

Musculoskeletal Assessment

Dr. Gary Mumaugh – Physical Assessment

General Principles

- Orthopedic exam is performed if
 - Symptoms justify it (injury, pain, decreased ROM)
- Focus on the symptomatic area
- Observe normal activity – what can't they do?
 - Specific limitations?
 - Was this a specific event? Trauma?
 - Mechanism of the injury? Specific mechanics?
- ROM – Range of Motion
- Strength, neurovascular assessment
- Any specific provocative maneuvers
- If patient is in acute pain, it is hard to assess as the patient will be guarding and protecting area
 - Limiting movement in the examination
- Examine the unaffected side first to get an idea of this patient's "normal"
 - Gains confidence
 - Develops a sense of normal for the patient

Historical Clues

- What are the functional limitations?
 - Decreased function and stiffness
 - Pain or no pain
- Symptoms is single joint vs. multiple joints
 - Injury or prior arthritic joints
- Acute vs. slowly progressive onset
- If injury, then what was the mechanism and mechanics?
 - Where there prior problems with this area?
- Systemic symptoms
 - Age related
 - Chronic systemic disease

Orthopedic Anatomical Terminology

- Articular structures
 - How do they articulate or interconnect? (Juxtaposition)
 - Include joint capsule and articular cartilage, synovial membrane and synovial fluid, intra-articular ligaments and articular bone
- Extra-articular Structures
 - Include periarticular ligaments, tendons, bursae, muscle, fascia, bone, nerve, and overlying skin
- Ligaments - collagen ropes connecting bone to bone
- Tendons - collagen ropes connecting muscles to bones

Extra-articular Structures

- Cartilage - collagen matrix overlying bony surfaces
- Bursae
 - pouches of synovial fluid that cushions tendons and muscles over bone or other joint surfaces
 - They ease joint movement
- Tendon sheaths
 - elongated cylindrical bursae wrapped around a tendon - in hand and foot

Three Types of Joints

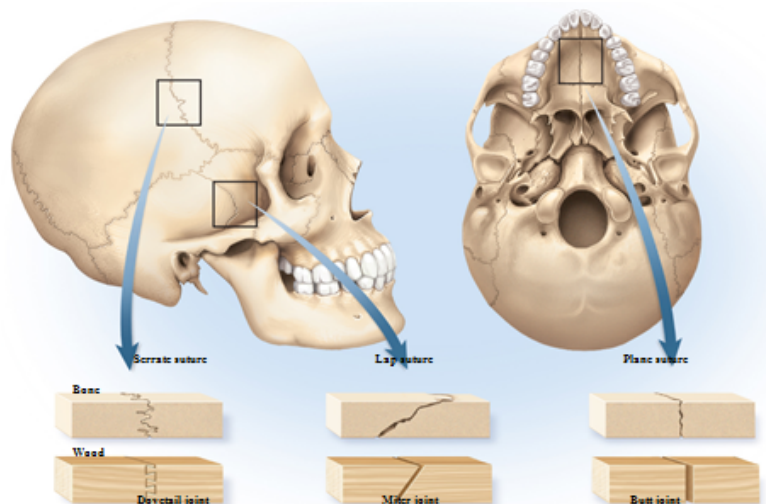
- Fibrous – virtually no movement
- Cartilaginous – slightly moveable
- Synovial – freely movable

Fibrous Joints

- Joints have no appreciable movement
- Fibrous joint, synarthrosis, or synarthrodial joint – a point at which adjacent bones are bound by collagen fibers that emerge from one bone, cross the space between them, and penetrate into the other
- Three kinds of fibrous joints
 - sutures
 - gomphoses
 - syndesmoses

Fibrous Joints - Sutures

- Sutures - immovable or slightly movable fibrous joints that closely bind the bones of the skull to each other
- Sutures can be classified as:
 - serrate – interlocking wavy lines
 - lap (squamous)- overlapping beveled edges
 - plane (butt)- straight, nonoverlapping edges

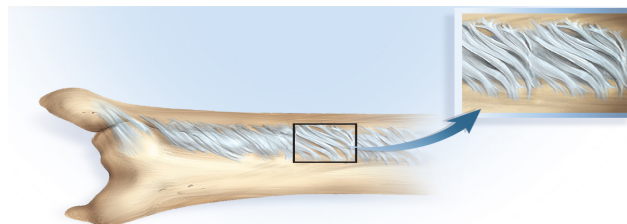


Fibrous Joint - Gomphoses

- gomphosis - attachment of a tooth to its socket
 - held in place by fibrous periodontal ligament

Fibrous Joint - Syndesmosis

- Syndesmosis – a fibrous joint at which two bones are bound by longer collagenous fibers than in a suture or gomphosis giving the bones more mobility
- interosseus membrane

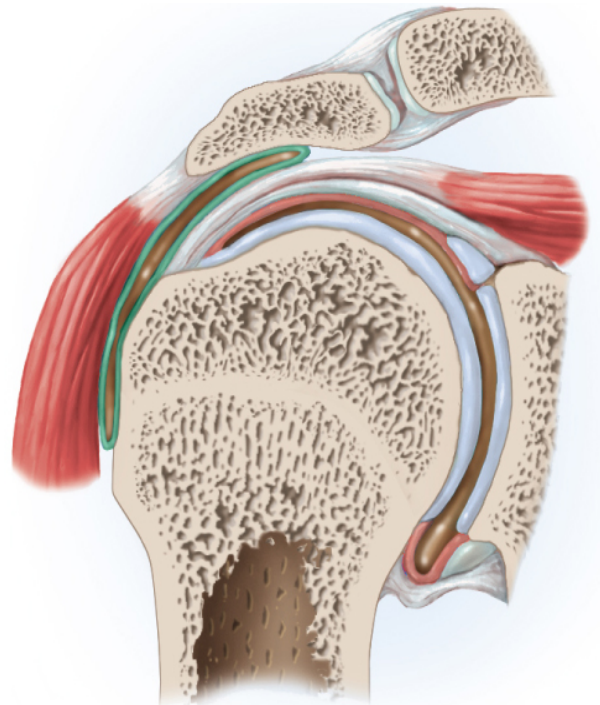


Cartilaginous Joints

- Joint is slightly moveable
- Cartilaginous joint, amphiarthrosis or amphiarthrodial joint – two bones are linked by cartilage
- Two types of cartilaginous joints
 - synchondrosis - bones are bound by hyaline cartilage
 - epiphyseal plate in children
 - first rib attachment to sternum
 - other costal cartilages are joined to sternum by synovial joints
 - symphysis - two bones joined by fibrocartilage
 - pubic symphysis in which right and left pubic bones joined by interpubic disc
 - bodies of vertebrae and intervertebral disc

Synovial Joint - Function – reduces friction

- Synovial fluid moistens and nourishes the cartilage (Cartilage is avascular)
- Synovial joint, diarthrosis or diarthrodial joint
 - joint in which two bones are separated by a space called a joint cavity
- Majority of all joints
- Most are freely movable
- Most structurally complex type of joint
- Most likely to develop painful dysfunction
- Their mobility make them important to quality of life



