

# Closed Reduction, Traction and Casting Techniques

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- Henry Ford Health System

# Objectives

- Closed Reduction Principles
- Splinting Principles
- Casting Principles
- Common Closed Reductions
- Skeletal Traction Principles



# 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:

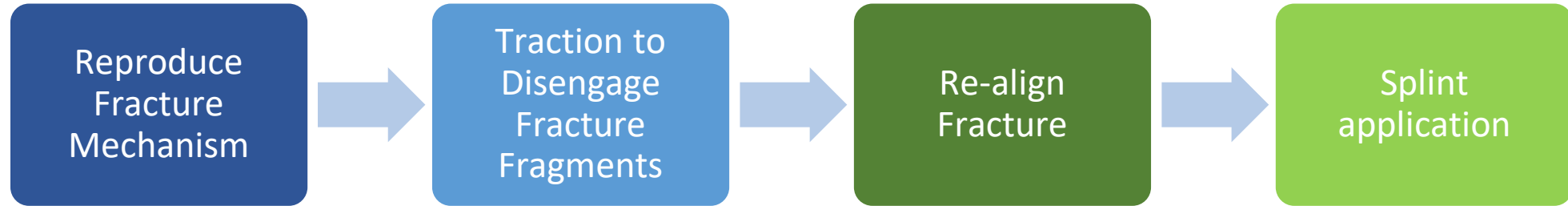
- H&P
- ABC's
- Evaluate skin, neurovascular status, and compartments
- Anesthesia type
  - local vs IV sedation
- Splint type
- Imaging
- Post Reduction neurovascular exam

# Reduction Principles: Anesthesia

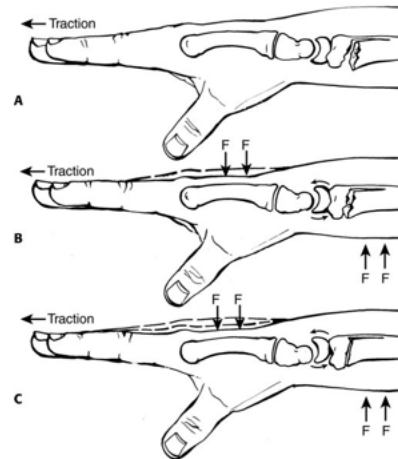


- Adequate analgesia and muscle relaxation
- Hematoma Block
- Intra-articular Block
- IV Sedation
  - Requires hemodynamic monitoring
  - Usually performed by ED, Anesthesia or Trauma team

# Closed Reduction Principles



\*\*\*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**

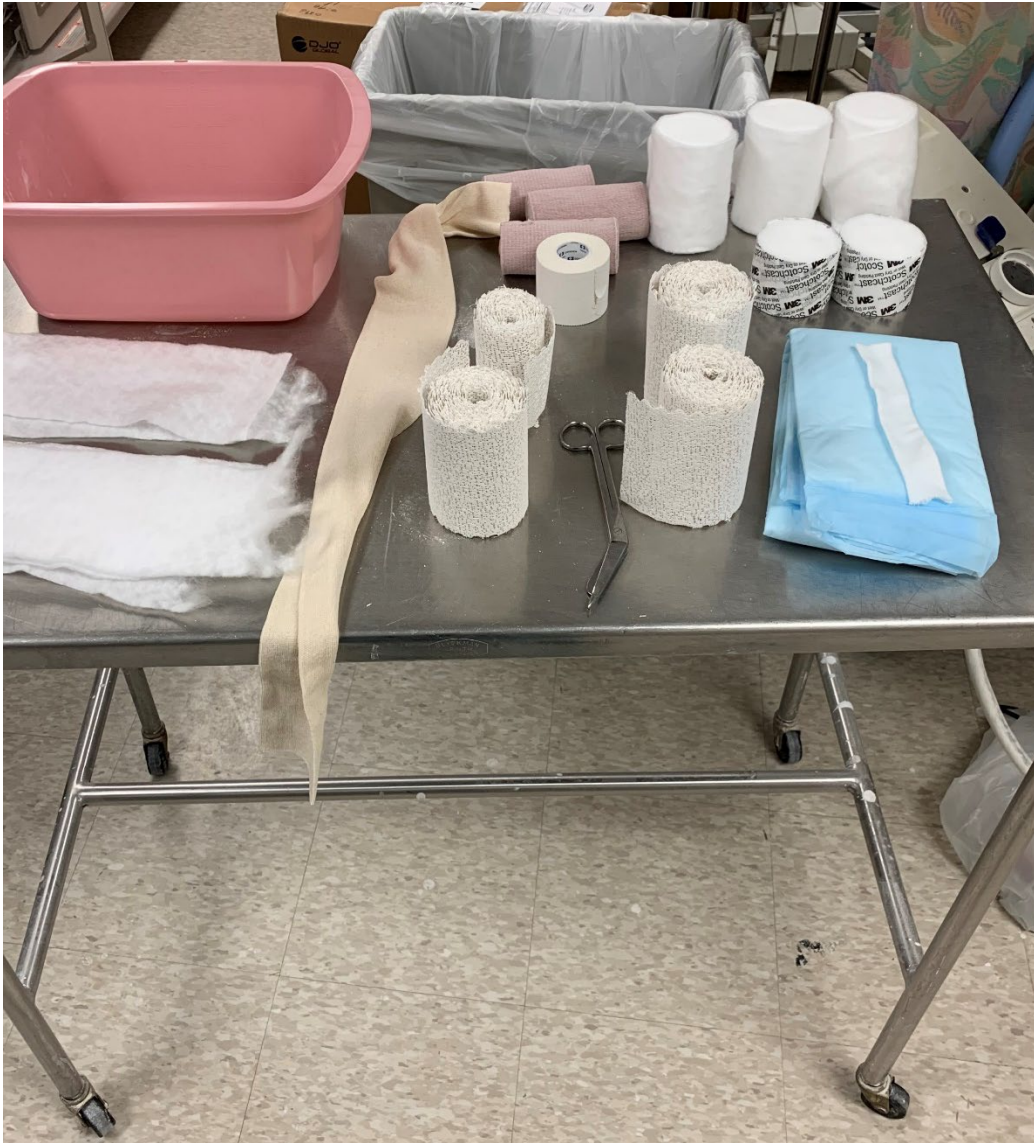
Rockwood and Green's Fractures in Adults, 9e, 2019



