Dermatomes (sitting):

- "Does this feel the same as this?"
- Always test unaffected side first for comparison

L1 = upper 1/3 of thigh (*follow hip angle from lateral → medial)
L2 = middle 1/3 of thigh
L3 = distal 1/3 of thigh
L4 = medial lower leg
L5 = lateral lower leg and dorsal surface of foot
S1 = lateral foot (5^{th} metatarsal) and plantar surface
S2 = popliteal fossa
S3/S4 = buttock and genitals (*ask for numbness in saddle/genital area during examination)

Deep Tendon Reflexes (sitting): ALWAYS compare to unaffected side for comparison
DTR Grading system:

- 0 = absent
- 1 = diminished
- 2 = average
- 3 = exaggerated
- 4 = clonus (*several beats – related to CNS problems such as stroke)
- Can also use: absent, decreased, normal, increased

L3/L4 = patellar reflex (*quadriceps is L3 myotome, DTR (dermatome) is most often attributed to L4)
- Use thumb and index finger to stabilize patellar tendon
- Look for muscle activation and motion
- Sitting:
  - Less reflex than supine may be due to bulge affecting disc
- Supine: NWB position
  - Use pillow or therapist knee to support leg
  - Decreased reflex is common due to less stretch (not pathological)
  - Increased reflex: better input due to less pressure on nerve root

S1 = Achilles tendon reflex
- Do in sitting and prone
- Support foot into DF at the toes
  - Watch for contraction of tibialis anterior (patient is not fully relaxed)

Myotomes:

L2 = hip flexion
- MMT technique (sitting) – stabilize hip

L3 = knee extension
- MMT technique (sitting) – unlock fully extended knee, support underneath thigh
- One leg half squat

L4 = tibialis anterior
- MMT technique (sitting) – bring foot UP + IN; stabilize behind ankle and apply resistance using broad hand contact
- Walking on heels

L5 = extensor hallucis longus
- Big toe extension – resist with one/two fingers

S1 = ankle PF or eversion
- MMT technique (toe raises = 15-20)
- Walking on toes
- Medial hamstring
  - Sitting knee flexion with tibia internally rotated (toes turned in)
  - Prone with knee flexed shy of 90º and thigh in slight medial rotation

S2 = hip extension
- MMT technique (prone): knee flexed shy of 90º
- Lateral hamstrings:
  - Sitting knee flexion with tibia externally rotated (toes turned out)
  - Prone with knee flexed shy of 90º with thigh in slight lateral rotation

LUMBAR SPINE TESTS

Nerve tension tests for sciatic nerve (L4-L5-S1 nerve roots)
- You do not have to do all the tests on every patient, but you will use most of them at one time or another
- With all those tests, the **asymptomatic side should be tested first**

Straight leg raise (SLR) or Lasegue's Test
- Patient supine
- LE is passively raised with the knee kept in extension to end-range
- Positive test: pain is felt in the lumbar spine, buttock, or posterior aspect of LE
    - **Only considered positive if symptoms occur between 30-70º of elevation**

Interpretation of SLR Test

Mechanics:
1. Normally, movement of the nerve at the greater sciatic notch begins almost immediately
2. During the first 30º - movement is seen more distally at the ilium region
3. From 30-70º - the majority of movement occurs at the intervertebral foramen (positive test)
4. Beyond 70º - minimal movement occurs with the development of tension along the entire course of the nerve

Interpretation
1. SLR test is sensitive = meaning that value is in being negative
    - SNOUT = negative result "rules out" nerve root irritation/involvement
2. SLR test is not specific = meaning that a positive test does not "implicate" nerve root involvement with a high degree of certainty

Sign of the buttock
- Done prior to performing the SLR test
- Normal pain-free hip flexion should be confirmed to rule out limitation of SLR due to hip/buttock pathology
- This can be achieved by simply:
    1. Testing hip flexion with the knee flexed prior to performing the SLR **or**
    2. If at the end of a positive or negative SLR test – the knee is bent and further hip flexion is performed
- A (+) SLR with no decrease in pain and no increase in hip flexion with the knee flexed = indicates hip pathology

Hamstring tightness
- Hamstring tightness can also cause posterior thigh pain at end range
- Findings:
    - Muscular end-feel
    - Symmetrical bilateral tightness
- Nerve-root irritation findings
    - Empty (painful) end-feel with a true positive SLR
    - Asymmetrical bilateral tightness
- Comparing amount of motion, end-feel, and perception at end range should help determine if pain is due to hamstring tightness

Hamstring strain
- Hamstring strain (especially near proximal insertion) may be confused with disc herniation
- Test: resisted knee flexion should help differentiate a hamstring strain from a positive SLR test
    - Pain limits motion = pain with resisted motion
- Resisted knee flexion should reproduce the pain with a hamstring (not for nerve root irritation)

Hip internal rotation and adduction
- Addition of hip IR and/or ADD at end of SLR will create further tension on sciatic nerve
- Should further increase the symptoms associated with a positive test

Braggard's Test:
- Similar to the SLR test initially
- Always start with unaffected side first
- Ask: Does this change anything?
- Add ankle DF without further hip flexion
- Positive test: reproduction or increase pain with ankle DF
    - Be careful of interpretation: also causing increased stretch on tissue (i.e. calf muscle)

Suto-Hall Test:
- Similar to SLR test initially
- Always start with unaffected side first

- If pain is reproduced – stop just short of pain and "back up" few degrees
- Have patient actively flex their neck without further hip flexion
- Positive test: reproduction or increase pain with neck flexion

Crossed SLR test (Firestein)

- Patient supine and the leg opposite the side of symptoms is tested
- Positive test: patient reports reproduction of symptoms or increased pain in the opposite buttock and/or posterior aspect of LE during elevation of the asymptomatic LE
- If positive – this test is a very strong indication of disc herniation
- Always test both sides

Interpretation of this test is opposite to the SLR test:

- Test is specific = meaning a positive test highly implicates a disc herniation with nerve root involvement
    - SPIN = "rules in"
    - Not sensitive = negative test does not rule out a disc herniation

Brechterw's Test

- Patient is sitting upright with slight lumbar lordosis (i.e. good posture)
- With the hips at 90º - passively extend the knee with the pretext of looking for "proper knee function"
- Reproduction of symptoms would confirm a positive SLR test
- Lack of reproduction of symptoms in a patient with a strong positive SLR rest may raise suspicion as to the veracity of the symptoms with the SLR
    - *Would expect patient with a positive SLR test to lack ability to extend knee and have reproduction of symptoms or increased pain in buttocks/posterior calf/thigh (good stretch on sciatic nerve)

Slump Test

- Patient is sitting at the edge of table with hands behind their back
- Patient slumps forward (flexion of lumbar and thoracic spine); continues looking straight ahead (neck extended)
- PT applies slight pressure over the upper thoracic region to create more flexion and maintain the position
- Patient is asked to flex the cervical spine to end range (looking down)
- PT applies slight pressure on back of head to maintain the position
- Patient is asked to DF the foot and slowly extend the knee (*asymptomatic side first, then symptomatic side)
- If pain reproduction when testing the symptomatic side – patient is asked to look up (extending cervical spine)
    - Should relieve pain and allow further knee extension if nerve root irritation
    - Hamstring tightness = no change pain or motion
- Reduction of pain and further knee extension confirms spinal nerve root involvement
- Lack of difference with neck extension: suggests soft tissue restriction (i.e. hamstrings) as the source of pain
- Pain in the thoracic and lumbar region is not unusual and is not considered positive

Nerve tension tests for femoral nerve (L2-L3-L4 nerve roots)

- Uncommon to be positive
- Patient is prone on table (*pillow underneath hips)
- Knee is slowly passively flexed to end range while monitoring the pelvis and lumbar spine to avoid increased anterior pelvic tilt and lordosis
- Positive test: pain in the groin and hip area going to the anterior medial thigh region (dermatome distribution)

Other neurological tests:

Babinski:

- Pressure is applied under the foot from the heel, lateral aspect of the foot and across the metatarsals with the back of the thumb or firm object
- Normal response = all 5 toes curl into flexion
- Positive test = indicates central nervous system dysfunction
    - Big toe goes into extension and the 4 lesser toes abduct

Stoop Test

- Can be performed to assess neurogenic intermittent claudication (spinal stenosis) vs. vascular claudication
- Patients with spinal stenosis will complain of pain in the calf region after ambulating a certain distance
- They will also report that after resting for a few minutes, they are able to walk again for a similar distance
- This is very similar to a patient with vascular claudication
- The difference is that for a patient with spinal stenosis, recovery will be faster if resting with the lumbar spine in a flexed position (sitting or leaning), as opposed to an extended position
- Recovery for patients with vascular claudication is not affected by the position of the lumbar spine