General Anatomy

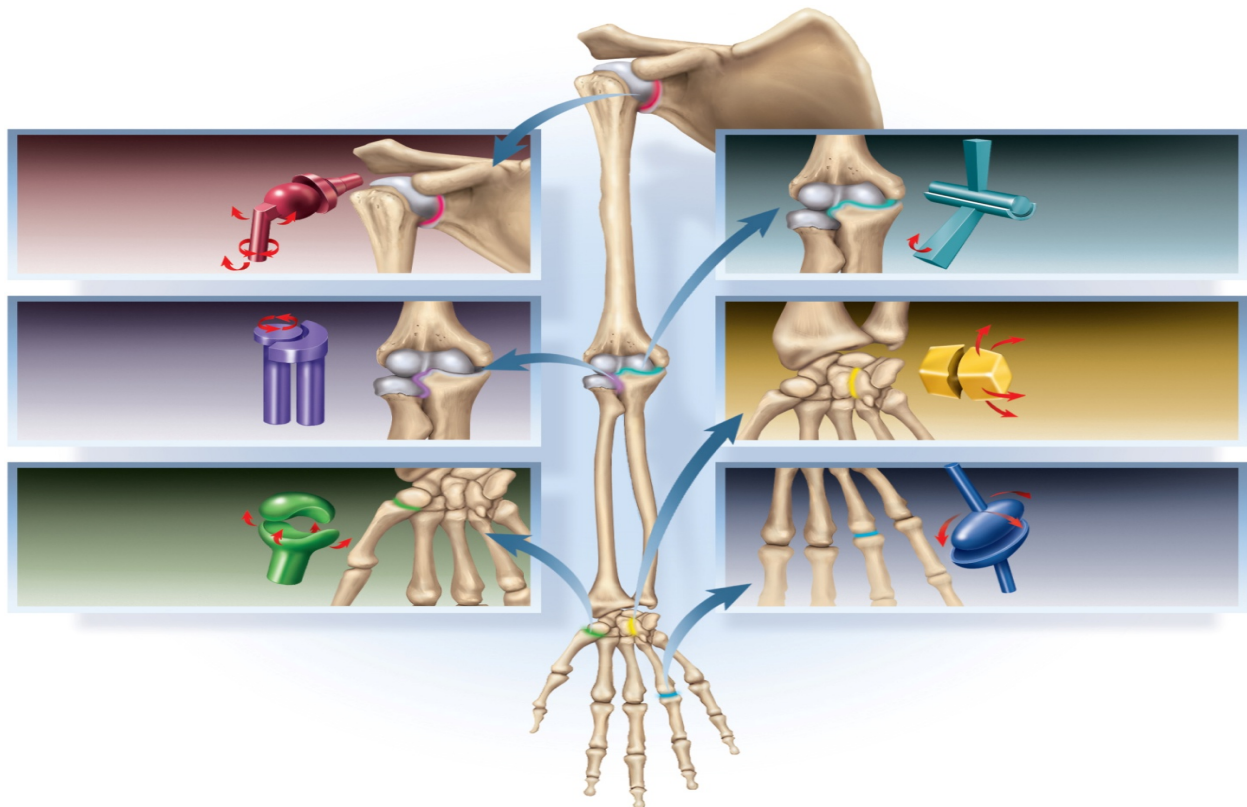
- Articular cartilage – layer of hyaline cartilage that covers the facing surfaces of two bones
- Joint (articular) cavity – separates articular surfaces
- Synovial fluid – slippery lubricant in joint cavity
 - gives it a viscous, slippery texture like raw egg whites
 - nourishes articular cartilage and removes waste
 - makes movement of synovial joints almost friction free
- Joint (articular) capsule – connective tissue that encloses the cavity and retains the fluid
 - outer fibrous capsule – continuous with periosteum of adjoining bones
 - Inner synovial membrane – composed mainly of cells that secrete synovial fluid and macrophages that remove debris from the joint cavity

General Anatomy

- In a few synovial joints, fibrocartilage grows inward from the joint capsule
 - articular disc forms a pad between bones
 - temporomandibular joint, distal radioulnar joints, sternoclavicular and acromioclavicular joints
 - meniscus – in the knee, two cartilages extend inward from the left and right
 - these cartilages absorb shock and pressure
 - guide bones across each other
 - improve the fit between bones
 - stabilize the joints, reducing the chance of dislocation

Classes of Synovial Joints

- Ball-and-Socket Joints
- Condylloid Joints
- Saddle Joints
- Plane or Gliding Joints
- Hinge Joints
- Pivot Joints



Tips for Assessing Joint Pain

- Ask the patient to point to the pain.
 - This saves considerable time since the patient descriptions of the pain may be vague and confusing
- Clarify and record the mechanism of the injury especially if the joint pain was caused by trauma
- Determine if the pain is
 - Localized or diffuse
 - Acute or chronic
 - Inflammatory or non-inflammatory

Techniques of Examination - Overview of the Major Joints

- Inspect for joint symmetry, alignment or any bony deformities
- Inspect and palpate surrounding tissues for any skin changes, nodules, muscle atrophy or crepitus
- Assess any degenerative or inflammatory changes, especially swelling, warmth, tenderness, or redness
- Perform ROM and use joint specific maneuvers to test
 - Joint function and stability
 - Integrity of ligaments, tendons and bursae

Generalized Screening Exam

- If any abnormalities, a more thorough exam of the joint needs to be done.
- Each joint is:
 - Inspected (look for abnormalities)
 - Palpated
 - Examined

Range of Motion (Active)

- Have patient range the joints
- Watch for decreased or increased movement of the joint compared to the other side as well as the norm
- Watch for pain with movement
- Listen for crepitus or “popping”
- Watch for abnormal movements

Range of Motion (Passive)

- Next range the joints passively, comparing the end points to the active
- Again note any decreased or increased movement
- Pain with the movement
- Crepitus or “popping”

Palpation

- When palpating a structure, you need to know the anatomy of that structure
- Palpate for swelling
- Palpate for warmth
- Palpate each area of the structure in turn evaluating for pain, and abnormalities as compared to the other side

Muscular and Neurological

- Check the following comparing one side to the other:
 - Grade strength (0-5)
 - Grade reflexes (0-4)
 - Sensory exam

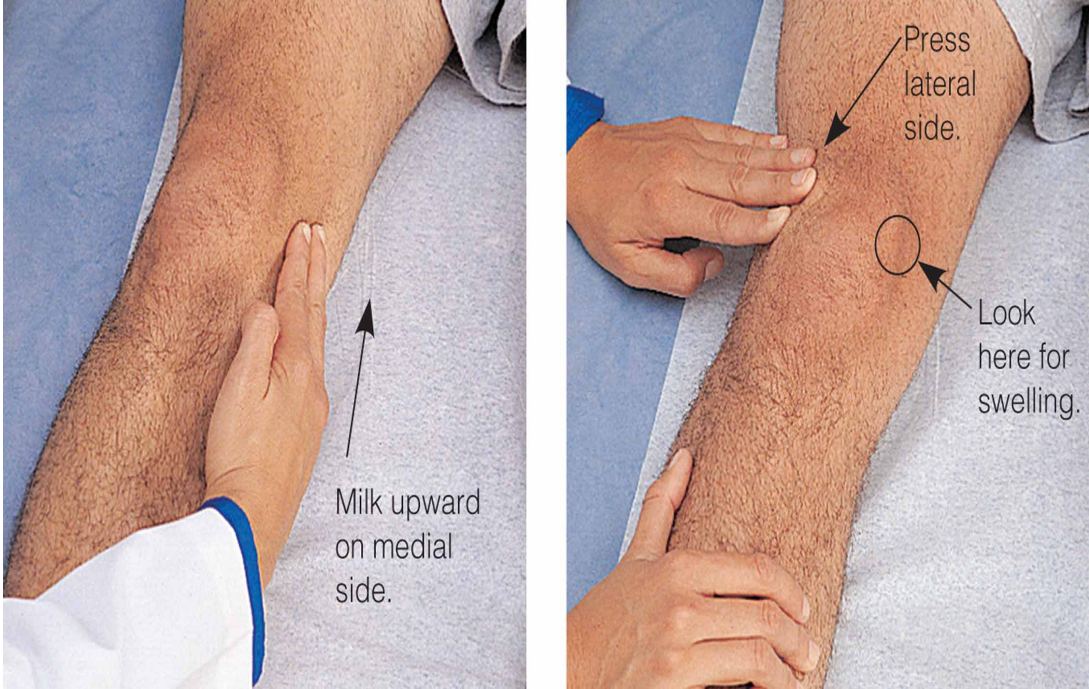
Grading Muscular Strength

GRADE	DESCRIPTION
0	No contraction; paralysis
1	Contraction felt, but no limb movement
2	Passive ROM
3	Full ROM against gravity
4	Full ROM against some resistance
5	Full ROM against full resistance

