Objectives

- Describe the steps of assessment for orthopedic injury
- Identify signs, symptoms, and causes of common orthopedic injuries
- Describe treatment options
- Identify appropriate information to send home with injured student
- Identify when a referral is needed urgently vs. emergently
- Describe methods of prevention and the school nurse’s role
- Provide a variety of resources regarding orthopedic injury.

Overview

- Common injuries and conditions
- Physical Assessment/Examination
Common injuries

- Contusion
- Sprain
- Dislocation
- Fracture

Subjective data: pain is the patient’s perspective

- Where does it hurt?
- When did it start?
- What does it feel like? Did it start quickly or gradually over time? Is it the same, better, worse?
- Was there an injury, or can you identify what started the pain?
- Quality: ache, sharp, constant or occasional?
- Rate pain on scale: 0-10, FACES, any scale.

Physical Assessment/Examination

- Assess situation: Conscious? Aware? Possibility of concussion?
- Approach - Inspection and palpation
Inspect Skin

- Color: erythema, ecchymosis
- Integrity: abrasion, threatened, poke hole

Examination of Injury

- Focused exam: is there deformity noted?
- Check joint above and below the injury
- Include neurovascular exam:
  1. Distal Pulses
  2. Capillary refill
  3. Temperature
  4. Sensation-numbness or tingling
  5. Motion

What is a fracture?
Hallmarks of Fracture

- Swelling
- Deformity
  - Point tenderness
  - Inability to bear weight on the extremity
- When in doubt, immobilize!

Fractures in Children

- Fractures in children are more common than in adults
- Fractures can occur after even minor trauma
- Chance of sustaining a fracture in childhood (birth-16 years)
  - 42% boys
  - 27% girls

Fracture Terms #1

- Fracture = Break
- Occult Fracture: Broken bone that is not seen on x-ray
- Plastic Deformity: Cortex not broken but bone bent
- Greenstick Fracture: One cortex broken
Fracture Terms #2

- **Displaced Fracture:** Bones are not anatomically aligned.
- **Open Fracture:** Fracture where a piece of bone has come through the skin.
- **Pathological Fracture:** Broken bone that is due to weakness of the bone from another disease.

Growth Plate Injuries

- **Growth Plate:** Area of developing bone cells near the ends of bones in children and adolescents where growth occurs.
  - Determines the future length and shape of bones. Last portion of the bone to solidify, so weak and vulnerable to fracture.
  - Growth plates are not seen on an X-ray.
  - **Long term consequences:** Difference in length of the bones or development of an angular deformity.

Growth Plates
INJURIES to the UPPER EXTREMITY IN CHILDREN

Upper Extremities
- Shoulder
- Elbow
- Wrist
- Hand

Shoulder
- Inspection - front, side, back, above
- Includes: clavicle, acromioclavicular (AC) joint, sternoclavicular (SC) joint, scapula
  - Skin: Intact? Red? Ecchymotic?
- Palpation: where does it hurt? All Over! Or in one spot?
Shoulder - continued

- Range of Motion (ROM)
- Abduction
- Adduction
- Rotation
- Forward Flexion
- Backward Extension

Direct Blow to Shoulder

Case study #1: 16 yo Juan was playing basketball, collided with another player and fell to the shoulder with immediate pain.

Clavicle fracture with shortening

Clavicle fracture: examination

*"Bump" or "Tend" Deformity*
CASE STUDY #2

- 6 yo male fell from top of slide to outstretched left arm. Pain at the left shoulder, left arm held lower than right. No gross deformity.

Proximal Humerus Fractures:
- sling and swathe
- pain med
- activity restriction
- ER vs clinic?
Shoulder Dislocation

Glenohumeral joint dislocation
2nd most common joint dislocation
Mechanism of injury
Shoulder abduction
External rotation
Anteriorly directed force
ER vs. clinic?

