Normal Musculoskeletal Anatomy and Review

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Learning Objectives

Upper Extremity

- Describe the rotator cuff muscles, actions and attachments and injuries.
- Describe major injuries associated with upper extremity peripheral nerve injuries.
- Explain the brachial plexus and upper extremity major peripheral innervations and lesions
- Explain hand/wrist muscles, bone, neuroanatomy and associated injuries.
Learning Objectives
Lower Extremity
• To describe lower extremity neuroanatomy and injuries.
• To explain knee anatomy, including ligaments and menisci and injuries.

Learning Objectives
Basic Sciences
• To describe normal bone formation and cell biology of bone
• To explain skeletal muscle contractions.

An otherwise healthy infant boy born via vaginal delivery has an abnormal appearance of his right upper limb. His arm hangs by his side, pronated and medially rotated. Which of the following muscles is still functioning?
A. Biceps
B. Deltoid
C. Infraspinatus
D. Supraspinatus
E. Triceps

Upper Extremity Innervation
- Biceps (musculocutaneous n. c5,6)
- Deltoid (axillary n. c 5,6)
- Infraspinatus (suprascapular n. c4,5,6)
- Supraspinatus (suprascapular n. c4,5,6)
- Triceps (radial n. C6,7,8)

Erb’s Palsy
- Most common birth injury neuropraxia
- UPPER nerve root/trunk lesion (C5/6)
- LOWER roots preserved
- Results in loss of abduction (delt/supSp), ER (infrasp), supination (supinator)
- (aka waiter’s tip)
16 y/o gymnast present to the ER after landing awkwardly on her ankle. She is diagnosed with a sprained ankle. Which of the following is most commonly injured in ankle sprains?

A: Anterior talofibular ligament (ATFL)
B: Calcaneofibular ligament (CFL)
C: Talonavicular ligament
D: Tibiocalcaneal ligament
E: Tibiotalar ligament
A 50 year old presents to the emergency department because of severe pain with even slight abduction of his arm following a skiing accident. He is diagnosed with a rotator cuff tear. Which of the following is most commonly injured in a rotator cuff tear?

A. Infraspinatus tendon
B. Subacromial bursa
C. Subscapularis tendon
D. Supraspinatus tendon
E. Teres minor tendon
The skeletal system develops via a process known as ossification in which long bones are created from preexisting mesoderm. By which of the following processes do the long bones ossify?

A. Chondrocytes deposit minerals directly from the mesoderm
B. Osteoblasts deposit minerals directly from the mesoderm
C. Osteoblasts deposit minerals over a hyaline cartilage mold
D. Osteoclasts develop into osteocytes when trapped in the matrix
E. Osteoblasts form osteoid as a precursor to bone formation

Bone Growth and Ossification

- **Endochondral Ossification**
  - Long bones (tibia)
  - Mesoderm → cartilaginous model (chondrocytes) → bone from ossification center (osteoblasts) → mineralization (bone)

- **Intramembranous Ossification**
  - Flat bones (skull)
  - Bones form directly from mesoderm without an intermediate cartilaginous model
A couple brings their 3y/o son to the ED, reporting that he fell down the stairs and broke his arm. The boy has a tearful face and gingerly holds his right arm by the elbow, but refuses to look the physician in the eye or to answer any questions. Xray of the arm is performed. Which of the following types of fracture is most likely to suggest an etiology of child abuse?

A. Bowing fracture  
B. Buckle fracture  
C. Greenstick fracture  
D. Spiral fracture  
E. Transverse fracture
Stress Fracture

- Partial or complete fracture of bones as a result of accelerated bone remodeling in response to habitual non-violent, repetitive stress.

  — Devas 1958

14 y/o football player is tackled from the side during a high school football game. When he tries to stand up, his right leg buckles. He is taken to the ED where physical exam reveals that the patient’s tibia is easily moved anteriorly in relation to the femur. An MRI of the patient’s knee is shown in the image. Which injured structure is responsible for the findings in the patient’s physical exam?

A. Anterior Cruciate Ligament
B. Lateral collateral ligament
C. Medial collateral ligament
D. Posterior cruciate ligament
E. Lateral cruciate ligament
Knee Bony Anatomy

Knee Valgus Injury

- ACL-MCL-Lateral Meniscus
  - Medial distraction injury
  - Lateral compression injury
A 21 y/o man presents to the ED following an injury to his shoulder that he sustained while playing football. His shoulder appears flattened and he is not able to abduct his arm. He is found to have a fracture at the surgical neck of his humerus. The muscle that is most likely injured in this patient receives innervation from which of the following nerve roots?