Bicycle Test of van Gelderen

- Can be performed to assess neurogenic intermittent claudication (spinal stenosis) vs. vascular claudiction
- Patients with spinal stenosis will complain of pain in the calf region after using a stationary bike with the trunk in an erect posture for a few minutes
- If asked to continue biking in a flexed posture, the pain should decrease despite the continuation of the exercise
- The pain should reappear if asked to continue biking after returning to sitting in an erect posture
- The lumbar position should not affect pain for a patient with vascular claudication

SACRO-ILIAC JOINT TESTS

Standing flexion test (assess movement of the ilium on the sacrum)
- Place thumbs under the PSIS
- Have patient FB
- Note cranial movement of the PSIS
    - Assess for symmetry and distance of movement on the way up
- Interpretation: One PSIS moves before the other or further cranially = possible SIJ dysfunction
    - Side of dysfunction: moves early (abnormal) or goes further due to loss of joint play

Gillet's Test (marching test)
- Patient standing near table (finger tips for support) and place thumbs under both PSIS
- Have patient stand on one leg and bring the opposite knee toward their chest (hip flexion > 90º)
- The PSIS on the lifted leg side should move caudally (because the sacrum is fixed)
    - Thumb drops relative to opposite stance leg
- The side that shows reduced downward motion = affected (hypomobile) side
- NOTE 1 = hip hiking is noticed if no caudal movement of the PSIS occurs = hypomobility of joint
- NOTE 2 = an alternative method of palpation is palpating the spinous process of S2 with one thumb and under the PSIS (leg tested) with other thumb

Sitting flexion test
- Repeat standing test in sitting (feet well supported and knees apart)
- Eliminates unilateral hamstring tightness which may cause PSIS not to move cranially
- ***Sacral torsion should typically match ilium mobility on side of dysfunction

Sit-slump test
- Patient sitting
- Palpate depth of sulci just medial to PSIS on each side
- Have the patient slump and feel for change in depth **(repeat 2-3x)**
    - Counter-nutation = posterior pelvic tilt = sulci should become more shallow
- Have the patient sit tall (hyperlorosis) and feel for change in the depth **(repeat 2-3x)**
    - Nutation = anterior pelvic tilt = sulci should become deeper
- Movement should normally be symmetrical
- Interpretation:
    - Determine which side is NOT moving (very small movement) = forward/backward torsion
    - **Side that moves normally = AOR**
    - Forward torsion
        - Sit-tall = feels more symmetrical (asymmetry disappears)
        - Slump = feels less symmetrical (asymmetry amplified)
    - Backward torsion
        - Sit tall = feels less symmetrical (asymmetry amplified)
        - Slump = feels more symmetrical (asymmetry disappears)

Prone-sphynx test
- Patient prone (relaxed = eliminates extensor activation)
- Palpate depth of sulci just medial to PSIS on each side
- Have patient move to a position of prone on elbows (sit tall) and feel for change in depth
    - Anterior pelvic tilt = sulci should become deeper
- Movement should normally be symmetrical
- Same interpretation as sit-slump test

Prone mobility test for SIJ
- **Good test for mobility of ilium**
- Patient prone and relaxed
- Palpate just medial to sulci with one hand (same side as you stand)
- Place fingertips of the other hand just under the corresponding ASIS (same side as you stand)

- Gently lift ASIS posteriorly (toward ceiling) in a rhythmic manner
- Feel for movement of the SIJ at the sulcus on the ipsilateral side

Compression-Distraction (gapping) tests = **provocation tests** designed to test joint irritability

- **Compression:**
  - Patient supine
  - Apply a medial to lateral force on ASIS (*take up skin slack by bringing hands to middle)
    - Gaps the anterior aspect of the joint (stretches the anterior ligament)
    - Compresses the posterior aspect
- **Distraction**
  - Patient supine
  - Apply a lateral to medial force on ASIS
    - Gaps the posterior aspect of the joint (stretches the posterior ligament)
    - Compresses the anterior aspect
  - This test can also be done in side-lying
- **Longitudinal ligament**
  - Patient supine
  - Using leg as fulcrum, hip in flexion and knee toward ipsilateral shoulder
  - Provide a force along the long axis of the femur while palpating the ipsilateral sulcus (2-3 mobs)
  - Ask patient if there is pain and assess (palpate) for mobility of the joint
    - Assess for: amount of motion and firm end-feel
  - Be careful not to use excessive hip ABD which may cause hip pain
- **Oblique ligament**
  - Patient supine
  - Using leg as fulcrum, hip in flexion and knee toward contralateral shoulder
  - Same as above
- **Transverse ligament**
  - Patient supine
  - Using leg as fulcrum, hip in flexion and knee toward contralateral hip
  - Same as above
  - **NOTE:** have patient confirm pain at SIJ vs. where you apply pressure

Sacral provocation tests: **ask for pain and reproduction of symptoms**

- Apply PA pressure to base of sacrum between PSIS (pain reproduction?) = FLEXION
- Apply PA pressure to apex of sacrum just above coccyx (pain reproduction?) = EXTENSION
- Apply PA pressure to inferior-lateral angles (ILA) of sacrum (pain reproduction?) = TORSION

HIP TESTS

Thomas test: for tightness of hip flexors and rectus femoris

- Have patient sit at edge of table (as close as possible w/out falling off)
- With one knee against chest, have patient lean back (assist patient if necessary) and lay supine on table
- Bring the other knee up against the chest **and** let go of one leg
- *Do not allow compensation by anterior tilt/lordosis = instruct patient to keep back flat on table

1. TFL tightness:
   - Normally, the leg should remain in the sagittal plane
   - If hip abduction occurs (J-sign), it suggests tightness of the TFL (this finding should be noted)
   - Prior to observation of the tightness of hip flexors, the leg should be brought back into flexion and guided back down so that it remains in the sagittal plane (prevent ABD) as the hip is extended
2. Hip flexor tightness:
   - Normally, the thigh should be lower to become parallel to the floor, if not tightness of hip flexors is present (*Measure hip angle to note about of motion lacking)
   - Watch for compensatory lordosis and maintain the back flat on the table with opposite hip flexion against chest.
3. Rectus femoris tightness:
   - In the same position, the lower leg (tibia) should reach a position perpendicular to the floor

- If not, the rectus femoris is tight
- Extent the knee (to confirm tightness): patient should gain hip extension

Ely's test: for tightness of rectus femoris
- Patient prone and therapist performs passive knee flexion
- Should be able to bring the heel near the buttock (~120 degrees)
- Watch for compensatory hip flexion or anterior pelvic tilt/increase lordosis **(keep one hand on buttock)**
- Stop at tightness and measure lacking motion
- Increase pain with femoral nerve problem (always for location of pain)

Ober's test (knee extended): for tightness of TFL and IT band
- Patient is side lying with the leg on the table slightly flexed
  - Therapist adequately stabilizes the pelvis (from behind over the iliac crest) to prevent rotation
- Passively abduct and extend the hip and allow the leg drop in adduction (*up until movement in the pelvis)
- Tightness is present when the leg remains abducted (the foot should be near the level of the table)
- May be performed with knee straight or with knee flexed **(be consistent)**
- **Look for:** point at which the pelvis drops
- **Pain:** likely bursitis if pain over greater trochanter

Hamstring length test (4 methods)
1. **Sitting toe-reach**:
   - Patient seated with one leg straight on the table and the other leg in a flexed/abducted position
   - The patient reaches forward (normal flexibility should allow the patient to touch their toes)
   - Non-specific flexibility test = combines lumbar spine + hamstrings (*does not differentiate)
2. **Tripod sign: (*differentiate from + neurological tension signs)**
   - Patient sits at the end of table with the hips at 90º and lumbar spine in slight lordosis (hands off the table)
   - The patient is then asked to actively extend the knee (one leg at a time)
   - Hamstring tightness is identified if the patient is unable to fully extend the knee without leaning back and using his/her hands for support (creating a tripod - 2 hands and buttock)
   - Most commonly seen = patient extending the knee; compensating with posterior pelvic tilt (↑ kyphosis)
3. **SLR**:
   - The patient is supine with both legs straight on the table
   - Therapist passively lifts one leg to the end of range, keeping the knee straight and making sure opposite leg remains flat on the table
   - The amount of hip flexion is measured with a goniometer (normal flexibility ~ 70º)
4. **90-90 test (allows for better control of compensations; make sure patient does not posterior pelvic tilt)**
   - The patient is supine with both legs straight on the table
   - Therapist passively brings the hip of the leg to be tested to 90º of flexion with the knee flexed
   - Passively extend the knee while keeping the hip at 90º (make sure opposite leg remains flat on the table)
   - Amount of knee flexion is measured with a goniometer (Normal flexibility ~ 20º short of full knee ext)
   - Can also be done with the patient actively extending the knee to facilitate measurement of knee flexion

