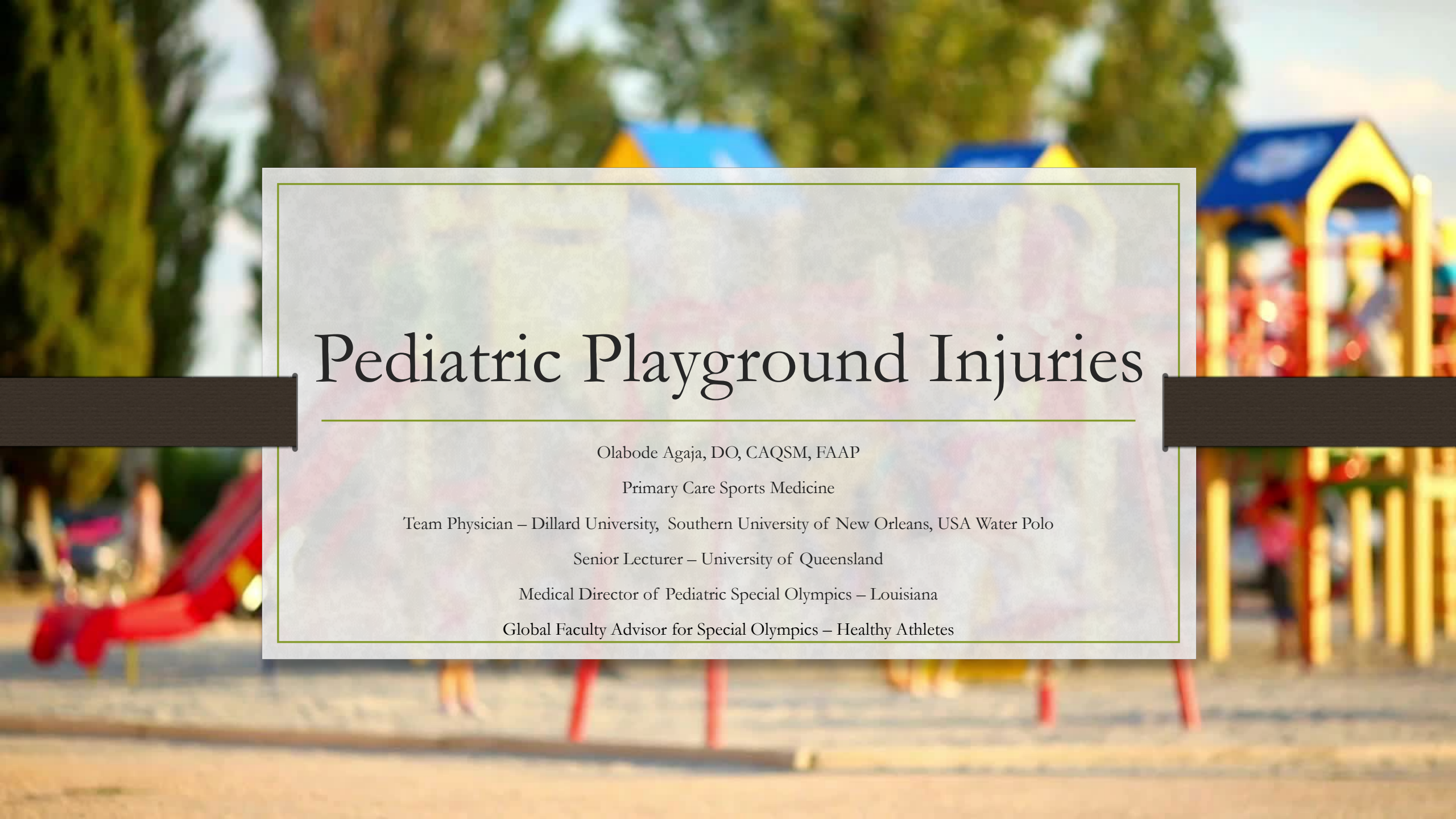


Pediatric Playground Injuries

Olabode Agaja, DO, CAQSM, FAAP

Primary Care Sports Medicine

Team Physician – Dillard University, Southern University of New Orleans, USA Water Polo

Senior Lecturer – University of Queensland

Medical Director of Pediatric Special Olympics – Louisiana

Global Faculty Advisor for Special Olympics – Healthy Athletes

Disclosures

- I have no disclosures

https://republicaimg.nagariknewscdn.com/shared/web/uploads/media/sports_20230518163956.jpg

Objectives

- Understand how the developing pediatric bone differs from the adult bone
- Learn about common school related injuries
- Learn the mechanism, presentation, and best practices for:
  - Upper Extremity Fractures
  - Splinting Basics
  - Upper Extremity Dislocations
  - Lower Extremity Injuries
  - Concussion
    - Initial Management
    - When to send to hospital
  - Lacerations, Foreign Bodies, and Tooth Avulsions

Playground Injuries – The Stats

- 200,000+ children/year in U.S. Emergency Departments for playground injuries
- ~ 75% are caused by falls
- ~ 35% of injuries result in fracture
- ~ 20% of injuries cause lacerations

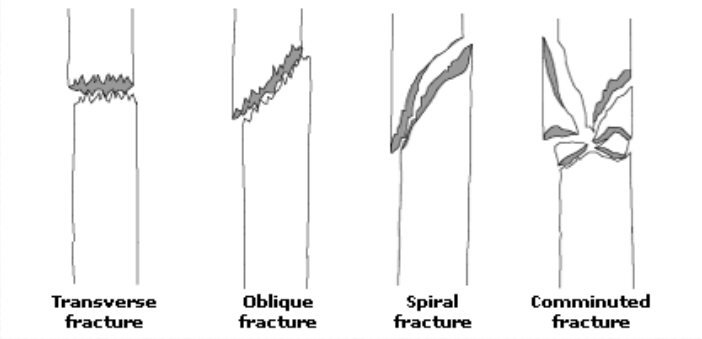
https://head2toefirstaid.com.au/wp-content/uploads/2019/06/Child-fall3-scaled.jpeg

The Developing Bone – How does it differ?

