Always at your side...

OrthoNotes
Clinical Examination Pocket Guide
Dawn Gulick

Includes...
- Wipe-free Forms
- Medical Red Flags
- Toolbox Tests
- Illustrated Special Tests
- Test Sensitivity & Specificity
- Differential Diagnosis
- Illustrated Pain Referral Patterns
- Illustrated Palpation Pearls
- Abbreviations & Symbols
- Pharmacologic Summary
<table>
<thead>
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### Have you ever experienced or been told you have any of the following conditions?

<table>
<thead>
<tr>
<th>Condition</th>
<th>Condition</th>
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<tbody>
<tr>
<td>Cancer</td>
<td>Chronic bronchitis</td>
</tr>
<tr>
<td>Diabetes</td>
<td>Pneumonia</td>
</tr>
<tr>
<td>High blood pressure</td>
<td>Emphysema</td>
</tr>
<tr>
<td>Fainting or dizziness</td>
<td>Migraine headaches</td>
</tr>
<tr>
<td>Chest pain</td>
<td>Anemia</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>Stomach ulcers</td>
</tr>
<tr>
<td>Blood clot</td>
<td>AIDS/HIV</td>
</tr>
<tr>
<td>Stroke</td>
<td>Hemophilia</td>
</tr>
<tr>
<td>Kidney disease</td>
<td>Guillain-Barré syndrome</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>Gout</td>
</tr>
<tr>
<td>Allergies (latex, food, drug)</td>
<td>Thyroid problems</td>
</tr>
<tr>
<td>Asthma</td>
<td>Multiple sclerosis</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>Tuberculosis</td>
</tr>
<tr>
<td>Rheumatic/scarlet fever</td>
<td>Fibromyalgia</td>
</tr>
<tr>
<td>Hepatitis/jaundice</td>
<td>Pregnancy</td>
</tr>
<tr>
<td>Polio</td>
<td>Hernia</td>
</tr>
<tr>
<td>Head injury/concussion</td>
<td>Depression</td>
</tr>
<tr>
<td>Epilepsy or seizures</td>
<td>Frequent falls</td>
</tr>
<tr>
<td>Parkinson’s disease</td>
<td>Bowel/bladder problems</td>
</tr>
<tr>
<td>Arthritis</td>
<td></td>
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</table>

### Have you ever had any of the following procedures?

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Procedure</th>
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</thead>
<tbody>
<tr>
<td>X-ray</td>
<td>Blood test(s)</td>
</tr>
<tr>
<td>CT scan</td>
<td>Biopsy</td>
</tr>
<tr>
<td>MRI</td>
<td>EMG or NCV</td>
</tr>
<tr>
<td>Bone scan</td>
<td>EKG or stress test</td>
</tr>
<tr>
<td>Urine analysis</td>
<td>Surgery</td>
</tr>
<tr>
<td>Normal Vital Signs &amp; Pathologies That Influence Them</td>
<td>Age</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td><strong>HR</strong></td>
<td>30-50</td>
</tr>
<tr>
<td><strong>RR</strong></td>
<td>10-20</td>
</tr>
<tr>
<td><strong>SBP</strong></td>
<td>&gt;85</td>
</tr>
<tr>
<td><strong>DBP</strong></td>
<td>&lt;130</td>
</tr>
</tbody>
</table>

**Increases Due to:**
- Infection, exercise, acute MI, anemia, anxiety, pain, blood sugar,
- Hematocrit, hemoglobin,
- Hyperkalemia, acute MI,
- Narcotics

**Decreases Due to:**
- Infection, exercise, acute MI, anemia, anxiety, pain, blood sugar,
- Hematocrit, hemoglobin,
- Hypokalemia, acute MI, anemia,
- Narcotics

**Deleterious Due To:**
- Infection, exercise, acute MI, anemia, anxiety, pain, blood sugar,
- Hematocrit, hemoglobin,
Signs/Symptoms of Emergency Situations

- SBP ≥180 mm Hg or ≤90 mm Hg
- DBP ≥110 mm Hg
- Resting HR >100 bpm
- Resting RR >30 bpm
- Sudden change in mentation
- Facial pain with intractable headache
- Sudden onset of angina or arrhythmia
- Abdominal rebound tenderness
- Black, tarry, or bloody stools

Generalized Systemic Red Flags

- Insidious onset with no known mechanism of injury
- Symptoms out of proportion to injury
- No change in symptoms despite positioning or rest
- Symptoms persist beyond expected healing time
- Recent or current fever, chills, night sweats, infection
- Unexplained weight loss, pallor, nausea, B&B changes (constitutional symptoms)
- Headache or visual changes
- Bilateral symptoms
- Pigmentation changes, edema, rash, nail changes, weakness, numbness, tingling, burning
- Psoas test for pelvic pathology = supine, SLR to 30° & resist hip flexion; (+) test for pelvic inflammation or infection is lower quadrant abdominal pain; hip or back pain is a (-) test
- Blumberg’s sign = rebound tenderness for visceral pathology—in supine select a site away from the painful area & place your hand perpendicular & push down deep & slow then lift up quickly; (−) = no pain; (+) = pain on release
- (+) McBurney’s point (appendix) = ⅓–⅓ the distance between the ASIS & umbilicus
- (+) Kehr’s sign (spleen) = violent L shoulder pain
# Visceral Innervation & Referral Patterns

<table>
<thead>
<tr>
<th>Segmental Innervation</th>
<th>Viscera</th>
<th>Referral Pattern(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3–5</td>
<td>Diaphragm</td>
<td>C-spine</td>
</tr>
<tr>
<td>T1–5</td>
<td>Heart</td>
<td>Anterior neck, chest, left UE</td>
</tr>
<tr>
<td>T4–6</td>
<td>Esophagus</td>
<td>Substernal &amp; upper abdominal</td>
</tr>
<tr>
<td>T5–6</td>
<td>Lungs</td>
<td>T-spine</td>
</tr>
<tr>
<td>T6–10</td>
<td>Stomach</td>
<td>Upper abdomen &amp; T-spine</td>
</tr>
<tr>
<td></td>
<td>Pancreas</td>
<td>Upper abdomen, low T-spine, &amp; upper L-spine</td>
</tr>
<tr>
<td></td>
<td>Bile duct</td>
<td>Upper abdomen, mid T-spine</td>
</tr>
<tr>
<td>T7–9</td>
<td>Gallbladder</td>
<td>Right UQ, right T-spine</td>
</tr>
<tr>
<td></td>
<td>Liver</td>
<td>Right T-spine</td>
</tr>
<tr>
<td>T7–10</td>
<td>Small intestine</td>
<td>Mid T-spine</td>
</tr>
<tr>
<td>T10–11</td>
<td>Testes/Ovaries</td>
<td>Lower abdomen &amp; sacrum</td>
</tr>
<tr>
<td>T10–L1</td>
<td>Kidney</td>
<td>L-spine, abdomen</td>
</tr>
<tr>
<td>T10–L1</td>
<td>Uterus</td>
<td>T/L &amp; L/S junction</td>
</tr>
<tr>
<td>S2–4</td>
<td>Prostate</td>
<td>Sacrum, testes, T/L jctn</td>
</tr>
<tr>
<td>T11–L2, S2–4</td>
<td>Ureter</td>
<td>Groin, suprapubic, medial thigh</td>
</tr>
<tr>
<td></td>
<td>Bladder</td>
<td>Sacral apex, suprapubic</td>
</tr>
</tbody>
</table>
Early Warning Signs of Cancer

"CAUTIONS" = Red Flags of Cancer

| C | Change in bowel & bladder lasting longer than 7–10 days |
| A | A sore that fails to heal in 6 weeks |
| U | Unusual bleeding or discharge |
| T | Thickening/lump (breast or elsewhere) |
| I | Indigestion, difficulty swallowing, early satiety |
| O | Obvious change in wart or mole |
|   | ■ A = Asymmetrical shape |
|   | ■ B = Border irregularities |
|   | ■ C = Color—pigmentation is not uniform |
|   | ■ D = Diameter >6 mm (bigger than a pencil eraser) |
|   | ■ E = Evolution (change in status) |
| N | Nagging cough or hoarseness (rust-colored sputum) |
| S | Supplemental signs/symptoms |
|   | ■ 10–15 lb wt loss in 10–14 days |
|   | ■ Changes in vital signs |
|   | ■ Frequent infections (respiratory or urinary) |
|   | ■ + change in DTRs |
|   | ■ + proximal muscle weakness |
|   | ■ + night pain |
|   | ■ + pathologic fracture |
|   | ■ >45 years old |

