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

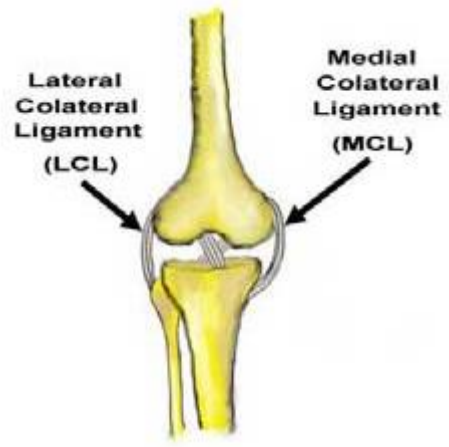
- Onset, location, radiation, severity?
- What makes it better? Worse? Treatments?
- What's **functional limitation**?
- Symptoms in **single** v **multiple** joints?
- **Acute** v **slowly** progressive?
- If **injury** → **mechanism**?
- **Prior problems** w/area?
- **Systemic** symptoms?

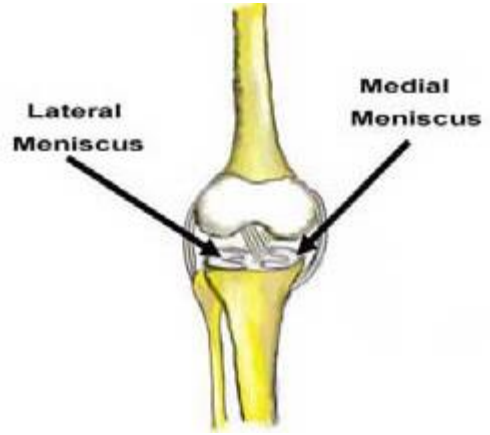
MSK ROS

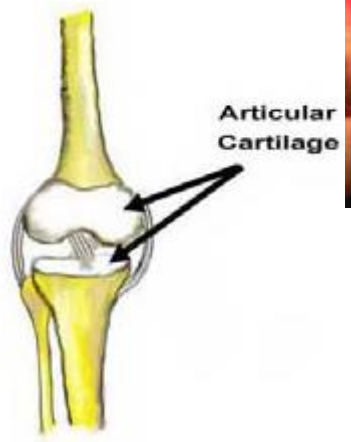
Examination Keys To Evaluating Any Joint

- 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)

Knee Anatomy:
Hinge Type Joint→ Logical Exam



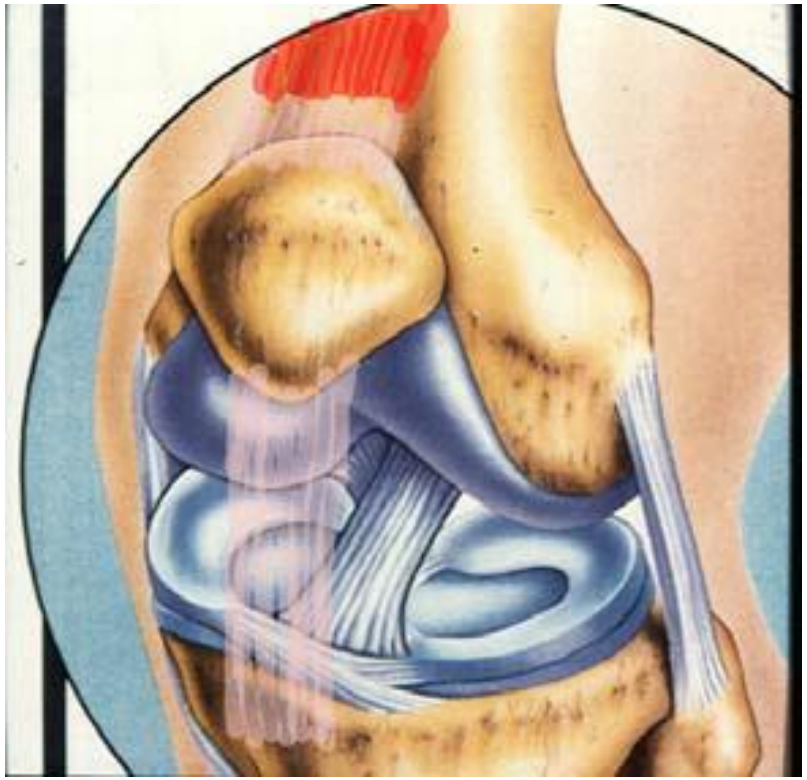




The Extensor Mechanism

Images courtesy of Dr. Ted Parks, Western Orthopaedics

Putting It All Together



Images courtesy of Dr. Ted Parks,
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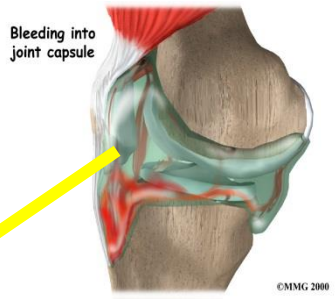
Observation

- Obvious pain or gait abnormality?
- Redness or other discoloration?
- Scars→ past surgery?
- Swelling → fluid in the joint (aka effusion)?
- Atrophic muscles (e.g. from chronic disuse)?
- Alignment: Bowing of legs (inward =s Valgus, outward =s Varus)?



Varus Deformity (bowing outward)

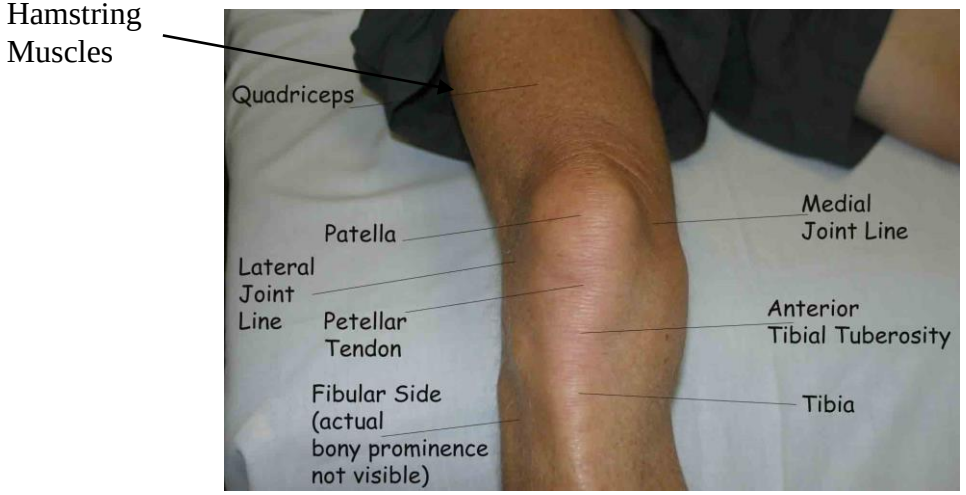
Valgus Deformity (bowing outward)

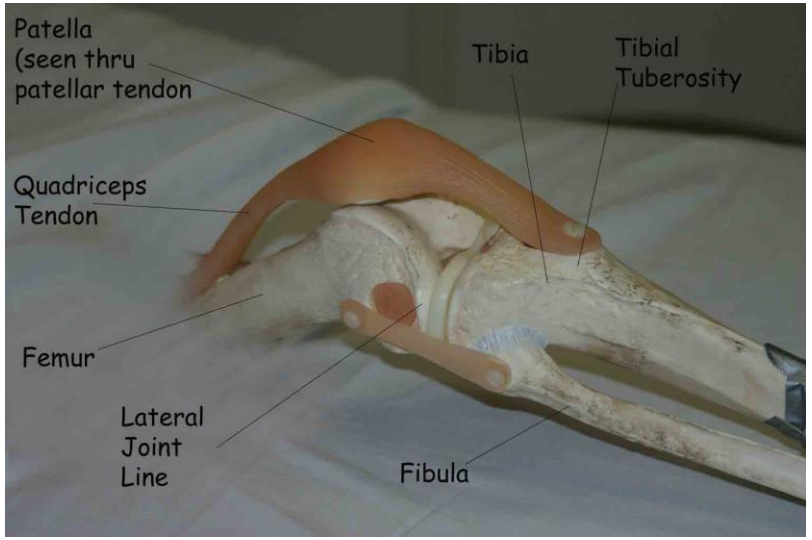
Surgical Scars

Obvious right knee effusion

Palpation: Patellar Mechanism

- Fully expose → take off pants, use gown or shorts!
- Palpate
  - note any **warmth** around knee
  - **quadriceps** & **hamstring** muscle groups
  - **patella** (knee cap)
  - **quadriceps and patellar tendons**
  - **anterior tibial tuberosity (insertion patellar tendon)**





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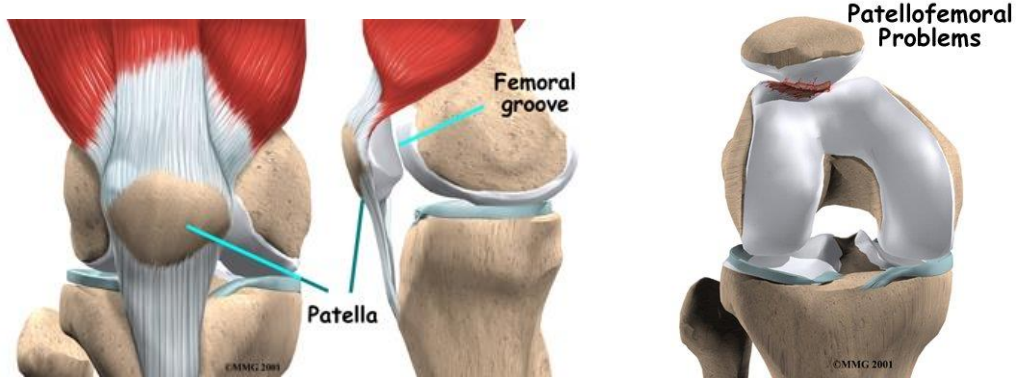
Patellar Palpation