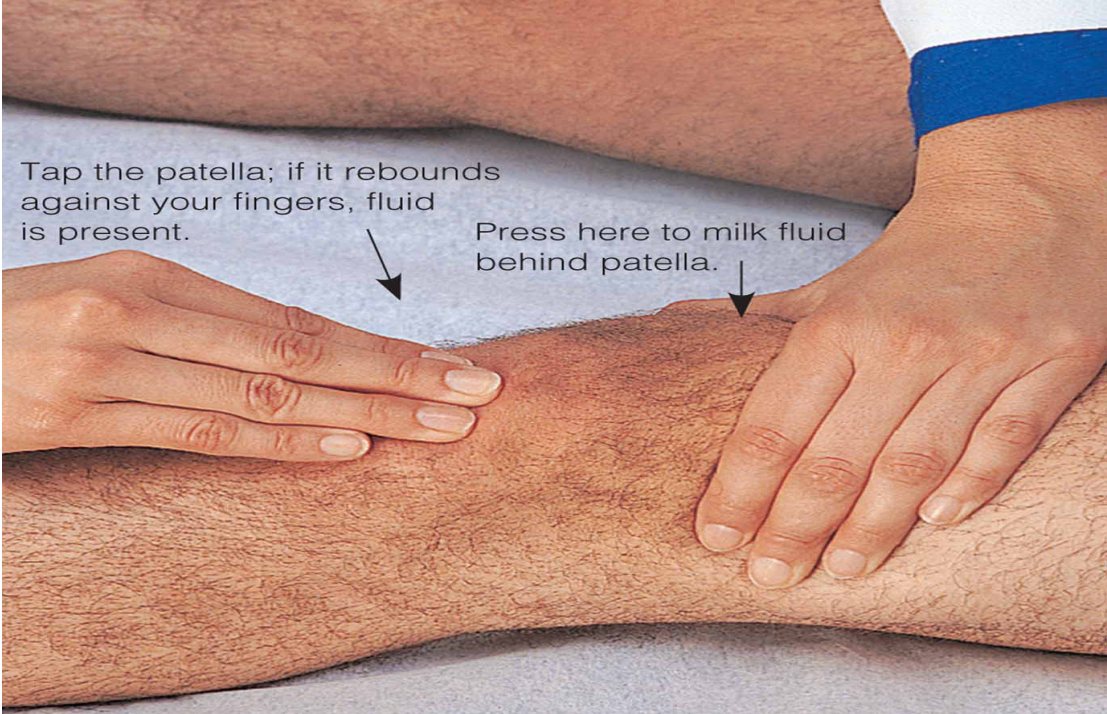
Instructions to Evaluate Muscle Strength

MUSCLE GROUP	INSTRUCTIONS
Eyes and lids	Close eyes tightly.
Facial muscles	Blow out cheeks, stick out tongue.
Neck	Put chin on chest, look up at ceiling, touch ear to the shoulder.
Deltoid	Hold arms up.
Biceps, triceps	Bend arm, straighten arm.
Wrist	Bend hand forward and backward.
Fingers	Shake hands, make a fist, squeeze nurse's fingers, spread fingers.
Gluteal and leg	Alternately cross legs while sitting, straighten leg.
Ankle and foot	Bend foot up and down.

Checking for Joint Bulging



Checking for Joint Ballottment



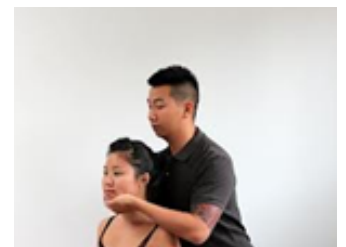
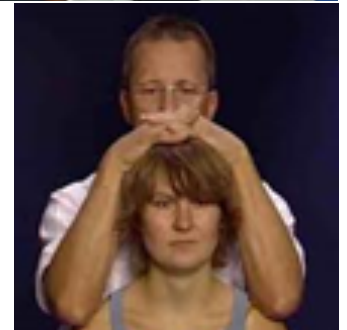
Cervical Spine Examination

- Cervical Spine Examination
- Neck: Active Range of Motion
- Chin to chest (flexion)
- “look at ceiling” (extension)
- Chin to each shoulder (lateral rotation)
- Ear to each shoulder (lateral flexion, i.e., head tilt)



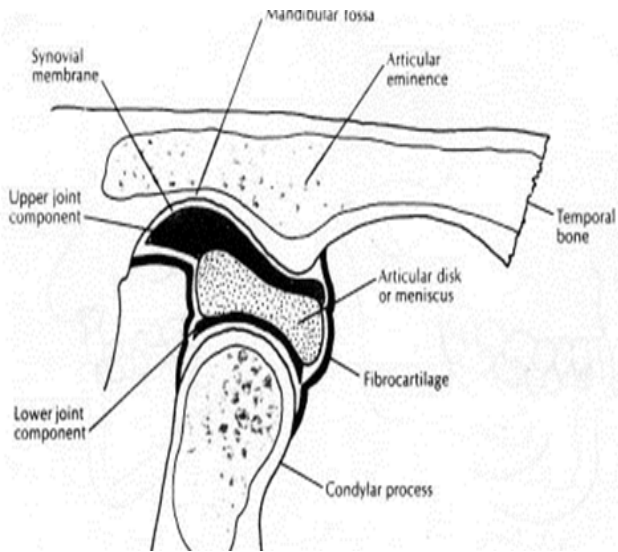
Special Tests for the Neck

- Dekleyn test
 - Head and neck rotation with extension
 - Tests for vertebral artery compression
- Spurling’s test (foraminal compression test or maximal compression test)
 - Patient extends rotates head to side, the examiner then applies axial load to the head.
 - Positive test is when there is pain radiating into arm. Indicates Pressure on a nerve root.
- Cervical Distraction Test
 - Opposite of compression test
 - Tests if pain is better
 - Nerve root compression vs. disc herniation
- Elvey test (upper limb tension tests)
 - Tests designed to put stress on the neurological structures of the upper limb.
 - Median nerve C5,6,7
 - Median nerve, axillary nerve
 - Radial nerve
 - Ulnar nerve C8, T1

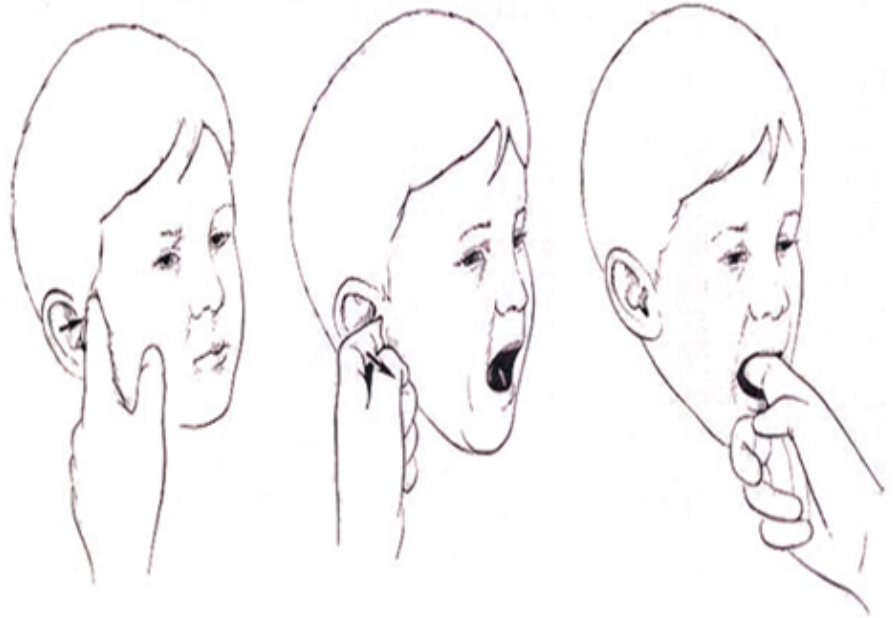


Temporomandibular Joint

- Synovial joint – condylar
- The most active joint in the body (>2000 x/day)
- Formed by fossa and articular tubercle
 - Fossa (temporal bone) – Tubercle (mandible condyle)
- Lies between external ear and zygomatic arch
 - Fibro-cartilaginous disc cushions condyles over the synovial membrane and capsule of the articulating surfaces of the temporal bone
- Principle muscles
 - Opening the mouth
 - External Pterygoids
 - Closing the mouth
 - Masseter, temporalis and internal pterygoids
- Innervated by CNV - Trigeminal



Three tests to reproduce pain

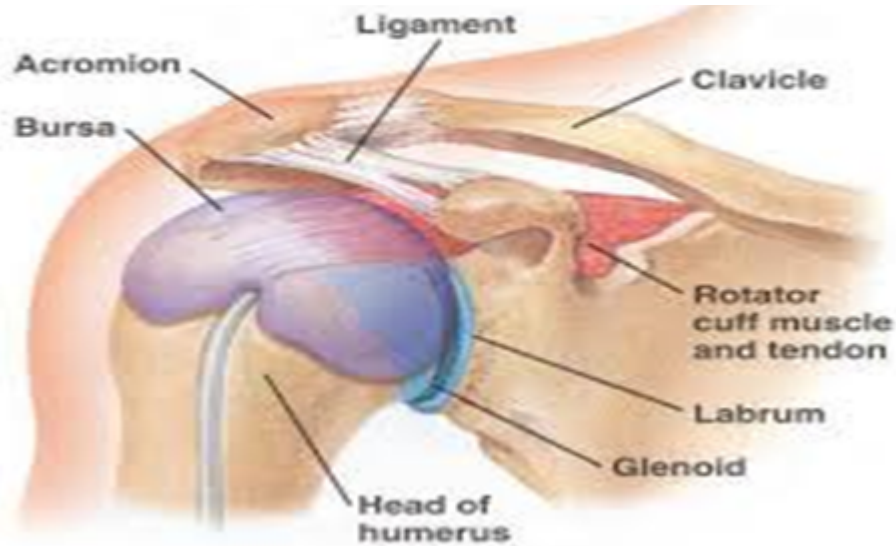


Shoulder Examination

- Inspection
- Palpation
- Passive Range of Motion
- Active Range of Motion
 - Appley scratch test for internal/external rotation
- Impingement Signs
- Bicep Tendonitis/Crossarm adduction/apprehension
- Neck exam: compression test
- Adson's maneuver