Patrick's (faber or figure-four) test: Tests combine movement of flex-abduction-ER of the hip
- Tests for general hip pathology and anterior medial capsule for flexibility limitation and pain
- Patient supine; PT brings the leg to be tested in flexion (placing ankle just above the patella of opposite LE)
- Examiner allows tested LE to gently fall into ABD + ER while stabilizing the opposite ASIS with other hand
  - Normal = knee parallel
- Overpressure can be applied at end range to assess for pain and end-feel
- This test also stresses the SIJ on the side tested = ask for pain location
- Pain in the posterior SIJ region may be indicative of SIJ problem

Quadrant or scouring test: Test for hip pathology, and posterior and lateral capsule flexibility
- Patient supine (at edge of table) and examiner flexes, adducts, and compresses (force down thru femur) the hip joint
- Examiner abducts-adducts the hip following a gentle arc of motion (abd/add, IR/ER, circumduction) feeling for any irregularity/roughness of movement, assessing end-feel, and asking if pain occurs with movement
- Can be done with very little initial compression and with various amount of motion
- Groin pain, indicates possible hip pathology; posterior hip pain may be more related to tightness of posterior capsule

Trendelenberg test: To determine weakness of hip abductors
- Patient is asked to stand on one leg
- Normally the iliac crest should rise (neutral or slightly higher) on NWB side

- Weakness of the hip abductors on WB side = pelvis on NWB side will drop (glut medius weakness on stance leg)
- Compensated Tredenlenburg (also indicates hip ABD weakness) = pt leans/bends/SB trunk over the WB side

Craig's test: test for femoral anteversion
- Patient prone with the knee flexed at 90º
- The therapist slowly rotates the hip in IR/ER while palpating the lateral aspect of the hip (greater trochanter)
- Therapist attempts to identify when the greater trochanter is most lateral (rolls under)
- Hip IR is measured at this corresponding position (Normal range = 8-15º)

Nelaton's line: test to identify a dislocated hip or coxa vara
- Line is drawn from the ischial tuberosity of the pelvis → ASIS on the same side
- The greater trochanter of the femur is palpated
- Normal = falls within the line; Abnormal = falls well above the line (indicative of the above conditions)

Ortolani's sign: for congenital hip dislocation in infants
- Infant supine and examiner flexes hips by grasping knees and palpating along the outside of the thigh
- With gentle traction, the thighs are abducted while pressure is applied against the greater trochanter of the femur
- A click may be felt at about 30 to 40º as the hip reduces

Femoral (femoral triangle): Palpation for pulse and tenderness
- Patient supine with leg positioned in a figure 4 position
- The edges of the triangle should be easily identified = sartorius laterally and adductor longus medially
- Superiorly = inguinal ligament extends from the ASIS → pubic symphysis
- Pulse can be palpated just distal to the inguinal ligament in the middle of the triangle
- Diffuse tenderness in this region may indicate infection distal to that site due to drainage by the lymphatics
    - Look for bruises in this area and ask for any recent cuts on the LE

Jansen's test: Test for possible OA of the hip or lack of hip mobility (gluteus maximus)
- Patient seated and asked to assume a figure 4-position
- Compensation will occur with trunk extension if unable
    - Lean back to avoid pinching the anterior capsule (knees remain high)

KNEE TESTS

Swelling:
- Can be visually observed and subjectively graded based on amount: none, minimal, moderate, severe
- Can be measured using circumference measurements

There are also 3 special tests of interest related to the identification of swelling of the knee.

1. Circumference measurements:
    - A tape measure is used to make side-to-side comparisons between both knees
    - Standard locations for measurements when both knees can be measured in full extension are the mid-patella, just above the superior pole of the patella (which reflects the suprapatellar pouch of the joint capsule) and the tibiofemoral joint line
    - Note that measurement above the superior patella pole can be affected by bulk of the vastus medialis
    - Note that the circumference measurements may be affected if the knees are not measured using the same angle (i.e. when knee extension is limited)
    - ** Circumference measurements are also often used to measure symmetry of muscle mass (or more diffuse lower extremity swelling)
        - Several alternatives exist, most commonly used being to simply measure muscle mass just above the superior pole of the patella and every 5 cm more proximal
        - Measurements below the knee can be made at regular intervals starting with the inferior pole of the patella or the edge of the lateral tibial plateau
2. Patellar tap (ballotable patella)
    - Patient supine with knee fully extended
        - Extension of the knee forces the intraarticular swelling to the anterior part of the knee
    - The examiner pushes the patella in an anterior to posterior direction against the intercondylar groove
    - The tester should normally feel a direct and firm contact
    - Intraarticular swelling = feel patella float against/through the fluid before meeting firm resistance
3. Fluctuation test
    - Patient supine with the knee in full extension
    - Examiner places one hand on the distal anterior thigh region just proximal to the superior pole of the patella and the other hand just below the distal pole of the patella
    - Therapist then alternately pushes with one hand while feeling for increase volume under the other hand
    - Intent: to displace fluid from the suprapatellar pouch to the inferior region of the joint capsule or the reverse by using hand pressure

Can also be performed with hands just lateral and medial to the patella capsule (medial/lateral aspect)

Test for subluxation/dislocation of the patella

Apprehension test: (tests lateral instability)

- Designed to determine if the patient has a feeling of apprehension (or excessive movement of the patella) when the patella is displaced in the lateral direction
- Patient supine with the knee at about 20° of flexion (using a towel roll, small pillow or the tester's knee)
- Using both index fingers slowly displace patella in the lateral direction (ask for pain or apprehension)
- A positive test would consist of:
    - Apprehension expressed by the patient (feels like it will slip out)
    - Excessive mobility (should normally be 25% of the width of the patella)**;↑ flexion = less displacement**
    - Pain is also possible if a recent history of subluxation or dislocation

Test for chondromalacia patellae

Active knee extension

- Patient seated at end of table and asked to actively-slowly extend the knee
    - Therapist lightly places his/her hand on the patella and feel for crepitus
- The following is evaluated
    - Presence or absence of crepitus:
        - Note: presence and amount of crepitus does not always correlate to the severity of knee pain
    - Quality of the crepitus: fine vs. coarse
        - Coarse crepitus is an indication of more advanced damage to the articular surfaces
    - Range of motion where crepitus is present:
        - Helps determine appropriate ROM to perform exercises and the arc of motion to avoid initially
- ***Crepitus and mostly reproduction of pain are suggestive of chondromalacia.

Grind test

- Patient supine with knee extended or slightly flexed
- Provide support under the knee with a towel if knee hyperextension
- Hold patella between both index fingers and thumbs and moves the patella in a distal-proximal back and forth direction while applying a gradually larger amount of compression of the PFJ (between patella and trochlear groove) by pressing the patella posteriorly
- Feel for crepitus and ask the patient if the test reproduces pain
- ***Crepitus and mostly reproduction of pain are suggestive of chondromalacia.

Palpation under the surface of the patella

- Patient supine with the knee extended
- Stand on the side to be tested, uses both thumbs to displace the patella in the medial direction.
- While holding end range position, use 1 or both index fingers to palpate under the medial surface of the patella along its entire length (*asked if there is tenderness/pain to palpation)
- Then, both index fingers are used to displace the patella in the lateral direction while both thumbs are used to palpate under the lateral surface of the patella **(*or switch sides)**
- Ask for tenderness/pain to palpation
- Reproduction of pain is suggestive of chondromalacia
    - Note: pain from peri-patellar structures (synovium and capsule), **not cartilage (avascular)**

Clarke's sign: (very irritable, avoid if necessary)

- Patient supine with knee extended or slightly flexed
- Provide support under knee with towel if knee hyperextension
- Place web space of hand just proximal to the superior pole of the patella and apply a downward/posterior force
- While holding the pressure, the patient is asked to perform a quadriceps contraction
- First apply small amount of pressure and repeat, increase to more pressure based on the response of the patient
- Reproduction of pain is suggestive of chondromalacia
- Note that some individuals without symptoms of chondromalacia may have pain with this test.

