Closed Reduction, Traction and Casting Techniques

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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

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

***Angulation beyond 90° is potentially required

Legend:
A. To apply the Aguilar maneuver, traction is first applied either manually or with fingerfraps. 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-circumferential
  • 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*
Rodewald and Green’s Fractures in Adults, 9e, 2019
Splinting Principles

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

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
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
- Surgar 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
From: 9 Principles of Nonoperative Management of Fractures

Legend:
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
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

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 flexion

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
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
**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://resources.aofoundation.org/-/jssmedia/surgery/42/42_o10_nonop_i610.ashx?w=400