

Upper Extremity Trauma: Wrist

Upper Extremity Trauma Wrist

3D Wrist CT

- Anatomy
- Radiographs
- 4 Views
- Other Views
- CT/MR
- FOOSH
- Colles
- Torus
- Barton
- Scaphoid
- Dislocations
- VISI/DISI
- WOW

Frontal view Ulna side view

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Upper Extremity Trauma Wrist

Radius: [L] "ray"

Arm: Radius rotates around ulna (radial head)

Wrist: Radius is the foundation upon which the carpal bones reside

Looking down on articular surface

- Normal anterior (volar) (palmar) tilt of distal radius
- Normal 2-20° volar
- Perpendicular to long axis
- Long axis of radius
- Anterior
- Ulna side view

Frontal view R Ulna side view R

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Upper Extremity Trauma Wrist

Scaphoid: [Gr] "boat"

aka "Navicular of hand" (confusing Navicular in foot)

Scaphoid bridges the proximal and distal carpal rows

- Distal Pole
- Waist
- Proximal Pole
- Distal pole sticks out anteriorly
- Proximal Pole

Frontal view R Ulna side view R

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Upper Extremity Trauma Wrist

Lunate: [L] "moon"

Should have opening up! Like a teacup holding tea

Lunate sits 1/2 over radius (lunate fossa), 1/2 over Triangular Fibro Cartilage (TFC)

Lunate is nearly surrounded by cartilage

- Lunate susceptible to AVN (Kienbock)
- One small artery anterior
- One small artery posterior

Frontal view R Ulna side view R

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Upper Extremity Trauma Wrist

Proximal Carpal Row: (S+L+Tq+P)

Triquetrum (Tq): [L] "three-cornered"

Pisiform (P): [L] "pea"

Smooth Arc

- Pisiform stick out anterior

Frontal view R Ulna side view R

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Upper Extremity Trauma Wrist

Ulna: [L] "elbow"

[L] "arm"... related to "el", "cubit". Unit of length equal to the forearm

Ulna major component of elbow, forearm

Role at wrist is limited

> Doesn't even normally touch carpal bones

Forms the Distal Radio-Ulnar Joint

- 1/2 Radius fxs have Ulnar styloid fxs
- Often remain ununited
- Seldom require surgery (if DRUJ stable)
- Ulna Styloid

Frontal view R U Ulna side view U

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Upper Extremity Trauma: Wrist

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Capitate:[L] "head"

Head-shaped round proximal end sits inside open end of the lunate

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Capitate Lunate Radius form a straight stack

Frontal view Ulna side view

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Upper Extremity Trauma Wrist

Hamate:[L] "hook"

Hook-shaped process (H) sticks out anterior

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Hook of Hamate sticks out anterior → Distal Pole Pisiform

Frontal view Ulna side view

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Upper Extremity Trauma Wrist

Metacarpals

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

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Frontal view Ulna side view

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Upper Extremity Trauma Wrist

Trapezoid:[Gr] "table shaped"

2 parallel sides

- Anatomy
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Trapezoid articulates with index finger MC aka "Lesser Multangular"

Frontal view Ulna side view

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Upper Extremity Trauma Wrist

Trapezium:[Gr] "little table"

no parallel sides

- Anatomy
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Trapezium articulates with the ThUMB aka "Greater Multangular"

Frontal view Ulna side view

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Upper Extremity Trauma Wrist

Carpal Tunnel

Walls of the carpal tunnel are made of the carpal bones that stick out anteriorly

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Frontal view

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Upper Extremity Trauma: Wrist

Upper Extremity Trauma Wrist

Hand ≠ Wrist

Anatomy

- Radiographs
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Hand PA Hand Obl Hand Lat

All Negative

R EW 12
ER

R,A 27yoM, fell off bike

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Upper Extremity Trauma Wrist

Hand ≠ Wrist

Anatomy

- Radiographs
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Wrist PA Wrist Obl Wrist Lat

Still Negative...

Wrist UI Dev

Bennett Fracture!

R,A 27yoM, fell off bike

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Upper Extremity Trauma Wrist

Hand ≠ Wrist

Anatomy

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PA Hand PA Wrist (next day)

G,M 44yoM

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Upper Extremity Trauma Wrist

Hand vs Wrist: X-ray Beam

Anatomy

- Radiographs
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Hand radiographs:
> X-ray beam centered @ 3rd MC head

Wrist radiographs:
> X-ray beam centered @ capitate

G,M 44yoM

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Upper Extremity Trauma Wrist

Wrist: PA = Standard View

Anatomy

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Elbow @ shoulder height

Elbow @ 90°

Shield → X-rays

↑ Raise cassette

↑ Low chair

X-ray beam Posterior → Anterior = "PA"

X-ray beam centered on Capitate

Marty age 15

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Upper Extremity Trauma Wrist

Wrist: PA View

Anatomy

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PA: Standard view

Carpal Alignment

Proximal Carpal Row

R-C Jt

C-MC

Ulna shorter than Radius

DRUJ

D,H 21yoF

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Upper Extremity Trauma: Wrist

Upper Extremity Trauma Wrist

Ulnar Variance

| | | |
|---|--|--|
| <p>Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW</p> | <p>Ulna shorter than Radius ➤ "Negative Ulnar Variance" ➤ Risk AVN Lunate (Kienböck)</p> <p>AVN Lunate with collapse</p> <p>Ulna is only slightly shorter than Radius</p> <p>Radius shortening</p> | <p>Ulna longer than Radius ➤ "Positive Ulnar Variance" ➤ 4 Views ➤ Ulna can punch hole in TFC ➤ Ulna can impact upon Lunate "Ulna Abutment Syndrome"</p> <p>Premature fusion radius, continued ulna growth → UV</p> <p>Treated with ulna shortening osteotomy</p> |
|---|--|--|