Test for plica = synovial fold on medial side of patella (often gets pinched)

Mediopatellar plica test:

- Patient supine with the knee flexed at 30-50°
- In this position, the therapist uses both thumbs to displace the patella in the medial direction

- Intent = to "pinch" the "irritated" plica between the patella and the medial femoral condyle
- Positive test = suggestive of inflammation of the plica; patient c/o pain during the test

Stutter test:

- Patient seated at the edge of table with the knee flexed at 90°
- The patient asked to slowly extend the knee while the therapist lightly palpates the patella during knee extension.
- A "stutter" or "jump" of the patella at around **45 to 60°** of flexion may indicate a thickening of the plica
- Positive test = suggestive of inflammation of the plica

Palpation of the plica (only 60% of people have plica)

- Patient supine with the knee extended
- Use index finger to palpate the area just next to the superior-medial corner of the patella
- Palpate near edge of the patella in a posterior-anterior direction feeling for band of fascia and pain reproduction
    - Palpate perpendicular for a rope "flicking" underneath your finger
- Pain with palpation of a band of fascia may suggest irritation of the plica

Test for IT band

Noble compression test (provocation test)

- Patient seated at edge of table with the knee at 90° of flexion
- Stand on opposite side being tested, uses a broad hand contact and applies firm pressure just proximal to the lateral femoral condyle over the lateral aspect of the thigh and IT band
- Use other hand to passively extend the patient's knee
- Reproduction of the pain on the lateral aspect of the knee when the knee is at about **30° of flexion** during passive fflexion or extension indicates irritation of the IT band **(IT band compressed against lat. femoral condyle)**
- Note: test is often negative even in individuals with IT band irritation - unless the symptoms of IT band irritation are quite severe or the patient has just been performing an activity that would have irritated the structure
    - IT band does NOT warm up like typically tendonitis
    - Negative test = do NOT rule out irritated IT band

IT band flexibility: The Ober test can be used to test IT band flexibility (see hip section)

Test for menisci (most injuries occur at the posterior horn)

Mc Murray:

- For the medial meniscus
    - Patient supine and relaxes during the test
    - With one hand over the anterior/medial aspect of the knee and the other hand just above the ankle, the patient's knee is brought in full flexion, the lower leg in full internal rotation, and a varus force (lateral) is applied by applying a force from the medial to the lateral direction with the hand on the knee and providing a counterforce with the hand above the ankle
    - This position brings the posterior horn of the medial meniscus (the most often injured part of the meniscus) under compression between the tibia and femoral condyle
        - Version #1:
            - In this position, maintaining the varus force, external rotation of the lower leg is performed while allowing only a small amount of extension to occur
            - Repeated 3 or 4 times trying to "catch" a possible meniscus tear
            - Focuses on the posterior horn of the medial meniscus.
        - Version #2:
            - The knee is slowly taken toward extension while maintaining the varus force and moving the lower leg toward external rotation
            - This version sweeps the entire length of the meniscus.
        - For both versions, a positive test consists of a "click" or "catching sensation" with or without reproduction of pain.
- For the lateral meniscus:
    - Patient supine and relaxes during the test
    - With one hand over the anterior/lateral aspect of the knee and the other hand just above the ankle, the patient's knee is brought in full flexion, the lower leg in full external rotation, and a valgus (medial) force is applied by applying a force from the lateral to the medial direction with the hand on the knee and providing a counterforce with the hand above the ankle
    - This position brings the posterior horn of the lateral meniscus (the most often injured part of the meniscus) under compression between the tibia and femoral condyle

- Version #1:
  - In this position, maintaining the valgus force, internal rotation of the lower leg is performed while allowing only a small amount of extension to occur
  - Repeated 3 or 4 times trying to "catch" a possible meniscus tear
  - Focuses on the posterior horn of the lateral meniscus
- Version #2:
  - The knee is slowly taken toward extension while maintaining the valgus force and moving the lower leg toward internal rotation
  - This version sweeps the entire length of the meniscus
- For both versions, a positive test consists of a "click" or "catching sensation" with or without reproduction of pain

Apley's compression (meniscus) - distraction (ligaments) test

- The patient is prone with the knee flexed at 90°
- Using both hands around the lower leg, just above the ankle, apply a compressive force along the long axis of the lower leg while rotating the lower leg in internal and external rotation
- Reproduction of pain or a catching sensation felt by the patient would indicate a possible meniscus tear
- The meniscus affected is based on the side (medial or lateral) of the symptoms **(testing both sides at same time)**
- The test can also be done with:
  - More knee flexion = testing the more posterior aspect of the meniscus
  - Less knee flexion = testing the more anterior section of the meniscus
- Complementary test to the compression test is the <u>distraction test</u> **(confirmation test)**
  - Same as compression test, but a distraction force is applied along the long axis of the lower leg instead.
  - Absence of pain (symptoms) with + compression test, further supports diagnosis of meniscus tear
  - Pain with the distraction test (↑ pain compared to the compression test) = <u>ligamentous</u> or <u>capsular</u> injury
  - In this situation, remember:
    - IR of the lower leg increases tension on the cruciate ligaments
    - ER of the lower leg increases tension on the collateral ligaments

Ligamentous testing

Ligamentous testing notes:

- Always test the uninvolved side first
- Apply the stress in a progressive manner
- Repeat application of stress 3 times
- Goal = to assess laxity (amount of movement), quality of the end-feel (resistance), reproduction of pain

Instability rating:

- 0 = equal displacement when compared to the uninvolved side (normal or fist degree)
- 1+ = < 5 mm greater laxity compared to the uninvolved side (mild second degree)
- 2+ = 5 to 10 mm greater laxity compared to the uninvolved side (severe second degree)
- 3+ = > 10 mm greater laxity compared to the uninvolved side (third degree)

<u>Collateral Ligaments</u>

Valgus stress test for MCL (0° and 20°)

- Patient supine with leg to be tested near the edge of the table; PT stands on side to be tested facing patient
- One hand placed on lateral aspect of knee (level of the joint line)
- Other hand on medial aspect of the lower leg just above the ankle
- Hip ABD such that the knee is flexed to 20º at the edge of table (thigh remains fully supported on table)
- Once the knee is flexed to 20º, the hand just above the ankle applies a <u>medial-to-lateral</u> directed force, while the hand on the lateral aspect of the knee simply prevents knee movement (keep leg in neutral rotation)
  - At 20º there should be some gapping (loose-packed position) followed by firm end-feel
- Positive test = pain with or without laxity
- Test is then repeated with the knee in full extension: minimal gapping (closed-packed position = firm end-feel)
- **Positive test (full extension) = major disruption of the ligament and possible rupture of the cruciate ligaments

Varus stress test for LCL (0° and 20°)

- Patient supine with leg to be tested near the edge of the table; PT stands on side to be tested facing patient
- One hand placed on the medial aspect of the knee (level of the joint line)
- Other hand on the lateral aspect of the lower leg just above the ankle
- Hip ABD such that the knee can be flexed up to 20º at the edge of table (thigh remains fully supported on table)
- Once the knee is flexed to 20º, the hand just above the ankle applies a <u>lateral-to-medial</u> directed force, while the hand on the medial aspect of the knee simply prevents knee movement (keep leg in neutral rotation)
- Positive test = pain with or without laxity
- **Positive test (full extension) = major disruption of the ligament and possible rupture of the cruciate ligaments.

<u>Posterior cruciate ligament</u>

- Advised to always rule out a tear of the PCL before testing any other ligamentous structures
- PCL tear will affect the accuracy of the rest of the examination, especially testing for ACL tear

- Assessment amount of movement, quality of movement, and end-feel

Posterior sag test for PCL

- Patient supine in hook-lying position, feet resting on table perfectly aligned next to each other, knees flexed 90° The patient simply relaxes in this position
- Therapist (standing on the side of the involved LE) looks if the proximal tibia (particularly the anterior tubercle) of the involved side appears to be located in a more posterior position (posterior sag) on the involved side compared to the uninvolved side
- A posterior sag of the tibia indicates a torn PCL.

