Musculoskeletal Examination: General Principles and Detailed Evaluation Of the Knee & Shoulder

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General Principles

• Musculoskeletal exam performed if symptoms (i.e. injury, pain, decreased function) – Different from “screening exam”
• Focused on symptomatic area
• Musculoskeletal complaints common frequently examined
Historical Clues

- Onset, location, radiation, severity?
- What makes it better? Worse? Treatments?
- What’s **functional limitation**?
- Symptoms in **single v multiple** joints?
- **Acute v slowly progressive**?
- If injury → mechanism?
- Prior problems w/area?
- **Systemic** symptoms?

**MSK ROS**
Examination Keys To Evaluating Any Joint

- **Area well exposed - no shirts, pants, etc**→ gowns
  - Make sure opposite arm or leg is visible for comparison
- **Inspect joint(s) in question.** Signs inflammation, injury (swelling, redness, warmth)? Deformity? Compare w/opposite side
- **Understand normal functional anatomy**
- **Observe normal activity** – what can’t they do? Specific limitations?
- **Palpate joint**→ warmth? Point tenderness? Over what structure(s)?
- **Range of motion**: active (patient moves it) and passive (you move it).
- **Strength, neuro-vascular** assessment.
- **Specific provocative maneuvers**
- **If acute injury & pain**→ difficult to assess as patient “protects”→ limiting movement, examination
  - **examine unaffected side first** (gain confidence, develop sense of their normal)
Anatomic Planes of The Body

The Anatomy Lesson
http://mywebpages.comcast.net/wnor/terminologyanatplanes.htm
**Terminology: Flexion/Extension, Abduction/Adduction**

- **Flexion:** Moving forward out of the frontal plane of the body (except knee and foot)
- **Extension:** Movement in direction opposite to flexion
- **Abduction:** movement that brings a structure away from the body (along frontal plane)
- **Adduction:** movement that brings a structure towards the body (along frontal plane)

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**Anatomic Position**
Knee Anatomy:

Observation & Identification of Landmarks

- Hinge-type joint - tolerates significant force, weight
- Anatomy straight forward → Exam make sense!
- Fully expose → take off pants, use gown or shorts!
- Surface landmarks: **patella** (knee cap), **patellar tendon**, **medial joint line**, **lateral joint line**, **quadriceps muscle**, **hamstring muscle group**, **tibia**, **anterior tibial tuberosity** (insertion of patellar tendon), **femur**.
Observation (cont)

• Obvious pain w/walking?
• Landmarks
• Scars → past surgery?
• Swelling → fluid in the joint (aka effusion)?
• Atrophic muscles (e.g. from chronic disuse)?
• Bowing of legs (inward = s Valgus, outward = s Varus)?

Varus Deformity (bowing outward)  Surgical Scars  Obvious right knee effusion
Range of Motion (ROM)

1. Active then passive (you move the joint)
2. Hand on patella w/extens. & flex → osteoarthritis, may feel grinding sensation (crepitus)

Normal range of motion:

Full Flexion: 140

Full Extension: 0
Strength and Neuro/Vascular Assessment: Most Relevant in Setting of Traumatic Injury

- Assess the strength of the major muscle groups:
  - Hamstrings $\rightarrow$ flex the knee
  - Quadriceps $\rightarrow$ extend the knee
- Assess distal pulses
  - Dorsalis pedis and posterior tibialis
  - Assessment of leg and foot perfusion
- Distal sensation and reflexes $\rightarrow$ will learn with the neuro exam
Assessment For A Large Effusion - Ballotment

An effusion = fluid w/in joint space –
Large effusions → obvious
Smaller effusions can be subtle

To Examine:
1. Flex knee
2. Hand on supra-pateallar pouch → above patella, communicates w/joint space.
4. W/other hand - push down on patella w/thumb.
5. If large effusion → patella floats & "bounces" back up when pushed down.