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Upper Extremity Trauma Wrist

Wrist: Lateral View

| | |
|---|--|
| <p>Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW</p> | <p>Anterior Normal 2-20° volar</p> |
|---|--|

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Upper Extremity Trauma Wrist

Can see most carpal bones on Lateral

| | | |
|---|--|--|
| <p>Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW</p> | <p>Hard to see Ulna as it overlaps Radius on a good lateral view</p> | <p>Can't see Triquetrum on lateral view...</p> |
|---|--|--|

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Upper Extremity Trauma Wrist

Triquetral Fracture

| | | |
|---|--|---|
| <p>Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW</p> | | <p>Classically presents as a tiny avulsion fracture dorsal to the mid-carpus</p> <ul style="list-style-type: none"> ➤ 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 |
|---|--|---|

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Upper Extremity Trauma Wrist

Wrist: Standard 3 Views

| | | | |
|---|---|---|--|
| <p>Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW</p> | <p>PA View</p> <p>Thumb Down ↓</p> | <p>Oblique View</p> <p>Thumb Halfway Between</p> | <p>Lateral View</p> <p>Thumb Up ↑</p> |
|---|---|---|--|

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Upper Extremity Trauma Wrist

Wrist: Oblique View

| | | |
|---|--|---|
| <p>Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW</p> | | <p>Best view of:</p> <ul style="list-style-type: none"> ➤ STT joint ➤ Thumb C-MC joint ✓ Common sites for OA <p>Additional view of:</p> <ul style="list-style-type: none"> ➤ Carpals (scaphoid) ➤ Metacarpals ➤ Radius (styloid) ✓ Sometimes a fracture is seen only on this view |
|---|--|---|

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Upper Extremity Trauma: Wrist

Upper Extremity Trauma Wrist

Scaphoid (Ulnar Deviation) View

Anatomy
Radiographs
4 Views
Other Views
CT/MR
FOOSH
Colles
Torus
Barton
Scaphoid
Dislocations
VISI/DISI
WOW

Patient holds wrist in ulnar deviation



Yields an elongated view of the scaphoid. Helps when looking for fractures.

5,B 21yoF


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Upper Extremity Trauma Wrist

4 View Series for Scaphoid Fracture

Lateral View
PA View
Oblique View
Scaphoid View



Dorsal swelling

Doesn't show scaphoid well

Negative

Negative?

Positive! scaphoid waist fx

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K,T 32yoF

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Upper Extremity Trauma: Wrist

Upper Extremity Trauma Wrist

Wrist: Standard 4 View Series

- Anatomy Radiographs**
 - 4 Views
 - Other Views
- 1. PA View**
 - Shows alignment of all bones & joints
- 2. Lateral View**
 - Important for Radius fractures
 - Important for Carpal alignment/dislocations
- 3. Oblique View**
 - Shows STT joint (OA, Scaphoid fractures)
- 4. Scaphoid (Ulnar Deviation) View**
 - Elongates Scaphoid (helps to find fractures)

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Upper Extremity Trauma Wrist

Wrist: Additional Views

- Anatomy Radiographs**
 - 4 Views
 - Other Views
- NOT part of standard wrist series**
(Ordered only in specialized circumstances)
- Reverse Oblique (Piso-Triquetral View)
 - ✓ Shows Piso-Triquetral joint
- Carpal Tunnel (Hook of Hamate) View
 - ✓ I find this view not particularly helpful
 - ✓ CT better to show Hook of Hamate fractures
- Clenched Fist AP View
 - ✓ Looking for Scapho-Lunate widening (diastasis)

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Upper Extremity Trauma Wrist

Reverse Oblique (Piso-Triquetral View)

Oblique View

Profiles:

- STT
- Thumb C-MC

Reverse Oblique View

We rarely do this view

Profiles:

- P-Tq joint
- Pisiform

LD 45yoM

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Upper Extremity Trauma Wrist

Carpal Tunnel (Hook of Hamate) View

X-ray beam

We rarely do this view

S,D 18yoM

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Upper Extremity Trauma Wrist

Chest: PA ≠ AP

Chest: PA is standard

Posterior → Anterior = "PA"

Portable Chest = AP

Anterior → Posterior = "AP"

Marty age 13

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Upper Extremity Trauma Wrist

Wrist: PA ≠ AP

PA: Standard view

PA view often doesn't profile SL

SL joint appears WIDER than other joints on AP

AP view tends to profile SL

Can't assess ulnar variance on AP

T,A 16yoM

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Upper Extremity Trauma: Wrist

Upper Extremity Trauma Wrist

Wrist: AP Clenched Fist View

Very specialized view

To look for an abnormally wide SL joint (diastasis)

- SL joint always appears wide on AP view
- ✓ c/w standard PA
- Clenched fist forces Capitate down between S & L
- ✓ Further widening
- Need to compare with other side

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Upper Extremity Trauma Wrist

Wrist: AP Clenched Fist View

Left wrist AP clenched fist

Right wrist AP clenched fist

SL wider than other joints

Supinated Radius outside Ulna inside

SL wider than other joints... but same as contralateral side

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R,T 33yoF

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Upper Extremity Trauma Wrist

We don't do PA clenched fist views

Left wrist PA clenched fist

Right wrist PA clenched fist

SL not profiled

Pronated Radius inside Ulna outside

SL not profiled

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R,T 33yoF

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Upper Extremity Trauma Wrist

Scapho-Lunate Diastasis

PA view Ulnar Deviation Radial Deviation

Normal SL width

Marked SL diastasis = Disruption SL lig.

