PEDIATRIC ORTHOPAEDIC TRAUMA

TRAUMA REACH 2023

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PEDIATRIC FRACTURES

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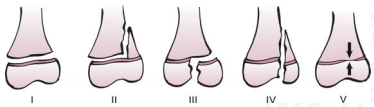
Salter-Harris Classification



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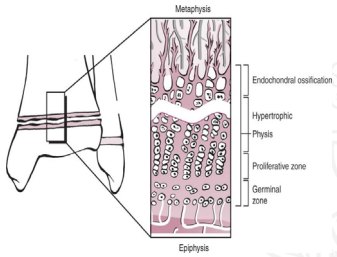
Growth Plate Considerations



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Lower Extremity Fractures

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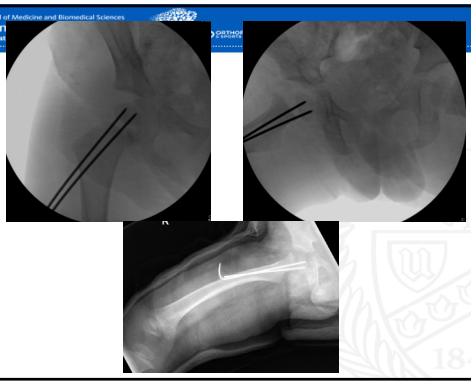

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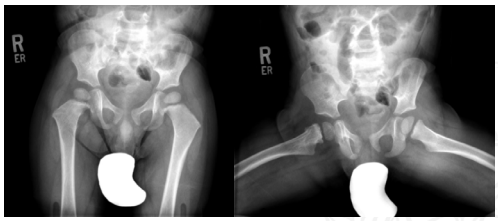
6 weeks postop



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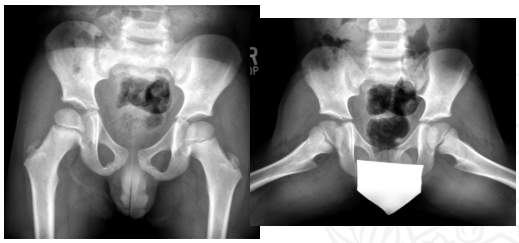

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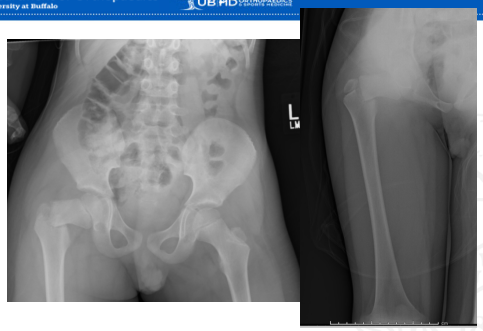

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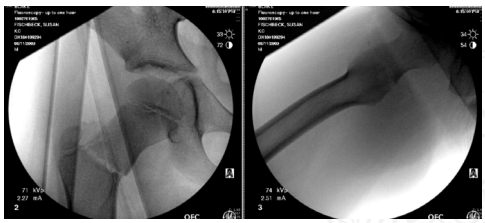

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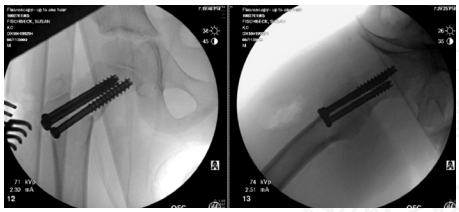

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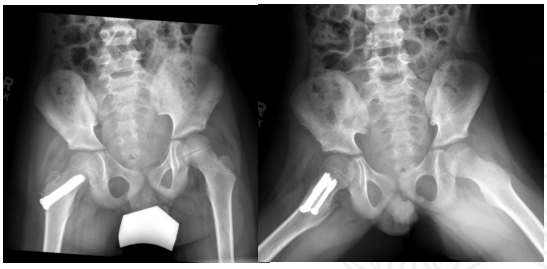

