-910.

## Scaphotrapezio-trapezoidal joint

-Trapezium, trapezoid, capitate and 3rd MC bones move as a unit relative to the scaphoid.
-Capitate and 3rd MC bone kinematics relative to the scaphoid = STT kinematics. (single degree of freedom)
-Radius-scaphoid joint is believed to have 5 degrees of freedom.

Moritomo H, Viegas SF, Elder K, Nakamura K, DaSilva MF, Patterson RM. The Scaphotrapezio-trapezoidal joint. Part 2: A kinematic study. J Hand Surg 2000; 25A: 911-920.

## Osteology-Carpal bones



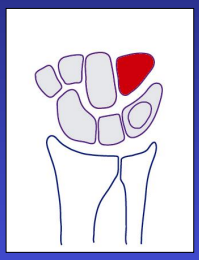
**Capitate**

- **Largest carpal bone;**
- **Keystone of the wrist;**
- **Isolated injury are rare due to protected position;**
- **Can act as wedge to damage Scapho-Lunate ligament;**
- **No ligament connection between capitate and lunate.**

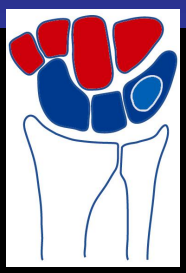
## Osteology-Carpal bones

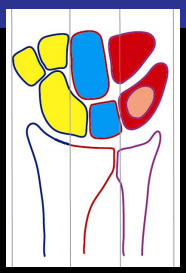
**Hamate**

- **Functionally important for power grip activities**
- **"critical zone" of vascularization at the base of the hook**

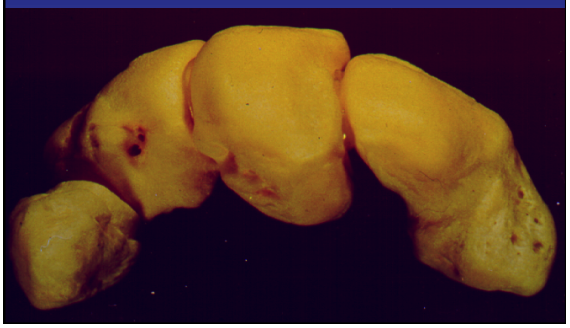


## Introduction
Rows & Columns

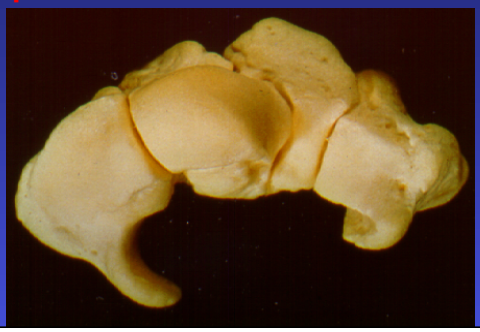




## Proximal Carpal Row:
proximal view

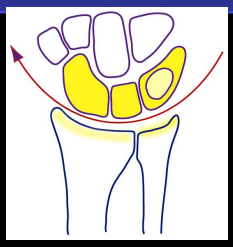


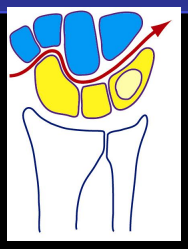
**Distal Carpal Row:**
**proximal view**



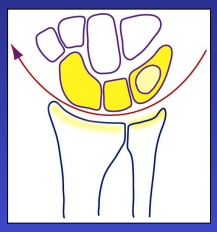
The 2 joints of the Wrist:

RCJ MCJ





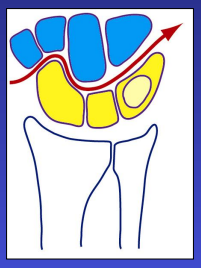
## Osteology- Joints of the Wrist



**Radiocarpal Joint (RCJ)**

- The stable distal radius, ulna, and articular disc
- More mobile proximal carpal row (scaphoid, lunate, triquetrum)

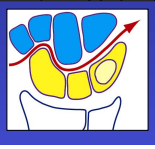
## Osteology- Joints of the Wrist



**Midcarpal Joint (MCJ)**

- "S" shaped
- The distal carpal row is "stiffer" and has a strong attachment to the base of the metacarpals

## Osteology- Joints of the Wrist



**Upon RD/UD, where does the most motion come from, RCJ vs MCJ?**

Mid carpal row via carpal flexion and extension:
86% with UD
60% with RD

Kaufmann R et al. Kinematic of the midcarpal and radiocarpal joints in radio-ulnar deviation: an in vitro study. J Hand Surg 2005;30A: 937-942.