Patellofemoral Anterior knee pain – secondary to patella articulation w/femur

To Test:

- Slightly flex knee.
- Patellar Apprehension Test: Move patella side to side→ if too much laxity → patient will fear subluxation
- Palpate patella facets: May elicit pain if Chondromalacia.
- Patella Grind (aka Quad Apprehension Test): Examiner pushes down on patella while patient contracts quadriceps → forces patella onto femur, eliciting pain behind knee cap in Patellofemoral syndrome



Courtesy Orthopedic Specialists of Gatonia
http://www.orthogastonia.com/index.php/

Range of Motion (ROM)

- Active then passive (you move the joint)
- Hand on patella w/extension & flexion →osteoarthritis, may feel grinding sensation (crepitus)

Normal range of motion:

Full Flexion: 140^0 Full Extension: 0^0

Joint Line Palpation

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

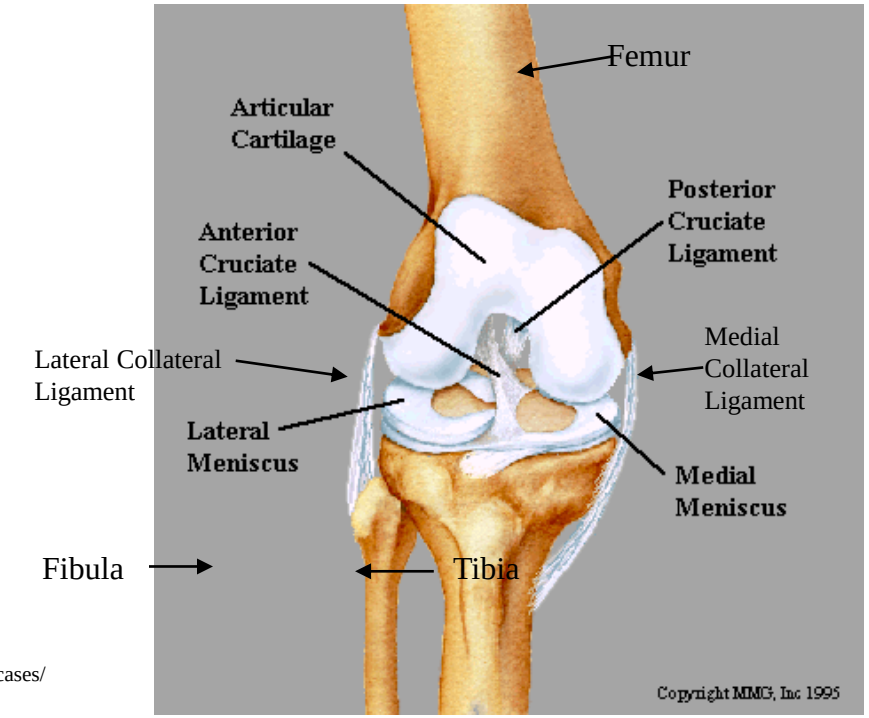
- Slightly flex knee.
- Find joint space along lateral & medial margins. Joint line perpendicular to long axis tibia.
- Palpate along medial, then lateral margins.
- Pain suggest underlying meniscus damage or OA

Lateral

Medial

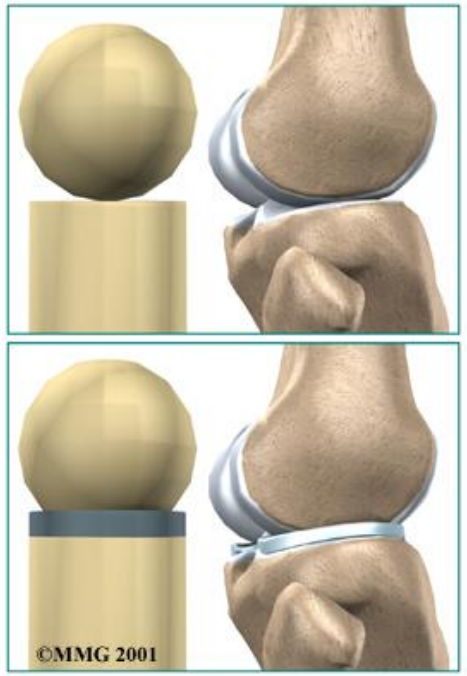
Menisci – Normal Function and Anatomy

- Medial & lateral menisci on top of tibia→ cushioned articulating surface between femur & tibia
- Provides 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



Courtesy U of Washington
http://courses.washington.edu/hubio553/cases/

Role of the Menisci



Without Meniscus

With Meniscus

Courtesy Orthopedic Specialists of Gatonia
http://www.orthogastonia.com/index.php/

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Additional Tests For Meniscal Injury
McMurray's Test – Medial Meniscus

McMurray's manipulates knee→

torn meniscus "pinched"→ pain & click

Medial meniscus:

- Left hand w/middle, index, & ring fingers on medial joint line.
- Grasp heel w/right hand, fully flex knee.
- Turn ankle→ foot pointed outward (everted), knee → pointed outward.
- Holding foot in everted position, extend & flex knee.
- 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

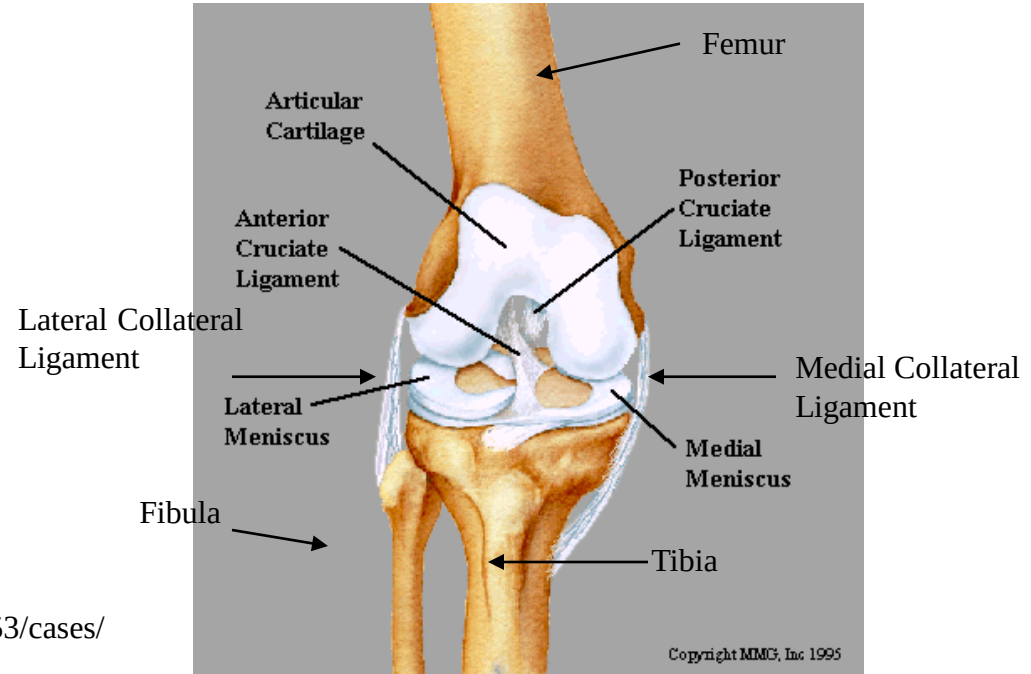
McMurray's Test – Lateral Meniscus

- Return knee to fully flexed position, turn foot inwards (inverted).
- Direct knee so pointed inward.
- Hand on knee, fingers along joint lines
- Extend and flex knee.
- 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

Ligaments – Normal Anatomy and Function

- 4 bands tissue, connecting femur → tibia – provide stability
  - MCL, LCL, ACL, PCL
- Ligamentous injury: requires significant force – can be non-contact →acute pain, swelling & often hear a "pop" (sound of ligament tearing) – longer term→ instability (give-way)



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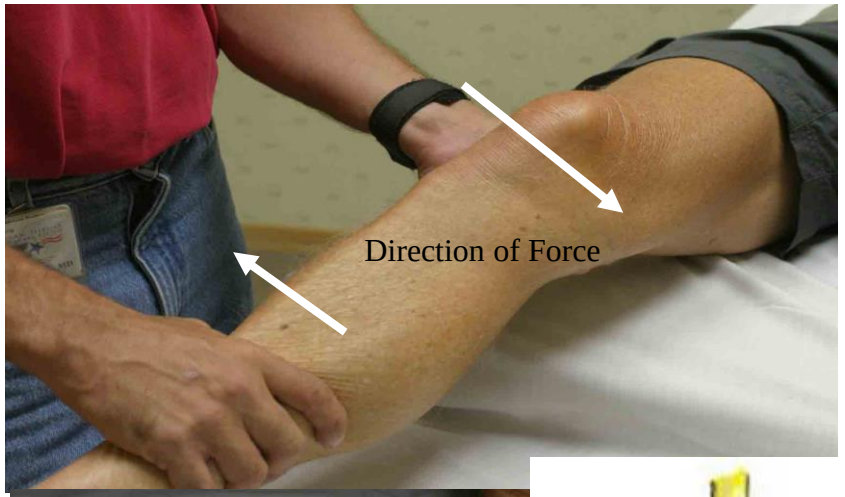
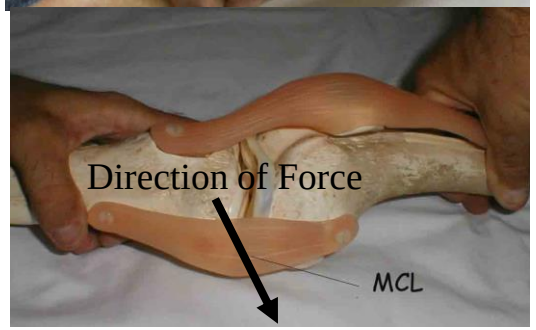
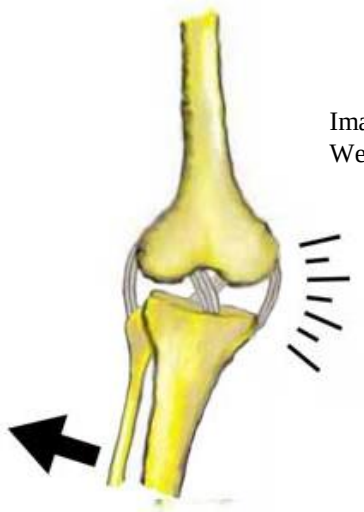
Specifics of Testing – Medial Collateral Ligament (MCL)

