The Children's Hospital of San Antonio™
CHRISTUS Health

Baylor College of Medicine

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Pediatric Fractures in the ER

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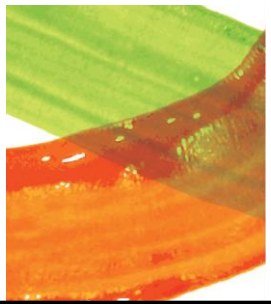


Introduction

- Attended Texas A&M
  - Fightin' Texas Aggie Band
- UT- Houston Medical School
- UTHSC San Antonio Department of Orthopedics Residency
- Baylor College of Medicine Pediatric Orthopedic Fellowship
  - Texas Children's Hospital and Shriner's Hospital for Children
- 3 Years on UTHSC San Antonio Faculty
- 10 Years in Private Practice
- Joined The Children's Hospital of San Antonio Faculty full time last summer
- Special interest in Spine Deformity and Trauma
  - Member Scoliosis Research Society

Objectives

- Basics of Physical exam/Workup of Pediatric Fractures
- Understand Basic Types of Fractures
- Understand Basic Treatments for Common Pediatric Fractures
- Recognize common pitfalls in pediatric orthopedic fractures
- Improve teamwork in the Orthopedic/Emergency Room Team
- Improve care for our patients and make them happy with us!!!

Disclosures

I have no relevant disclosures related to this talk.

Important Points

- Rotational Deformity of Finger Fractures
  - Check Finger cascade on all finger fractures
- Don't Miss Open Fractures
  - Unwrap all "presents"
  - Lift up extremity and check undersurface
- Don't Miss Posterior Shoulder Dislocation
  - Always get Axillary lateral despite Rad Tech protest
- Splints should go past joint above and below fracture
  - Padding goes to skin surface of patient
- Always ask when the patient last ate before calling orthopedics
- Check Elbow for Monteggia dislocation with forearm fractures. Radius should point to capitellum

Children Are Not Little Adults

- **Distinctive Properties of the growing bone**
  - Less Dense and More Porous
  - Often Bend Before Breaking: 'Plastic Deformation"
  - Growth Plates
    - Point of Structural Weakness
    - Allow for Remodeling
  - Thicker Periosteum
    - Help stabilize reductions
  - Ligaments are Stronger than Growth Plate
    - Less Sprains. More Fractures
    - Take longer to heal, but often heal better

Pediatric Fractures

- 12-15% of all Emergency Room Visits/year
- Significant Cost and Morbidity
- Birth- 16 years:
  - Girls: 27% of sustaining a fracture
  - Boys: 42% chance of sustaining a fracture
- Despite Injury Prevention campaigns, the overall rate of pediatric fractures is increasing

Fracture Frequency

Frequency of the most common pediatric fracture types	
Fracture type	Percentage
Distal Forearm	22.7
Hand, phalanges	18.9
Carpal-metacarpal	8.3
Clavicle	8.1
Ankle	5.5
Tibia, diaphysis	5.0
Tarsal-metatarsal	4.5
Foot, phalanges	3.4
Radius-ulna, diaphysis	3.4
Supracondylar region of the humerus	3.3
Proximal end of the humerus	2.2
Facial Skeleton	2.1
Skull	1.8
Femur Shaft	1.6

Examination

Observation

- Swelling
  - Difficult to tell just by looking in chunky/toddlers
    - Always gently feel the area and compare to uninjured side
- Deformity
  - Can be subtle
  - Compare to uninjured side
- Skin
  - Abrasion
  - Ecchymosis
  - Open wounds
  - Look on Back Side of Limb!

Examination

Range of Motion

- If able to follow directions
  - Ask child to move the extremity at each joint and record limitations and why (pain, anxiety, etc)
- If unable to follow directions
  - Observe and see what they do spontaneously
    - Can use toys, phones, etc., to get child to walk, reach

Examination

Palpation

- Tell the child what you are doing
  - Acutely injured will be afraid
- Palpate extremity gently
  - May find areas of tenderness that are unexpected
  - Can go back for second round with more force if necessary
- Area of injury LAST
  - Gains trust
  - Distracting

Nerve Exam

Radial Nerve

- Motor= EPL= Thumb Extension
- Sensation= 1st Dorsal Webspace

Median Nerve

- Motor
  - AIN=FPL and FDP to Index
  - Recurrent Motor= Thumb Palmar Abduction
- Sensation
  - Radial Border of index finger

