A Primer on the Musculoskeletal Examination Technique and Commonly Missed Injuries in Student Health

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Learning Objectives

• Identify commonly missed orthopedic injuries of the upper extremities
• Identify commonly missed orthopedic injuries of the lower extremities
• Understand proper technique to perform common orthopedic examinations
Disclosures:

“Research” at the Smithsonian American Art Museum
Approach to the MSK exam

• *History* is the most important component of the MSK evaluation
  – 85% of diagnoses are from the history alone

• Know an appropriate differential diagnosis (DDX) for each major joint in the college aged student
  – *DDX of MSK injuries varies with age*
Bayesian theorem

A statistical method used in applied practice to predict the probability of an outcome or an event based on 1) the **pretest probability** of the outcome based on demographic, prognostic, and clinical factors and 2) the effectiveness or ability of diagnostic tests (sensitivity and specificity)
Caution

• Few MSK tests are both highly sensitive and specific.
• Most are highly sensitive and poorly specific.
Bayesian theorem + MSK exam

- Differential Diagnosis
  - traumatic vs overuse
    - Was there a recalled injury?
- Pre-test probability
- Commonly performed MSK exams
  - Knowledge of what structure each exam is responsible for
Approach to the MSK exam

• Inspection
  – Swelling, ecchymosis, deformity, asymmetry

• Palpation
  – Knowledge of anatomy & landmarks

• Range of Motion (active vs. passive)
  – Compare sides, don’t get bogged down with measurements

• Special tests
  – Learn one for each injury/diagnosis
Shoulder: Inspection/Palpation

- AC joint
- SC joint
- Biceps tendon
Shoulder: ROM

- Forward flexion
- Extension
- ABduction
- ADduction
- External rotation
- Internal rotation
Shoulder: DDX of pain generators

- AC Joint
  - Sprain
  - Scarf test

- Impingement
  - Rotator cuff
  - Tendinitis/bursitis
  - Neer’s test
  - Rotator cuff testing

- Labral tear
  - Dislocation/subluxation
  - Apprehension test

- Biceps Tendon
  - Biceps tendinitis
  - Speed’s test
Impingement

• **Mechanism:** repetitive overhead motion leading to rotator cuff tendinitis and subacromial bursitis resulting in a painful overhead arc of motion

• **Neer’s test**

• **Rotator cuff testing**
Rotator Cuff testing
Rotator Cuff testing

- **Supraspinatus** - "Empty Can test"
- **Infraspinatus** – resisted external rotation
- **Subscapularis** – “lift off test”
Acromioclavicular Sprain
(aka Shoulder separation)

- **Mechanism:** falling directly onto the affected shoulder
- **Exam:** TTP at the AC joint
- **Scarf test**
Labral Tear

• Mechanism: Usually a history of dislocation or subluxation
• 95% dislocations are anterior
• Apprehension test
Biceps tendinitis

- **Mechanism:** overhead throwing sports/repetitive biceps activities. Anterior shoulder pain, worse with overhead motion
- **Speed’s test**
Shoulder Exam
Elbow: Inspection/Palpation

- Lateral epicondyle
- Olecranon
- Cubital tunnel
- Medial epicondyle
Elbow: ROM

- Flexion
- Extension
- Supination
- Pronation

Normal Elbow Motion

- Normal ROM:
  - Elbow 0-145°
  - Pronation: 80°
  - Supination: 85°

- Functional ROM:
  - Elbow 30-130°
  - Pronation: 50°
  - Supination: 50°
Elbow: DDX of pain generators

- Lateral Epicondylitis
- Medial Epicondylitis
- Radial head fracture
- Cubital Tunnel
Medial Epicondylitis

- **Mechanism:** non-traumatic tendinopathy of the forearm flexor group
- **Test:** Passively supinate the forearm & extend the elbow and wrist while palpating the medial epicondyle
Lateral Epicondylitis

• **Mechanism:** non-traumatic tendinopathy of the forearm extensor group

• **Test:** passively pronate the forearm, flexing the wrist with the elbow in extension while palpating the lateral epicondyle
Cubital Tunnel

