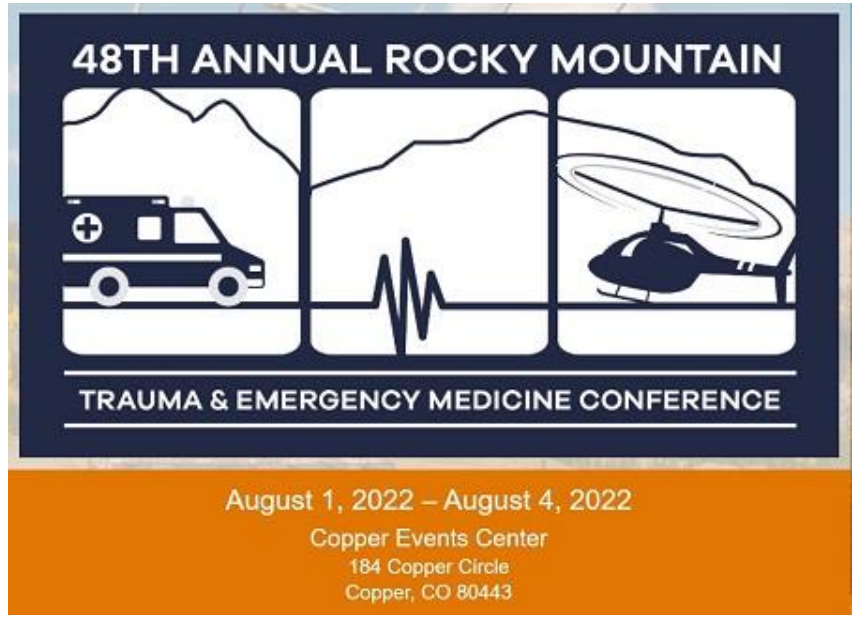
Orthopedic Reductions for the ED



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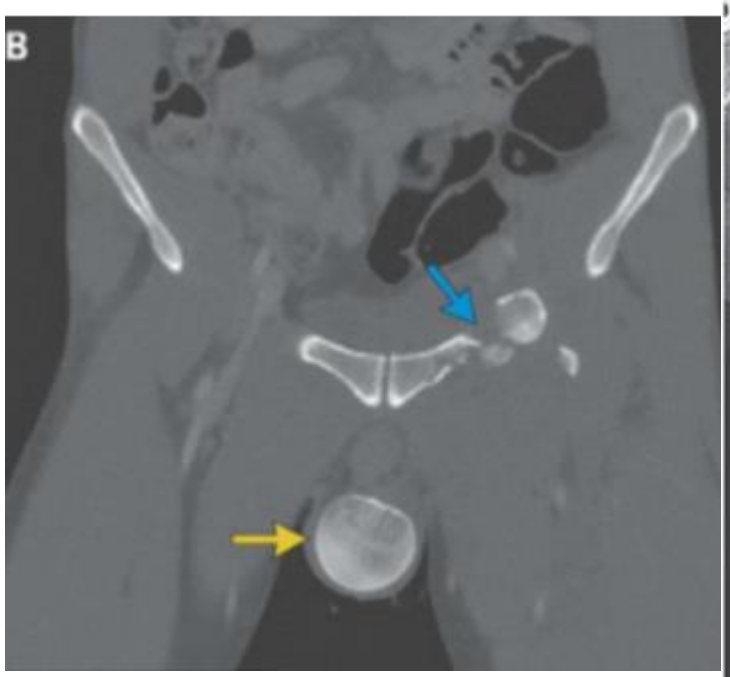
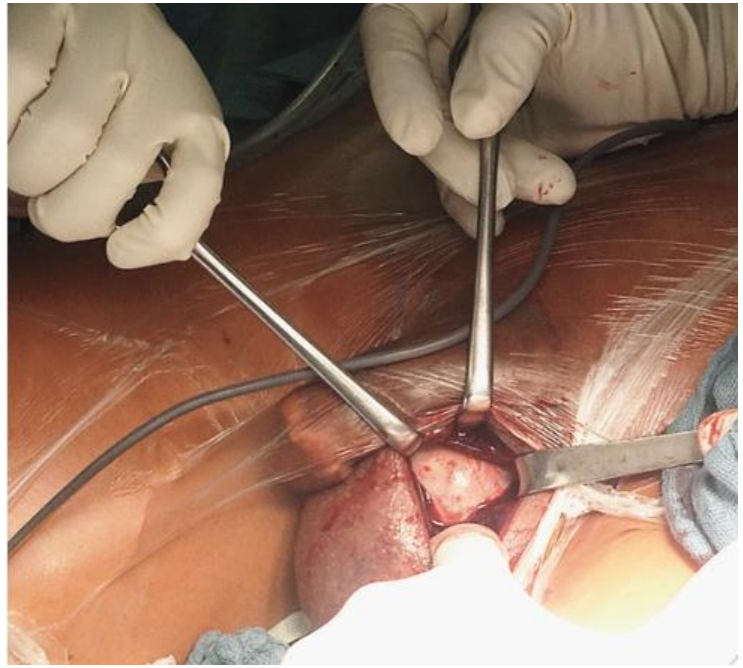
Disclosures

- None relevant to this talk

WTF?

- 33 yo M s/p MCC – hard, swollen, bluish scrotum and ER/shortened left leg

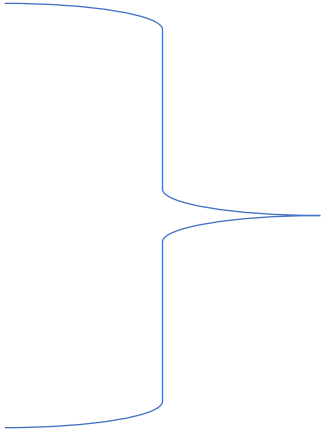




- Overview
- Closed Reduction Principles
- Splinting Principles
- Common Closed Reductions

Basic Overview

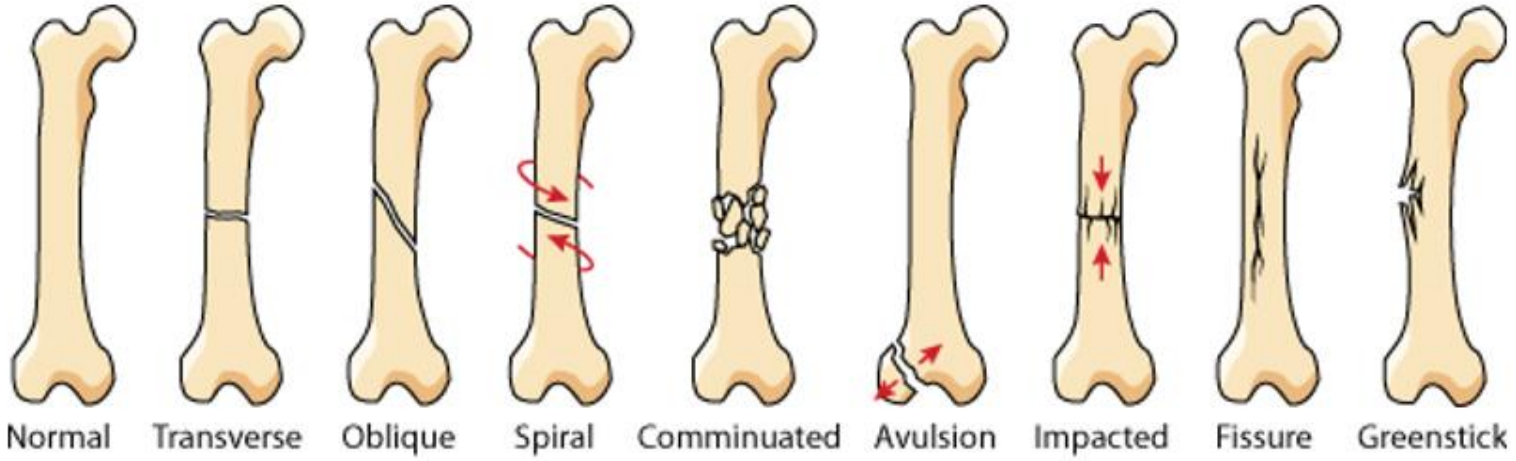
- Joint dislocations are rarely life-threatening
- Morbidity can be severe
- “VONCHOP”
  - Vascular Compromise
  - Open Fracture
  - Neurologic Deficit (cauda equina)
  - Compartment syndrome
  - Hip dislocation
  - Osteomyelitis (septic arthritis)
  - Pelvic fracture (unstable)

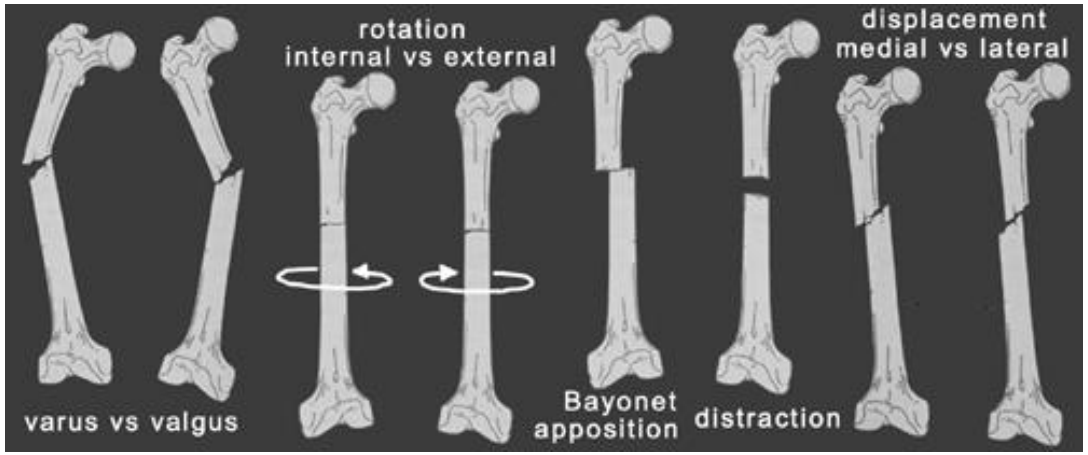


Only true orthopedic emergencies!

Ortho Lingo - Nomenclature for Fractures

- Open vs Closed
- Description
  - Bone
  - Left vs Right
  - Reference Points – neck, tubercle, styloid, process, olecranon, etc…
  - Long Bones – divide into thirds and junctions
- Direction of Fracture Line
  - Transverse
  - Oblique
  - Spiral
- Simple vs Comminuted





Ortho Lingo – Fractures and Dislocations

- Position
  - Fragments described relative to their normal position
  - Displacement – any deviation from normal position
  - Distal fragment described relative to proximal
- Alignment
  - Relationship of the longitudinal axis of one fragment to another
  - Angulation – deviation from the normal alignment
  - Direction of angulation determined by direction of the apex of an angle formed by two fragments
- Complete vs Incomplete
- Involvement and Percentage of Articular Surface

Why Closed Reduction?

1. Improve Fracture alignment and add stability
2. Pain management
3. Soft tissue protection and swelling
4. Treatment planning

Closed Reduction Principles

Prior to Reduction:

- H&P
- ABC's
- Evaluate skin, neurovascular status, and compartments
- Anesthesia type
  - local vs IV sedation
- Splint type
- Imaging
- Post Reduction neurovascular exam

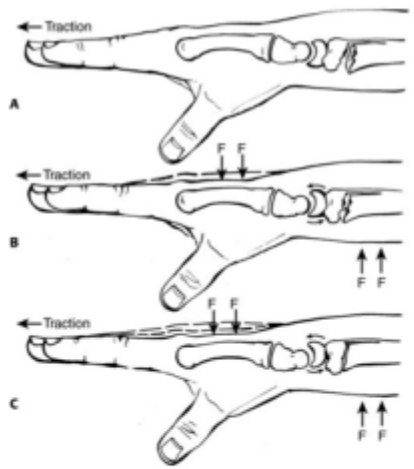
Reduction Principles: Anesthesia

- Adequate analgesia and muscle relaxation
- Hematoma Block
- Intra-articular Block
- IV Sedation
  - Requires hemodynamic monitoring
  - Usually performed by ED, Anesthesia or Trauma team

Closed Reduction Principles

Reproduce Fracture Mechanism → Traction to Disengage Fracture Fragments → Re-align Fracture → Splint application

***Angulation beyond 90° is potentially required



Legend:

A: To apply the Agee maneuver, traction is first applied either manually or with fingertraps. B: A volar translation force (F) is applied to the distal fragment of the radius. C: The lunate translates on the distal radius, causing the distal fragment to tilt in a volar direction.