Ulnar Nerve

- Motor= 1st Dorsal Interosseous
- Sensation= Ulnar Border of small Finger

Nerve Exam Testing

Radial Nerve
- Check Thumb Extension

Median Nerve
- OK Sign Test (AIN n)
- Sensation Radial Border of Index

Ulnar Nerve
- Finger Crossover test
- Resisted finger spread
- Sensation of Ulnar border Small Finger





Fractures Evaluation

Describe the Fracture
- Which Bone? P1, P2, P3
- Where: Diaphysis, Metaphysis, Epiphysis? Proximal? Distal? Radial Head is at the Elbow!
- Is Skin Intact? Open or Closed
- Fracture Pattern: Greenstick, Incomplete, Comminuted.
- Is the Fracture Displaced?
- Is the Fracture Angulated? Describe which way the apex of angulation points. For Example: Apex Dorsal or Apex Volar Deformity. Avoids confusion.

Communication

- Age of patient
- Open or Closed
- Side (Helps with OR Scheduling)
- Bone. Where. Displacement. Which direction. Bonus points for measurement of angle. (Use Cobb Angle tool!)
- Neurovascularly Intact (When do I have to do it)
- NPO (When can I do something)

Example: 10 yo male with closed left distal radius that is completely displaced with apex volar angulation. The patient is neurovasculary intact and is NPO since noon.

We are orthopedists. We cant handle too much info at once!

Unfortunately, I must add……Covid negative. Hope this goes away soon.

Splinting

- Splint all fractures as soon as possible
- Don't assume its going to OR soon, stuff happens
- General rule is to include joint above and joint below.
- Padding side points to patient
- Wrap loosely with webril before applying.
- Do not wrap too tight with cotton or ace wrap.
- Don't forget to elevate and apply ice!!!
- I have seen compartment syndrome likely caused by transfer without a splint

Splints

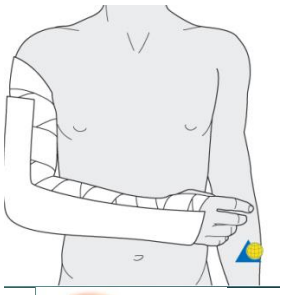
Distal Radius
- Often volar splint from hand to proximal forearm is acceptable
- Sugartong also work

Forearm Shaft
- Sugartong

Elbow
- Long arm posterior

Humeral Shaft
- Coaptation splint
- Proximal Humerus and Clavicle
- Sling +/- Swathe

Growth plate injuries Distal Tibia
- LONG LEG POSTERIOR SPLINT!!!



Guidelines for Referral

Call At Time of Presentation If:
- Needs Reduction
- Displaced (Helps logistically even if done as outpatient)
- Dislocated
- Open
- Nerves not working
- Poor vascularity

MOST ALL OF US PREFER TO SEE FRACTURES IN CLINIC ASAP! WE DON'T LIKE TO SEE THEM WHEN THEY START HEALING WHICH CAN BE 7-10 DAYS IN CHILDREN!

WE HAVE BLOCKIT Appointments. Direct Ortho Line 210-704-4199. Our schedulers are instructed to get fractures in as soon as possible.

Torus (Buckle) fractures

Buckle of the Cortex
Immobilization
No Reduction Necessary

Volar Splint and Outpatient Follow-up

Plastic Deformation

The Bone is Bent
Immobilization (LAS or Sugartong)
Sometimes Needs Reduction
Timely Outpatient Follow-up (Within 3-5 days)

Greenstick Fractures

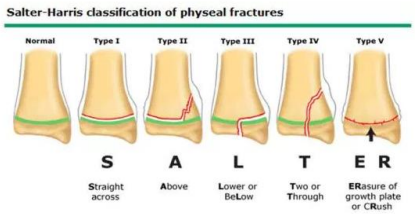
Incomplete Fracture. One cortex intact

May need Reduction

Immobilization in Sugar Tong

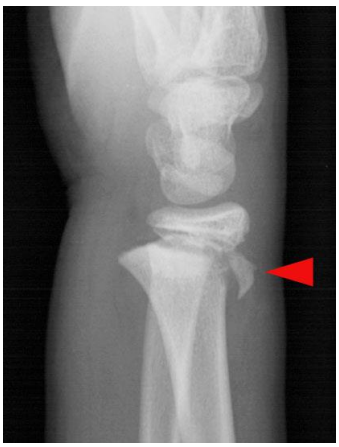
Growth Plate Fractures

- Potential For Growth Arrest
- Limit Force and Number of attempts at Reduction
- Need to Follow Some for Growth Arrest
- Timely Follow-up (3-5 days)