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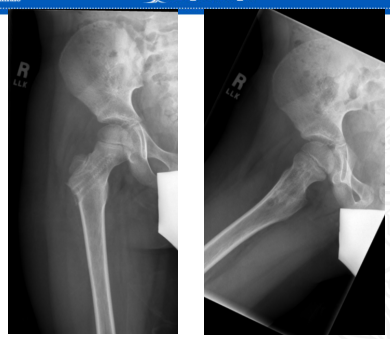

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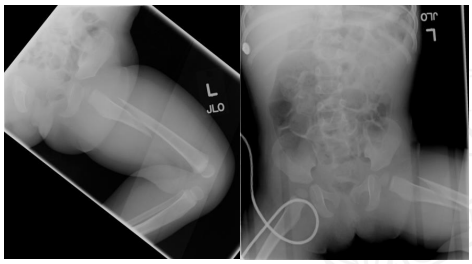

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Traction Setup

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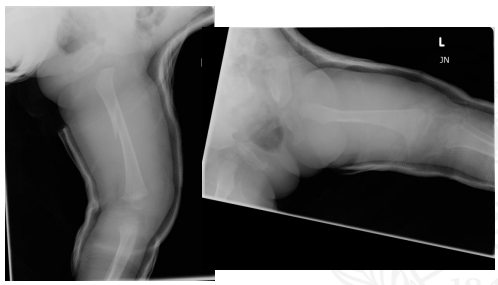

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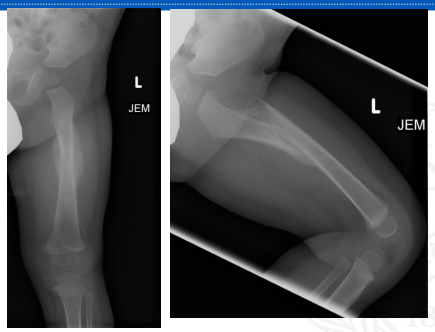

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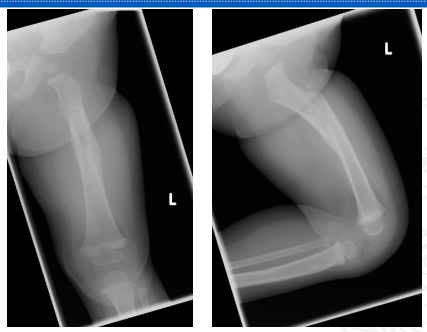
3 months postop



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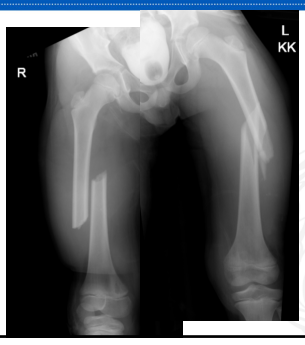
1 year postop



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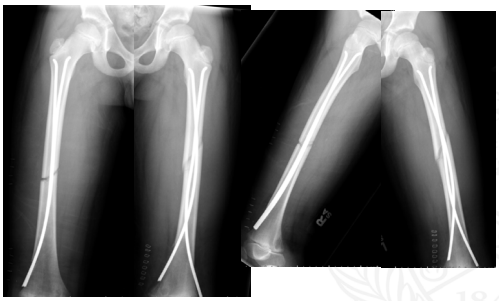
Immediate Postop



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2 Day Postop

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1 & 7 Postop

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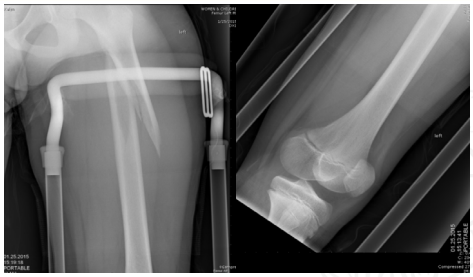