Normal SL width

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P,L 39yoM

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Upper Extremity Trauma Wrist

Scapho-Lunate Diastasis

PA view PA view: Post-operative

Proximal pole dislocated out of scaphoid fossa

K-wires stabilize proximal carpal row

Suture anchors repair SL ligament

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P,J 32yoM

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Upper Extremity Trauma Wrist

Wrist Imaging

Radiographs:

- Trauma
- Pain
- ✓ Arthritis (Hand radiographs)

CT

- Surgical planning known fractures

MR

- Occult fractures (scaphoid)
- Synovitis (w/Gd) (Usually includes MCPs ± IPs)
- ...pain?

RG 95% MR 3% CT 2%

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UW data 2005

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Upper Extremity Trauma: Wrist

Upper Extremity Trauma Wrist

Wrist: CT

Good for complex fractures

- Aid in surgical planning
- Good to assess fracture healing**
- Even in the presence of metal

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E,A 18yoM
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Upper Extremity Trauma Wrist

Wrist CT: Positioning

We don't scan patients with their wrist down at their side

- Excess radiation across torso
- X-ray scatter decreases res.

We scan patients with their wrist over the head

- No excess radiation to body
- No X-ray scatter

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Upper Extremity Trauma Wrist

Wrist: CT

NOT good for occult fractures

- Fractures non-displaced on radiographs...
...are non-displaced on CT

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L,N 21yoF
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Upper Extremity Trauma Wrist

Wrist MR: Positioning

We scan patients with their wrist over the head

- In a wrist coil
- Functions best in the center of the magnetic field

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Upper Extremity Trauma Wrist

Wrist: MR

Good for occult fractures

- **We don't miss fractures with MR!**

Good for synovitis, infection

- Needs IV contrast to show pannus, abscess

Good for masses, tumors, cysts, ...

- Needs IV contrast to show vascularity

Tears? (SL/LT ligaments, TFCC)

- Arthrogram-MR: Intra-articular contrast
- I find tears better seen on the arthrogram

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Upper Extremity Trauma Wrist

Wrist: Arthrogram-MR

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C,A 19yoM
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Upper Extremity Trauma: Wrist

Upper Extremity Trauma Wrist

Fall On Out-Stretched Hand (FOOSH)

Anatomy Radiographs 4 Views Other Views CT/MR

- FOOSH
- Colles
- Torus
- Barton
- Scaphoid
- Dislocations
- VISI/DISI
- WOW

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

Upper Extremity Trauma Wrist

The most famous penguin on the Internet

Anatomy Radiographs 4 Views Other Views CT/MR

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Upper Extremity Trauma Wrist

Fall On Out-Stretched Hand (FOOSH)

Anatomy Radiographs 4 Views Other Views CT/MR

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- WOW



Hyperextend Wrist
 Hyperextend Wrist
 HAND
 RADIUS
 ULNA
 S
 FOOSH

Upper Extremity Trauma Wrist

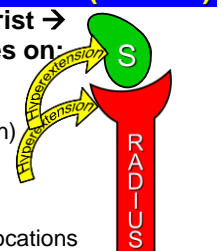
Fall On Out-Stretched Hand (FOOSH)

Anatomy Radiographs 4 Views Other Views CT/MR

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Hyperextension of wrist → Hyperextensive forces on:

- Radius
 - ✓ Colles fracture
 - ✓ Torus fracture (children)
- Carpal bones
 - ✓ Barton fracture
 - ✓ Scaphoid fracture
 - ✓ Lunate/perilunate dislocations




Upper Extremity Trauma Wrist

Colles Fracture

Anatomy Radiographs 4 Views Other Views CT/MR

- FOOSH
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- Scaphoid
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- WOW

Transverse Fx distal radius
 ➤ Hyperextension forces cause:
 ✓ Dorsal angulation
 ± Dorsal displacement



Lateral view
 Lateral view
 Dorsal Angulation
 Dorsal Angulation
 S
 RADIUS
 U
 DORSAL

DORSAL ANGLULATION ALWAYS ABNORMAL!

Upper Extremity Trauma Wrist

Dorsal Angulation is Bad ☹️

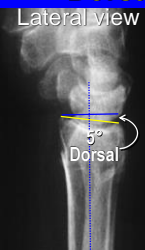
Anatomy Radiographs 4 Views Other Views CT/MR

- FOOSH
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- WOW

Lateral view

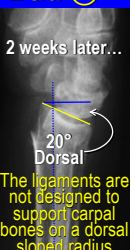
To measure angle:
 ➤ Draw line along distal radius
 ✓ From front corner
 ✓ To back corner
 ➤ Draw line along shaft of radius
 ✓ Perpendicular to this
 ➤ Measure this angle
 ✓ Normal is VOLAR
 ✓ 2-20°

Dorsal = Abnormal



3° Dorsal

2 weeks later...



20° Dorsal

The ligaments are not designed to support carpal bones on a dorsal sloped radius

Upper Extremity Trauma: Wrist

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Upper Extremity Trauma Wrist

Must reduce angle to heal right

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

ER lateral view: Marked dorsal angulation ☹️

Following reduction & casting in ER: Volar angulation ☹️

6 weeks later: Healing, normal volar angulation ☺️

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Upper Extremity Trauma Wrist

Colles fractures very common

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

In children

- > Fall a lot
- > Torus fracture

In women

- > Osteopenia
- > 2 women in my life...

In the media...