Salter Harris I

Salter Harris II



Salter Harris III

Salter Harris IV - Triplane

Through the Metaphysis, Growth Plate, and Epiphysis

Usually an Articular Component

Risk of Growth Arrest

Beware Hard to see Articular split

CT Scan

Clavicle fractures




Clavicle fractures

Laterally directed force on shoulder

- Fall
- Sports

Usually midshaft; can have medial/lateral ends

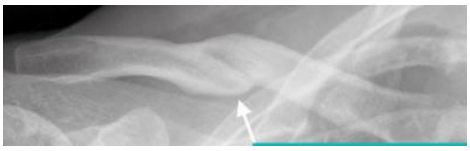
- Angulated/displaced

Goal of treatment is comfort

- Sling (Make sure neck strap is Padded). Avoid Figure of 8 Braces!
- Swathe usually not necessary

Generally non operative

Call with skin concerns (Open or Skin Tenting)



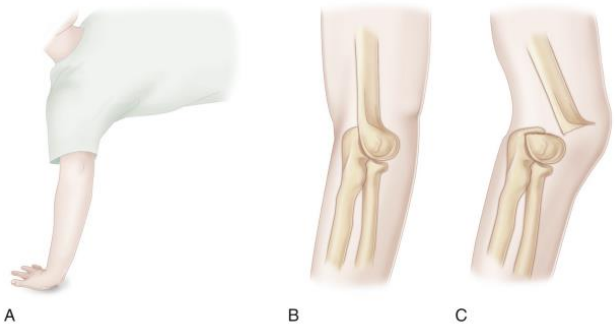
Pitfall: Palpate Sternoclavicular joint and AC joint. If SC joint is Tender: Get Seredipity Views of SC Joint

Proximal Humerus Fractures

- Tremendous Remodeling Potential in the proximal humerus
- Rarely Need Surgery even with significant Displacement
- Sling +/- Swathe
- AP and Axillary Lateral of the shoulder
- I have seen missed Fracture/dislocation!!!!

Closer to Skeletal Maturity (Approximately >11) and Significantly displaced are the exception. They sometimes need pinning. Call us with these!

Supracondylar Fractures



Tachdijian's

Gartland Type I

Anterior Humeral Line

Fat Pad

Effusion

Gartland II

Anterior Humeral Line does not cross capitellum

Posterior cortex intact

Gartland III

Which Need Surgery?

Type I

• Cast

Type II

• Closed Reduction/Pinning

• May be Outpatient

Type III

• Closed Reduction and Pinning

• Hand Pink/Warm?

• Pulses

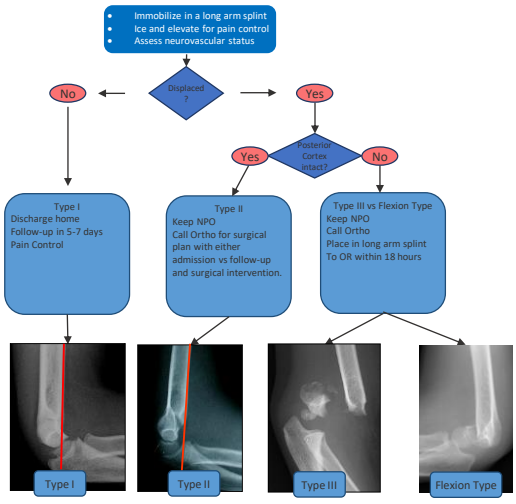
• Nerves?