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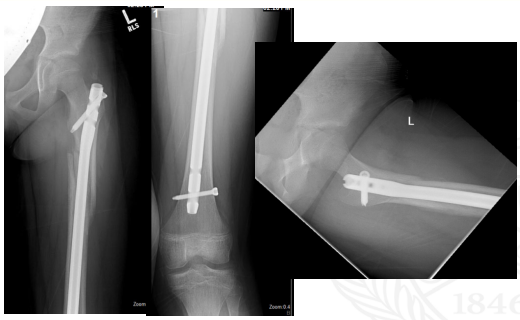
3 weeks postop



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4 months postop

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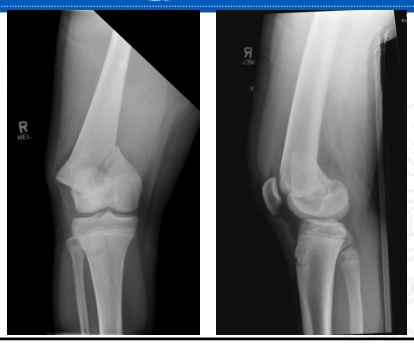

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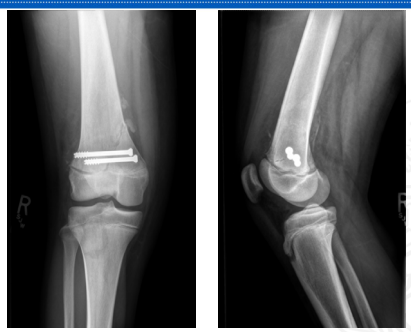
2 weeks postop



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6 months postop

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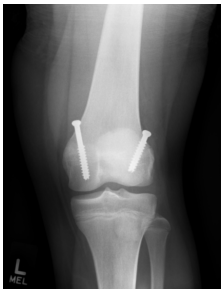
7 months post injury



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Patellar sleeve avulsion

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Tibial spine (eminence) fracture

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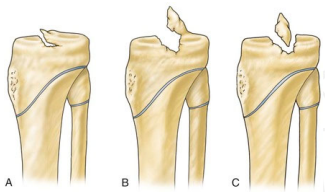
Meyers and McKeever Classification of Tibial Spine (Intercondylar Eminence) fractures



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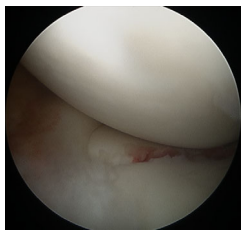

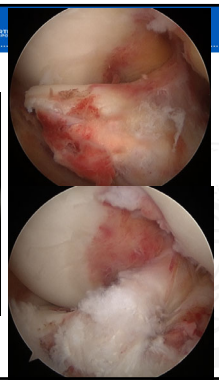

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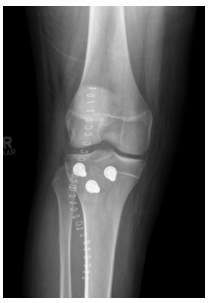

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Post reduction

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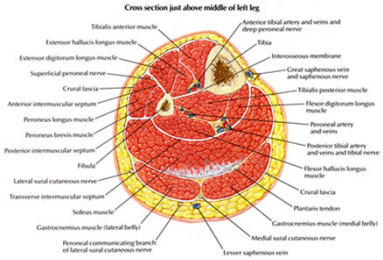
Cross Sectional Anatomy



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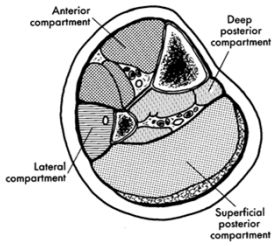
Cross Sectional Anatomy