- The pediatric bone is less dense and more porous than adult bone
  - Easier to bend/fracture the bone
- Ligaments are strong in comparison to bone
  - The physis tends to be the weakest part of the bone
  - Therefore, ligament injuries and dislocations are less common
- **Kids tend to sustain fractures before sprains**
  - When fractures do occur, they commonly heal quickly and remodel well

Pediatric Fracture Patterns

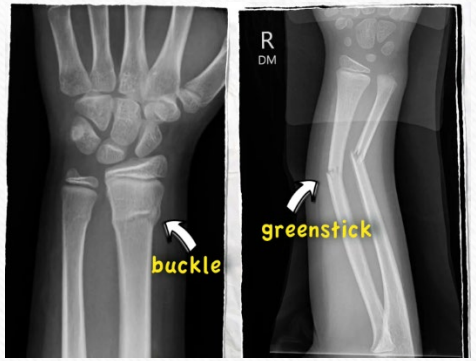
- Pediatric patients can sustain complete fractures similar to adults
  - Transverse fractures
  - Oblique fractures
  - Spiral fractures
  - Comminuted fractures

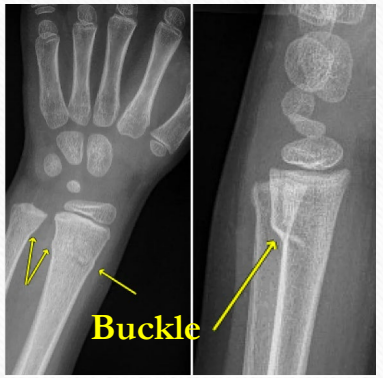


https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcTuQG-5haNnTF6pz-d_70j3-2iFCpK6oztYCA&s

Pediatric Fracture Patterns

There are also fractures that are unique to pediatric patients



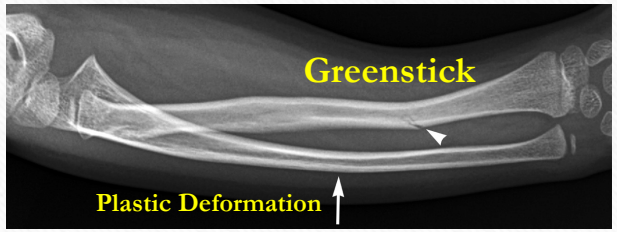


Buckle (Torus) Fracture

- Compression/impaction injury of a single cortex
  - Often subtle radiographically

Greenstick Fracture

- Incomplete fracture
- Disruption of cortex on the tension side while opposite cortex remains intact.
  - Commonly occurs in diaphysis

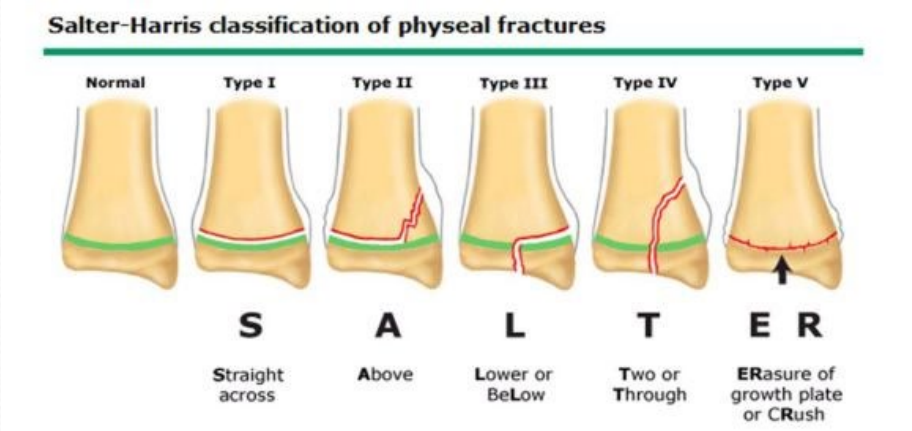


Plastic Deformation

- Bone shape is altered without fracture (bowing)
  - Common in ulna or fibula

Pediatric Fracture Patterns

- Continuation of unique pediatric fractures
  - **Physeal Fractures**
    - Highest incidence in preadolescent period
    - **Salter-Harris classification**
      - The **standard method** for classifying physeal fractures
      - Describes the plane or trajectory of the fracture relative to the physis



https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcSNO_w7642_mFQQTHD44z4t4uRRBAzN42Uybg&s

Clinical Clues – How Does It Present?

Pediatric patients can be poor historians

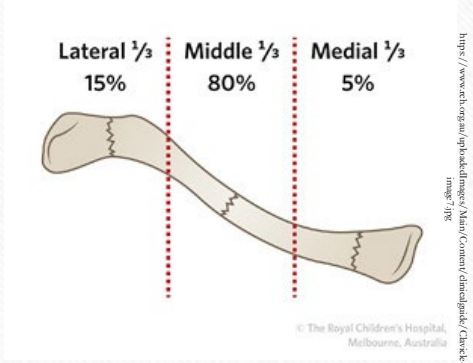
- Consider mechanism of action
  - Was there a fall?
  - Was it witnessed?
    - Monkey bars, slide, swings, etc.
- Assess for swelling, bruising, deformity
  - Not always present
  - May only restrict motion of the affected extremity
- Are they able to bear weight?
  - Is there a limp?