# 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



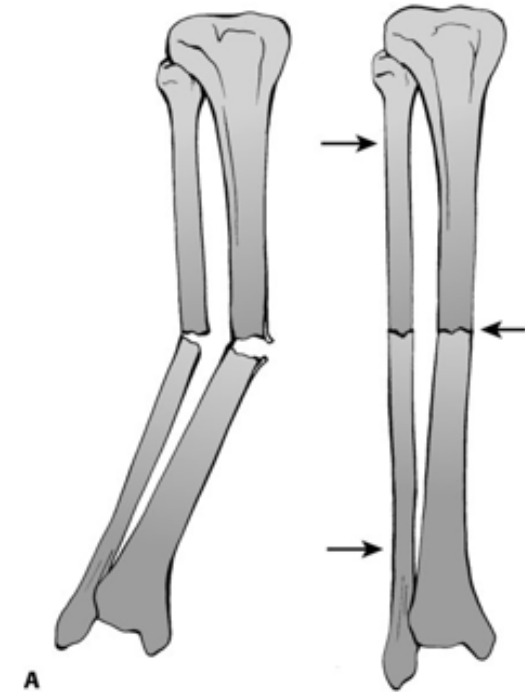
# Splinting Principles

- 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

# Splinting Principles

- Removing any of the 3 points of contact results in loss of reduction



From: **41 Diaphyseal Fractures of the Radius and Ulna**

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

# Common Upper Extremity Splints

- Coaptation
  - [OTA Video Link](#)
- Long Arm Post-Mold
- Sugar-tong
  - [OTA Video link](#)
- Ulnar Gutter
- Volar/Dorsal Forearm
- Volar/Dorsal Hand
- Resting Hand
- Thumb Spica



# Common Lower Extremity Splints

- Long Leg Posterior-Mold
  - +/- side struts
- Lateral Long leg
- Short Leg Posterior-Mold
  - +/- Stir-ups (U splint)
  - [OTA video link](#)
- Bulky Jones





# Casting Principles

- Similar principles to splinting
  - Utilized intact soft tissues
  - 3-point mold
  - Hydrostatic pressure
- “**Straight Casts** lead to **Crooked Bones**”
- “**Crooked Casts** lead to **Straight Bones**”
- Bivalve in acute setting to allow for soft tissue swelling

# Cast Disease or Fracture Disease?

- Prolonged immobilization can lead to:
  - Joint Stiffness
  - Muscle Atrophy
  - Disuse Osteopenia/Osteoporosis
  - Complex Regional Pain Syndrome
- Consider minimizing time immobilized and/or weight-bearing casts
- Same problems can be seen when fractures are treated without cast/spint