Courtesy Orthopedic Specialists of Gatonia
http://www.orthogastonia.com/index.php/
Menisci – Normal Function and Anatomy

• Medial & lateral menisci on top of tibia → cushioned articulating surface between femur & tibia
• Provides joint stability, distributes force, & protects underlying articular cartilage (covers bone, allows smooth movement)
• Menisci damaged by trauma or degenerative changes w/age.
• Symptoms if torn piece interrupts normal smooth movement of joint → pain, instability ("giving out"), locking &/or swelling
Evaluating for Meniscal Injury – Joint Line Palpation

Joint Line Tenderness ➔ medial or lateral meniscal injury (& OA)

1. Slightly flex knee.
2. Find joint space along lateral & medial margins. Joint line perpendicular to long axis tibia.
3. Palpate along medial, then lateral margins.
4. Pain suggest underlying meniscus damage or OA
Additional Tests For Meniscal Injury

McMurray’s Test – Medial Meniscus

McMurray’s manipulates knee ➔
torn meniscus “pinched” ➔ pain & click

Medial meniscus:
1. Left hand w/middle, index, & ring fingers on medial joint line.
2. Grasp heel w/right hand, fully flex knee.
3. Turn ankle ➔ foot pointed outward (everted). Direct knee ➔ pointed outward.
5. If medial meniscal injury, feel "click" w/hand on knee w/extension. May also elicit pain.

Simulated McMurray’s – Note pressure placed on medial meniscus
McMurray’s Test – Lateral Meniscus

1. Return knee to fully flexed position, turn foot inwards (inverted).
2. Direct knee so pointed inward.
3. Hand on knee, fingers along joint lines
4. Extend and flex knee.
5. If lateral meniscal injury → feel "click" w/fingers on joint line; May also elicit pain.

Note: McMurray’s Test for medial and lateral meniscus injuries are performed together
Additional Assessment For Meniscal Injury – Appley Grind Test

1. Patient lies on stomach.
2. Grasp ankle & foot w/both hand, flex knee to ninety degrees.
3. Hold leg down w/your leg on back of thigh.
4. Push down while rotating ankle.
5. Puts direct pressure on menisci ➔ if injured ➔ pain.
6. Test opposite leg.

Simulated Appley – Note how downward pressure pinches menisci.
Ligaments – Normal Anatomy and Function

- 4 bands tissue, connecting femur to tibia – provide stability
- Ligamentous injury (requires significant force – eg leg struck from side with foot planted) → acute pain, swelling & often report hearing a "pop" (sound of ligament tearing).
- After acute swelling & pain, patient may report pain & instability (sensation of knee giving out) with maneuver exposing deficiency assoc w/damaged ligament

Courtesy U of Washington
http://courses.washington.edu/hubio553/cases/
Specifics of Testing – Medial Collateral Ligament (MCL)

1. Flex knee ~ 30 degrees.
2. Left hand on lateral aspect knee.
3. Right hand on ankle or calf.
4. Push inward w/left hand while supplying opposite force w/right.
5. If MCL torn, joint "opens up" along medial aspect.
6. May also elicit pain w/direct palpation over ligament

Compare w/non-affected side – “normal” laxity varies from patient to patient

Courtesy Orthopedic Specialists of Gatonia
http://www.orthogastonia.com/index.php/
Lateral Collateral Ligament (LCL)

1. Flex knee ~ 30 degrees.
2. Right hand medial aspect knee.
3. Left hand on ankle or calf.
4. Push steadily w/right hand while supplying opposite force w/ left.
5. If LCL torn, joint will "open up" on lateral aspect.
6. May elicit pain on direct palpation of injured ligament.
Another Method For Assessing The LCL and MCL

1. Flex knee ~ 30 degrees, cradle heel between arm & body.
2. Place index fingers across joint lines.
3. Using your body & index fingers, provide medial then lateral stress to joint
Anterior Cruciate Ligament (ACL) – Lachman’s Test

1. Grasp femur w/left hand, tibia w/right.
2. Flex knee slightly.
3. Pull up sharply (towards belly button) w/right hand, stabilizing femur w/left.
4. Intact ACL limits amount of distraction, described as “firm end point” w/Lachmans
5. If ACL torn, tibia feels unrestrained in forward movement.

Direction of Force

Courtesy Orthopedic Specialists of Gatonia
http://www.orthogastonia.com/index.php/
Drop Lachman’s Test
For Patient’s With Big Legs &/or Examiners With Small Hands

1. Patient hangs leg off table
2. Place ankle between your legs to stabilize & hold knee in ~30 degrees flexion
3. Place hand on femur, holding it on table
4. Grasp tibia w/other hand & pull forward
Anterior Cruciate Ligament (ACL) – Anterior drawer

1. Patient lies down, knee flexed ~ 90 degrees.
2. Sit on foot. Grasp below knee w/both hands, thumbs meeting @ front of tibia.
3. Pull forward - Intact ACL limits amount of distraction, described as “firm end point”
4. If ACL torn, tibia feels unrestrained in forward movement.