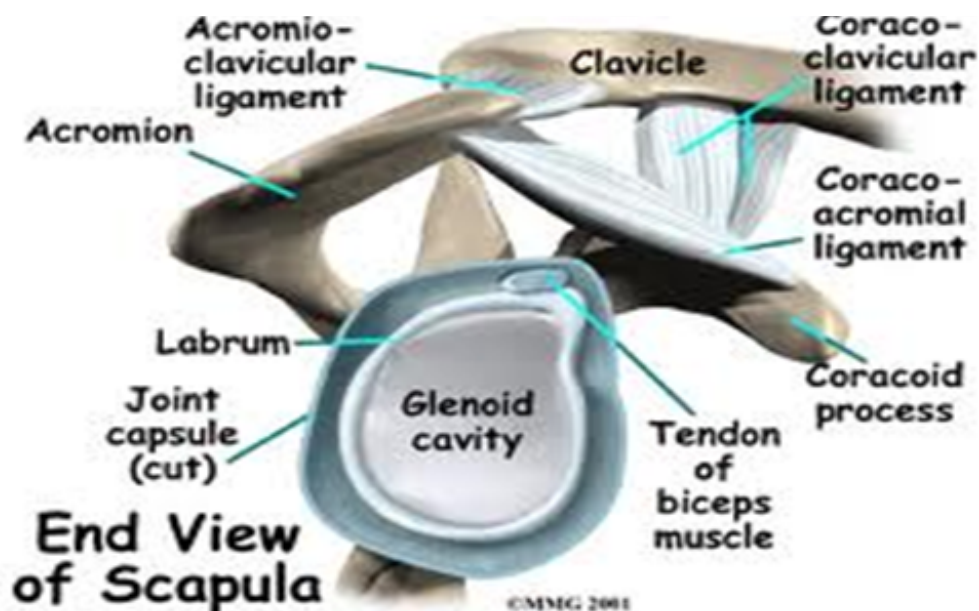
The Shoulder - Joints of the Shoulder

- Glenohumeral
- Sternoclavicular
- Acromioclavicular
- Scapular thoracic (not a true joint)



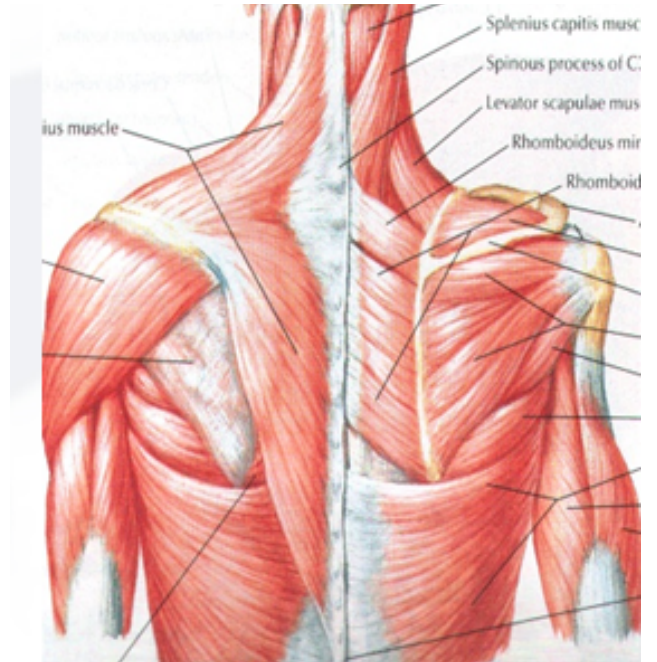
Glenohumeral Joint

- Glenohumeral Ligaments
 - Folds in the anterior capsule produce the superior, middle and inferior glenohumeral ligaments.
 - Like the capsule these ligaments come into play based upon arm position and rotation.
- Glenoid Labrum
 - Glenoid labrum: a fibrocartilaginous rim to increase the contact area and depth of the glenoid
 - Triangular on cross-section and three sides which face the humeral head, joint capsule, and glenoid surface respectively
 - An intact labrum increases humeral contact area by 75% in vertical and 56% in transverse directions



Scapulothoracic

- Scapular stabilizing muscles:
 - Trapezius (all three portions)
 - Serratus anterior
 - Rhomboids
 - Levator scapulae
 - Pectoralis Minor



Acromioclavicular Joint

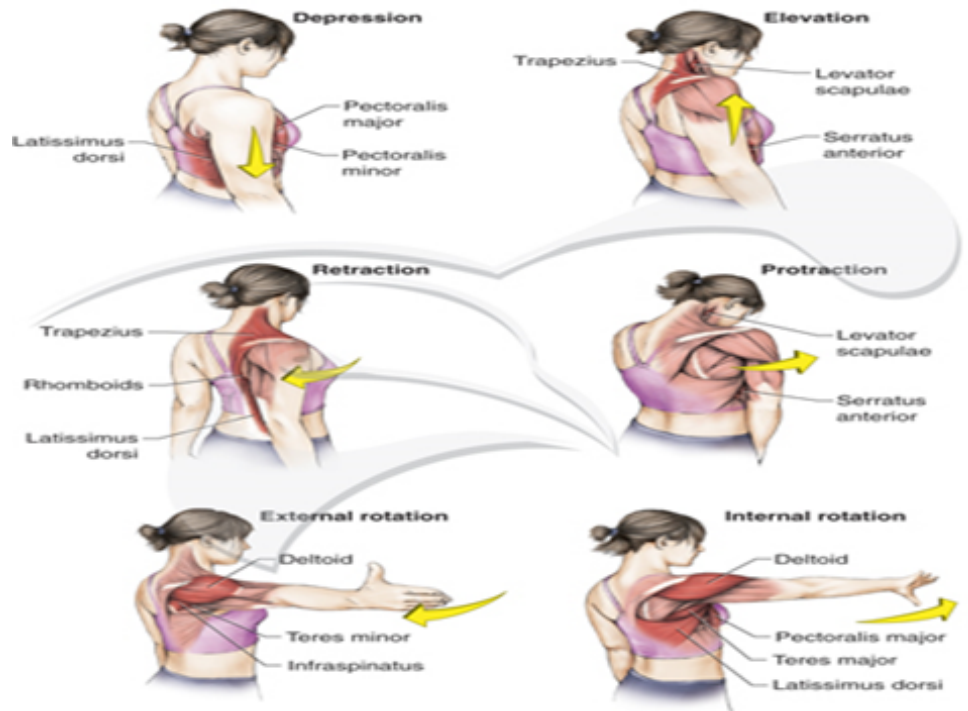
- Acromioclavicular ligament: resists axial rotation and posterior translation
- Trapezoid: is anterolateral, resists axial compression of the distal end of the clavicle
- Conoid: is posteromedial, resists anterior and superior translation

