

PEDIATRIC FRACTURES AND DISLOCATIONS

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INTRODUCTION

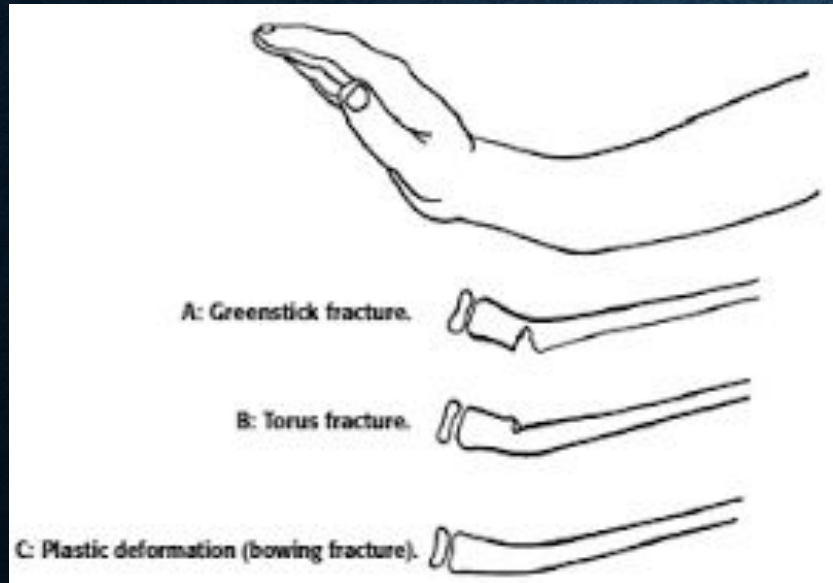
PEDIATRIC FRACTURES

- Incidence of pediatric fractures is increasing with time
 - Increased sports participation
- From ages 0-16
 - 42% of boys will sustain at least one fracture
 - 27% of girls
- Peak incidence for fracture
 - Age 16 for boys
 - Age 12 for girls

PEDIATRIC FRACTURES

- Immature bone differs from adult bone
- Children's bone:
 - less mineralized
 - more porous
 - more vascular channels compared to adults
 - This results in a more elastic bone
 - Able to absorb more energy before failure

PEDIATRIC FRACTURES



- Plastic Deformation
 - Microscopic mechanical failure of bone
 - Radiographs reveal angulation without an obvious fracture line
- Greenstick fracture
 - Occurs with greater force than plastic deformation
 - Results in failure (fracture) on one side of the bone but plastic deformation on the other
- Torus (buckle) fracture
 - Occur in the metaphyseal of bones which is composed of cancellous (soft) bone and thin cortical (hard) bone
 - The thin cortical bone fails in compression buckling outwards
 - The periosteum remains intact

**WHAT
ABOUT
THE
GROWTH
PLATE
(PHYSIS)?**



PHYSEAL CONSIDERATIONS

- Open physes leads to greater remodeling potential
 - Occurs more rapidly in plane of joint motion
 - Greater closer to the physis
- Most active physes:
 - Proximal humerus
 - Distal radius
 - Distal femur
 - Proximal tibia

PHYSEAL CONSIDERATIONS

- Physeal Fractures
 - **The growth plate is weaker than bone and ligaments**
 - Forces that produce sprains in adults often result in fractures in children

SALTER HARRIS CLASSIFICATION

Salter-Harris I



SALTER HARRIS CLASSIFICATION

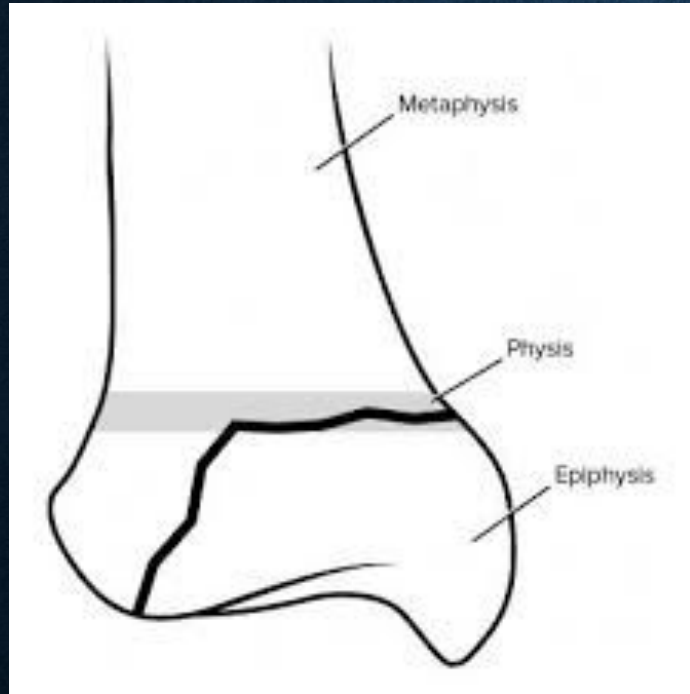
- Growth Plate (Physeal) Fractures
 - AKA Salter-Harris Fractures
 - 5 types
 - Type I
 - Fracture traverses entire growth plate
 - Diagnosis is difficult as radiographs are usually normal
 - Patient is point tender over the physis with localized swelling

SALTER HARRIS CLASSIFICATION



- Growth Plate (Physeal) Fractures
 - AKA Salter-Harris Fractures
 - 5 types
 - Type II
 - Most common
 - Fracture line passes through a portion of the growth plate and exits through a segment of the METAPHYSIS

SALTER HARRIS CLASSIFICATION



- Growth Plate (Physeal) Fractures
 - AKA Salter-Harris Fractures
 - 5 types
 - Type III
 - Fracture line passes through the physis and exits into the epiphysis
 - Intra-articular fracture

SALTER HARRIS CLASSIFICATION



- Growth Plate (Physeal) Fractures
 - AKA Salter-Harris Fractures
 - 5 types
 - Type IV
 - Fracture line crosses all zones
 - Metaphysis, physis, and epiphysis
 - Intra-articular fracture

SALTER HARRIS CLASSIFICATION

- Growth Plate (Physeal) Fracture
 - AKA Salter-Harris Fractures
 - 5 types
 - Type V
 - Crush injury to the physis
 - Rare



SALTER-HARRIS FRACTURES

INJURY TO GROWTH PLATE

I CAN'T FEEL MY EPIPHYSIS!

YOU'RE LOOKIN' AT THE MOST COMMON TYPE. I'M SO COOL.