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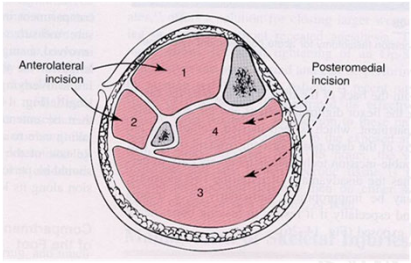
2 Incision, 4 Compartment Fasciotomy



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Foot Ankle Orthopaedics

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Post reduction

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6 weeks Postop

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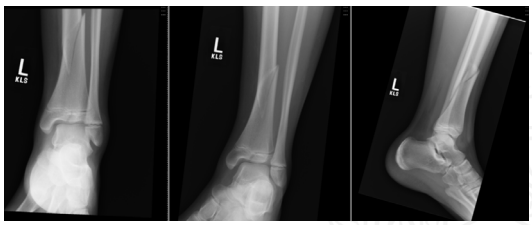

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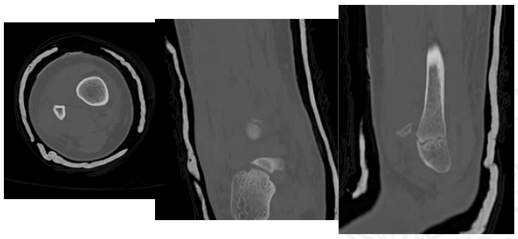

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3 Wk postop

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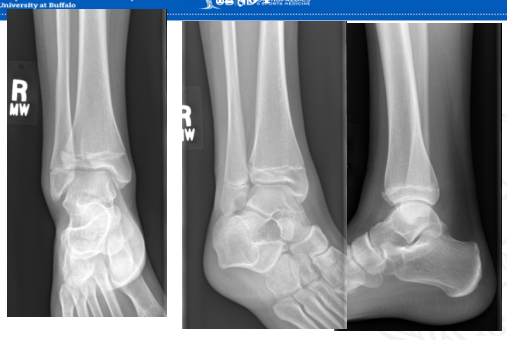

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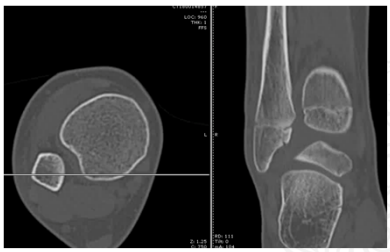

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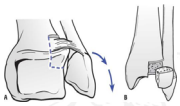
Tillaux Fracture

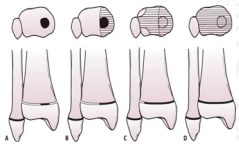
Occurs in children btwn 13-16 y/o

Closure of the distal tibial physis begins centrally (A), extends medially (B), and then laterally (C) before final closure (D).

The central and medial portions of the distal tibial physis have already fused

18 month window where the lateral physis remains open





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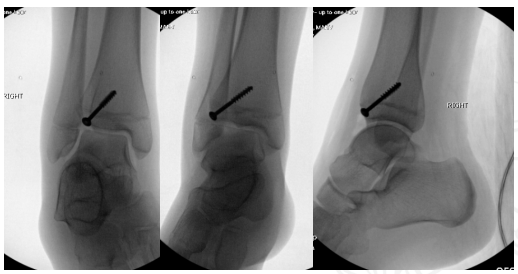

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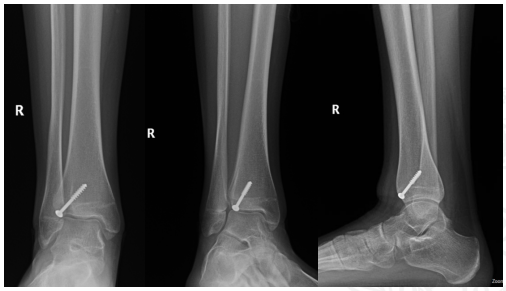