- **Mechanism:** impingement of the ulnar nerve within the cubital tunnel. Medial elbow pain and paresthesia in the ulnar nerve distribution
- **Test:** Tinel’s sign at the cubital tunnel
Radial head fracture

- **Mechanism:** most common elbow fracture in adults, generally from a fall onto an outstretched hand
- **Exam:** pain, effusion and tenderness over the radial head are typical signs
- Look for “sail” or “fat pad” sign on radiographs with occult fracture
Elbow Exam
Wrist: Inspection/Palpation

- Ulnar styloid
- Radial styloid
- Anatomic snuffbox
- Flexor retinaculum
Wrist: ROM

- Flexion
- Extension
- Ulnar deviation
- Radial deviation
Wrist: DDX of pain generators

- Scaphoid fracture
- Snuffbox tenderness
- De Quervains Tenosynovitis
- Finklestein test
- Extensor carpi ulnaris tenosynovitis
- Carpal Tunnel
- Tinel test
- Phalen’s test
*Scaphoid fracture*

- **Mechanism:** FOOSH injury
- High rates of non-union. Leading to chronic pain and disability
- *X-rays often will not demonstrate subtle fracture. Radial wrist pain after a FOOSH injury should be treated as if a scaphoid fracture is present*
- **Exam:** anatomic snuffbox tenderness
- Thumb spica splint and re-image 7-10 days
Carpal Tunnel Syndrome

- **Mechanism:** median nerve entrapment causing pain, weakness, and paresthesia of the hand
- Most common nerve entrapment syndrome
- **Tests:** Tinel/Phalen, Flick sign
De Quervain tenosynovitis

- **Mechanism:** acute or chronic inflammation of the EPB & APL tendons against the radial styloid under the extensor retinaculum. Pain with use of the thumb and ulnar/radial deviation of the wrist

- **Test:** Finkelstein test

  - It is a provocative test used in diagnostic for de Quervain's tenosynovitis.
  - Makes a fist with the thumb inside.
  - Now ask the patient to bend the wrist toward little finger
Extensor carpi ulnaris tenosynovitis

- **Mechanism**: seen with wrist overuse (racket sports and rowing are common sports related causes). Present with non-traumatic pain over the dorsal-ulnar aspect of the wrist.
- **Exam**: pain with resisted wrist extension and ulnar deviation
Hand Anatomy/Nomenclature

DIP  PIP  MCP

Dorsal Hand

Index  Middle  Ring  Small
Finger ROM

- Extension
- Flexion
- ABduction
- ADduction
- Opposition
*Jersey Finger*

- **Mechanism**: catching finger in an opponent’s jersey. Rupture of the flexor digitorum profundus tendon. Usually the ring finger.
- **Exam**: inability to flex the DIP joint (must isolate the joint when testing)
- **Requires** *urgent* hand surgery consult
• **Mechanism**: “jammed finger”. Pain and swelling of the PIP joint. Results in a tear in the central slip of the extensor tendon.

• **Exam**: tenderness along the dorsal aspect of the PIP and pain with resisted PIP extension

• If not treated correctly, lateral bands can migrate and result in loss of function, chronic pain, and a boutonniere deformity

• Splint in extension 6-8 weeks
*Mallet Finger*

- **Mechanism**: from forced flexion of an extended DIP joint with rupture of the distal extensor tendon.
- **Exam**: inability for the patient to actively extend the DIP joint of the affected finger
- **Complications**: permanent loss of extension of the DIP. May lead to a swan neck deformity
- **Treatment**: place the DIP joint in extension for 6-8 continuously
*Gamekeeper’s Thumb*

- **Mechanism**: FOOSH injury causing Abduction of the thumb and a tear of the ulnar collateral ligament. Also called ’skier’s thumb’
- **Exam**: tenderness at the ulnar aspect of the 1st MCP joint, instability when stressing the joint.
- If not treated properly, can lead to chronic pain and grip weakness
- **Treatment**: thumb spica splint 4-6 weeks. Ortho referral if unstable joint, Stener lesion, or significant associated articular avulsion fracture
Hip: Inspection/Palpation