Secretary Judy

Wife Lynn

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Upper Extremity Trauma Wrist

Colles vs Smith Fracture

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

LAW & ORDER

Anatomically impossible?

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Upper Extremity Trauma Wrist

Smith Fracture = Reverse Colles

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

Smith: > Hyperflexion > VOLAR angulation

Lateral view: Too much volar angulation ☹️

Reduction & cast: Normal volar angulation ☺️

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Upper Extremity Trauma Wrist

Mechanisms: Colles vs Smith

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

FOOSH

Colles: > Hyperextension > DORSAL angulation

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Upper Extremity Trauma Wrist

Mechanisms: Colles vs Smith

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

FOOSH → Hyperextension → Colles whether fall **Forwards** or **Backwards**

FOOSH

Colles

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Upper Extremity Trauma: Wrist

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Upper Extremity Trauma Wrist

Mechanisms: Colles vs Smith

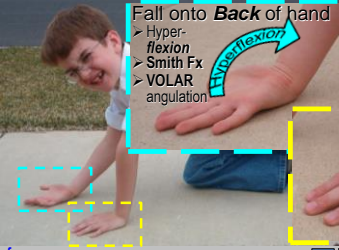
Anatomy
Radiographs
4 Views
Other Views

CT/MR
FOOSH

- Colles
- Torus
- Barton
- Scaphoid
- Dislocations

VISI/DISI
WOW


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Fall onto **Back** of hand

- Hyperflexion
- Smith Fx
- VOLAR angulation

Smith fracture is much less common than Colles



Colles:

- Hyper-extension
- DORSAL angulation

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Upper Extremity Trauma Wrist

Abraham Colles (1773-1843)

Anatomy
Radiographs
4 Views
Other Views

CT/MR
FOOSH

- Colles
- Torus
- Barton
- Scaphoid
- Dislocations

VISI/DISI
WOW

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THE EDINBURGH
MEDICAL AND SURGICAL JOURNAL:


On the Fracture of the Carpal extremity of the Radius. By A. Colles, M. D. one of the Professors of Anatomy and Surgery in the Royal College of Surgeons in Ireland.

"I should consider this as by far the most common injury to which the wrist or carpal extremities of the radius and ulnar are exposed."

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

VOLUME TENTH. (81 years before Roentgen)
1814.

babel.hathitrust.org



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Upper Extremity Trauma Wrist

Robert William Smith (1807-1873)

Anatomy
Radiographs
4 Views
Other Views

CT/MR
FOOSH

- Colles
- Torus
- Barton
- Scaphoid
- Dislocations

VISI/DISI
WOW

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TREATISE ON FRACTURES
OF THE VICINITY OF JOINTS,
OF CERTAIN FORMS
OF ACCIDENTAL AND CONGENITAL
DISLOCATIONS.


BY ROBERT WILLIAM SMITH, M.D. M.R.I.A.

(1847?) MDCCCL=1850

HODGKIN AND SMITH, CALCUTTA STREET.

FRACTURE OF THE LOWER EXTREMITY OF THE RADIUS, WITH DISPLACEMENT OF THE LOWER FRAGMENT FORWARD.

This is an injury of exceedingly rare occurrence, and one which presents characters closely resembling those of dislocation of the carpus forwards. It generally occurs in consequence of a fall upon the back of the hand, and the situation of the fracture is from half an inch to an inch above the articulation; it is accompanied by great deformity, the principal features of which are a dorsal and a palmar tumour, and a striking projection of the head of the ulna at the posterior and inner part of the forearm; the dorsal tumour occupies the entire breadth of the forearm.



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Upper Extremity Trauma: Wrist

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Upper Extremity Trauma Wrist

Fractures in Children

Anatomy Radiographs
 4 Views
 Other Views
 CT/MR
 FOOSH
 Colles
 Torus
 Barton
 Scaphoid
 Dislocations
 VISI/DISI
 WOW

Lateral
 PowerPoint Model
 Child Lateral
 PA view

Epiphysis
 physis (growth plate)
 Metaphysis
 Diaphysis
RADIUS

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Upper Extremity Trauma Wrist

FOOSH Fractures in Children

Anatomy Radiographs
 4 Views
 Other Views
 CT/MR
 FOOSH
 Colles
 Torus
 Barton
 Scaphoid
 Dislocations
 VISI/DISI
 WOW

Lateral
 PowerPoint Model
 Child Lateral

Insion
 Torus
RADIUS

Adult bones: Brittle
 > Snap under force
Child bones: Soft
 > Bend under force
 > FOOSH →
 ✓ Hyperextension distal radial metaphysis
 ✓ Buckling metaphysis-diaphysis junction
 ✦ Buckle Fracture
 ✦ "Torus Fracture"

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Upper Extremity Trauma Wrist

Torus Fractures: Lateral View

Anatomy Radiographs
 4 Views
 Other Views
 CT/MR
 FOOSH
 Colles
 Torus
 Barton
 Scaphoid
 Dislocations
 VISI/DISI
 WOW

Lateral
 Lateral

Torus
 Torus
 Cortex of radius & ulna overlap

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!

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Upper Extremity Trauma Wrist

Torus Fractures: PA View

Anatomy Radiographs
 4 Views
 Other Views
 CT/MR
 FOOSH
 Colles
 Torus
 Barton
 Scaphoid
 Dislocations
 VISI/DISI
 WOW

Axial Load
 Axial Load
RADIUS
 PA view

Cortex buckles OUTWARD

FOOSH
 PowerPoint Model
 Child PA View

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Upper Extremity Trauma Wrist

Torus Fractures: Common... Subtle

Anatomy Radiographs
 4 Views
 Other Views
 CT/MR
 FOOSH
 Colles
 Torus
 Barton
 Scaphoid
 Dislocations
 VISI/DISI
 WOW

Run eyes along cortex
 > Focus on metaphysis
 > PA view
 ✓ Buckles outward
 > Not sure?
 ✓ Compare to normal side
 ✓ Use other views!