https://www.creativesystems.com/wp-content/uploads/2022/10/Untitled-design-2.jpg

Upper Extremity Injuries

Clavicle Fractures

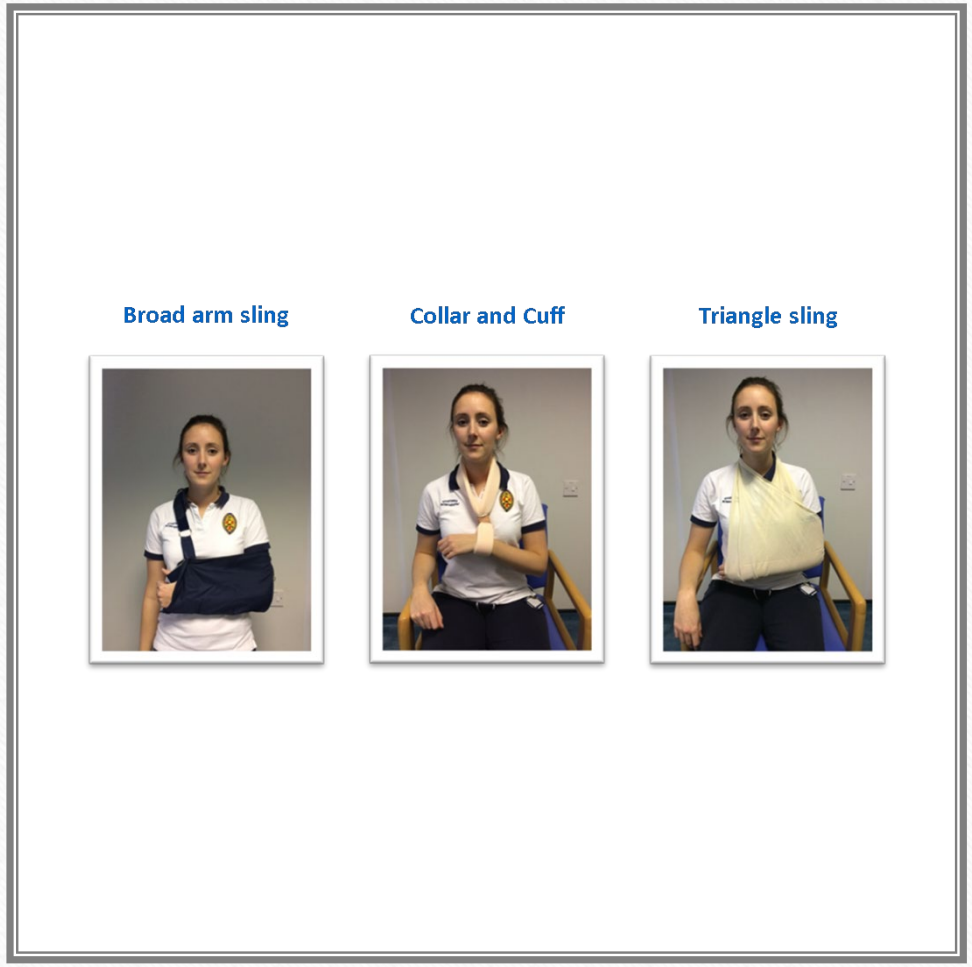
- **Mechanism:**
  - Fall onto shoulder
  - Direct blow



https://www.rch.org.au/uploadedImages/Main/Content/clinicalguide/Clavicle-image_1.jpg

- **Presentation:**
  - Pain with any movement of shoulder
  - A bulge is often visible at the fracture site
  - Point tenderness at fracture site
  - Tenting of skin may occur if fragments displaced
    - Can be associated with pneumothorax, hemothorax, and neurovascular injury
    - Require more urgent/emergent referral to ED


https://orthoinfo.aaos.org/globalassets/figures/a00072f03.jpg



Clavicle Fractures

- **Treatment (on the playground):**
  - Assess for tenting
  - Assess vascular status
    - Pulse, Capillary Refill, Strength/Sensation
      - Compare to uninjured side
  - Immobilize the shoulder via alternative sling methods
- **Treatment (in office):**
  - Confirm diagnosis (via x-ray)
  - Immobilize in sling (until pain free ROM below shoulder level)
  - Return to contact sport typically 2 months

Figure 4-9. Application of triangular bandage to form slin

Splint/Sling Alternatives

If at playground:

- Stick to support effected extremity → can secure with belt, shoestring, etc.
- Sweatshirt → place injured arm inside and tie sleeves around neck
- Belt → cradle arm like sling, tie at neck

If at school:

- Cardboard (tie above & below affected area)
- Ruler (great for forearm/wrist, secure with hair ties or tape)

Supracondylar Fractures

The most common source of severe injuries in children

- Commonly occur via low-energy mechanisms

- **Mechanism:**
  - Fall on an outstretched hand (FOOSH)

- **Incidence:**
  - Average age 4 to 8 years old
  - But may occur between walking age and 12 years old

- **Presentation:**
  - In mild fractures, no history other than they do not want to use it
  - Otherwise, present with elbow swelling, loss of ROM, +/- deformity

https://www.indianahandtoshoulder.com/wp-content/uploads/toddler-with-nursemaids-elbow.jpg

Supracondylar Fractures

Treatment (on the playground):

- Assess vascular status
  - Color, Temperature, Pulse, Capillary Refill, & Strength/Sensation
    - Compare to uninjured side
- Neurovascular compromise more likely if the child fell from an elevated height
  - Tree, Playground Equipment, Window
- If there is an obvious fracture the arm should not be manipulated or painfully positioned
- Immobilize the elbow above and below the joint via a splint

https://www.verywellhealth.com/thmb/wwPmfCIc8kw__j-AlbH2k3-i59M=/1500x0/filters:no_upscale():max_bytes(150000):strip_icc()/Arm10-56a2f3913df78cf7727b45d0.jpg

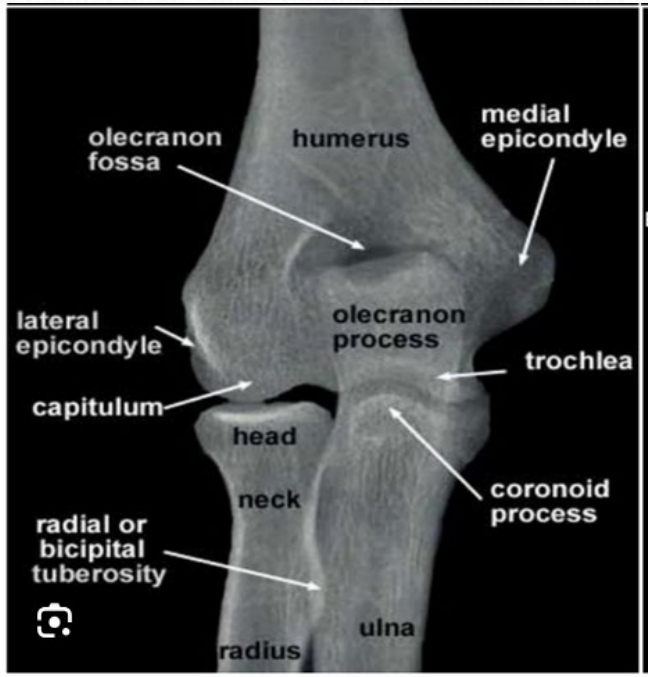
Supracondylar Fractures

- **In office:**
  - Diagnose via radiographs
- **Pearls:**
  - Knowledge of the appearance of the ossification centers in the pediatric elbow is essential to help guide treatment
- **Elbow Ossification Centers:**
  - **Mnemonic: "CRITOE"**
    - **C**apitellum: **1** Y
    - **R**adial head: **3** Y
    - **I**nt. epicondyle: **5** Y
    - **T**rochlea: **7** Y
    - **O**lecranon: **9** Y
    - **E**xt. epicondyle: **11** Y