Elbow

- Inspection, skin integrity, deformity
- Palpation
- ROM
  - Flexion
  - Extension
  - Pronation
  - Supination

Supracondylar Humerus Fractures

- Most common elbow fracture in children
- 98% of the fractures are extension fractures; fall onto outstretched arm from a height
- Occurs in children ages 3-8 yrs old
- Does not affect the growth plate
- Nerve injuries and/or blood vessel injuries are common
Types of Supracondylar Humerus Fracture

- **Type I**: Stable fracture/minimal or no displacement. May not be seen on x-ray. "Fat pad sign"
- **Type II-III**: Unstable fracture with possible displacement, increased risk blood vessel/nerve injury
- **Treatment**: Long arm cast with elbow flexed at 90 degrees for 3 weeks and/or closed reduction and percutaneous pinning

Case Study #3
Jenny, an 8 year old female falls off the monkey bars and is unable to move her right arm, gross deformity noted at the elbow, pain.

What diagnosis do you suspect and what do you find on physical exam?
Percutaneous Pinning of SCH fx

Lateral view AP view

Post op complications?

- Cast too tight? Compartment syndrome
- Pain?
  - Wet cast?
  - Fever/illness → Infection?
  - ER vs. Clinic?

Compartment syndrome

- Increased osseofascial compartment pressure leads to decreased perfusion
- May lead to irreversible muscle and nerve damage
- May occur anywhere that skeletal muscle is surrounded by fascia, but common in forearm, hand, leg
- Fractures are most common cause
- Tight casts!
- Pathophysiology
  - Local trauma and soft tissue destruction → bleeding and edema → increased interstitial pressure → vascular occlusion → ischemia
Compartment Syndrome continued - Symptoms

- Pain out of proportion
- Pain with passive stretch of digits
- Paraesthesia
- Palpable swelling - Tense (if not in cast)
- Absence of peripheral pulses (late finding)

Need emergent evaluation → fasciotomies to all involved compartments

Forearm/Wrist

- Inspection
- Palpation
- ROM
  - Flexion
  - Extension
  - Supination
  - Pronation

Case Study #4

Jimmy, a 7 year old male falls 5-6 feet off playground apparatus, sustaining injury to right arm. No head trauma, no LOC.

- What would your focused physical assessment include?
- What is your likely diagnosis and how would you treat this injury?
- ER vs clinic?
Displaced Midshaft Radius and Ulna Fracture

Lateral of Forearm showing dislocation radial head and ulna fracture

Think skin integrity!
Non-surgical Treatment of Displaced Fractures

- Closed reduction under conscious sedation in the ER/OR
- Application of long arm cast
- Follow up in 1 week to check bone position
- May need to follow up every week for first 3 weeks to check alignment
- May require repeat close reduction in the OR if bones have moved (25-30%)

Case Study #5

9 yo Amanda was walking in her classroom at school 2 days ago, and tripped, falling to her outstretched hand. Presents with pain, minimal swelling in the wrist. Has good ROM. No elbow pain.

ER vs clinic?
Buckle Fracture of the distal radius

Treatment: Short arm cast or Volar wrist splint x 3 weeks.
Return to activity if pain free and full ROM.

Hand

- Inspection – swelling
- Alignment: is there a finger out of place?
- Skin & Nails: is the nail bed intact? Is there a break in the skin or are there bite marks?
- Palpation
- ROM
  - Metacarpalphalangeal (MCP) joint
  - Proximal interphalangeal (PIP) joint
  - Distal interphalangeal (DIP) joint

Examination:
digital cascade to assess rotation
Case Study #6

Tanesha an 8 ½ year old girl was playing at recess, went to catch the ball and her left small finger was hyperextended.

What injury do you suspect? How would you treat this injury? ER vs. clinic?

Minimally displaced left 5th digit proximal phalanx fx

Case Study #6

Kevin is a 12 yo male who got into a fist fight 2 weeks ago. He punched another person in the mouth with his closed fist, sustained a bite to the dorsum of the right 4th digit. Now presents with inability to extend the digit, pain and swelling.
Closed fist injuries

- Human bites over the knuckles are very serious.
- High risk for infection. Once infected, these bites can lead to serious tissue damage. An infected bite in this area will require an overnight stay in the hospital, a wash out, and antibiotics.

