Upper Extremity Trauma: Wrist

**Scaphoid**: [Gr] “boat”  
- Bridges the proximal and distal carpal rows
- Also called the navicular of the hand (confusing with navicular in the foot)

**Lunate**: [L] “moon”  
- Sits ½ over radius (lunate fossa), ½ over Triangular Fibrocartilage (TFC)
- Lunate is nearly surrounded by cartilage
- Slightly convex on the dorsal and concave on the volar side

**Proximal Carpal Row**: (S+L+Tq+P)  
- Triquetrum (Tq): [L] “three-cornered”
- Pisiform (P): [L] “pea”
- Radio-Carpal Joint
- Triangular Fibrocartilage (TFC)

**Ulna**: [L] “elbow”  
- Lateral head: Related to the olecranon
- Head fits into the trochlear notch of the humerus
- Body establishes the elbow’s flexion-extension axis
- Styloid process: Lateral styloid process is fixed (united), medial styloid process mobile

**Wrist**: Radius is the foundation upon which the carpal bones reside
- U-Lunate’s Tubercle (dorsal)
- Normal anterior (volar) tilt of distal radius
- Normal anterior (volar) tilt of distal ulna
Capitate:[L] "head"
- Head-shaped round proximal end sits inside open end of the lunate

Hamate:[L] "hook"
- Hook-shaped process (H) sticks out anterior

TFC
- Trapezium (Gr) "table shaped"

Trapezoid:[Gr] "table shaped"
- Trapezoid articulates with index finger MC
- 2 parallel sides

Trapezoid:[Gr] "table shaped"
- Trapezoid articulates with index finger MC
- 2 parallel sides

Hamate: [L] "hook"
- Hook of Hamate sticks out anterior

Capitate: [L] "head"
- Hamate: [L] "hook"
- Capitate: [L] "head"
- Radius: [L]
- Ulna: [S]
- Carpal Tunnel
- Walls of the carpal tunnel are made of the carpal bones that stick out anteriorly

Metacarpals
- Capitate articulates with Long finger MC
- Hamate articulates with Ring & Small finger

Trapezium (Gr) "table shaped"
- Trapezium (Gr) "table shaped"
- No parallel sides

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Upper Extremity Trauma: Wrist

Hand ≠ Wrist

Anatomy
- Hand PA
- Hand Obl
- Hand Lat

Radiographs:
- CT/MR
- FOOSH

CT/FOOSH
- Colles
- Torus
- Barton
- Scaphoid

Wrist

Upper Extremity Trauma

Hand ≠ Wrist

Anatomy
- Wrist PA
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Radiographs:
- CT/MR
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CT/FOOSH
- Colles
- Torus
- Barton
- Scaphoid

Still Negative...

Bennett Fracture!

Hand ≠ Wrist

G,M 44yoM

PA Hand

PA Wrist (next day)

Hand vs Wrist: X-ray Beam

Anatomy
- Hand radiographs: X-ray beam centered @ 3rd MC head
- Wrist radiographs: X-ray beam centered @ capitate

CT/FOOSH
- Colles
- Torus
- Barton
- Scaphoid

Hand: PA = Standard View

Wrist: PA View

Anatomy
- Elbow @ shoulder height
- Elbow @ 90°
- Radius
- Ulna
- Carpal Row

CT/FOOSH
- Colles
- Torus
- Barton
- Scaphoid

Ulna shorter than Radius

Carpal Alignment
- Proximal Carpal Row Joint Alignment
- Radio-Carpal Joint
- Carpal-Metacarpal Jt
- Distal Radio-Ulnar Jt

Ulnar Length
- Normally, Ulna same length as Radius

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Ulnar Variance

Upper Extremity Trauma: Wrist

Ulna shorter than Radius

- "Negative Ulnar Variance"
- Risk AVN Lunate (Kienböck)

Ulna longer than Radius

- "Positive Ulnar Variance"
- Ulna can punch hole in TFC
- Ulna can impact upon Lunate

"Ulna Abutment Syndrome"

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"Ulna Abutment Syndrome"

Can see most carpal bones on Lateral

Wrist: Standard 3 Views

PA View

Oblique View

Lateral View

Best view of:

- STT joint
- Thumb C-MC joint
- Common sites for OA

Additional view of:

- Carpals (scaphoid)
- Metacarpals
- Radius (styloid)
- Sometimes a fracture is seen only on this view

Triquetral Fracture

Classically presents as a tiny avulsion fracture dorsal to the mid-carpus

- There are no normal ossicles dorsal to the carpal bones
- If you see a small bone back there, it’s a fracture
- May be old, as these tiny fractures don’t always heal

Can’t see Triquetrum on lateral view...