TYPE 1

THROUGH GROWTH PLATE



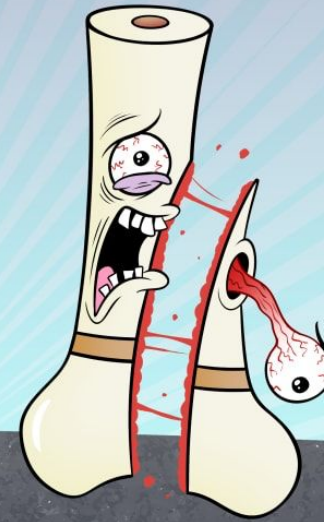
TYPE 2

THROUGH GROWTH PLATE AND METAPHYSIS



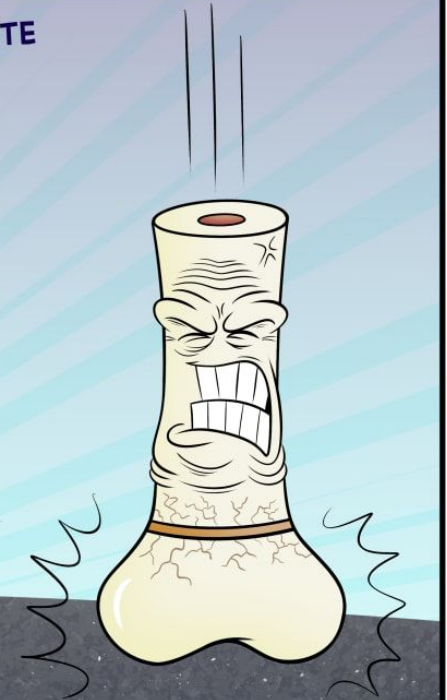
TYPE 3

THROUGH GROWTH PLATE AND EPIPHYSIS



TYPE 4

THROUGH ALL THREE ELEMENTS



TYPE 5

CRUSH INJURY OF GROWTH PLATE

UPPER EXTREMITY FRACTURES

CLAVICLE FRACTURES



- Common fracture
 - 15% pediatric upper extremity injuries
- Shaft fractures vast majority (>80%)
- Symptoms
 - Pain to shoulder region
- Physical exam
 - Deformity
 - Tenting of skin, assess if skin is at risk (impending open fracture)
- Imaging
 - 2 views of affected clavicle +/-
 - AP of both clavicles

CLAVICLE FRACTURES

Treatment

- Majority treated nonoperatively in a sling
- Operative indications
 - **CONTROVERSIAL**
 - Adolescent fractures with significant shortening (>2cm)
 - Absolute Indications
 - Open fractures
 - Displaced fracture with soft-tissue at risk from tenting
 - Subclavian artery or vein injury



PROXIMAL HUMERUS FRACTURES

- 80% of humeral growth occurs at the proximal humeral physis
 - Great remodeling potential
- Salter-Harris 2 most common
- Most common in adolescents

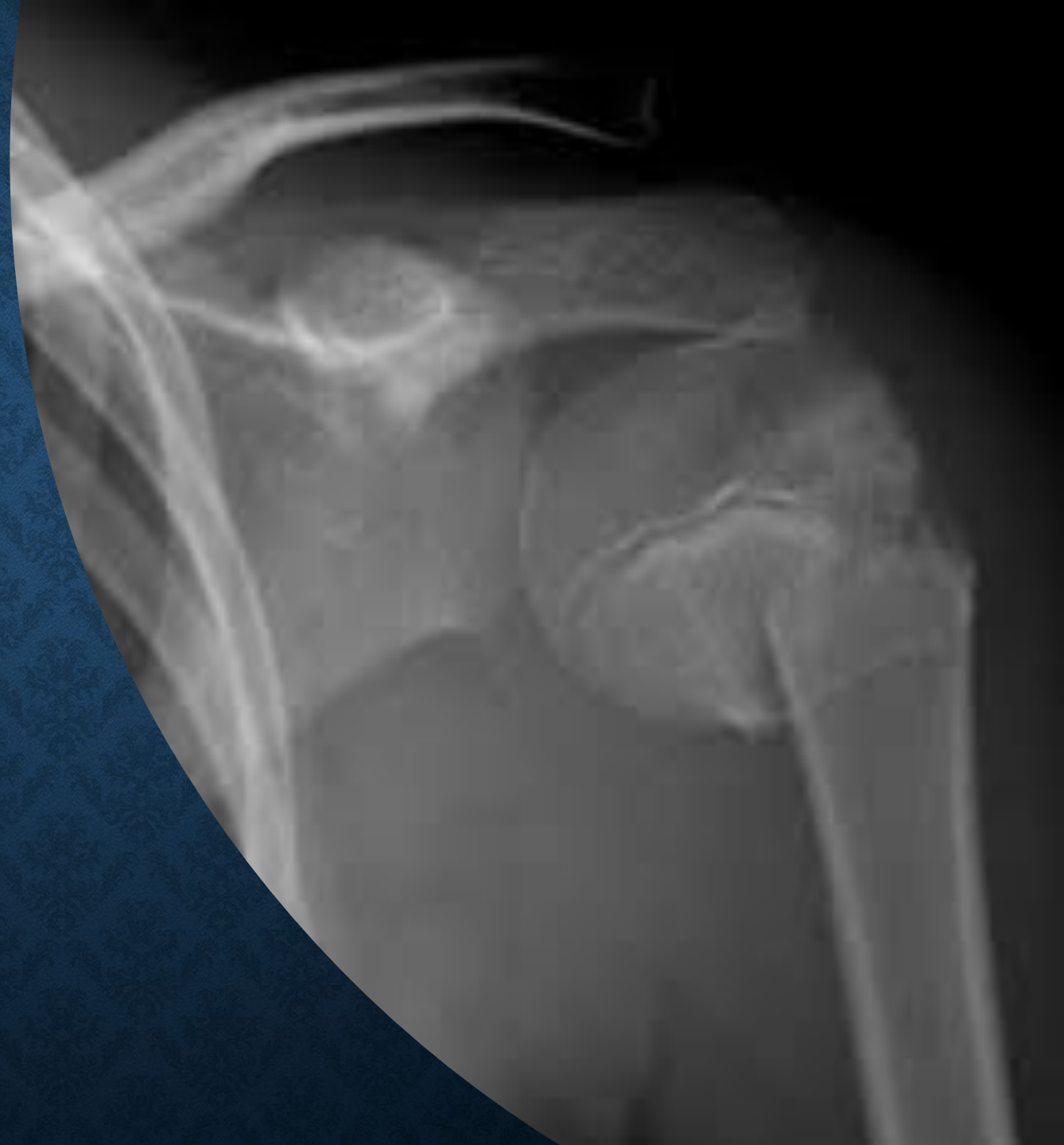
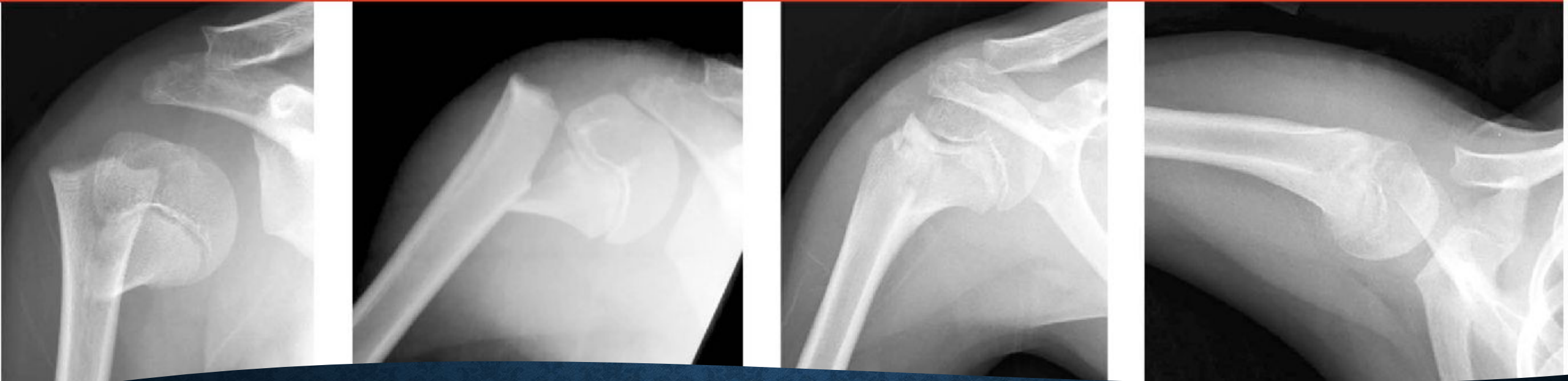