From: **42 Fractures of the Distal Radius and Ulna**

Rockwood and Green's Fractures in Adults, 9e, 2019

Splinting Supplies

Have supplies ready prior to performing reduction:

- Splint type
- Stockinette
- Padding
- Plaster (premeasured)
- Room temperature water (risk of burn with hot water)
- Ace wrap
- Tape

Splinting Principles: Supplies

- Extremity support/traction
  - Assistants
  - Assistive device

Quigley's Traction

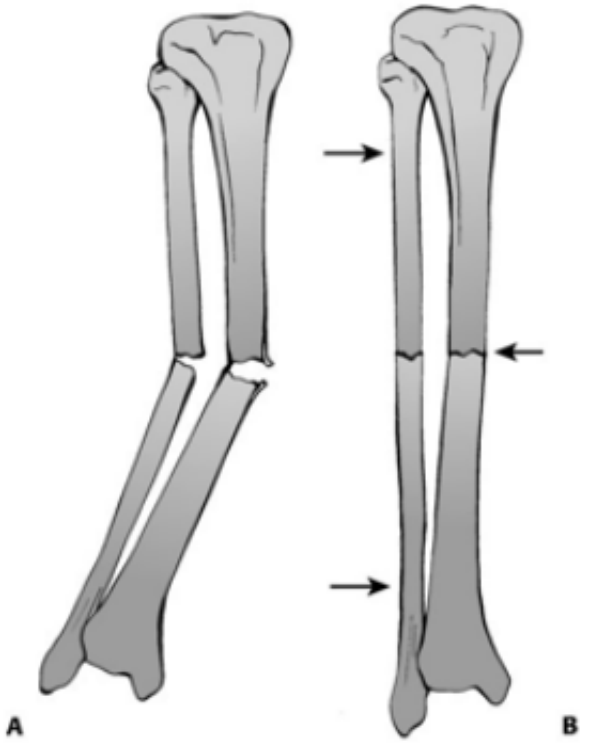
Finger Traps and weight

Splinting Principles

- Non-circumferencial
  - Allows for changes in swelling and soft tissue evaluation
- Plaster vs prefabricated fiberglass
  - Plaster more versatile
  - Plaster better for customized mold
- Padding
  - 3-4 layers thick
  - Too thin – risk of burn
  - Too thick – harder to hold reduction
- Cold water to optimize time for placing molds & prevent burns
  - Plaster will set faster with warm water after gaining experience and comfort with supplies

Splinting Principles

- 3-point mold
  - To resist deforming forces
  - Maintain reduction
- "**Straight Casts** lead to **Crooked Bones**"
- "**Crooked Casts** lead to **Straight Bones**"



Legend:

A: An OTA A3.3 fracture with valgus angulation. B: Three-point fixation, or pressure, will reduce fracture if a soft tissue hinge is present.

From: **9 Principles of Nonoperative Management of Fractures**

Rockwood and Green's Fractures in Adults, 9e, 2019

Why Does This Matter? → Complications

- Thermal injury
- Compartment syndrome
- Loss of reduction
- Pressure Necrosis/Skin Sores
  - Place molds with broad hand surfaces
  - Avoid pressure points from molding with fingers
  - Extra padding over bony prominences
- Cuts and burns from removal
- Joint stiffness
- DVT/PE
- Skin wounds from sharp edges of cast/splint

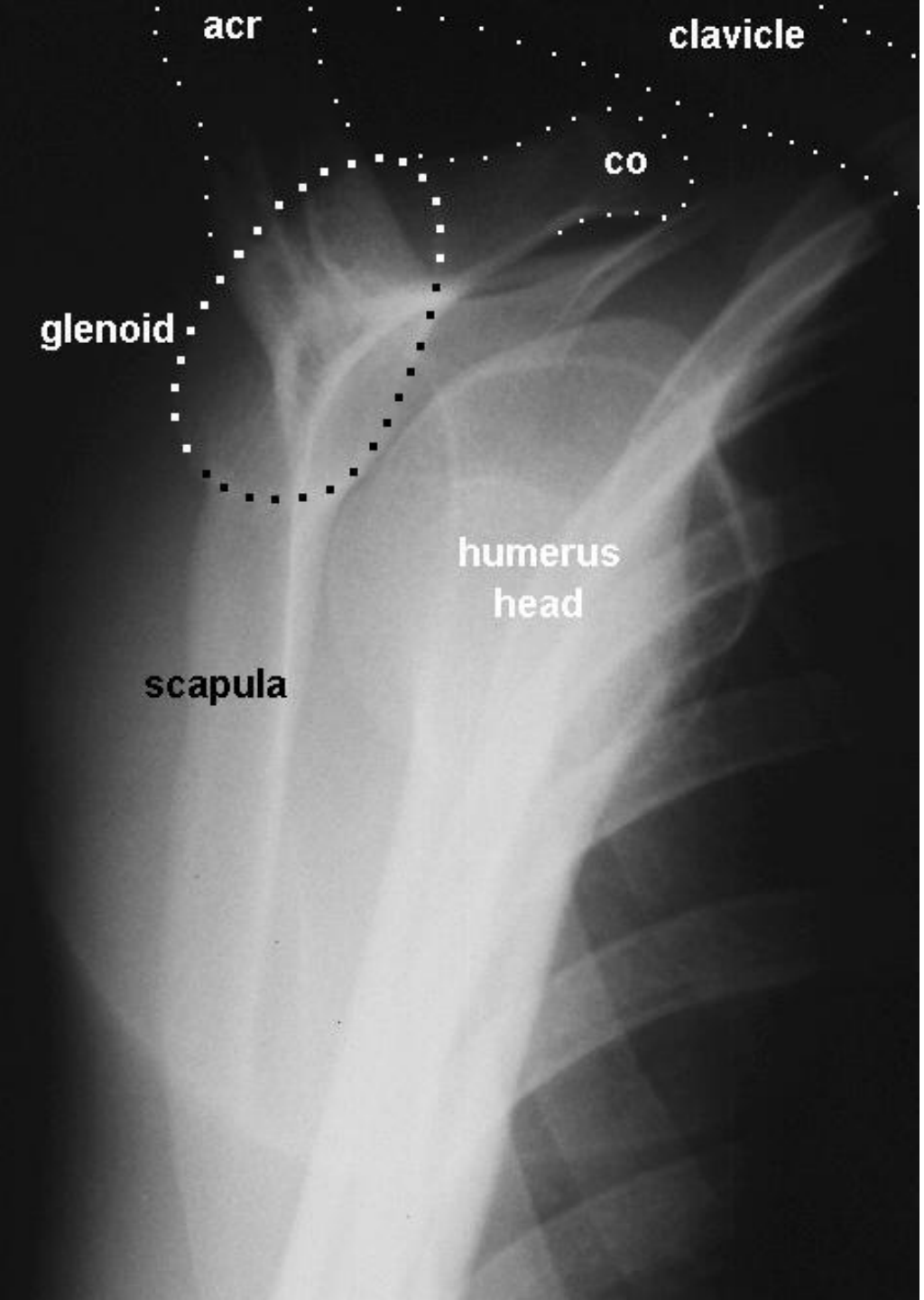
From: **3 Cast and Splint Immobilization**

Rockwood and Wilkins' Fractures in Children, 9e, 2019

10 Common Closed Reductions

Diagnosis?

Shoulder (Glenohumeral) Dislocation



- Most common
  - Anterior – 95-97%
  - Posterior – 2-4%
  - Subclav/Intrathoracic – 1%
- Arm held in classic position
- Pre-reduction neurovascular exam & x-rays
- Procedural sedation vs Intra-articular anesthesia

Reduction (ant disloc)

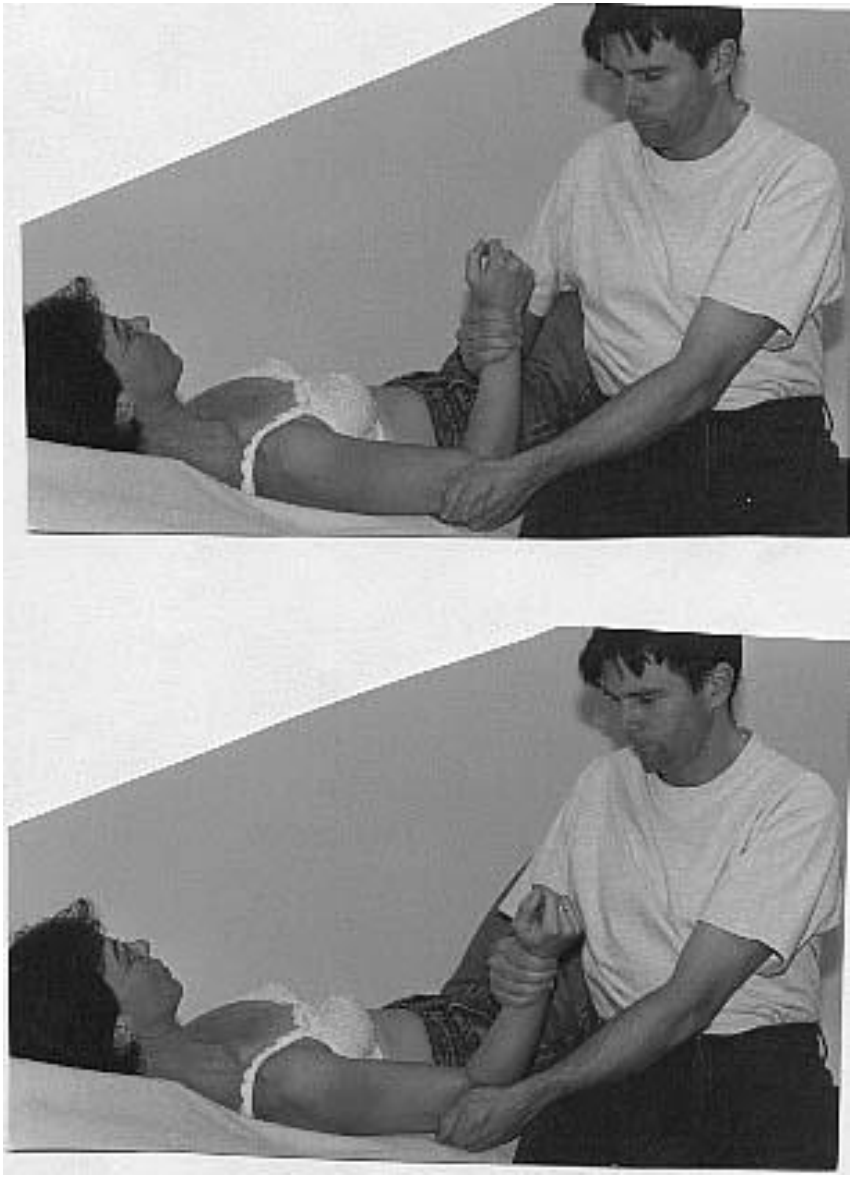
- Stimson (hanging weight technique)
- Scapular Manipulation
- Leidelmeyer (external rotation)
- Milch
- Traction-Countertraction