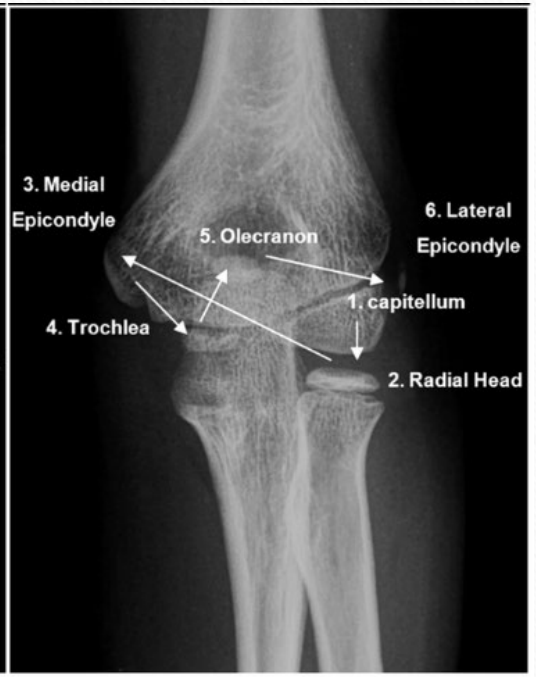
Supracondylar Fractures

Ossification Centers	Age at appearance (years)	Age at closure
Capitellum	1	14
Radial head	3	16
Internal epicondyle	5	15
Trochlea	7	14
Olecranon	9	14
External epicondyle	11	16

Supracondylar Fractures

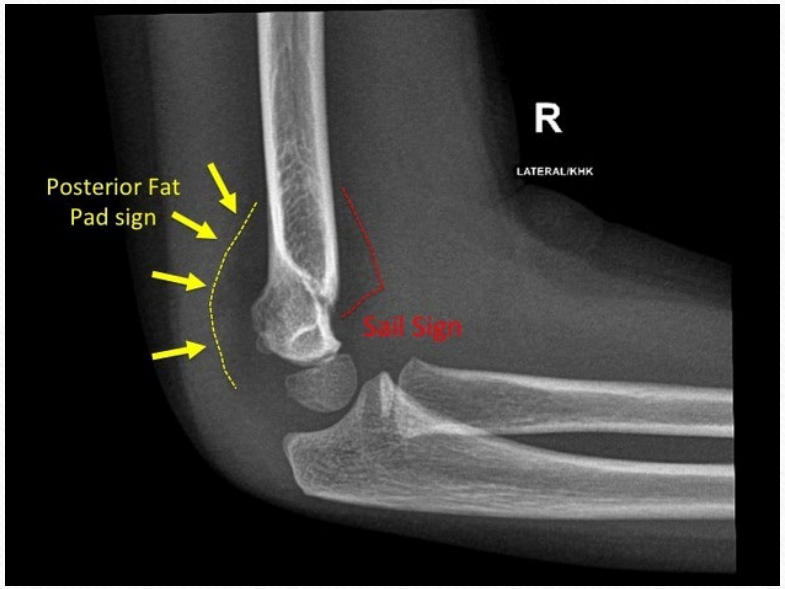


Adult Elbow



Pediatric Elbow

Supracondylar Elbow Fractures

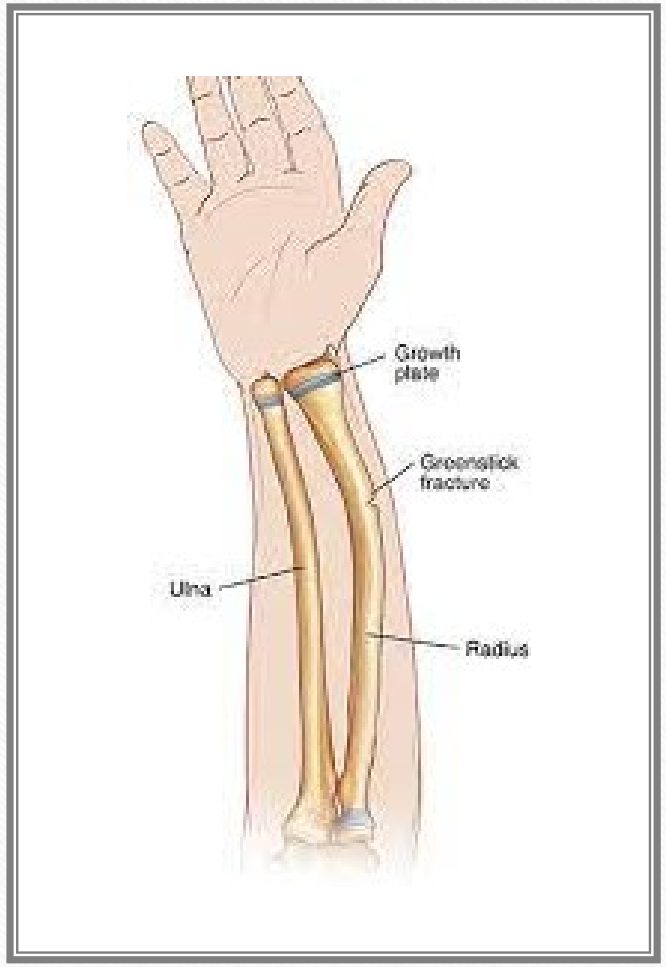


https://prod-images-static.radiopaedia.org/images/31668954/c4def9fb9e763fa5341f0b803cc245.jpg

- Occult supracondylar elbow fractures are identified by effusion on x-ray
- **How do we assess for an effusion?**
  - **Elbow Fat Pad Signs**
    - Anterior Fat Pad
      - Normal if lying flat against the humerus
      - Abnormal when extended/elevated = **"sail sign"**
    - Posterior Fat Pad
      - If present, always abnormal
    - Abnormal anterior or posterior fat pad **indicates hemarthrosis**
      - Fracture more likely at the distal humerus or proximal radius/ulna

Elbow Fractures

- **Treatment (in office):**
  - If nondisplaced, treat with a long arm splint or cast for 3 weeks
    - Refer, if displaced, as little to no remodeling occurs at distal humerus
  - Return to contact sport/activity 6-8 weeks