## The Wrist

**Capsuloligamentous considerations of the wrist**

## Ligamentous Anatomy

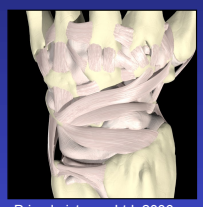
Wrist ligaments are either intracapsular or intra-articular

The intracapsular ligaments are contained within the capsular sheath of loose connective tissue except:

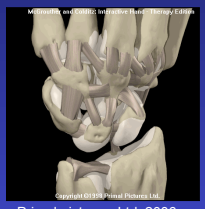
- *-transverse carpal ligament*
- *-distal connection pisiform-hamate*
- *-distal connection pisiform-base of 5th MC*

Green DP, Pederson WC, Hotchkiss RN, Wolfe SW. Green's Operative Hand Surgery 5th ed. Elsevier Inc. Philadelphia. 2005.

## Intracapsular Wrist Ligaments



Primal pictures, Ltd. 2006



Primal pictures, Ltd. 2006

**Extrinsic: Connect FA bones with the carpus**

**Intrinsic: Origin and insertion within the carpus**

## Intracapsular Wrist Ligaments

Extrinsic

**-Stiffer / Lower yield strength**

**-3 major groups:**

- **Volar radiocarpal (4)**
- **Volar ulnocarpal (3)**
- **Dorsal radiocarpal (1)**
- **(no dorsal lig. between the ulna and carpus)**

## Intracapsular Wrist Ligaments

Extrinsic

**Volar radiocarpal (4):**

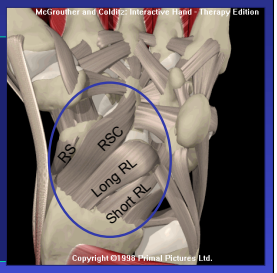
**-Radio scaphoid (RS)**

***(Also considered radial collateral ligament)***

**-Radioscaphocapitate (RSC)**

**-Long Radio lunate (Long RL)**

**-Short Radio lunate (Short RL)**




## Intracapsular Wrist Ligaments

Extrinsic

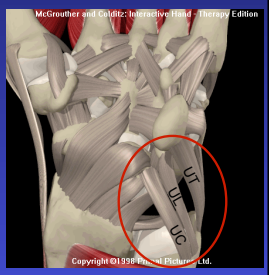
**Volar ulnocarpal (3):**

**-Ulno capitate lig. (UC)**

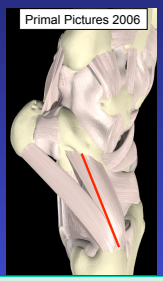
**-Ulno triquetral lig. (UT)**

***(Also considered collateral ligament)***

**-Ulno lunate lig. (UL)**




## Wrist "collateral" Ligaments





Ulnotriquetral ligament also considered the ulnar collateral ligament.

Radioscaphoid ligament also considered radial collateral ligament.

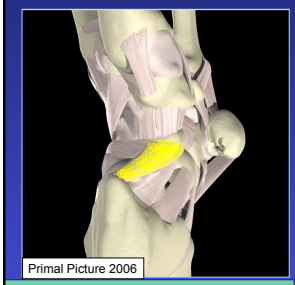
## Wrist "collateral" Ligaments


**UCL:**
- -Bifid
- -Origin= Ulnar styloid process
- -Insertion= Volar and dorsal aspect of triquetrum

Note: no true ulnar collateral ligament of the wrist exist because the wrist is not a true hinge joint.

Green DP et al. Green's Operative Hand Sugery 5th ed. Elsevier Inc. Philadelphia. 2005.

## Wrist "collateral" Ligaments




**RCL:**
- -Bifid
- -Origin: Radial styloid
- -Insertion: Volar and dorsal aspect of proximal pole of scaphoid

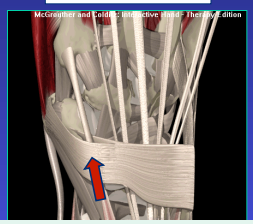
Note: no true radial collateral ligament of the wrist exist because the wrist is not a true hinge joint.

Green DP et al. Green's Operative Hand Sugery 5th ed. Elsevier Inc. Philadelphia. 2005.

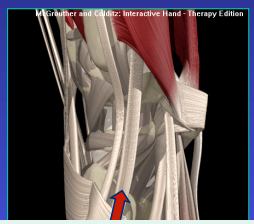
## Wrist "collateral" Ligaments

Functionally substituted by:

ECU tendon

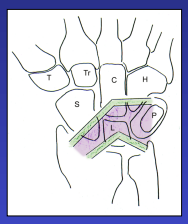


APL tendon

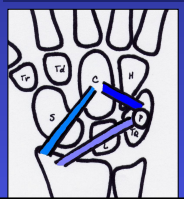


Green DP, Pederson WC, Hotchkiss RN, Wolfe SW. Green's Operative Hand Surgery 5th ed. Elsevier Inc. Philadelphia. 2005.