*Anterior drawer less sensitive than Lachman’s
Posterior Cruciate Ligament (PCL) – Posterior Drawer Test

1. Patient lies down, knee flexed ~ 90 degrees.

2. Sit on foot. Grasp below knee w/both hands, thumbs meeting @ front of tibia.

3. Push backward, noting movement of tibia relative to femur. Intact PCL → discrete end point.

4. If PCL torn, tibia feels unrestrained in movement backwards.
Anterior Knee Pain: Assessment for Patellofemoral Problems and Chondromalacia

Common source anterior knee pain – secondary to patella articulation w/femur – To Test:

1. Slightly flex knee.
2. Push down on patella w/both thumbs ➔ elicits pain in setting Chondromalacia (osteoarthritis underside patella).
3. Move patella side to side ➔ palpate its undersurface. May elicit pain if Chondromalacia.
4. Hold patella in place w/ hand & direct patient to contract quadriceps ➔ forces inferior surface patella onto femur, eliciting pain if Chondromalacia

Courtesy Orthopedic Specialists of Gatonia
http://www.orthogastonia.com/index.php/
<table>
<thead>
<tr>
<th>Name of Maneuver</th>
<th>Clinical Interpretation</th>
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<tbody>
<tr>
<td>Observe knee &amp; surrounding structures, identify surface anatomy, palpation for pain/explore abnormal appearing areas</td>
<td>Variety of pathologic processes</td>
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<tr>
<td>Range of motion (with palpation)</td>
<td>Abnormal w/variety pathologic processes, crepitus with DJD</td>
</tr>
<tr>
<td>Assess strength, distal pulses, distal sensation, reflexes</td>
<td>Most important in setting of trauma ➔ identify co-existing injuries</td>
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<tr>
<td>Joint line tenderness</td>
<td>Meniscal injury, djd</td>
</tr>
<tr>
<td>McMurray’s Test (foot everted, knee varus position, flex/extend while palpate medial joint line; then invert foot, knee valgus, palpate lateral joint line while flex/extend)</td>
<td>Pain or palpable click with hand on joint line suggests Meniscal injury</td>
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<td>Appley Grind Test (patient supine, knee flexed 90 degrees, examiner rotates foot while providing downward pressure)</td>
<td>Pain suggests meniscal injury along side being palpated</td>
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<tr>
<td>Medial and Lateral joint line stress</td>
<td>Excessive laxity suggest MCL or LCL tear</td>
</tr>
<tr>
<td>Lachman’s Test (stabilize femur with one hand, pull anteriorly on tibia with other)</td>
<td>Excessive laxity suggests ACL tear</td>
</tr>
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<td>Drop Lachman’s Test – useful if large leg or small hands (leg positioned over side of table, stabilize ankle between examiner’s legs, hold femur down w/one hand, pull upward on tibia w/other)</td>
<td>Excessive laxity suggests ACL tear</td>
</tr>
<tr>
<td>Anterior Drawer test</td>
<td></td>
</tr>
<tr>
<td>Posterior Drawer Test (knee 90 degrees, examiner sits on patient’s foot and pushes posteriorly on tibia)</td>
<td>Excessive laxity suggests PCL tear</td>
</tr>
<tr>
<td>Assorted patellar manipulation (push down on patella, palpate undersurface)</td>
<td>Pain suggests Chondromalacia Patellae</td>
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The Shoulder Exam
Overview of Anatomy

- Shoulder created by 3 bony structures: scapula, humerus & clavicle.
- Held together by ligaments & web of muscles
- Tremendous range of motion → “golf ball on a tee” structure
- Compared w/knee, shoulder anatomy more complex – exam w/more Eponyms!
Observation & Palpation

- Expose both shoulders
- Compare sides, noting: Swelling? Discoloration? Deformity? Atrophy? Surgical incisions or scars?
- Remember: problems elsewhere (e.g. neck, abdomen) can cause referred pain (i.e. appreciated in shoulder) – should be uncovered via good Hx and P.E.
- Identify & palpate each of the surface landmarks:
  - Clavicle - Scapula
  - Acromion - Deltoid muscle
  - Sternum - Supraspinatus region
  - Acromio-clavicular joint - Infraspinatus region
  - Sterno-clavicular joint - Teres Minor region
Active Range Of Motion
Flexion/Extension and Abduction/Adduction

1. Trace arc while reaching forward with elbow straight (forward flexion)
   a. Should be able to move hand to position over head - normal range is 0 to 180 degrees.