# Casting Principles

Avoid wrinkles in stockinette



Cut along concave surface and overlap for smooth contour



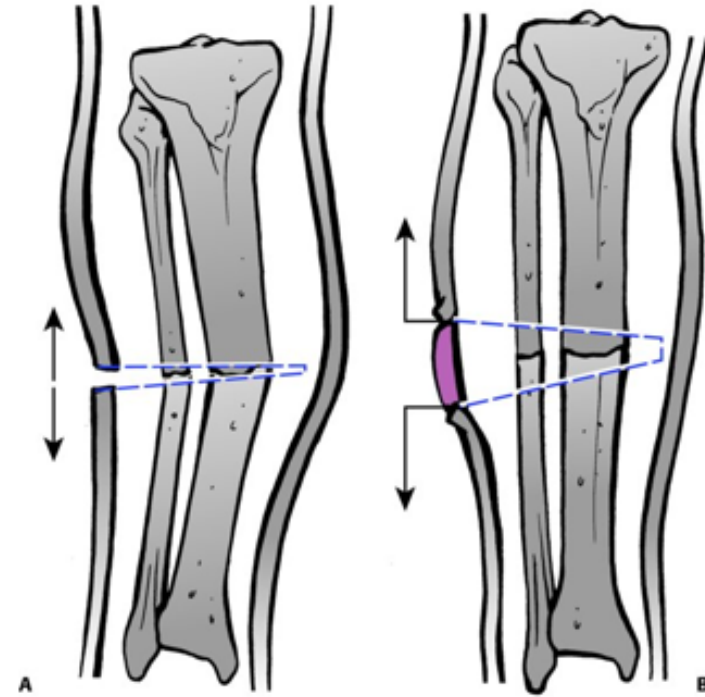
# Casting Principles

- Cast Padding
- Roll distal to proximal
- 50% overlap
- Minimum of 3 layers thickness
- Extra padding at bony prominences
- Use cold water with fiberglass roll
- [OTA Video on application of LAC](#)



# Cast Wedging

- X-ray or Fluoroscopy used to identify fracture site
- Cast cut leaving 2-3 cm hinge
- Appropriate size wedge placed
- More cast material applied



Wedging a cast to straighten a diaphyseal fracture of the tibia and fibula.

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

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



# Complications with Casts and Splints

- 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

# Shoulder Dislocation

- Multiple techniques using traction/counter traction
  - Disengage humeral head from glenoid
- Immobilize in sling



Stimson Maneuver

# Elbow Dislocation

- Medial/Lateral displacement of olecranon is corrected first
- Flex elbow to at least 30 degrees and apply traction while stabilizing humerus
- Direct pressure over olecranon may help
- Supination may also help
- Take through arc of flexion/extension/sup/pron
- Splint in position of maximum stability
  - Posterior long arm splint
  - +/- sugar tong



From: 15 Dislocations of the Elbow and Medial Epicondylar Humerus Fractures

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





# Distal Radius Fracture Closed Reduction

- Finger traps with weighted counter-traction
- Assess the deformity as reduction may be subtle
- Skin evaluation to evaluate for poke-hole open fractures
- Continue traction while you prep your supplies
- Over-exaggeration of the fracture pattern
  - Take care not to slough sensitive dorsal skin in elderly patients
- +/- fluoroscopy to confirm reduction
- Sugar tong splint application



Video is embedded in this slide. Please download the PowerPoint version for viewing here: [PPT link](#)

# Splint Placement

- Obtain post-reduction imaging
- Assess N/V status post-reduction
- Sling and educate to elevate as much as possible
- [OTA Video Link](#)