Cardiovascular Signs to Discontinue Exercise

- Resting HR <40 or >130
- Irregular pulse; palpitations
- > 6 arrhythmias per hour
- Blood glucose >250 mg/dL
- O₂ saturation <90%
- Temp >100°F
- SBP >250 or DBP >120 mm Hg
- Fall in SBP >10 mm Hg
- Cognitive changes
- Cold, clammy, cyanotic
- PO₂ <60; hemoglobin <8 g/dL
- Dyspnea; orthopnea
- Dizziness, syncope
- Bilateral leg or foot edema
- Chest pain (with or without UE radiation)
- Isolated biceps or mid-thoracic pain in females
Signs & Symptoms of Specific Organ Pathology

**Pulmonary**

- Cough with or without blood
- Sputum
- SOB or DOE
- Clubbing of nails
- Chest pain
- Wheezing
- Pain with deep inspiration
- Pain ↑ when recumbent & ↓ on involved side
- ↓ O₂ saturation
- Signs of a PE
  - Pleural pain
  - SOB
  - Rapid RR
  - Rapid HR
  - Coughing up blood

**Hepatic**

- □ UQ pain
- Weight loss
- Ascites/LE edema
- Carpal tunnel syndrome (bilateral)
- Intermittent pruritus
- Weakness & fatigue
- Dark urine/clay-colored stools
- Asterixis (liver flap) = flapping tremor resulting from the inability to maintain wrist extension with forearm supported
- Jaundice, bruising, yellow sclera of the eye
- Pain referral to T-spine between scapula, □ shoulder, □ upper trap, □ subscapular region
Gastrointestinal

- Epigastric pain with radiation to the back
- Blood or dark, tarry stool
- Fecal incontinence or urgency
- Tenderness @ McBurney’s point
- Pain/symptoms that change with eating
- Nausea, vomiting, bloating
- Diarrhea or absence of bowel movement
- Food may help or aggravate symptoms
- Weight loss, loss of appetite

Renal

- (+) Murphy’s test = percussion over kidney
- Fever; chills
- Blood in urine (hematuria)
- Cloudy or foul-smelling urine
- Painful or frequent urination
- Pain is constant (stones)
- Back pain at the level of the kidneys
- Costovertebral angle tenderness

Prostate

- Men >50 yo
- Difficulty starting or stopping urine flow
- Change in frequency
- Nocturia
- Incontinence/dribbling
- PSA level >4 ng/mL
- Sexual dysfunction
Gynecological

- Cyclic pain
- Abnormal bleeding
- Nausea, vomiting
- Vaginal discharge
- Chronic constipation
- Low BP (blood loss)
- Missed or irregular periods

Tasks That May Aggravate & Incriminate Visceral Pathology

- GB = forward bending
- Kidney = lean to affected side
- Pancreas = sit up or lean forward
- Esophagus = swallowing
- GI = eating
- Heart = cold air or exertion
- Renal = side bending away from involved side

Signs & Symptoms of Hyperglycemia

- Blood glucose >180 mg/dL
- Skin is dry & flushed
- Fruity breath odor
- Blurred vision
- Dizziness
- Weakness
- Nausea
- Vomiting
- Cramping
- Increased urination
- LOC/seizure
Signs & Symptoms of Hypoglycemia

- Blood glucose <50–60 mg/dL
- Skin is pale, cool, diaphoretic
- Disoriented or agitated
- Headache
- Slurred speech
- Tachycardic
- LOC

Asthmatic Response(s)

- Coughing, wheezing
- Substernal chest tightness
- Use of accessory muscles of respiration
- RR >24 bpm
- Peak flow <80% predicted or baseline value
- After an asthma attack, FEV1 peak flow should ↑ by >15% within 5 min of use of inhaler

Signs & Symptoms of Marfan’s Syndrome (inherited autosomal dominant disorder)

- Disproportionately long arms, legs, fingers, & toes (tall—lower body longer than upper body)
- Long skull with frontal prominence
- Kyphoscoliosis
- Pectus chest (concave)
- Slender ↓ sub-q fat
- Weak tendons, ligaments, & joint capsules with joint hypermobility
- Defective heart valves = murmur
- High incidence of dissecting aortic aneurysm
- Hernia
- Sleep apnea
- Dislocation of eye lens; myopia
- “Thumb sign” = oppose the thumb across the palm, if tip of thumb extends beyond the palm, the test is (+)
**Signs & Symptoms of Depression**

- Sadness; frequent/unexplained crying
- Feelings of guilt, helplessness, or hopelessness
- Suicide ideations
- Problems sleeping
- Fatigue or decreased energy; apathy
- Loss of appetite; weight loss/gain
- Difficulty concentrating, remembering, & making decisions

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**Signs & Symptoms of Lyme’s Disease**

*Note:* This is a multisystemic inflammatory condition. The transmission of the tick spirochete takes ~ 48 hrs. Blood work is used to confirm the disease, not to diagnose it. Clinician should r/o GBS, MS, & FMS.

**Early Localized Stage**

- Rash with onset of erythema within 7–14 days (range is 3–30 days)
- Rash may be solid red expanding rash or a central spot with rings (Bull’s-eye)
- Average diameter of rash is 5”–6”
- Rash may or may not be warm to palpation
- Rash is usually not painful or itchy
- Fever
- Malaise
- Headache
- Muscle aches
- Joint pain

**Early Disseminated Stage**

- ≥ 2 rashes not @ the bite site
- Migrating pain
- Headache
- Stiff neck
- Facial palsy
- Numbness/tingling into extremities
- Abnormal pulse
- Sore throat
- Visual changes
### Alerts/Alarms
- 100°–102° fever
- Severe fatigue

### Late Stage
- Arthritis of 1–2 larger joints
- Neurological changes—disorientation, confusion, dizziness, mental “fog,” numbness in extremities
- Visual impairment
- Cardiac irregularities

## Dementia Scales

<table>
<thead>
<tr>
<th>Score</th>
<th>Maximum</th>
<th>Task</th>
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</table>
| 5     | 5       | **Orientation:**
|       |         | What is the (year) (season) (date) (day) (month)?
|       |         | Where are we (state) (country) (town) (building) (floor)? |
| 3     |         | **Registration:**
|       |         | Name 3 objects: 1 second to say each. Ask the patient all 3 after you have said them.
|       |         | Give 1 pt for each correct answer. Repeat them until he/she learns all 3.
|       |         | Count & record trials: ________ |
| 5     |         | **Attention & Calculation:**
|       |         | Serial 7s. Score 1 point for each correct answer. Stop after 5 answers.
|       |         | (Alternative question: Spell “world” backward.) |
| 3     |         | **Recall:**
|       |         | Ask for the 3 objects repeated above. Give 1 point for each correct answer. |
| 2     |         | **Language:**
| 1     |         | Name a pencil & watch. |
| 3     |         | Repeat the following, “No, ifs, ands, or buts.” |
| 1     |         | Read & obey the following: “Close your eyes.” |
| 1     |         | Write a sentence. |
| 1     |         | Copy the design shown: |
| 30    |         | **Total score** (Normal ≥24) |
### Deep Tendon Reflexes

<table>
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<tr>
<th>Grade</th>
<th>Response</th>
<th>Jendrassik’s Maneuver</th>
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<tbody>
<tr>
<td>0</td>
<td>Absent; areflexia</td>
<td>For UE = patient crosses LEs at ankles &amp; then isometrically abducts LEs</td>
</tr>
<tr>
<td>1+</td>
<td>Decreased; hyporeflexia</td>
<td>For LE = patient interlocks fingertips &amp; then isometrically pulls elbows apart</td>
</tr>
<tr>
<td>2+</td>
<td>Normal</td>
<td></td>
</tr>
<tr>
<td>3+</td>
<td>Hyperactive; brisk</td>
<td></td>
</tr>
<tr>
<td>4+</td>
<td>Hyperactive with clonus</td>
<td></td>
</tr>
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</table>

### Cranial Nerves

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Function</th>
<th>Test</th>
</tr>
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<tbody>
<tr>
<td>I. Olfactory</td>
<td>Smell</td>
<td>Identify odors with eyes closed</td>
</tr>
<tr>
<td>II. Optic</td>
<td>Vision</td>
<td>Test peripheral vision with 1 eye covered</td>
</tr>
<tr>
<td>III. Oculomotor</td>
<td>Eye movement &amp; pupillary reaction</td>
<td>Peripheral vision, eye chart, reaction to light</td>
</tr>
<tr>
<td>IV. Trochlear</td>
<td>Eye movement</td>
<td>Test ability to depress &amp; adduct eye</td>
</tr>
<tr>
<td>V. Trigeminal</td>
<td>Face sensation &amp; mastication</td>
<td>Face sensation &amp; clench teeth</td>
</tr>
<tr>
<td>VI. Abducens</td>
<td>Eye movement</td>
<td>Test ability to abduct eye past midline</td>
</tr>
<tr>
<td>VII. Facial</td>
<td>Facial muscles &amp; taste</td>
<td>Close eyes &amp; smile; detect various tastes—sweet, sour, salty, bitter</td>
</tr>
<tr>
<td>VIII. Vestibulocochlear (Acoustic)</td>
<td>Hearing &amp; balance</td>
<td>Hearing; feet together, eyes open/closed x 5 sec; test for past-pointing</td>
</tr>
<tr>
<td>IX. Glossopharyngeal</td>
<td>Swallow, voice, gag reflex</td>
<td>Swallow &amp; say “ahh” Use tongue depressor to elicit gag reflex</td>
</tr>
<tr>
<td>X. Vagus</td>
<td>Swallow, voice, gag reflex</td>
<td></td>
</tr>
<tr>
<td>XI. Spinal Accessory</td>
<td>SCM &amp; trapezius</td>
<td>Rotate/SB neck; shrug shoulders</td>
</tr>
<tr>
<td>XII. Hypoglossal</td>
<td>Tongue mov’t</td>
<td>Protrude tongue (watch for lateral deviation)</td>
</tr>
</tbody>
</table>
**MEDIAN NERVE TEST**