- Flex knee ~ 30^0
- Left hand on lateral aspect knee.
- Right hand on ankle or calf.
- Push inward w/left hand (Valgus force).
- If MCL torn, joint "opens up" along medial aspect.
- May also elicit pain w/direct palpation over ligament

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



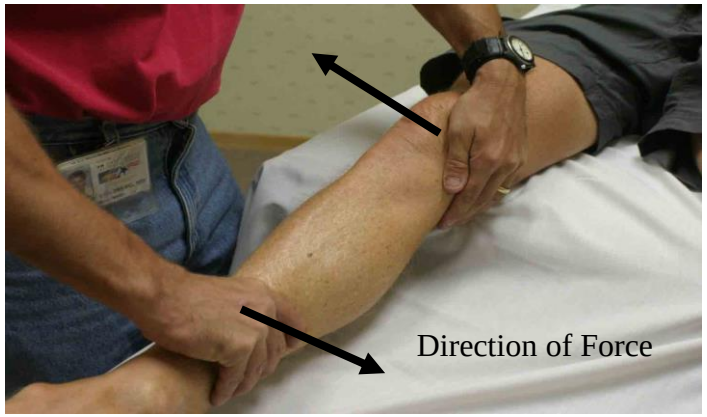


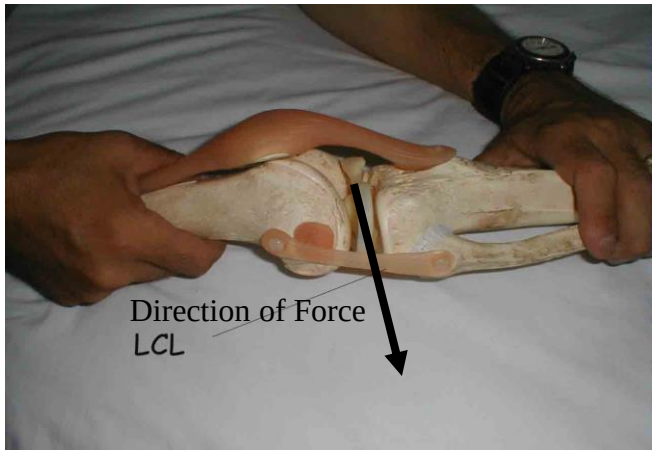


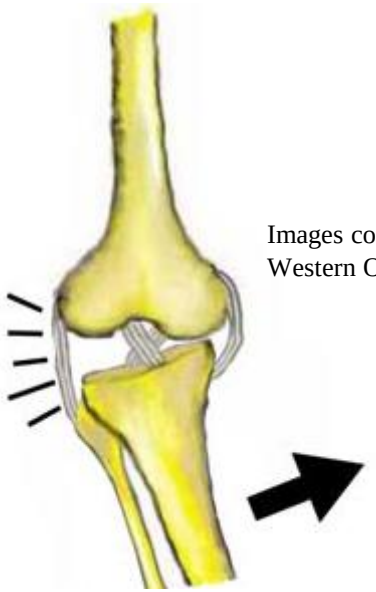
Images courtesy of Dr. Ted Parks, Western Orthopaedics

Lateral Collateral Ligament (LCL)

- Flex knee ~ 30^0
- Right hand medial aspect knee.
- Right hand on ankle or calf.
- Push steadily w/left hand (Varus force)
- If LCL torn, joint will "open up" on lateral aspect.
- May elicit pain on direct palpation of injured ligament







Images courtesy of Dr. Ted Parks, Western Orthopaedics

Anterior Cruciate Ligament (ACL) – Lachman's Test

- Grasp femur w/left hand, tibia w/right.
- Flex knee slightly.
- Pull up sharply (towards belly button) w/right hand, stabilizing femur w/left.
- Intact ACL limits amount of distraction, described as "firm end point" w/Lachman's
- If ACL torn, tibia feels unrestrained in forward movement.

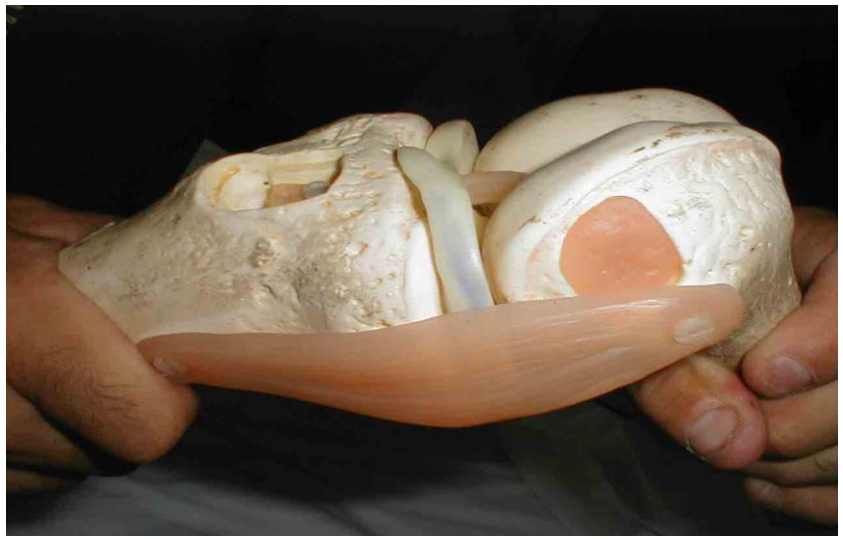
Courtesy Orthopedic Specialists of Gatonia
http://www.orthogastonia.com/index.php/

Drop Lachman's Test:
For Patient's With Big Legs &/or Examiners With Small Hands

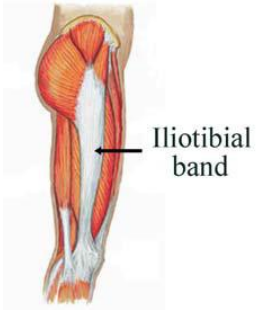
- Patient hangs leg off table
- Place ankle between your legs to stabilize & hold knee in ~30^0 flexion
- Place hand on femur, holding it on table
- Grasp tibia w/other hand & pull forward

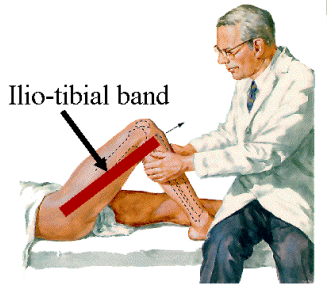
Anterior Cruciate Ligament (ACL): Anterior Drawer Test

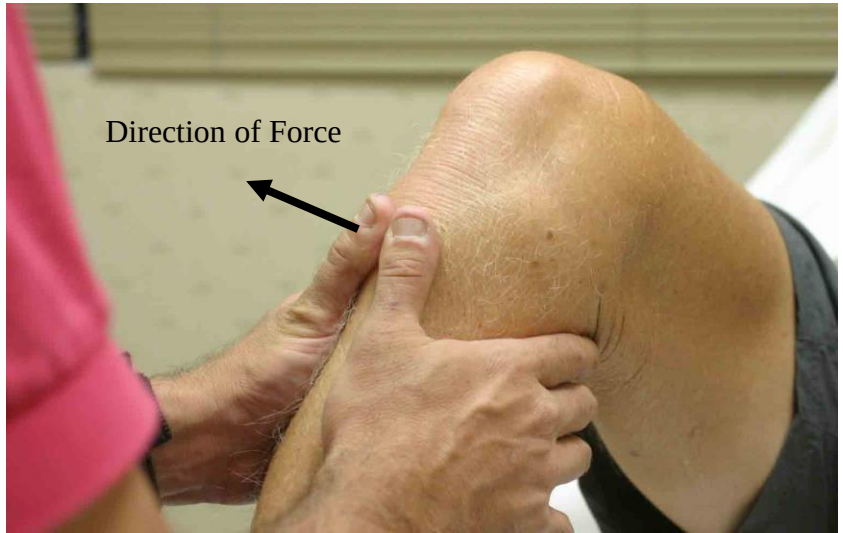
- Patient lies down, knee flexed ~ 90^0
- Sit on foot. Grasp below knee w/both hands, thumbs meeting @ front of tibia.
- Pull forward - Intact ACL limits amount of distraction, described as “firm end point”
- If ACL torn, tibia feels unrestrained in forward movement.