PA view Symptomatic side
 PA view Asymptomatic side

A,B 14yoF
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Upper Extremity Trauma Wrist

Torus Fractures: Common... Subtle

Anatomy Radiographs
 4 Views
 Other Views
 CT/MR
 FOOSH
 Colles
 Torus
 Barton
 Scaphoid
 Dislocations
 VISI/DISI
 WOW

Run eyes along cortex
 > Focus on metaphysis
 > Lat view
 ✓ Buckles inward
 > Not sure?
 ✓ Compare to normal side
 ✓ Use other views!

PA view Symptomatic side
 Lat view Symp.
 Lat view Asympt.

A,B 14yoF
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Upper Extremity Trauma: Wrist

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Upper Extremity Trauma Wrist

"Torus"

[L]: "swelling, protuberance, bulge"

Capital

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

Wisconsin State Capitol
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RadioGraphics 2004; 24:p1025
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Upper Extremity Trauma Wrist

Fall On Out-Stretched Hand (FOOSH)

Anatomy Radiographs 4 Views Other Views
CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

Hyperextension of wrist → Hyperextensive forces on:

- Radius
 - ✓ Colles fracture
 - ✓ Torus fracture (children)
- Carpals bones (Proximal carpal row)
 - ✓ Barton fracture

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Upper Extremity Trauma Wrist

Barton Fracture

Anatomy Radiographs 4 Views Other Views
CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

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

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Upper Extremity Trauma Wrist

Dorsal Barton Fracture

Anatomy Radiographs 4 Views Other Views
CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

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)

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Upper Extremity Trauma Wrist

Volar Barton Fracture

Anatomy Radiographs 4 Views Other Views
CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

Lateral view **CT- Sagittal** **Open Reduction Internal Fixation**

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A,D 43yoM
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Upper Extremity Trauma Wrist

John Rhea Barton (1794-1871)

Anatomy Radiographs 4 Views Other Views
CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

Views and Treatment of an important Injury of the Wrist. By J. RHEA BARTON, M. D.

Any further observations on a class of accidents, so common, and which have been so often the subject of inquiry, as that of injuries of the forearm and wrist-joints, may be deemed superfluous by those who read, but have no personal experience in surgery. But to those engaged in the active pursuits of our profession, it is well known that, notwithstanding the volumes that have been written on this subject, there are yet certain injuries involving these parts which are not fully understood, and consequently not successfully treated.

My attention was early fixed upon such cases, and through a series of years they have been particularly interesting to me; and it is from my conviction that, up to this time, error prevails, both as to the nature and the treatment of them, that I am induced to publish my views and practice therein.

I do not know any subject on which I have been more frequently consulted than on deformities, rigid joints, inflexible fingers, loss of the pronator.

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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The Medical Examiner Nov 7, 1838; 1, 23; p 365-8
www.kmls.co.uk whonamedit.com
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Upper Extremity Trauma: Wrist

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Upper Extremity Trauma Wrist

Fall On Out-Stretched Hand (FOOSH)

Anatomy Radiographs
4 Views
Other Views
CT/MR
FOOSH
Colles
Torus
Barton
Scaphoid
Dislocations
VISI/DISI
WOW

Hyperextension of wrist →
Hyperextensive forces on:

- Radius
 - ✓ Colles fracture
 - ✓ Torus fracture (children)
- Carpal bones (Proximal carpal row)
 - ✓ Barton fracture (Distal carpal row)
 - ✓ Scaphoid fracture



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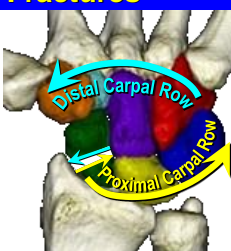
Upper Extremity Trauma Wrist

Scaphoid Fractures

Anatomy Radiographs
4 Views
Other Views
CT/MR
FOOSH
Colles
Torus
Barton
Scaphoid
Dislocations
VISI/DISI
WOW

Scaphoid THE most common carpal bone to be fractured.

- 71% of all carpal fx's*
- Scaphoid bridges the carpal rows
- ✓ Traumatic shear forces between the rows ⇄... shearing fracture across the scaphoid



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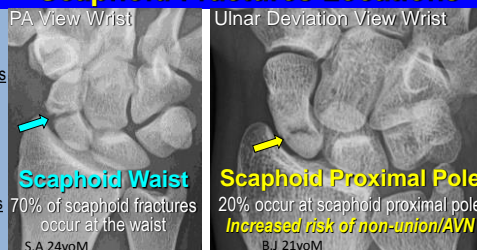
Upper Extremity Trauma Wrist

Scaphoid Fractures Locations

Anatomy Radiographs
4 Views
Other Views
CT/MR
FOOSH
Colles
Torus
Barton
Scaphoid
Dislocations
VISI/DISI
WOW

PA View Wrist
Scaphoid Waist
70% of scaphoid fractures occur at the waist

Ulnar Deviation View Wrist
Scaphoid Proximal Pole
20% occur at scaphoid proximal pole
Increased risk of non-union/AVN