**Position:** Supine or sitting with contralateral cervical SB & ipsilateral shoulder depressed  
**Technique:** Extend UE in plane of scapula with elbow extended, forearm supinated, & wrist/fingers extended  
**Interpretation:** + test = pain or paresthesia into median nerve distribution of UE  
**Statistics:** Sensitivity = 94%; specificity = 22%

**RADIAL NERVE TEST**

**Position:** Supine or sitting with contralateral cervical SB & ipsilateral shoulder depressed  
**Technique:** Extend UE with elbow extended, forearm pronated, wrist flexed, & fingers extended  
**Interpretation:** + test = pain or paresthesia into radial nerve distribution of UE  
**Statistics:** Sensitivity = 97%; specificity = 33%

**ULNAR NERVE TEST**

**Position:** Supine or sitting with ipsilateral shoulder depressed  
**Technique:** Abduct shoulder to 90° with ER, flex elbow, pronate forearm, extend wrist/fingers in an attempt to place the palm of the hand on the ipsilateral ear  
**Interpretation:** + test = pain or paresthesia into ulnar nerve distribution of UE
Brachial Plexus

- Axillary nerve
- Radial nerve
- Musculocutaneous nerve
- Median nerve
- Ulnar nerve

C4
C5
C6
C7
T1
Axillary Nerve

Musculocutaneous Nerve
Radial Nerve
Median Nerve
Lumbosacral Plexus

Iliohypogastric nerve

Ilioinguinal nerve

Lateral cutaneous nerve of thigh

Genitofemoral nerve

Femoral nerve

Lumbosacral trunk

Sciatic nerve

Posterior cutaneous nerve of thigh

Obturator nerve

Inferior rectal nerve

Dorsal nerve of penis

Pudendal nerve

Perineal nerve
Femoral, Obturator, Sciatic, Tibial, & Common Peroneal Nerve

- Femoral nerve
- Obturator nerve
- Sciatic nerve
- Common peroneal nerve
- Tibial nerve
- Posterior branch
- Anterior branch
Deep & Superficial Peroneal Nerves

Common peroneal nerve

Deep peroneal nerve

Superficial peroneal nerve

Common peroneal nerve
# Pharmacologic Summary by Drug Classification

## Nonnarcotic Analgesic

### Indications
- Pain, fever

### Generic Name

### Adverse Reactions
- Doses > 15g are toxic to liver & kidney; may be fatal
- May be fatal if consuming ≥ 3 glasses of alcohol/day
- Alcohol = ↓ risk of liver damage (not recommended)
- Caffeine = ↓ analgesic effects
- Warfarin = ↓ anticoagulant effect
- Barbiturates = ↑ effects & ↓ liver toxicity

### Interactions

<table>
<thead>
<tr>
<th>Brand Names</th>
<th>Generic Name</th>
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<tbody>
<tr>
<td>Tempra</td>
<td>Acetaminophen</td>
</tr>
<tr>
<td>Acetophen</td>
<td>Panadol</td>
</tr>
<tr>
<td>Lidiprifen</td>
<td>Anacin-3</td>
</tr>
<tr>
<td>Tylenol</td>
<td>Acetaminophen</td>
</tr>
</tbody>
</table>

### Nonnarcotic Analgesic

### Indications
- Pain, fever

### Generic Name

### Adverse Reactions
- Upset stomach, rash, bruising, anemia
- Doses > 15g are toxic to liver & kidney; may be fatal
- May be fatal if consuming ≥ 3 glasses of alcohol/day
- Alcohol = ↑ risk of liver damage (not recommended)
- Barbiturates = ↑ effects & ↓ liver toxicity
- Caffeine = ↑ analgesic effects
- Warfarin = ↓ anticoagulant effect
- Alcohol = ↑ risk of liver damage (not recommended)

### Interactions

<table>
<thead>
<tr>
<th>Brand Names</th>
<th>Generic Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tempra</td>
<td>Acetaminophen</td>
</tr>
<tr>
<td>Acetophen</td>
<td>Panadol</td>
</tr>
<tr>
<td>Lidiprifen</td>
<td>Anacin-3</td>
</tr>
<tr>
<td>Tylenol</td>
<td>Acetaminophen</td>
</tr>
<tr>
<td>Generic name</td>
<td>Adverse Reactions</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Acetylsalicylic acid (ASA)</td>
<td>• abdominal pain, coughing</td>
</tr>
<tr>
<td>Ibuprofen</td>
<td>• anti-inflammatory reaction, anxiety, hematomas, edema, edema, urinary retention, seizures, cardiac arrhythmias, MI</td>
</tr>
<tr>
<td>Sulindac</td>
<td></td>
</tr>
<tr>
<td>Meloxicam (preferential inhibition of COX-2 over COX-1)</td>
<td></td>
</tr>
</tbody>
</table>

**Ant-Infammatoty doses > Analgesic doses**

**Indications** = RA, OA, JRA, pain, fever, prevent thrombosis, reduce risk of MI, TIA, CVA
### Indications
- RA, OA, JRA, pain, fever, prevent thrombosis, reduce risk of MI, TIA, CVA

### Anti-inflammatory doses are > analgesic doses

### Adverse Reactions
- Tinnitus, GI, rash, edema, pruritus, hepatitits
- Dizziness, h/a, erythema, rash, h/a, dizziness
- GI, rash, edema, ecchymoses, rash, h/a, dizziness
- Not recommended for children

### Interactions
- Naproxen, Naproksen, Anaprox
- Acetaminophen, ibuprofen, celecoxib
- Alemtuzumab, cyclosporine, probucol, valproic acid
- Rouve isolated, endothelial cells, and platelets
- Not recommended for children

### Generic Name (Brand names)
- Piroxicam (Feldene)
- Diflunisal (Dolobid)
- Naproxen (Naprosyn)
- Flecainide

### Exercise concerns
- Negative effect on myogenesis & regeneration (anabolic effects)
- Greater risk of GI bleeding than other NSAIDs
- Not recommended for children

### nephrotoxicity
- Can produce acute renal failure with lithium
- Can produce acute renal failure with used
- Less severe extent than nonselective (Brand names)
- Can ↓ BP (COX-2 inhibitors) to plaixi, & heparin
- With aminoglycosides, heparin, & warfarin, Lw-doses aspirin
- Can ↑ cardiotrophic effects of all NSAIDs

### Anti-inflammatory activity
- Aminosalicylates, sulfasalazine, COX-2 inhibitors, opioid analgesics
- NSAIDs:
  - Can ↓ cardioprotective effects of low-dose aspirin
  - Can ↑ risk of bleeding when used
  - Can ↑ neurotoxicity when used
  - Can ↑ BP (COX-2 inhibitors) to plaixi, & heparin
### Analgesic & NSAID—cont’d