*Anterior drawer less sensitive than Lachman’s – due to affect of iliotibial band



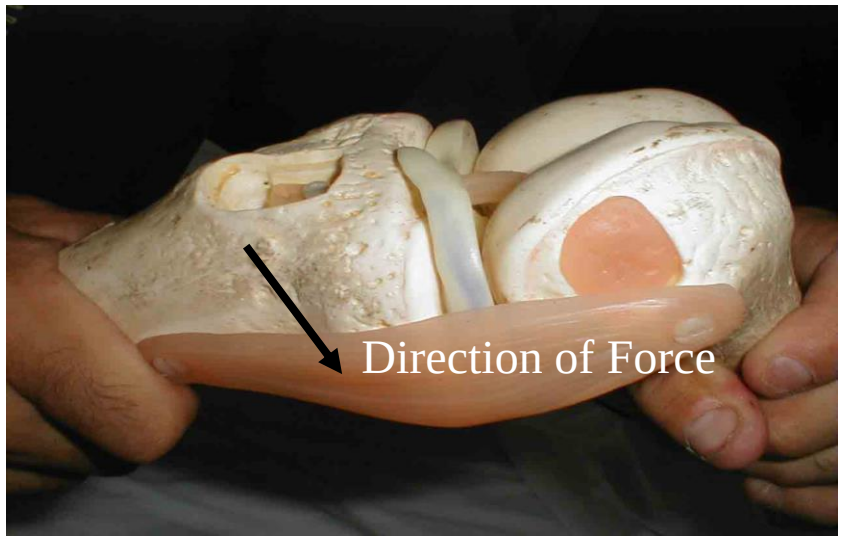




Images courtesy of Dr. Ted Parks, Western Orthopaedics

Posterior Cruciate Ligament (PCL): Posterior Drawer Test

- Patient lies down, knee flexed ~ 90^0
- Sit on foot. Grasp below knee w/both hands, thumbs meeting @ front of tibia.
- Push backward, noting movement of tibia relative to femur. Intact PCL → discrete end point.
- If PCL torn, tibia feels unrestrained in movement backwards.



PCL Tear
“Sag Sign”

Images courtesy of Dr. Ted Parks,
Western Orthopaedics

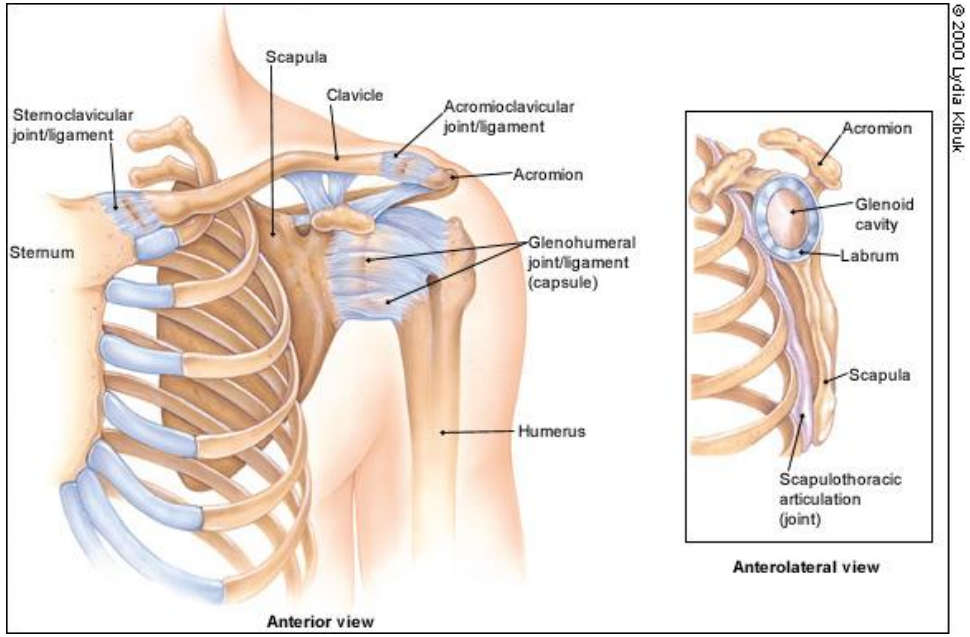
Strength and Neuro/Vascular Assessment: Most Relevant in Setting of Traumatic Injury

- Assess the strength of the major muscle groups:
  - Hamstrings→ flex the knee
  - Quadriceps→ extend the knee
- Assess distal pulses
  - Dorsalis pedis and posterior tibialis
  - Assessment of leg and foot perfusion
- Distal sensation and reflexes→ will learn w/the neuro exam

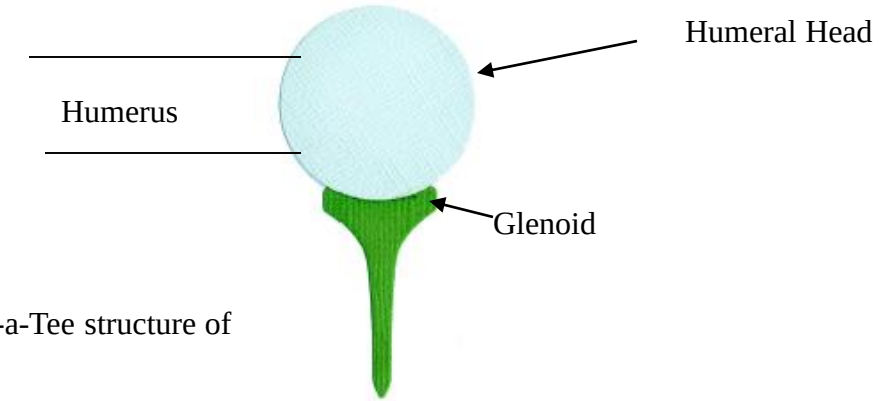
The Shoulder Exam

Overview of Shoulder 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!

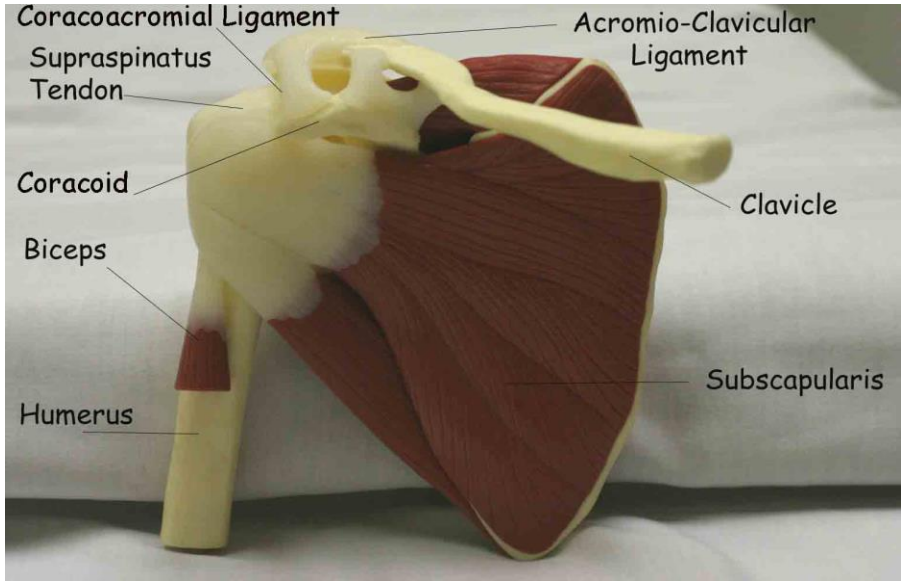


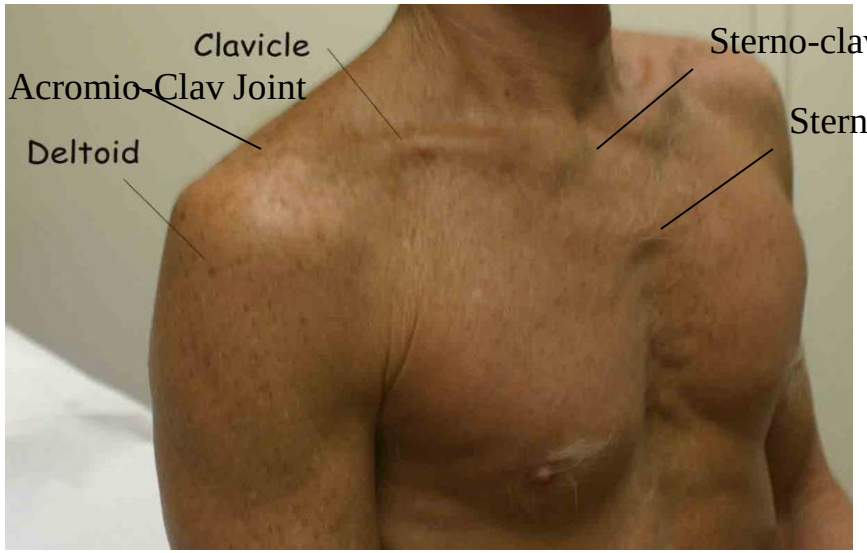
Courtesy Americian Family Physician
http://www.aafp.org/afp/20000515/3079.html



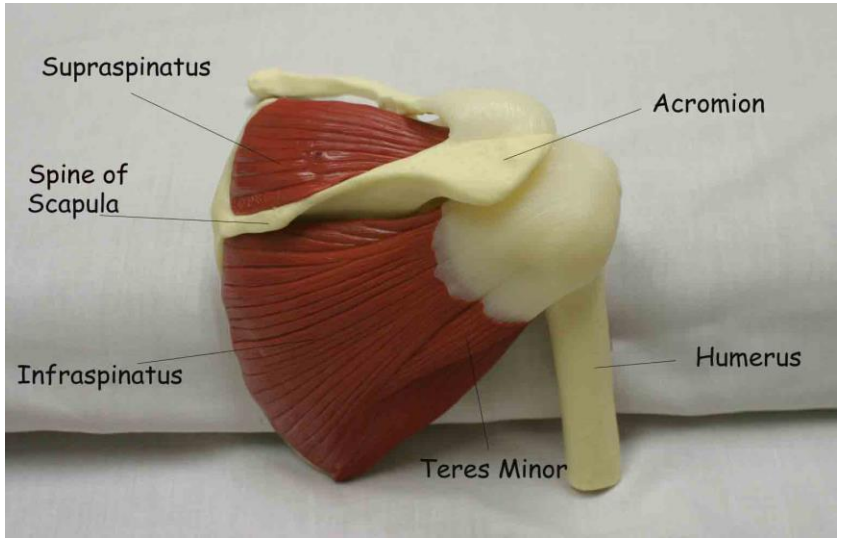
Golf -ball-on-a-Tee structure of shoulder

