Fracture Description and Management: Is it Broken or Fractured?

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Disclosures

- No Financial Disclosures

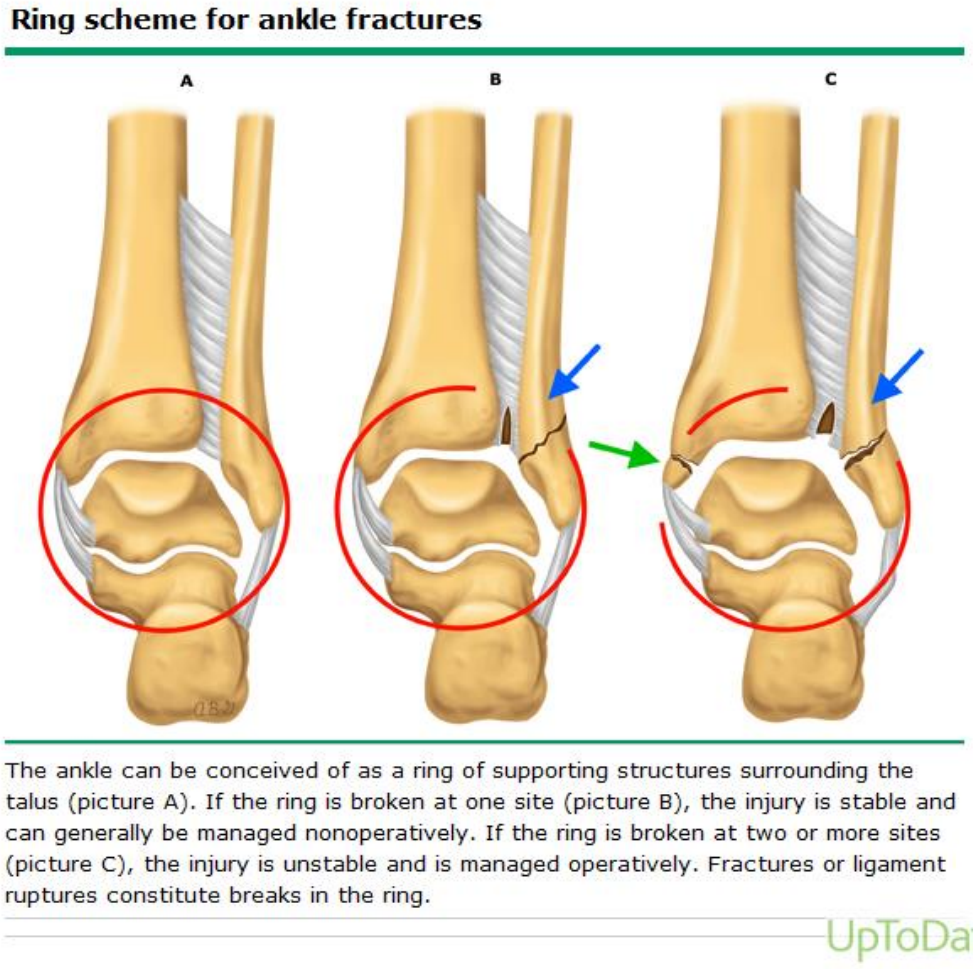
Most Common Reasons Things are MISSED!!!

- Incomplete physical exam
- Inadequate radiographs
- Failure to re-examine patient
- Inadequate follow-up
- Improper immobilization
- Improper/lack of mobilization

- **DON'T MISS**: Open fractures, compartment syndrome, Necrotizing Fasciitis, Long bone fracture or dislocations

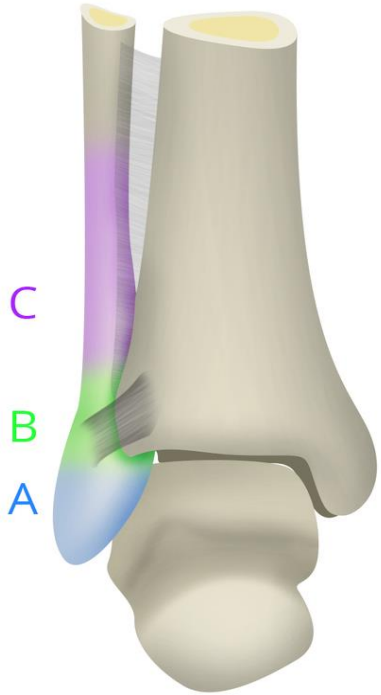
Ankle Fracture

- Unimalleolar-68%
  - Isolated Fibular
  - Weber Classification
- Bimalleolar-25%
  - Lateral & medial most common
- Trimalleolar-7%
  - Lateral, medial & posterior
- Open Fracture-2%
- Fracture Dislocation
  - Usually lateral
  - watch medial skin