- AIN (OK Sign)

- Radial

Supracondylar Humerus Fractures

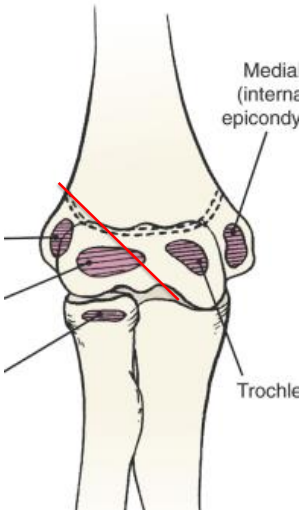
- Displaced Fractures Need to Be Pinned
- Type II Can Be done as outpatient. May depend on logistics
- Type II and Flexion Types should be done within 18 hours
- Closed injury with intact skin and neurovascularly intact can wait until next day/morning
- Reasons to do immediately:
- Open
- Skin tenting/pucker
- Poor Vascularity
- Nerve deficit (AIN is most common OK!)
- Rarely if ever a reason to reduce in ER. Call Orthopedist
- Splint Extremity in place. Apply ice to elbow



Lateral Condyle Fracture

Remember cartilage can not be seen on radiograph

Look for flecks of bone
Intra-articular fracture



Lateral Condyle

Most need surgery to restore joint surface

Any Displacement, Call Orthopedics

AP/Lateral/Obliques

If non-displaced
•F/U within 3 days

Pins stay in 3 weeks
•Same for supracondylar

Tachdjian's

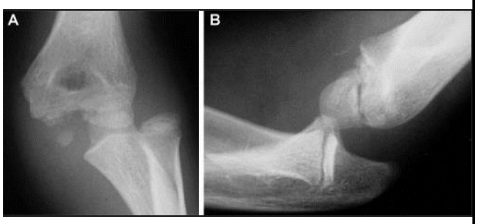
Be Careful!!!! Easy to Miss

Monteggia Fractures

- Get Elbow X-rays with Forearm fractures!!!
- Don't let fracture distract you
- Radial head should point to the capitellum
  - Anterior
  - Posterior
  - Lateral
- Can easily be missed
- Easily treated acutely
- Difficult to treat after a few weeks
- Needs reduction, often with fixation of the ulna
- Long arm splint. Ice. Call orthopedist on call.

Elbow Dislocation

- 10-15 years old
- Medial Epicondyle fracture often occurs. Need to look for it medially. If absent, look for small bone in joint!
- Usually can reduce the elbow with longitudinal traction followed by flexion
- Get X-rays after. Congruent Joint. Look for Medial epicondyle in the joint! If it is, it needs operative treatment
- Recommend calling your orthopedic surgeon before reducing these!
- High risk of stiffness after these



Technique

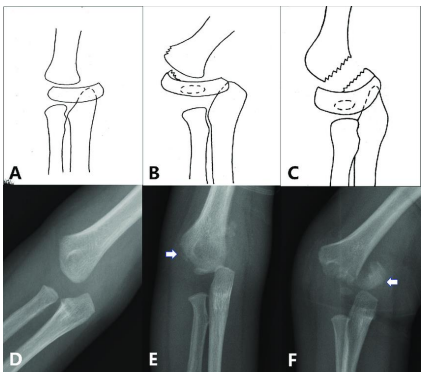
- Adequate sedation (muscle relaxation)
- Position so that humerus is on the stretcher with elbow joint free to manipulate – optimize ergonomics
- Longitudinal traction with elbow in slight flexion – assistant providing counter traction by holding upper arm – careful not to occlude the brachial artery
- Correct varus/valgus/translation
- Supinate forearm (palm up – 'can hold soup")
- May need to extend/hyperextend to unlock the coronoid
- Wrap hand around posterior elbow – fingers on olecranon/thumb in antecubital fossa – and pull olecranon forward while pulling traction
- Pull hard and flex the elbow

Supine

Prone

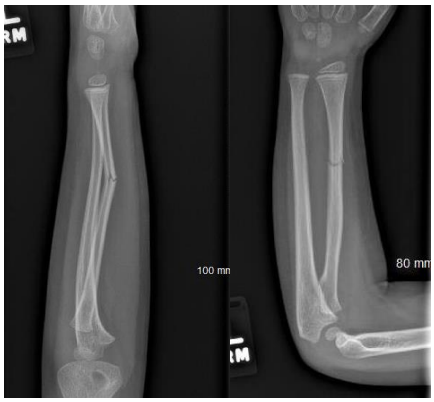
Transphyseal Fracture

- Usually in children <3 years old
- Clinically, elbow looks dislocated
- X-ray shows translation of distal fragment without obvious fracture
- Needs to be reduced and pin fixation
- Call your orthopedist
- The X-ray just doesn't look right, but you can't tell exactly what is wrong.
- ? Non accidental trauma