Figure 3

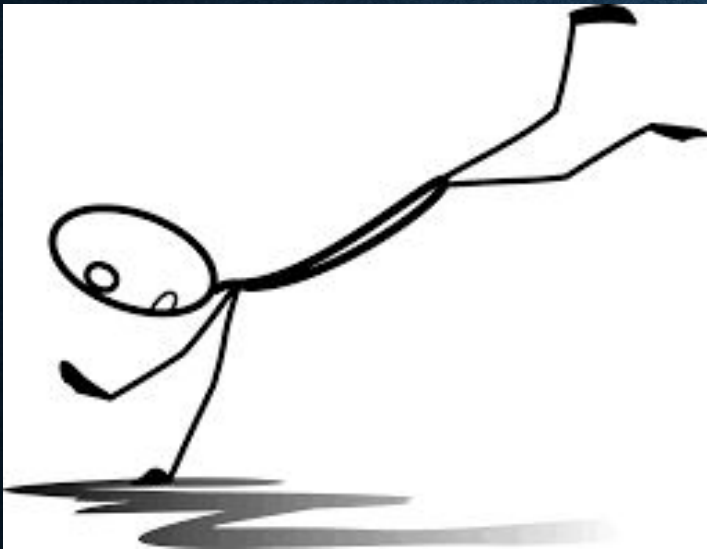


PROXIMAL HUMERUS FRACTURES

• Treatment

- Immobilization
 - Acceptable alignment for non-operative management
 - <10 years old = any degree of angulation
 - 10-12 years old = up to 60-75° of angulation
 - >12 years old = up to 45° of angulation or 2/3 displacement

WRIST FRACTURES



- Most common fracture in children under 16
- ~ 1/4 of all pediatric fractures
- Typically results from a fall on an outstretched hand
- Fracture patterns vary based on patient age

WRIST FRACTURES

- Clinical Evaluation
 - Pain
 - Swelling
 - Deformity
 - Reduced wrist range of motion
 - Refusal to use limb



WRIST FRACTURES



- . Radiographic evaluation
- . 2 views of the wrist

WRIST FRACTURES



- Buckle fractures
- Common in younger children (0-8)
 - Treated in a cast / brace for 4 weeks
- Universally do well



WRIST FRACTURES

- Growth plate fractures
 - More common in older children (8-14)
 - May need closed reduction +/- percutaneous pinning for displaced fractures followed by cast immobilization x 6 weeks
 - The greater the degree the displacement the greater the risk of growth arrest

SCAPHOID FRACTURES

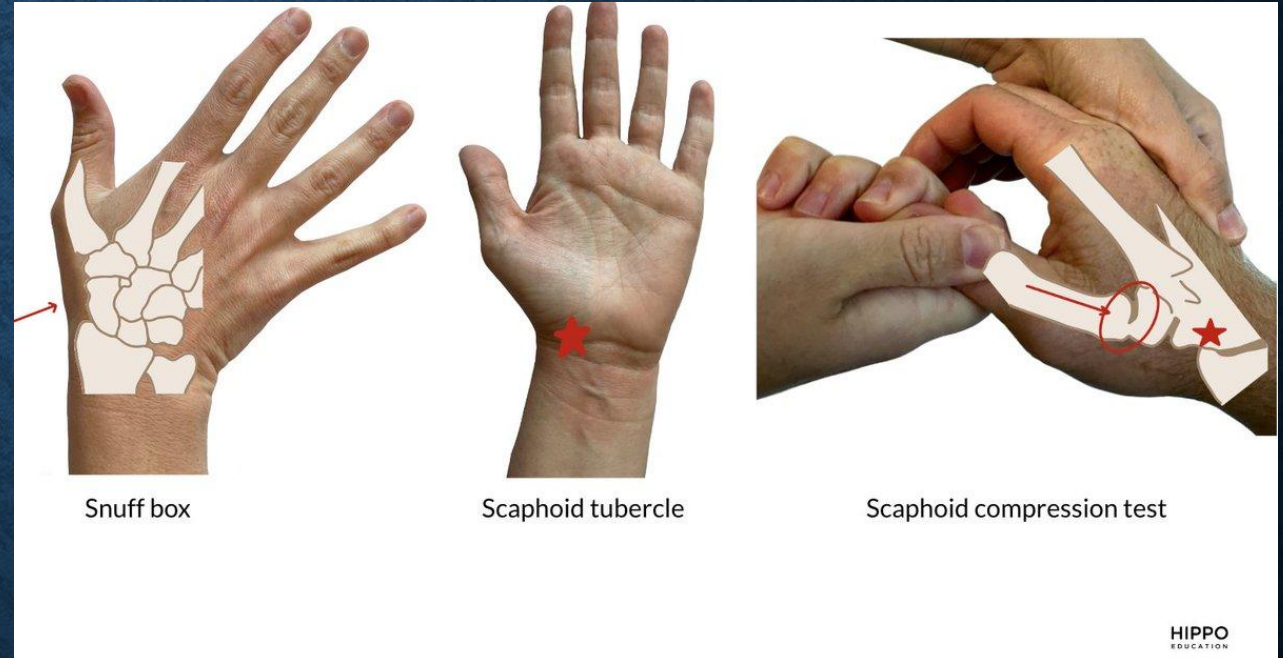
- Most common carpal bone fracture
- Fall on outstretched hand
- Patients complain of wrist pain
- Swelling but rarely ecchymosis or deformity
- Pain with wrist ROM



SCAPHOID FRACTURES

- Anatomic snuffbox tenderness dorsally
- Scaphoid tubercle tenderness volarly
- Scaphoid compression test

- Pain reproduced with axial load applied through the thumb metacarpal



SCAPHOID FRACTURES

- Diagnosis
 - 4 views of affected wrist
 - Radiographs can be negative initially (about $\frac{1}{4}$ of the time)
 - Repeat radiographs in 7-14 days
 - MRI
 - CT