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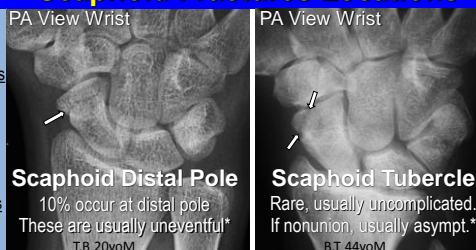
Upper Extremity Trauma Wrist

Scaphoid Fractures Locations

Anatomy Radiographs
4 Views
Other Views
CT/MR
FOOSH
Colles
Torus
Barton
Scaphoid
Dislocations
VISI/DISI
WOW

PA View Wrist
Scaphoid Distal Pole
10% occur at distal pole
These are usually uneventful*

PA View Wrist
Scaphoid Tubercle
Rare, usually uncomplicated.
If nonunion, usually asympt.*



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Upper Extremity Trauma Wrist

Scaphoid & Radius Fractures

Anatomy Radiographs
4 Views
Other Views
CT/MR
FOOSH
Colles
Torus
Barton
Scaphoid
Dislocations
VISI/DISI
WOW

Same common mechanism (FOOSH)

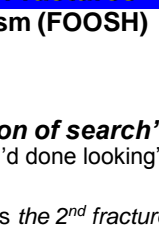
- Distal Radius Fracture
- Scaphoid Fracture
- ...BOTH!

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



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Upper Extremity Trauma Wrist

Scaphoid with Radius Fracture

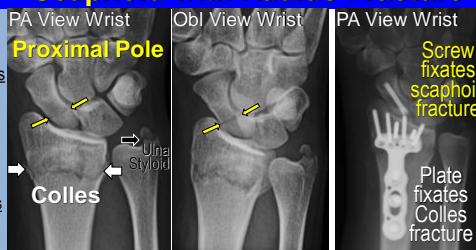
Anatomy Radiographs
4 Views
Other Views
CT/MR
FOOSH
Colles
Torus
Barton
Scaphoid
Dislocations
VISI/DISI
WOW

PA View Wrist
Proximal Pole

Obli View Wrist
Colles

PA View Wrist
Screw fixates scaphoid fracture

Plate fixates Colles fracture



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Upper Extremity Trauma: Wrist

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Upper Extremity Trauma Wrist

Scaphoid doesn't heal as well as other bones

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

PA View Hand 2 months later...

V,G 22yoM

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Upper Extremity Trauma Wrist

Scaphoid doesn't heal as well as other bones

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

after 4 months... CT: Coronal CT: Sagittal Oblique

V,G 22yoM

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Upper Extremity Trauma Wrist

Scaphoid has a tenuous blood supply

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

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.

Obli Hand Heavy arterial calcification Pt w/ diabetes / renal failure

L,T 60yoM

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Upper Extremity Trauma Wrist

Scaphoid Non-Union → AVN

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

PA View Wrist CT: Coronal CT: Sagittal Oblique

Non-union scaphoid waist fx

Collapse & fragmentation PP = AVN

Q,B 62yoF

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Upper Extremity Trauma Wrist

Proximal Row Carpectomy

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

PA View Wrist Lateral View Wrist

C R

Resection: Scaphoid, Lunate, Triquetrum
 Radius articulates with Capitate (distal row)
 Only treatment for fragmented scaphoid AVN

Q,B 62yoF

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Upper Extremity Trauma Wrist

To avoid non-union → AVN → PRC

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

All scaphoid fx's 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 because they are non-displaced
 So how do we know if a patient has a non-displaced scaphoid fracture?

SNUFFBOX TENDERNESS = PRESUMED SCAPHOID FRACTURE

Q,B 62yoF

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Upper Extremity Trauma: Wrist

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Upper Extremity Trauma Wrist

Anatomical Snuffbox

Anatomy
Radiographs
 4 Views
 Other Views
CT/MR
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 Dislocations
VISI/DISI
WOW

Extensor Pollicis Longus Tendon
 Extensor Pollicis Brevis Tendon

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Upper Extremity Trauma Wrist

Snuffbox Tenderness

Anatomy
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VISI/DISI
WOW

= PRESUMED SCAPHOID FRACTURE

- > What if the radiographs are normal?
 - ✓ Beautiful! Then it's a non-displaced fracture
 - ✓ Treat anyway with a cast/splint
- > Have patient follow-up in 2 weeks
 - ✓ Get repeat radiographs (out of the cast/splint)
 - ❖ We're taught occult fxs become visible after 1-2 weeks from bone resorption at fx margins... *I'm not sure it's true...*
 - ✓ Re-examine... if still tender... back into the splint
- > If you *really* need to know...
 - ✓ MRI (we don't miss fractures on MRI)

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Upper Extremity Trauma Wrist

Resorption of Fracture Margins?

Anatomy
Radiographs
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 Torus
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 Scaphoid
 Dislocations
VISI/DISI
WOW

PA View: No scaphoid fx
 Scaphoid View: No scaphoid fx
 Oblique View: No scaphoid fx...
 Radius fractures

Importance of multiple views!

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Upper Extremity Trauma Wrist

Resorption of Fracture Margins?

Anatomy
Radiographs
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 Other Views
CT/MR
FOOSH
 Colles
 Torus
 Barton
 Scaphoid
 Dislocations
VISI/DISI
WOW

PA View: 8 days later Still snuffbox tenderness
 Still no scaphoid fx
 Occult scaphoid fracture!

MRI: 19 days after injury
 Coronal T1: Bone marrow edema in Scaphoid
 Coronal T2fs: Black fx line
 Bone marrow edema in Radius

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Upper Extremity Trauma Wrist

Resorption of Fracture Margins?