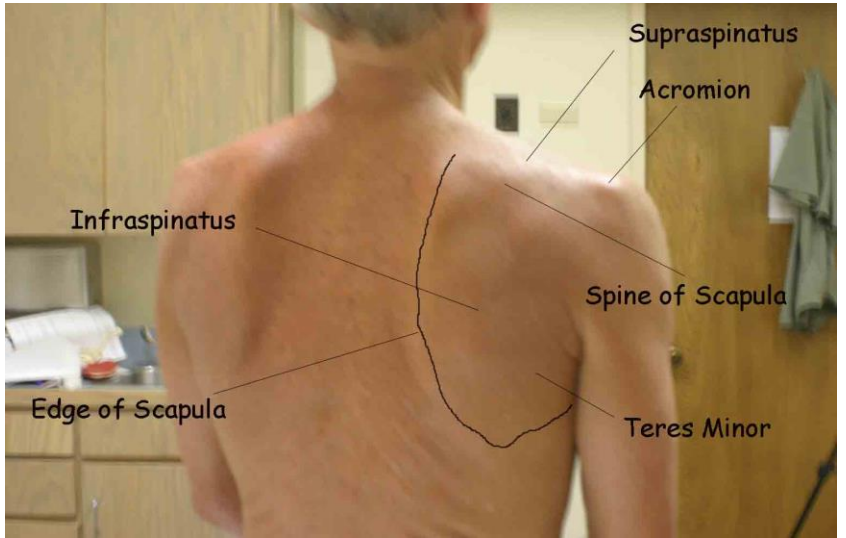
Anatomy: Anterior View





Anatomy: Posterior View





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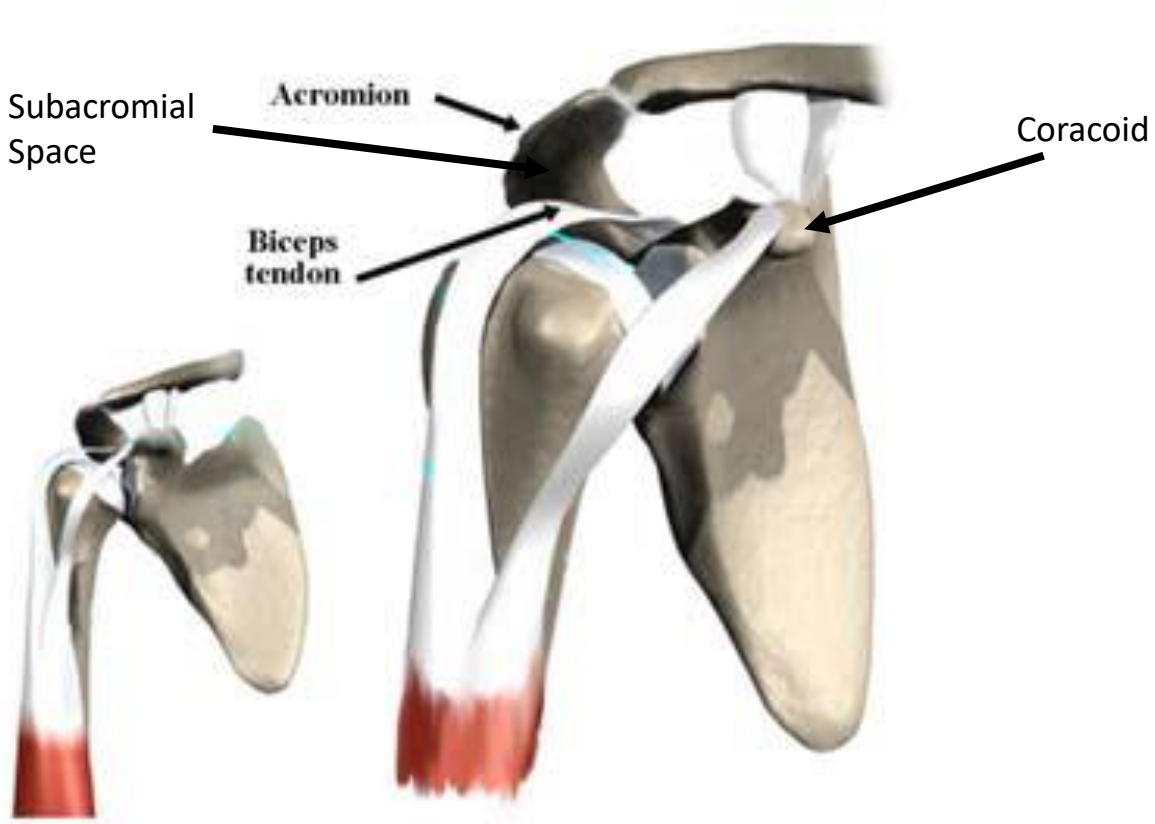
Observation

- 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 History and P.E.
- Identify each surface landmarks:
    - Clavicle
    - Acromion & Subacromial
    - Space
    - Sternum
    - Acromio-clavicular joint
    - Sterno-clavicular joint
    - Scapula
    - Deltoid muscle
    - Supraspinatus region
    - Infraspinatus region
    - Teres Minor region

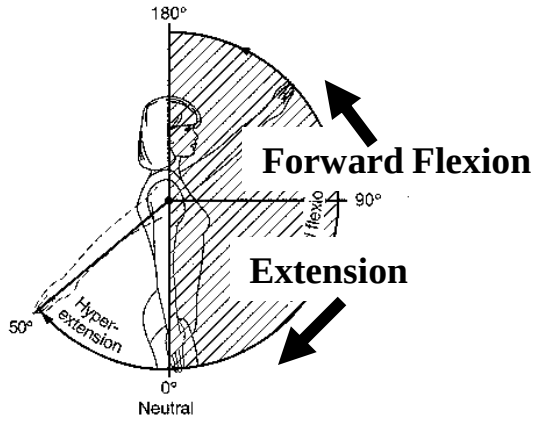
Palpation: **A**, **B**, **C**s

- Palpate the following
  - **A**cromion
  - **B**iceps tendon
  - **C**oracoid
  - **S**ubacromial Space

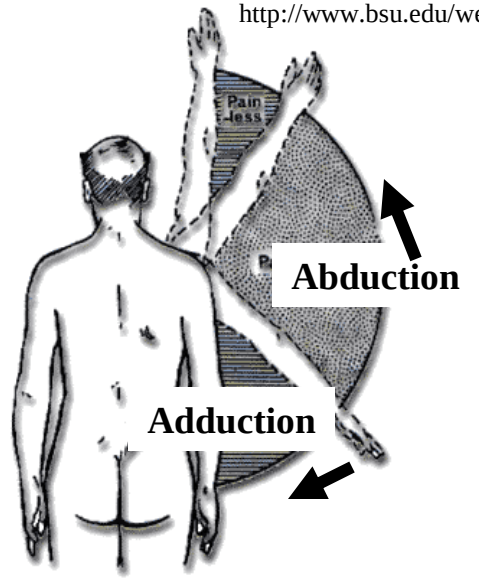


Active Range Of Motion
Flexion/Extension and Abduction/Adduction

- Trace arc while reaching forward with elbow straight (forward flexion)
    a. Should be able to move hand to position over head - normal range 0^0 to 180^0
- Reverse direction & trace arc backwards (extension).
    a. Should be able to position hand behind their back
- Direct patient to abduct their arm to position with hand above their head
    a. Movement should be smooth and painless
    b. Normal range is 0^0 to 180^0



Courtesy Ball State University
http://www.bsu.edu/web/ykwon/pep294/lab2/rom_lab.html



Courtesy Dr. C J Thakkar
http://www.cjthakkar.com/shoulderpain2.html

Passive ROM

- If pain w/active ROM, assess same w/passive ROM.
  - Grasp humerus & move shoulder through ROMs described previously.
  - 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 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?

The Rotator Cuff and Deltoid

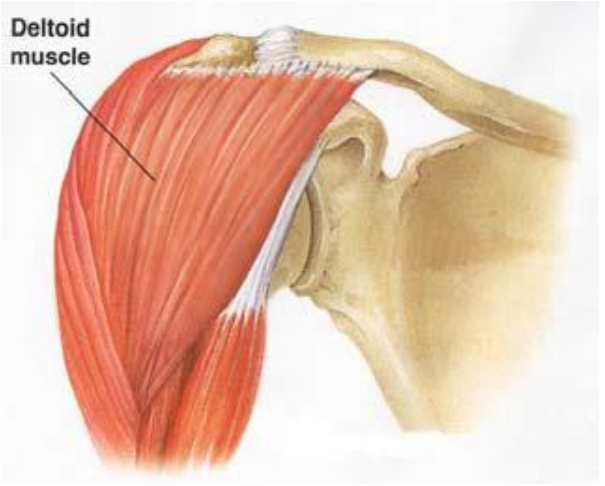
- Deltoid: Major abductor
- 4 major muscles of Rotator Cuff (RC)
- RC muscles (SITS) and function:

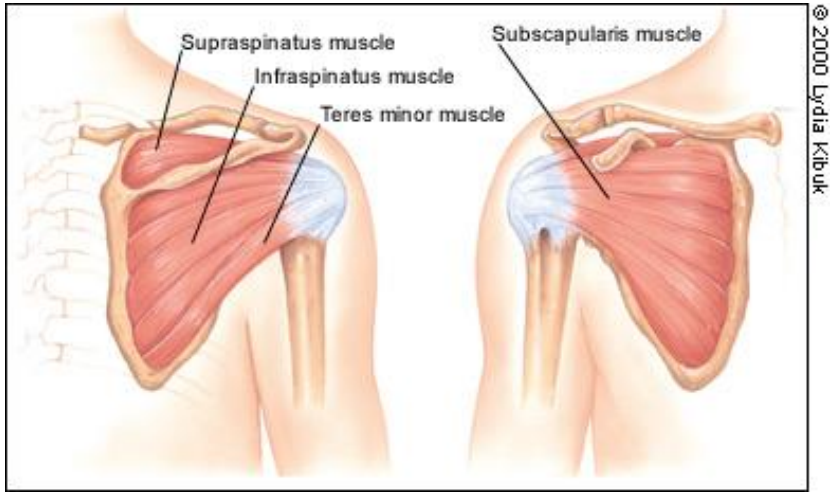
  Supraspinatus – Abducts shoulder (up to ~ 50^0)