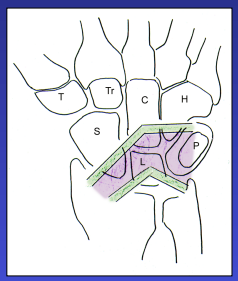
## Volar Extrinsic Wrist Ligaments




2 LAYERS:
- Superficial portion
- Deep portion

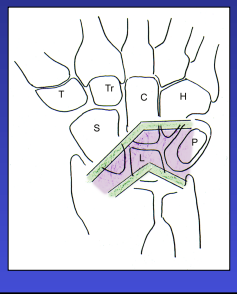



## Volar Extrinsic Wrist Ligaments



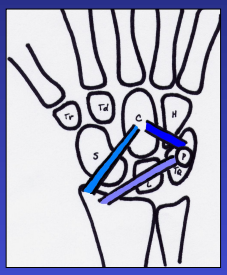

Superficial portion
- "V" shaped
- Base at the radius and on the lunate and ulna
- Extends distally and inserts on the capitate & triquetrum

## Volar Extrinsic Wrist Ligaments




Superficial portion
- Generally course from radius to the carpus in an ulnar direction
- Attaches at the ulnar styloid

## Volar Extrinsic Wrist Ligaments

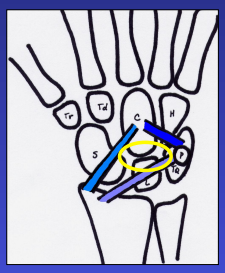


Deep Extrinsic Ligaments

- Noted arcuate complexes: labral configuration at scapho-capitate and triquetro-capitate junctions

Berger RA. The anatomy of the ligaments of the wrist and distal radioulnar joints. Clin Orth Rel Res 2001; 383:32-40.

## Volar Extrinsic Wrist Ligaments



Deep Extrinsic Ligaments

- Space of Poirier: no direct ligamentous support between the capitate and lunate
- This makes the central column (especially the lunate) more prone to instability

## Intracapsular Wrist Ligaments

Extrinsic

**Dorsal radiocarpal (1):**

**-Radio triquetral ligament**

## Dorsal Extrinsic Wrist Ligament

"Dorsal ligaments play a greater and more important role in carpal stability and carpal kinematics than was previously recognized"

Viegas, et al. The Dorsal Wrist Ligaments of the Wrist: Anatomy, Mechanical Properties, and Function. J Hand Surg. 1999; 24A: 456-468.

Kauer JMG. Anatomy and function of the wrist and hand. In: Gilula LA Yin Y eds. Imaging of the wrist and hand. Philadelphia, WB Saunders, 1996:48.

## Dorsal Extrinsic Wrist Ligament

DORSAL RADIOCARPAL LIGAMENT

- Helps prevent translation
- Indirect scaphoid stabilization
- Restraint without motion limit
- Guides the carpus into pronation
- Contributes to proximal row instability when compromised

Berger RA. The anatomy of the ligaments of the wrist and distal radioulnar joints. Clin Orth Rel Res 2001; 383:32-40.

Viegas, et al. The dorsal ligaments of the wrist: Anatomy, mechanical properties, and function. J Hand Surg 1999; 24A: 456-468.

## Dorsal Extrinsic Wrist Ligaments

Variations in the DORSAL RADIOCARPAL LIGAMENT

Viegas, et al. The dorsal ligaments of the wrist: Anatomy, mechanical properties, and function. J Hand Surg. 1999; 24A: 456-468.

## Intracapsular Wrist Ligaments

Intrinsic

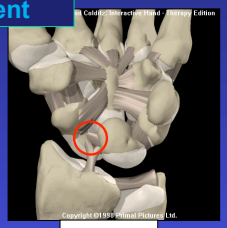
- -Larger area of insertion into cartilage
- -Less content of elastic fibers
- -Main components:
  - -Scapholunate ligament
  - -Lunotriquetral ligament
  - -Midcarpal ligaments
  - -Distal carpal row interosseous ligaments

## Intracapsular Wrist Ligaments

Intrinsic

Scapholunate ligament

Dorsal view



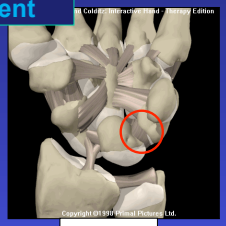
Volar view

## Intracapsular Wrist Ligaments

Intrinsic

Lunotriquetral ligament

Dorsal view

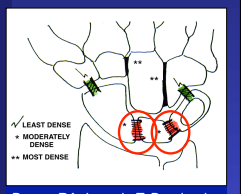


Volar view

## Intrinsic Wrist Ligaments

Deep Intrinsic Ligaments

- Proximal row of carpals are connected by highly elastic ligaments
- This elasticity results in the highest level of mobility potential
- S-L and L-T ligaments have the most mobility potential

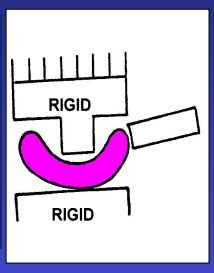



Berger RA, Imeada T, Berglund L, An K-N. Constraint and material properties of the subregions of the scapholunate interosseous ligament. J Hand Surg. 1999; 24A: 953-962.