- Iliac crest
- ASIS
- Greater Trochanter

umbilicus
Hip: ROM

- Flexion
- Extension
- ABduction
- ADduction
- Int. rotation
- Ext. rotation

POSSIBLE HIP MOVEMENTS

flexion  extension  abduction  adduction  external/ internal rotation

Featured on www.sequencewiz.com
Hip: DDX pain generators

- Hip Impingement
- Femoral neck stress fracture
- Hop test
- Hip strains
- Trochanteric Bursitis
  - Ober test
- Snapping Hip
  - Ober test
Hip Impingement

Femoral acetabular impingement (FAI)

• **Mechanism:** when areas of bony deformity of the acetabulum and/or femoral head-neck junction cause injury to the acetabular labrum/cartilage at extremes of motion

• Insidious onset of pain, generally felt in the groin or in the “C-sign” distribution

• **Test:** FADIR

**PHYSICAL EXAMINATION**

- The anterior impingement test or FADIR (*Flexion Adduction Internal Rotation*) test is performed by flexing the hip to 90 degrees, adducting across the midline, and maximally internally rotating the hip
Hip Strain

- **Mechanism**: acute traumatic strain of the lower abdominals, hip flexors, or adductors vs. tendinopathy
- “groin strain”
- **Test**: palpation/passive stretch/or resisted motion to aggravate involved muscle group
*Femoral Neck Stress Fracture*

- **Mechanism:** overuse injury; usually with vague pain in the groin associated with weight bearing activity. More common in running athletes, military recruits, and Relative Energy Deficiency Syndrome (REDS). Symptoms may be proceeded with an increase in exercise intensity or activity level.

- **Test:** Pain with passive internal rotation, +Hop test, +Fulcrum test
Snapping Hip

- **Mechanism**: characterized by a snapping or popping sensation that occurs as tendons around the hip move over bony prominences
- Most common IT band over the greater trochanter (external), also iliopsoas over the pectineal eminence of the pelvis (Internal) or from labral tears of acetabulum
- **Tests**: Ober test to assess for IT band tightness
Greater Trochanteric Bursitis

- **Mechanism**: insidious onset lateral hip pain from a tight IT band causing friction over the greater trochanter, leading to bursitis. Worse when rising from a chair, prolonged waking, or lying on the affected side.

- **Exam**: Palpation of the bursa, Ober test.
Hip Exam
Knee: Inspection/Palpation

- IT Band
- Lateral femoral condyle
- Fibular head
- Patella
- Medial femoral condyle
- Pes anserine bursa
- Patellar tendon
Knee: ROM

- Flexion
- Extension
Knee: DDX pain generators

- IT band
  - Ober test
- LCL
  - Varus stress test
- Pes anserine
  - Palpation
- Patellofemoral
  - Pain
  - Grind/palpation
- ACL/PCL
  - Drawer tests
- MCL
  - Valgus stress test
- Meniscal tears
  - Jointline tenderness
ACL tear

- **Mechanism**: most are non-contact injuries. Audible pop + swelling within an hour + inability to return to the contest = 85% PPV of injury
- Usually pain, effusion, and instability on history
- **Exam**: Anterior drawer, Lachman exam
PCL tear

- **Mechanism**: direct blow to the knee while it is bent. Dashboard injury, falling onto a flexed knee.
- **Symptoms**: may be vague. Swelling, pain, and instability. Often goes undiagnosed (2% of NFL combine attendees).
- **Exam**: posterior drawer
MCL sprain

- **Mechanism**: most common ligamentous injury of the knee due to a valgus stress to the knee
- **Symptoms**: medial knee pain, swelling, instability
- **Exam**: valgus stress test
LCL sprain

- **Mechanism**: isolated injury is rare, usually associated with other injuries resulting from a varus stress to the knee
- **Symptoms**: lateral knee pain and swelling, instability
- **Exam**: varus stress test
Meniscal tears