  Infraspinatus – External rotation

  Teres Minor – External rotation

  Subscapularis – Internal rotation
- **As a unit (referred to as SITS),** RC muscles keeps humerus in close contact w/glenhoid →facilitates abduction





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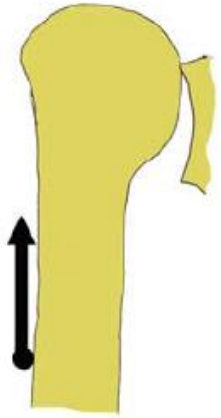
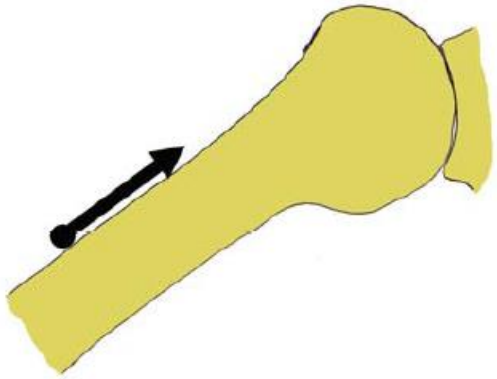
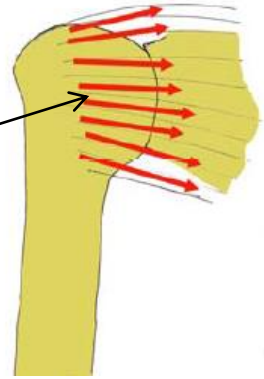
Impact of Rotator Cuff on Abduction



Force vector for deltoid (without rotator cuff) due to shallowness of glenhoid



Force vector for deltoid resulting from effect of rotator cuff muscles



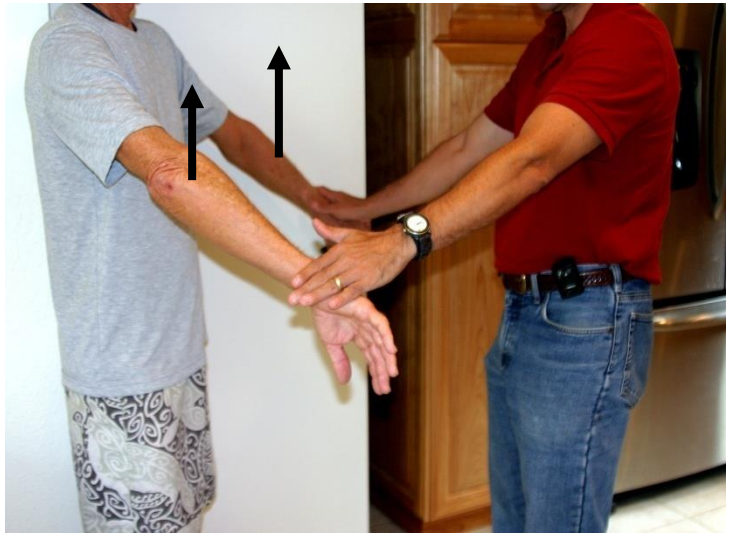
Images courtesy of Dr. Ted Parks, Western Orthopaedics

RC Testing – Supraspinatus ("Empty Can" or Jobe's Test)

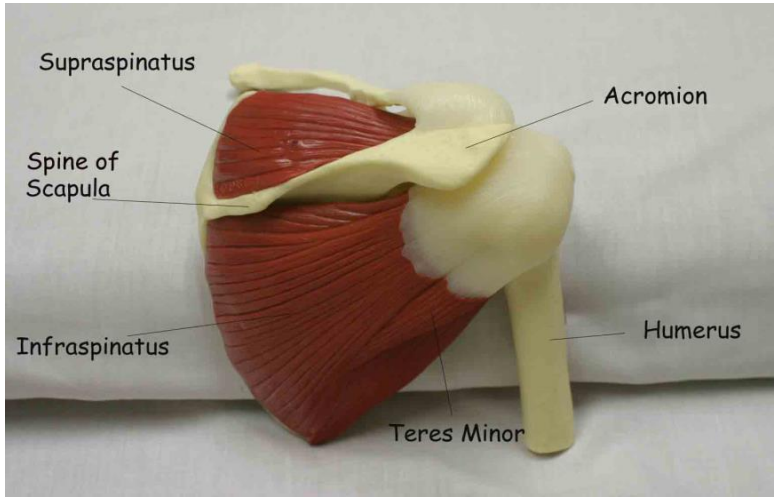
Anatomy: Connects top of scapula → humerus; W/Firing → shoulder abducts. Most commonly damaged of rotator cuff muscles.

Testing:

- Patient elevates shoulder 30^0 (30^0 forward flexion & full internal rotation - i.e. turned so thumb pointing downward)
- Forward flex shoulder, w/o resistance.
- Repeat w/resistance
- Note that Deltoid responsible for abduction beyond ~ 70^0
- If partial tear, pain & some element weakness w/above maneuver
- Complete disruption of tendon prevents any abduction



Supraspinatus ("Empty can") Test

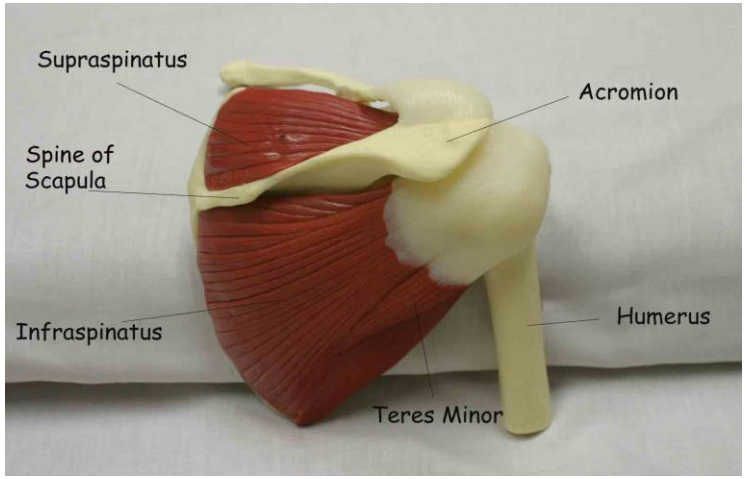


Supraspinatus – Posterior View

RC Testing – Infraspinatus and Teres Minor

Anatomy:

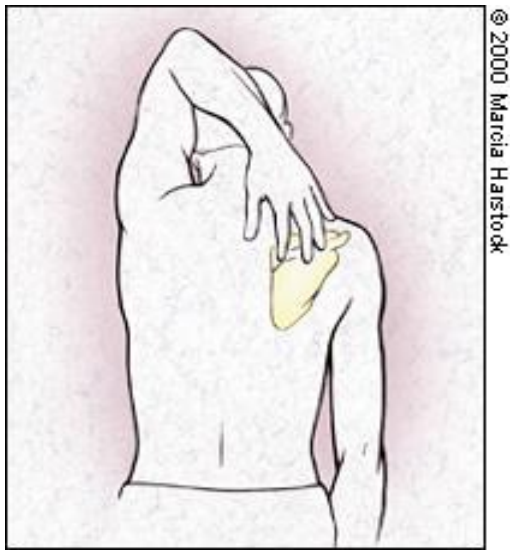
- Both muscles connect scapula → humerus.
- Muscle firing→ arm rotates externally



Infraspinatus and Teres Minor – Posterior View

Range of Motion Testing

- Ask patient to externally rotate, compare side to side
- Ask patient to reach behind head and down spine
- Should be able to reach ~C7 (prominent cervical spine “bump”)

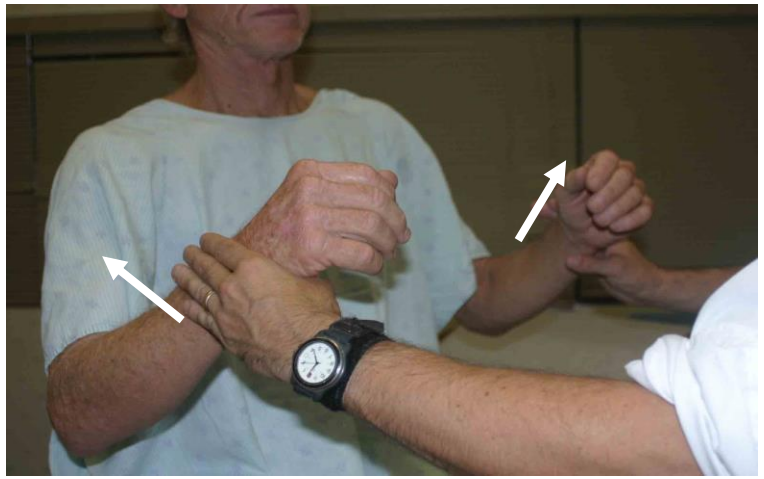


Courtesy American Family Physician
http://www.aafp.org/afp/20000515/3079.html

RC Testing – Infraspinatus and Teres Minor (cont)

Strength Testing:

- Patient slightly abducts (20^0-30^0) shoulders, elbows @ 90^0
- Place your hands on outside of their forearms
- Direct patient to push arms outward (externally rotate) while you resist
- Tears in tendon→ weakness and/or pain



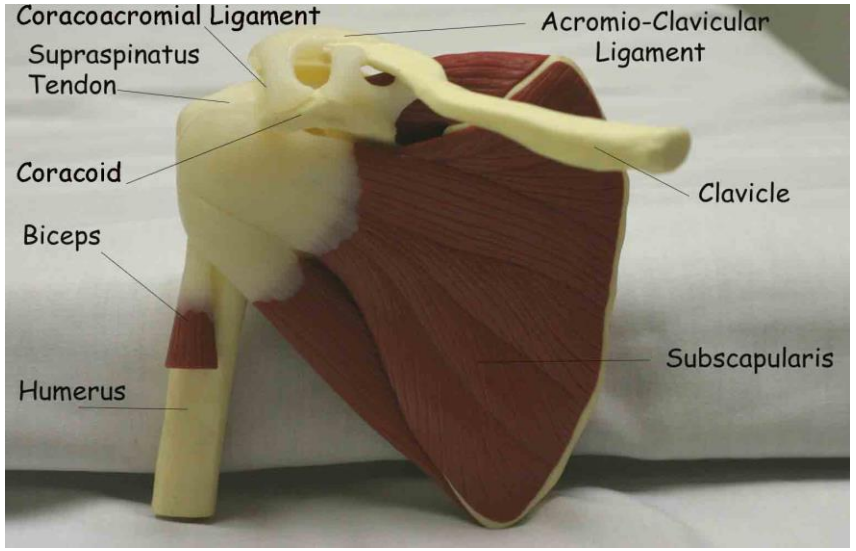
RC Testing - Subscapularis

Anatomy: Connects scapula to humerus, w/origin on anterior surface of scapula.