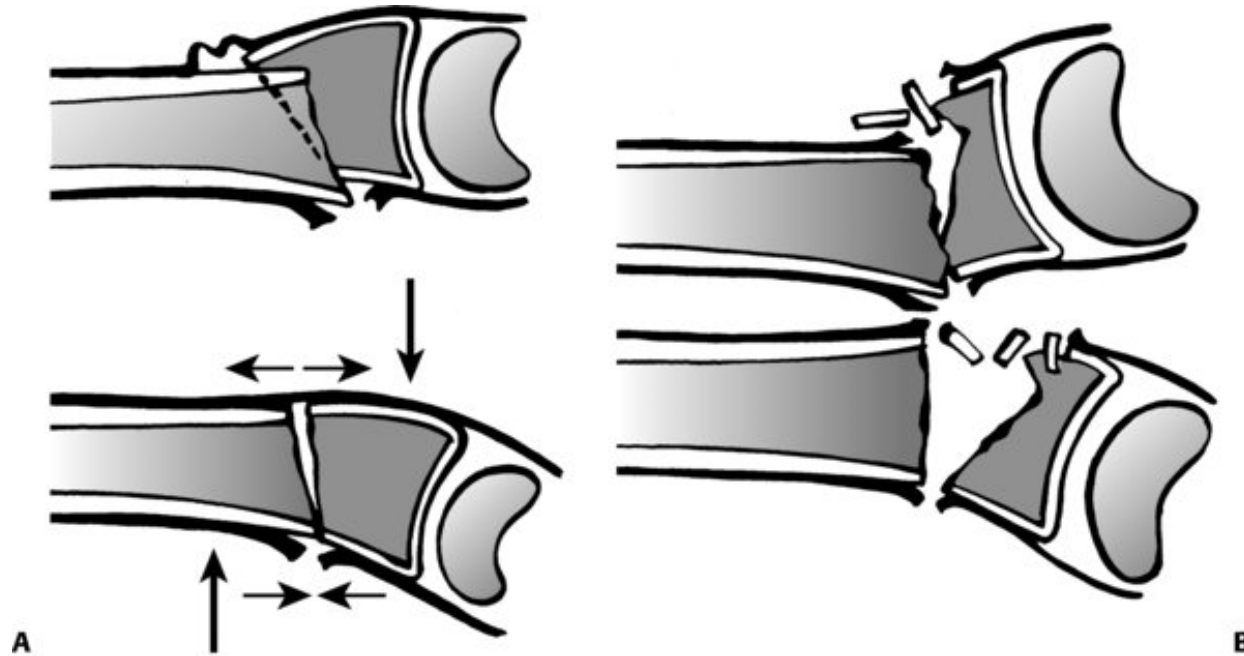


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From: **9 Principles of Nonoperative Management of Fractures**

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**Legend:**

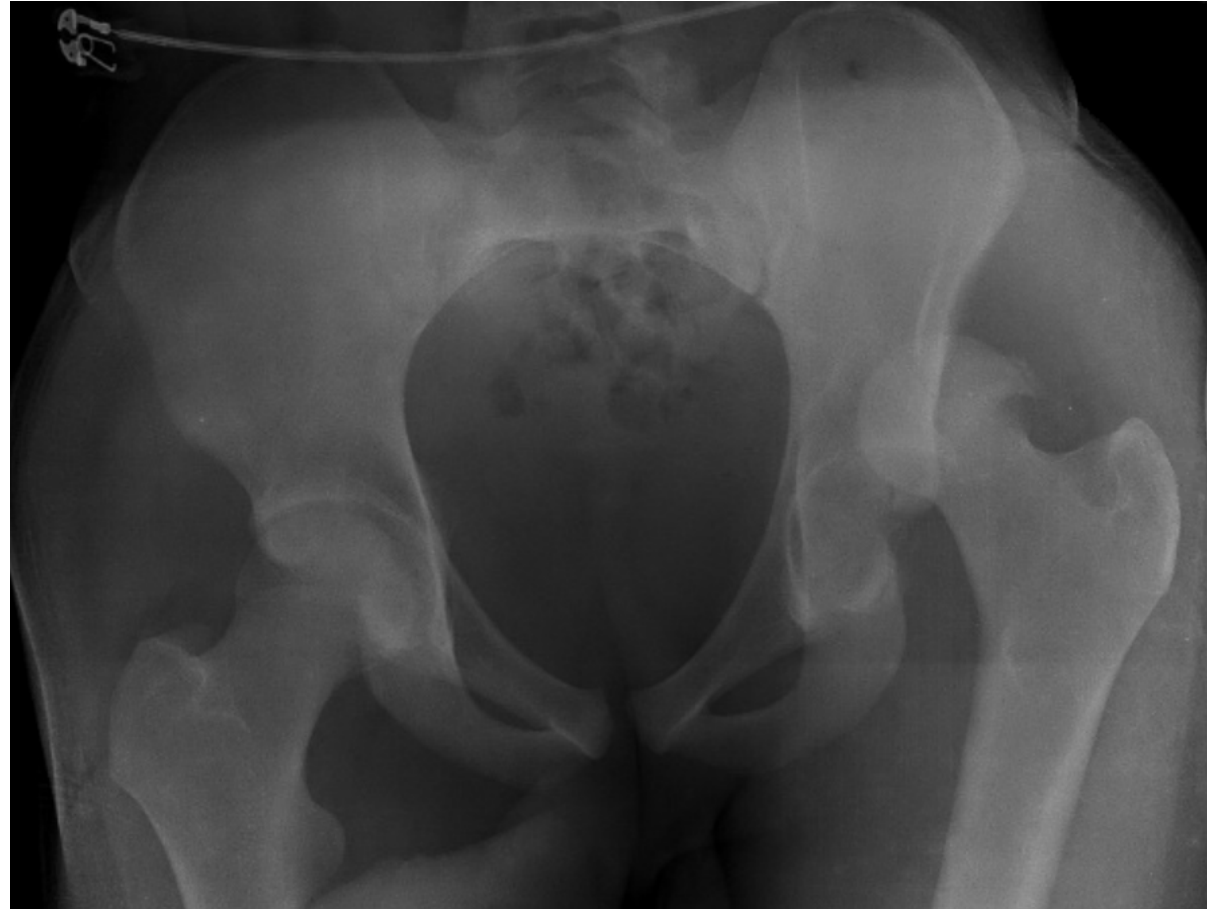
A: The use of an intact soft tissue hinge and three-point fixation in a distal radial fracture in a young patient. B: The same situation in an older patient with poor soft tissues and bone comminution.