**Indications:** RA, OA, JRA, pain, fever, prevent thrombosis, reduce risk of MI, TIA, CVA

Anti-inflammatory doses are > analgesic doses

<table>
<thead>
<tr>
<th>Nephrotoxicity</th>
<th>Peripheral edema</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are gastrointestinal &amp; can produce</td>
<td>Dyspepsia, h/a, dizziness, insomnia, tinnitus,</td>
</tr>
<tr>
<td>can produce acute renal failure</td>
<td>Not recommended for children</td>
</tr>
<tr>
<td>can produce acute renal failure</td>
<td></td>
</tr>
<tr>
<td>can produce acute renal failure with use with</td>
<td></td>
</tr>
<tr>
<td>a lesser extent than nonsteroid (NSAIDs)</td>
<td></td>
</tr>
<tr>
<td>can ↓ BP (COX-2 inhibitors ↓ BP to</td>
<td></td>
</tr>
<tr>
<td>Plavix, Nexium</td>
<td></td>
</tr>
<tr>
<td>with vitamin E, warfarin,</td>
<td></td>
</tr>
<tr>
<td>can ↓ risk of bleeding when used</td>
<td></td>
</tr>
<tr>
<td>low-dose aspirin</td>
<td></td>
</tr>
<tr>
<td>Can ↑ cardioprotective effects of</td>
<td></td>
</tr>
<tr>
<td>All NSAIDs:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interactions</th>
<th>Adverse Reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>H/A, drowsy, dizziness, nausea, GI, consti</td>
<td></td>
</tr>
<tr>
<td>Diarrhea, blurred vision,</td>
<td></td>
</tr>
<tr>
<td>NSAIDs, diarrhea, CHF, dizziness, ↓ BP,</td>
<td></td>
</tr>
<tr>
<td>Not recommended for children</td>
<td></td>
</tr>
<tr>
<td>Not recommended for children</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exercise concerns: Negative effect on myogenesis &amp; regeneration (anabolic effects)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ondansetron</td>
</tr>
<tr>
<td>Ketorolac</td>
</tr>
<tr>
<td>Ketoprofen</td>
</tr>
<tr>
<td>Indomethacin</td>
</tr>
<tr>
<td>Indocin</td>
</tr>
<tr>
<td>Etoricoxib</td>
</tr>
<tr>
<td>Lodine</td>
</tr>
<tr>
<td>Indomethacin</td>
</tr>
<tr>
<td>All NSAIDs:</td>
</tr>
<tr>
<td>Can ↓ cardioprotective effects of</td>
</tr>
<tr>
<td>Can ↓ cardioprotective effects of</td>
</tr>
<tr>
<td>Can ↓ nephrotoxicity &amp; can produce</td>
</tr>
<tr>
<td>Can produce acute renal failure</td>
</tr>
<tr>
<td>Can produce acute renal failure with use with</td>
</tr>
<tr>
<td>a lesser extent than nonsteroid (NSAIDs)</td>
</tr>
<tr>
<td>Can ↓ BP (COX-2 inhibitors ↓ BP to</td>
</tr>
<tr>
<td>Plavix, Nexium</td>
</tr>
<tr>
<td>with vitamin E, warfarin,</td>
</tr>
<tr>
<td>Can ↓ risk of bleeding when used</td>
</tr>
<tr>
<td>low-dose aspirin</td>
</tr>
<tr>
<td>Can ↑ cardioprotective effects of</td>
</tr>
<tr>
<td>All NSAIDs:</td>
</tr>
</tbody>
</table>
**Analgesic & NSAID—cont’d**

**Indications** = RA, OA, JRA, pain, fever, prevent thrombosis, reduce risk of MI, TIA, CVA

**Ant-inflammatory doses are > analgesic doses**

<table>
<thead>
<tr>
<th>Interactions</th>
<th>Adverse Reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AII NSAI DS</strong></td>
<td><strong>AII NSAID:</strong></td>
</tr>
<tr>
<td>nephrotoxicity</td>
<td></td>
</tr>
<tr>
<td>Are gastric irritants &amp; can produce</td>
<td>Can produce acute renal failure</td>
</tr>
<tr>
<td>a lesser extent than nonselectives (e.g., can ↓ BP with COX-2 inhibitors)</td>
<td>Can ↓ BP with lithium</td>
</tr>
<tr>
<td>Can ↓ neuro toxicity when used</td>
<td>Can ↓ neuro toxicity when used</td>
</tr>
<tr>
<td>with gastric irritants &amp; side effects of low-dose aspirin</td>
<td>with gastric irritants &amp; side effects of low-dose aspirin</td>
</tr>
</tbody>
</table>

**Interactions**

- Diclofenac (Voltaren, Cataflam)
- Nabumetone (Relafen)
- Celecoxib (Celebrex)
- Gabapentin (Neurontin)
- Carbamazepine (Tegretol)

**Adverse Reactions**

- **Generic name**
- **Brand name(s)**
- **Most frequent are bolded**

**Exercise concerns:** Negative effect on myogenesis & regeneration (anabolic effects), i.e., may delay muscle healing

**Negative effect on myogenesis & regeneration (anabolic effects), i.e., may delay**

- **Not recommended for children**
- **Not recommended for children**
- **Not recommended for children**

- **H/A, GI, dizziness, hypotension**
- **H/A, dyspnea, diaphoresis**
- **H/A, dizziness, high BP, edema, dizziness**
- **H/A, GI, dizziness, edema, dizziness**

- **Nephrotic px, GI, pyrexia, dizziness**
- **Nephrotic px, GI, pyrexia, dizziness**

**Indications = RA, OA, JRA, pain, fever, prevent thrombosis, reduce risk of MI, TIA, CVA**

**Antihypertensive doses are > analgesic doses**

**Interactions**

- Diclofenac (Voltaren, Cataflam)
- Nabumetone (Relafen)
- Celecoxib (Celebrex)
- Gabapentin (Neurontin)
- Carbamazepine (Tegretol)

**Adverse Reactions**

- **Generic name**
- **Brand name(s)**
- **Most frequent are bolded**
**Narcotic Analgesics: APAP = Acetaminophen**

### Indication = Pain

<table>
<thead>
<tr>
<th>Adverse Reactions</th>
<th>Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Depression</strong></td>
<td>MAO inhibitors = ↓ effects</td>
</tr>
<tr>
<td><strong>Dizziness, nausea, pruritus</strong></td>
<td>CNS depression = ↓ effects</td>
</tr>
<tr>
<td><strong>Nausea, vomiting, SOB, pruritus</strong></td>
<td><strong>Tolerance after 2 wks</strong></td>
</tr>
<tr>
<td><strong>Constitutional, pruritus, rash</strong></td>
<td><strong>Increased CNS depression</strong></td>
</tr>
<tr>
<td><strong>Lightheaded, dizziness, nausea, pruritus</strong></td>
<td>Tylenol #3</td>
</tr>
</tbody>
</table>

**Exercise concerns:** Reduced exercise capacity due to respiratory depression especially with COPD, especially with COPD.

**Alerts/Alarms:**
- Muscle relaxers = ↓ CNS effects
- ALL opioids are addicting; withdrawal symptoms may appear in 6–10 hours & last 5 days. Symptoms may include body aches, diarrhea, fever, gooseflesh, insomnia, irritability, loss of appetite, nausea, vomiting, runny nose, shivering, & stomach cramps.

**Interactions:**
- Antihistamines, antipsychotics, or antianxiety agents = ↑ CNS depression
- Antipsychotics, antianxiety agents, or Anticholinergics with codeine = paralytic
- Alcohol = CNS depression
- Antipsychotics, antidepressants, or Antihistaminics, antipsychotics, or CNS depressants

**Adverse reactions:**
- Dizziness, nausea, pruritus
- Nausea, vomiting, SOB, pruritus
- Dysphoria, dizziness, rash, pruritus
- Constipation, pruritus, rash
- Hypotension, rash
- Vomiting, pruritus
- Constipation, pruritus, rash
- Loss of appetite, nausea, vomiting, SOB, pruritus
- Constipation, pruritus, rash
- All opioids are addicting; withdrawal symptoms may appear in 6–10 hours & last 5 days. Symptoms may include body aches, diarrhea, fever, gooseflesh, insomnia, irritability, loss of appetite, nausea, vomiting, runny nose, shivering, & stomach cramps.

**Should not be taken with MAO inhibitors:**
- **Tylenol**
- **Perocetre**
- **APAP/Codeine**

**Warnings:**
- Muscle relaxers = ↓ CNS effects
- ALL opioids are addicting; withdrawal symptoms may appear in 6–10 hours & last 5 days. Symptoms may include body aches, diarrhea, fever, gooseflesh, insomnia, irritability, loss of appetite, nausea, vomiting, runny nose, shivering, & stomach cramps.

**Interactions:**
- Antihistamines, antipsychotics, or antianxiety agents = ↑ CNS depression
- MAO inhibitors = ↓ effects
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- Alcohol = CNS depression
- Antipsychotics, antidepressants, or Anticholinergics with codeine = paralytic
- Antihistaminics, antipsychotics, or CNS depressants

**Adverse reactions:**
- Dizziness, nausea, pruritus
- Nausea, vomiting, SOB, pruritus
- Dysphoria, dizziness, rash, pruritus
- Constipation, pruritus, rash
- All opioids are addicting; withdrawal symptoms may appear in 6–10 hours & last 5 days. Symptoms may include body aches, diarrhea, fever, gooseflesh, insomnia, irritability, loss of appetite, nausea, vomiting, runny nose, shivering, & stomach cramps.