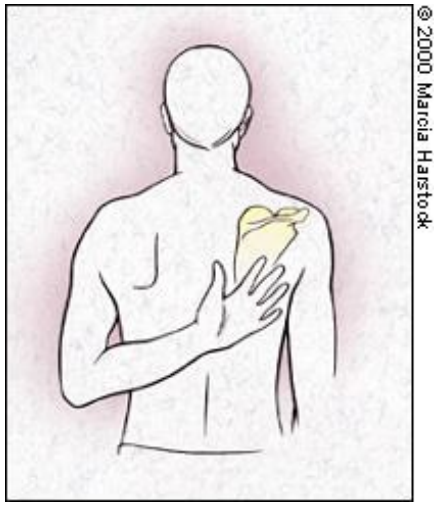
- Muscle Firing → internal rotation.

Range of Motion:

- Ask patient to internally rotate, compare side to side
- Ask patient behind back and up spine
- Note how far up they can reach – typically to lower border of scapula (~T 7)



Subscapularis – Anterior View

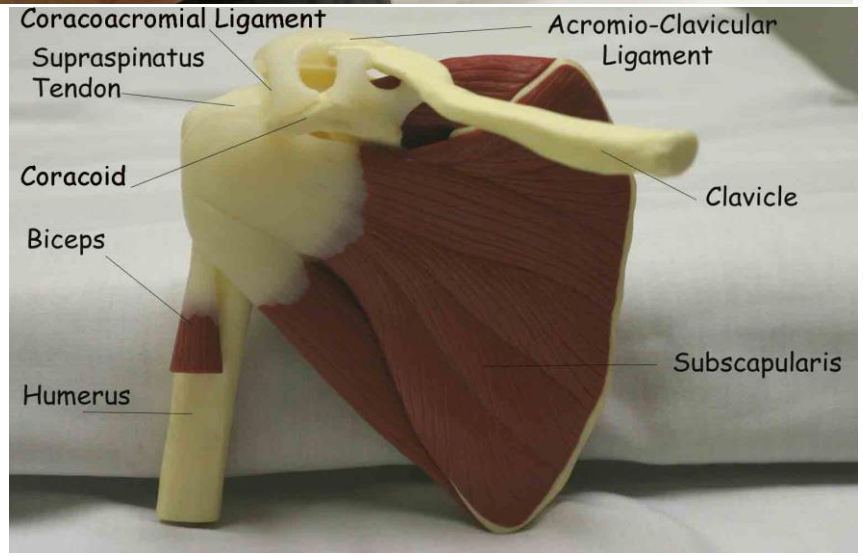


Courtesy American Family Physician
http://www.aafp.org/afp/20000515/3079.html

RC Testing – Subscapularis (Cont)

Strength Testing:

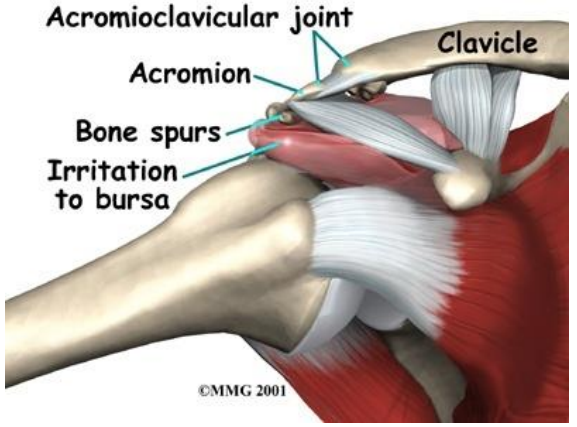
- With patient's hand resting on back, direct them to push into your hand (Gerber's Lift Off test)
- If tendon partially torn, movement limited or causes pain.
- Complete tears prevents any movement in this direction



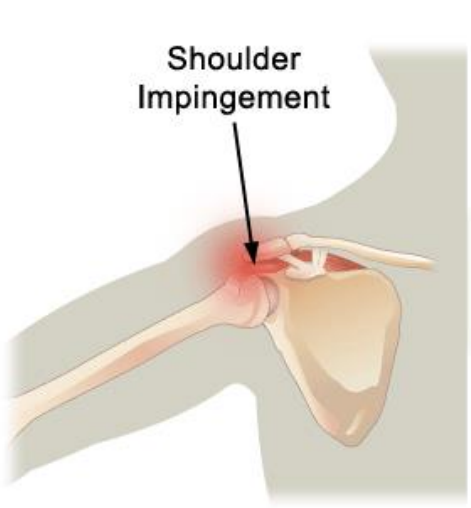
Subscapularis – Anterior View

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 ligament & tendons can become narrowed
- Causes tendons (in particular, supraspinatus) to become "impinged upon"→ friction inflames tendons & subacromial bursa
- Result: Shoulder pain, particularly raising arm over head (e.g. swimming, reaching up on a top shelf, arm positioning during sleep)
- Supraspinatus tendon in particular can weaken and tear



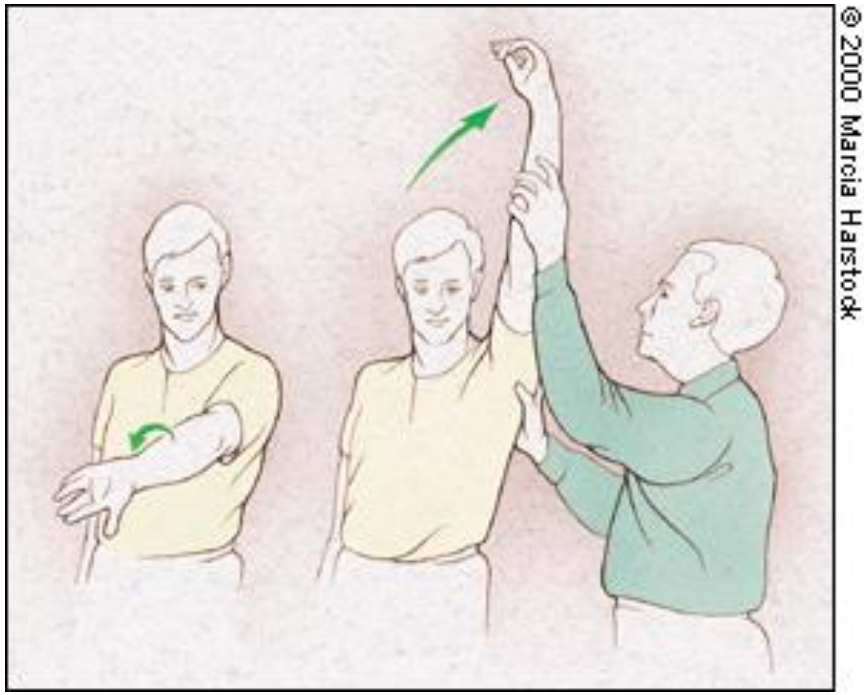
Courtesy Orthopedic Specialists of Gatonia
http://www.orthogastonia.com/index.php/



Images courtesy of Dr. Ted Parks,
Western Orthopaedics

Neer’s Test For Impingement

- Place 1 hand on patient's scapula & grasp forearm w/other.
- Arm internally rotated (thumb pointed downward).
- Forward flex arm, positioning hand over the head.
- Pain→ impingement.