PEDIATRIC THORACOLUMBAR TRAUMA

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Introduction

- Thoracolumbar injuries in pediatric population frequently associated with high energy trauma and concurrent thoracic or abdominal injuries
- Can lead to compression and burst fractures, flexion-distraction injuries (e.g. Chance fractures), fracture dislocation injuries, apophyseal fractures/herniations, spinous process and transverse process fractures.
- Pediatric spine trauma accounts for 2-5% of all spine trauma
- Younger patients have less protection form overlying muscles and bony structures, such as underdeveloped iliac crests, resulting in higher risk for intra-abdominal and intrathoracic organ injuries

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Initial Management and Diagnosis

- ATLS protocol for children
- Spinal immobilization via log roll precautions and application of hard cervical collar
- Pediatric spine board or an adult backboard with a pad to boost child's torso to prevent neck hyperflexion, neurologic injury and airway closure
- Detailed neurologic assessment including motor and sensory exam, rectal and genital examination when appropriate, reflex testing
- Palpation of the entire spine and paraspinal region should be performed when patient is log-rolled
- Any step offs, crepitus, bruising, or open injuries should be noted

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Initial Management and Diagnosis

- Associated intraabdominal and intrathoracic injuries are common, up to 42% of patients
- Common injuries include small bowel injury, pancreatic rupture, hemo or pneumothorax, lung contusion, and aortic injury
- >30% of children with thoracolumbar trauma may have associated head injury
- Important to assess for possible occult head, chest, or abdominal injury

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Radiographic Evaluation

- AP and lateral radiographs are favored for initial imaging
- MRI for children with neurologic deficits
- CT scan should be considered in patients with significant mechanism of injury
- In children diagnosed with spine fractures XR of the cervical, thoracic, and lumbar spine should be obtained as there is an 11-34% risk of multilevel involvement

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Injury Patterns – Compression Fracture

- Most common pediatric spine fracture
- Most often occur near T/L junction
- Low energy mechanisms such as falls, sports injuries
- Mechanism: axial loading and flexion of the spine resulting in collapse of the anterior cortex of the vertebral body
- Often seen in multiple contiguous levels
- If there is greater than 50% height loss, consideration for failure of the posterior elements and MRI should be considered
- Often heals without surgical intervention
- TLSO bracing and activity modification is mainstay of treatment

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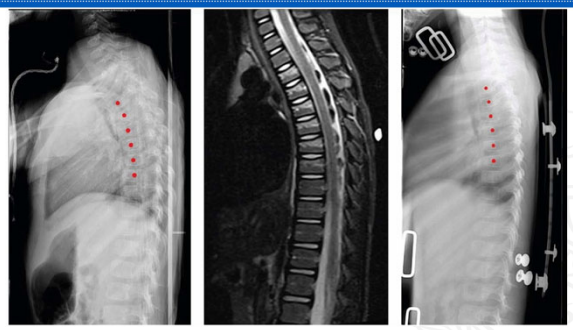

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Injury Patterns – Burst Fracture

- Mechanism: axial load injuries, axial compression force drives the nucleus pulposus into the vertebral body, leading to fracture of the anterior and middle columns
- Often occurs around the T/L junction
- May lead to biomechanical instability, neurologic injury and dural tear
- Level of injury more important than amount of canal compromise (e.g. thoracic level fractures more likely to cause neurologic injury)
- May be biomechanically unstable if there is focal kyphosis, greater than 50% retropulsion, lamina fractures, facet subluxation and or neurologic injury
- CT useful to assess amount of neural compression, posterior element involvement and osseous retropulsion
- MRI utilized to evaluate posterior ligamentous complex

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Burst Fracture

- Stable burst fractures without neurologic compromise can be managed with a TLSO brace
- Unstable burst fractures are treated with posterior instrumentation

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Injury Patterns – Flexion-Distraction