**Should not be taken with MAO inhibitors:**
- **Tylenol**
- **Perocetre**
- **APAP/Codeine**

**Warnings:**
- Muscle relaxers = ↓ CNS effects
- ALL opioids are addicting; withdrawal symptoms may appear in 6–10 hours & last 5 days. Symptoms may include body aches, diarrhea, fever, gooseflesh, insomnia, irritability, loss of appetite, nausea, vomiting, runny nose, shivering, & stomach cramps.
### Narcotic Analgesic: ASA = Aspirin

<table>
<thead>
<tr>
<th>Generic name (Brand names)</th>
<th>Indication = Pain</th>
<th>Adverse reactions (Most frequent are bolded)</th>
<th>Interactions (All interaction effects of ASA apply)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASA/codeine**</td>
<td>ASA/oxycodone</td>
<td>ASA/paracetamol</td>
<td>ASA/propoxyphene</td>
</tr>
<tr>
<td>Empirin with codeine</td>
<td>Percodan</td>
<td>Percodan</td>
<td>Percodan</td>
</tr>
<tr>
<td>Take with food</td>
<td>Take with food</td>
<td>Take with food</td>
<td>Take with food</td>
</tr>
</tbody>
</table>

**Exercise concerns: Negative effects on myogenesis & regeneration (anabolic effects)**

- Lightheadedness, nausea, dizziness, vomiting, euphoria, pruritus, apnea, constipation, circulatory depression, hemorrhage, hypotension
- Dizziness, nausea, vomiting, euphoria, pruritus, apnea, constipation, tinnitus, ha, vomiting, pruritus, rash

**Take with food:**

- NSAIDs = peptic ulcers
- Alcohol = CNS depression
- Muscle relaxants = CNS effects, impairment of CNS functions
- Anticoagulants, phenothiazines, tranquilizers, methotrexate, or sulfonamides = ↑ effects
- Analgesics, phenothiazines, tranquilizers, or alcohol = ↑ CNS depression, impairment of CNS functions
- ACE inhibitors = ↓ pain relief
- Angiotensin-converting enzyme (ACE) inhibitors = ↓ pain relief
- NSAIDs = ↑ peptic ulcers
- Methotrexate = ↑ toxicity
- Methotrexate = ↑ toxicity

*ALL opioids are addicting; withdrawal symptoms may appear in 6–10 hours & last 5 days. Symptoms may include body aches, diarrhea, fever, gooseflesh, insomnia, irritability, loss of appetite, nausea, vomiting, runny nose, shivering, & stomach cramps.

**Should not be taken with MAO inhibitors.**
### Muscle Relaxers/Antispasmodics

**Indications**
- Manage spasticity (muscle tone), reduce muscle guarding

**Generic name**
- Adverse reactions (Most frequent are bolded)
- Interactions

<table>
<thead>
<tr>
<th>Brand name</th>
<th>Adverse reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baclofen, Lioresal</td>
<td>Drowsiness, dry mouth, dizziness, confusion, transient visual hallucinations</td>
</tr>
<tr>
<td>Carisoprodol, Soma</td>
<td>Drowsiness, pain, phlebitis at injection site, dizziness, constipation</td>
</tr>
<tr>
<td>Diazepam, Valium</td>
<td>Drowsiness, dry mouth, dizziness, arrhythmias, confusion, transient visual hallucinations</td>
</tr>
<tr>
<td>Tizanidine, Zanaflex</td>
<td>Drowsiness, dry mouth, dizziness, weakness, confusion, vomiting, Drowsiness, nausea, dizziness</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Brand name</th>
<th>Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baclofen</td>
<td>CNS depressants or alcohol = additive effect</td>
</tr>
<tr>
<td>Carisoprodol</td>
<td>CNS depressants or alcohol = additive effect</td>
</tr>
<tr>
<td>Diazepam, Valium</td>
<td>CNS depressants or alcohol = additive effect</td>
</tr>
<tr>
<td>Tizanidine, Zanaflex</td>
<td>CNS depressants or alcohol = additive effect</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Brand name</th>
<th>Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baclofen, alcohol, or other CNS depressant</td>
<td>CNS depressants or alcohol = additive effect</td>
</tr>
<tr>
<td>CNS depressants or alcohol</td>
<td>CNS depressants or alcohol = additive effect</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Brand name</th>
<th>Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baclofen</td>
<td>Drowsiness, dry mouth</td>
</tr>
<tr>
<td>Carisoprodol</td>
<td>Drowsiness, dry mouth</td>
</tr>
<tr>
<td>Diazepam, Valium</td>
<td>Drowsiness, dry mouth</td>
</tr>
<tr>
<td>Tizanidine, Zanaflex</td>
<td>Drowsiness, dry mouth</td>
</tr>
</tbody>
</table>

**Interactions**
- CNS depressants or alcohol = additive effect
- CNS depressants or alcohol = additive effect
- CNS depressants or alcohol = additive effect
- CNS depressants or alcohol = additive effect

**CNS depressants or alcohol = additive effect**
- Smoker or effects may occur = may cause depression
- MAO inhibitors or Tramadol = may cause depression
- CNS depressants or alcohol = additive effect
- CNS depressants or alcohol = additive effect
- CNS depressants or alcohol = additive effect
- CNS depressants or alcohol = additive effect
- CNS depressants or alcohol = additive effect

**Adverse reactions**
- Dry mouth, UTI, dizziness, Bradycardia, Somnolence, Sedation, Hypotension, Hypotension
- Drowsiness, pain, phlebitis at injection site, Drowsiness, dry mouth, dizziness
- Drowsiness, dizziness, confusion, transient visual hallucinations
- Drowsiness, dry mouth, dizziness, confusion, transient visual hallucinations
- Drowsiness, dry mouth, dizziness, confusion, transient visual hallucinations
- Drowsiness, dry mouth, dizziness, confusion, transient visual hallucinations

**Exercise concerns: Interferes with strengthening goals**
- Exercise concerns: Interferes with strengthening goals

**Contraindication**
- Contraindication

**Additional information**
- Interactions
- Contraindication

**Additional information**
- CNS depressants or alcohol = additive effect
- CNS depressants or alcohol = additive effect
- CNS depressants or alcohol = additive effect
- CNS depressants or alcohol = additive effect

**Adverse reactions**
- CNS depressants or alcohol = additive effect
- CNS depressants or alcohol = additive effect
- CNS depressants or alcohol = additive effect
- CNS depressants or alcohol = additive effect

**Generic name**
- Antispasmodics
**Indication** = High BP

<table>
<thead>
<tr>
<th>ACE Inhibitors</th>
<th>Generic name</th>
<th>Adverse reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACE Inhibitors</td>
<td>Captopril</td>
<td>Cough, hemoptysis, pruritus, dizziness, dry cough, h/a, fatigue, diarhrea, nausea</td>
</tr>
<tr>
<td></td>
<td>Quinapril</td>
<td>Cough, h/a, fatigue, dizziness, dry cough, h/a, fatigue, diarhrea, nausea</td>
</tr>
<tr>
<td></td>
<td>Fosinopril</td>
<td>Weakness, dry cough, h/a, fatigue, back pain, rash, dizziness, h/a, nausea</td>
</tr>
<tr>
<td></td>
<td>Monopril</td>
<td>Weakness, dry cough, h/a, fatigue, diarhrea, nausea</td>
</tr>
<tr>
<td></td>
<td>Zestril</td>
<td>Dizziness, nasal congestion, dry cough, h/a, rash, dizziness, h/a, fatigue, diarrhea</td>
</tr>
<tr>
<td></td>
<td>Prinivil</td>
<td>Dizziness, nasal congestion, dry cough, h/a, rash, fatigue, back pain, dry cough, h/a, nausea</td>
</tr>
<tr>
<td></td>
<td>Lisinopril</td>
<td>Dizziness, nasal congestion, dry cough, h/a, rash, fatigue, back pain, dry cough, h/a, nausea</td>
</tr>
<tr>
<td></td>
<td>Enalapril</td>
<td>Weakness, dry cough, h/a, fatigue, diarhrea, nausea</td>
</tr>
<tr>
<td></td>
<td>Capoten</td>
<td>Weakness, dry cough, h/a, fatigue, back pain, rash, dizziness, h/a, nausea</td>
</tr>
<tr>
<td></td>
<td>Captopril</td>
<td>Weakness, dry cough, h/a, fatigue, back pain, rash, dizziness, h/a, nausea</td>
</tr>
</tbody>
</table>

**Interactions**

- **Antacids** = ↑ effects
- **Digoxin** = ↑ digoxin levels
- **Insulin** = ↑ hypoglycemia
- **NSAIDs** = ↑ antihypertensive effects
- **Diuretics or Phenothiazines** = Hypotension
- **Digoxin** = ↓ digoxin levels
- **Antacids** = ↓ effects

**Exercise concerns:** No effect on exercise capacity
**ACE Receptor Blockers**

**Indication:** High BP

<table>
<thead>
<tr>
<th>Interactions</th>
<th>Adverse Reactions</th>
</tr>
</thead>
</table>
| Dizziness, h/a, runny nose, URI | Dizziness, h/a, weakness, fatigue,
| | chest pain, diarrhea, anemia, flu-like |

Due to ↑ K+ levels, should not be taken with K+-containing supplements, salt substitutes, or K+-sparing diuretics.