Sternoclavicular Joint

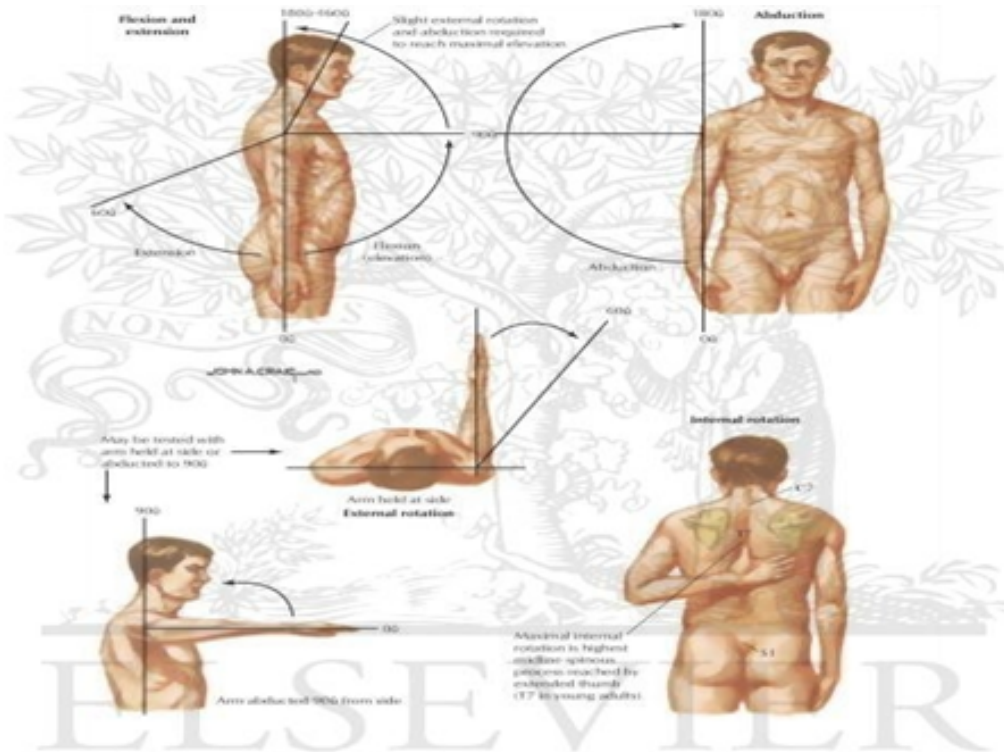


Shoulder

- Palpation of the shoulder includes:
 - Sternoclavicular joint



- Acromioclavicular joint
- Subacromial area
- Bicipital groove
- Muscles of the Scapula
- Have patient place each hand:
 - Behind head (external rotation and abduction)
 - Up the small of the back (internal rotation)



Shoulder - Rotator cuff:

- Supraspinatus
- Infraspinatus
- Teres Minor
- Subscapularis

Palpation of AC Joint

- Patient's arm at his/her side
- Note swelling, pain, and gapping.

Palpation of Bicipital Groove

- Patient sitting, beginning with the arm straight
- Patient actively flexes biceps muscle while examiner provides supination and ER
- Examiner palpates the bicipital groove for pain

Range of Motion (ROM)

- Evaluate active ROM
 - If movement limited by pain, weakness, or tightness, assist passively
 - Lack of full ROM with active and passive exam is found in adhesive capsulitis and arthropathy
- Evaluate bilaterally for comparison

Range of Motion

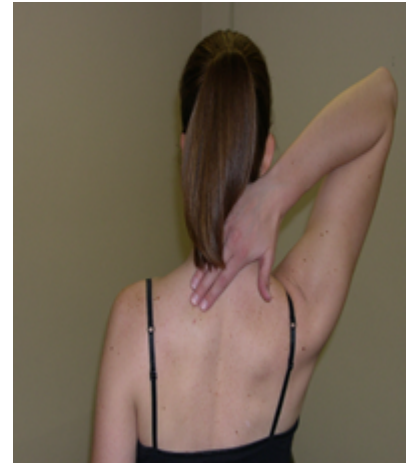
- Forward flexion - 180°
 - Arm straight and brought upward through frontal plane, and move as far as patient can go above his head
 - 0° is defined as straight down at patient's side, & 180° is straight up
- Extension (behind back) - 40°
- Abduction - 180° (with palms up)
 - Arm straight
 - Hand – palm up (arm supinated)
 - ROM measured in degrees as for forward flexion
- Adduction - 0°
- External rotation - 45° (arm at side, elbow flexed)
- Internal rotation - 55° (arm at side, elbow flexed)
 - Arm at side, elbow flexed to 90° and held at waist
 - Examiner externally or internally rotates arm

Apley scratch test for ER/IR

- Internal rotation and adduction
- Reach for lower scapula
- Compare bilaterally – note level reached

Strength Tests

- Flexion
- Extension
- External rotation
 - Infraspinatus
 - Teres minor
- Internal rotation
 - Subscapularis
- Empty can test
 - Supraspinatus
- Lift off test
 - Subscapularis



Drop Arm Test

- Purpose: tears in the rotator cuff, primarily supraspinatus muscle
- Method: patient abducts (or examiner passively abducts) arm and then slowly lowers it
 - May be able to lower arm slowly to 90° (deltoid function)
 - Arm will then drop to side if rotator cuff tear
- Positive test: patient unable to lower arm further with control
 - If able to hold at 90°, pressure on wrist will cause arm to fall

Impingement - Neer's Sign

- Patient seated with arm at side, palm down (pronated)
- Examiner standing
- Examiner stabilizes scapula and raises the arm (between flexion and abduction)
- Positive test = pain

Impingement - Hawkin's Test

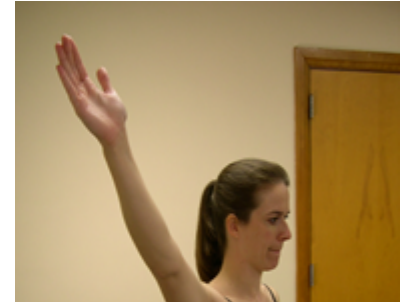
- Patient standing
- Examiner forward flexes shoulder to 90°, then forcibly internally rotates the arm
- Positive test = pain in area of superior GH joint or AC joint

Apprehension Test - Sitting or Lying Down

- Sitting
 - 90° of abduction
 - Examiner applies slight anterior pressure to humerus and externally rotates arm
 - Positive test = patient expresses apprehension
- Supine
 - Patient in supine position with affected shoulder at edge of table, arm abducted 90°
 - Examiner externally rotates by pushing forearm posteriorly.
 - Positive test = patient expresses apprehension

Elbow Exam

- Palpation
 - lateral and medial epicondyles, olecranon, radial head, groove on either side of the olecranon
- Inspect the carrying angle, and any nodules or swelling
- Movements
 - Flexion



- Movement of forearm to shoulder by bending the elbow to decrease the angle
- Extension
 - Movement of forearm away from shoulder straightening the elbow to increase the angle

Movements

- Pronation (palm-up to palm-down position)
 - internal rotary movement of radius on ulna that results in hand moving from palm-up to palm-down position
- Supination (palm-down to palm-up position)
 - external rotary movement of radius on ulna that results in hand moving from palm-down to palm-up position

Special Tests for the Elbow

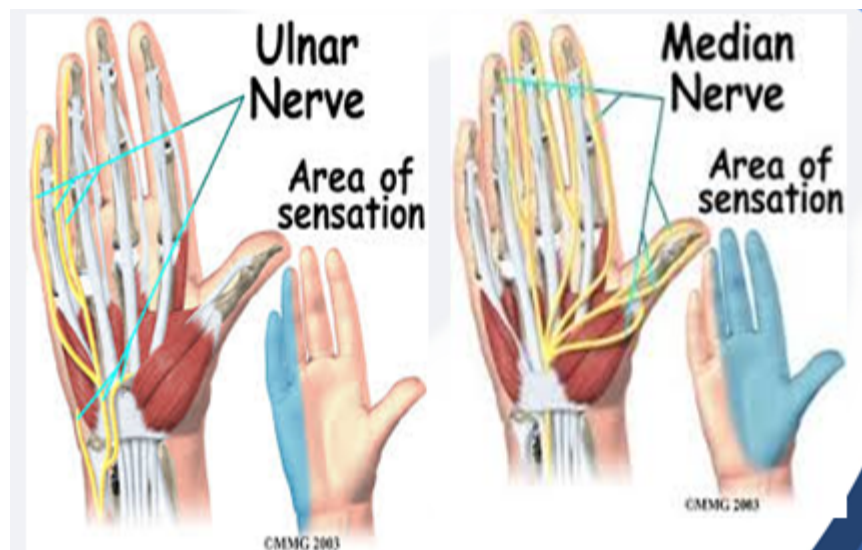
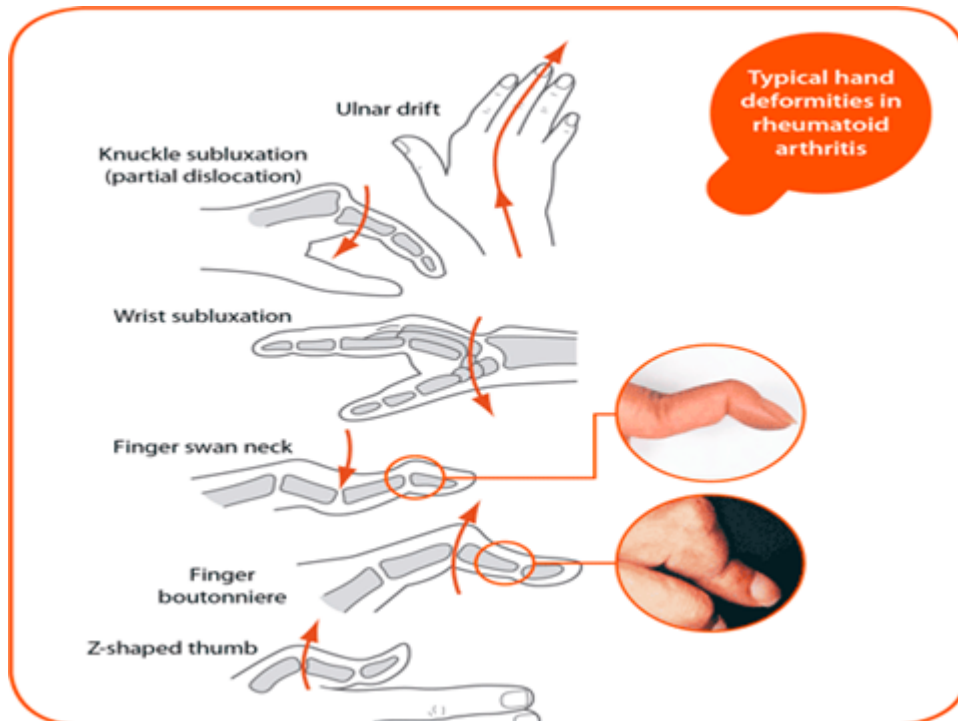
- Varus test
 - Tests for ligamentous stability of the lateral collateral ligament
- Valgus test
 - Tests the medial collateral ligament
- Lateral Epicondylitis / Tennis elbow test
 - Patient makes fist and pronates the forearm radially deviates and extends the wrist against resistance.
 - Positive if pain in the lateral epicondyle area.
- Golfer's elbow test
 - While palpating the medial epicondyle, the forearm is supinated and the elbow and wrist are extended.
 - Positive if pain over the medial epicondyle.
- Tinel's of the elbow
 - Percussion of the ulnar nerve in the groove.
 - Positive if radiating sensation down arm into hand.