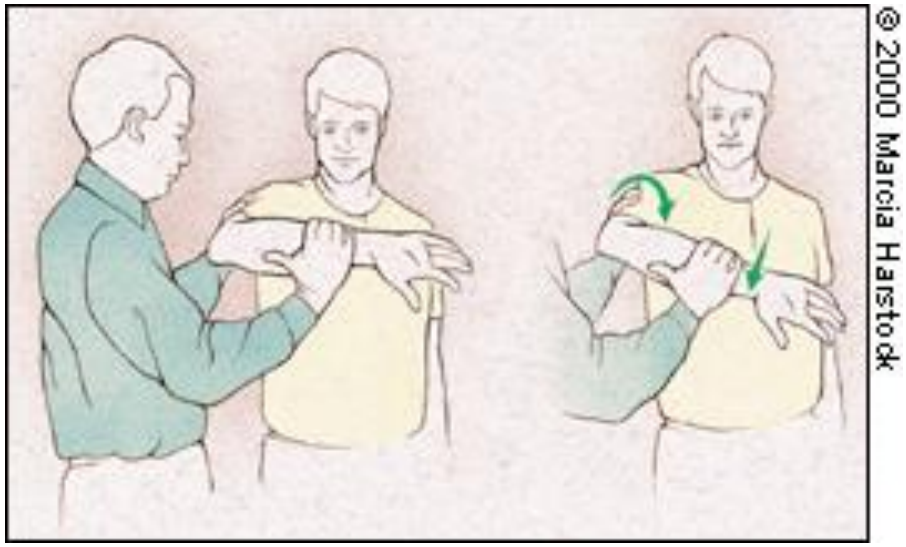


Courtesy American Family Physician
http://www.aafp.org/afp/20000515/3079.html

Hawkin's Test For Impingement

Hawkin's Test:

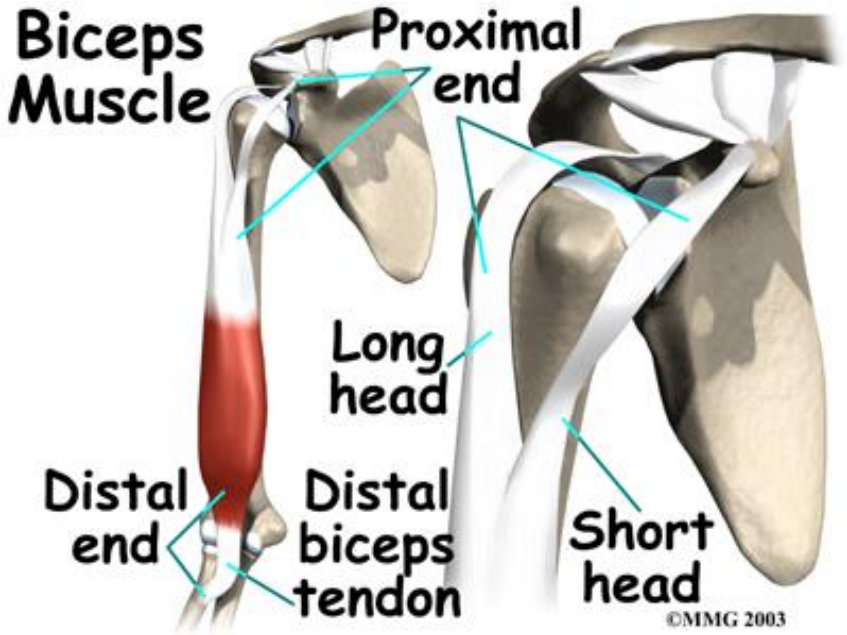
- Raise patient's arm to 90^0 forward flexion.
- Rotate internally (i.e. thumb pointed down)→places greater tubercle humerus in position to further compromise space beneath acromion.
- Pain→ impingement.



Hawkin's Test
Courtesy American Family Physician
http://www.aafp.org/afp/20000515/3079.html

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.

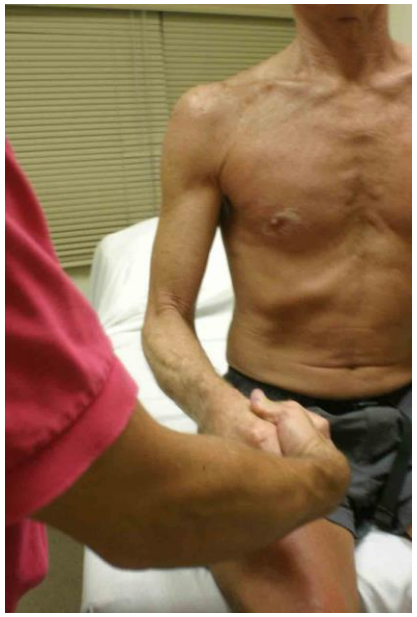


Courtesy Orthopedic Specialists of Gatonia
http://www.orthogastonia.com/index.php/

Biceps Tendon Testing and Pathology: Yeragson's Test

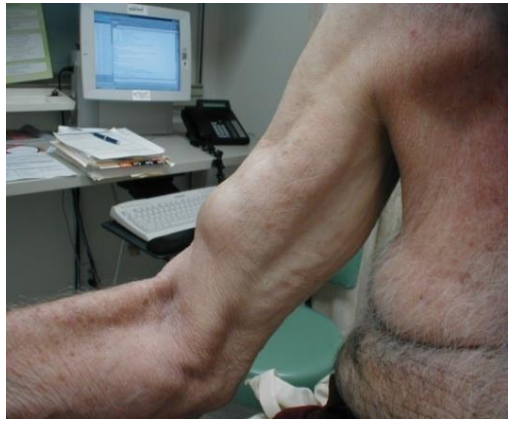
Resisted Supination (Yergason's Test):

- Elbow flexed 90^0, shoulder adducted (i.e. elbow bent @ right angle, arm against body).
- Grasp patient's hand, direct them to rotate arm such that hand is palm up (supinate) while you resist.
- Pain→ biceps tendonitis



Yergason's

Palpation



"Popeye Muscle" → Bicep's Rupture

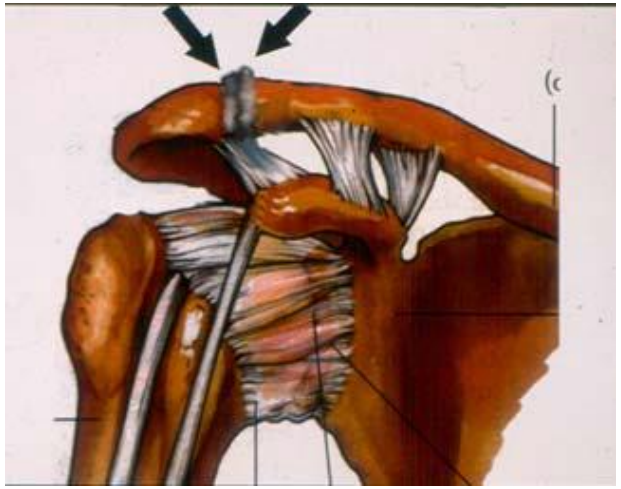
Speed’s Test (biceps tendonitis)

- Patient's elbow slightly flexed and forearm supinated.
- Examiner resists forward flexion of arm while palpating the patient's biceps tendon
- Pain localizing to the biceps tendon is a positive test.

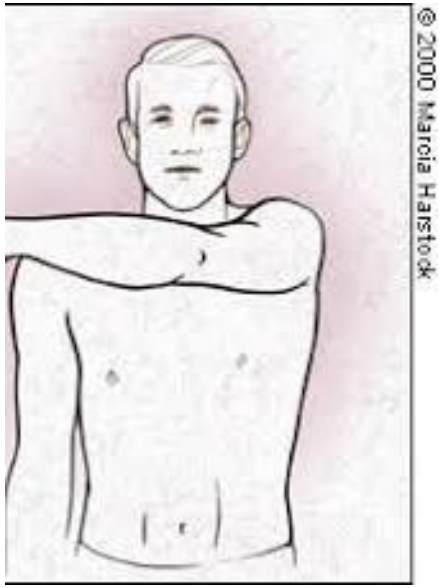
Acromio-Clavicular Joint Testing

A-C joint minimally mobile. Inflammation & degeneration→ shoulder pain.

- Scarf test:
  - Ask patient to move arm across towards opposite shoulder
  - Pain suggests AC pathology
- Cross arm test:
  - Ask patient to reach across towards opposite shoulder
  - Then push with their hand into examiner's hand
  - Pain suggests AC pathology



Scarf Test



Cross Arm Test

Neuro/Vascular Assessment

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

*You'll learn these techniques w/the neuro exam

Other Tests (not covered today)

- Shoulder:
  - Labrum pathology
  - Instability
- And a number of other “named” maneuvers → to be continued…
- Excellent videos for **both knee** and **shoulder** exams – SD Msk Project:
  - Drs. Kali Hose and Anna Quan
  - YouTube: SD Musculoskeletal Channel – Many useful MSK Videos https://www.youtube.com/channel/UCkXg4f8pFtWjHj_84QAJy-w/videos?disable_polymer=1
  - First view:
    - Primary Care 2 Minute Knee Exam
    - Primary Care 3 Minute Shoulder Exam

SUMMARY OF SKILLS: KNEE EXAM

□ Wash hands

□ Observation knee, gait

Palpation patellar mechanism

- □ Effusion
- □ Patella: sides, top/bottom, quad & patellar tendon
- □ Patella grind
- □ Tibial tubercle

Range of motion

- □ Active
- □ Passive w/hand on patella to assess crepitus

Palpation knee at 90^0

- □ Medial and lateral joint line tenderness (DJD, menisci); LCL, MCL

Provocative tests

- □ Anterior Drawer (ACL): knee 90^0, examiner sits on patient's foot, pulls anteriorly on tibia
- □ Posterior Drawer (PCL): knee 90^0, examiner sits on patient's foot, pushes posteriorly
- □ Lachman's (ACL): knee $30^{0,}$ stabilize femur with one hand, pull anteriorly on tibia w/other
- □ Varus stress at 30^0 (LCL); □ Valgus stress at 30^0 (MCL)
- □ McMurray's (menisci): Foot everted, knee varus position, flex/extend while palpate medial joint line; then invert foot, knee valgus, palpate lateral joint line while flex/extend

SUMMARY OF SKILLS – SHOULDER EXAM

□ Observation

□ Palpation of key structures

Range of motion and Strength

□ Active ROM; Passive if can't perform

Supraspinatus

□ROM: 0-~70^0 abduction; □ Motor "Empty can test:" arm abducted 60^0, forward flexed ~ 30^0, thumb down, resistance to additional flexion

Infraspinatus and Teres Minor

□ ROM external rotation; □ Resisted external rotation

Subscapularis

□ ROM internal rotation; □ Resisted Internal rotation

□ Gerber's liftoff

Provocative tests - Impingement

□ Hawkin's test: Elbow 90^0, arm forward flexed 90^0, examiner internally rotates

□ Neer's test: Thumb down, elbow straight, examiner raises arm thru forward flexion

Provocative tests – Biceps tendonitis

□ Yergasons: elbow 90^0, arm adducted, patient attempts supination while examiner resists

□ Speeds: palm up, elbow slightly flexed, resisted forward flexion at shoulder

Provocative tests – AC joint (DJD)

□ Scarf Test; □ Cross arm test

□ Wash hands