- Caused by distractive force in which the posterior column fails in tension and the anterior columns fails in distraction or compression flexion
- Can be purely osseous, purely ligamentous/disk injuries or a combination of both
- Concomitant visceral and head injuries occur in 40% of pediatric patients
- **Patients taken emergently to the OR for laparotomy following high-energy trauma should have an assumed spinal injury until proven otherwise** (high risk of delay in diagnosis)
- Pure osseous injuries can be managed with TLSO brace, if acceptable alignment is obtained in brace can proceed with nonoperative treatment, if not surgery should be considered

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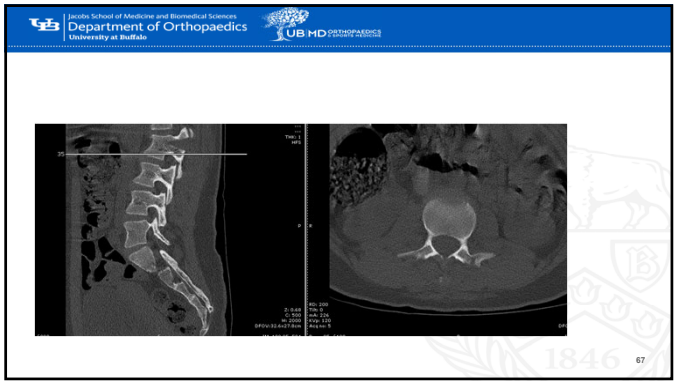
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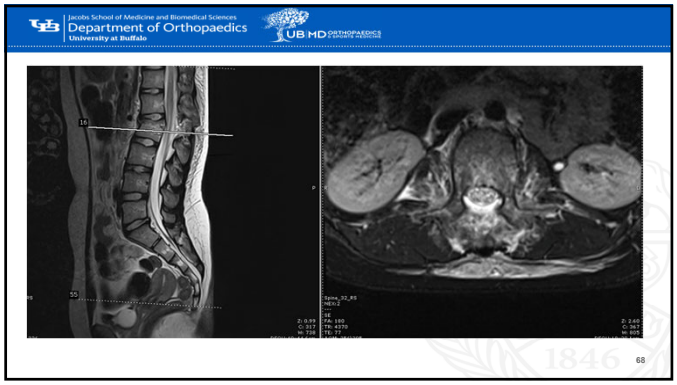
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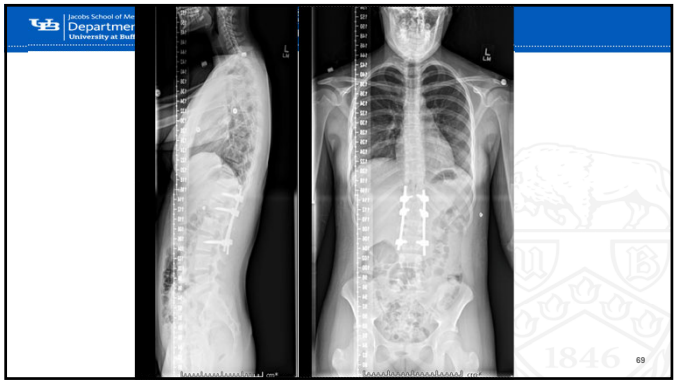
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Upper Extremity Fractures

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Presenting Xrays

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Ossification Centers of the Elbow

Name	Ossify	Fuse
Capitellium	1	12
Radial Head	4	15
Medial Epicondyle (internal condyle)	6	17
Trochlea	8	12
Olecranon	10	15
Lateral Epicondyle (external condyle)	12	12

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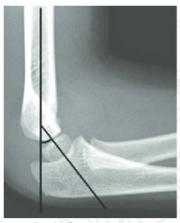
Radiographic Parameters

Anterior Humeral line
Intersects middle 1/3 of capitellium



Shaft- Condylar Angle
30-40 degrees anterior

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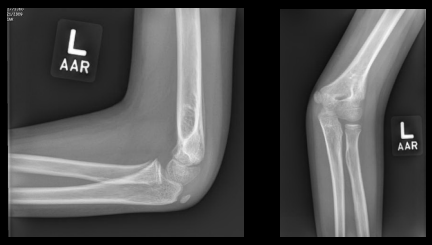
Long arm casting for 3 weeks



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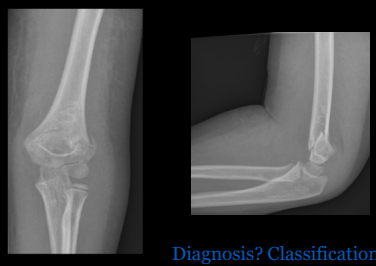

Diagnosis? Classification?