Reduction (post disloc)

- Traction on internally rotated and adducted arm with pressure on humeral head

- Stimson
  - Prone position
  - Arm hanging
  - Traction in forward flexion using 5, 10 or 15 pound weight
  - May take 15-30 minutes
  - Use with scapular manipulation

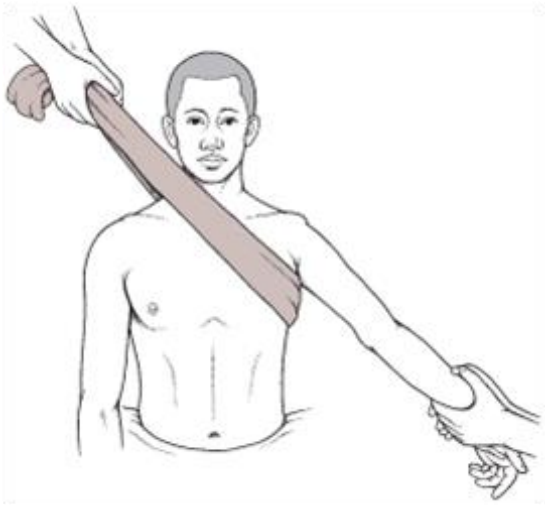
- Scapular Manipulation
  - Stimson technique
  - Scapular tip medially
  - Slight dorsal displacement of scapular tip
  - Reduction may be subtle



- Leidelmeyer
  - Supine
  - Arm adducted
  - Elbow flexed 90°
  - Gentle external rotation

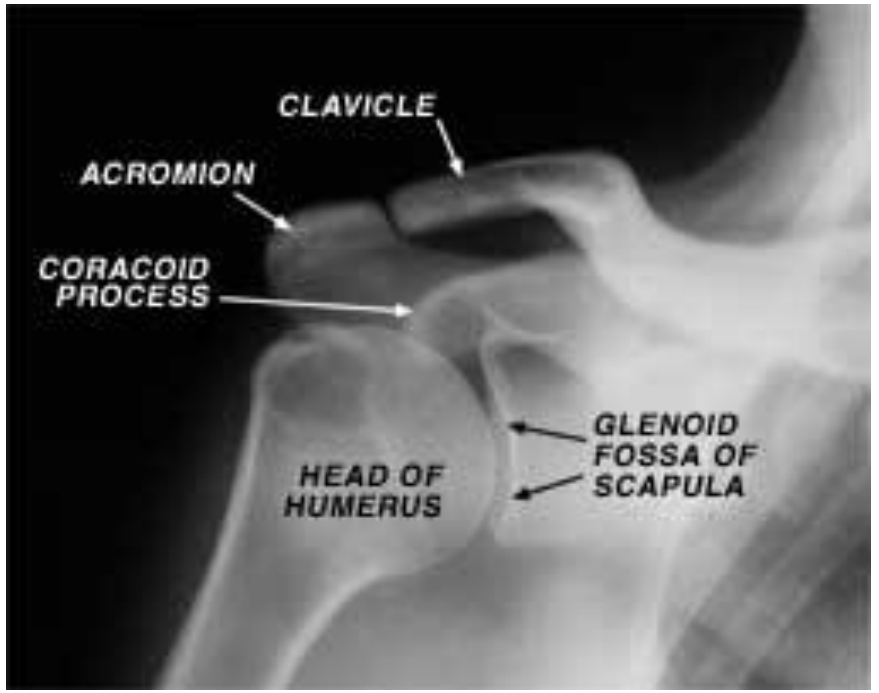
- Milch
  - Forward flexion or abduction until arm is directly overhead
  - Longitudinal traction
  - Slight external rotation
  - Manipulate humeral head upward into glenoid fossa

- Traction-Countertraction
  - Supine
  - Bed sheets tied
  - Slight abduction of arm
  - Continuous traction
  - Gentle external rotation
  - Gentle lateral force to humerus
  - Change degree of abduction

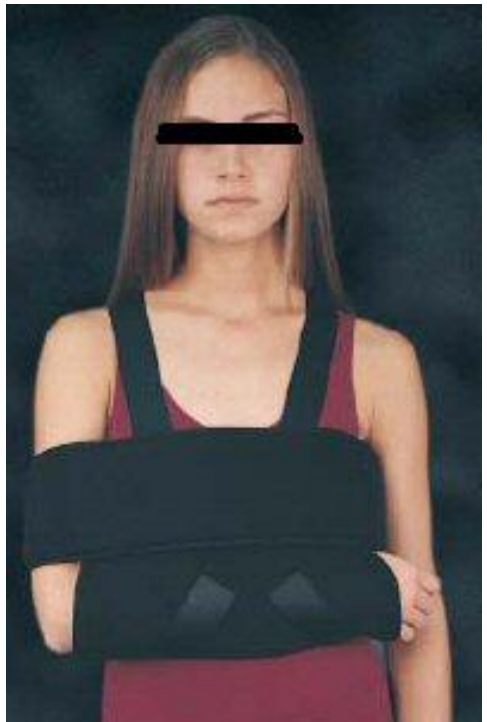


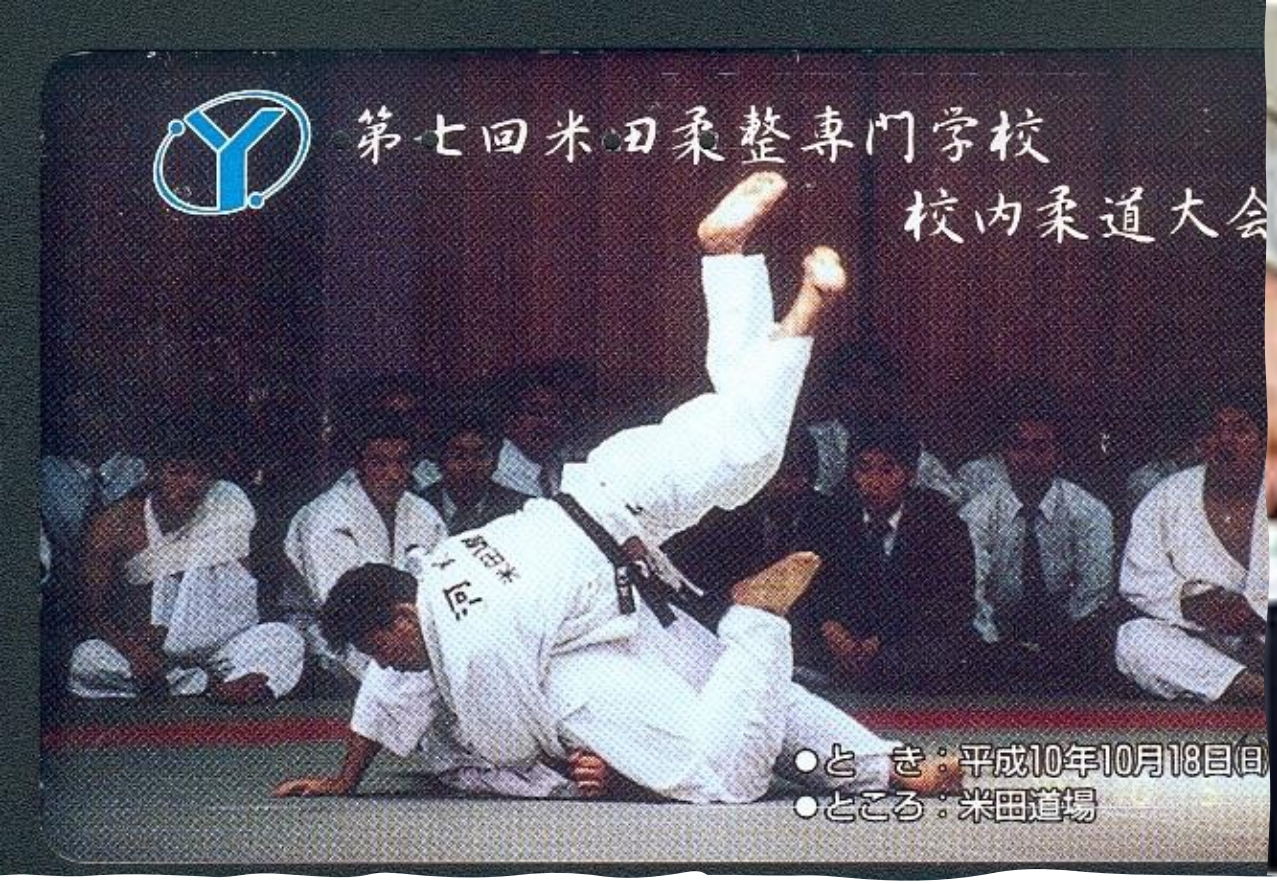
- Post-reduction neurovascular exam
  - Axillary nerve
  - Radial pulse

- Post-reduction x-rays
  - Reduction
  - Fractures



- Disposition
  - Sling and swathe
    - Younger ~2-3 weeks
    - Elderly ~1 week
  - Analgesia
  - Ortho follow-up
    - Younger 1-2 weeks
    - Eldery 5-7 days





Diagnosis?