Forearm Shaft Fracture

- Radius and Ulna are designed to rotate to allow supination and pronation
- Varies by age, but rule of thumb is that more than 10 degrees of angulation should be reduced
- Bayonet apposition is often acceptable as long as angulation within limits
- Greenstick Fractures may be appropriate for ER MD reduction
- 2 schools of thought. Complete fracture or preserve cortex. Don't want to tear periosteum!!
- Bent splints/cast make straight arms.
- Check Elbow for Monteggia
- Splints need to go above elbow
- Compartment Syndrome



Forearm Shaft

- Complete Fractures can often be treated with closed reduction and long arm casting
- Can be difficult-Call Orthopedist
- Sometimes Closed Reduction Fails
- Sometimes need Fixation is needed
- Flexible Intramedullary Rods
- Plates in older kids

Compartment Syndrome

- Increased pressure inside a fascial compartment
- Pressure mismatch impeding perfusion
- Caused by internal or external source
- Muscle/nerve tissue can die within 6 hours (May be longer in kids fortunately)
- Most important sign is increasing pain and/or analgesic requirement
- Time is muscle
  - If there is concern make a call
- Children may be lethargic instead of agitated. Beware. Kids are different
- Children have larger layer of fat, so they can disguise tense compartments

Distal Radius Fractures

Tremendous Remodeling in Distal Radius Physis

Acceptable Angulation

- Apex Volar= 20 degrees
- Apex Dorsal=15-20 degrees
- Bayonet Apposition Is OK if followed closely

Can Vary with age.

Usually treated with Short Arm Cast

Casted 4-6 weeks

Distal Radius Fractures

Challenges to non-orthopedic ER reduction

- Need to be treated in cast
- Hard to transition to cast in clinic in children (Unhappy mom and child)
- Can make stable fracture unstable with manipulation
- Growth Plate needs to not be traumatized repeatedly
- Key is early communication with orthopedic surgeon
- We can help you avoid failure to reduce

Finger Injuries

Second most common fracture

" I thought it was just jammed"

If not moving normally 3-4 days after injury, get an xray
Physical exam

- Open wounds – base of nail for Seymour fracture
- Rotational malalignment (More important that radiology report)
- Describe which finger by name – thumb, index, long, ring and small

Seymour fractures

Physeal or juxtaphyseal fracture of the distal phalanx with an associated laceration of the nail matrix and avulsion of the proximal end of the nail plate

Needs thorough irrigation and debridement
- removal of nail
- extract flap of periosteum in the fracture site
- reduce fracture: usually stable
- repair nail matrix if able
- replace nail to protect eponychial fold

Very similar treatment for fingertip partial amputations

Seymour fracture/tip amputation tips

Do all suture work with ABSORBABLE sutures

- Chromic
- Monocryl - greater initial tensile strength so can use smaller suture
- Vicryl Rapide

Can use dermabond, but use judiciously

- Have to make sure it is COMPLETELY dry before placing any dressing

Early followup with ortho (2-3 days) To:

- Check alignment
- Get initial dressing off, and into a protective cast
- Make sure they are taking antibiotics

Phalangeal Neck and Condyle fractures

Can be either proximal or middle phalanx

Typically unstable and need surgical treatment

Neck fracture – think of as similar to supracondylar humerus fracture

Condyle fracture – think of as similar to a lateral humeral condyle fracture

Minimal remodeling potential

Phalangeal Neck and Condyle fractures

Not as surgically urgent as elbow fractures

Need followup in 1-2 days in order to set up surgical treatment

Call Ortho/Hand on call to arrange

Parents need to understand need for surgery – many times they feel that it's a minor injury and do not follow up until 2-3 weeks later

- Nearly healed

Rotational alignment

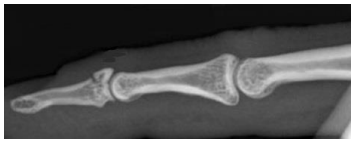
In extension, look at plane of nails

Obvious cross-over sign

Bony Mallet Fractures

What's important?