# 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>



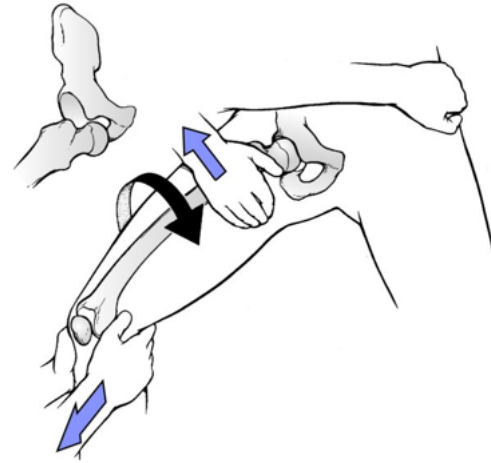
# Hip Dislocation



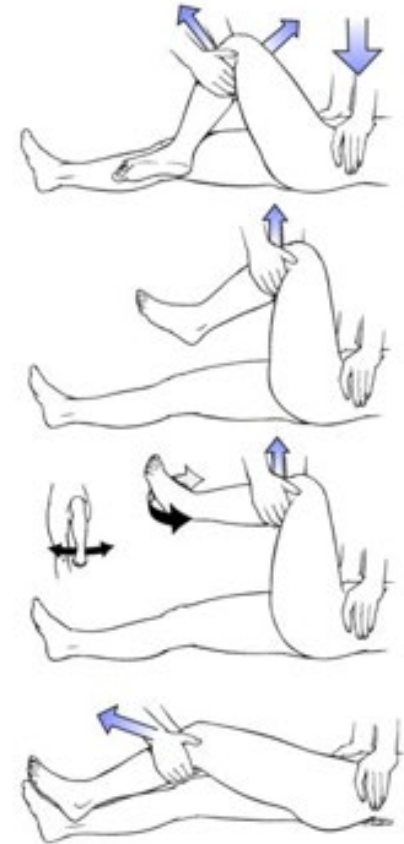
- Posterior Hip dislocation

# Hip Dislocation

- Posterior
  - IV sedation with paralytics
  - Allis Method
  - Hip and knee in flexion
  - Adduction and internal rotation
  - Traction/counter traction
- Anterior
  - Traction, Abduction, Lateralization, Internal Rotation
- Knee Immobilizer/abduction pillow



The Allis maneuver for anterior hip dislocations.



The Allis reduction technique for posterior hip dislocations.

From: **51 Hip Dislocations and Femoral Head Fractures**

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

# Knee Dislocation

- Associated injuries: popliteal artery, peroneal nerve, fractures, ligaments, cartilage, meniscus
- Reduction:
  - Traction with gentle flexion/extension and correction of medial/lateral translation
- Knee Immobilizer to immobilize joint
  - May require External fixation
- Post reduction evaluation for NV injury and compartment syndrome