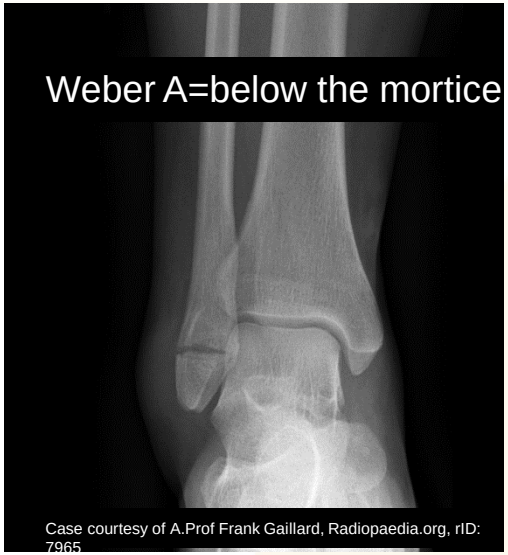


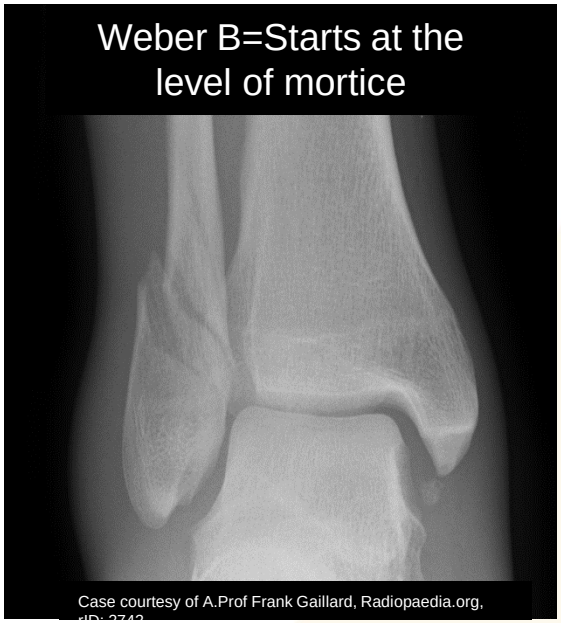
Weber Classification

Distal fibula fractures

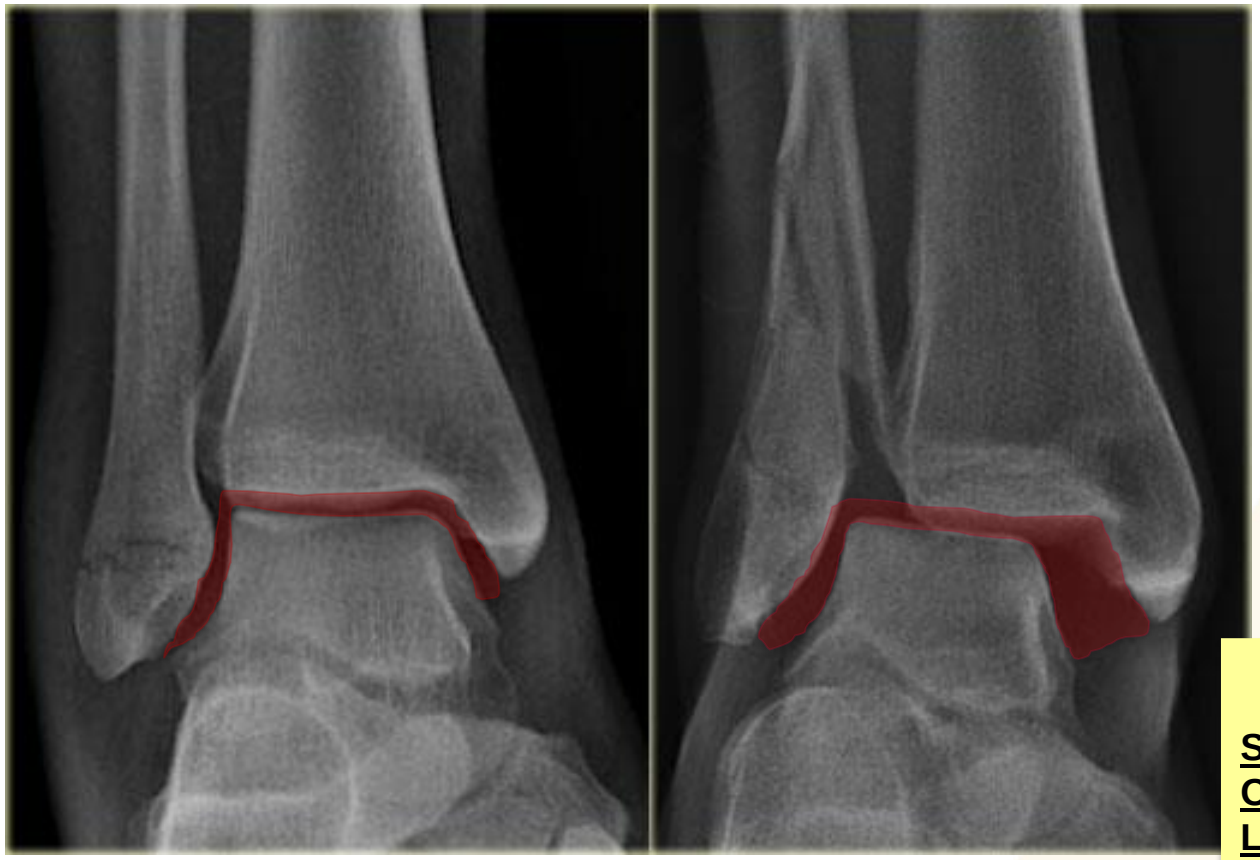


Case courtesy of Dr Matt Skalski, Radiopaedia.org, rID: 35644





Ankle Mortise

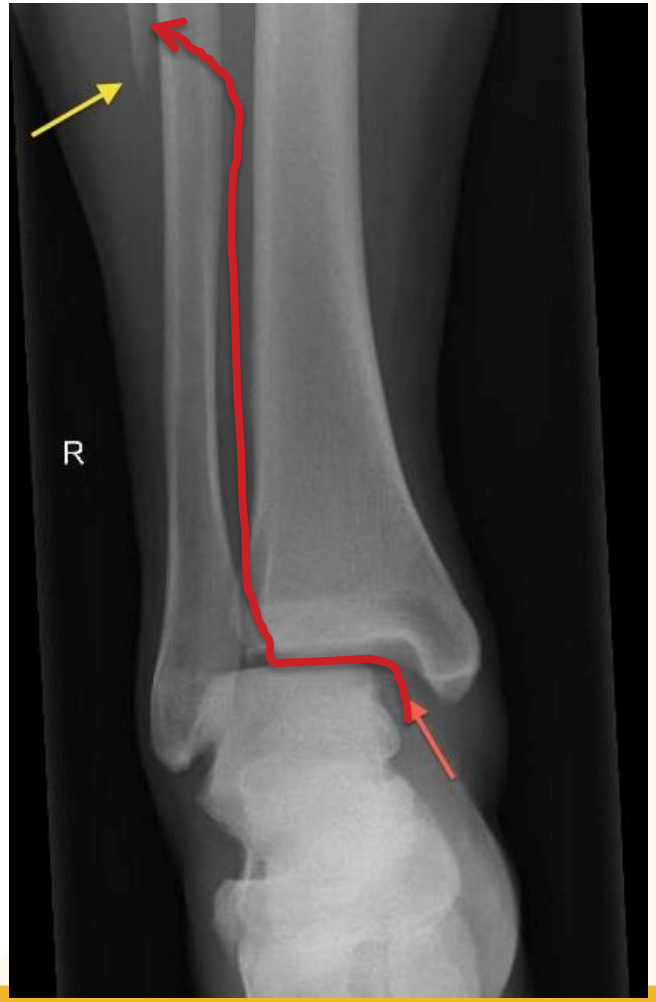


Fracture Description

S-Closed
O-Long spiral
L-Left distal fibula fracture
D-Ankle is dislocated laterally with 12mm of medial mortise widening

Maisonneuve Fracture

- Disruption of ankle mortise.
  - Deltoid Ligament injury
- Disruption of interosseous membrane
- Proximal fibula fracture.
- Sometimes medial malleolus is pulled off.



Ankle Reduction Tips

- Flex patient's knee to 90 degrees
- Inline traction
- Reduce
- HOLD REDUCED!!!
  - Grab big toe and hold
    - Holds ankle inverted and anterior
- Must hold reduction until splint set
  - DO NOT SPLINT AND WALK AWAY
  - Posterior and Sugar tong splint
- Must get post-reduction x-rays

Ankle Fracture/ Dislocation

- Traction with deformity correction
- Bend knee to relax gastric/ soleus complex
- Posterior and Lateral dislocation
  - Quiggly Maneuver
  - Posterolateral to anteromedial directed mold on splint
- Medial dislocation
  - Traction to reduce
  - Medial to lateral directed mold

5th Metatarsal Fracture

- Stress Fracture
- Jones Fracture
  - Watershed Area
  - Surgical fixation
- Avulsion Fracture
  - Most Common
  - Non-op tx
  - WBAT in tall boot

5th Metatarsal Fracture

- Mechanism:
- Jones fracture-mechanism is seen frequently with a forced adduction of the forefoot while the ankle is in a plantar flexion position
- Avulsion type fracture-seen with an inversion of the ankle
- Stress fractures-associated with repetitive activity and pes cavus

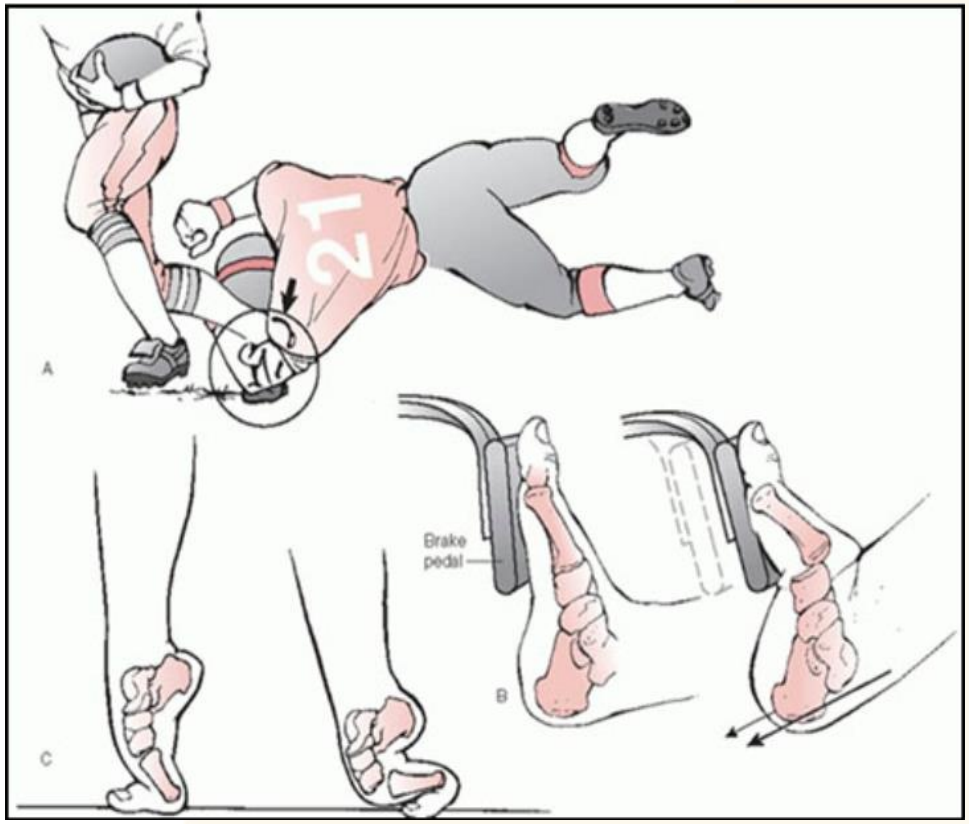
Jones Fracture

Fifth Metatarsal Fractures

- PLAN:
  - Protective weight bearing
  - Tubigrip and CAM/walking boot or Splint
  - Follow-up 5-7 days with physician
- Complications:
  - Jones Fracture - 10-15% delayed or non-union

Lisfranc Fracture

- Midfoot injury involving the Medial Cuneiform and 2nd metatarsal
- Common in football and soccer
- MOI: twist and fall, hyperplantarflexed axial load, fall from height
- Difficulty bearing weight



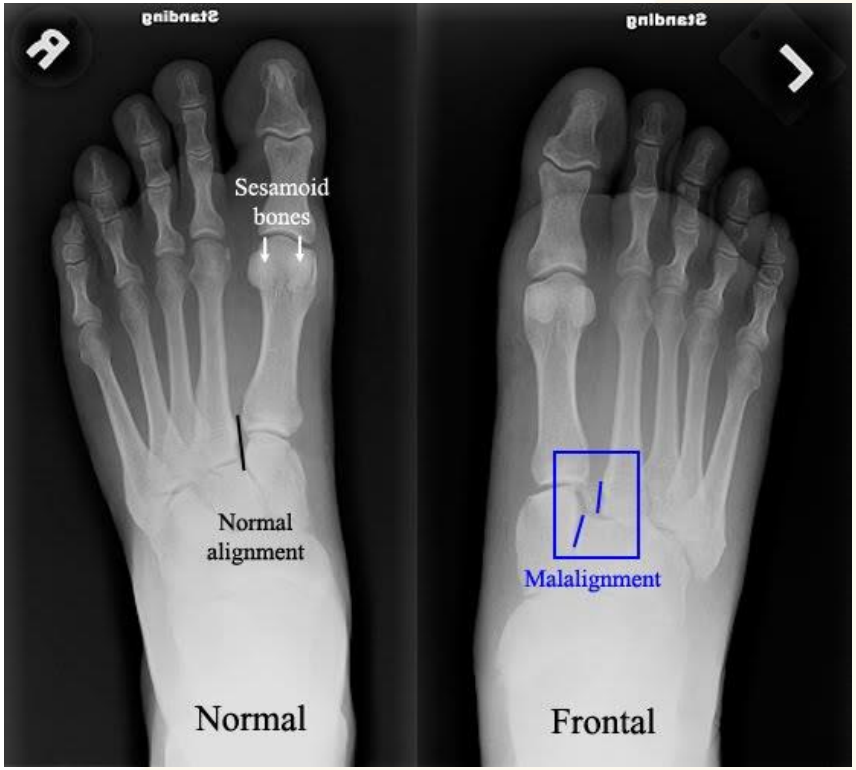
Lisfranc Fracture

Examination

- Massive swelling – "Michelin Man"
- Pain with weight bearing
- Fracture blisters not uncommon
- Bruising along the medial arch
- Pain with palpation to the mid-foot especially at the first and second tarsal metatarsal joint.
- Commonly missed on ER x-ray

Lisfranc Fracture

- SIGNS: plantar ecchymosis and pain with palpation of midfoot
- Foot x-ray must be weight-bearing; consider comparison view of other foot
- Fractures- consider CT
- Normal x-ray with suspicious exam- MRI



Stress Fractures

- More than 50% occur in the lower extremity
- MOI: Overuse injury, increasing activity too rapidly, unfamiliar surface, improper equipment, poor nutrition
- Female Athlete Triad: Eating Disorder/ Amenorrhea/ Osteoporosis (1990s)
- Relative Energy Deficiency in Sports (RED-S)- Low Energy Availability (LEA) (last 10 years)