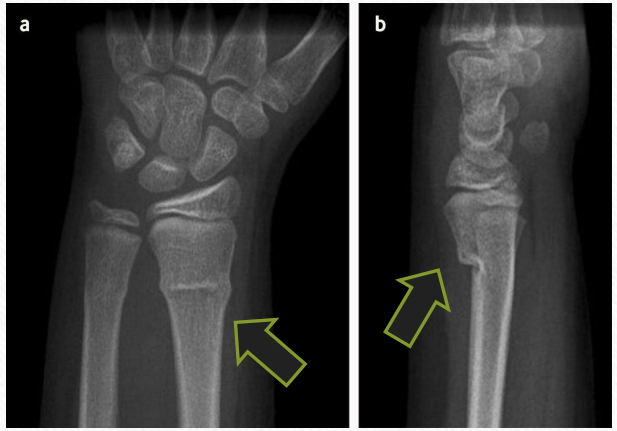


Forearm Fractures

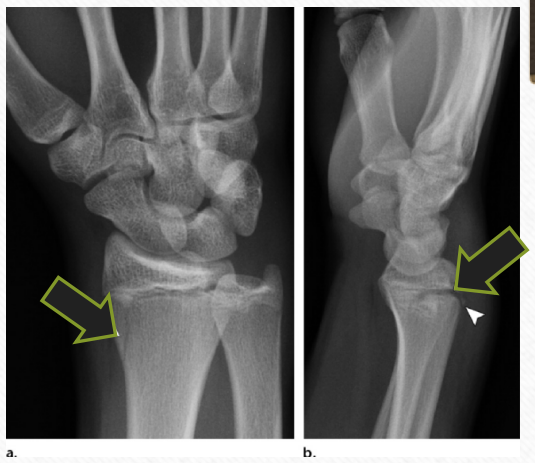
- Distal
  - >75% of fractures occur at the radius and ulna
- Mid-shaft
  - 18-20%
- Proximal
  - ~4%

Distal Forearm Fractures

- **Mechanism:**
  - FOOSH
  - Direct blow
- **Fracture Patterns:**
  - Can range from buckle fractures to displaced and angulated or overriding fractures of the distal radius/ulna
- **Presentation:**
  - May have no swelling, bruising, or deformity
  - Parents commonly mistaken for "a sprain"
  - Physical exam may reveal loss of supination and tenderness over distal radius



Distal Radius Buckle Fracture



Distal Radius Salter Harris II Fracture

Distal Forearm Fractures

- **Treatment (on the playground):**
  - Assess vascular status
    - Color, Temperature, Pulse, Capillary Refill, & Strength/Sensation
  - Immobilize the forearm above and below the fracture via a splint
- **Treatment (in office):**
  - If nondisplaced, buckle fracture of distal radius/ulna can immobilize in:
    - Cock-up wrist brace
    - Short arm exos brace
      - ~ 4 weeks of immobilization
  - Other fracture patterns of the distal radius/ulna consider cast or short arm exos brace
  - Return to contact sport/activity in 4-6 weeks (can sometimes play in brace)

https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcRHLFMmVz08o2DLBBifoIMBRRy4lMubE2kdQ&s

Finger Fractures

- **Mechanism:**
  - Blunt Trauma (slammed in door)
  - Hyperextension or Hyperflexion
  - Twisting Forces
- **Presentation:**
  - Swelling, pain, tenderness, ecchymosis
- **Treatment (on playground/in office):**
  - Buddy Tape
  - Splint with popsicle stick or finger splint (if available)

https://journals.sagepub.com/cms/10.1177/17531934241293338/asset/4a9e05f4-d65a-4ec3-8fad-1c3c50652101/assets/images/large/10.1177_17531934241293338-fig1.jpg

Subluxation/Dislocations

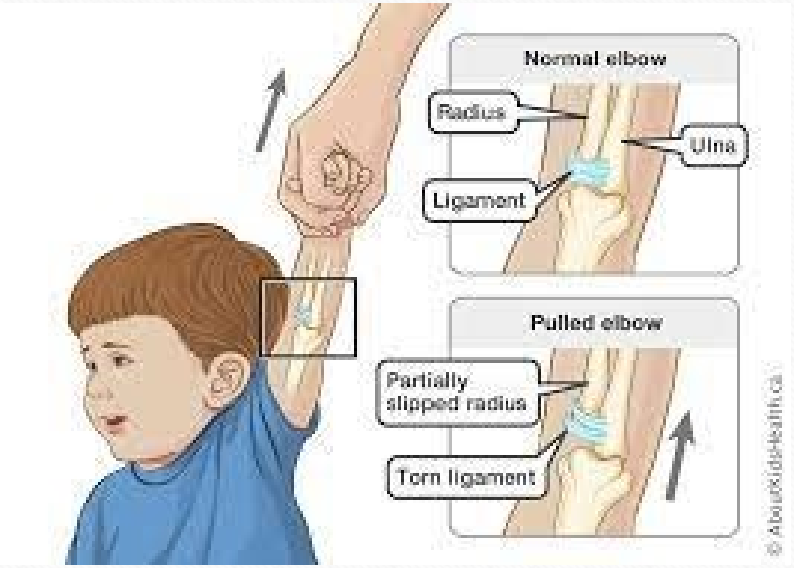
Nursemaid's Elbow

- Transient subluxation of the radial head caused by annular ligament displacement

- **Mechanism:**
  - Longitudinal traction to the arm or fall on outstretched arm

- **Incidence:**
  - Peak: 1-3 years of age
  - Can happen as young as 6 months to 10 years old

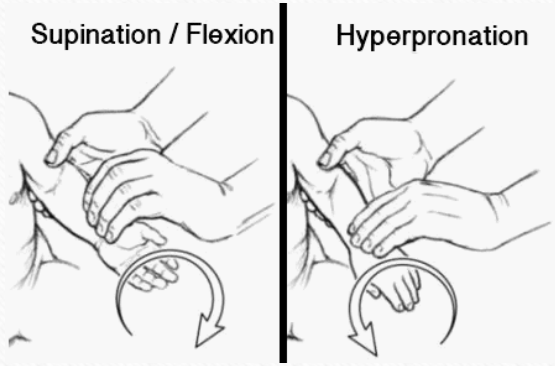
- **Presentation:**
  - Refusal to use the arm
  - Pain with attempted movement of elbow
  - Arm held in adduction against the body



https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcTmeQN_XZrTrMESjkz-ayIM6bl2J-fEKn5LgQ&s

Nursemaid's Elbow Reduction

- **Treatment Techniques (on the playground/in office):**
  - Supinate forearm, then flex
  - Hyper pronation
- **Supinate/flexion technique:**
  - Place thumb over radial head and supinate then fully flex the elbow with the other hand
  - There may be a palpable "click" or audible "clunk" with reduction
- **Hyperpronation Technique:**
  - Place thumb over radial head then hyperpronate the arm
  - May be less painful



https://epomedicine.com/wp-content/uploads/2020/04/pulled-elbow-reduction.gif

Nursemaid's Elbow – Additional Considerations

- They will resist/be hesitant
- If the event is unwitnessed and cannot rule out fracture, then defer reduction until x-ray's obtained
- Once reduced, observe the child until normal usage of arm
  - Usually occurs within 5-15 minutes but can take longer in apprehensive younger children
- If reduction unsuccessful, defer to pediatrician, urgent care, ED, etc.