SCAPHOID FRACTURES

- Treatment

- Thumb spica cast

- Nondisplaced fracture

- Surgery

- Displaced fracture

← Scaphoid Fracture

- Some athletes with nondisplaced fracture

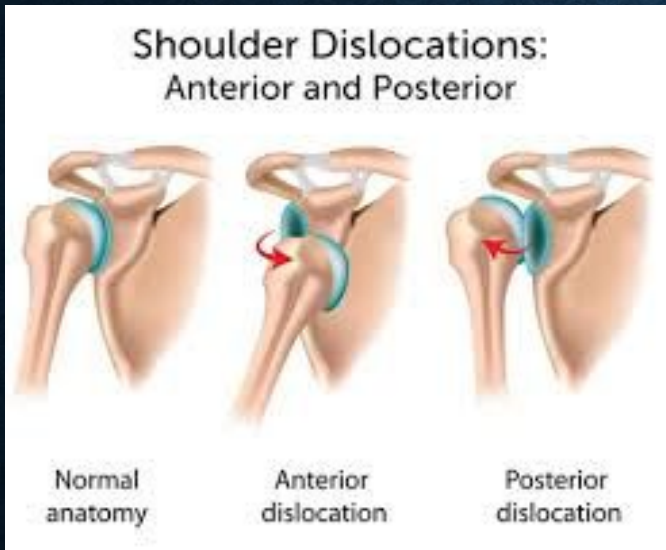
- Decreased time to union, faster return to sport

SCAPHOID FRACTURES

- Complications
 - Nonunion
 - 5-10%
 - Avascular necrosis
 - 13-50%
 - Worse with more proximal fractures
 - Malunion
 - Arthritis

UPPER EXTREMITY DISLOCATIONS

SHOULDER DISLOCATION



- 10% of all shoulder dislocations occur from age 10-20
- Vast majority are anterior dislocations (> 90%)
 - Typically occurs with the shoulder in abduction and external rotation
- Posterior dislocations are more rare
 - Seizures or electric shock common causes

SHOULDER DISLOCATION



- Symptoms

- Pain
- Deformity to the shoulder
 - Anterior Dislocation
 - Upper extremity held in slight abduction and elbow flexed
 - Squaring of the shoulder
 - Posterior Dislocation
 - Less deformity - Upper extremity held in adduction and internal rotation

SHOULDER DISLOCATION

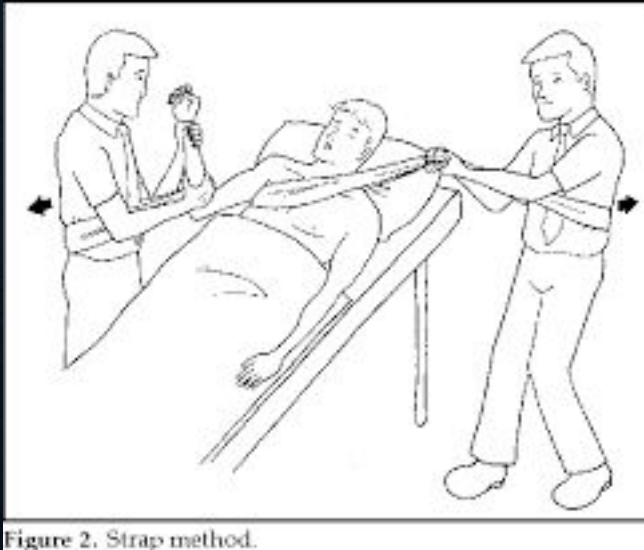
- Radiographic Evaluation

- AP, axillary lateral, +/- scapular Y

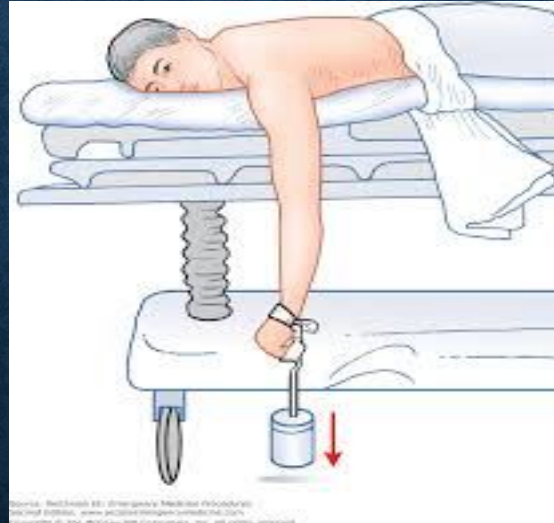


SHOULDER DISLOCATION

- Treatment
 - Urgent closed reduction
 - Sling immobilization



Traction –
Counter
Traction

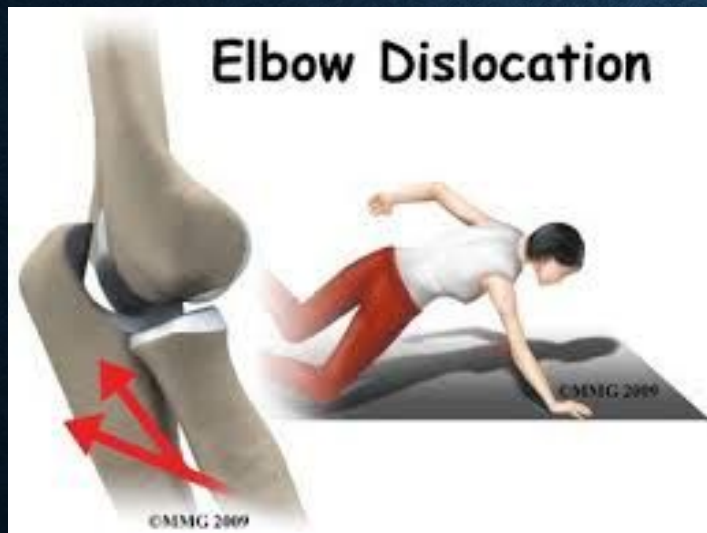


Stimson
Technique



Posterior Dislocation –
In Line Traction and
Lifting of Humeral Head

ELBOW (ULNOHUMERAL) DISLOCATION



- 3-6% of all elbow injuries
- Peak age 13-14
- High incidence of associated fractures
 - Medial epicondyle, coronoid, radial head and neck
- Most commonly occurs after a fall on an outstretched hand or elbow

ELBOW (ULNOHUMERAL) DISLOCATION



Symptoms of Elbow Dislocation

- Bruising is present
- Swelling is present
- Severe pain
- Deformity of the elbow joint
- Warmth may be present
- Inability to move the elbow