Wrist & Hand Examination

- Wrist and Hand
- Inspect for swelling or deformities
- Palpate: anatomic snuff box, volar and dorsal aspects of the wrist, all joints of the fingers

- Flexion, extension, ulnar and radial deviation of the wrist
- Have patient make a fist and extend and spread the fingers.
- Wrist & Hand Examination
- Inspect for smooth motion, surface contour, alignment of wrist and fingers, and any bony deformities
 - At rest the fingers should be slightly at rest and parallel
- Palpate
 - Distal radius and ulna at the wrist
 - 8 carpal bones, MCP, PIP, DIP joints for tenderness and swelling
 - Anatomical snuffbox



Special Tests of Hand and Wrist

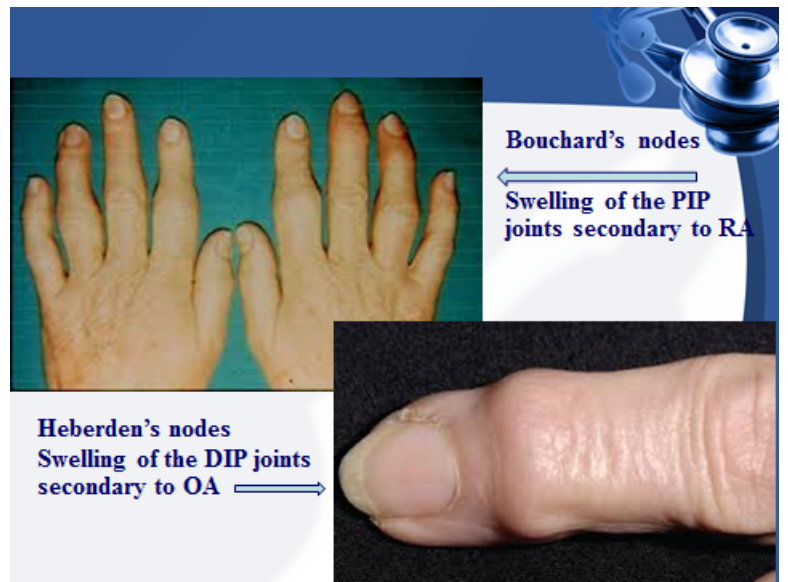
- Tinel's sign: Positive if tingling into the fingers of the median nerve distribution, indicating carpal tunnel syndrome.
- Phalen's test: Position must be held for one minute. If positive indicates carpal tunnel syndrome. The dorsal aspect of the hands is pushed together to maximal flexion of the wrists.



Special Tests of Hand and Wrist

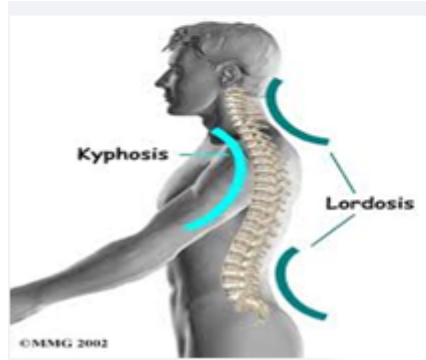
- Swan-neck deformity: Flexion of the MCP and DIP joints, with extension of the PIP joint. This is due to contracture of the intrinsic muscles. Seen after trauma or in RA.
- Ulnar drift: Ulnar deviation of the digits most commonly due to RA.
- Dupuytren's contracture: This is due to contracture of the palmar fascia. Most common in the ring finger or little finger, men more than women, ages 50-70.

- Trigger finger: Results from a thickening of the flexor tendon sheath, causing sticking of the tendon. At later stages the finger can become stuck in flexion, needing to be passively extended. Associated with RA.
- Drop- wrist: Secondary to radial nerve palsy.
- Clubbing: Can be caused by many medical problems such as pulmonary or cardiac diseases, as well as genetic.
- Heberden's nodes: Swelling of the DIP joints secondary to OA.
- Bouchard's nodes: Swelling of the PIP joints secondary to RA.
- Special Tests of Hand and Wrist
- Ganglion cyst: Localized swelling usually on the dorsum of the hand.
- Carpal Compression test: Pressure applied directly to the carpal tunnel for 30 seconds. If positive, indicates carpal tunnel syndrome.
- Allen test: Tests for competency of the ulnar and radial arteries.



Thoracolumbar Examination

- Low Back Pain (LBP)
- 90% of all Americans
- Minor insults → major injuries
- Maintain normal lordotic (curves in) and kyphotic (curves out) curves to avoid injury

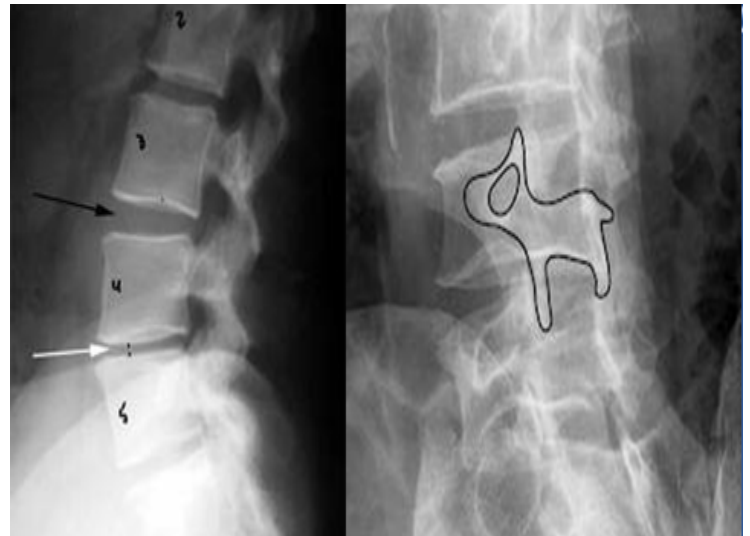


Clinical Anatomy

- 5 vertebrae - lumbar spine
- Facets
- Processes
- Foramen
- “Scotty Dog”

History

- Location of pain:
 - Localized or radiating?
- Onset of pain:
 - Acute, chronic, insidious?
- Consistency of pain:
 - Constant/intermittent?
 - Improves/Worsens with activity?
- Mechanism:
 - Flexion, extension, rotation, lateral flexion
 - Direct blow/trauma



History

- PMH of injuries/surgery?
- Smoker?
- Bowel/bladder symptoms?
 - Incontinence or ↑ frequency
 - Immediate referral
- Referral history
 - Time in the medical system?
 - # of health care providers seen?