Godfrey test for PCL

- Patient supine with the hips and knees at 90° of flexion and perfectly aligned next to each other
- Patient simply relaxes while the therapist supports the lower extremities just proximal to the ankles
    - An easier alternative is to place the heels of the patient on a chair located on the table
- Therapist (standing on the side of the involved LE) looks if the proximal tibia (particularly the anterior tubercle) of the involved side appears to be located in a more posterior position on the involved side compared to the uninvolved side
- More posterior location of the tibia indicates a torn PCL
- ** Verified by placing a posterior-to-anterior directed force (i.e. anterior glide) behind the proximal end of the lower leg and looking at the alignment of the leg (correction of the posterior location) and the amount of anterior displacement compared to the other side

Posterior drawer test for PCL:

- Patient supine with the LE to be tested in a hook-lying position: foot resting on table and knee at 90° of flexion
- Patient simply relaxes in this position and PT sits on table (near foot) on side of the involved LE
- Place heel of both hands on the anterior aspect of the proximal lower leg, just below the tibiofemoral joint line
- Thumbs are directed upward to palpate the tibiofemoral joint line
- Fingers of both hands are wrapped around the lower leg, with the lateral aspect of the index finger of both hands **palpating the hamstrings to ensure they are relaxed**
- Once properly positioned, use both hands to apply a posteriorly directed force to the proximal aspect of lower leg
- Positive test = indicated by excessive posterior displacement or soft end-feel
- **Soft end-feel may be the most important indication of a PCL tear, because if the tibia is already sagging posteriorly at the start of the test, there may not be much additional posterior displacement when the force is applied (typically painfree if the PCL is completely torn)

Quadriceps extension test (active drawer test) for the PCL:

- Patient supine with LE to be tested in a hook-lying position: foot resting on table and knee at 90° of flexion.
- Sit on table (near foot) on the side of the involved LE and gently places both hands on the anterior aspect of the proximal lower leg, just below the tibiofemoral joint line
- Palpate the femoral condyles and anterior aspect of the tibial plateau with both index fingers.
- With patient relaxed, the tibial plateaus should be slightly anterior to the femoral condyles if the PCL is intact
- While the therapist maintains the foot of the leg tested on the table (preventing knee extension) the patient is asked to activate the quadriceps and gently try to extend the knee
- Quad contraction = tibial plateaus (felt with index fingers) should normally move posteriorly very slightly
- Torn PCL = the tibial plateau will move forward (anterior) due to its initial more posteriorly located position - which should have been felt by the therapist in the initial stage of the test.

<u>Anterior cruciate ligament</u>

Lachman test for ACL

- Patient supine with the LE to be tested supported with the knee at 15°- 20° of flexion
    - Easiest to support the thigh by placing the therapist's thigh under the distal thigh region of the patient
- Stabilize the femur with one hand placed on the anterior aspect of the distal thigh
- With the other hand placed on the medial aspect of the proximal end of the lower leg (thumb on anterior tibial tubercle and fingers wrapped around the posterior aspect of the lower leg), the proximal end of the lower leg is brought forward in a relatively fast manner
- Normally, there should be a small displacement of the lower leg followed by a firm abrupt stop
- ACL tear is likely when excessive mobility is noted accompanied by a soft end-feel at the end of displacement.
- The test is rarely painful even in the presence of an ACL tear
- The therapist should ensure that the hamstrings are relaxed during the test

Anterior drawer test for ACL

- Patient supine with the LE to be tested in a hook-lying position: foot resting on table and knee at 90° of flexion.
- The patient simply relaxes in this position
- Sit on the table at the level of the foot on the side of the involved lower extremity
- Place heel of both hands on the anterior aspect of the proximal lower leg, just below tibiofemoral joint line
- In this position, the thumbs are directed upward to palpate the tibiofemoral joint line and the fingers of both hands are wrapped around the lower leg, with the lateral aspect of the index finger of both hands palpating the hamstrings to ensure they are relaxed
- Once positioned, use both hands to apply an anteriorly directed force to proximal aspect of the lower leg
- Positive test = indicated by excessive anterior displacement or soft end-feel
- The test is rarely painful even in the presence of an ACL tear.

** For both tests, a false positive test (excessive movement with an intact ACL) may be possible if the pt has a PCL tear.

- In this situation, the more posterior initial position of the tibia on the femur may result in a greater amount of forward translation of the tibia during the test, giving the impression of an ACL tear
- But the end-feel should be firm - raising doubt as to the accuracy of the test
- Therefore, the integrity of the PCL should always be tested prior to testing for ACL tear to avoid this situation.

ANKLE TESTS

Circumference measurements (figure 8)

- **Figure 8 method =** most efficient manner to measure swelling at the ankle
  - Patient long sitting on the table with foot and ankle extending over the edge of table
  - Ankle held in neutral position
    - (1) Start distal to medial malleolus
    - (2) Over cuboid (just proximal to styloid process of 5th metatarsal)
    - (3) Lateral to medial direction wraps around medial aspect of foot over navicular tubercle
    - (4) Just distal to the lateral malleolus
  - Wrapped behind the ankle (over achilles tendon) toward its point of origin under the medial malleolus.
- **Alternative #1:** Swelling of lower leg can be measured using the tip of medial or lateral malleolus as a starting point from which circumferential measurements are made at regular 5 cm intervals moving proximally
- **Alternative #2:** Swelling of foot can be measured using specific bony landmarks
  - Around the metatarsal heads, mid-metatarsals, and around the foot over the cuboid
- ** If available, an alternative although more time consuming method, is to use volumetric measurements.

Plantar fasciitis

- **Palpation**:
  - Patient long-sitting on table with foot extending over the edge
  - Palpate insertion of plantar fascia on medial tubercle of the calcaneus (*may help to come from side)
  - Palpation can be done with the plantar fascia in a relaxed position (the ankle in relative PF) and by applying tension by passively bringing the ankle in DF by pushing on the MET heads
  - Pain with palpation of the plantar fascia near its insertion is an indication of plantar fasciitis
  - Severity of irritation corresponds to how far from the insertion pain is felt with palpation.
- **Simultaneous dorsiflexion of the ankle and toes**:
  - Patient long-sitting on table with the foot extending over the edge, passively bring the ankle in maximum DF by applying force under the metatarsal heads
  - Passively bring the hallux and toes in maximum DF = creates maximum tension of the fascia
  - Pain felt at insertion and/or along the plantar fascia indicates irritation of the structure
- ***Combination of both: palpation + passive DF of ankle/toes**

Tinel sign:

- Consists of gentle tapping over a peripheral nerve with finger tips
- Used to determine if pain or tingling is felt distal to the area that is being stimulated by tapping
- Pain or tingling felt distal to the site of tapping is considered indicative of nerve compression or healing
    - **Typically not involved unless diabetic neuropathy present:**
        - Anterior tibial branch of deep peroneal nerve: tap ankle just lateral to EHL tendon
        - Posterior tibial nerve: tap just behind the medial malleolus

Pulse: (*Be careful not to press too hard)

- Dorsalis pedis artery: Palpate over the dorsum of foot just lateral to the EHL tendon
- Posterior tibialis artery: Palpate just behind medial malleolus

Tap Test:

- Patient is long-sitting on table with foot extending beyond edge of table
- Use one hand to bring the ankle in near neutral position and heel of other hand to tap directly on the heel
    - Gentle manner at first with progressively more force if pain-free
- Pain with this test may indicate the presence of a fracture **or** sprain of distal tibiofibular ligaments

Anterior drawer test: This test is used to test the integrity of the anterior talofibular ligament

- Patient long-sitting on table with foot extending beyond edge of table (*PT stands on medial side)
- Use one hand to apply posteriorly directed force over anterior aspect of lower leg for stabilization
- Other hand grasps posterior aspect of calcaneus and forearm (same hand) brings the ankle to about 20° of PF
- Hand behind calcaneus applies an anterior (and lateral) directed force
- Indication of ligamentous injury would consist of: excessive displacement, soft end-feel, and pain
- **Alternative Test:**
    - Patient supine in hook lying position with knee flexed greater than 90°
    - Foot flat on the table with the ankle at about 20° of PF
    - Place one hand on dorsum of foot to stabilize
    - Use other hand to provide a posteriorly directed force on the anterior aspect of distal tibia
    - Posterior displacement of the tibia is judged for amount of displacement, firmness of end-feel, and pain
- **Note:** because deltoid ligament is on the medial side, the talus will NOT move straight forward (also lateral)
- **Note:** test should be performed with ankle in slight PF (possibly slight knee flexion) to avoid false negative from calf tightness
- Stress radiographs can be done with the anterior drawer test:
    - 3-5 mm of displacement is normal
    - 6-10 mm indicates that the anterior talofibular ligament is ruptured
    - > 10 mm indicates that the anterior talofibular ligament and the calcaneofibular ligament are ruptured

Varus stress (talar tilt test): The test if used to test the integrity of the calcaneofibular ligament

- Patient long-sitting on table with the foot extending beyond edge of table
- One hand applies force over the anterior aspect of the lower leg (**do not hold talus)** for stabilization
- Other hand grasps posterior aspect of calcaneus while forearm (same hand) bring the ankle to about 20° of PF
- Using hand behind the calcaneus, the calcaneus is inverted
- Indication of ligamentous injury would consist of excessive displacement, soft end-feel, and pain

Valgus stress (talar tilt test): The test if used to test the integrity of the deltoid ligament

- The patient is long-sitting on the table with the foot extending beyond the edge of the table
- Use one hand applying over the anterior aspect of the lower leg for stabilization
- Other hand grasps the posterior aspect of the calcaneus while the forearm of that same hand bring the ankle to about 20° of plantar flexion
- Using the hand behind the calcaneus, the calcaneus is everted
- Indication of injury to the deltoid ligament would consist of excessive displacement, soft end-feel, and pain.