- **Mechanism**: from rotational injury to a flexed knee. Most common indication for knee surgery. Medial > Lateral. More common in ACL deficient knees
- **Symptoms**: pain, delayed/intermittent swelling and mechanical symptoms (locking/clicking)
- **Exam**: joint line tenderness most sensitive finding. Many special tests: Apley, Thessaly, McMurray
Patellofemoral pain

- **Mechanism**: etiology is multifactorial: abnormal patella tracking, muscle weakness, limb misalignment, chondral lesions. Most common in adolescents and young adults. Women > Men
- **Symptoms**: diffuse peripatellar pain, worse with stairs, “Theater sign”
- **Exam**: Patellar grind test, tenderness along the patellar facets
Iliotibial band friction syndrome

- **Mechanism**: a condition characterized by excessive friction between the ITB and the lateral femoral condyle. Most symptoms at 30 degrees of flexion
- **Symptoms**: non-traumatic lateral knee pain, most commonly in runners
- **Exam**: Ober test
Pes anserine bursitis

- **Mechanism**: excessive friction from the pes anserine tendons causes irritation of the bursa. May be caused by excessive hill running/increase in mileage, tight hamstrings.

- **Symptoms**: anteromedial knee pain (below the joint line). Worse with activity/stairs.

- **Exam**: tenderness at the bursa
Knee Exam
Ankle: Inspection/Palpation

Area of ATFL ligament

Base of 5th metatarsal

Tarsal navicular
Ankle: ROM

- Dorsiflexion
- Plantarflexion
- Inversion
- Eversion
Ankle Sprain: physical exam

High ankle sprain: Squeeze test

Medial sprain: Eversion tarsal tilt

Lateral sprain:
  - ATFL: Anterior Drawer Test
  - CFL: Tarsal tilt
Lateral ankle sprain

- **Mechanism**: account for >90% of ankle sprains
  - ATFL: plantar flexion/inversion (most common)
  - CFL: dorsi flexion/inversion (2nd most common)
- **Symptoms**: pain with weight bearing and instability
- **Exam**: Anterior drawer for ATFL
  - Tarsal tilt for CFL
Medial ankle sprain

- **Mechanism:** traumatic eversion of the ankle. Much less common than lateral sprains. May be associated with fibular fractures
- Medial ankle pain, swelling, instability
- **Exam:** eversion tarsal tilt

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**Talar Tilt (Eversion)**

- Patient sitting with legs over table
- Stabilize distal tibia, and grasp calcaneus
- Tilt the calcaneus into abduction
- Pain and/or laxity indicates deltoid ligament damage
Ottawa Ankle Rules

An ankle x-ray series is required only if there is any pain in malleolar zone and any of these findings:
- Bone tenderness at A
- Bone tenderness at B
- Inability to bear weight both immediately and in emergency department

A foot x-ray series is required only if there is any pain in midfoot zone and any of these findings:
- Bone tenderness at C
- Bone tenderness at D
- Inability to bear weight both immediately and in emergency department

Ottawa ankle rules for use of radiography in acute ankle injuries (adapted from Stiell et al)

Sensitivity 100%; Specificity 30-50%
Ankle Exam
“High ankle sprain”

- **Mechanism**: external rotation of the leg with a planted foot.
- **Symptoms**: pain and swelling proximal to the ATFL, medial ankle pain/swelling, often unable to bear weight
- **Exam**: squeeze test; external rotation stress test
- **Missed injuries may lead to chronic instability/end-stage arthritis**
*Jones fracture*

- **Mechanism**: medio-lateral force applied when the heel is raised and the foot is plantar flexed (e.g. sudden change in direction). Jones area is a vascular watershed and non-union is common.
- **Symptoms**: lateral midfoot pain, swelling, ecchymosis
- **Treatment**: non-weight bearing, ortho referral
**Lis Franc Injury**

- **Mechanism**: axial load through a hyperplantar flexed foot creating a disruption of the tarsal-metatarsal joint complex. Missed as an “ankle sprain”
- **Symptoms**: severe midfoot pain and swelling with inability of bear weight
- **Missed injuries can lead to progressive foot deformity, chronic dysfunction, and pain**
- **Exam**: can reproduce pain with pronation and abduction of the forefoot
Hands-On!!!!
Questions???