Elbow Dislocation

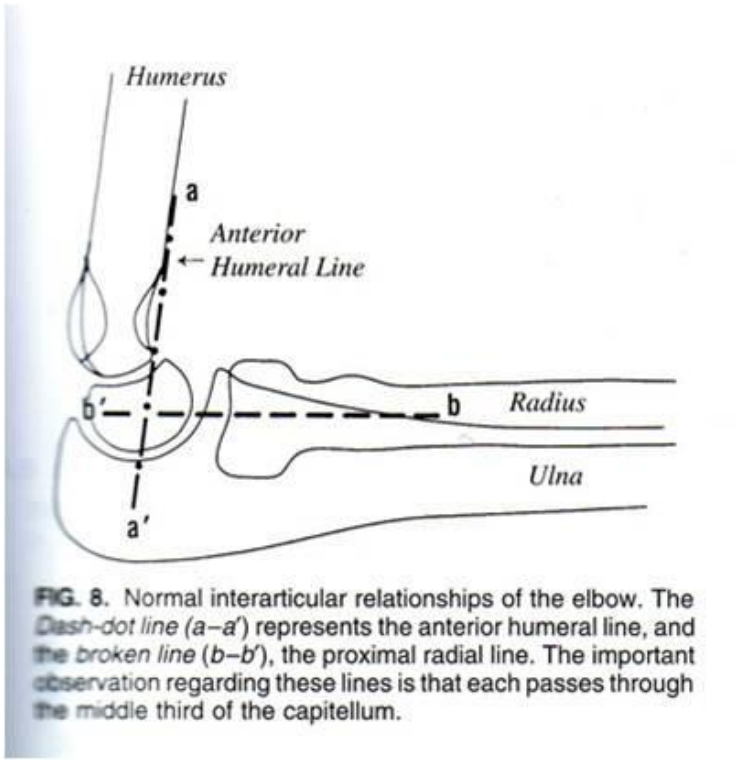


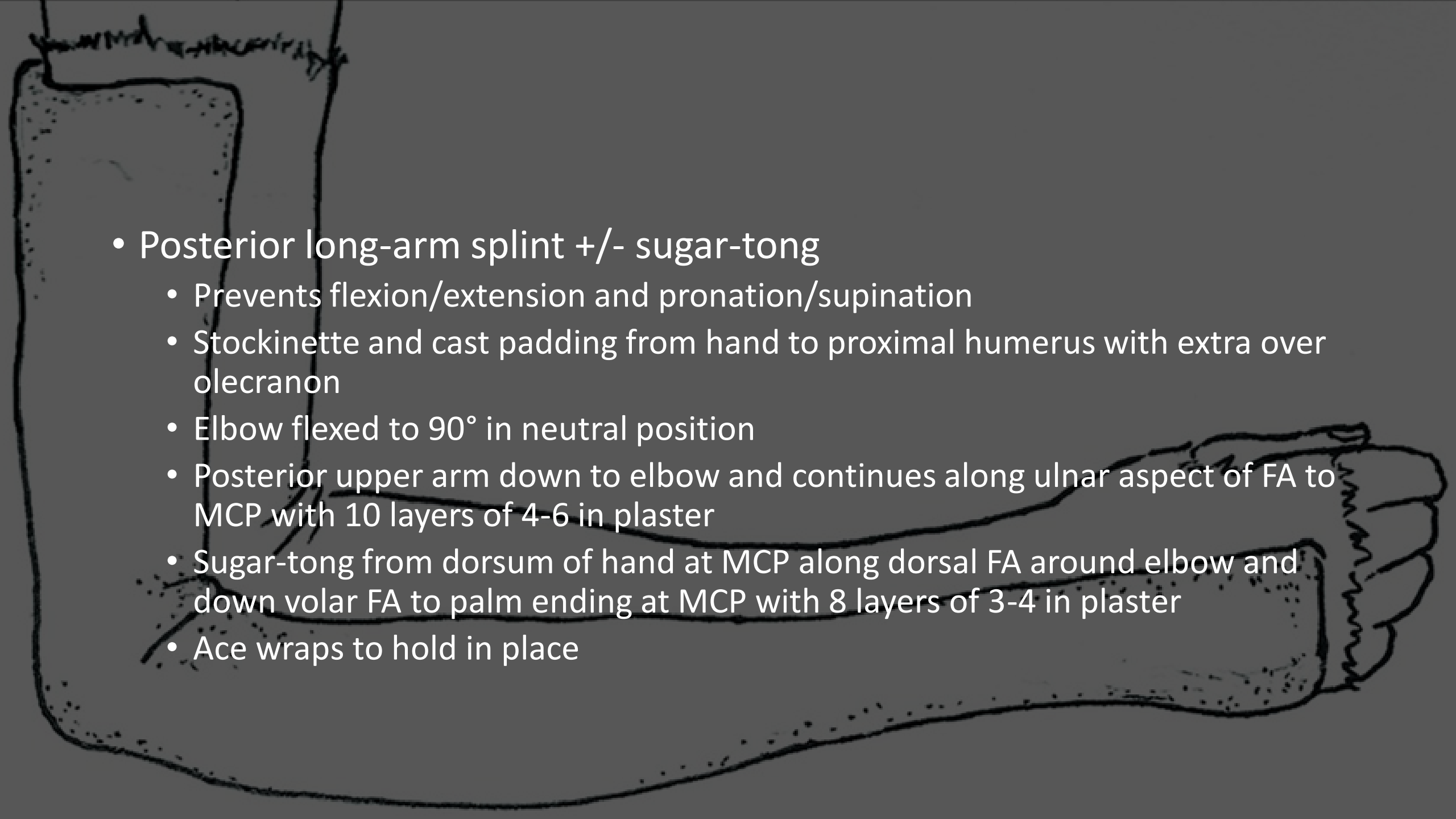
FIG. 8. Normal interarticular relationships of the elbow. The dash-dot line (*a*–*a*′) represents the anterior humeral line, and the broken line (*b*–*b*′), the proximal radial line. The important observation regarding these lines is that each passes through the middle third of the capitellum.

- 2nd most common overall
  - Posterior
  - Anterior
  - Medial/Lateral
- Pre/post-reduction neurovascular exam and x-rays
- Conscious sedation
- Local anesthesia
- Immediate reduction for vascular compromise
- 90° long-arm posterior splint
- Consult ortho if significant swelling, bruising, vascular/neuro deficit

- Posterior Dislocation
  - Shortened forearm, flexed ~45°, prominent olecranon
  - Traditional reduction
    - Supine with humerus stabilized
    - Medial/lateral displacement of olecranon corrected first
    - Steady in-line traction at wrist
    - Supination
    - Flex elbow
    - Direct pressure over olecranon
    - Splint in position of maximum stability

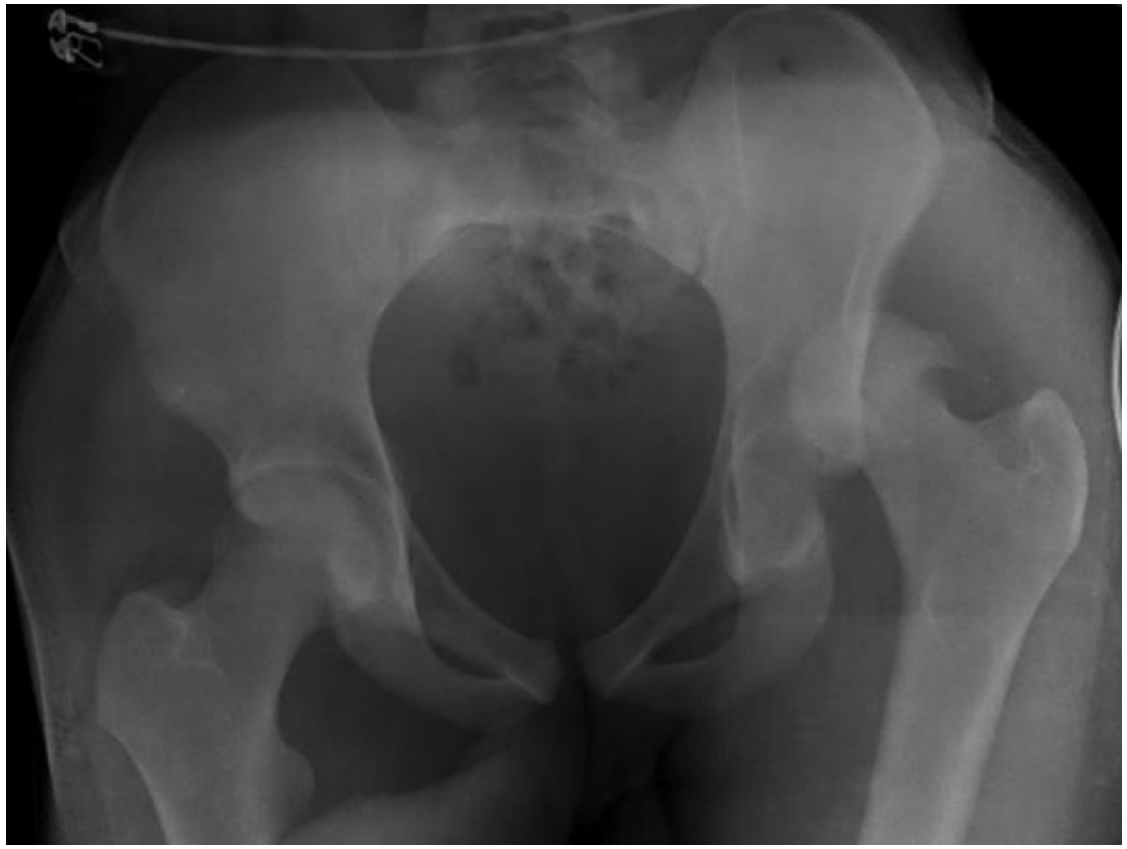
- Prone reduction method
  - Arm hanging over edge of bed
  - Apply pressure to olecranon
  - Downward traction at wrist

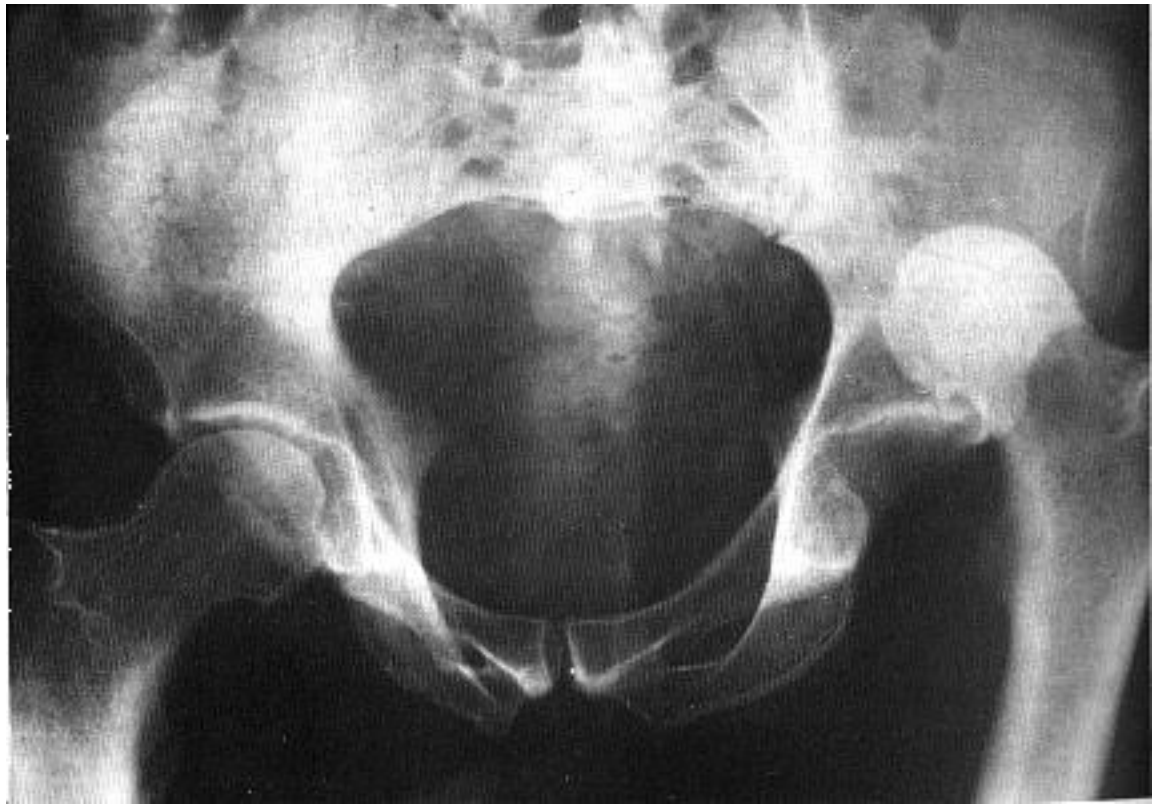
- Anterior dislocation (very rare)
  - FA extended, ant tenting prox FA, prominence dist humerus post
  - Reduction – in-line traction and backward pressure of prox humerus
  - Consult ortho
- Nursemaid's elbow (Radial head subluxation)
  - Common in 1-3 yo
  - Mechanism – longitudinal traction of arm with wrist pronated
  - Child without distress and arm held slightly flexed and pronated
  - Reduction – thumb applies pressure to radial head as arm flexed and supinated in one fluid motion
  - Check for use of arm within 30 minutes
  - Splint for residual pain or re-subluxation



- Posterior long-arm splint +/- sugar-tong
  - Prevents flexion/extension and pronation/supination
  - Stockinette and cast padding from hand to proximal humerus with extra over olecranon
  - Elbow flexed to 90° in neutral position
  - Posterior upper arm down to elbow and continues along ulnar aspect of FA to MCP with 10 layers of 4-6 in plaster
  - Sugar-tong from dorsum of hand at MCP along dorsal FA around elbow and down volar FA to palm ending at MCP with 8 layers of 3-4 in plaster
  - Ace wraps to hold in place

Diagnosis?