Case Study #8

- Mike, 16 yo, just broke up with his girlfriend. He punched his locker in frustration and now has swelling over the dorsum of his hand and he can’t take his MCAS because writing is too painful.

ER vs clinic?

5th metacarpal Fracture
Boxer’s fracture
Cast x 3 weeks
Case Study #9

Cash, 9 year old male, sustained a direct blow to his right long finger from a basketball; he presents with obvious deformity and pain with bleeding at base of nail

What injury do you suspect?

How would you treat this injury?

ER vs. clinic?

Seymour’s fracture

- Physeal fracture of distal phalanx with nailbed laceration
- Pain, swelling, subungual hematoma
- +/- nailplate avulsion
Nursemaid’s Elbow

- Presentation
  - History of a young child with sudden pull of an extended arm
  - Generally ages 1-3
  - Initial arm pain, unwillingness to use extremity
  - Presents holding the arm flexed and pronated
  - Little to no swelling of elbow
  - Radial head subluxation

Nursemaid’s elbow cont.

- No x-rays needed for appropriate history
- Reduction maneuver
  - Firm supination of the forearm with other hand supporting elbow in 90 degrees of flexion
  - Feel/listen for a click (although absence is often noted in successful reduction
  - Child should resume use of arm within 30 minutes
  - If use of arm is not witnessed after 30 minutes, orthopedic evaluation required

Trampolines!! We love ‘em! (NOT)
Lower Extremities

- Hip
- Knee
- Ankle
- Foot

Assessment

- Was there an injury?
- Are they walking?
- How are they walking?
- Inspection (compare) and Palpation
- NV exam

Knee/Tibia

- Inspection – swelling, bruising, deformity
- Palpation
- ROM
  - Flexion
  - Extension
**Case Study #10**

Nick, a 10-year-old boy, was playing with his friends at and was slide tackled playing soccer. He falls over with significant leg pain.

**What would your physical examination include? What would you do?**

- **ER vs. Clinic?**

**X-ray tibia and fibula**

- **Inspection**
- **Palpation**
- **ROM**
  - Dorsiflexion
  - Plantarflexion
  - Inversion
  - Eversion

**Ankle & Foot**
Case Study #11

Stacey, a 13 year old girl, was doing handsprings with her friends on the playground. She lost her balance and fell to the ground in pain to her ankle.

What would you do?
What do you think could be going on with her?
ER vs. clinic?
Sprain vs fracture?

AP of ankle  Lateral of ankle

SH IV of distal tibia, SH I of distal fibula
Case Study #12

10 year old Sharon limps into your office reporting that her laptop fell onto her right foot yesterday and she has had swelling and worsening pain.

- What is your presumed diagnosis?
- How would you treat this injury?
  - ER vs. clinic
Case Study #12

Jamal an 12 year old comes to the nurse with right knee pain and a significant limp. States he has had leg pain for a year but just fell from a slide and his pain is worse he can barely walk. He weighs 80 kg.

- What would you expect to find on physical exam?
  - ER vs clinic?

Slipped Capital Femoral Epiphysis

- Femoral head slips off femoral neck at level of epiphysis “ice cream falls off cone”
- Multi-factorial etiology; endocrine
- Most often males (2-3x more than females); 12-16 years old; often overweight
- Acute, chronic, acute on chronic - Needs immediate referral!!
- Pain with ROM hip, unable to weight bear
- Pain often referred to knee!
- Risk avascular necrosis

Slipped Capital Femoral Epiphysis

AP view of right hip
Common Knee Injuries

- Vast majority of pediatric knee injuries are minor cuts, bruises and strains
- Bony contusion/strain treated by PMD with rest, ice, compression and elevation (RICE), pain management, weight-bearing as tolerated with crutches
- Suspect a fracture/dislocation/ligament tear with gross edema, joint effusion, pain, decreased ROM; refer to ER/Orthopedics

Case #13

Olivia is 12 year old female with Ehlers Danlos who was doing the obstacle course and gym and twisted her leg awkwardly and fell to the ground. Reports terrible knee pain and she is unwilling to move/stand up.