## Intrinsic Wrist Ligaments

Deep Intrinsic Ligaments

- **Proximal carpal row is an "intercalated segment"**
- **It acts as a "disc" between the radius/ulna and the rigid distal row of carpals**



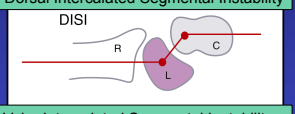

Berger RA, Imeada T, Berglund L, An K-N. Constraint and material properties of the subregions of the scapholunate interosseous ligament. J Hand Surg. 1999; 24A: 953-962.

## Intrinsic Wrist Ligaments

Failure of those ligaments = DISI or VISI

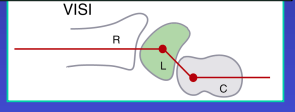
SL lig.

Dorsal Intercalated Segmental Instability




LT lig.

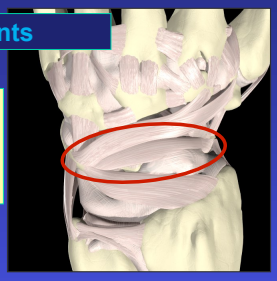
Volar Intercalated Segmental Instability



## Intracapsular Wrist Ligaments

Intrinsic

**Midcarpal ligaments**



Dorsally:
Dorsal intercarpal ligament

## Dorsal Intrinsic Wrist Ligaments

Variations in the

DORSAL INTERCARPAL LIGAMENT

Viegas S, Yamaguchi S, Boyd, Patterson R. The dorsal ligaments of the wrist: Anatomy, mechanical properties, and function. J Hand Surg 1999; 24A: 456-468.

## Dorsal Intrinsic Wrist Ligaments

DORSAL INTERCARPAL LIGAMENT (DIC)

- Much thicker!
- Contributes to the transverse stability of the wrist
- Contributes to wrist instability within the proximal row when compromised

Viegas, et al. The dorsal ligaments of the wrist: Anatomy, mechanical properties, and function. J Hand Surg 1999; 24A: 456-468.
Moskal MJ, Savoie FH, Field LD. Arthroscopic capsulodesis of the lunatotriquetral joint. Clin Sports Med 2001; 20: 141-53.

## Dorsal Intrinsic Wrist Ligaments

DORSAL INTERCARPAL LIGAMENT (DIC)

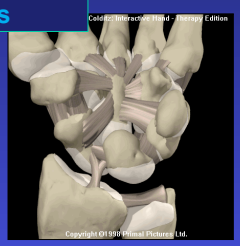
- provides stability to resist flexion forces at the scaphoid
- with a proximal scaphoid fracture, prevents flexion of the fragment

Morimoto H, Viegas S, Elder KW, Nakamura K, DaSilva MF, Boyd NL, Patterson R. Scaphoid nonunions: A 3-dimensional analysis of patterns of deformity. J Hand Surg 2000; 25A: 520-528.

## Intracapsular Wrist Ligaments

Intrinsic

**Midcarpal ligaments**

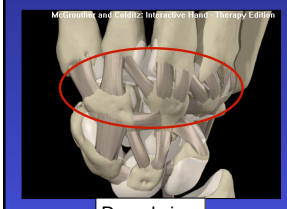



Volarly:
-TqHC ligamentous complex
-Anteromedial SC lig.
-STT lig.

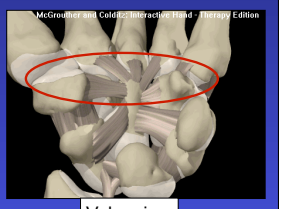
## Intracapsular Wrist Ligaments

Intrinsic

**Distal carpal row interosseous ligaments**




Dorsal view

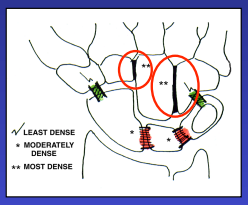



Volar view

## Intrinsic Wrist Ligaments

### Deep Intrinsic Ligaments

- Distal row of carpals have ligaments that are more dense, with less elasticity
- Their function is stability




Berger RA, Imeada T, Berglund L, An K-N. Constraint and material properties of the subregions of the scapholunate interosseous ligament. J Hand Surg. 1999; 24A: 953-962.