Hip Dislocation

- True ortho emergency – must reduce within 6 hours
- AVN, traumatic arthritis, permanent sciatic nerve palsy and joint instability exponentially increase with length of time hip dislocated
- Consider multisystem injury as significant force required

- Classifications
  - Posterior – shortened, flexed, adducted, internally rotated
  - Anterior – abducted, flexed, externally rotated

- Pre/post-reduction neurovascular exam and x-rays
  - Sciatic nerve – palsy in 10%
  - Femoral vessels – primarily with anterior dislocation
  - AP/Lateral Pelvis - Up to 88% associated with fractures
- Consider CT scan to look for occult fracture
- Contraindication to reduction is femoral neck fracture
- Stimson vs Allis reduction
- Conscious Sedation
- Admit to Ortho

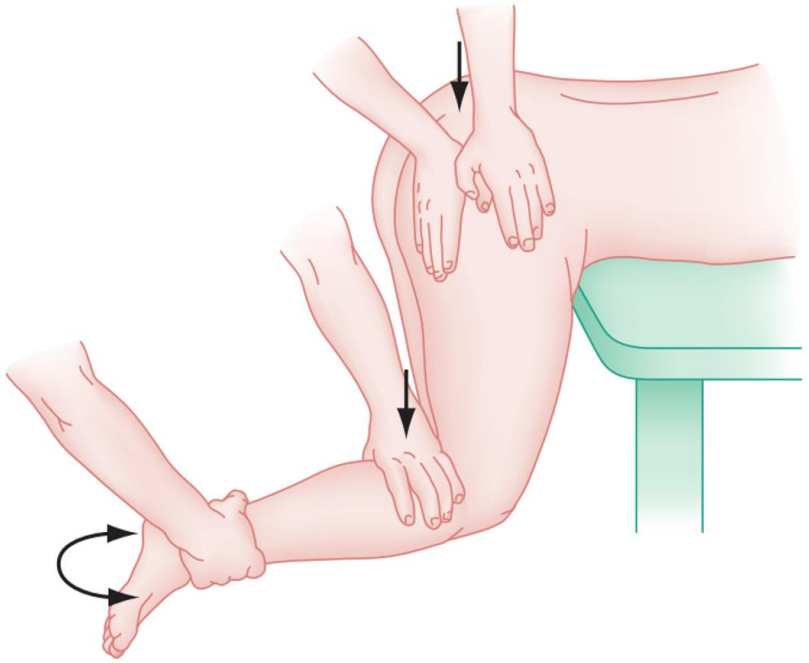
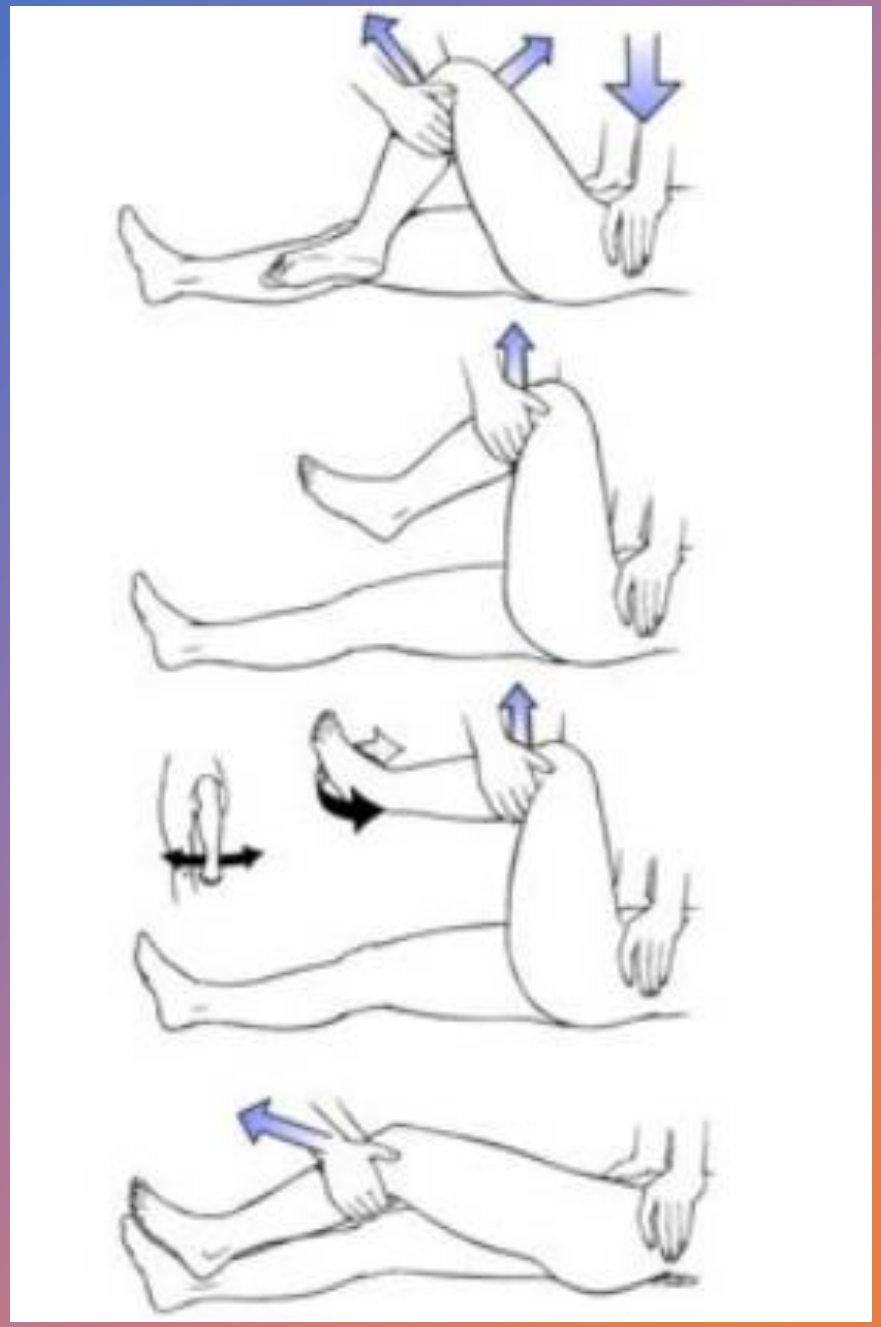


Figure 56-27. Stimson's technique for hip reduction. See text for a description of this method.

Stimson Technique - not practical for trauma patient

Procedure

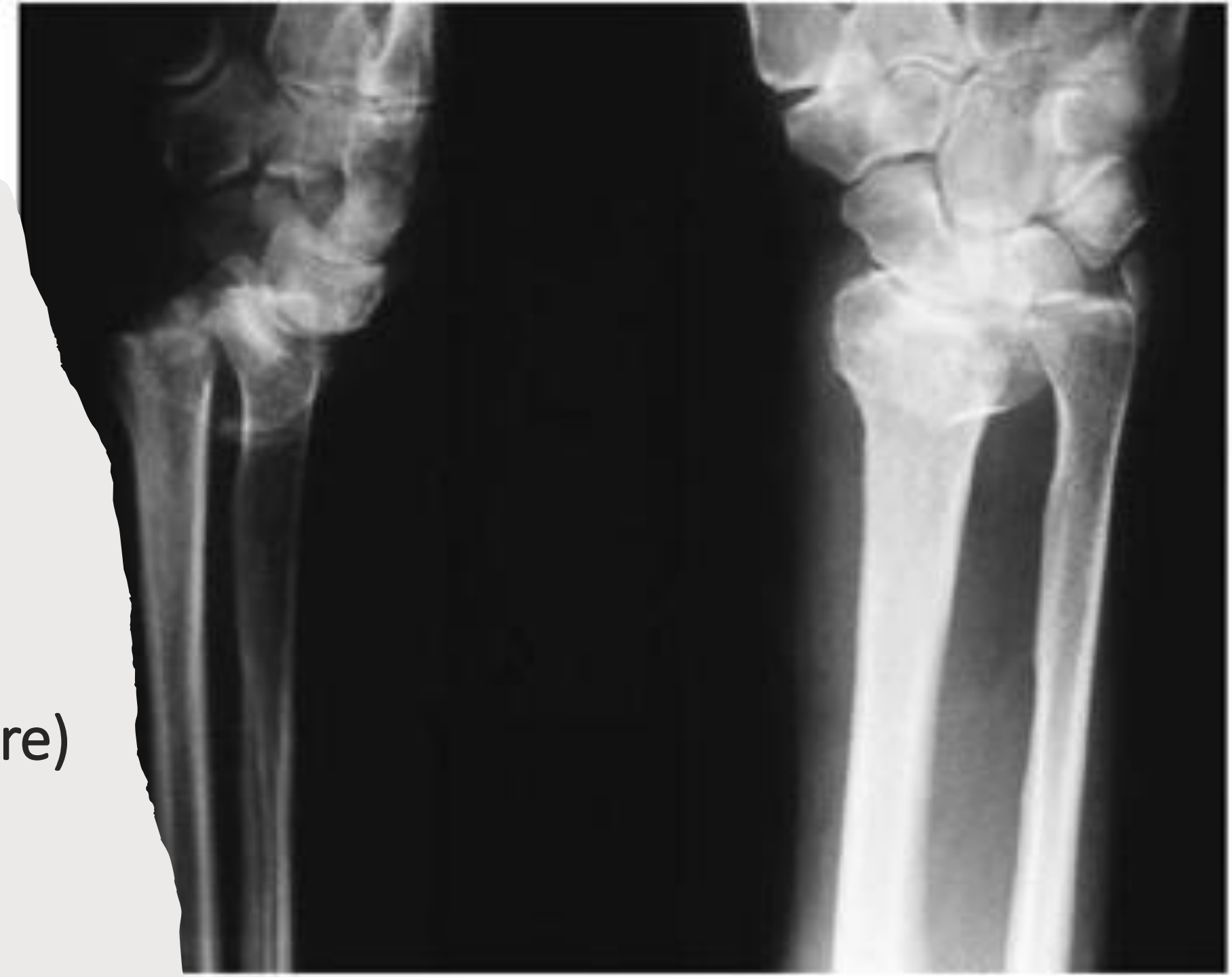
- Prone with legs off edge of bed
- Stabilize pelvis
- Hip, knee, ankle flexed 90°
- Steady downward pressure in line with femur
- Internal/external rotation of hip
- Direct downward pressure on femoral head



- Allis Technique – most common
  - Supine with knee flexed
  - Pelvis stabilized
  - In line upward traction while hip slowly flexed to 90 deg
  - Greater trochanter pushed forward toward acetabulum
  - Internal/external rotation at hip
  - Once reduced, hip extended while maintaining traction