Ulna is only slightly shorter than Radius

AVN Lunate

Radius shortening

Treated with ulna shortening osteotomy
**Upper Extremity Trauma: Wrist**

### Scaphoid (Ulnar Deviation) View
- **Patient holds wrist in ulnar deviation**
- **Yields an elongated view of the scaphoid. Helps when looking for fractures.**

### 4 View Series for Scaphoid Fracture
- **Lateral View**
- **PA View**
- **Oblique View**
- **Scaphoid View**
- **Doesn’t show scaphoid well**
- **Negative**
- **Negative?**
- **Positive! scaphoid waist fx**

### Wrist: CT
- **Good for complex fractures**
- **Aid in surgical planning**
- **Good to assess fracture healing**
- **Even in the presence of metal**

### Wrist CT: Positioning
- **Wrist coil**
- **In a wrist coil**
- **Functions best in the center of the magnetic field**

### Wrist: MR
- **Not good for occult fractures**
- **Fractures non-displaced on radiographs... are non-displaced on CT**

### Wrist MR: Positioning
- **Wrist coil**
- **In a wrist coil**
- **Functions best in the center of the magnetic field**
Most injuries to the wrist are due to one common mechanism. Perhaps THE most common injury:

- 1-in-6 ER fractures occur in the distal radius*
- Humans are a clumsy species
- We walk upright
- We’re top heavy
- When falling, we instinctively protect our head, by
  - Extending our arm
  - Striking the ground with our hand

This mechanism of injury is perhaps UNIQUE to humans.

* orthopedics.about.com
Upper Extremity Trauma: Wrist

**Must reduce angle to heal right**

- **ER lateral view**: Marked dorsal angulation
- **Following reduction & casting in ER**: Volar angulation
- **6 weeks later**: Healing, normal volar angulation

**Colles fractures very common**

- **In children**: Fall a lot
- **In women**: Torus fracture
- **Osteopenia**: 2 women in my life...
- **In the media...**

**Colles vs Smith Fracture**

- **FOOSH**: Hyperextension → Colles
- **Mechanisms**: Colles vs Smith

- **Smith Fracture = Reverse Colles**

- **Smith**: Hyperextension → Volar angulation
- **Lateral view**: Too much volar angulation
- **Reduction & cast**: Normal volar angulation

**Mechanisms: Colles vs Smith**

- **FOOSH**: Hyperextension → Colles

**Smith Fracture = Reverse Colles**

- **Mechanisms**: Colles vs Smith

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**Mechanisms: Colles vs Smith**

Fall onto **Back of hand**

- Hyperextension
- *Smith Fracture*
- VOLAR angulation

Colles:

- Hyperextension
- DORSAL excoriation

Smith fracture is much less common than Colles

**Abraham Colles (1773-1843)**

Abraham Colles (1773-1843)

"The injury to which I wish to direct the attention of surgeons, had not, as far as I know, been described by any author."

Colles: Hyperextension, Dorsal excoriation

Smith fracture is much less common than Colles

**Robert William Smith (1807-1873)**

Robert William Smith (1807-1873)

This is an injury of exceedingly rare occurrence and one which presents characters utterly astonishing those of anatomists of the larger frame. It generally exists in combination of a fracture of the head of the radius; the bone being broken to the length of the middle finger on the side of the ulna, the principal features of which are a dorsal and a palmar tumour; and a striking propriety of the head of the bone at the posterior and inner part of the forearm; the dorsal tumour occupies the entire breadth of the forearm.
Upper Extremity Trauma:
Wrist

Fractures in Children

CT/MR
FOOSH
Colles
Torus Barton Scaphoid

FOOSH Fractures in Children

Adult bones: Brittle
Child bones: Soft

PA View

Cortex buckles IN
FOOSH (Colles)
Dorsal cortex
Fall on back of wrist (Smith)
Volar cortex
Hyperextension distal radial metaphysis
Buckling metaphysis-diaphysis junction
Buckle Fracture
“Torus Fracture”

Torus Fractures: Lateral View

Cortex buckles IN
FOOSH (Colles)
Dorsal cortex
Fall on back of wrist (Smith)
Volar cortex
Nature does not make angles...
Nature makes smooth curves
If you see cortex angulation in a child that should be smooth, it’s likely a torus fracture!

Torus Fractures: PA View

Cortex buckles OUTWARD

Torus Fractures: Common... Subtle

Run eyes along cortex
Focus on metaphysis
FOOSH (Colles)
Dorsal cortex
Fall on back of wrist (Smith)
Volar cortex
Hyperextension distal radial metaphysis
Buckling metaphysis-diaphysis junction
Buckle Fracture
“Torus Fracture”

Run eyes along cortex
Focus on metaphysis
PA view Symptomatic side
Lat view Symptotic side
Not sure?
Compare to normal side
Use other views!

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"Torus" Wrist

[Image of Wisconsin State Capitol]

**Torus**

[L]: "swelling, protuberance, bulge"

[Architecture]: A large convex molding, semicircular in cross section, at base of a classical column.