- Displacement of fragment
- Congruency of the DIP joint



Treatment of Mallet finger fracture

Nonoperative treatment

- Extension splinting of the DIP joint for 6-8 weeks for 24 hours a day

- Initial splint can be alumifoam volarly with finger in full extension
- Do not hyperextend PIP joint – can lead to skin issues
- watch tape placement and tightness

We will change to stack splint once swelling resolved enough

Volar plate injuries

MOI – hyperextension of PIP joint

Basketball!!!

AKA – the 'jammed' finger

Extension block splinting (PIP slightly flexed) for 1-2 weeks, followed by buddy taping

More severe injuries can develop late swan neck deformity

Small fracture, bad fracture

Pediatric Knee Injuries

Must take into account that the physis is the weak link in the knee

MCL Injury=Distal Femoral Physis Injury

ACL Injury= Tibial Spine Fracture

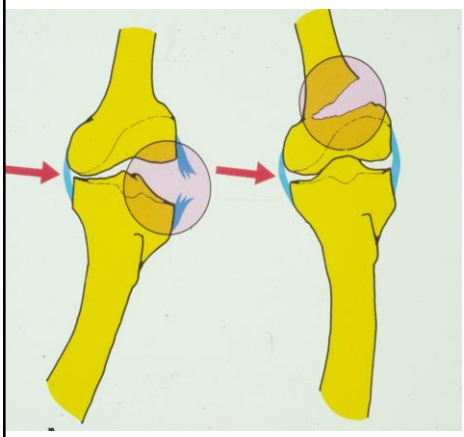
Patellar Tendon injury=Tibial Tubercle Injury

Patella Fracture=Patella Sleeve Fracture

Different Treatments than adults

May develop growth deformity depending on age at injury and injury type to physis

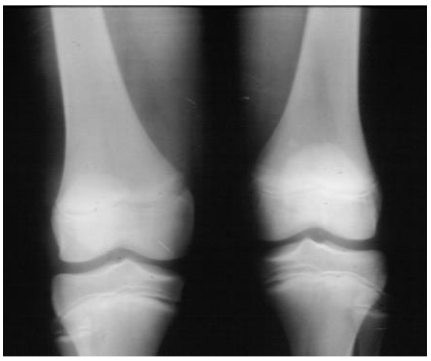
Distal Femoral Physis Injuries



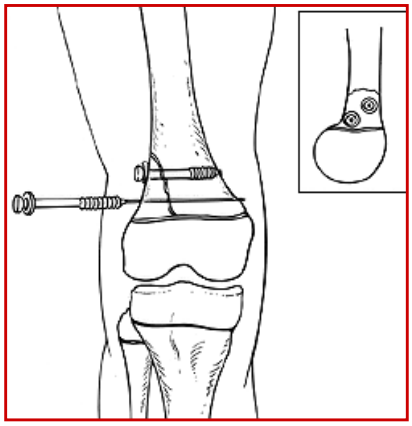
70 % of growth of femur
Ligaments are stronger than physis.
Males Close 17-18 yo
Females Close 16-17 yo
High rate of growth disturbance/angular deformity

Knee Immobilizer or Long Leg Splint

Stress Views

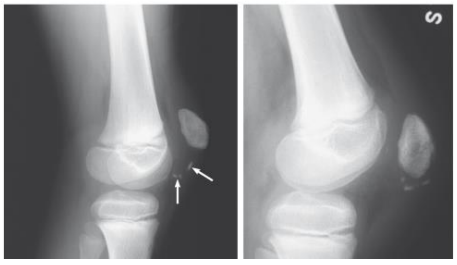


Screw Fixation



Patellar Sleeve Fracture

If extensor mechanism is out then must treat operatively
Most treated in long leg cast in extension for 4 weeks.
Need help getting ROM knee back
Knee Immobilizer or Long Leg Splint



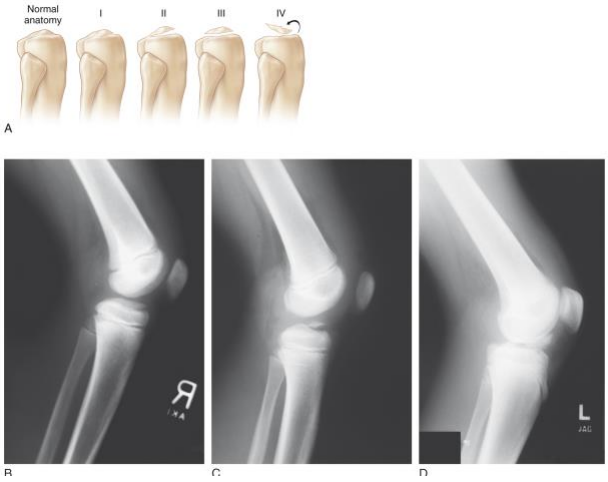
Tachdjians Online

Tibial Spine Fracture

Meniscus gets trapped underneath the fragment.