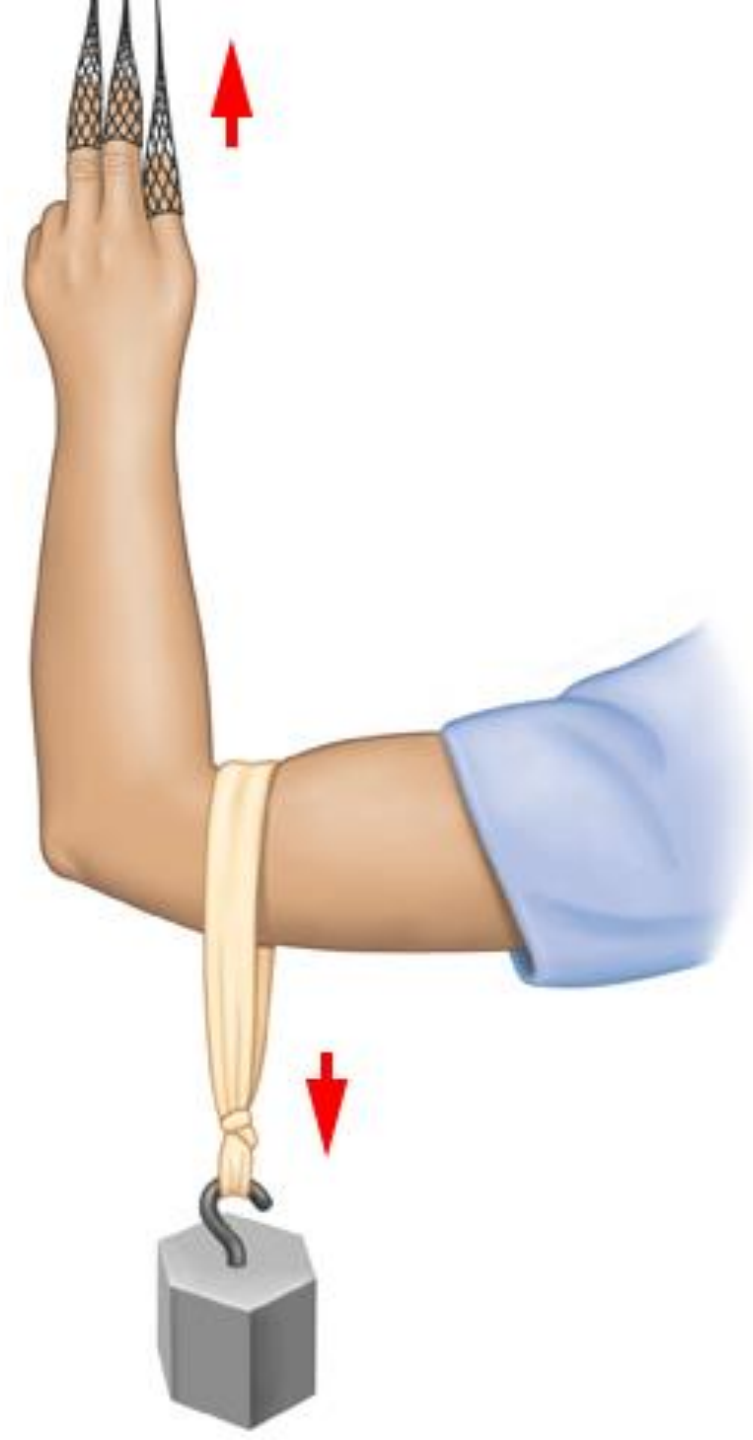
Diagnosis?

Distal Radius (Colles' Fracture)

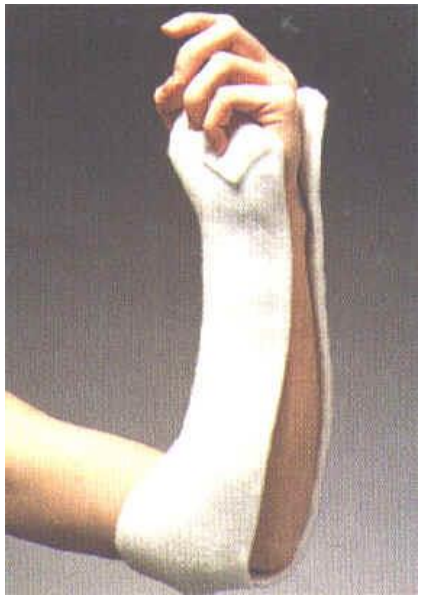


- Transverse fracture of distal radial metaphysis with dorsal displacement and angulation often 2° FOOSH
- Pre/post-reduction neurovascular exam and x-rays
- Hematoma vs Bier block vs Conscious sedation
- Reduction
- Splint
- Ortho follow-up

- Traction-countertraction
  - With/without finger traps
  - Finger traps
    - Attach thumb, index, middle
    - Hang 5-10 lb weight with elbow flex 90°
    - 5-10 min prior to reduction
- Active reduction
  - Fingers in finger trap
  - Thumbs on dorsum of distal fragment
  - Fingers on palmar forearm
  - Over-exaggerate the deformity
  - Distal fragment pushed distally, palmarly and ulnarly



- Splinting – sugar tong splint
  - Plaster preferred over fiberglass
- 15° palmar flexion
- 15° ulnar deviation
- Slight pronation



From: **9 Principles of Nonoperative Management of Fractures**

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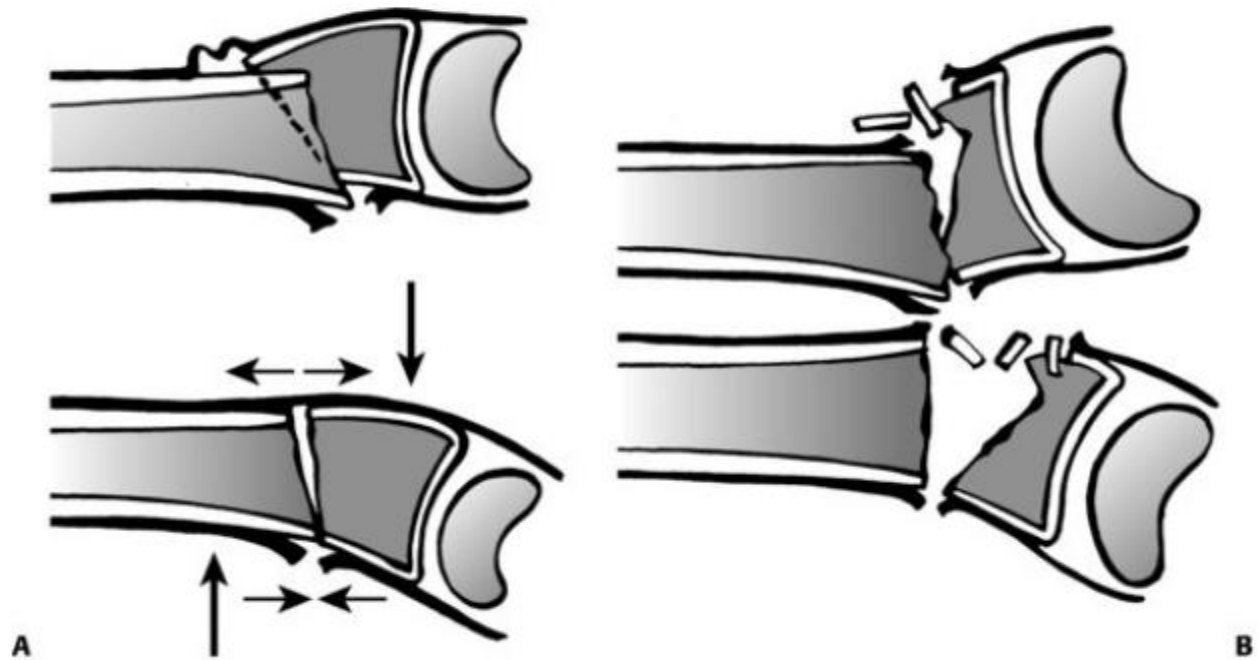
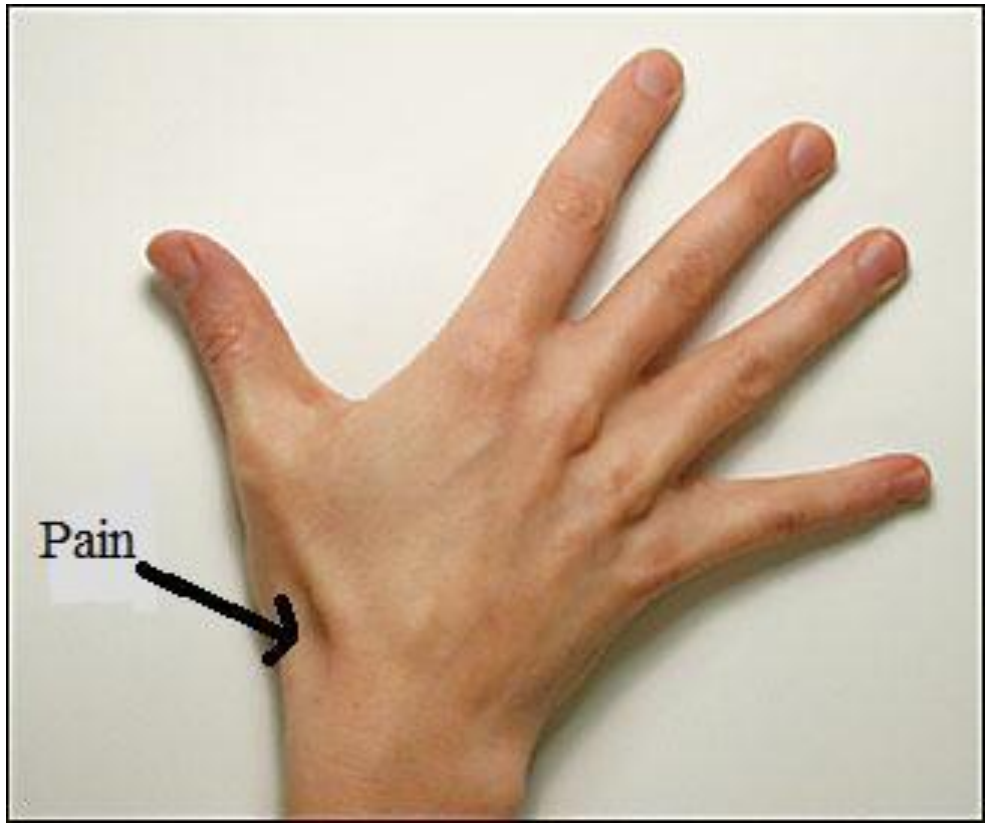


Legend:

A: The use of an intact soft tissue hinge and three-point fixation in a distal radial fracture in a young patient. B: The same situation in an older patient with poor soft tissues and bone comminution.

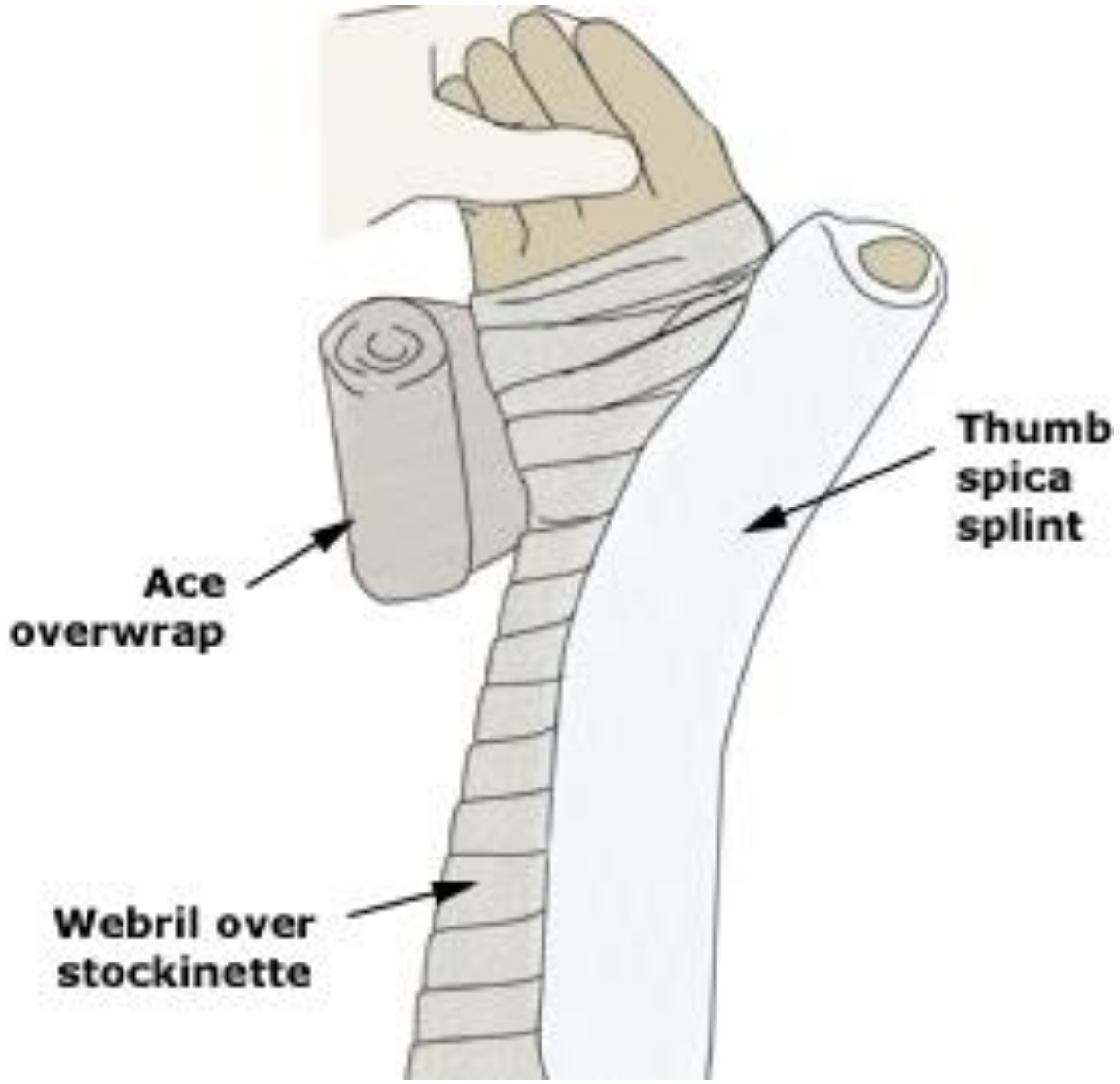


Diagnosis?