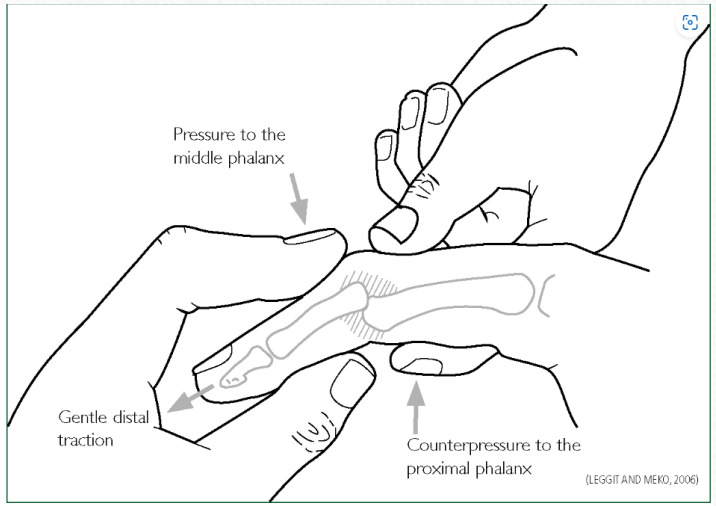
Dislocated Joints – Fingers

- Dorsal dislocations are the most common
- **Mechanism:**
  - Hyperextension injury
- **Presentation:**
  - Present with hyperextension deformity, pain, and swelling

https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQZNvHOzroISSYJyP5yowJZEnL0mXO-FOnCuA&s

Dislocated Joints – Finger

- **Treatment (on the playground/in office):**
  - Likely splint or put in comfortable position and defer to ED
  - If adequate training/comfortable can attempt to reduce



https://www.paramedicpractice.com/media/d0tjf4ve/jpar201799398_f05.jpg

Lower Extremity Injuries

Lower Extremity Injuries

- **Most Common**
  - Ankle Sprains
  - Strains
  - Contusions
  - Fractures
- **Presentation**
  - Swelling, pain, ecchymosis
  - Inability to bear weight

- **Treatment (on the playground):**
  - Splint/Immobilize
  - Crutches (if available)

Toddler Fracture

- Is an oblique or spiral fracture of the distal tibial shaft
- **Incidence:**
  - Occurs between 9 months and 6 years old
- **Mechanism:**
  - Minimal trauma, usually occurs during a trip or fall while running/playing
    - Torsional force to the foot results in fracture of the tibia
- **Presentation:**
  - Refusal to walk or weight bear
  - Tenderness over the mid-lower tibia

https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcRbghv-j6GA97uBa7krw0sD9bjgaL0m6RaCyQ&s

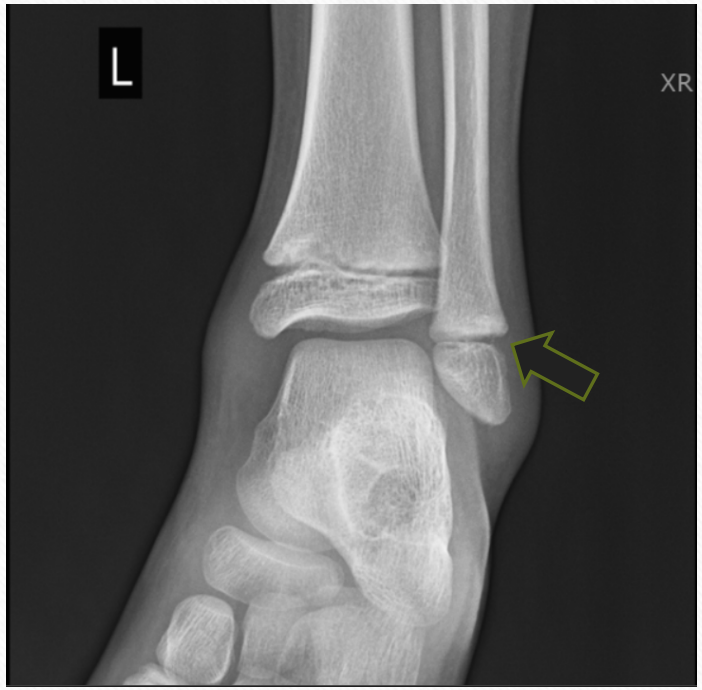
Toddler Fracture

- **Diagnosis:**
  - via radiographs of the tibia
    - May show faint oblique fracture line but often appear normal
    - If suspicion, with normal radiographs repeat imaging in 7-10 days

- **Treatment (in office):**
  - Immobilization in long leg walking cast (if proximal)
  - Immobilization in short leg walking cast if mid to distal shaft
    - Immobilize for ~ 4-6 weeks
  - If fracture presents late (> 2 weeks), casting ,may not be necessary unless symptoms significant

Salter Harris I Distal Fibular Fracture

- Most common acute injury of the ankle and foot
  - In skeletally immature child
- **Mechanism:**
  - Same as an ankle sprain, acute inversion
- **Presentation:**
  - Lateral ankle pain
  - Painful weight bearing
  - Tenderness over the distal fibular physis
    - 1 cm above the tip of the fibula



Subtle asymmetric widening at the distal fibular physis
=
Salter Harris I Distal Fibular Fracture

Salter Harris I Distal Fibular Fracture

- **Treatment (in office):**
  - If clinical suspicion, but radiographs negative, treat as Salter Harris I fracture
    - Repeat radiographs/ reassess in 2 weeks
  - Immobilization via a tall walking boot, cast, or air stirrups for approximately 4 weeks