May need arthroscopic reduction.

Knee Immobilier or Long Leg Splint



Tachdjians Online

Proximal Tibia Fractures

Proximal Tibia accounts for 55% of growth of tibia

Proximal Epiphysis closure 18-19 yo in males and 16-17 in females

Tibial Tuberosity closes at approximately 19

Beware compartment syndrome

Beware of Vascular injury!!!!!

Distal Tibial Fractures/Ankles

- Often Salter Harris II, III, or IV
- Triplane Fracture
- We often get CT scan after reduction for surgical planning
- Experience has taught me to assume there is a articular component I can't see until proven otherwise

- Reduction sometimes needed
- Neurovascular compromise
- Skin compromise
- Prior to transfer
- Xrays prior (At least 2 Views)
- Watch out for Subtalar dislocation

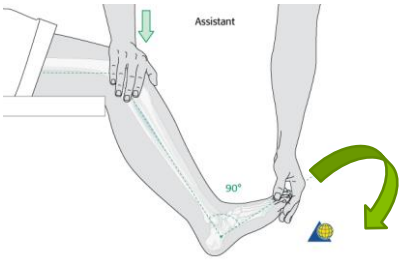
Technique

Flex knee 70-90 degrees

- Hang off edge of stretcher
  - Raise the stretcher and sit on a stool
- Bolster under thigh

Plantarflex ankle

→ Both of these relax the gastrocsoleus complex



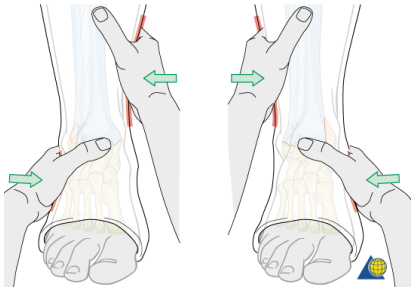
Plantarflex ankle

Technique

Longitudinal traction: hold for muscle to relax

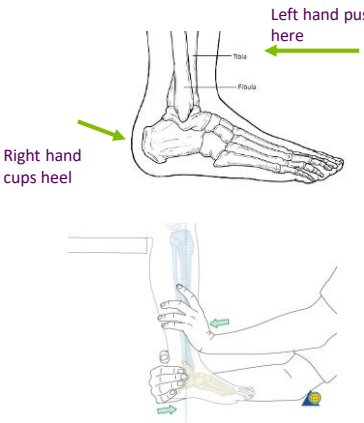
Reverse deformity – need at least one assistant

Splint in neutral dorsiflexion with lots of padding, three sided splint



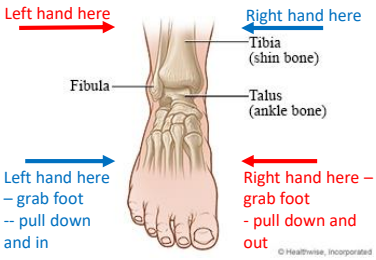
Patient supine with lots of helpers
- knee bent
- foot in equinus
- longitudinal traction

Posterior dislocation



For right ankle, reverse for left ankle

Medial dislocation



Lateral dislocation

Important Points

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  - Check Finger cascade on all finger fractures
- Don't Miss Open Fractures
  - Unwrap all "presents"
  - Lift up extremity and check undersurface
- Don't Miss Posterior Shoulder Dislocation
  - Always get Axillary lateral despite Rad Tech protest
- Splints should go past joint above and below fracture
  - Padding goes to skin surface of patient
- Always ask when the patient last ate before calling orthopedics
- Check Elbow for Monteggia dislocation with forearm fractures. Radius should point to capitellum

Thank You!

Questions?

Pediatric Orthopedic scheduling 210-704-4199

Locations:

- La Cantera
- Stone Oak
- Downtown
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We have 5 surgeons and 4 APP's!

IF IN DOUBT, CALL US!!

Obligatory Kid Pic