For More Information,
Visit: www.epainassist.com



- Radiographic Evaluation

- 2 views of the elbow

ELBOW (ULNOHUMERAL) DISLOCATION

ELBOW (ULNOHUMERAL) DISLOCATION

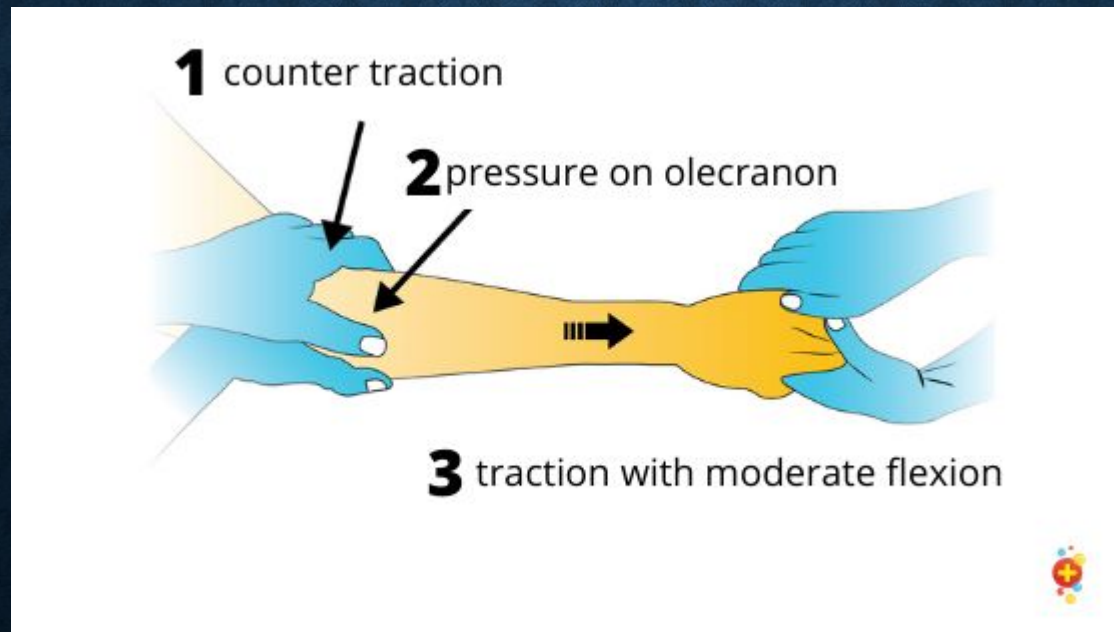
- Treatment

- Urgent reduction and splinting
- Typically splint for about a week
- Meticulous analysis of post reduction to ensure concentric reduction with no incarcerated fragments
 - Medial epicondyle



ELBOW (ULNOHUMERAL) DISLOCATION

- Reduction
 - inline traction to improve coronal displacement
 - forearm supination to shift the coronoid under the trochlea
 - elbow flexion while placing direct pressure on tip of olecranon

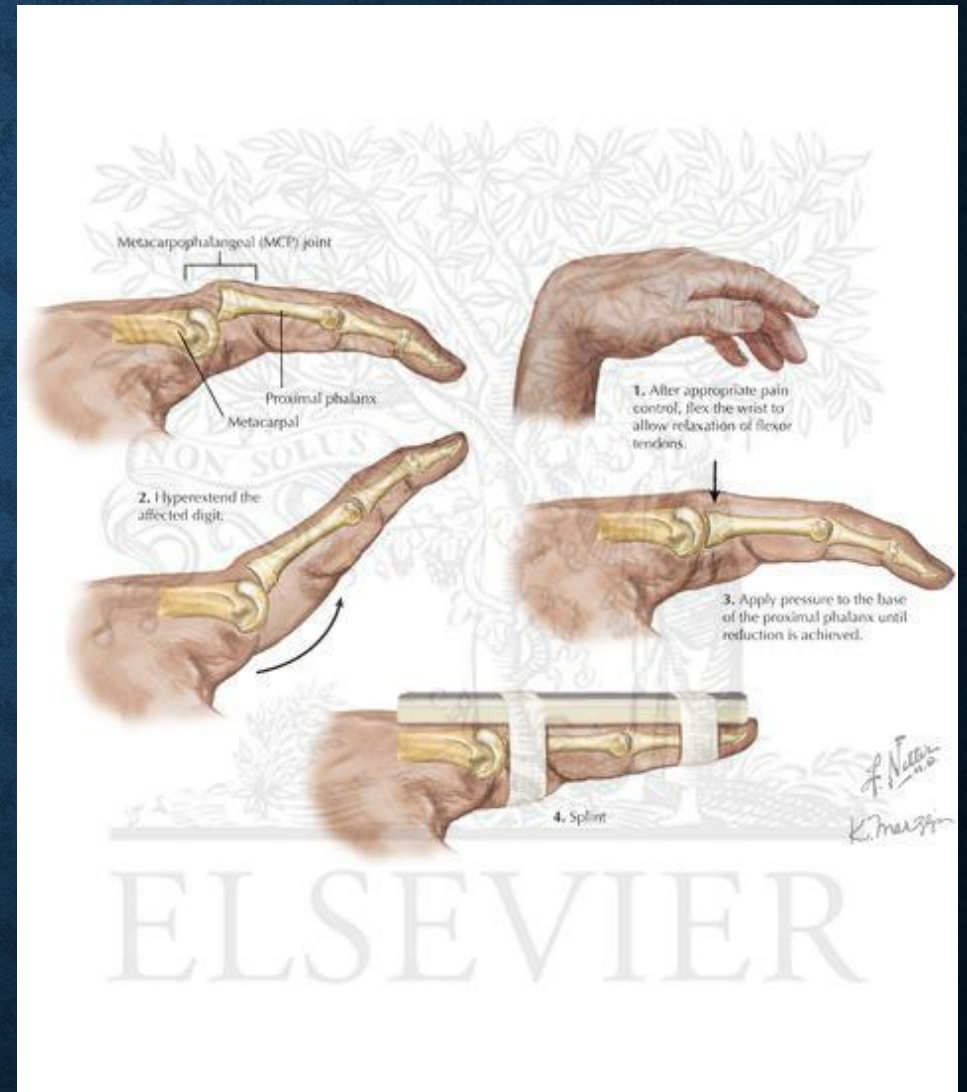


METACARPOPHALANGEAL DISLOCATION

- Usually dorsal
- Index finger most common, followed by thumb
- Fall onto hand
- Diagnose clinically and with radiographs
- Treatment
 - Closed reduction
 - Open reduction for complex dislocations
 - Bayonet positioning of proximal phalanx with skin dimpling in proximal palmar crease

METACARPOPHALANGEAL DISLOCATION

- Closed reduction
 - Direct pressure over dorsal/volar aspect of proximal phalanx
 - Dorsal pressure for dorsal dislocation / volar pressure for volar dislocation
 - Wrist in flexion
 - Avoid simple longitudinal traction as it may pull the volar plate into the joint making reduction irreducible
 - Splint