*NSAIDs & ASA = antiinflammatory effects*

<table>
<thead>
<tr>
<th>Most frequent are (brand names)</th>
<th>Generic name</th>
</tr>
</thead>
</table>

| Losartan | Cozaar |

<table>
<thead>
<tr>
<th>Intsequential</th>
<th>Losartan K+ &amp; Cozaar</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVAPRO</td>
<td>IRBESARTAN</td>
</tr>
</tbody>
</table>

Exercise concerns: No effect on exercise capacity.

- Stomach, sore throat, UTI, vomiting
- Headache, fatigue, nausea, upset
- Anxiety, chest pain, diarrhea, dizziness

<table>
<thead>
<tr>
<th>Losartan K+• Cozaar</th>
<th>Candesartan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dizziness, h/a, fatigue, chest pain, diarrhea, anemia, flu-like</td>
<td>Dizziness, h/a, weakness, fatigue, chest pain</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exercise concerns: No effect on exercise capacity</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Dizziness, h/a, runny nose, URI</th>
</tr>
</thead>
</table>

**ACE Receptor Blockers**

**Indication = High BP**
### Indication = Angina

<table>
<thead>
<tr>
<th>Generic name</th>
<th>Adverse reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diltiazem, Verapamil</td>
<td>Dizziness, h/a, fatigue, nausea, flushing, rash, 1° heart block</td>
</tr>
<tr>
<td>Calcium Channel Blockers</td>
<td>Le edema, dizziness, nausea, flushing, rash, constipation, hypotension, AV block</td>
</tr>
</tbody>
</table>

### Interactions

- Digoxin: elevated digitalis levels
- Anesthetics: ↑ anesthetic effects & depression of cardiac contractility
- Cyclosporine: ↑ cyclosporine level
- Diazepam: ↑ CNS depression
- Beta-blockers: hypotension, AV block

### Exercise concerns: Drugs may cause arthralgia/myalgia that may negatively influence exercise capacity

- SLR's weak = drug effect
- Ginkgo or grapefruit juice = effects
- Beta blockers = hypotension
- Cimetidine = ↓ plasma level of nifedipine
- Fenitoin = severe hypotension
- Antunginals or erythromycin = effects

### rare edema, nausea

- Dizziness, h/a, fatigue, nausea, flushing, rash, constipation, hypotension, AV block

### When combined with another antihypertensive = hypotension

- When combined with an alpha blocker = hypotension & reflex

### Verapamil:

- Dizziness, h/a, fatigue, nausea, flushing, rash, constipation, hypotension, AV block

### Nifedipine:

- Le edema, dizziness, nausea, flushing, rash, constipation, hypotension, AV block
### Beta Blockers/Antihypertensives

**Indications**
- Angina
- Arrhythmias
- Hypertension

**Generic name**

**Adverse reactions** (Most frequent are bolded)

<table>
<thead>
<tr>
<th>Drug Name</th>
<th>Adverse Reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propranolol</td>
<td>Lightheaded, rash, bronchospasm, palpitations, dizziness, nausea, fatigue, abdominal cramping, rash, Raynaud’s, hypertension, headache, tachycardia, chest pain, bradycardia, hypotension, rigidity, vertigo, blurred vision, impotence, dry mouth, flushing, impotence, hypotension, lightheadedness, nausea, rash, bronchospasm, palpitations, dizziness, fatigue, abdominal cramping, rash, Raynaud’s, hypertension, headache, tachycardia, chest pain, bradycardia, hypotension, rigidity, vertigo, blurred vision, impotence, dry mouth, flushing</td>
</tr>
<tr>
<td>Atenolol</td>
<td>Hypotension, rash, bronchospasm, palpitations, dizziness, nausea, fatigue, abdominal cramping, rash, Raynaud’s, hypertension, headache, tachycardia, chest pain, bradycardia, hypotension, rigidity, vertigo, blurred vision, impotence, dry mouth, flushing</td>
</tr>
<tr>
<td>Timolol</td>
<td>Hypotension, rash, bronchospasm, palpitations, dizziness, nausea, fatigue, abdominal cramping, rash, Raynaud’s, hypertension, headache, tachycardia, chest pain, bradycardia, hypotension, rigidity, vertigo, blurred vision, impotence, dry mouth, flushing</td>
</tr>
<tr>
<td>Metoprolol</td>
<td>Hypotension, rash, bronchospasm, palpitations, dizziness, nausea, fatigue, abdominal cramping, rash, Raynaud’s, hypertension, headache, tachycardia, chest pain, bradycardia, hypotension, rigidity, vertigo, blurred vision, impotence, dry mouth, flushing</td>
</tr>
<tr>
<td>Labetalol</td>
<td>Hypotension, rash, bronchospasm, palpitations, dizziness, nausea, fatigue, abdominal cramping, rash, Raynaud’s, hypertension, headache, tachycardia, chest pain, bradycardia, hypotension, rigidity, vertigo, blurred vision, impotence, dry mouth, flushing</td>
</tr>
</tbody>
</table>

**Interactions**

<table>
<thead>
<tr>
<th>Drug Name</th>
<th>Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSAIDs</td>
<td>→ antihypertensive effect</td>
</tr>
<tr>
<td>Verapamil</td>
<td>→ additive effects</td>
</tr>
<tr>
<td>Cimetidine</td>
<td>↓ ibuprofen plasma levels</td>
</tr>
<tr>
<td>MAC inhibitors, cimetidine, hydralazine, calcium channel blockers or prazosin</td>
<td>↓ hypotension</td>
</tr>
<tr>
<td>Cardioactive glycosides</td>
<td>↓ = severe bradycardia</td>
</tr>
</tbody>
</table>

**Warning**

- Should not be taken with MAO inhibitors

**Other effects**

- ↑ LDL cholesterol, bradycardia, fatigue, dizziness, nausea, rash, bronchospasm, palpitations, dizziness, nausea, fatigue, abdominal cramping, rash, Raynaud’s, hypertension, headache, tachycardia, chest pain, bradycardia, hypotension, rigidity, vertigo, blurred vision, impotence, dry mouth, flushing

**Other drugs**

- Epinephrine = severe peripheral vasoconstriction
- Insulin = hypoglycemia
- Phenothiazines = adverse reactions
- NSAIDs = additive effects
- ACE inhibitors = additive effects
- Diuretics = additive effects
- Acetaminophen = additive effects

**Additional information**

- Metoprolol | Toprol
- Lopressor
- Propranolol
- Inderal
- InnoPran
- Tenormin
- Blocadren
- Metoprolol
- Timolol
- Atenolol
- Leotiron
- Verapamil
- Propafenone
- Indorphan
- Prazosin
### Antilipemics

**Indications**: Reduce LDL, total cholesterol, & triglyceride levels

**Generic name**

**Adverse reactions**

- **Most frequent are bolded**

**Interactions**

- Atorvastatin • Lipitor
  - Exercise concerns: Muscle weakness & cramping, myalgia
  - Constipation, muscle pain, flatulence, ↑ liver transaminase, dyspepsia, rhabdomyolysis
  - Constipation, muscle pain, flatulence, ↑ plasma level of atorvastatin
  - Antacids = ↓ plasma level of atorvastatin
  - Digoxin or erythromycin = ↓ plasma level of atorvastatin

- Antilipemics
  - Exercise concerns: Muscle weakness & cramping, myalgia
  - Constipation, muscle pain, flatulence, ↑ liver transaminase, dyspepsia, rhabdomyolysis
  - Constipation, muscle pain, flatulence, ↑ plasma level of atorvastatin
  - Antacids = ↓ plasma level of atorvastatin
  - Digoxin or erythromycin = ↓ plasma level of atorvastatin

### Antihypertensives—cont’d

**Indications = Angina, arrhythmias, hypertension**

**Generic name**

**Adverse reactions**

**Interactions**

- Carvedilol • Coreg
  - Exercise concerns: As a result of a blunting of HR, exercises to 20 bpm above resting HR; beta blockers mask symptoms of & delay recovery from hypoglycemia
  - ↑ LDL cholesterol, asthenia, dizziness, fatigue, hypotension, diarrhea, hyper-glycemia, wt gain, URI
  - May produce bronchoconstriction in patients with asthma or chronic bronchitis

- NSAIDs = anti hypertensive effect
  - Disulfiram = ↑ anti hypertensive effect
  - CYP450: channel blockers = conduction
  - MAO inhibitors = Bradycardia & BP ↓
  - Carvedilol = ↓ carvedilol plasma levels