Scaphoid Fracture

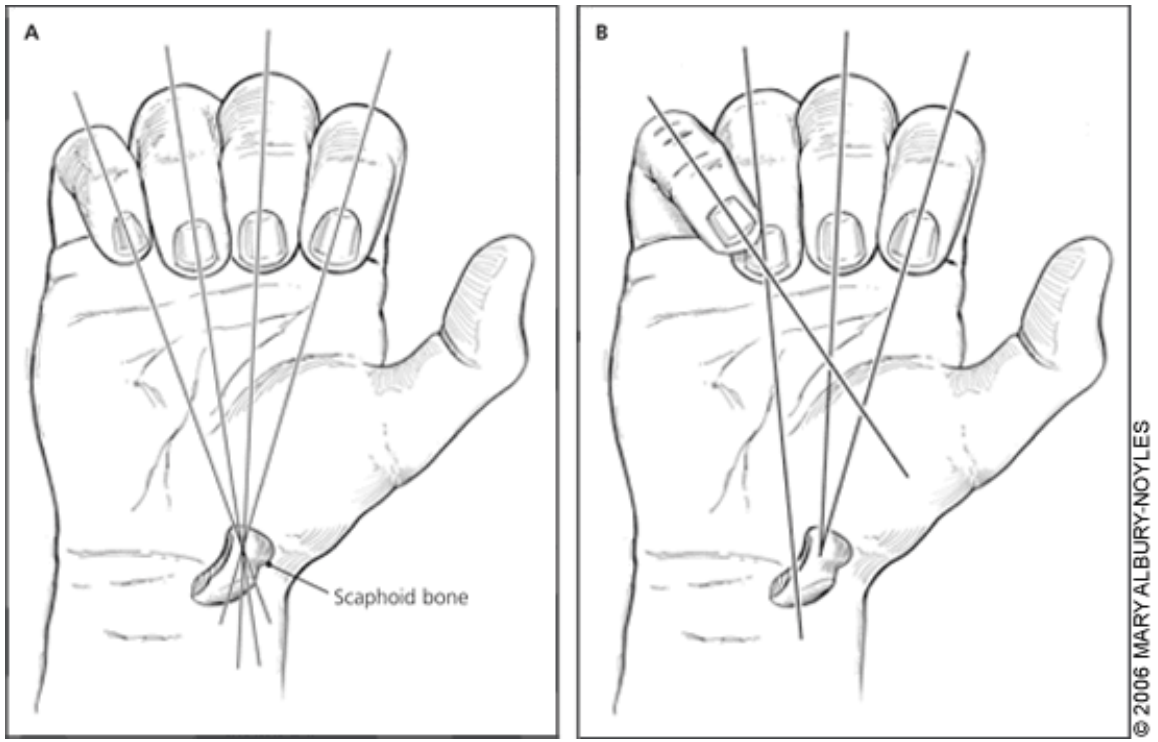
- Most common carpal bone fracture
- FOOSH
- High risk of nonunion and avascular necrosis
- Snuff-box pain/TTP → x-rays and always splint
- Ortho follow-up for repeat x-rays within 1-2 weeks

- Thumb spica splint
  - Forearm neutral
  - Wrist extended 25°
  - 8 layers of 3 inch plaster measured from mid-forearm to just beyond thumb
  - Mark location of MCP
  - Transverse cuts ~1cm distal to mark
  - Wrap flaps around thumb



Diagnosis?

Boxer's Fracture



- 5th metacarpal neck fracture with apex usually dorsal
- 40° dorsal angulation without adverse functional outcome
- Reduce and refer to ortho or hand surgery for rotational deformity

- Hematoma block vs Ulnar block
- Reduction – attempt with any angulation
  - Dorsal pressure to volarly displaced head and volar pressure to proximal fragment
  - Proximal phalanx or PIP can be used for distal traction and as a lever for dorsal pressure
- Ulnar gutter splint
- Ortho or hand surgery follow-up

- Ulnar Gutter Splint
  - 8 layers of 3 inch plaster
  - Incorporates little and ring finger
  - Mid-forearm distally past DIP of little finger
  - Wrist extended 20°
  - MCP flexed 90°
  - PIP/DIP flexed 10°

Diagnosis?

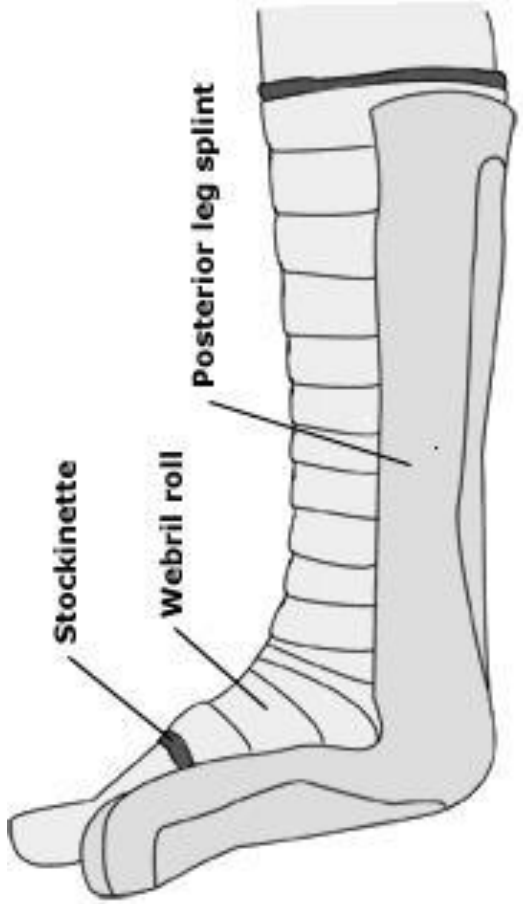
Ankle Fracture Dislocation

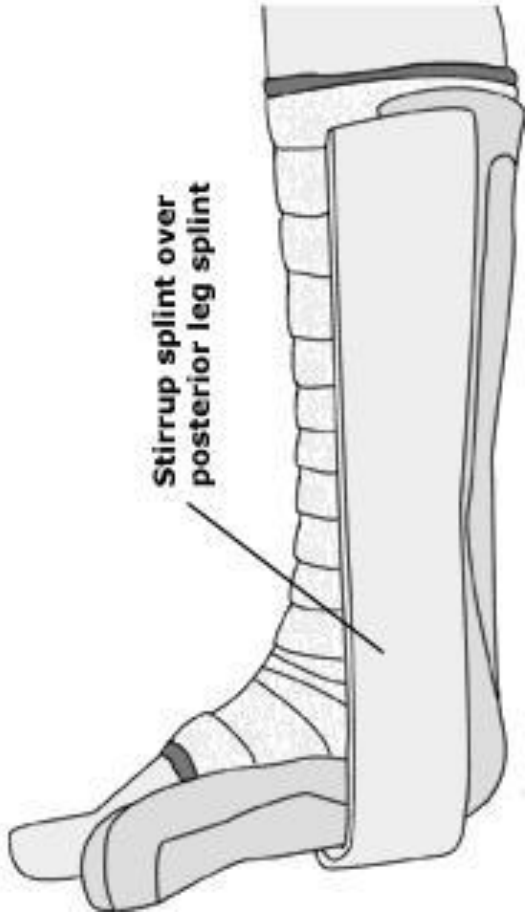
- Described by relationship of talus to tibia
- Usually associated with fracture
- Pre/post-reduction neurovascular exam and x-rays
- Adequate analgesia vs conscious sedation
- Reduction (even if open)
- Splint
- Ortho for washout if open

- Reduction
  - Supine
  - Knee flexed
  - Traction-Countertraction

- Posterior Ankle Splint
  - Applied first
  - 10-20 layers of 4-6 inch plaster
  - Prone with knee flexed 90° and ankle at 90°
  - Extend from plantar aspect of great toe to fibular head

- Stirrup (U-Splint)
  - 10 layers of 4-6 inch plaster
  - Prone with knee flexed 90° and ankle at 90°
  - Plaster across plantar surface extending up lateral and medial aspect of lower leg
  - Molded to medial and lateral malleoli



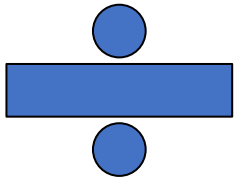


Diagnosis?