Anatomy
Radiographs
 4 Views
 Other Views
CT/MR
FOOSH
 Colles
 Torus
 Barton
 Scaphoid
 Dislocations
VISI/DISI
WOW

PA View after 29 days...
 Still no resorption scaphoid fracture margins
 Negative radiographs do not exclude a scaphoid fracture
 Snuffbox Tenderness = Presumed Scaphoid Fracture!
 Still see lucent radius fractures

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Upper Extremity Trauma Wrist

Anatomical Snuffbox?

Anatomy
Radiographs
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Upper Extremity Trauma: Wrist

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Upper Extremity Trauma Wrist

Normal Carpal Alignment

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

3D CT Lateral View PowerPoint Model

Capitate sits on/in cupped Lunate
Lunate sits on/in cupped Radius

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Upper Extremity Trauma Wrist

FOOSH → Carpal Dislocation

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

Hyperextend Wrist

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Upper Extremity Trauma Wrist

Dorsal Dislocation of the Carpus

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

20 yo Male Riding ATV Breaks locked Flew over handlebars

Lateral View

Very rare injury (I've seen this twice in 20 years)

R,J 20yoM Slide 99 of 131

Upper Extremity Trauma Wrist

FOOSH → Carpal Dislocation

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

If the hyperextensive forces are applied to the distal carpal row Capitate (& distal carpal row) dislocates dorsal to the Lunate (& proximal carpal row)

Capitate (& distal carpal row) then gets stuck dorsal to the Lunate (& proximal carpal row)

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Upper Extremity Trauma Wrist

Perilunate Dislocation

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

Lunate NOT dislocated. Carpal bones around lunate (perilunate bones) dislocated. CAPITATE DISLOCATES

Lateral View

R,S 56yoM Slide 101 of 131

Upper Extremity Trauma Wrist

Perilunate Dislocation becomes...

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

Sometimes the perilunate bones will relocate... shoving the Lunate volar.

This is how a *perilunate* dislocation becomes a **Lunate Dislocation**

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Upper Extremity Trauma: Wrist

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Upper Extremity Trauma Wrist

Lunate Dislocation

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

Lateral View

Lunate IS dislocated

Capitate NOT dislocated

D, D 18yoM

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Upper Extremity Trauma Wrist

Occasionally Lunate VERY Dislocated

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

Lateral View

PA View

L, H 38yoM

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Upper Extremity Trauma Wrist

Lunate vs Perilunate Dislocations

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

Lunate dislocated beyond volar radial line

Carpals should be between the lines

Capitate dislocated beyond dorsal radial line

Volar Radial Line

Dorsal Radial Line

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Upper Extremity Trauma Wrist

Continuance of Same Injury

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

Lunate Dislocation

Mid-Carpal Dislocation

Perilunate Dislocation

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Upper Extremity Trauma Wrist

Mid-Carpal Dislocation

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

Lateral View

Mid-Carpal Dislocation

PA View

Hard to appreciate these dislocations on the PA views

B, J 26yoM

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Upper Extremity Trauma Wrist

Dislocations: Lateral vs PA Views

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

Lateral View

PA View

- Easy to detect on Lateral view
- Alignment of L & C to R
- Harder to detect on PA view
- Orientation of Lunate
 - Tipped (Pie-shaped)
 - Lack of Parallelism

B, J 26yoM

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Upper Extremity Trauma: Wrist

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Upper Extremity Trauma Wrist

The Importance of the Lateral View

Lateral Reduced
C
L
R

Lateral View Lunate Disloc
C
L
R

PA View Lunate Disloc
Lack of parallelism
Lunate Tipped (Pie-shaped)

PA View Reduced
Parallel articular surfaces
Normal Lunate Orientation (Cup-shaped)

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Upper Extremity Trauma Wrist

Lunate/Perilunate/Mid-Carpal Dislocations

Anatomy Radiographs 4 Views Other Views
CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

Comprise ~10% of all wrist injuries

- > "Because the **subtlety** of wrist injuries often is not appreciated fully, many believe that perilunate injuries in general are **underdiagnosed**."
- > I maintain they shouldn't be underdiagnosed if recognize the **importance of the lateral view!**

61% also have scaphoid fractures

> SCAPHOID BRIDGES CARPAL ROWS!

- > "Trans-Scaphoid Perilunate Fracture Dislocation"
- > Anytime we see one of these carpal dislocations, need to look for the accompanying scaphoid fx!

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Upper Extremity Trauma Wrist

Trans-Scaphoid Perilunate Fracture Dislocation

Lateral View
C
L
R

PA View
C
L
DP
PP
Lack of parallelism between C & L
Scaphoid waist fracture

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Upper Extremity Trauma Wrist

Volar Perilunate Dislocation

Anatomy Radiographs 4 Views Other Views
CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations VISI/DISI WOW

Most Perilunate dislocations are dorsal

Blow to the back of the wrist

Result of wrist hyper-extension

(like from a night-stick)

can result in a VOLAR Perilunate dislocation

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Upper Extremity Trauma Wrist

Volar Perilunate Dislocation

Lateral View
C
L
R

PA View

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Upper Extremity Trauma Wrist

C-MC Dislocations

Lateral Reduced
C-MC joints aligned

Lateral
MC bases articulating w/ nothing

PA View
Lack of parallelism between MC bases and distal carpal row

PA View Reduced
Parallelism restored along C-MC joints

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Upper Extremity Trauma: Wrist

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Upper Extremity Trauma Wrist

Lunate Tilting (Volar/Dorsal)

[Anatomy](#)
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[Torus](#)
[Barton](#)
[Scaphoid](#)
[Dislocations](#)
[VISI/DISI](#)
[WOW](#)