- Cimetidine = ↓ carvedilol plasma levels

- Carvedilol • Coreg
  - LDL cholesterol, asthenia, dizziness, ↓

- MAO inhibitors = Bradycardia, hypertension, diarrhea, hyper-Glycemia, wt gain, URI

- Beta Blockers/Antihypertensives—cont’d

- BPG = ↑ plasma level of BCP

- *May produce bronchoconstriction in patients with asthma or chronic bronchitis*

- *Beta Blockers/Antihypertensives—cont’d*
## Diuretics

### Indications = Edema, hypertension

### Adverse reactions = (Most frequent are bolded)

<table>
<thead>
<tr>
<th>Generic name</th>
<th>(Brand names)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furosemide (loop diuretic)</td>
<td>Lasix</td>
</tr>
<tr>
<td>Diuretics</td>
<td></td>
</tr>
<tr>
<td>Thiazide</td>
<td>Losil</td>
</tr>
<tr>
<td>K+sparing</td>
<td>Aldactone</td>
</tr>
<tr>
<td>Lasix</td>
<td>Zaroxolyn</td>
</tr>
<tr>
<td>Loop &amp; thiazide diuretic</td>
<td>Sun = photosensitivity</td>
</tr>
<tr>
<td>Risk of hypotension &amp; arrhythmias</td>
<td>Loop + thiazide diuretic</td>
</tr>
<tr>
<td>Risk of hypotension</td>
<td></td>
</tr>
<tr>
<td>Hypokalemia, muscle cramps,</td>
<td>Cardiac arrhythmias</td>
</tr>
<tr>
<td>Hypocalcemia, cardiac arrhythmias</td>
<td></td>
</tr>
<tr>
<td>Dizziness, muscle weakness, cramps,</td>
<td></td>
</tr>
<tr>
<td>Thirst, hyperglycemia, stomach discomfort</td>
<td></td>
</tr>
<tr>
<td>Dehydration, muscle cramps, hypokalemia, hypocalcemia</td>
<td></td>
</tr>
<tr>
<td>Dizziness, weakness, fatigue, h/a, diarrhea, dry mouth, muscle cramps</td>
<td></td>
</tr>
<tr>
<td>Exercise concerns: Diminished exercise performance; limited muscle endurance; volume depletion; 2° hypokalemia</td>
<td></td>
</tr>
</tbody>
</table>

### Interactions

- Antihypertensives or Ca++ channel blocker = ↑ risk of hypotension & arrhythmias
- Loop + thiazide diuretic = ↑ risk of hypotension
- NSAIDs = inhibit diuretic response
- Cardiac glycosides = ↑ risk of digoxin toxicity
- Sun = photosensitivity
- Cardiac arrhythmias with K+ loss

### K+ sparing

| Thiazide | Hydrodiuril |
| Lozol | Furosemide |

<p>| Diuretics | |
| K+sparing | Diuretics |
| Diuretics | |
| K+sparing | Diuretics |
| Diuretics | |
| K+sparing | Diuretics |
| Diuretics | |
| K+sparing | Diuretics |
| Diuretics | |
| K+sparing | Diuretics |
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| K+sparing | Diuretics |
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| K+sparing | Diuretics |
| Diuretics | |
| K+sparing | Diuretics |
| Diuretics | |
| K+sparing | Diuretics |
| Diuretics | |</p>
<table>
<thead>
<tr>
<th>Indication</th>
<th>Adverse Reactions</th>
<th>Interactions</th>
</tr>
</thead>
</table>

**Antidepressants**

- **Indication**: Depression, OCD, anxiety
- **Generic name**
- **Adverse reactions**
  - Drowsiness, dizziness, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Seizures, tachycardia, drapes, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Insomnia, agitation, dry mouth, tremor, abnormal dreams, headache, nausea, constipation, vomiting,
  - Tachycardia, arrhythmia, seizures, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Vision, weight gain, seizures, phototoxicity, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Seizures, tachycardia, drapes, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Insomnia, agitation, dry mouth, tremor, abnormal dreams, headache, nausea, constipation, vomiting,
  - Tachycardia, arrhythmia, seizures, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Vision, weight gain, seizures, phototoxicity, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
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  - Insomnia, agitation, dry mouth, tremor, abnormal dreams, headache, nausea, constipation, vomiting,
  - Tachycardia, arrhythmia, seizures, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Vision, weight gain, seizures, phototoxicity, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Seizures, tachycardia, drapes, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Insomnia, agitation, dry mouth, tremor, abnormal dreams, headache, nausea, constipation, vomiting,
  - Tachycardia, arrhythmia, seizures, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Vision, weight gain, seizures, phototoxicity, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Seizures, tachycardia, drapes, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Insomnia, agitation, dry mouth, tremor, abnormal dreams, headache, nausea, constipation, vomiting,
  - Tachycardia, arrhythmia, seizures, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Vision, weight gain, seizures, phototoxicity, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Seizures, tachycardia, drapes, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Insomnia, agitation, dry mouth, tremor, abnormal dreams, headache, nausea, constipation, vomiting,
  - Tachycardia, arrhythmia, seizures, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Vision, weight gain, seizures, phototoxicity, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Seizures, tachycardia, drapes, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Insomnia, agitation, dry mouth, tremor, abnormal dreams, headache, nausea, constipation, vomiting,
  - Tachycardia, arrhythmia, seizures, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Vision, weight gain, seizures, phototoxicity, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Seizures, tachycardia, drapes, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Insomnia, agitation, dry mouth, tremor, abnormal dreams, headache, nausea, constipation, vomiting,
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  - Tachycardia, arrhythmia, seizures, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Vision, weight gain, seizures, phototoxicity, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
  - Seizures, tachycardia, drapes, dry mouth, confusion, urinary retention, blurred vision, tachycardia,
### Antidepressants—cont'd

<table>
<thead>
<tr>
<th>Indication</th>
<th>Adverse Reactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression, OCD, anxiety</td>
<td>Nervousness, somnolence, insomnia, fatigue, h/a, tremor, dizziness, Insom-</td>
</tr>
<tr>
<td></td>
<td>nia, somnolence, dry mouth, nausea,</td>
</tr>
<tr>
<td></td>
<td>diarrhea, anorexia, nausea,</td>
</tr>
<tr>
<td></td>
<td>anxiety, drowsiness, h/a, tremor,</td>
</tr>
<tr>
<td></td>
<td>Beta blockers, heart block, Bradycardia</td>
</tr>
</tbody>
</table>

**Indication = Depression, OCD, anxiety**

<table>
<thead>
<tr>
<th>Generic name</th>
<th>Brand name (Most frequent are bolded)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoxetine*</td>
<td>Prozac</td>
</tr>
<tr>
<td>Sertraline*</td>
<td>Zoloft</td>
</tr>
</tbody>
</table>

**Exercise concerns:** Improved motor performance following ischemic stroke

<table>
<thead>
<tr>
<th>Interactions</th>
<th>Warfarin = ↑ bleeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>St John’s Wort = serotonin syndrome</td>
<td></td>
</tr>
<tr>
<td>MAO inhibitors, tinnitus, insomnia, or</td>
<td></td>
</tr>
<tr>
<td>Benzodiazepines = ↓ effects</td>
<td></td>
</tr>
</tbody>
</table>

**Adverse Reactions:**

- Suicidal behavior, akathisia
- Diarrhea, male sexual dysfunction
- Fatigue, h/a, tremor, dizziness, Insom-

**Interactions:**

- **Beta blockers = heart block, Bradycardia**
- **Warfarin = ↑ bleeding**
- **St John’s Wort = serotonin syndrome**
- **MAO inhibitors, tinnitus, insomnia, or**
- **Benzodiazepines = ↓ effects**

*Should not be taken with MAO inhibitors.*
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Decongestants, Antihistamines, & Bronchodilators

Indications = Bronchospasms, COPD, emphysema

Generic name
Adverse reactions
(Brand names) (Most frequent are bolded)
Interactions
Albuterol
Tremor, nervousness, h/a, hyperactiv- CNS stimulant = ↑ CNS effects
MAO inhibitors or antidepressants = ↑ adverse
• Proventil
ity, tachycardia, nausea, vomiting,
• Ventolin
muscle cramps, hypocalcemia, cough, CV effects
Beta blockers = contraindicated, may cause
• Brethine
hyperglycemia
bronchoconstriction
Beta blockers = contraindicated, may cause
Pirbuterol
Tremor, nervousness, dizziness,
• Maxair
tachycardia, nausea, vomiting, cough, bronchoconstriction
MAO inhibitors or antidepressants = ↑ effects
hyperglycemia
Beta blockers = contraindicated, may cause
Nasopharyngitis, URI, h/a, tremor,
Salmeterol
bronchoconstriction
nausea, nervousness, tachycardia,
• Serevent
MAO inhibitors or antidepressants = ↑ risk of
myalgia
discus
severe CV effects
Exercise concerns: Diminished exercise performance; limited muscle endurance; systemic administration
may ↑ hyperglycemia

ALERTS/
ALARMS


Abbreviations & Symbols Specific to Orthopedics

Please note:
This list is not comprehensive and is subject to modification by various facilities to meet the needs of their patient population.