1. Reverse direction & trace arc backwards (extension).
   a. Should be able to position hand behind their back

1. Direct patient to abduct their arm to position with hand above their head
   a. Movement should be smooth and painless
   b. Normal range is 0 to 180.
Abduction and External Rotation:
1. Direct patient to place hand behind head.
2. Then, reach as far down spine as possible.
4. Should be able to reach ~C 7 level (C-7 has most prominent posterior “bump” on cervical spine & easily palpated).

Adduction and Internal rotation:
1. Direct patient to place hand behind back.
2. Instruct them to reach as high up spine as possible.
3. Note extent of reach in relation to scapula or thoracic spine.
4. Should be able to reach lower border of scapula (~ T 7 level).
Passive ROM

• If pain w/active ROM, assess same w/passive ROM.
  1. Grasp humerus & move shoulder through ROMs described previously.
  2. Feel for crepitus (indicative of arthritis) w/hand placed on shoulder.
• Note which movement(s) precipitate pain. Pain/limitation on active ROM but not passive suggests a structural problem w/muscles/tendons (they’re firing w/active ROM but not passive).
• Note limitations in movement. Where exactly in the arc does this occur? Due to pain or weakness? How compare w/other side?
Neuro/Vascular Assessment

• Palpate radial artery, assess hand perfusion
• Assess distal sensation and reflexes
  – Concurrent neurological dysfunction and/or Neurological based etiology for symptoms

*We’ll teach these techniques w/the neuro exam
The Rotator Cuff

- 4 major muscles = Rotator Cuff
- Allow wide range arm movement @ shoulder & keeps humerus in close contact w/scapula
- RC muscles and function:
  - **Supraspinatus** – Abducts shoulder (up to ~ 80 degrees)
  - **Infraspinatus** – External rotation
  - **Teres Minor** – External rotation
  - **Subscapularis** – Internal rotation

Courtesy American Family Physician
http://www.aafp.org/afp/20000515/3079.html
Anatomy: Connects top of scapula→humerus. W/Firing→shoulder abducts. Most commonly damaged of rotator cuff muscles. Testing as follows:

1. Patient elevates shoulder 30 degrees (30 degrees forward flexion & full internal rotation - i.e. turned so thumb pointing downward).
2. Forward flex shoulder, w/o resistance.
3. Repeat w/resistance
4. Note that Deltoid responsible for abduction beyond ~ 70 degrees
5. If partial tear of Supraspinatus, patient experiences pain & some element weakness w/above maneuver. Complete disruption of muscle prevents patient from achieving any abduction
RC Testing – Infraspinatus and Teres Minor

Anatomy: Both muscles connect scapula→humerus.
Firing→arm rotates externally.

Specifics of testing:
1. Patient slightly abducts (20-30 degrees) shoulders, elbows @ 90 degrees.
2. Place your hands on outside of their forearms.
3. Direct pt to push arms outward (externally rotate) while you resist.
4. Tears in tendon→ weakness and/or pain

Infraspinatus and Teres Minor – Posterior View
Anatomy: Connects scapula to humerus, w/origin on anterior surface of scapula. Firing ➔ internal rotation. Function can be tested using "Gerber's lift off test:

1. Patient places hand behind back, palm facing out.
2. Pt lifts hand away from back.
3. If tendon partially torn, movement limited or causes pain. Complete tears prevents any movement in this direction.
Impingement, Rotator Cuff Tendonitis and Sub-Acromial Bursitis

- 4 tendons of RC pass underneath acromion & coraco-acromion ligament → insert on humerus.
- Space between acromion/coracoacromial lig & tendons can become narrowed.
- Causes tendons (in particular, supraspinatus) to become "impinged upon." → resulting friction inflames tendons & subacromial bursa (between tendons & acromion).
- Net result =s shoulder pain, particularly raising arm over head (e.g. swimming, reaching up on a top shelf, arm positioning during sleep).