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Upper Extremity Trauma Wrist

VISI & DISI

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Volar Intercalated Segmental Instability
Dorsal Intercalated Segmental Instability

Intercalated:[L] "interposed", "inserted"
 Applied to the proximal carpal row...
 the Lunate is the *intercalated segment* (IS)
 between the Scaphoid and Triquetrum.
VISI=Lunate tipped forward
DISI=Lunate tipped backward

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Upper Extremity Trauma Wrist

Measuring VISI/DISI

Lateral View

- Draw 3 Lines
 - ✓ Lunate long axis
 - ✓ Scaphoid long axis
 - ✓ Capitate long axis
- Measure 2 Angles
 - ✓ Capito-Lunate angle
 - ∠ Normally between 0-30°
 - ✓ Scapho-Lunate angle
 - ∠ Normally between 30-60°

[Anatomy](#)
[Radiographs](#)
 4 Views
 Other Views
[CT/MR](#)
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Upper Extremity Trauma Wrist

Measuring VISI/DISI

Lateral View

- Draw 3 Lines
 - ✓ Lunate long axis
 - ❖ First draw SHORT axis, between
 - Dorsal distal corner
 - Volar distal corner
 - ❖ Long axis perpendicular to short
 - On our PACS, I use the Cobb angle to draw these lines

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[Radiographs](#)
 4 Views
 Other Views
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Upper Extremity Trauma Wrist

Measuring VISI/DISI

Lateral View

- Draw 3 Lines
 - ✓ Lunate long axis
 - ✓ Scaphoid long axis
 - ❖ Between
 - Volar proximal edge
 - Volar distal edge

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Upper Extremity Trauma Wrist

Measuring VISI/DISI

Lateral View

- Draw 3 Lines
 - ✓ Lunate long axis
 - ✓ Scaphoid long axis
 - ✓ Capitate long axis
 - ❖ Just eyeball it

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Upper Extremity Trauma: Wrist

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Upper Extremity Trauma Wrist

Measuring VISI/DISI

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations

Measurement valid only for lateral wrist radiograph

- Not CT
- Not MR

Needs to be a "True Lateral"

- S-P-C Lateral

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Upper Extremity Trauma Wrist

S-P-C Lateral

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations

True Lateral View Off-Lateral Repeat

Pisiform should be between Capitate and distal pole of Scaphoid

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Upper Extremity Trauma Wrist

Measuring VISI/DISI

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations

True Lateral View

- Draw 3 Lines
 - Lunate long axis
 - Scaphoid long axis
 - Capitate long axis
- Measure 2 Angles
 - Capito-Lunate angle
 - Normally between 0-30°
 - Scapho-Lunate angle
 - Normally between 30-60°

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Upper Extremity Trauma Wrist

VISI (Lunate Tipped Forward)

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations

PA View True Lateral

Lunate Tipped (Pie-shaped) Lunate Tipped Forward

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Upper Extremity Trauma Wrist

DISI (Lunate Tipped Backward)

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PA View True Lateral

Lunate Tipped (Pie-shaped) Lunate Tipped Backward

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Upper Extremity Trauma Wrist

VISI/DISI Numbers

Anatomy Radiographs 4 Views Other Views CT/MR FOOSH Colles Torus Barton Scaphoid Dislocations

VISI Normal DISI

S-L < 30° C-L > 30° Lunate tips Volar S-L decreases C-L increases

30° < S-L < 60° 0° < C-L < 30°

S-L 60-80° gray zone

S-L > 80° C-L doesn't matter Lunate tips Dorsal S-L increases C-L backwards

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Upper Extremity Trauma: Wrist

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Upper Extremity Trauma Wrist

Wrist: What to Order When (WOW)

Wrist Radiographs (95%)

- > 3-view wrist series
 - ✓ PA (*not AP*)
 - ✓ Lateral
 - ✓ Oblique
- > If snuffbox tenderness, add 4th view
 - ✓ Scaphoid (ulnar deviation)
- > If snuffbox tenderness + negative radiographs
 - ✓ **TREAT AS PRESUMED SCAPHOID FRACTURE**
 - ✓ Cast/splint, follow-up in 2 weeks
 - ✓ If still has snuffbox tenderness, keep treating

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Upper Extremity Trauma Wrist

Wrist: What to Order When (WOW)

Wrist CT

- > Predominantly used for surgical planning of known radius/carpal bone fractures
 - ✓ Ordered by Orthopedics from ER or clinic
- > Assess healing of known scaphoid fracture
 - ✓ With or without prior screw fixation
 - ✦ Small screws cause virtually no CT artifacts
- > We always reformat in 3 orthogonal planes
 - ✓ For scaphoid, we add oblique sagittal
- > **We have a specialized protocol for DRUJ instability**
- > All protocols at: www.radiology.wisc.edu

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Upper Extremity Trauma Wrist

Wrist: What to Order When (WOW)

Wrist MR

- > Occult fractures (scaphoid)
 - ✓ Persistent symptoms despite negative radiographs
- > Synovitis (RA)
 - ✓ Needs IV contrast
 - ✦ Normal synovium does not enhance
 - ✦ Vascularized pannus greatly enhances
 - ✓ Ordering provider should specify area of concern
 - ✦ Just intercarpal joints
 - ✦ Also Metacarpal-phalangeal joints
 - ✦ Also Interphalangeal joints
 - ↑ Field of View = ↓ Resolution

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Upper Extremity Trauma Wrist

Wrist: What to Order When (WOW)


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

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Upper Extremity Trauma Wrist

That's all we have on wrists...



Marty age 7

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