Evidenced Based Medicine: Stress Fractures

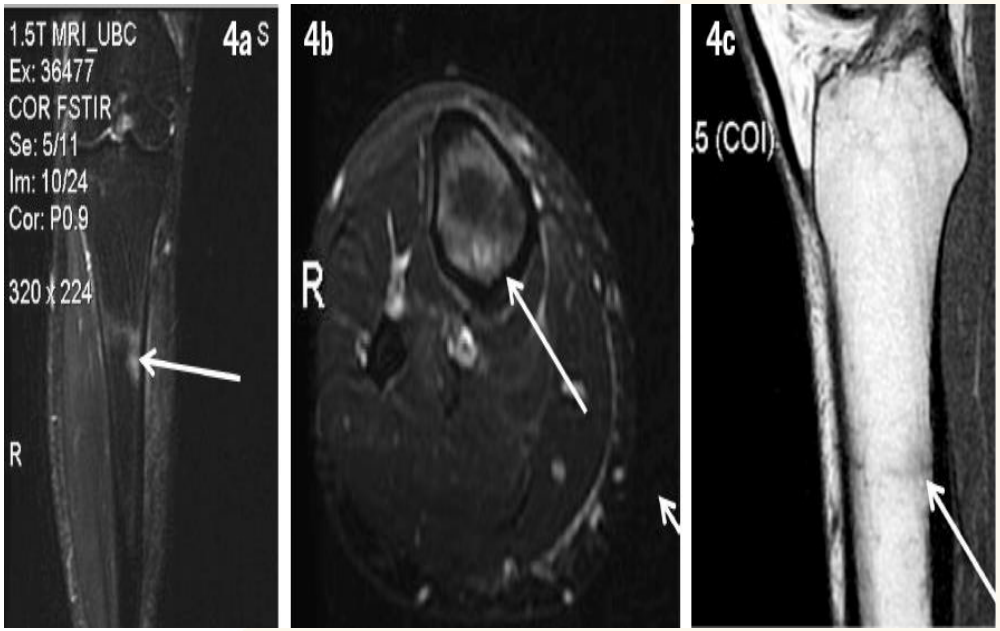
- X-rays
  - Sensitivity of 15-35% on initial examination
  - Sensitivity increases to 30-70% at 2-3 week follow-up evaluation
  - Should obtain plain film x-rays prior to advanced imaging
- MRI
  - MRI has surpassed bone scans in imaging for stress fractures
  - MRI is 90-100% sensitive and up to 85% specific
  - Bone Scans are 90% sensitive but only 50% specific for stress fractures

Stress Fractures

Treatment

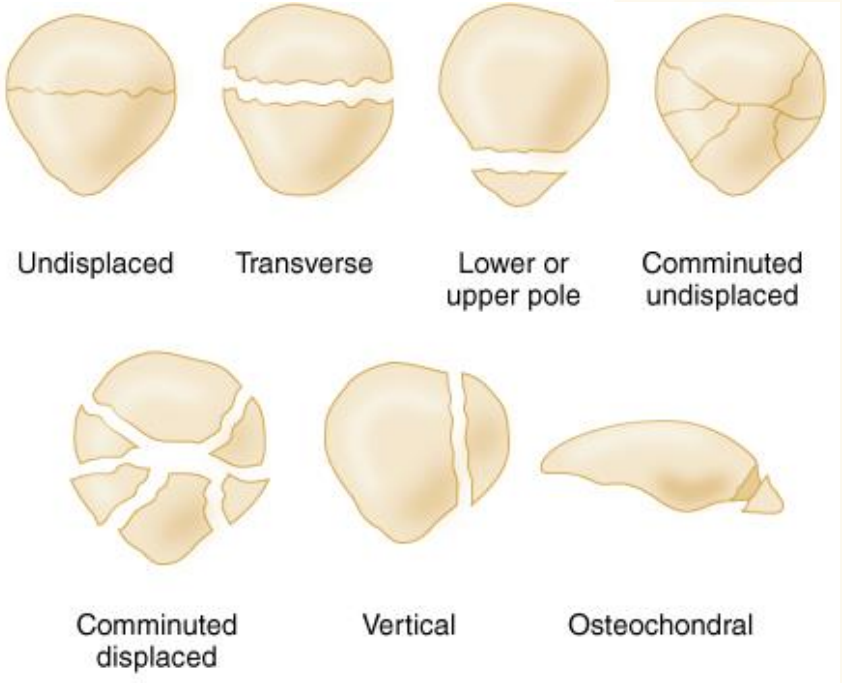
- REST
- Alleviate activity causing stress; cross train
- Evaluate and correct any biomechanical issue
- Correct nutritional deficiencies (ex. Vit. D)
- Gradual return to play progression after pain free

MRI



Patella Fracture

- Mechanism
  - Direct impact
    - Fall
    - Dashboard
  - Hyperflexion
  - Forceful contraction of quads
    - Jump from a height



Patella Fracture

- Assess ability perform straight leg raise
  - Extensor mechanism intact vs disrupted
  - May consider injection of local to help pain and evaluate ability to SLR
- Initial treatment
  - WBAT in immobilizer
- Surgical Indication
  - Open
  - >2mm displacement
  - Extensor mechanism disrupted

Patella Fracture

Don’t be fooled by bipartite patella

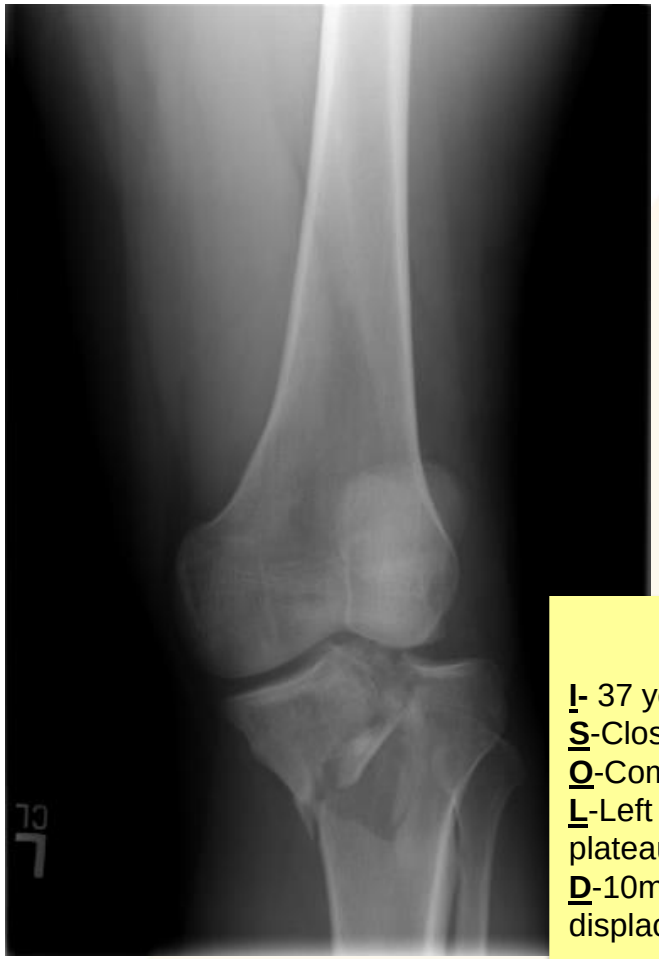
Medial Tibial Plateau Fractures

Think Knee

Dislocation...

CHECK ABI's

(Ankle / Brachial Index)



Example

I- 37 year old male
S-Closed
O-Comminuted
L-Left medial tibial plateau fracture
D-10mm of displacement

ABI-Ankle Brachial Index

$$ABI = \frac{Systolic\ BP_{Leg}}{Systolic\ BP_{Arm}}$$

Less than 0.9 gets a CTA

Hip Fracture

- Often with shortened and externally rotated extremity.

Hip fractures
- Shortened Extremity
- ER Extremity

Hip Fractures

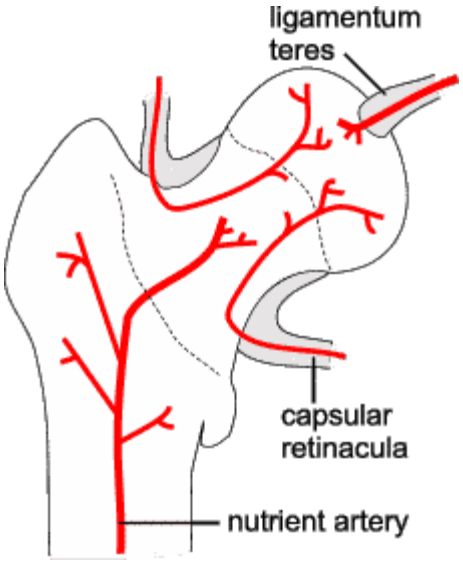
- Little old lady hip fx
  - (femoral neck, Intertrochanteric (IT), subtroch)
  - usually need surgical clearance
  - don't usually go to OR that night
  - no HARE traction
  - buck's traction once on floor may help with pain control.
- Young patients with femoral neck & intertroch fx
  - surgically urgent injury
  - vascular supply
  - **NO Traction**