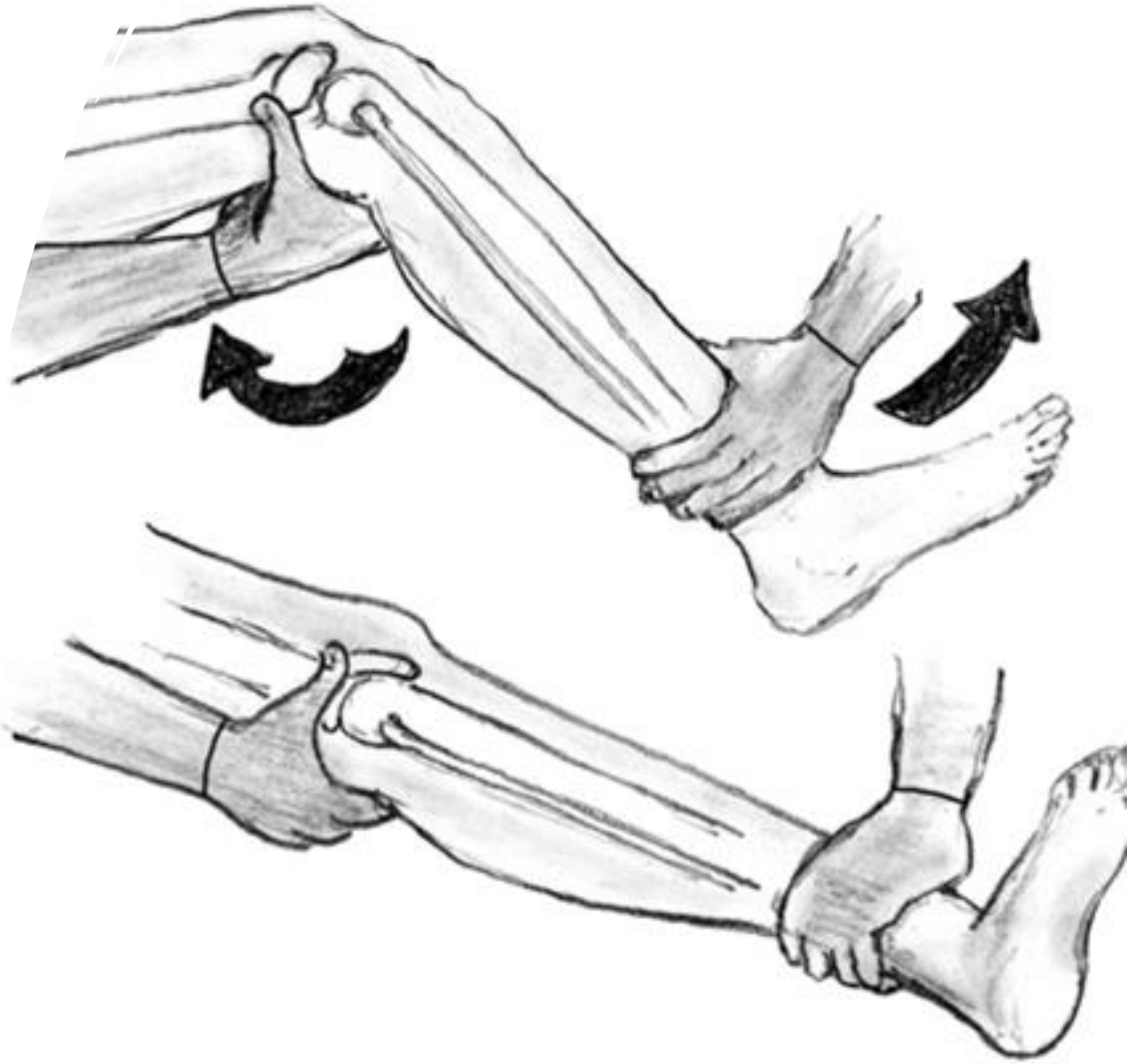
Knee Dislocation

- Gross deformity or hemarthrosis
- Vascular exam
  - Posterior ecchymosis
  - Expanding hematoma
  - Popliteal/DP/PT pulses
  - Thrill or bruit
  - ABI
  - CT Angio
- Neuro exam
- X-rays
- Light Sedation → Conscious Sedation
- Reduction
- Splint in 15° flexion
- Ortho consult for all suspected/confirmed dislocations

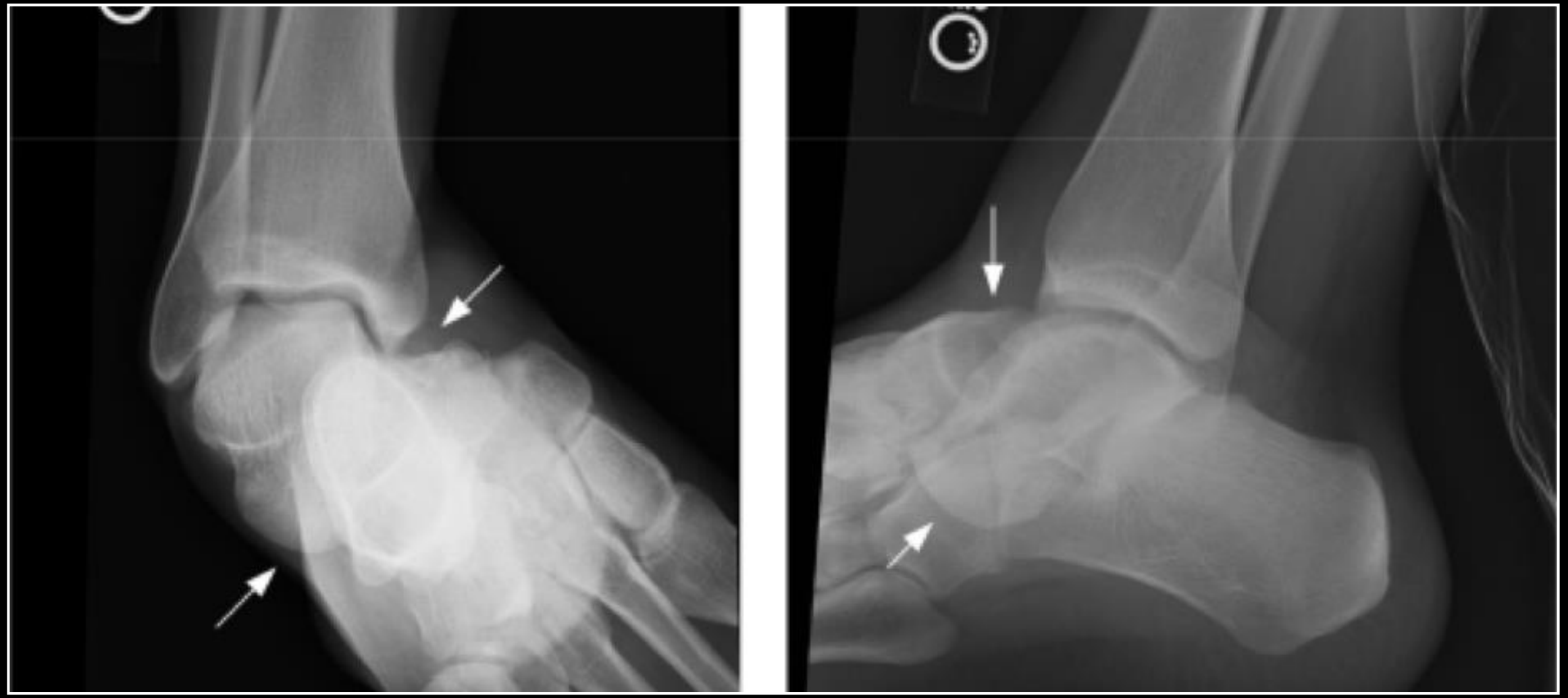
- Ankle Brachial Index
  - Ankle systolic blood pressure
  - Higher of bilateral brachial systolic blood pressures
  - Ankle systolic BP/Brachial systolic BP = ABI
  - Normal 0.9-1.3



- Traction-countertraction
  - Anterior – lift distal femur
  - Posterior – life proximal tibia
  - Medial, Lateral and Rotatory - Medial/lateral pressure as needed
  - Surgical reduction if not reducible



- **Diagnosis?**



Subtalar Dislocation

- Evaluate for soft tissue compromise
- Knee flexion to relax GSC
- Ankle plantar flexion
- Traction and manual pressure
- Well padded post-mold with stirrups and some plantar

From: **65 Fractures and Dislocations of the Talus**

Rockwood and Green's Fractures in Adults, 9e, 2019

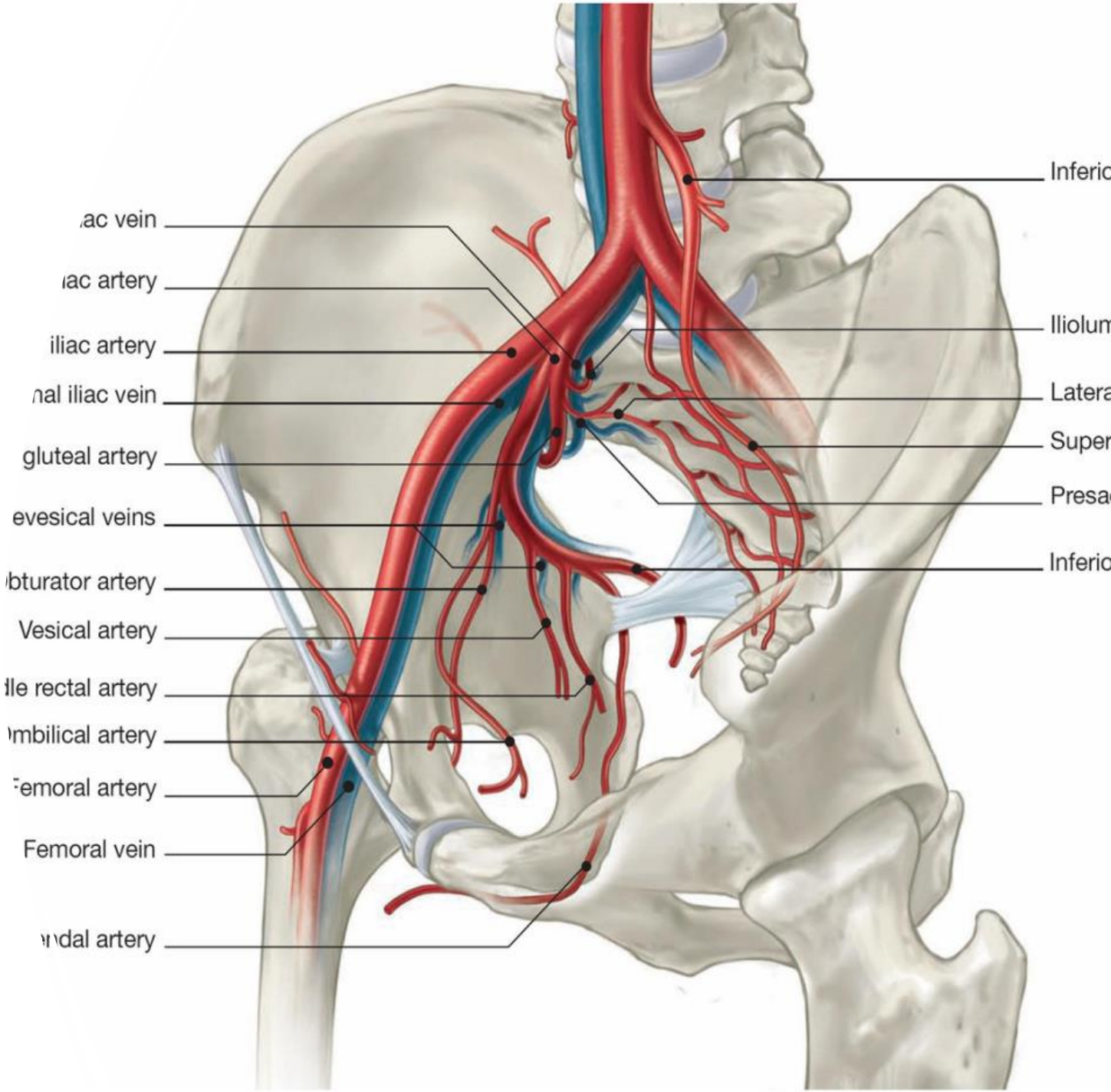
Finally…

It Wouldn’t Be an Ortho Trauma Talk Without Mentioning the Pelvis

Why Pelvic Frx is So Concerning…

- Usually takes a tremendous amount of force
- The pelvis is highly vascularized
- One of the places you can lose a lot of blood without any obvious signs
- damage to the genitourinary system

- Major Assessment and Treatment
  - make sure you “rock the pelvis” as part of your trauma assessment
  - Apply pelvic binder



Open Book Pelvic Ring

- Place bed sheet or pelvic binder at level of greater trochanters
- Internal rotation of legs
- Traction counter traction if vertical component
- Compression through greater trochanters
- Fasten binder or apply clamps to sheet
- OTA Video link: https://otaonline.org/video-library/45036/procedures-and-techniques/multimedia/18849826/circumferential-pelvic-antishock-sheeting

Take Home Points

Do a good physical exam including neurovascular exam

Get adequate imaging

Control Pain

Reduce and immobilize with pre/post reduction exams/imaging

May require local anesthetic or conscious sedation

3-point molds to maintain reduction

Consult ortho if help is needed

Follow-up on the patient

References

- **Closed Reduction, Traction, and Casting Techniques; OTA.ORG Online Resident Core Curriculum Lecture**
- **https://otaonline.org/book/2573/rockwood-and-greens-fractures-in-adults-9e**
- **Desgrange, R.**; Sawasky, J. (2019, October). *Orthopaedic Reduction Techniques for Physician Assistants: A Visual Guide to the Successful Reduction of the Most Common Orthopaedic Conditions.* Presented at the Fall Michigan Academy of Physician Assistants Conference, Traverse City, Michigan.
- **https://resources.aofoundation.org/-/jssmedia/surgery/42/42_o10_nonop_i610.ashx?w=400**

Thank You