Homan's test: tests for thrombophlebitis (blood clot) of deep (posterior tibialis) vein in the calf

- Patient long-sitting on table with knee in full extension
- **1st part:** Passively bring the ankle into DF and ask for reproduction of pain
    - Pain in the proximal calf region is a possible indication of blood clot
- **2nd part:** Ankle returned to resting position, gently squeeze calf and ask for reproduction of pain
    - Pain with squeezing the calf region is a possible indication of blood clot
- **Alternative:** apply deep pressure to the posterior aspect of the calf (*central proximal 1/3 of gastroc bellies)
- Possible indications of thrombophlebitis:
    - Hx of inactivity
    - Recent surgery along with pain at rest and LE swelling
    - Discoloration or coolness of LE
- Differential diagnosis should include:
    - Vascular claudication = c/o of calf pain with exercise
    - Sciatic nerve irritation = compression/distraction test; nerve tension test
    - Muscle strain = pain with resisted
    - Neurogenic intermittent claudication = stoop or Gelderen test; flexed posture relieves pain

Thompson: To assess integrity of Achilles tendon
- Patient prone on table with foot extending beyond edge of table
- Squeeze calf and look for plantar flexion of the ankle
- Absence of plantar flexion as the calf is squeezed indicates tear of the Achilles tendon
- **Alternative:** patient kneeling on a chair

Simmond's test: To assess integrity of Achilles tendon (partial tear)
- Patient prone on table with foot extending beyond edge of table
- Squeeze calf of and look for plantar flexion of the ankle
- Partial tear of the tendon = foot will deviate to the intact side as opposed to the ankle moving in straight PF
- **Alternative:** patient kneeling on a chair

Claudication:
- Exercise induced calf pain, typically occurs within a defined distance and relieved by rest
- No history of trauma, negative musculoskeletal examination for calf strain
- Positive stoop and van Gelderen tests **(*flexed posture does not relieve pain)**
- Patient should be referred for vascular studies (ultrasound, doppler arteriogram)

Morton's neuroma test:
- Patient supine on table with foot extending beyond edge of table
- Squeeze the forefoot region using one hand, causing compression between the 5 metatarsal heads
- Compression of an irritated interdigital nerve (Morton's neuroma) would cause pain
- Treatment: metatarsal pad underneath MET head
- **Alternative test:**
  - Test each interdigital nerve individually by grasping 2 adjacent metatarsal heads
  - Combination of compression and shear force is applied to each metatarsal space: apply pressure between adjacent metatarsal heads and move one metatarsal head vs other in a dorsal-plantar direction (shear)
  - Pain localized to interspace between metatarsal heads being tested

Compression of the tibia and fibula: To rule out fracture of the tibia and/or fibula
- Patient supine on table with the foot extending beyond edge of table
- Use heel of both hands to apply pressure on each side of the lower leg (*bends fibula = bone being tested)
- Compressive force applies stress to tibia and fibula - pain away from site of compression may indicate a fracture
- Compressive force applied to proximal 1/3 of lower leg and reapplied progressively more distally if pain-free
  - Never go closer than 4-5 inches

Myotomes: isometric resisted motion in neutral
C1 = neck rotation
C1-2 = neck flexion
C3 = neck lateral flexion
C4 = shoulder girdle elevation
C5 = biceps, shoulder abduction
C6 = wrist extension, brachioradialis
C7 = elbow extension, wrist flexion
C8 = thumb extension, wrist ulnar deviation
T1 = hand intrinsics (finger abd/add)

Dermatomes
C1 = superior aspect of cranium
C2 = occiput and sides of cranium
C3 = lateral aspect of neck
C4 = superior aspect of shoulder
C5 = deltoid area and lateral forearm
C6 = thumb and lateral forearm
C7 = middle finger (posterior aspect)
C8 = 5th finger and ulnar border of hand
T1 = medial forearm/arm region

CERVICAL SPINE TESTS

Distraction test
- Establish if the patient has pain or other symptoms just prior to that test (if so, where?)
  - symptoms at rest = distraction before compression
  - no symptoms at rest = compression before distraction
- Patient seated with therapist positioned behind
- Cup both hands under the mastoid process and apply gentle and progressive distraction lifting upward
- Hold for a few seconds
- Results:
  - Relief of pain or other symptoms – indicates the nerve root pressure has been removed and may point to a disc protrusion
  - Increased pain or other symptoms – may indicate injury to muscular, ligamentous, or capsular structure

Distraction Test (supine):
- Examiner grasps under the chin and occiput
  - Alternate hand placement: one hand under occiput, other hand over the forehead)
- Flex neck to position of comfort

- Gradually apply distraction force (14kg)
- Positive criteria: symptom diminuation

Compression Test
- Establish if the patient has pain or other symptoms just prior to that test
- Patient seated with therapist positioned behind
- Cup both hands over the head of the patient and apply gentle and progressive compressive force directly downward
- Neck in slight flexion to avoid backward bending of the spine during testing
    - would result in compressive force applied to the posterior facets and closure of the foramen
- Hold for a few seconds
- Results:
    - Increased pain or other symptoms: may indicate the nerve root pressure has been increased and there is a disc protrusion

Upper limb nerve tension test:
- Active test: "pointing high", "pointing low", "waiter tip", "carrying a tray"
- Always test unaffected side first
- Provide good support to help patient relax
- All tests are repeatable with:
    - Cervical spine laterally flexed in contralateral direction = ↑ symptoms, ↓ elbow extension
    - Cervical spine laterally flexed in ipsilateral direction = ↓ symptoms + ↑ elbow extension

ULNT 1 (median nerve) test
- Starting position:
    - Patient in supine with cervical spine in neutral position
    - Patient's shoulder is abducted slightly and resting on table
    - Elbow at 90º of flexion
    - Forearm, wrist, and fingers in neutral position
- Shoulder girdle is depressed by the therapist and stabilized by pressing fist into table
- Shoulder girdle is abducted to 110º or tissue tightness
- The wrist and finger are brought into extension
- The forearm is supinated
- The shoulder is brought to 90º of external rotation
- Progressively bring elbow into extension until pain reproduction
- Degree of elbow flexion is noted along with the amount, location, and type of pain/symptoms

ULNT 2 (median nerve) test
- Starting position: described for the patient's right arm
    - Patient lies slightly diagonal across table with shoulder just over the edge of the table to allow contact with therapist's thigh
    - Therapist's right hand holds patient's wrist
    - Therapist's left arm cradles and supports patient's forearm and elbow
- The shoulder girdle is passively depressed with shoulder in 10º ABD
- The elbow is extended
- The entire arm is externally rotated
- The wrist and fingers are extended
- The should is ABD up to 40º

ULNT 3 (radial nerve) test
- Starting Position: same ULNT 2
- The shoulder girdle is depressed with shoulder in 10º ABD
- Elbow extension
- Entire arm is internally rotated
- Wrist flexion
- * Thumb flexion + ulnar deviation prior to wrist flexion to increase tension in the radial nerve

ULNT 4 (ulnar nerve) test:
- Starting position: described for patient's left arm
    - Therapist in stride starting position
    - Therapist places left arm under patient's scapula and fingers reach from under to grasp patient's shoulder so that the shoulder girdle is depressed and the shoulder is abducted to 110º
- Shoulder external rotation
- Elbow flexion

- Wrist and finger extension
- Forearm pronation

Quadrant Test (foraminal compression test)

- Closure of the foraminal opening:
  - Ipsilateral rotation
  - Side bending
  - Extension
- Patient is asked to turn head to ~45º, side bend and extend in the same direction to end range
- Patient is asked if movement creates or increases symptoms
- Slight passive overpressure may be applied at end range is no pain
- Results:
  - Local cervical pain to the side of the test may indicate irritation/inflammation of the posterior facets
  - Pain or reproduction of symptoms in the distal upper extremity: may indicate irritation/compression of nerve root at the foramen

Spurling Test

- Patient is seated
- Neck is passively side-bent towards the symptomatic side
- Apply overpressure (~7 kg)
- Positive criteria: symptom reproduction

Vertebral Artery Test: test for vertebral artery (Barre-Lieu Syndrome) due to irritation or obstruction of vertebral artery

Blood supply to the brain:

1. Vertebral artery: provides blood more directly to the brain stem
   - Brain stem (autonomic) function: pupil size, dizziness, nausea
   - Originates from the subclavian artery
   - Travels through the foramen transversarium of C6 to the occiput
   - At C1, loops around before entering the foramen magnum (loop serves to dampen the arterial blood flow before entry into cranium)
   - Vertebral vein and nerve (sympathetic nerve fibers) travel with artety
2. Carotid artery: provides blood more directly to the cerebral cortex
   - Cerebral cortex function: motor, sensory, cognitive (memory, counting) function

Pre-screening:

1. Ask patient for symptoms of dizziness and/or fainting (esp. related to neck rotation or extension to end range)
2. Ask patient if they have suspected: visual disturbances, blurred vision, nausea, facial or intraoral numbness, tinnitus (ringing in the ears), diplopia (double vision), dysarthria (difficulty with speech), or dysphagia (difficulty swallowing)
3. Patient supine; turn head to the ® for 10 seconds
4. Ask patient for sensation of dizziness, fainting, nausea
5. Neutral for 10 sec
6. Turn head to L for 10 seconds
7. Neutral for 10 sec
8. Extension for 10 sec

Vertebral Artery Screening:

1. Explain test and tell patient to notify you if they feel dizzy, faint, nauseous
2. Explain that you will be asking them to keep their eyes open at all time and count backward from 10
3. Patient supine with head over edge of the table resting in your hands
4. Rotate to the end range, gently drop the head back into extension to end range
5. Ask the patient if they feel dizzy, faint, or nauseous
6. Ask patient to count backward from 10
7. Observe any signs or symptoms
   - Symptoms: nystagmus, vertigo, pupil dilation or constriction, headache, voice change, memory loss, fainting, patient reporting feeling faint, dizzy, or nauseous.
   - If any signs/symptoms are present: avoid neck extension and end range neck rotation
   - Refer patient to physician
8. Hold position for 15-30 secs, then REPEAT to other side

Mechanism of vertebral artery testing

- Interpretation #1: The test should not occlude blood flow; positive test indicates that blood flow of the artery tested was occluded
- Interpretation #2: The test does occlude blood flow on the side tested; occlusion of only one artery should not result in a positive test; a positive test implied inadequate blood flow from one or more of the other 3 arteries
- **Positive test:** patient must be seen by a physician for further vascular studies

Tectorial membrane/ligament: "Clunk Test – 3 stages"

- Patient in neutral supine posture
- Therapist cradles occiput with one hand and contracts forehead with other hand

- With all 3 tests in a normal anatomic condition, the end-feel will appear firm but arresting
- In the presence of pathomechanics of the tectorial ligament (due to laxity/tears): end-feel may be delayed, absent, or "spongy"
- **Positive test**: all 3 tests must feel delayed, absent, or "spongy"
    1. Stage 1: Neutral phase with LAD
        a. Position one hand under occiput, other hand on forehead
        b. Gently introduce a long axis distraction to sub-cranial region
        c. Be careful not to flex mid-cervical spine
    2. Stage 2: Flexion phase with LAD
        a. Apply gentle sub-cranial flexion/nodding
        b. Provide gentle long axis distraction
    3. Stage 3: Fixation of axis with LAD
        a. Therapist fixates axis with 1st and 2nd digits (soft/firm contact) by pinching the sides of C2 spinous process with one hand in a neutral head position
        b. Provide gentle increasing long axis distraction (more aggressive)

Alar Ligament: "Cranial Side Tilt"

- Good test for fracture of the dens
- Vertical axis of rotation = nose
- Attachments of alar ligament: C2 → occipital bones

1. Patient in neutral supine posture with therapist cradling the occiput with one hand and simultaneously contracting the R/L lateral aspects of C2 spinous process with the tips/pads of the 3rd digit
2. Gently introduce cranial side-tilt first to R and then L
3. Do not side bend through the mid-cervical spine
4. Repeat test in craniocervical flexion and extension
5. Results:
    a. Normal: the spinous process will instantaneously move *opposite* the side-tilting of the cranium into your finger tips (atlas rotates to the same side as side-bending)
    b. Ligamentous laxity or tear: rotational response of the atlas may be delayed or absent
6. **Positive test**: must be positive in all 3 positions to be fully positive

SHOULDER TESTS

Special Tests for the Rotator Cuff

Drop arm test:

- Passively bring the patient's arm to 90º of abduction
- Have the patient hold arm up
- Have patient slowly lower arm back down
- Inability to hold the arm up at 90º or slowly lower the arm may indicate a rotator cuff tear
- Make sure to spot the patient's arm throughout the movement in case of positive test

Supraspinatus test:

- STEP 1: Resist shoulder abduction at 90º of shoulder abduction (palm down)
- STEP 2: Resist shoulder abduction at 80º of shoulder abduction with shoulder medially rotated (thumb down) and 30º of horizontal adduction ("empty can test")
- Positive test: pain or weakness indicates irritation of the supraspinatus

Impingement test:

- The therapist is standing next to the patient on the side to be tested
- One hand is placed behind the patient's shoulder (on the scapula) to stabilize the patient and prevent rotation and extension of the trunk
- The other hand holds the arm behind the elbow to provide the passive force at the distal end of the humerus while controlling elbow flexion

- Passively elevate the arm in forward flexion and apply a gentle overpressure at the end range
- This action compresses the greater tuberosity against the anterior-inferior acromial surface
- Pain at end range indicates irritation of the supraspinatus or long head of the biceps
- Do this test first with the thumb (leading the movement)
- If pain free, the test can be performed again with the thumb down
- This causes further compression of the rotator cuff therefore increasing provaction on the structures
- The amount of arm elevation before pain is provoked and the 2 variations of the test can be used to monitor progress

Hawkins- Kennedy Impingement Test

- Stand in front of the patient
- Hold the patient's arm to 90º of shoulder flexion (neutral shoulder rotation) and the elbow bent to 90º
- With one hand supporting behind the elbow and the other around the wrist, passively internally rotate the shoulder to end range for reproduction of pain
- The shoulder can be slightly horizontally abducted to decrease the severity of the test
- The shoulder can be slightly horizontally adducted to increase the provocation of the test
- This test compresses the supraspinatus tendon against the coracoacromial ligament
- The amount of internal rotation before pain provocation and the amount of horizontal adduction to reproduce the pain can be used to monitor progress

Speed's Test

- To test for long head of biceps tendonitis
- The test is started with the shoulder at 90º of flexion and the forearm supinated (palm up)
- The elbow is slightly bent in flexion (10-20º)
- With the therapist applying resistance to the anterior aspect of the forearm, the patient initially resists the therapist with an isometric muscle action (simply matching the resistance), then the patient slowly allows the shoulder toward extension (eccentric – letting the therapist "win")
- It is important to have the elbow slightly bent and applying the resistance against the forearm to activate the long head of the biceps

Inferior (multidirectional) laxity

Sulcus sign

- The test is performed with the patient sitting "relaxed", the arm along his/her side
- The forearm should be supported on the patient's thigh to relax the long head of the biceps
- Make sure the patient is looking straight ahead (as opposed to looking at his/her shoulder)
- A downward pull is applied to the arm (just above the elbow) by the examiner
- It is important not to use the forearm because activation of the long head of the biceps would negate your test
- Observe a "sulcus" under the tip of the acromion as the arm is pulled down or palpate with the index finger located under the acromion

- Good test for general instability of the shoulder – this test specifically tests the superior glenohumeral ligament and superior capsule
    - 1+ = <1 cm displacement – less than a finger width (normal amount of displacement)
    - 2+ = 1-2 cm displacement – more than 1 finger width (excessive laxity)
    - 3+ = >2 cm displacement – 2 finger width or more (very excessive laxity)

Anterior Laxity:

- All three tests are performed with the patient supine, with the arm at 90º of abduction
- The upper arm should be supported by the table with the elbow extending just over the edge to allow full shoulder external rotation to occur
- Make sure the tip of the elbow is fairly level with the shoulder (not lower than the shoulder – use a towel under the distal end of the upper arm if needed)

1. Apprehension Test
    - With the shoulder starting in neutral rotation position, the shoulder is passively externally rotated to end range or to the point of apprehension of the patient
    - With this test, one hand should be supporting the elbow and the other hand supports the wrist
2. Relocation Test
    - The apprehension test is repeated-starting with the shoulder at 90º of abduction and in neutral rotation, but the hand which was used to support the elbow is now applying a posterior force over the head of the humerus before passive external rotation is performed
    - The relocation test is useful to confirm inability if the apprehension test is positive
    - If a positive apprehension test was present, applying pressure on the anterior aspect of the shoulder should eliminate or decrease the apprehension (and increase the amount of external rotation of the shoulder)

- ***Note that some individuals simply apply the posterior pressure at the end of the apprehension test to determine "relief" of the apprehension without returning to the start position