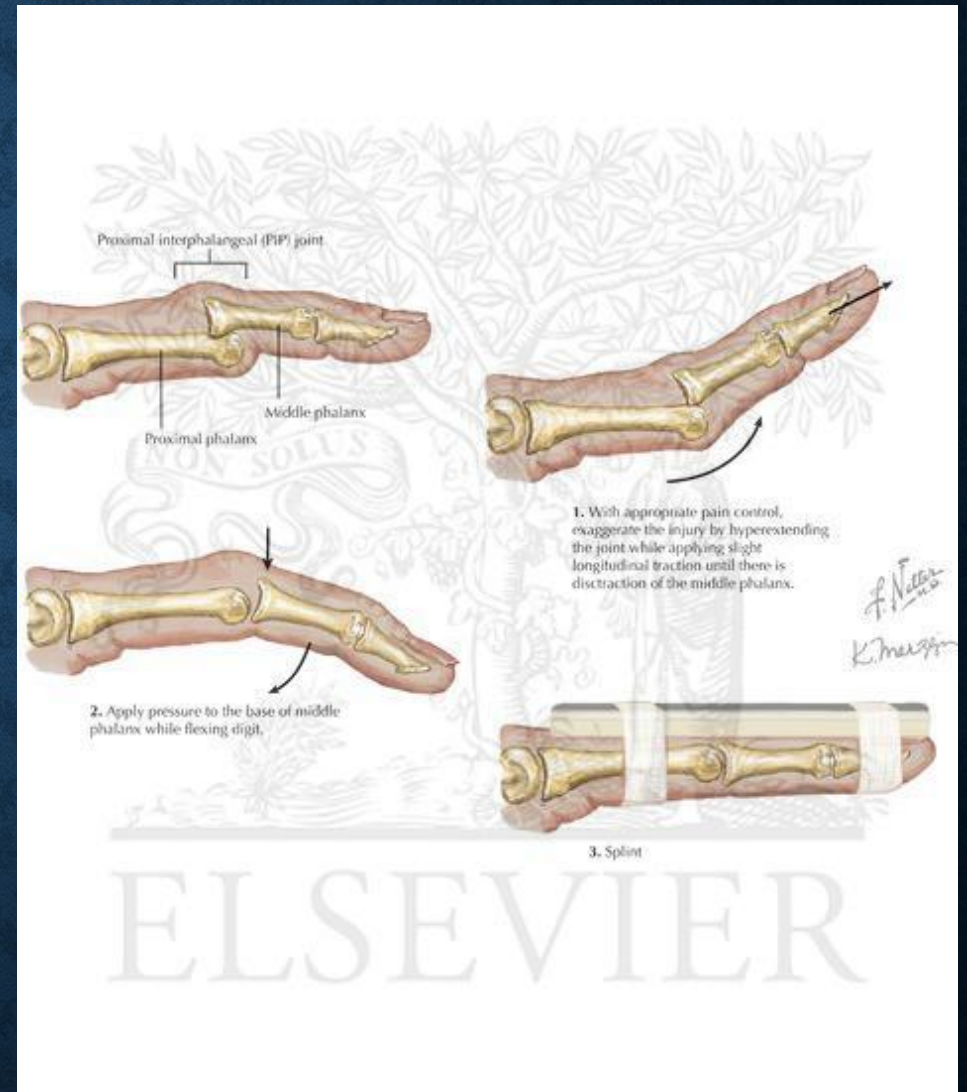


PHALANX DISLOCATIONS

- Can involve the PIP or DIP joint
- Dorsal dislocations more common than volar
- Usually from a direct blow
- Pain and deformity of digit
- Diagnose clinically and with radiographs
- Treatment
 - Closed reduction
 - Open reduction for failed closed reduction

PHALANX DISLOCATIONS

- Exaggerate the injury
- Longitudinal traction
- Direct pressure on distal aspect
- Splint



LOWER EXTREMITY FRACTURES

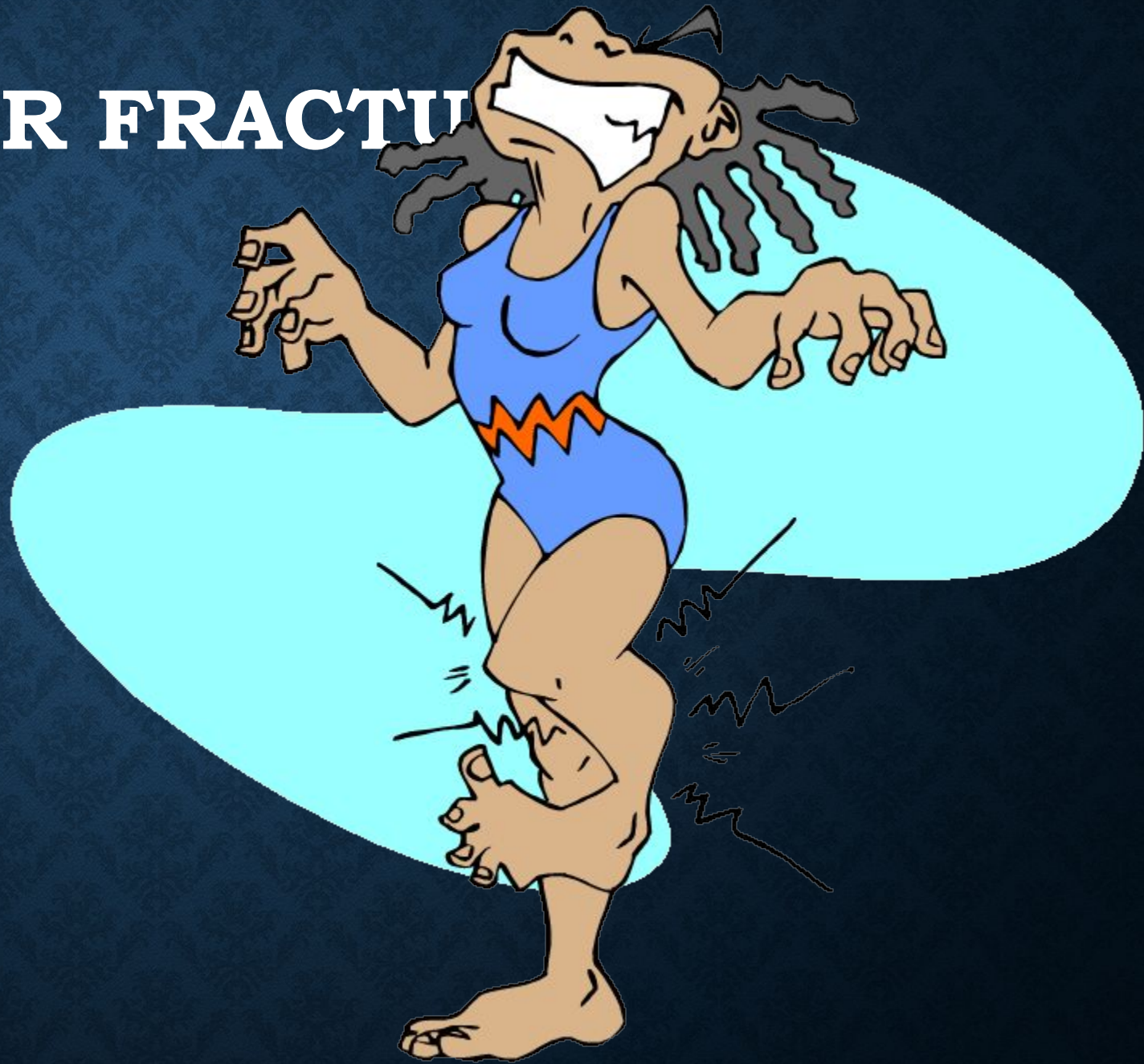
FEMUR FRACTURES

- 1.6% of all pediatric fractures
- Bimodal distribution of incidence
 - Peak between age 2-4
 - Peak during mid-adolescence
- Higher incidence during summer
- Non-ambulators – 80% secondary to non-accidental trauma
- Mechanism varies



FEMUR FRACTURE

- Symptoms
 - Inability to ambulate
 - Extreme pain
 - Swelling
 - Deformity



FEMUR FRACTURES

- Radiographic Evaluation
 - 2 views of entire femur



FEMUR FRACTURES

- Treatment

- Based on age

- < 6 months

- Pavlik harness

- 6 months- 4 years old

- Spica cast

- > 4 - ~ 10
 - Flexible intramedullary nails
- > 10
 - Plate and screws vs rigid nail