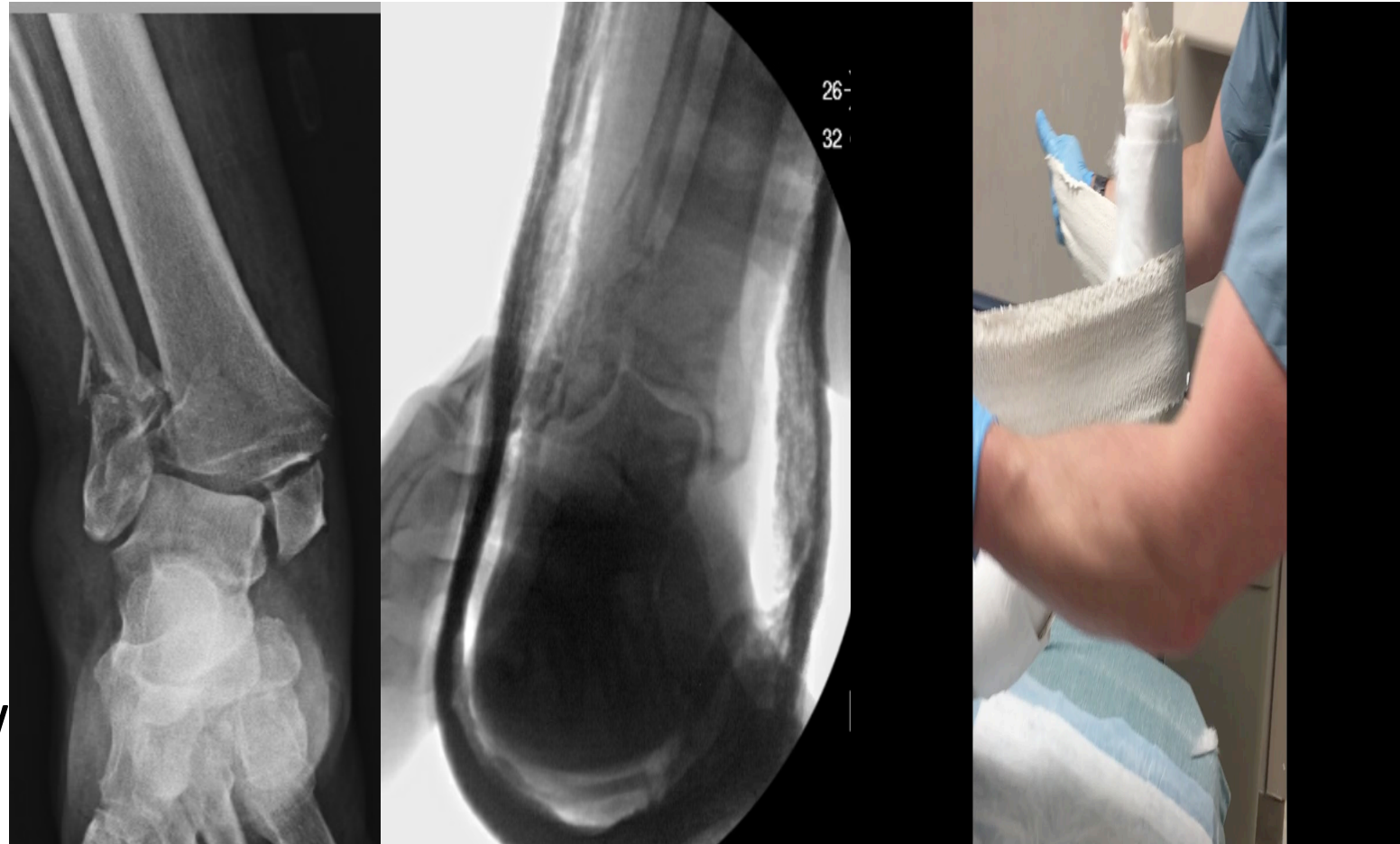






# Ankle Fracture

- Reduction technique dependent on direction of instability
- Knee flexion to relax GSC
- Posterior mold with stirrups and custom mold
- Consider splinting in plantar flexion with posterior mal fx and posterior instability
- Post reduction x-rays will show areas of splint/cast molding



Video is embedded in this slide. Please download the PowerPoint version for viewing here: [PPT link](#)