Inspection & Observation

- Sagittal curvature
- Scoliosis
- Frontal curvature
- Normal curves
- Standing posture
- Shoulders
- Head
- Walking posture (gait)
- Observation & Inspection
- Paravertebral muscles
- Symmetry / spasm
- PSIS level
- Overall attitude

Palpation

- Transverse processes
- Spinous processes
- PSIS
- Paravertebral musculature
 - Symmetry
 - Spasm

Functional Testing

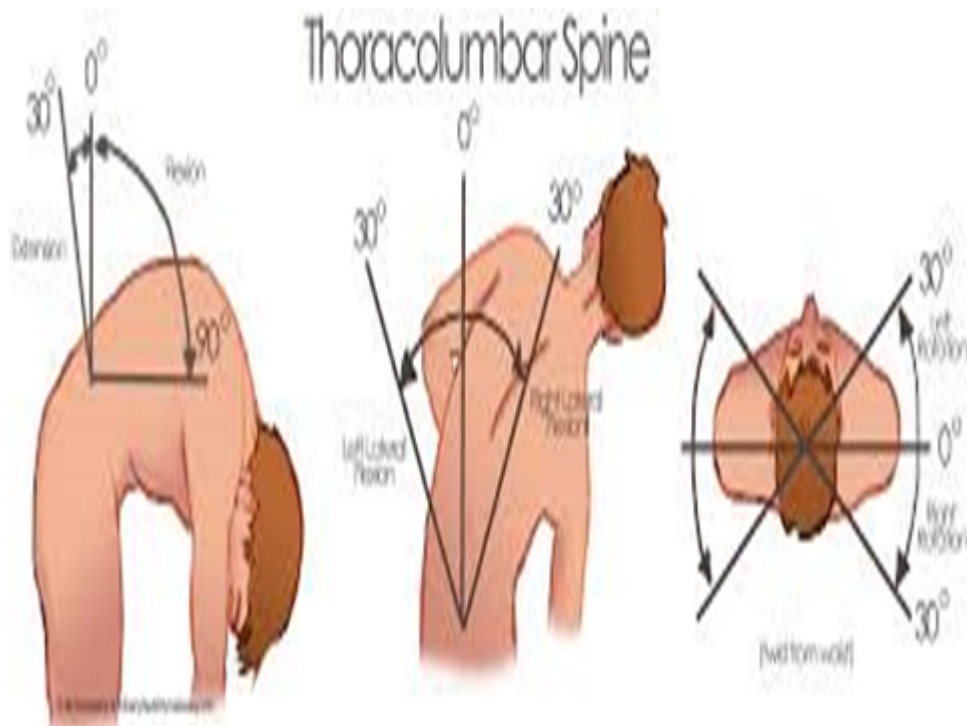
- Gross ROM assessment only
- Trunk Extension = 45°
 - Lordosis should increase
- Trunk Flexion = 90°
 - Lordosis should decrease
- Rotation
- Lateral flexion
- Symmetry > Goniometry

Pathologies & Injuries

- Muscle strains
- Facet joint syndrome
- Disk lesions
- Spondylopathies

Muscle Strains

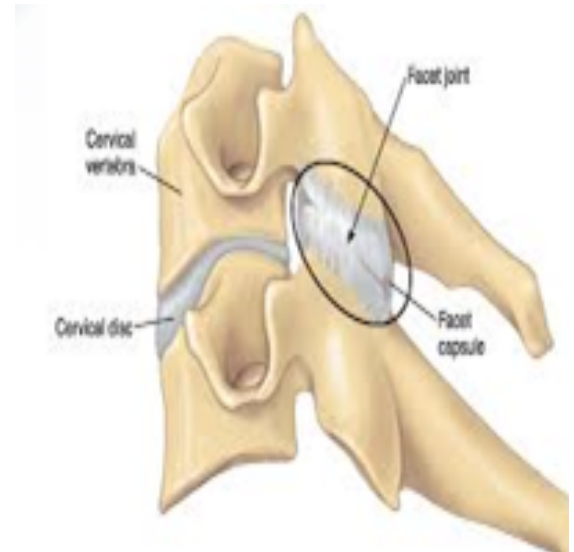
- Pain localized to paraspinal musculature & PSIS
- Spasm probable



- Limited flex. & ext. (pain)
- No radiating pain
- May not correlate to specific mechanism

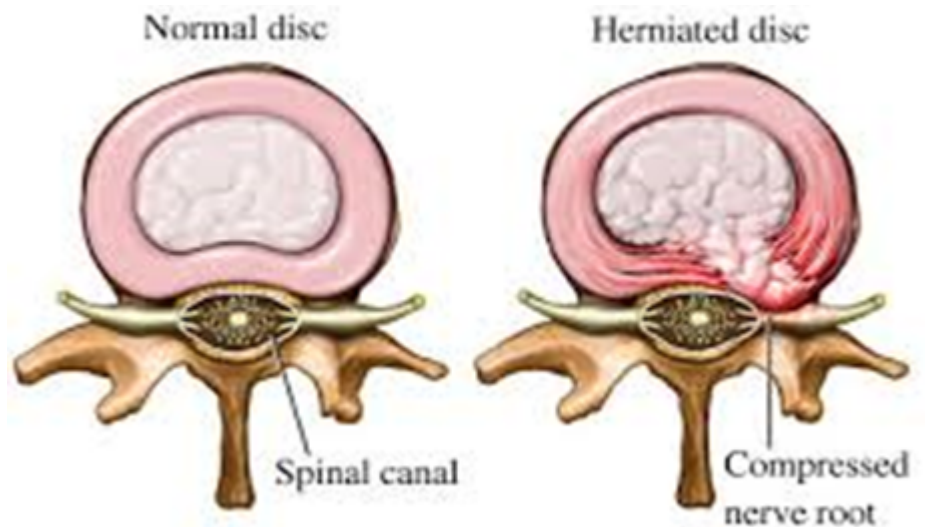
Facet Joint Syndrome

- ~40% of all LBP
- Vague symptoms that mimic other pathologies
- Common with repeated spine-loading activities
- Localized pain
- Often *improves* with activity
- Nerve entrapment may result from compensatory posturing
- Worsened by:
 - Repeated spine-loading activities (extension, side bending, rotation)
 - Poor LE flexibility
 - Poor Trunk strength



Disk Lesion

- Crack in annulus fibrosus leads to herniation of nucleus pulposus
- Pressure on nerve root lead to pain/burning sensation
- “Bulge” ≠ pathology
- Radiating pain into buttocks and down leg
- MRI for best diagnosis
- Altered standing posture
- Symptoms ↑ with activity
- Bilateral or unilateral symptoms
- Usually acute onset

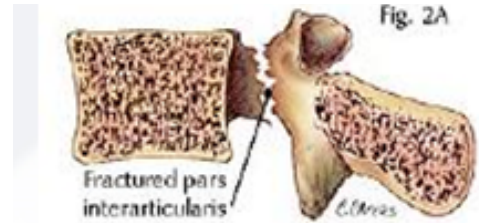


Spondylopathies

- Vertebral defect
- May occur at any age/sports
- Congenital?
- Stress fx?
- Common in sports with forced hyperextension
- Generally occurs at L4-L5 or L5-S1 levels

Spondylolysis

- Defect at pars
- Unilateral or bilateral
- Signs/ Symptoms:
 - NL spinal alignment
 - LBP ↑ during & after activity
 - Localized lumbar spine pain
- X-rays show “collared” Scotty Dog



Spondylolsthesis

- May occur with spondylolysis
- Anterior displacement of proximal vertebrae on distal
- Pain more intense/constant than spondylolysis
- Neuro signs sometimes (+) if displacement worsens
- Possible step-off deformity
- X-rays show “decapitated” Scotty Dog



Straight Leg Raise Test (SLR)

- Supine with knees extended
- PROM hip flexion to point of discomfort or end of range
- Decrease hip flexion and move into passive dorsiflexion
- (+) = pain reproduced and *recurs* with reduced SLR
- (-) = pain reproduced but *does not return* with reduced SLR
- If pain does not recur:
 - Tight hamstrings

Well-Leg SLR Test

- Supine with knees extended
- Passively raise one leg
 - Similar to SLR test
 - Raise leg with symptoms
 - Provocation test
- (+)=Symptoms felt in the other leg (“well” leg)



Valsalva Maneuver

- Increasing intrathecal pressure to reproduce symptoms
- (+)=Reproduced symptoms : Radiating Pain or Numbness

Kernig's Test

- Provocation test to elongate the spinal cord
- Active SLR until point of pain (knee straight)
- Flex knee @ point of pain
- (+)= pain in LB or radiating pain in LE
- Brudzinski's Test = Kernig with cervical flexion



Babinski Test

- Tests presence of upper motor neuron pathology
- Blunt device moved across plantar aspect of foot from calcaneus to 1st metatarsal head (great toe)
 - (-)=toe flexion
 - (+)=great toe extension with splaying of other toes
- Normally (+) in newborns