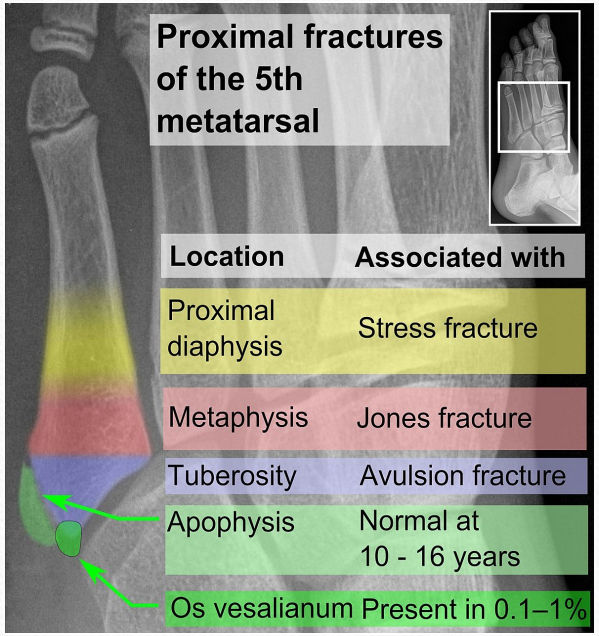
Base of 5th Metatarsal Fractures

- **Mechanism:**
  - Same as an ankle sprain, excessive inversion on a plantar flexed ankle
- **Presentation:**
  - Sudden painful pop at the lateral foot
  - Difficulty weight beating
  - Tenderness, swelling, and ecchymosis
- **Diagnosis:**
  - via radiographs
    - Differentiate a normal apophysis from a fracture
      - Normal apophysis is parallel to the long axis of 5th metatarsal
      - Can obtain comparison view if questionable fracture

https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcTxZOeJZQgoX78P-Y7IJMeuU1sLGDSBIlSOfQ&s

Base of 5th Metatarsal Fractures

- **Treatment (in office):**
  - Short walking boot or cast shoe
    - Consider crutches until pain free ambulation in walking boot
    - Immobilize ~ 4-6 weeks
  - Jones fracture (metaphyseal-diaphyseal junction) is a watershed area
    - Increase risk of non-union
  - Tuberosity fractures > 2 mm displaced require surgical fixation



https://upload.wikimedia.org/wikipedia/commons/2/25/Proximal_fractures_of_5th_metatarsal.jpg

Concussion


https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQuAQtfetnma7enTAWkK0WZjFQuzPF5Wzj9tA&s

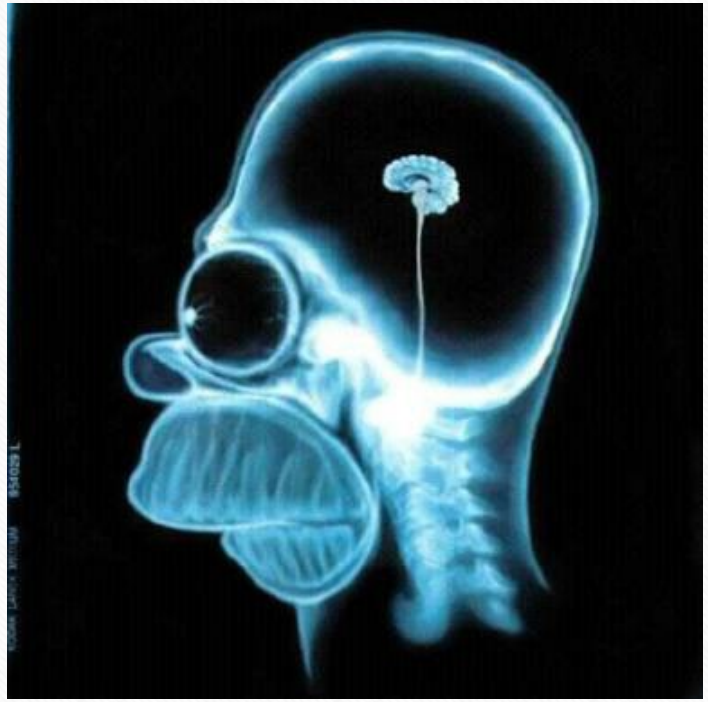
Concussion – What is it?

- It is a mild TRAUMATIC brain injury
- It is a complex pathophysiological process affecting the brain, induced by biomechanical forces:
  - Impulsive force transmitted to head, neck, or shoulder
  - Short-lived impairment of neurologic function that resolves spontaneously
  - Neuropathological changes – functional disturbance, **not structural problem**
  - Graded set of clinical symptoms that may or may not involve loss of consciousness.

https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GeR2sgPGo5yL2LIAH493D5P9J26wM2adNS6W5Q&s

Concussion – How Do We Diagnose?

- No definitive test for diagnosing concussion
- Neuroimaging is typically normal and therefore not typically indicated
- Concussion remains a **clinical diagnosis**
  - Relies on patient reporting
  - Recognition of certain signs and symptoms
  - Requires a high index of suspicion



https://www.researchgate.net/publication/277820221/figure/fig2/AS:609423601999885@1536614432979/Homer-Simpsons-brain-seen-with-MRI-X-ray-Image-reproduced-on-many-Internet-sites.ppm

Concussion – How Do We Diagnose?

- **Diagnosis is challenging because every concussion is unique**
- Symptoms often delayed – evolving injury
- Numerous symptoms grouped into four categories:
  - Somatic (physical)
  - Cognitive
  - Emotional
  - Sleep

https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcRXZ61877nhxbj2okgpaCyb-WRG8Bt_foCy5Q&s

Concussion – what are the symptoms?

Somatic (physical)

- HEADACHE
- Nausea/vomiting
- Dizziness
- Visual Disturbances
- Photophobia
- Phonophobia
- Fatigue
- Numbness/tingling
- Balance/coordination problems

Concussion – what are the symptoms?