Courtesy Orthopedic Specialists of Gatonia
http://www.orthogastonia.com/index.php/
Neer’s Test For Impingement

1. Place 1 hand on patient's scapula, & grasp forearm w/other. Arm internally rotated (thumb pointed downward).

2. Foreward flex arm, positioning hand over the head.


Courtesy American Family Physician
http://www.aafp.org/afp/20000515/3079.html
Hawkin’s Test For Impingement and Subacromial Palpation

Hawkin’s Test:
1. Raise patient's arm to 90 degrees forward flexion.
2. Rotate internally (i.e. thumb pointed down) → places greater tubercle humerus in position to further compromise space beneath acromion.

Subacromial Palpation:
1. Identify acromion by following scapular spine laterally to tip
2. Palpate in region sub-acromial space → pain if tendons/bursa inflamed.
Biceps Tendon – Anatomy and Function

- Long head biceps tendon runs in bicipital groove humerus, inserting @ top of glenoid.
- Subject to same forces/stresses as tendons of RC.
- Biceps flexes & supinates forearm
- Inflammation (tendonitis) → pain @ top & anterior shoulder areas, particularly w/flexion or supination.

Courtesy Orthopedic Specialists of Gatonia
http://www.orthogastonia.com/index.php/
Biceps Tendon Testing and Pathology

Palpation:
1. Palpate biceps tendon bicipital groove. Pain $\rightarrow$ tendonitis.
2. Confirm you’re on tendon $\rightarrow$ patient supinates while you palpate

Resisted Supination (Yergason’s Test):
1. Elbow flexed 90 degrees, shoulder adducted (ie elbow bent @ right angle, arm against body).
2. Grasp patient's hand, direct them to rotate arm such that hand is palm up (supinate) while you resist.
3. Pain $\rightarrow$ tendonitis

“Popeye Muscle” $\rightarrow$ Bicep’s Rupture
Acromio-Clavicular Joint Pathology


Specifics of Testing:
1. Palpate point @ where end of clavicle articulates w/acromion.
2. Push on area → ? pain
3. Ask patient to move arm across chest → stresses A-C joint → pain in setting of DJD.
4. A-C joint separation → swelling & pain on cross arm testing or palpation
Other Tests (not covered today)

• Labrum pathology
• Instability
• And a number of other “named” maneuvers
  → to be continued…
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<td>□ Observe shoulder &amp; surrounding structures, identify surface anatomy, palpation for pain/explore abnormal appearing areas</td>
<td>General orientation, obvious abnormalities</td>
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<tr>
<td>□ Range of motion (flexion/extension, abduction/adduction, internal/external rotation), with palpation</td>
<td>Decreased with variety shoulder pathology, crepitus on palpation with DJD</td>
</tr>
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<td>□ Neuro/Vascular assessment: radial pulse, perfusion of hand, distal sensation, reflexes</td>
<td>Particularly important if traumatic injury to identify other affected organ systems; Also sometimes disorders affecting the nervous system can sometimes present as shoulder pain (e.g. pathology of spine, cervical nerve roots, brachial plexus)</td>
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<td>□ “Empty can test” (arm abducted 60 degrees, forward flexed ~ 30 degrees, thumb down, resistance to additional flexion)</td>
<td>Pain/weakness suggests Supraspinatus tear</td>
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<tr>
<td>□ Resisted external rotation</td>
<td>Pain/weakness suggests Infraspinatus or Teres Minor tear</td>
</tr>
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<td>□ Resisted internal rotation and lift off from back (Gerber’s test)</td>
<td>Pain/weakness suggests Subscapularis tear</td>
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<td>□ Sub-acromial palpation</td>
<td>Pain suggests bursitis/impingement</td>
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<td>□ Hawkin’s test (elbow 90 degrees, arm forward flexed 90 degrees, examiner internally rotates)</td>
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<tr>
<td>□ Neer’s test (thumb down, elbow straight, examiner raises arm thru forward flexion)</td>
<td>Pain suggests bursitis/impingement</td>
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<td>□ Long head biceps palpation</td>
<td>Pain suggests biceps tendonitis</td>
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<tr>
<td>□ Yergason’s (elbow 90 degrees, arm adducted, patient attempts supination while examiner resists)</td>
<td>Pain suggests biceps tendonitis</td>
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<td>□ A-C joint tenderness, Cross arm test (reach across towards opposite shoulder)</td>
<td>Pain suggests a-c joint pathology (djd, dislocation)</td>
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