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**Fall On Out-Stretched Hand (FOOSH)**

Hyperextension of wrist

- Hyperextensive forces on:
  - Radius
    - Colles fracture
    - Torus fracture (children)
  - Carpal bones (Proximal carpal row)
    - Barton fracture

---

**Barton Fracture**

Hyperextension of wrist → Impaction of carpal bones on radius dorsal rim → Fracture radius rim

- Intra-articular fracture
  - Potentially more serious than Colles (extra-articular fracture)
  - May require surgical fixation
  - Surgeon may order CT for planning

---

**Dorsal Barton Fracture**

Dorsal Barton

- Due to FOOSH is much more common than Volar Barton
- Due to blow to back of wrist (Just as Colles is much more common than Smith fracture)

---

**Volar Barton Fracture**

Volar Barton

- Due to FOOSH is much more common than Dorsal Barton
- Due to blow to back of wrist (Just as Colles is much more common than Smith fracture)

---

**John Rhea Barton (1794-1871)**

It was said that Barton was ambidextrous and that once he had positioned himself for an operation, he did not move about.

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Upper Extremity Trauma: Wrist

Fall On Out-Stretched Hand (FOOSH)

Hyperextension of wrist → Hyperextensive forces on:
- Radius
  - Colles fracture
  - Torus fracture (children)
- Carpal bones (Proximal carpal row)
  - Barton fracture
    - (Distal carpal row)
  - Scaphoid fracture

Scaphoid Fractures

Scaphoid THE most common carpal bone to be fractured.
- 71% of all carpal fx *
- Scaphoid bridges the carpal rows
  - Traumatic shear forces between the rows ⇒ shearing fracture across the scaphoid

Scaphoid Fractures Locations

Scaphoid Waist
- 70% of scaphoid fractures occur in the waist

Scaphoid Proximal Pole
- 20% occur at scaphoid proximal pole

Scaphoid Distal Pole
- 10% occur at distal pole
  - Increased risk of non-union

Scaphoid Tubercle
- Rare, usually uncomplicated.
  - If nonunion, usually asymptomatic.*

Scaphoid & Radius Fractures

Same common mechanism (FOOSH)
- Distal Radius Fracture
- Scaphoid Fracture
  - ...BOTH!

Watch out for “satisfaction of search”
- “Aha, I found the fracture… I’d done looking”

Old Radiology Axiom:
- The hardest fracture to find is the 2nd fracture

Scaphoid with Radius Fracture

Proximal Pole
- Screw fixes scaphoid fracture
- Plate fixes Colles fracture

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Upper Extremity Trauma: Wrist

Scaphoid doesn't heal as well as other bones

Radiographs
CT/MR
FOOSH
Colles
Torus
Barton
Scaphoid

2 months later...

Non-union scaphoid waist

Scaphoid Non-Union → AVN

Radial artery supplies:
- Distal Pole (DP) of Scaphoid (S)
- Not Proximal Pole (PP)
- The more proximal the fracture, the greater the risk of non-union.
- The more distracted the fracture, the greater the risk of non-union.

Scaphoid has a tenuous blood supply

Scaphoid Non-Union → AVN

Proximal Row Carpectomy

To avoid non-union → AVN → PRC

All scaphoid fxs require early treatment!
- Probably with a screw if displaced
- At least with a splint or cast if non-displaced
- But non-displaced fractures are hard to see

So how do we know if a patient has a non-displaced scaphoid fracture?

SNUFFBOX TENDERNESS = PRESUMED SCAPHOID FRACTURE

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Anatomical Snuffbox

Snuffbox Tenderness

Resorption of Fracture Margins?

Anatomical Snuffbox

Snuffbox Tenderness

Resorption of Fracture Margins?

Anatomical Snuffbox?
Upper Extremity Trauma: Wrist

**Wrist: What to Order When (WOW)**

**Radiographs:**
- **Trauma**
- **Pain**
- **Arthritis (Hand radiographs)**
- **CT**
- **Surgical planning known fractures**
- **MR**
  - **Occult fractures (scaphoid)**
  - **Synovitis (w/Gd)** (Usually includes MCPs ± IPs)
  - **…pain?**

**CT/MR:**
- **Colles**
- **Torus**
- **Barton**
- **Scaphoid**

**FOOSH**

**CT**
- **RG**
  - **95%**
- **CT**
  - **2%**

**Wrist Charges**
- **Wrist Radiographs**
  - 3 views = 4 views = $137
  - It costs nothing to add the scaphoid view to a 3 view series
  - 1 view = 2 views = $128
  - Going from 2 views to 4 views adds only $9 (7%)

- **Wrist CT**
  - (without contrast) = $1,460
- **Wrist MR**
  - (without contrast) = $2,921
  - (with contrast) = $3,377

**That’s all we have on wrists…**

*Marty age 7*