Cognitive

- LOC
- Vacant stare
- Mental fogginess or feeling slow
- Disorientation
- Difficulty concentrating
- Difficulty remembering
- Slow or incoherent speech
- Word finding difficulties

Emotional

- Irritability
- Sadness
- Emotional lability
- Nervousness

Sleep Disturbances

- Drowsiness
- Too much/little sleep
- Difficulty falling asleep

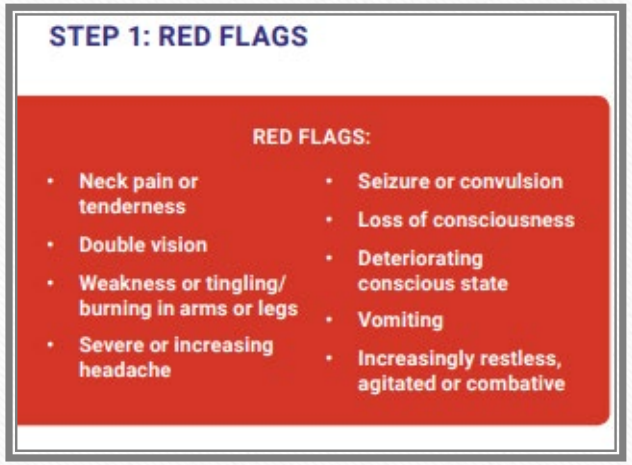
Initial Concussion Management

- Referral for evaluation by concussion specialist
- Cognitive and physical rest remain "cornerstone" of concussion management
- Limited evidence supporting use of medications
- Once evaluated by primary care or concussion specialist, consider return to school
  - via return to learn protocol
    - Allows for slow progression back to activity as tolerated via light mental activity

Concussion Management – When to Send to Hospital?

- GCS score< 13 on initial assessment; <15 two-hours after injury
- Examination findings suspicious for skull fracture
- High impact or high-risk mechanism for intracranial bleed
- Post-traumatic seizure
- Acute worsening of symptoms – may suggest ICH
  - Nausea/vomiting (>1 episode since injury)
  - Focal neurological deficit
  - Deteriorating Neurological Status:
    - Somnolence, slurred speech, difficulty walking, worsening mental status

- LOC or amnesia with history of bleeding/clotting disorder, dangerous mechanism of injury OR > 30 minutes of retrograde amnesia of events immediately before injury.



Other Considerations - Lacerations

- Facial, scalp, extremity, joints, high-tension areas

- Treatment (on the playground):
  - Remove visible debris
  - If bleeding, control with direct pressure
  - Assess motor/sensory function of affected area

Other Considerations - Lacerations

- Treatment (in office):
  - Identify superficial vs. deep
    - Superficial – consider steri-strips
    - Moderate – simple sutures
    - Deep – layered closure
  - Antibiotics (consider if):
    - Contaminated or concern for tetanus
- Refer:
  - Deep wounds near tendons, nerves, or joints
  - Heavily contaminated wounds
  - Possible foreign body
  - Uncontrolled bleeding after 10-15 mins
  - Child uncooperative

Other Considerations – Foreign Bodies

- Retained splinters or embedded debris (fall in mulch, sand, etc.)
- Consider imaging if deep puncture or suspect radiopaque foreign body (glass, metal)

- Treatment (in office):
  - Remove with sterilized tweezers, after cleaning, if superficial
  - If partially embedded, can use scalpel, after cleaned
  - Deep or near joint, refer to urgent care or ED

Other Considerations – Tooth Avulsion

- Complete displacement of tooth from its socket
- Ideally, reimplant within < 60 minutes

- Treatment (on the playground):
  - Find tooth and handle by its crown
  - Rinse briefly with saline or milk (if dirty), do not scrub/no alcohol
  - Reimplant immediately in socket, if possible, then refer
  - If unable to reimplant:
    - Place tooth in cold milk, saline, or child's saliva (buccal pouch)
  - Urgent referral to dentist or ED

https://media.springernature.com/full/springer-static/image/art%3A10.1038%2Fs41406-020-0142-x/MediaObjects/41406_2020_142_Fig1_HTML.jpg

★ Take Home Points ★

1. Pediatric bones ≠ adult bones.

- Growth plates are weaker than ligaments→ kids' fracture, more often than sprain.

2. Mechanism matters.

- FOOSH → Supracondylar fracture
- Traction → Nursemaid's elbow
- Torsion → Toddler Fracture

3. Every Concussion is Unique.

- Delayed symptoms are common→ prioritize return to learn before return to play

4. Tooth Avulsions are Time Sensitive.

- < 60 minutes to implant
- Store in milk or saliva

https://as2.ftcdn.net/jpg/01/06/44/71/1000_F_106447102_J34Unmwrz6fnyNMtUiNhZW58c2Rz7s8H.jpg

References

1. **knadmin**. “Pediatric Fractures in Developing Bone.” *PM&R KnowledgeNow*, 9 Mar. 2017.
   ➤ https://now.aapmr.org/pediatric-fractures-in-developing-bone
2. **Eiff, M. Patrice, and Robert L. Hatch.** *Fracture Management for Primary Care*, Updated Edition E-Book. Elsevier, 2017.
3. **Madden, Christopher C., et al.** *Netter’s Sports Medicine*. Philadelphia, PA: Elsevier, 2018.
4. **Sarwark, John F., and Cynthia R. LaBella.** *Pediatric Orthopaedics and Sports Injuries: A Quick Reference Guide*. Elk Grove Village, IL: American Academy of Pediatrics, 2014.
5. **Tintinalli, Judith E., et al.** *Tintinalli’s Emergency Medicine: A Comprehensive Study Guide*, 9th ed. McGraw-Hill, 2020.
6. **American Academy of Pediatrics.** *Pediatric Emergency Medicine Textbook*. 2022 Edition.
7. **Mayo Clinic Staff.** “First Aid for Cuts and Scrapes.” Mayo Clinic.
   ➤ https://www.mayoclinic.org/first-aid/first-aid-cuts/basics/art-20056711
8. **Schmitz, G.R., et al.** “Foreign Bodies: Retained Soft-Tissue Foreign Bodies and Management.” *UpToDate*, 2024.
9. **American Association of Endodontists.** “Tooth Knocked Out – What to Do.”
   ➤ https://www.aae.org/patients/dental-symptoms/tooth-knocked-out/
10. **International Association of Dental Traumatology (IADT).** “Dental Trauma Guidelines for the Public.”
    ➤ https://www.iadt-dentaltrauma.org/for-patients.html
11. **Andersson, L., et al.** “Guidelines for the Management of Traumatic Dental Injuries.” *Dental Traumatology*, 2020. DOI: 10.1111/edt.12573

Questions? ☺

- LinkedIn: Olabode Agaja
- Instagram: drolabodeagaja
- Twitter (X): @drolabodeagaja
- Email: drolabodeagaja@gmail.com
- Cell: (216) 854-8732