# Subtalar Dislocation

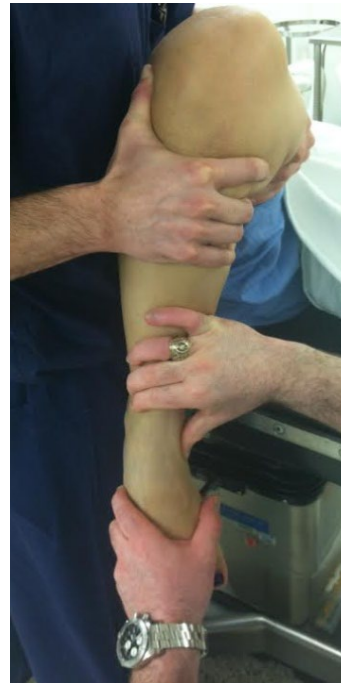
Evaluate for soft tissue  
compromise

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

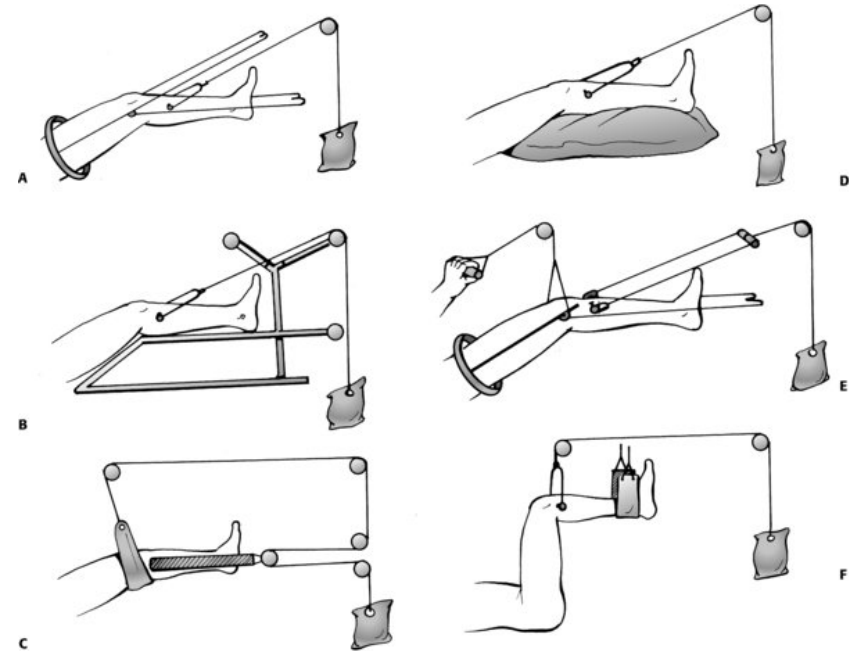
# Lis Franc Dislocation

- Reduction:
  - Traction with correction of medial/lateral translation.
  - May require direct dorsal pressure to reduce dorsal displacement
- Posterior mold +/- stirrups
- May require pinning to hold reduction until soft tissue allow for definitive fixation



# Skeletal Traction

- Rare in upper extremities
- More common in lower extremities for temporizing:
  - Vertically unstable pelvic ring
  - Acetabulum fractures
  - Femur fractures
- Requires anesthesia for insertion
  - IV Sedation
  - Local
- Ex-Fix's act as “Traveling Traction” and often replace the need for skeletal traction



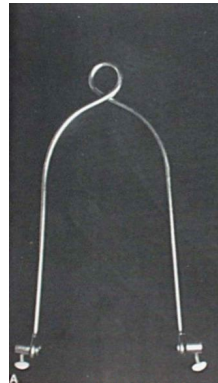
From: **9 Principles of Nonoperative Management of Fractures**

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



# Skeletal Traction

- Pin types
  - Thin vs Thick
  - Smooth vs Threaded
- Bow Type
  - Standard
  - Tension
  - Pad anterior tibia to prevent skin pressure sores
- Balanced vs Longitudinal Traction
- [OTA Video link](#)