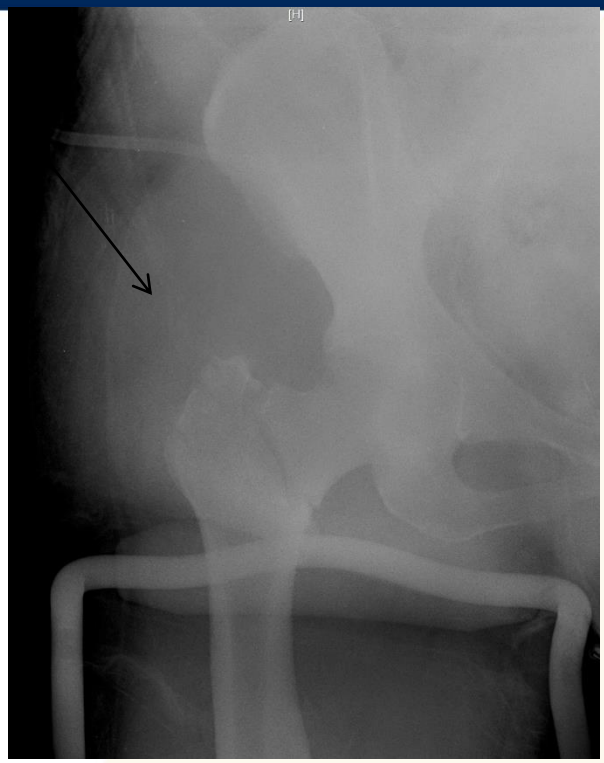
Younger patient Hip fractures

- Do not use traction.
- Surgical urgency

Dont use HARE traction for femoral neck fractures

- You will be compromising the blood supply further



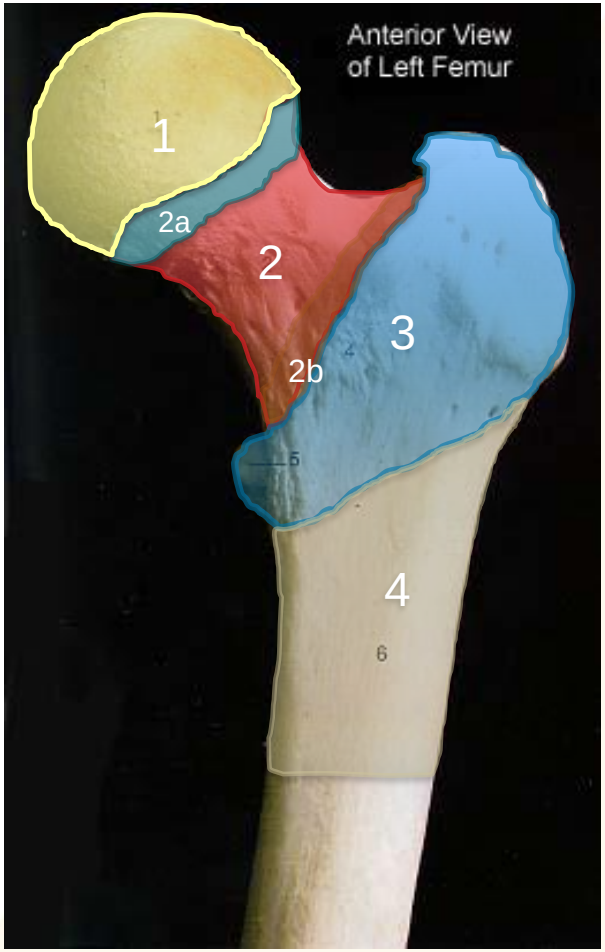


Younger patient Hip fractures

- Do not use traction.
- Surgical urgency

Hip Fractures

1. Femoral Head
2. Femoral Neck
    a. Subcapital
    b. Basicervical
3. Intertrochanteric
4. Subtrochanteric



Femoral Neck Stress Fractures

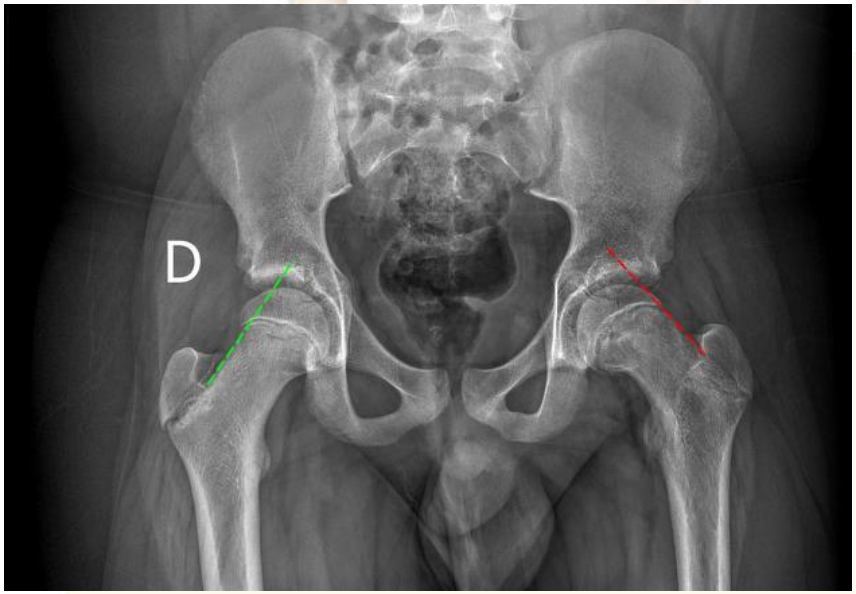
- Imbalance between rate of breakdown/ stress and formation
- Pain with single leg hop/ axial load and hip rotation
- Standing AP pelvis / hip
  - May see fracture line
  - May see sclerosis/increased density
  - May see nothing
- If high clinical suspicion, order an MRI
- Assess for Female Athletic Triad
  - Energy Imbalance (Disordered eating)
  - Dysmenorrhea (Irregular periods)
  - Low bone mineral density (Osteopenia)
- Relative Energy Deficiency in Sports (RED-S)

Femoral Neck Stress Fractures

- MRI without contrast
  - Bone edema
  - “Dreaded black line”
- Treatment
  - Activity modification, risk assessment and protected weight bearing
  - Operative management for displaced fractures or fractures that occur on the **tension** side of the femoral neck
  - Possibility of protected weight bearing with crutches (8 weeks) if the stress fracture is on the **compression** side of femoral neck

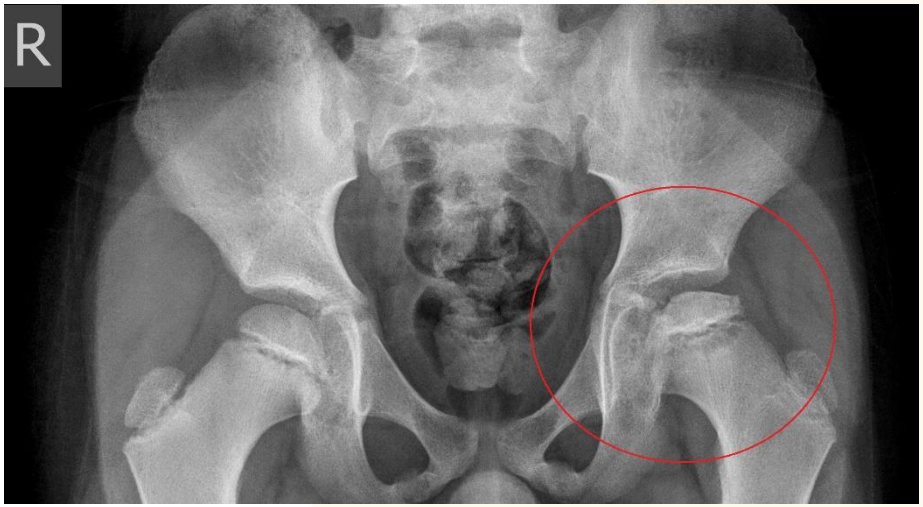
Slipped Capital Femoral Epiphysis (SCFE)

- Disorder of the epiphyseal growth plate during adolescents, typically in obese males (ages 12-14; rapid growth)
- Patients walk with a limp or inability to bear weight or present with **KNEE PAIN**
- Imaging: AP pelvis and frog leg lateral (Klein's line)
- Treatment: Protect weight bearing and immediate referral to Peds Ortho for percutaneous screws



Legg-Calve Perthes Disease

- Idiopathic avascular necrosis in younger patients (< 8 years old) where the femoral head forms abnormally
- ~ 75% of patients have sort of coagulopathy
- Better prognosis in patients the younger they present
- Findings: limp (may be painless); referred pain to knee or thigh
- Treatment: protected weight-bearing and activity modification; referral to Peds Ortho



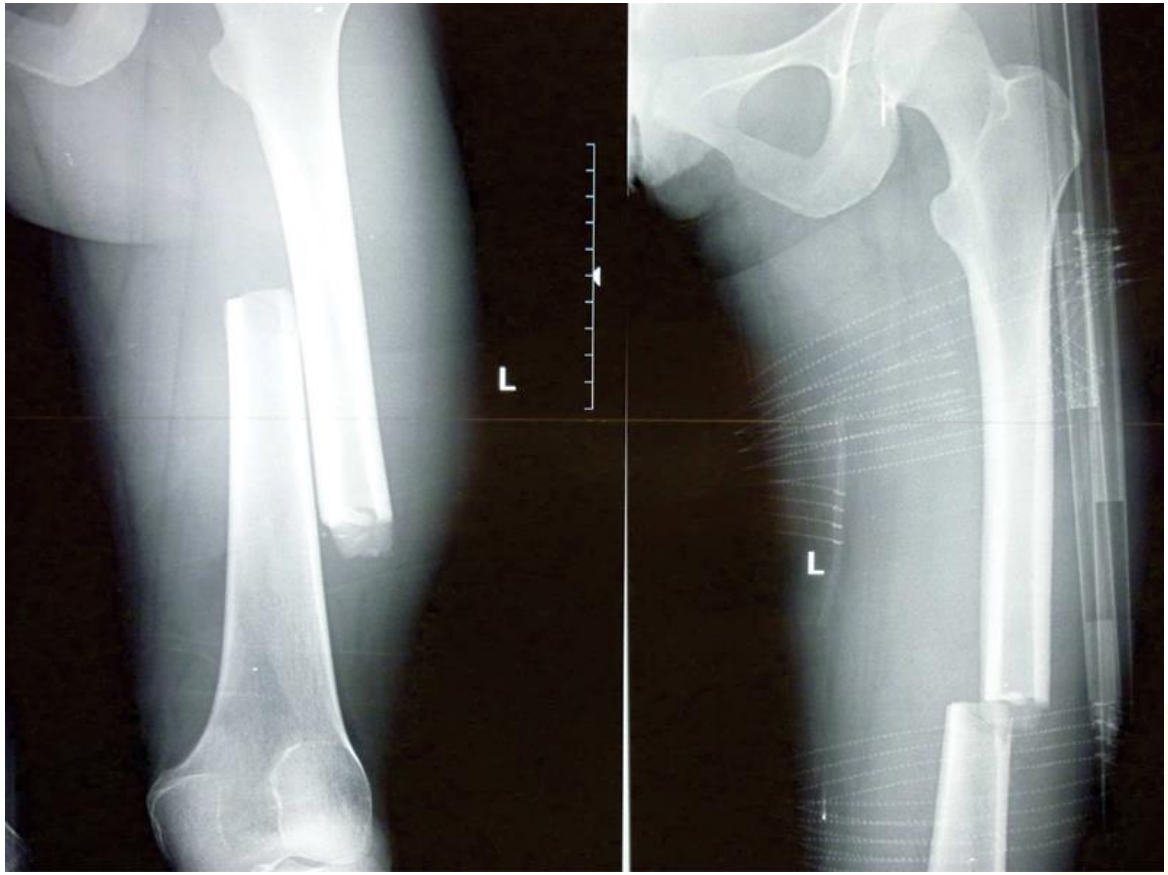
Femur Fractures
Femoral shaft

- High energy
- Obvious deformity
  - Shortened
  - Rotated
- Look for other associated injuries
  - Pelvis
  - Knee (20-50%)
  - Abdominal
- Neurovascular injury from femur fracture is rare but make sure you document NV status.
- Remember up to 1500ml blood loss from Femur fracture
- Evaluate for compartment syndrome

HARE traction

- Apply to proximal femur / thigh deformities
- Document pulses prior to application of traction
- Can use if tibia fxd as well
  - Splint tibia first then apply traction cuff over splint and add traction

Femur fx…after HARE



-Check Neurovascular Status before and AFTER application
-Ankle cuff may decrease Dorsalis pedis pulse
-Usually posterior tib pulse is fine
-Use doppler if needed
-Consider slightly loosening amount of traction

Tibia fracture Immobilization

- You want to protect the soft tissues in order to prevent Compartment syndrome

- Tibial plateau fx (proximally)
  - knee immobilizer & cryo cuff

- Mid-shaft & Distal tibia fx
  - Posterior & sugar tong splint

Compartment Syndrome

Medical condition where pressure inside a myofascial compartment exceeds the perfusion pressure of the contents causing ischemia and necrosis.