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Presenting Images

Diagnosis? Treatment?

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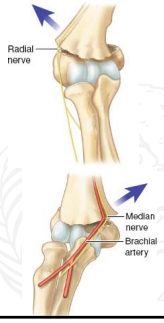
Fracture Displacement

- Posteromedially displaced fractures
  - Medial periosteum is intact
  - Radial nerve at risk
  - Reduction may be aided with forearm in pronation
- Posterolaterally displaced fractures
  - Lateral periosteum intact
  - Median nerve and brachial artery are at risk
  - Reduction may be aided with forearm in supination



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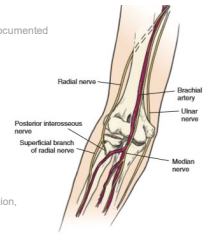
Neurovascular Exam

- Neurologic Status
  - Sensation and motor function tested and documented
  - Nerve Injuries
    - Most common – AIN
    - 2nd most common – Radial
- Vascular Status
  - Warm hand, pink, palpable radial pulse
  - Warm hand, pink, absent radial pulse
  - Cool hand, blue/white, absent radial pulse
- Compartment evaluation
  - In children presentation with Anxiety, agitation, increasing analgesic requirement



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Timing of operative fixation

- Non-urgent – can wait overnight
  - Warm and well perused hand without neurologic deficits
  - Splinted in 30-40 degrees of flexion, observe as inpatient
- Urgent – Same day
  - Pulseless but well perfused
  - Sensory neurologic deficits
  - Excessive swelling
  - Brachialis sign
  - Floating elbow
- Emergent
  - Pulseless, poorly perfused hand

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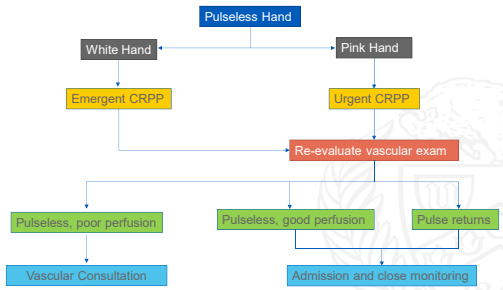

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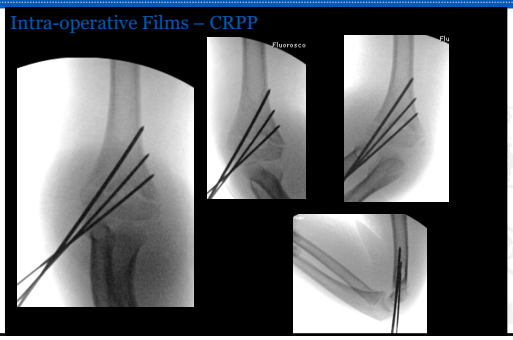
Intra-operative Films – CRPP



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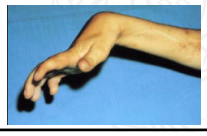
Complications of Supracondylar humerus fractures

- Neurologic injuries
  - Overall neuropraxia rate is 13%
  - AIN palsy most common, followed by radial nerve palsy
  - Almost all are neuropraxia, no further diagnostic studies required acutely
- Volkmans Contracture
  - Ischemic paralysis and contracture of the muscles of the forearm
  - Can be seen with hyperflexion casting



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Presenting Films

Diagnosis? Treatment?