A) C3-5  
B) C5-6  
C) C6-7  
D) C7-8  
E) C8-T1

### UE Strength Testing

<table>
<thead>
<tr>
<th>MOTION</th>
<th>MUSCLE</th>
<th>Nerve Root</th>
<th>Peripheral Nerve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abduction</td>
<td>Supraspinus</td>
<td>C5-6</td>
<td>Suprascapular</td>
</tr>
<tr>
<td>ER</td>
<td>Infraspinus</td>
<td>C5-6</td>
<td>Suprascapular</td>
</tr>
<tr>
<td>IR</td>
<td>Subscapular</td>
<td>C5-6</td>
<td>Subscapular</td>
</tr>
<tr>
<td>Abduction</td>
<td>Deltoid</td>
<td>C5-6</td>
<td>Axillary</td>
</tr>
<tr>
<td>Elbow flexion</td>
<td>Biceps Brachii</td>
<td>C5-6</td>
<td>Musculocutane.</td>
</tr>
<tr>
<td>Wrist extension</td>
<td>Wrist extensors</td>
<td>C6</td>
<td>Radial</td>
</tr>
<tr>
<td>Wrist flexion</td>
<td>Wrist flexors</td>
<td>C7</td>
<td>Median</td>
</tr>
<tr>
<td>Finger flexion</td>
<td>Flexor tendons</td>
<td>C8</td>
<td>Median</td>
</tr>
<tr>
<td>Finger abduction</td>
<td>Dorsal interossei.</td>
<td>T1</td>
<td>Ulnar</td>
</tr>
</tbody>
</table>
A 60 y/o man presents to the physician with a limp that he has had since childhood. When he walks, the patient takes a step with his right leg, then leans all the way over to his right, so that he can swing his left leg to take a step. He reports one major illness as a child after which he developed this limp. Which of the following nerves or roots is most likely injured in this patient?

A. Inferior gluteal nerve (gluteus maximus)
B. L5-S1 (nerve to quadratus femoris)
C. Obturator nerve (adductors)
D. S1 and S2 (piriformis)
E. Superior gluteal nerve (gluteus medius)
A 32 y/o old woman who is a tennis player presents to the physician with pain on the lateral aspect of the elbow radiating down her forearm. Repetitive use of which of the following muscles most likely lead to this patient’s condition?

A. Biceps
B. Extensor carpi radialis
C. Extensor carpi ulnaris
D. Flexor carpi ulnaris
E. Pronator teres
ELBOW MUSCULAR ANATOMY

RESISTED WRIST EXTENSION

- LATERAL EPICONDYLITIS (Elbow Tendinosis)
  → Tennis Elbow

RESISTED WRIST FLEXION

- MEDIAL EPICONDYLITIS (Elbow Tendinosis)
  → Golfer’s Elbow
A 15 y/o boy is brought to the ED because he has pain in his hand following a fist fight. The physician tells the patient that he has a broken hand. Which of the following is the most likely site of this patient’s fracture?

A. Distal Radius  
B. Hamate  
C. Metacarpals  
D. Phalanges  
E. Scaphoid

**Anatomy**

- 24 bones in the hand and wrist
  - Carpal
  - Metacarpal
  - Phalanges
- Numerous muscles, tendons, ligaments
- Radiocarpal articulation
- TFCC

**Carpal Bones**

1. Scaphoid  
2. Lunate  
3. Triquetrum/Triquetral/Quadratum Plaform  
4. Trapezium  
5. Trapezoid  
6. Capitate  
7. Hamate
Neurovascular Anatomy

- Median Nerve (lateral 3 ½)
- Ulnar Nerve (medial 1 ½)
- Radial Nerve (dorsolateral 3 ½)
- Radial & Ulnar arteries

Scaphoid Fracture

- SCAPHOID FRACTURE
  - 5-V wrist XR
  - Proximal pole, waist, distal pole
  - Distal pole with best blood supply
  - Avascular necrosis risk for proximal fracture

Boxer’s Fracture

- Metacarpal fracture of 4th or 5th
- Tolerates up to 40 degrees of angulation
A 20-year-old male soccer player gets kicked on the lateral side of the leg. He has some swelling, and a limp. You examine him and he most likely has which of the following findings:
A. Weakness with plantar flexion and sensory loss of the sole of the foot
B. Weakness with knee flexion and sensory loss on the lateral knee
C. Weakness with dorsiflexion and sensory loss on the anterolateral leg
D. Weakness with foot inversion and sensory loss on the medial dorsum of the foot
E. Weakness with ankle eversion and no sensory change

Peroneal nerve injury
Weakness with dorsiflexion and the anterolateral leg

Which of the following occurs with skeletal muscle contraction?
A. Ca^{2+} binds to ATP causing a conformational change
B. ADP binds ATP causing release from actin filament.
C. Action potential depolarization opens Ca^{2+} channels in sarcoplasmic reticulum
D. Repolarization travels along muscle cell and down the H band
E. ATP hydrolysis supplies energy for the power stroke