- Causes…
  - Trauma – crush injury
  - Reperfusion
  - Iatrogenic
  - Tight dressings/casts
  - External compression
- Surgical emergency
- We infrequently measure compartments
  - Diagnosis of clinical experience

Compartment Syndrome

- Long bone fractures
  - Tibial shaft fractures
  - Femur
- Forearm fractures
- Pediatric supracondylar humerus fractures
- Other areas
  - Hand, foot, buttock,

Skin ALWAYS SHINES like this

Notice the skin edges

REASSESS YOUR PATIENTS

- Compartment syndrome can develop within hours of the injury
- Limb is TIGHT (very swollen and skin is stretched and shiny) and FIRM (not supple)
- Symptoms/Exam
  - PAIN OUT OF PROPORTION…severe, deep, constant, poorly localized
  - TENSE COMPARTMENT (wood like feeling)
  - PAIN WITH PASSIVE ROM

Other stuff that doesn't matter b/c it's too late

- Pale (arterial injury)
- Pulseless (arterial injury)
- Paresthesias (numb and tingling-diminished blood supply to limb) or Paralysis
- Poikilothermia (failure to thermoregulate)

Importance of Immobilization

- Reduces blood loss
  - Femur fx can lose up to ?? 1500 ML
  - Tibia fx can lose up to ?? 1000 ML
- Decreases pain
- Decreases compartment syndrome
- Protects vessels, nerves & skin (surgical sites)

Open Fractures

Immobilize all fractures

- Apply a sterile **saline** dressing to cover wound
- Document what the wound looks like and location then KEEP IT COVERED!!!
- IV antibiotics & tetanus

Antibiotics

- Administer gram positive antibiotics ideally within 2 hours of injury.
- Cephazolin – appropriate weight-based dosing
  - <50kg - 1gm IV Q 6-8hr
  - 50-100kg – 2gm IV Q 6-8hr
  - >100kg – 3gm IV Q 6-8hr

<u>Lake/ standing water/ Farm</u>

- anaerobe coverage

-High dose Penicillin is added.

Antibiotics

- Skin/ Gram + Cocci
  - Staph: 1. Trimethoprim/ Sulfamethoxazole (98%)
    2. Doxycycline (97%)
    3. Clindamycin (76%)
  - Strep: 1. Amoxicillin
    2. Cefadroxil
    3. Cephalexin

Linezolid (100%) for staph and strep

- Clostridium: 1. Penicillin +
  2. Clindamycin or Linezolid

Antibiotics

- GI/ Dirt/ Gram – Rods
  - Enterobacteriaceae
    1. Amoxicillin/ Clavulanate Potassium (Augmentin)
    2. Ciprofloxacin
    3. Levaquin
    4. Trimethoprim/ Sulfamethoxazole (Bactrim)

- Water
  - Pseudomonas/ Aeoromonas/ Mycobacteria
    1. Ciprofloxacin
    2. Levaquin

Tetanus Vaccination

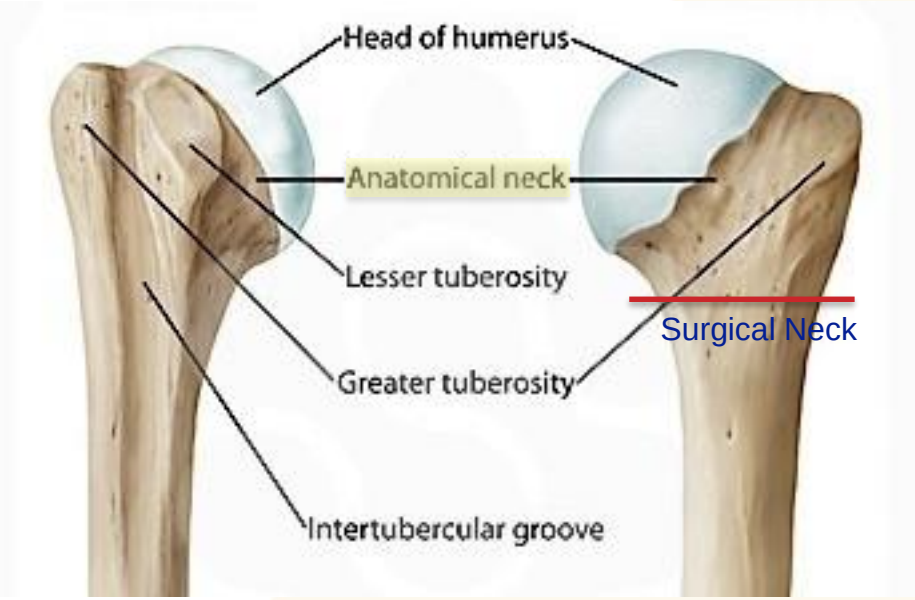
- Anaerobic conditions carry risk of germination of C. tetani spores
- Always check Tetanus status particularly with open fracture!
- Tetanus toxoid-containing vaccine indicated (Tdap preferred)
  - Less than 3 tetanus toxoid containing vaccines in the past
  - More than 5 years has passed since last tetanus toxoid containing vaccine

Anticoagulation

- DVT Prophylaxis
  - High risk surgeries: TKA, THA, hip fracture surgery
  - Agents of Choice
    - Low- Molecular Weight Heparin (LMWH)
      - Enoxaparin 40 mg SC daily
    - Direct Oral Anticoagulants (DOACs)
      - Apixaban (Eliquis) 10 mg PO daily
      - Rivaroxaban (Xarelto) 2.5 mg PO BID
      - Dabigatran (Pradaxa)
      - Edoxaban (Savaysa)
    - Aspirin 81 mg BID for 4-6 weeks (Arthroplasty)
  - Start POD1 and treat minimum of 10-14 days

Proximal Humerus Fractures

- 4-5% of all fractures
- 70% occur in age >60
  - Fall from standing height
  - 3-4x more frequent in female vs male
- High energy-MVA
  - Younger patients



Proximal Humerus Fractures

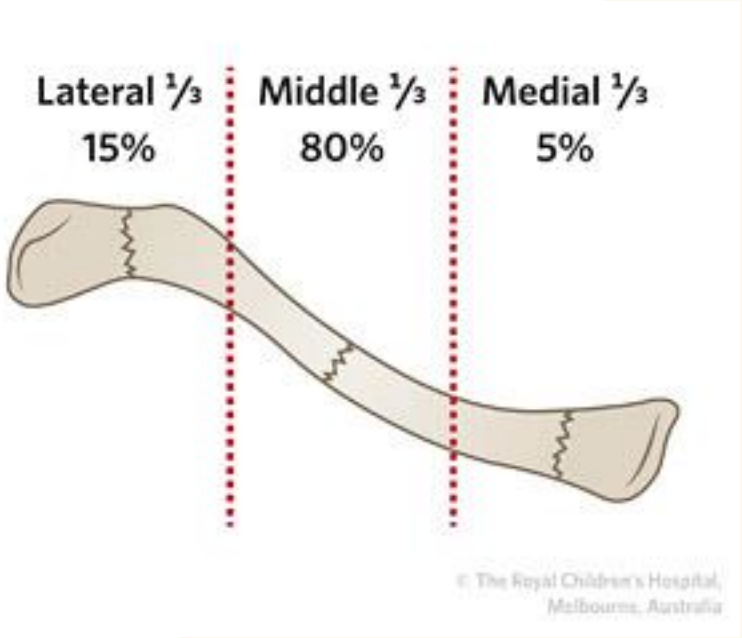
Proximal Humerus Fracture

- Multiple factors in treatment
  - Age
  - Fracture pattern
  - Expectations
  - Lifestyle
- Treatments
  - Non-op
  - ORIF
  - Hemiarthroplasty
  - Reverse total shoulder

- Approx. 80% are non-op
- Neck fractures at risk for AVN
- Painful Injuries
- Early motion is often beneficial
  - Close outpatient FU (1 week)
- Sling or shoulder immobilizer