standard



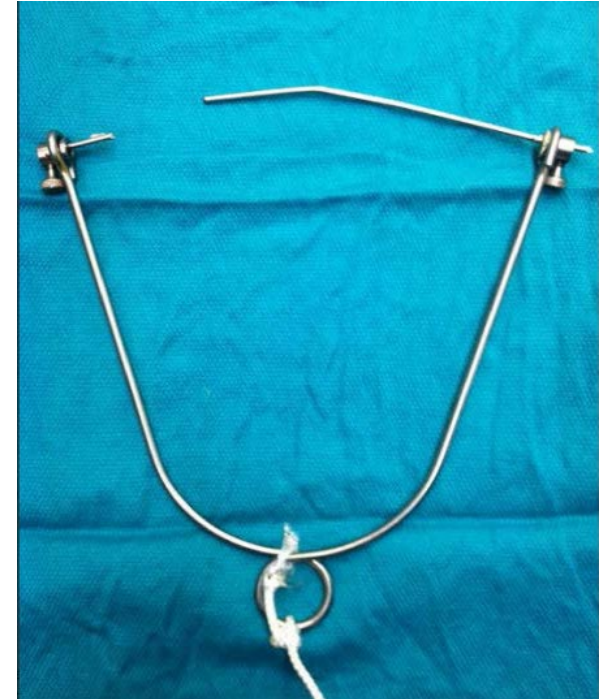
Tension





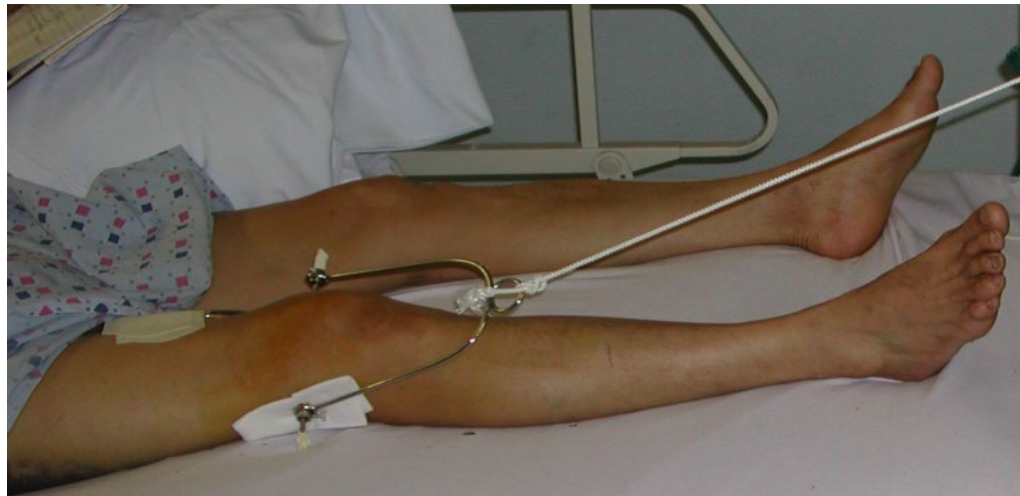
# Skeletal Traction

- Thin Wire vs Thick
  - Thin requires tension traction bow to prevent breakage
- Smooth vs Threaded
  - Smooth is stronger but can slide in bone
  - Threaded will not slide in bone but is weaker
- Insertion can induce bone thermal necrosis



# Distal Femoral Traction

- Place pin **Medial to Lateral** at level of adductor tubercle
  - Just proximal to epicondyle
- Used for:
  - Vertically unstable pelvic ring
  - Acetabular fractures
  - Femur fractures if concerned for ligamentous knee injury



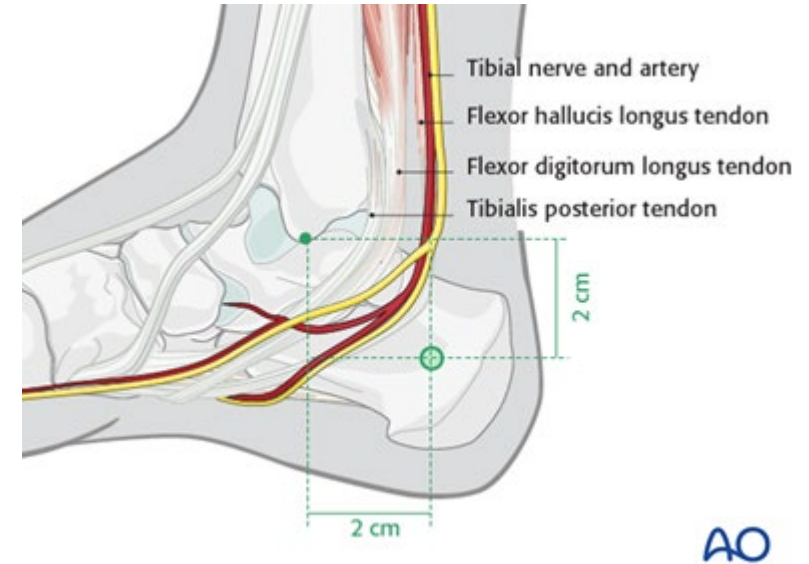
# Proximal Tibial Traction

- Place pin 2cm posterior and 1cm distal to tibial tubercle
- Place pin from **Lateral to Medial**
  - Reduce risk of peroneal nerve injury



# Calcaneal Traction

- Place Pin from **Medial to Lateral**
- 2-2.5cm posterior and inferior to medial malleolus
- Reduce risk of injury to medial NV structures



AO online Surgery Reference

# Summary

## Closed reduction and splinting /casting

- Temporary for soft tissue and pain management
- May require local anesthetic or conscious sedation
- Nonoperative treatment
- 3-point molds to maintain reduction

## Skeletal Traction

- Temporizing until OR
- Know anatomy to minimize injury



# 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](https://resources.aofoundation.org/-/jssmedia/surgery/42/42_o10_nonop_i610.ashx?w=400)