Hamstring Flexibility

- Tripod sign
- 90-90 position for testing
- Tight hamstrings causes pelvic tilt causes stretched extensors causes pain/spasm



Hip Examination

- Hip Inspection
- Inspect gait in flexion and extension
- Inspect swing (foot moves forward, non-weight bearing) and stance (foot on ground, weight bearing)
- Assess width of base (2-4 inches heel to heel)
- Assess shift of the pelvis (smooth and continuous)
- Assess flexion of the knee (flexed throughout the stance phase)
- Inspect anterior and posterior surfaces of the hip for muscle atrophy or bruising

Hip Palpation

- Palpate bony landmarks
- Anterior landmarks
 - Iliac crest, iliac tubercle, ASIS, greater trochanter, pubic symphysis
- Posterior landmarks
 - PSIS, greater trochanter, ischial tuberosity, SI joint

Hip Range of Motion

- Flexion
 - Bend knee to chest and pull against abdomen
 - Check for flexion deformity (opposite knee goes into flexion)
- Extension

- Leg extends posteriorly with patient carefully positioned near the edge of the table
- Abduction & Adduction
 - Grasp opposite hip, grasp ankle and move laterally, then medially, toward opposite hip
- External and Internal Rotation
 - Flex hip and knee to 90, grasp ankle, rotate flexed lower leg medially, than laterally

Knee Examination

- Assessing a Knee Injury
 - Components of the assessment include
 - Focused history
 - Attentive physical examination
 - Thoughtfully ordered tests/studies

Focused History Questions

- Onset of Pain
 - Date of injury or when symptoms started
- Differential diagnosis by LOCATION
 - *Anterior* – Patellofemoral syndrome, bursitis, Osgood-Schlatter’s disease, patellar tendinitis, patellar fracture
 - *Medial* – meniscus, MCL, DJD, pes anserine bursitis
 - *Lateral* – Meniscus, LCL, DJD, iliotibial band friction syndrome, fibular head dysfunction
 - *Posterior* – hamstring injury, tear of posterior horn of medial or lateral meniscus, Baker’s cyst, neurovascular injury (popliteal artery or nerve)
- Mechanism of Injury - helps predict injured structure
 - Contact or noncontact injury?
 - If contact, what part of the knee was contacted?
 - Anterior blow?
 - Valgus force?
 - Varus force?
- Contact injuries or blows to the knee
 - Commonly cause injury to: collateral ligaments, patellar dislocation, epiphyseal fractures in children with open growth plates
 - Valgus forces are more common than varus-directed forces
 - Blow to lateral aspect of knee resulting in stretch injury to soft tissues of medial knee (MCL more prone to injury than LCL)
 - Pearl to help remember the difference between varus and valgus stress, Valgus has “L” as in lateral and patella.

Focused History Questions

- Non Contact Injuries
 - Vulnerable structures:
 - Cruciate ligaments (most common)
 - Menisci

- Joint capsule
- Was foot of affected knee planted on the ground?
 - Think ACL INJURY any time you have a patient with a significant NON-CONTACT injury with foot planted on the ground
- Injury-Associated Events
 - *Pop* heard or felt?
 - Ligament or meniscus injury
 - *Swelling* after injury (immediate vs. delayed)
 - Immediate refers to less than 6 hours after injury and correlates to:
 - Cruciate ligament tear
 - Articular fracture
 - Knee dislocation
 - Delayed swelling usually follows meniscal injuries
 - *Nontraumatic Effusion* - septic arthritis, tumor, gout, degenerative arthritis, synovitis, symptomatic arthritides
- *Catching / Locking*
 - Knee gets caught or stuck (“locked”) in a flexed position due to something blocking normal joint motion and person cannot voluntarily flex further.
 - Often due to:
 - Tear in meniscus
 - Detached tissue lodging in knee joint
 - Injury to cruciate ligament(s)
- Pseudolocking
 - Due to pain and muscle spasm secondary to increasing edema
- Buckling / Instability (“giving way”)
 - Displacement of osseous components of the knee suggesting ligamentous laxity or patellar instability OR
 - Quadriceps inhibition due to pain (such as during patellar subluxation or with meniscus tear) or weakness due to injury

Focused History Questions

- Aggravating Factors
 - Activities, changing positions, stairs, kneeling
- Relieving Factors/treatments tried
 - Ice, medications, crutches

Historical Clues to Knee Injury Diagnoses

Noncontact injury with "pop"	ACL tear
Contact injury with "pop"	MCL or LCL tear, meniscus tear, fracture
Acute swelling	ACL tear, PCL tear, fracture, knee dislocation, patellar dislocation
Lateral blow to the knee	MCL tear
Medial blow to the knee	LCL tear
Knee "gave out" or "buckled"	ACL tear, patellar dislocation
Fall onto a flexed knee	PCL tear

Physical Exam - General

- Inspection
- Palpation
- Range of motion
- Strength testing
- Special tests

Physical Exam - Exposure

- Adequate exposure - groin to toes bilaterally
- Examine in supine position
- Compare knees

Observe – Static Alignment

- Patient stands facing examiner with feet shoulder width apart
 - Ankles, subtalar joints – pronation, supination
 - Feet – pes planus, pes cavus
- Patient then brings medial aspects of knees and ankles in contact
 - Knees – genu valgum (I), genu varum (II)
- Observe – Dynamic Alignment
 - Pronation/Supination may be enhanced with ambulation
 - Antalgic gait indicates significant problem (anti = against, algic = pain)

Inspect Knee

- Warmth
- Erythema
- Effusion
- Evidence of local trauma
 - Abrasions
 - Contusions
 - Lacerations
- Patella position
- Muscle atrophy

Inspect Knee-Related Muscles

- Quadriceps atrophy
 - Long-standing problem
- Vastus medialis atrophy
 - After surgery

Palpation

- Palpation – Anterior
- Palpation - Medial
- Palpation – Lateral
- Palpation - Posterior
 - Popliteal fossa
 - Abnormal bulges
 - Popliteal artery aneurysm
 - Popliteal thrombophlebitis
 - Baker’s cyst

Range Of Motion Testing

- Extension 0° 135°
 - Describe loss of degrees of extension
 - Example: “lacks 5 degrees of extension”
 - Locking = patient unable to fully extend or flex knee due to a mechanical blockage in the knee (i.e., loose body, bucket-handle meniscus tear)
- Flexion

Strength Testing

- Test knee extensors (quadriceps) and knee flexors (hamstrings)
 - Can test both with patient in seated position, knees bent over edge of table
 - Ask patient to extend/straighten knee against your resistance
 - Then ask patient to flex/bend knee against your resistance
- Compare to unaffected knee

Special Tests – Anterior Knee Pain

- Patellar apprehension test
- Patellofemoral grind test

Special Tests - Ligaments

- Assess stability of 4 knee ligaments via applied stresses
- Stress Testing of Ligaments
- Use a standard exam routine
 - Direct, gentle pressure
 - No sudden forces
- Abnormal test
 - Excessive motion = laxity
 - Soft/mushy end point
- Collateral Ligament Assessment
- Valgus Stress Test for MCL
- Anterior Drawer Test for ACL
- Posterior Drawer Testing- PCL

Assess Meniscus – Knee Flexion

- Most sensitive test is full flexion
 - Examiner passively flexes the knee or has patient perform a full two-legged squat to test for meniscal injury
- Joint line tenderness
 - Flexion of the knee enhances palpation of the anterior half of each meniscus

Foot & Ankle Examination

- Inspection and Palpation
 - Inspect the surfaces of the ankles and feet for any deformities, nodules, swelling, calluses or corns
- Palpate
 - Anterior foot and ankle for boggiess, swelling and tenderness
 - Achilles tendon foe tenderness or nodules
 - Heel for tenderness
 - Medial and lateral malleolus for tenderness
 - Metatarsalphalangeal joints for tenderness
 - Heads of the 5 metatarsals
- Range of Motion
 - Ankle flexion – plantar flexion - Point foot toward floor
 - Ankle extension - Point foot toward ceiling
 - Inversion - Bend heel inward
 - Eversion - Bend heel outward

Movement Manuevers

- Tibiotalar joint (ankle)
 - Dorsiflex and plantar flex the foot at the ankle
- Subtalar joint (talocalcaneal joint)
 - Stabilize the ankle and grasp the heel, invert and evert the heel
- Transverse tarsal joint
 - Stabilize the heel, invert and evert the forefoot
- Metatarsophalangeal joints
 - Flex the toes in relation to the feet

Collateral Ligament Assessment



Valgus Stress Test for MCL