Hip Spica Cast

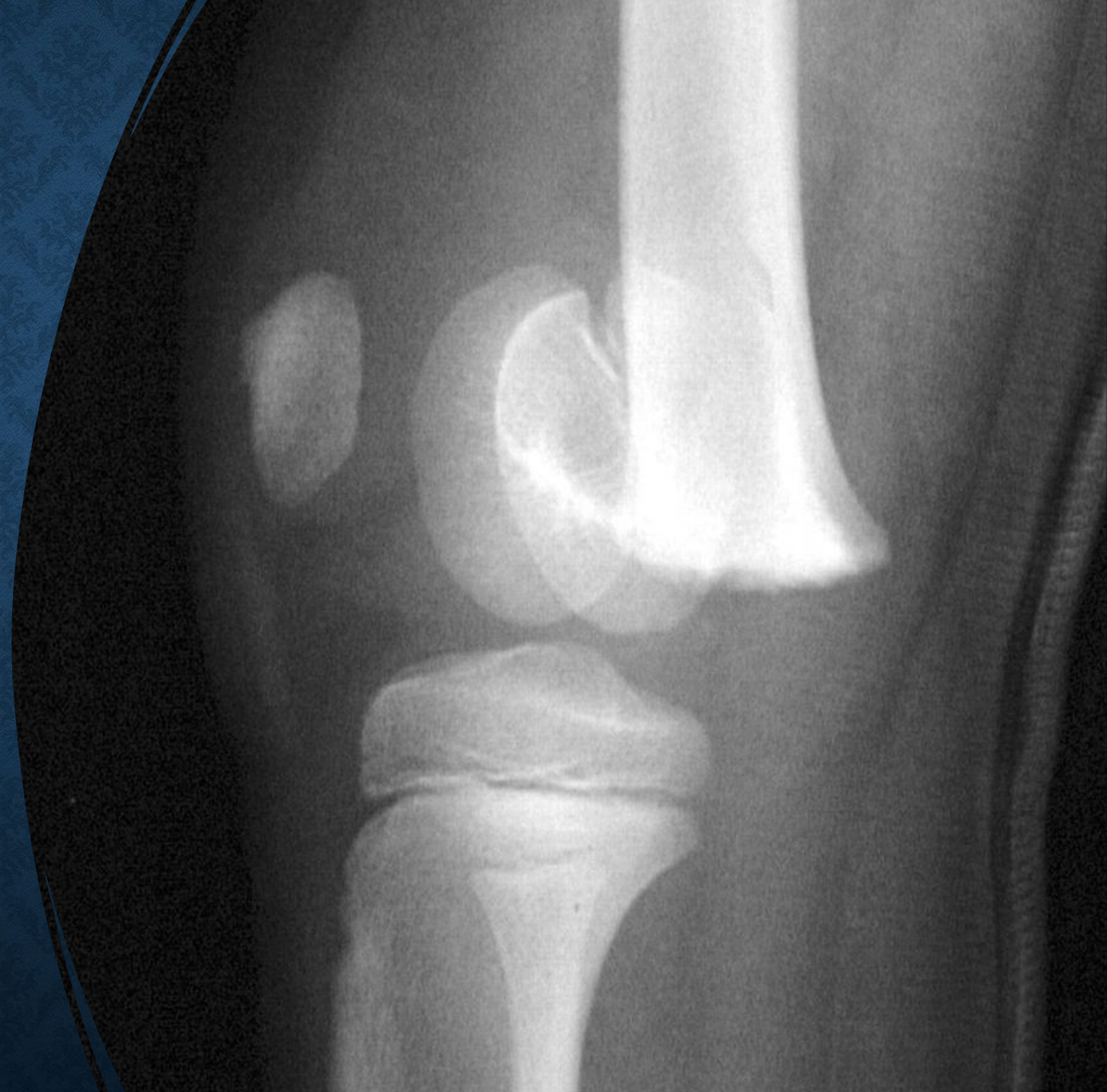
DISTAL FEMORAL PHYSEAL FRACTURES

- Common from direct trauma
 - Valgus force or hyperextension
- Can present similar to collateral ligament injury
- Salter Harris 2 most common, followed by Salter Harris 3 and 4



DISTAL FEMORAL PHYSEAL FRACTURES

- Growth arrest is common
 - 36% of SH 1 fractures
 - 58% in SH 2 fractures
 - 49% in SH 3 fractures
 - 64% in SH 4 fractures



DISTAL FEMORAL PHYSEAL FRACTURES

- Treatment
 - Long leg cast – nondisplaced fractures
 - CLOSE FOLLOW UP
- Operative most of the time



TIBIAL EMINENCE FRACTURE

- Tibial spine fracture
- Intra-articular fracture at the bony attachment of the ACL on the tibia
- Age 8-14
- Same mechanism as ACL tear
- Associated injuries
 - Meniscal injury
 - Collateral ligament injury
 - Capsular damage
 - Osteochondral fracture



TIBIAL EMINENCE FRACTURE

- Presents like ACL tear
- Swelling
- Pain
- Difficulty with weightbearing
- Positive Lachman's and anterior drawer sign
- Diagnose with x-ray, CT, MRI



TIBIAL EMINENCE FRACTURE

- Treatment
 - Nonoperative
 - Nondisplaced fracture
 - Cast or brace in extension
 - Operative
 - Displaced fractures
 - Open reduction or arthroscopic reduction
 - Screw or suture fixation



TIBIAL TUBERCLE FRACTURE

- Common in adolescent boys near the end of skeletal growth
 - Age 12-15
- Occur during athletic activity
 - Basketball, football, sprinting, high jump
- Concentric contraction of the quads muscle during jumping



TIBIAL TUBERCLE FRACTURE

- Symptoms
 - Sudden onset of pain
 - Inability to ambulate
 - Swelling to anterior knee
 - Extensor lag or deficiency
 - Compartment syndrome



TIBIAL TUBERCLE FRACTURE

- Radiographs

- AP and lateral



- Treatment

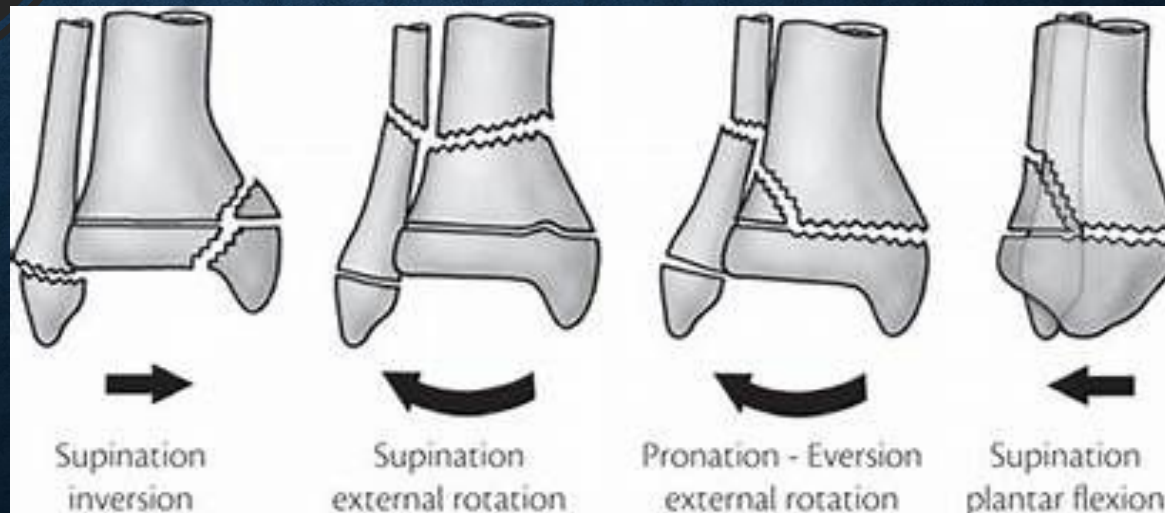
- Long leg cast x 6 weeks
 - Minimally displaced fractures