What would you expect to find on physical exam?

ER vs clinic?
Patellar dislocation vs subluxation

- Acute traumatic vs chronic
- Mechanism of injury: noncontact twisting with knee extended
- Risk factors: ligamentous laxity (EDS); previous event
- Acute vs chronic management

Patellar instability continued

Case #14

Alicia is an otherwise healthy 7 year old who limps into your office reporting atraumatic pain to her left knee. She reports a recent cold and has low grade fever in your office.

- What would you expect to find on physical exam?
- Urgent?
The painful limp/joint:
- Toxic Synovitis
- Septic Arthritis
- Osteomyelitis
- Lyme Arthritis

Concerning symptoms:
- Fever
- Limited motion
- Limp
- Swelling
- Warmth
- No history of trauma

Toxic Synovitis:
- Most common cause of painful hips in childhood
- Short lived acute inflammatory process of the inner lining of the capsule of the hip joint
- Cause is unknown but may be due to a virus
- Seen in children ages 3-8 years
- More common in boys than girls
- Diagnosis of exclusion
- Treatment
  - Supportive (NSAID's, rest)
  - Self-limited without antibiotics
Septic Arthritis

- Infection of a joint characterized by pain, fever, chills, inflammation and swelling
- Cause: bacteria in the joint
- Can occur in children of all ages
- Medical emergency - damage to bone and cartilage
- Potential for septic shock - fatality
- Typically seen in one joint, usually the hip
- Treatment:
  - Admission to hospital
  - Possible surgery for washout
  - Antibiotics (IV & PO)

Osteomyelitis

- Similar presentation to septic arthritis
- Infection in a bone rather than a joint
- Characterized by fever, chills, inflammation and swelling
- Cause: bacteria
- Can occur in children of all ages
- Typically seen in one location - arms or legs
- Treatment same as septic arthritis:
  - Admission to hospital
  - Possible surgery for washout
  - Antibiotics (IV & PO)

Lyme Arthritis

- Lyme disease - systemic infection with Borrelia burgdorferi spirochete following bite of deer tick
- Arthritis consider a latent stage of lyme infection (months to years after bite)
- Acute or chronic joint pain
- Limp with swelling/joint effusion - often knee
- Often able to bear weight (differentiates from septic joint)
- Labs: + antibody/Elisa → western blot (specific)
- Treatment oral antibiotics; occasional I+D
When is an injury an Emergency?

- NV compromise: weak pulse, poor perfusion, delayed cap refill
- Obvious deformity
- Break in skin with high suspicion of underlying fracture
- High level of Pain
- Confounding medical problem

Urgent Cast/Post op Issues

- Numbness or tingling that does not go away
- Severe pain when moving fingers
- Redness or blueness to fingers
  - Cool fingers
  - Decreased ability to move fingers
  - Pain that is not relieved by medication
  - Foul odor or drainage from the cast
  - Fever higher than 101.5

Emergency Management

- Call 911
- Stabilize and/or immobilize the injured body part if possible
- Comfort measures - age appropriate
- Pain control
  - Rest
  - Ice
  - Compression
  - Elevation
RICE

- REST
  - Stop activity, limit weight bearing if LE
- ICE
  - COMPRESSION
    - Ensure wrap is not too tight to compromise circulation
  - ELEVATION
    - Above the level of the heart

Suggested References

- Boston Children's Hospital Orthopedics
  - http://www.childrenshospital.org
- American Academy of Orthopedic Surgeons
  - http://www.aaos.org
- Wheeless' Textbook of Orthopedics
  - http://www.wheelessonline.com/
    - http://www.orthobullets.com/

Thank you School Nurses!