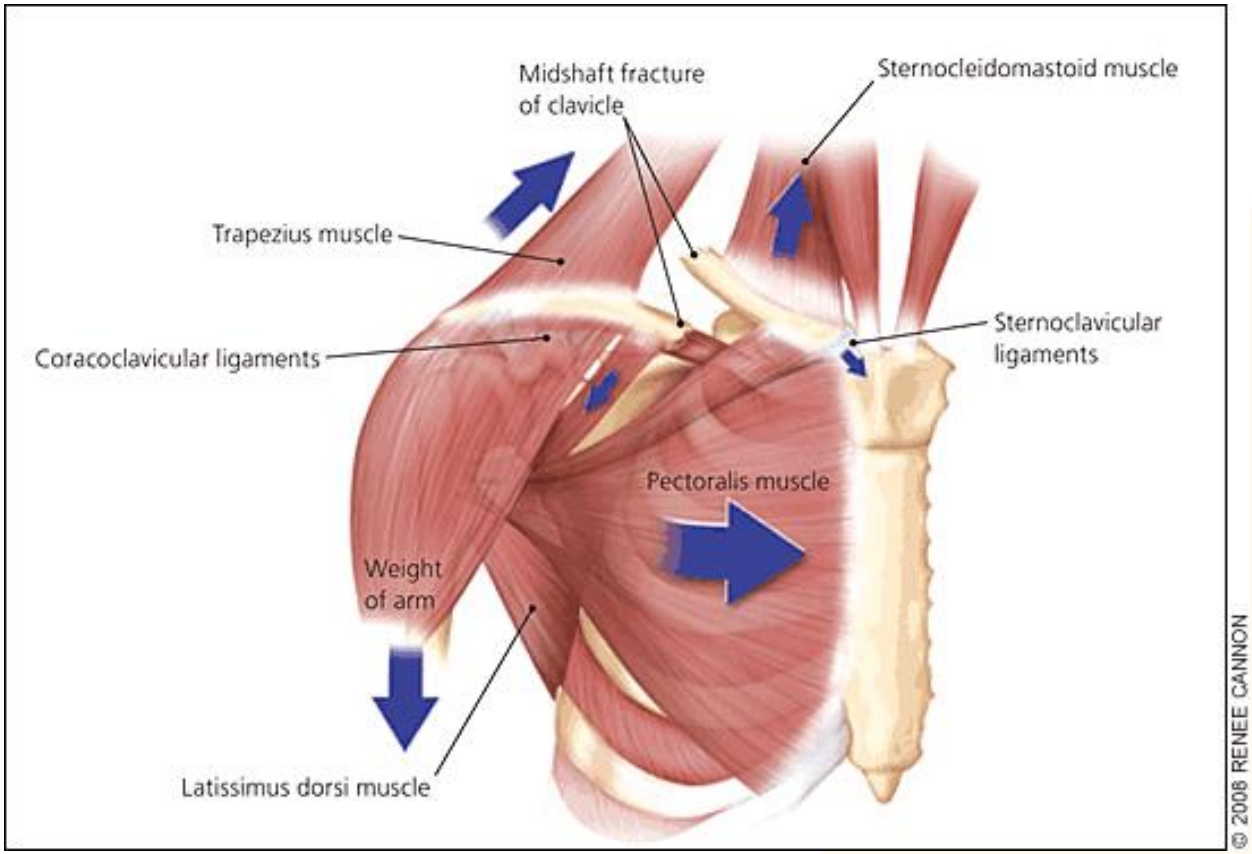
Clavicle Fractures

- Most can be treated non-op
- Most occur in the middle 1/3
- Mechanism
  - Fall on shoulder
    - Bike accident
    - Football
  - High speed MVA



Clavicle Fracture

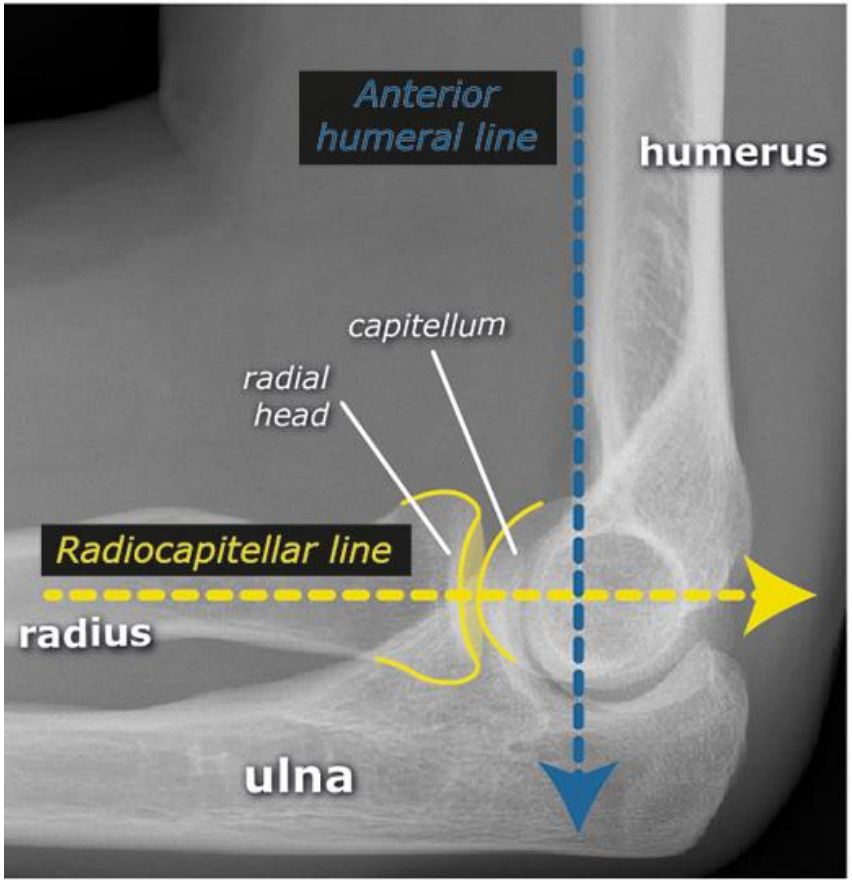
Deforming forces

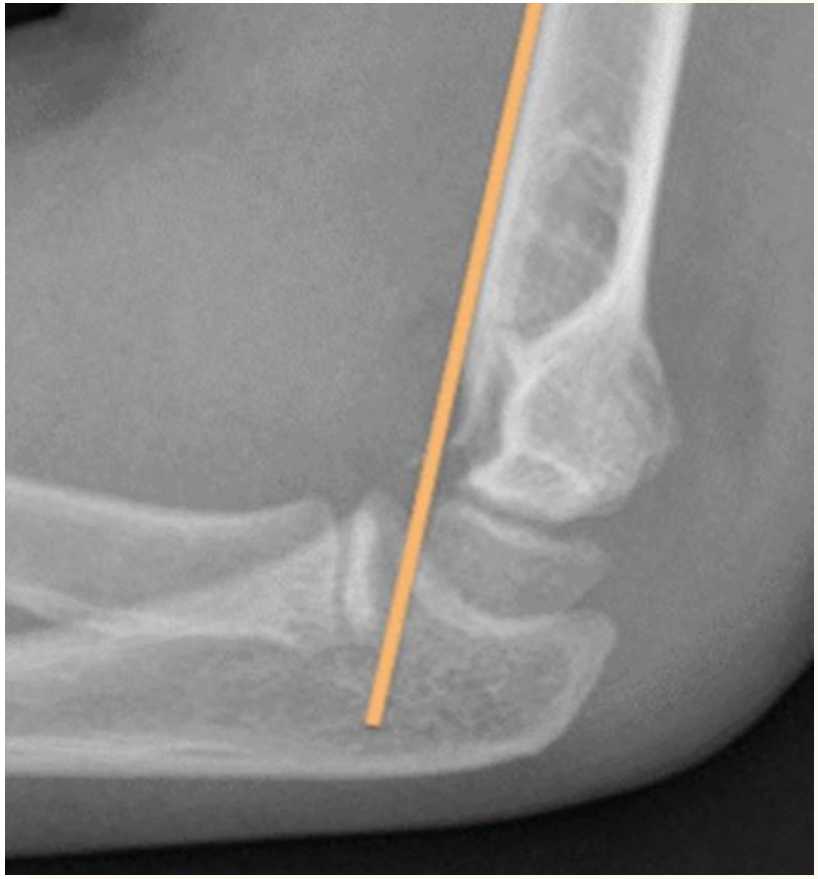


Clavicle Fractures

- Indications for Surgery
  - Open Fracture
  - Skin compromise (tenting)
  - Nerve or vascular injury
- Initial treatment
  - Sling or shoulder immobilizer
  - Pain medicine
  - FU within 1-2 weeks

Pediatric: Supracondylar Humerus Fracture





Little Leaguer's Shoulder

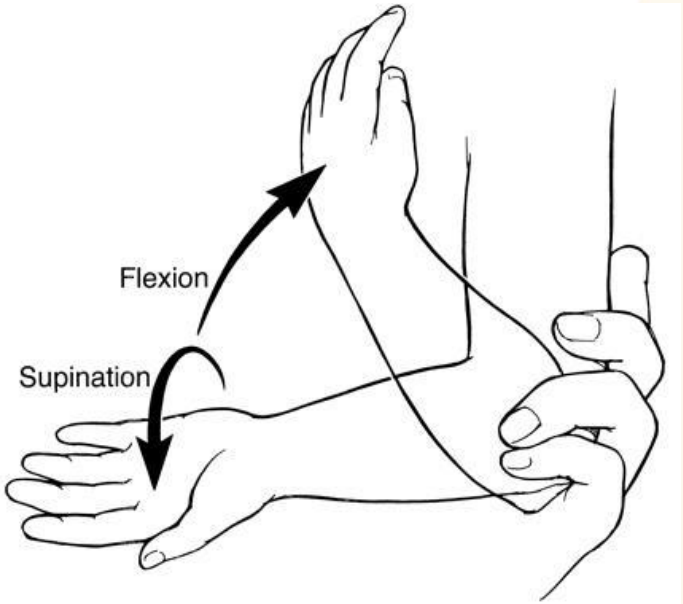
- Overuse shoulder injury in young baseball pitchers resulting in epiphysiolysis of the proximal humerus (Salter Harris Type 1)
- Diagnosed with widening of proximal humeral growth plate
- Tx: shoulder rest from throwing, PT and gradual return to throwing after sufficient rest

Little Leaguer's Elbow

- Overuse elbow injury in young/ skeletally immature baseball players
- Pain and tenderness over the medial elbow worse with valgus stress
- ENFORCE pitch counts in all players…particularly youth.
- Tx: rest, PT and activity modification

Nursemaid's Elbow

- Common in children from 1-4 years of age
- MOI: sudden, longitudinal traction applied to hand with elbow extended
- Annular ligament becomes interposed between radial head and capitellum
- May present with limited supination and refusing to move elbow



Forearm Fractures

- Think of the forearm as a ring or hard pretzel
  - Can't break in only one spot