- Open reduction internal fixation



ANKLE FRACTURES

- 10-40% of all injuries in skeletally immature athletes
- Male : Female - 2:1
- Age 8-15
- Risk Factors
 - Sports participation
 - Obesity
- Twisting injury or direct blow



ANKLE FRACTURES

- Clinical Evaluation
 - Pain to ankle
 - Inability to ambulate
 - Swelling
 - Ecchymosis
 - Tenderness to ankle
 - Deformity



ANKLE FRACTURES

- Radiographic Evaluation
 - 3 views of ankle



ANKLE FRACTURES

- Salter Harris I Distal Fibula



- Common in growing athletes
- Pain over lateral ankle
- Swelling over lateral ankle
- Tender over distal fibula physis
- Xrays - normal aside from lateral swelling
- Treated with cast or walking boot x 4 weeks
- Excellent outcomes
 - Growth arrest very rare

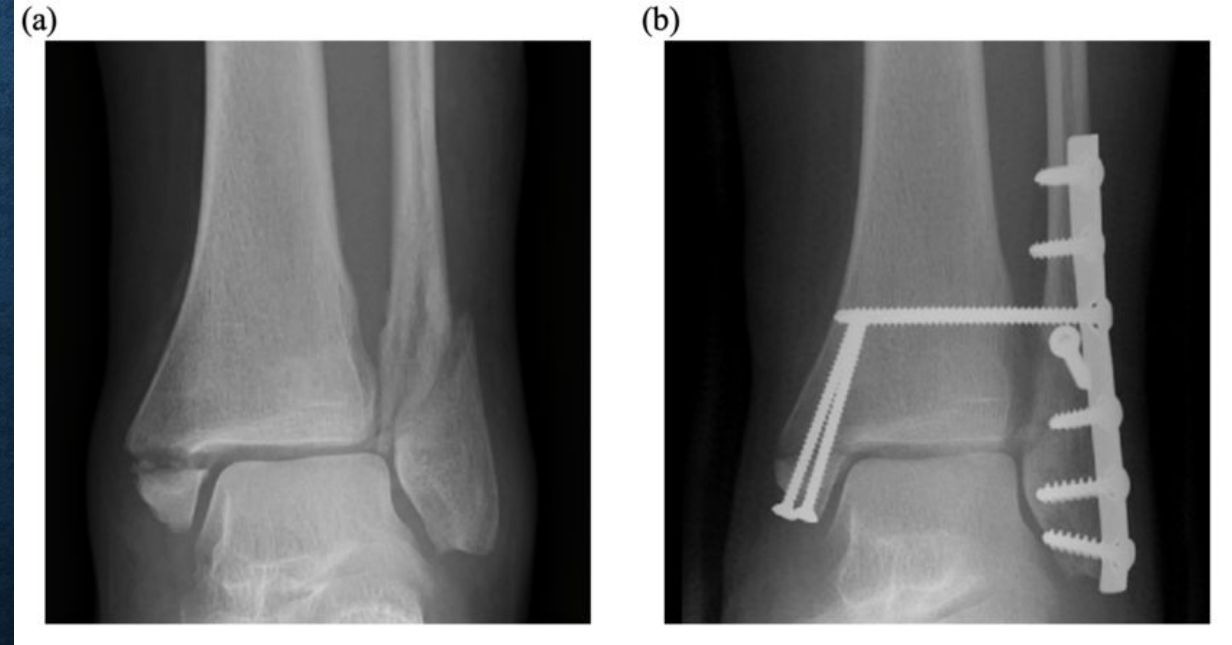
ANKLE FRACTURES

- Physeal Fractures
 - Account for 25-40% of all growth plate fractures
 - Any degree of displacement requires operative treatment



ANKLE FRACTURES

- Nonoperative management – Boot or cast
 - Nondisplaced medial or lateral malleolus fracture
 - Avulsion fractures
- Operative management
 - Displaced fractures



LOWER EXTREMITY DISLOCATIONS

PATELLAR DISLOCATION

- Common in athletes
 - More common in women
- Non-contact injuries
- Risk factors:
 - Female gender
 - Femoral Anteversion
 - Patella Alta
 - Trochlear Dysplasia
 - Increased Q angle
 - Lateralized tibial tubercle (Increased TT-TG distance)
- Genu Valgum
- External tibial torsion
- Prior patellar dislocation
- Ligamentous laxity
- Collagen disorders (i.e. Ehlers-Danlos)
- Vastus medialis obliquus (VMO) and core weakness

PATELLAR DISLOCATION

- Clinical Evaluation
 - Often reduce spontaneously
 - Hemarthrosis
 - Inability to flex knee
 - Deformity



PATELLAR DISLOCATION



- . Radiographic Evaluation
 - . 3 views of the knee
 - . AP/ lat / Sunrise

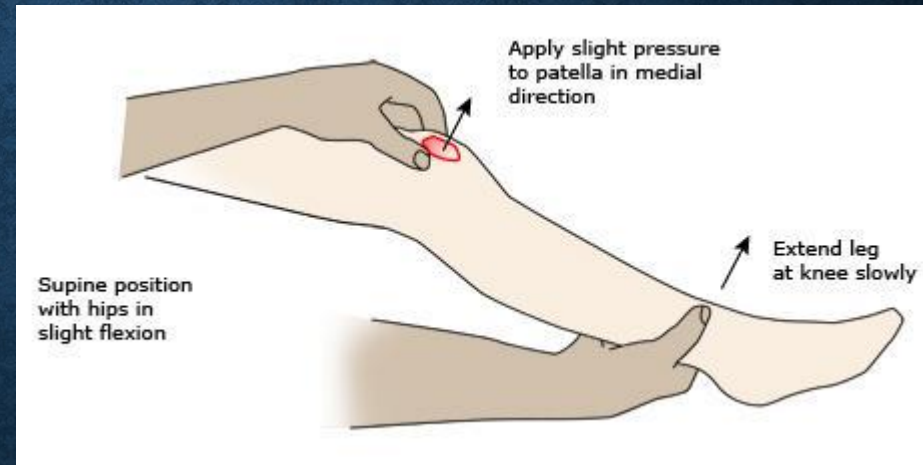


PATELLAR DISLOCATION

- Treatment
 - Gentle reduction and immobilization
 - Knee immobilizer
 - Surgery
 - Recurrent cases
 - Osteochondral fracture / loose body

PATELLAR DISLOCATION

- Push patella medially
- Extend the leg





SUMMARY

SUMMARY

- Children can sustain a variety of unique fractures
- Nondisplaced fractures are typically treated non-operatively
- Displaced fractures often require surgical intervention
- Dislocations should be reduced urgently



THANKS!

Questions?