3. Fulcrum Test
   - The apprehension test is repeated – starting with the shoulder at 90º of abduction and in neutral rotation, but the hand which was used to support the elbow is now behind the proximal humerus acting as a fulcrum and promoting anterior displacement of the humeral head
   - The fulcrum test is useful to augment the apprehension test in a case where the apprehension test is negative or questionably positive
   - This test should increase the patient's apprehension and/or reduce the amount of external rotation before apprehension

Posterior Laxity
- The test is performed with the patient supine, arm at 90º of flexion (elbow bent)
- One hand of the therapist is behind the shoulder palpating along the posterior aspect of the gleniod rim, the other hand is over the elbow
- The therapist applies a posteriorly directed force along the long axis of the humerus
- Feel for excessive mobility and establish if patient is apprehensive to the test

SLAP/Labral Tears

Clunk Test:
- The test is performed with the patient supine, arm over 90º of abduction (the hand of the patient falls at the end of the table)
- Holding the elbow of the patient, the arm is rotated and circumducted (through ½ arcs 12-3 and 9-12) for reproduction of pain and "clunk"

Compressive test
- The test is performed with the patient supine, arm below 90º of abduction
- Similar to the clunk test, the arm is rotated and circumducted for reproduction of pain
- In this test – compression is applied through the long axis of the humerus

Active Compression Test
- STEP 1: Empty can test with the arm across the body in horizontal adduction (resist elevation)
- STEP 2: Redo with thumb up
- If the pain changes (less with thumb up) – the test may indicate a SLAP lesion
- If the pain does not change – likely to ACJ pain
- The concept is that pronation of the forearm with the thumb down would increase tension on the long head of the biceps

Thoracic Outlet Syndrome

Adson's
- Test the anterior and middle scalene muscles for thoracic outlet impingement
- The therapist places first palpates for the radial pulse
- Patient is asked to turn head towards the affected side and extend the head
- Therapist rotates and extends patient's shoulder, palpating for the radial pulse
- Patient is asked to take a deep breath and hold for 15-30 seconds
- Examiner feels for disappearance of pulse and asks the patient if there is reproduction of symptoms
- The key finding is reproduction of symptoms
- Loosing the radial pulse without reproduction of symptoms could be noted but is not considered to be a strong positive test

Allen Maneuver (hyperabduction test)- FOR THORACIC OUTLET
- Tests pectoralis minor tightness
- The therapist first palpates for the radial pulse
- Patient's arm is abducted to 135º and pulled back slightly
- The opposite hand of the therapist provides support behind the shoulder (over the scapula)
- Patient rotates head away from tested side
- The position is held for up to 30 seconds (minimum of 15 seconds)
- Examiner feels for disappearance of pulse and asks the patient if there is reproduction of the symptoms
- Thy key finding is reproduction of symptoms
- Loosing the radial pulse without reproduction of symptoms could be noted but is not considered to be a strong positive test

Costoclavicular syndrome test
- Patient assumes an exaggerated military position (ask the patient to first elevate the shoulder blades, then retract the shoulders, and finally to lower the shoulder blades down)

- The position is held for up to 30 seconds (minimum of 15 seconds)
- This maneuver narrows the costoclavicular space by approximating the clavicle to the 1st rib and compression the neurovascular structures
- Examiner feels for disappearance of pulse and asks the patient if there is reproduction of the symptoms
- The key finding is reproduction of symptoms
- Loosing the radial pulse without reproduction of symptoms could be noted but is not considered to be a strong positive test

Roos Test
- Patient is standing
- Have patient abduct and externally rotate both shoulder to 90º, with the elbows bent to 90º of flexion (the elbows must be slightly behind the frontal plane)
- In this position, the patient closes and opens their hands slowly and continuously for 3 minutes
- A positive test is indicated by the inability to hold test position for the duration of the test and/or ischemic pain, heaviness, profound weakness of the arm, and numbness and tingling of the hand
- The key is reproduction of symptoms on the affected side

Pectoralis major tightness
- Patient supine, hands behind head
- Start with the elbows pointing toward the ceiling and progressively move the elbows away from midline
- With normal flexibility, the elbow should be able to rest on the table with the arms parallel to the table surface
- The patient should be hook lying (supine knees bent) to eliminate lumbar lordosis

Pectoralis minor tightness
- Patient shows excessive rounded shoulder when supine or sitting
- With patient supine, simply observe the amount of elevation of the acromion off the table

ELBOW EXAM

Ligamentous instability test for the LCL
- Patient supine
- Stablize behind upper humerus just above joint line (keep hand on table)
- Apply a varus force to the proximal (flexed to 20º) to test the lateral (radial) collateral ligament
- Rotate humerus 10º laterally
- Examiner assesses amount of movement (laxity), end-feel, and pain

Ligamentous instability test for the RCL
- Patient supine

- Stablize behind upper humerus just above joint line (keep hand on table)
- Apply a valgus force to the proximal forearm (flexed to 20º) to test the medial (ulnar) collateral ligament
- Rotate humerus 10º medially
- Examiner assesses amount of movement (laxity), end-feel, and pain

3 Tests for **medial epicondylagia** (and palpation): contractile vs. inert structures

Test #1:
- Examiner passively stretches the wrist flexors and flexor digitorum superficialis by a combination of:
  - Elbow extension, forearm supination, and wrist extension
- Positive test: pain over the medial epicondyle
- Extend fingers to specifically test: flexor digitorum superficialis
  - Is there more pain?

Test #2:
- Starting position: 90º elbow flexion, forearm supinated, neutral wrist
- Resist wrist flexion with two fingers over palmar aspect of hand, stabilizing distal forearm
- Positive: pain over the medial epicondyle

Test #3:
- Tests: pronator teres
- Starting position: 90º elbow flexion, neutral forearm
- Resist: forearm pronation

4 Tests for **lateral epicondylagia** (and palpation)

Test #1:
- Tests: extensor carpi radialis brevis and extensor digitorum
- Examiner passively stretches the wrist extensors by a combination of:
  - Elbow extension, forearm pronation, and wrist flexion
- Positive test: pain over the lateral epicondyle
- Flex fingers to specifically test: extensor digitorum
  - Is there more pain?

Test #2:
- Starting position: 90º elbow flexion, forearm pronated, neutral wrist
- Resist wrist extension with two fingers over radial side of hand to isolate ECRB; stabilize distal forearm
- Positive test: pain over the lateral epicondyle

Test #3:
- Tests: Extensor digitorum communis (specifically extensor indicis)
- Starting position: 90º elbow flexion, forearm pronated, neutral wrist
- Resist: extension of 3rd finger over proximal phalanx
- Positive test: pain over lateral epicondyle

Test #4:
- Tests: Supinator
- Starting position: 90º elbow flexion, neutral forearm
- Resist: forearm supination

* You can also palpate the common insertion of the wrist extensors and supinator over and just distal to the lateral epicondyle for pain and tenderness

Perform Tinel's Sign for the ulnar nerve at the cubital groove
- By itself – does not tell you which nerve ("tapping over nerve")
- Tests the ulnar nerve in the groove between the olecranon and medial epicondyle
- Gently tap the ulnar nerve in the cubital fossa with elbow slightly bent
- Positive test: reproduction of symptoms; tingling/numbness in medial forearm and 4th/5th fingers
  - Indicates irritation of the ulnar nerve

Perform the elbow flexion test
- Test for: cubital tunnel syndrome
- The patient holds the elbow in full flexion for 5 minutes
  - Wrist extended + shoulder adducted and depressed to stretch brachial plexus (entire length of nerve)
    - Good test, but not specific to elbow
- Positive test indicated by: tingling or paresthesia in the ulnar nerve distribution

Perform the test for Wartenberg's sign

- Tests for: ulnar nerve neuropathy
- Positive test: Inability to squeeze the little finger to the remainder of the hand
- Expect atrophy of palmar interossei
- Extensor Digiti Minimi pulls 5th finger into abduction

Perform the pinch grip test

- Tests anterior interosseous nerve (a branch of the median nerve)
- It may become compressed as it passes between the two heads of the pronator muscle
- Patient is asked to pinch the tips of the index finger and thumb together
- Weak FPL and FDP
- Positive test: patient cannot pinch tip to tip, but rather pulp to pulp

Perform the test for pronator teres syndrome

- Tests: maximal compression of median nerve under pronator teres
- Starting position: 90º elbow flexion
- Passively take patient into full supination
- Examiner strongly resists pronation as the elbow is extended passively
    - Extension further stretches pronator teres (slight flexion potential at the elbow)
- Positive test indicated by: tingling or paresthesia in the median nerve distribution