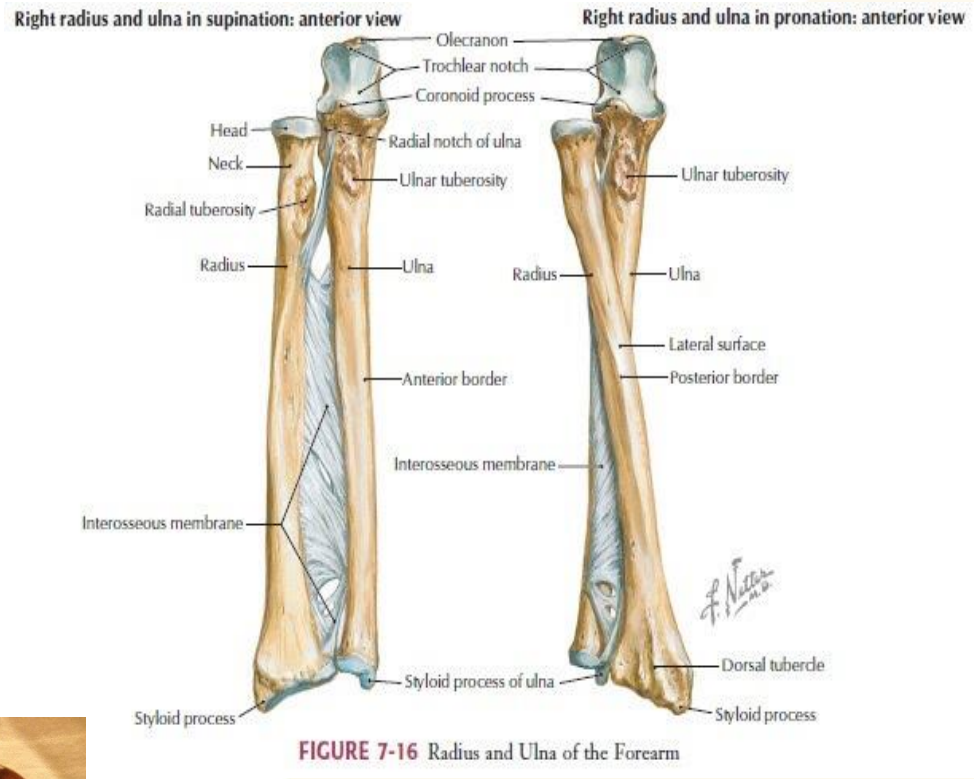


FIGURE 7-16 Radius and Ulna of the Forearm

- If you see one facture
- LOOK FOR A SECOND ONE

Forearm Fractures
acronym MUGR (Mugger)

Monteggia

- MU-GR
- Ulna Fracture
- Radial head injury
  - Fracture
  - Dislocation

Gaeleazzi

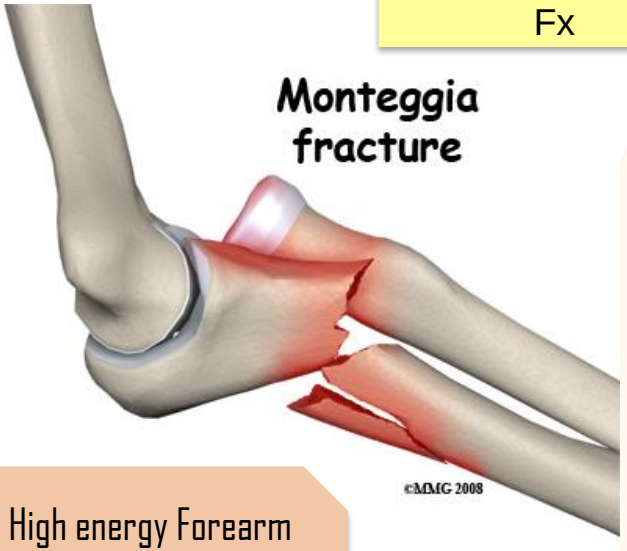
- MU-GR
- Radius Fracture
- Distal Radial Ulnar Joint Injury (DRUJ)

of one forearm
ne other

Monteggia

MUGR
Monteggia-Ulna Fx
Galeazzi-Radius Fx

- MU GR = Mugger
- Monteggia = Ulnar fracture with radial head dislocation
- Special b/c of the force it takes to create and the destruction of the soft tissue

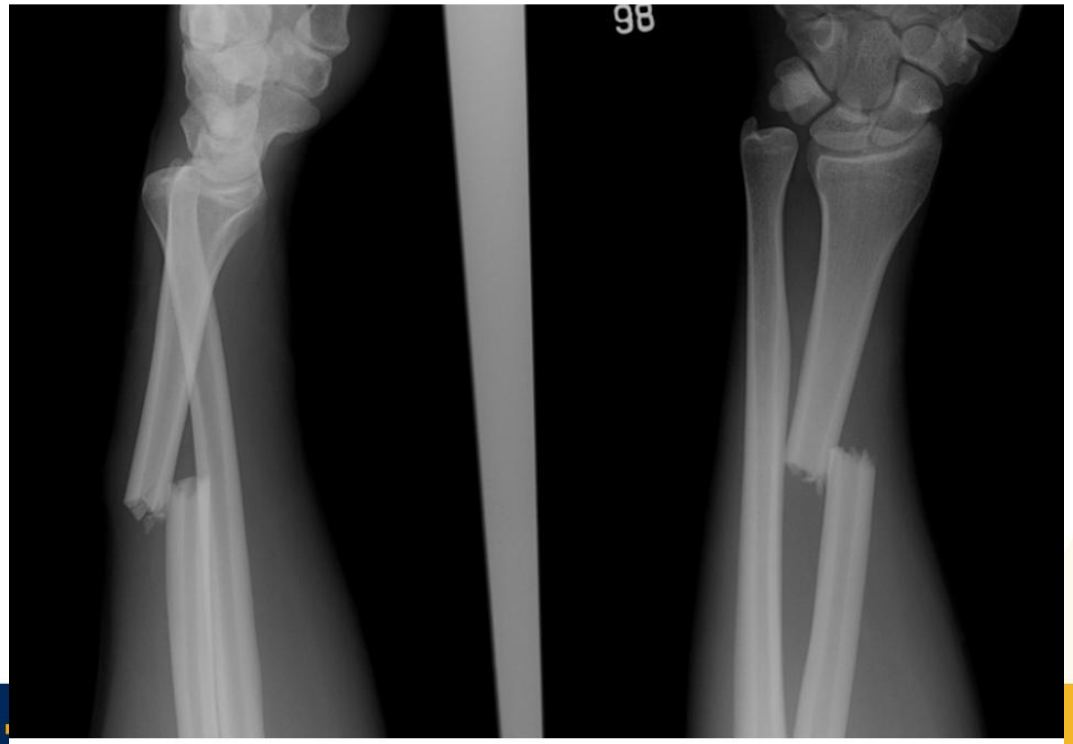


High energy Forearm Fracture
High incidence of compartment syndrome

Galeazzi

MUGR
Monteggia-Ulna Fx
Galeazzi-Radius Fx

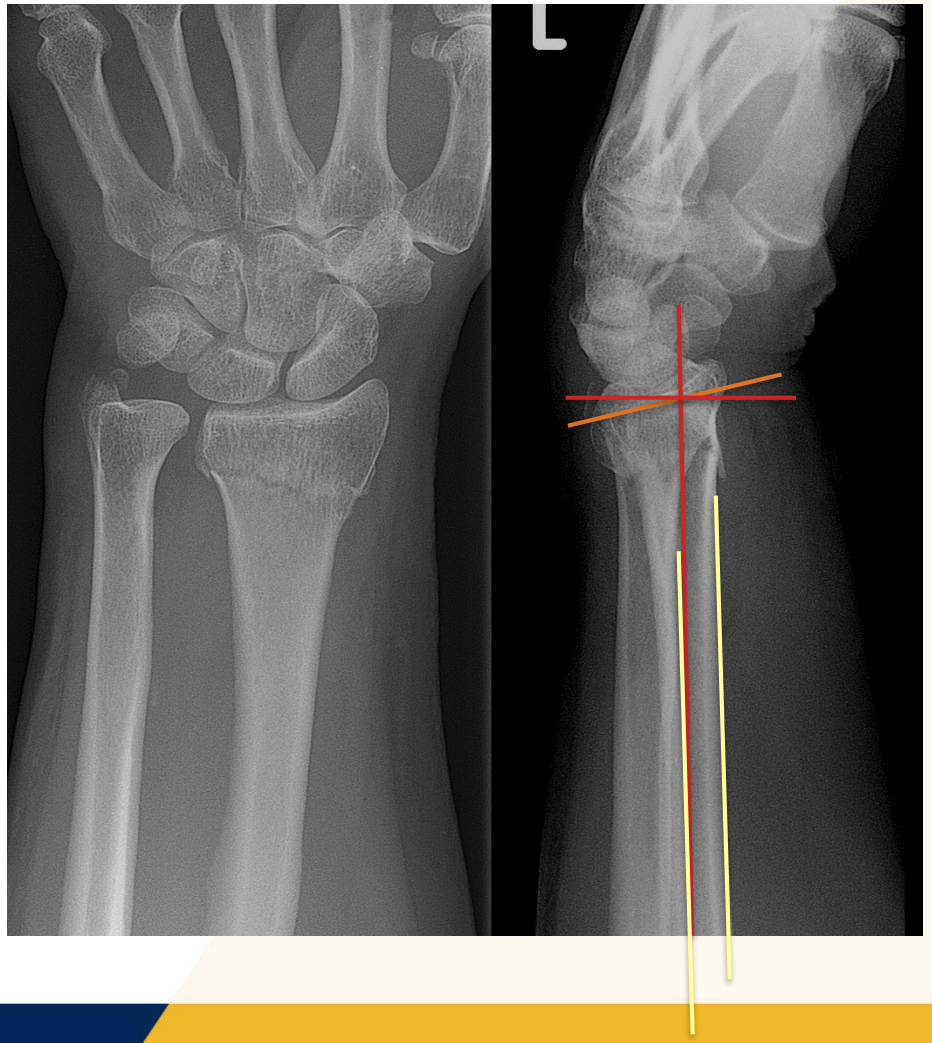
- MU GR = Mugger
- Galeazzi = Radial fracture with (DRUJ) ulnar dislocation at wrist



DRUJ
Distal Radial Ulnar Joint

Distal Radius Wrist Fractures

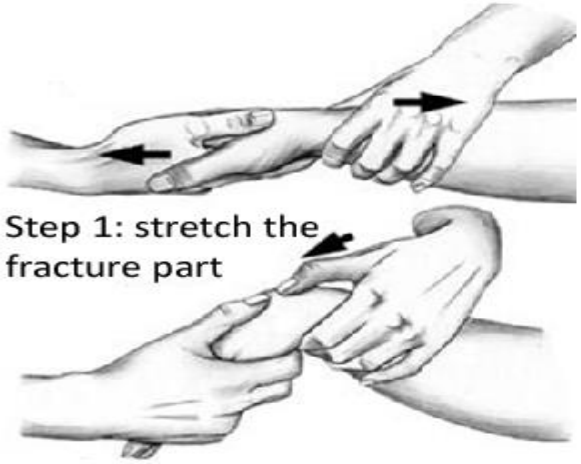
Normal Lateral



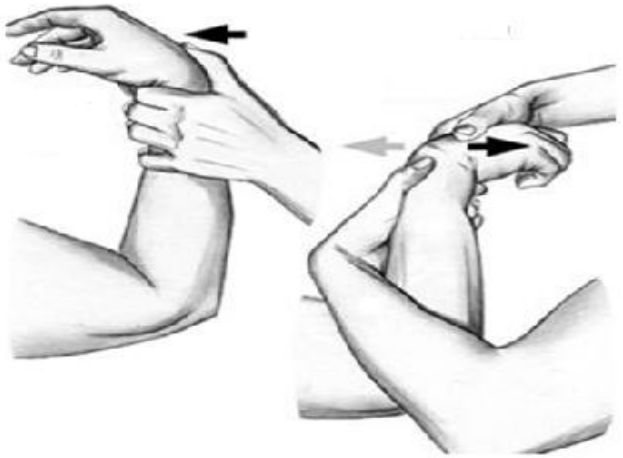
Distal Radius Fracture

- Hematoma block
- Longitudinal Traction
  - Finger traps or manual
- Exaggerate the deformity
- Push distal fragment and pull hand for length and deformity reversal
- Immobilize in Sugar tong splint