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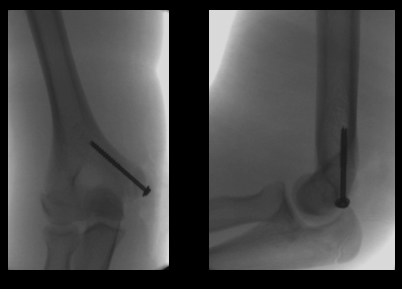
Open reduction internal fixation



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Medial Epicondyle Fractures

- Medial Epicondyle
  - Appears at ~ age 6
  - Fuses at ~ age 17
  - Traction apophysis for MCL and Wrist Flexors
- Mechanism - Valgus stress on the elbow with traction injury on the medial epicondyle
- Associated with elbow dislocations in 50%
  - Ulnar nerve dysfunction reported in 10-16%, often transient

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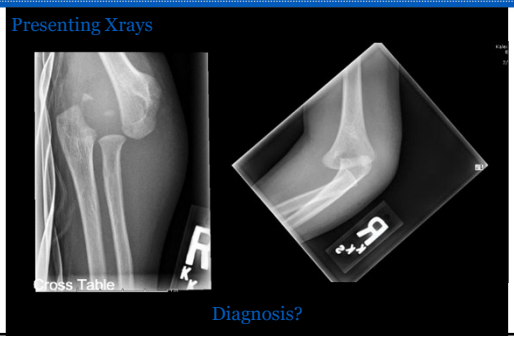

Diagnosis?

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Transphyseal Fractures

- Fracture through the distal humeral growth plate
  - Most common in ages < 3 years old
- Mechanism
  - Associated with non-accidental trauma
  - Birth related trauma
  - Fall onto hyperextened arm
- Classification – Salter Harris Classification
  - < 12 months – SH1 fx
  - 12 months – 3 years – SH2 fx

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Transphyseal Fractures – Imaging

- Findings
  - Posterior-medial displacement of the radius/ulna
  - If capitellium ossification center is present – will be aligned with radius

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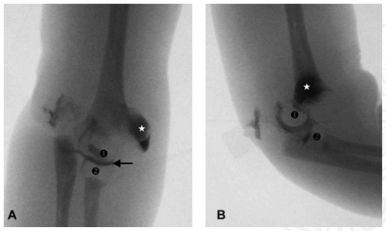
Elbow Arthrogram



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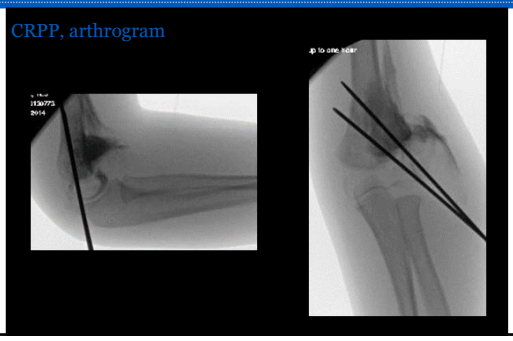
CRPP, arthrogram



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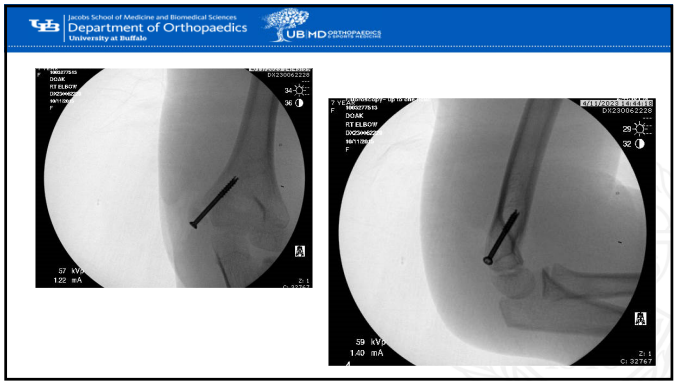
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