- Apply ulnar deviation to reestablish radial height length
- Keep patient's thumb collinear with forearm
- Volar directed distal force over Lister's tubercle (Colles)



Step 2: move the distal fragment

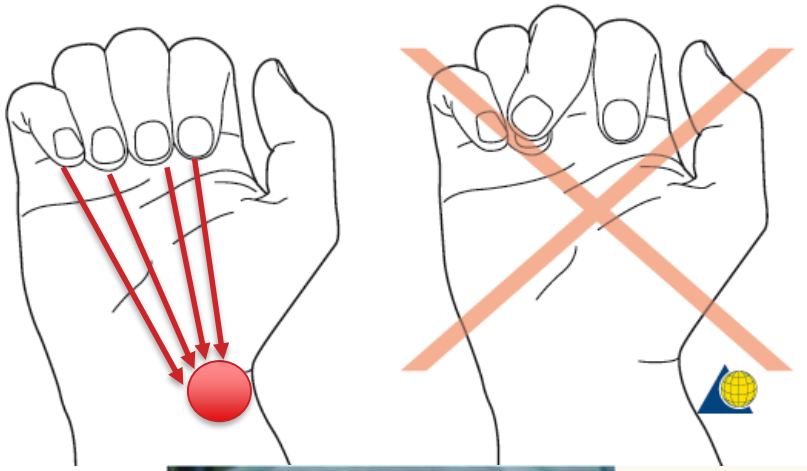


Step 3: maintain the position of flexion and ulnar deviation

Metacarpal Fractures

- Acceptable angulation
  - Index, long & ring finger (2nd, 3rd, 4th)
    - 10-15 degrees
  - Small finger (5th) up to about
    - 20 degrees
  - ***No rotation is acceptable***
- Make sure they can hyperextend MCP joint
- Can attempt closed reduction with the MCP flexed in

Fingers should point to scaphoid



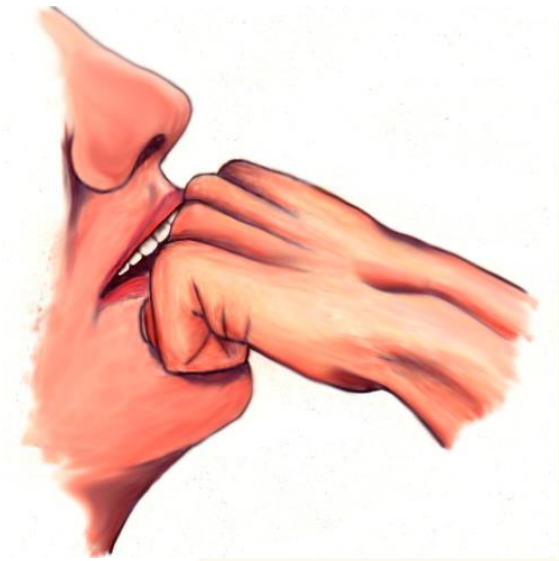
Metacarpal Fracture

Example
I-34 year old
S-Closed
O-Oblique
L-Right 3rd metacarpal midshaft fracture
D-3mm of shortening and displacement

Example
I-27 year old male
S-Closed
O-Transverse
L-Left 2nd metacarpal midshaft fracture
D-50% Displaced and shortened 3mm

Fight Bite

- Sustained when clenched fist strikes tooth
- Small lac over the MP joint from punch in mouth
- High concentration of aerobic and anaerobic bacteria
  - Tetanus
  - Ampicillin/ Sulbactam (Unasyn) or Amoxicillin/ Clavulanate Potassium (Augmentin)
- Often causes injury to extensor tendon and joint capsule
- Inability to fully extend finger



- Require operative irrigation and debridement
- Wound almost always left open

Carpal Fracture

Scaphoid Fractures

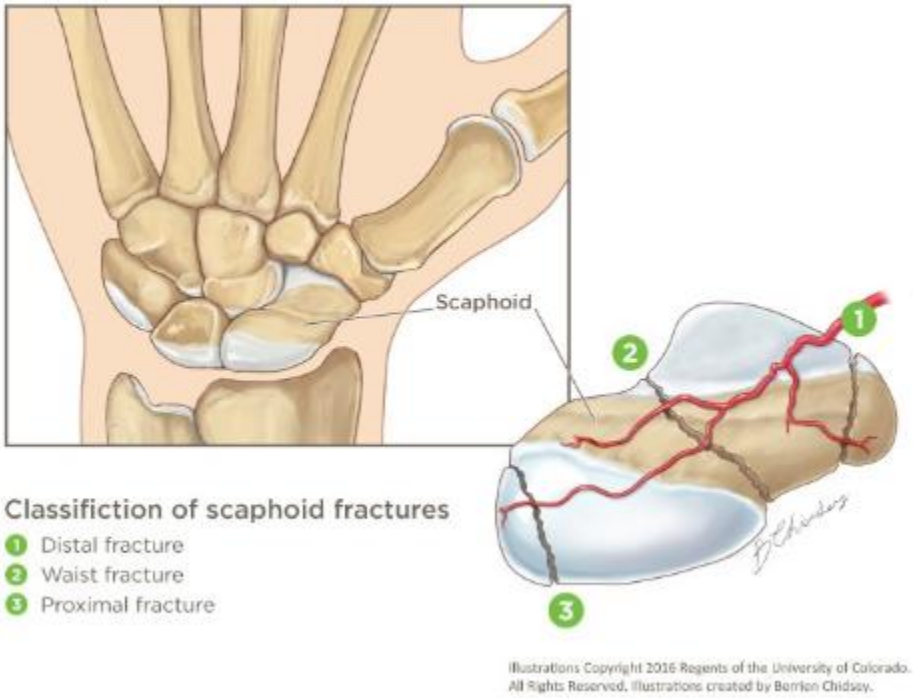
- Most common carpal fracture (70%)
- 80% covered with articular cartilage
- >1mm of displacement:
  - 55%-90% nonunion rate
- Exam-
  - Snuffbox tenderness
  - swelling

NEGATIVE X-RAY

- Must have high suspicion of scaphoid fracture when someone has injury with snuffbox tenderness and swelling
  - Splint in thumb spica splint and FU in 10-14 days
  - MRI helpful if high suspicion and negative x-rays

X-ray shows a scaphoid fracture Follow-up within a week

Scaphoid Fractures



Classifiction of scaphoid fractures

1. Distal fracture
2. Waist fracture
3. Proximal fracture

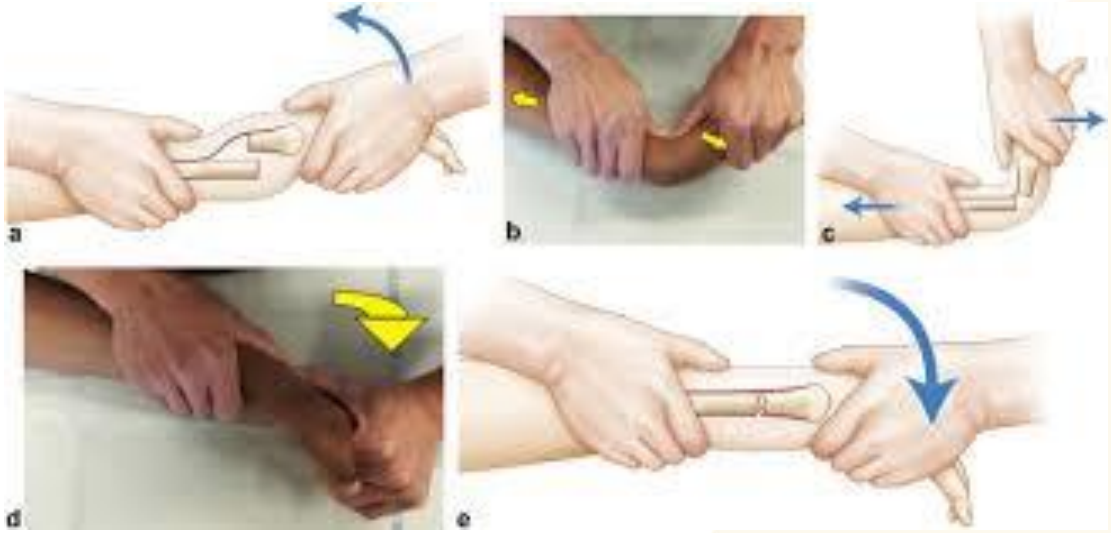
Finger Dislocations

- Test joint stability before & after reduction
- Full neurovascular examination
- May use a digital or wrist block
- Full active ROM after reduction without displacement indicates joint is stable
- Examination of joint stability
  - Radial and ulnar stress in extension
  - Volar plate stress
- Instability or unreducible require

Closed Reduction Principles

1. Reproduce the fracture mechanism
2. Traction to disengage fracture fragments
3. Re-align fracture

** Angulation beyond 90 degrees may be required



Immobilization

UPPER EXTREMITY

- Short Arm/Volar
  - Wrist/hand soft tissue injuries
  - Kids buckle fracture
- Long arm
  - Soft tissue elbow injuries
  - Radial head fractures
- Sugar Tong
  - Distal radius fractures
- Double Sugar Tong
  - Forearm fractures
  - Elbow Fractures
- Coaptation
  - Humeral shaft
- Ulnar gutter
  - 3-5th metacarpal fractures
- Radial gutter
  - 2nd -3rd Metacarpal fractures
- Thumb Spica
  - Thumb injuries/fractures
  - Scaphoid fracture

LOWER EXTREMITY

- Short Leg
  - Achilles rupture
  - Ankle sprain
- Long Leg
  - Knee ligament injuries
  - Tibial plateau ?
  - Distal femur
- Sugar tong
  - Ankle fractures

Upper Extremity Splints

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