á . . . . . . . . . . . before
A . . . . . . . . . . . assistance
AAA . . . . . . . . . . . abdominal aortic aneurysm
AAROM . . . . . . . active, assistive range of motion
Abd . . . . . . . . . . . abduction
ABG . . . . . . . . . . . arterial blood gases
ACL . . . . . . . . . . . anterior cruciate ligament
A.C. . . . . . . . . . . before meals
Add . . . . . . . . . . . adduction
ADLs . . . . . . . . . . . activities of daily living
ad lib . . . . . . . . . . as desired
AE . . . . . . . . . . above elbow
AFib . . . . . . . . . . . atrial fibrillation
AFO . . . . . . . . . . . ankle foot orthosis
AK . . . . . . . . . . above knee
AMA . . . . . . . . . . against medical advice
amb . . . . . . . . . . ambulation
ANS . . . . . . . . . . . autonomic nervous system
AP . . . . . . . . . . . anterio-posterior
APL . . . . . . . . . . . abductor pollicis longus
ARD . . . . . . . . . . adult respiratory distress
AROM . . . . . . . active range of motion
ASA . . . . . . . . . . . aspirin
ASCVD . . . . . . . arteriosclerotic cardiovascular disease
ASIS . . . . . . . . . . anterior superior iliac spine
ATFL . . . . . . . . . . anterior talofibular ligament
A-V . . . . . . . . . . . arterio-venous
B . . . . . . . . . . . . . bilateral
BBB . . . . . . . . . . . bundle branch block
B&B . . . . . . . . . . . bowel & bladder
BE . . . . . . . . . . . below elbow
BID . . . . . . . . . . . twice daily
BK . . . . . . . . . . . . below knee
BMI . . . . . . . . . . . body mass index
BMR . . . . . . . . . . . basal metabolic rate
BM . . . . . . . . . . . .bowel movement
BOS . . . . . . . . . . . .base of support
BP . . . . . . . . . . . .blood pressure
BRP . . . . . . . . . . . .bathroom privileges
BS . . . . . . . . . . . .breath sounds
BUN . . . . . . . . . . . .blood urea nitrogen
Bx . . . . . . . . . . . .biopsy
č . . . . . . . . . . . . . .with
Ca++ . . . . . . . . . . . .calcium
CA . . . . . . . . . . . .cancer
CABG . . . . . . . . . . . .coronary artery bypass graft
CAD . . . . . . . . . . . .coronary artery disease
CBC . . . . . . . . . . . .complete blood count
CC . . . . . . . . . . . .chief complaint
CCE . . . . . . . . . . . .clubbing, claudication, edema
CHF . . . . . . . . . . . .congestive heart failure
CHI . . . . . . . . . . . .closed head injury
CKC . . . . . . . . . . . .closed kinetic chain
CN . . . . . . . . . . . .cranial nerve
CNS . . . . . . . . . . . .central nervous system
c/o . . . . . . . . . . . .complaints of
CO . . . . . . . . . . . .cardiac output
COPD . . . . . . . . . . . .chronic obstructive pulmonary disease
CP . . . . . . . . . . . .cerebral palsy
CP . . . . . . . . . . . .chest pain
CPK . . . . . . . . . . . .creatine phosphokinase
CPM . . . . . . . . . . . .continuous passive motion
CPP . . . . . . . . . . . .closed packed position
CPR . . . . . . . . . . . .cardiopulmonary resuscitation
CSF . . . . . . . . . . . .cerebral spinal fluid
CT . . . . . . . . . . . .computed tomography
CTS . . . . . . . . . . . .carpal tunnel syndrome
Ctx . . . . . . . . . . . .cervical traction
CVA . . . . . . . . . . . .cerebral vascular accident
CXR . . . . . . . . . . . .chest x-ray
D/C . . . . . . . . . . . .discharge
DDD . . . . . . . . . . . .degenerative disc disease
DDX . . . . . . . . . . . .differential diagnosis
DF . . . . . . . . . . . .dorsiflexion
DIP . . . . . . . . . . . .distal interphalangeal
DJD . . . . . . . . . . . .degenerative joint disease
ALERTS/
ALARMS

DM ............diabetes mellitus
DNR ............do not resuscitate
DOB ............date of birth
DOE ............dyspnea on exertion
DPT ............diphtheria, pertussis, tetanus
DSD ............dry sterile dressing
DTR ............deep tendon reflexes
DVT ............deep vein thrombosis
Dx .............diagnosis
EAA ............essential amino acids
BL .............estimated blood loss
EEG ............electroencephalogram
ECK, EKG .......electrocardiogram
EMG ............electromyogram
ENT .............ear, nose, throat
EOMI ............extra-ocular motion intact
EPB ............extensor pollicis brevis
ER .............external rotation
ESR ............erythrocyte sedimentation rate
ETOH ...........ethyl alcohol
ev ............eversion
Ex .............exercise
Ext .............extension
F .............frequency
FAQ ............full arc quads
FB .............feedback
f/b ............followed by
FCU ............flexor carpi ulnaris
FDP ............flexor digitorum profundus
FEV ............forced expiratory volume
flex ............flexion
FOOSH ........fall on outstretched hand
FPL ............flexor pollicis longus
FRC ............functional residual capacity
FUO ............fever of unknown origin
FVC ............forced vital capacity
FWB ...........full weight bearing
Fx ............fracture
f/u ............follow-up
GB ............gallbladder
GI ............gastrointestinal
Grav. 1 ....... number of pregnancies (para = births)
GSW ......... gunshot wound
GTO ......... Golgi tendon organ
GTT ......... glucose tolerance test
GU .......... genitourinary
GXT ......... graded exercise tolerance
H&H .......... hematocrit & hemoglobin
HA .......... headache
Hct ........ hematocrit
HDL .......... high density lipoprotein
HEENT ....... head, ears, eyes, nose, throat
Hgb .......... hemoglobin
HIV .......... human immunodeficiency virus
HNP .......... herniated nucleus pulposus
H/O .......... history of
HOB .......... head of bed
HP .......... hot pack
HPI .......... history of present illness
HR .......... heart rate
HTN .......... hypertension
Hx .......... history
I .......... independent
I + D .......... incision & drainage
I + O .......... input & output
ICS .......... intercostal space
ICU .......... intensive care unit
IDDM .......... insulin dependent diabetes mellitus
I/E ratio .......... inspiratory/expiratory ratio
IM .......... intramuscular
inv .......... inversion
IP .......... interphalangeal joint
IPPB .......... intermittent positive pressure breathing
IR .......... internal rotation
IRDM .......... insulin resistant diabetes mellitus
ITB .......... iliotibial band
IV .......... intravenous
JODM .......... juvenile onset diabetes mellitus
JRA .......... juvenile rheumatoid arthritis
JVD .......... jugular vein distension
KAFO .......... knee ankle foot orthosis
KUB .......... kidney, ureter, bladder
L .................left
LBP .............low back pain
LBQC ..........large-base quad cane
LCL ...........lateral collateral ligament
LDH ..........serum lactic dehydrogenase
LE ............lower extremity
LKS ...........liver, kidney, spleen
LLB ..........long leg brace
LLC ..........long leg cast
LLQ ..........left lower quadrant
LMN ..........lower motor neuron
LMP ..........last menstrual period
LOC ..........loss of consciousness
LOS ..........length of stay
LP ...........lumbar puncture
LTG ..........long-term goal
LUQ ..........left upper quadrant
MAFO ........molded ankle foot orthosis
MAL ..........midaxillary line
max ..........maximum
MCL ..........midclavicular line
MCL ..........medial collateral ligament
MCP ..........metacarpal phalangeal
MH ..........moist heat
min ..........minimum
MI ..........myocardial infarction
mm ..........muscle
MMR ..........measles, mumps, rubella
MMT ..........manual muscle test
mod ..........moderate
MOI ..........mechanism of injury
MRI ..........magnetic resonance imaging
MRSA ..........methicillin-resistant Staph. aureus
MS ..........multiple sclerosis
MTrP ..........myofascial trigger point
MTP ..........metatarsal phalangeal
MVA ..........motor vehicle accident
MWD ..........microwave diathermy
n/a ..........not applicable
N + V ..........nausea and vomiting
NAD ..........no acute distress
NCV . . . . . . . . . . . .nerve conduction velocity
g . . . . . . . . . . . .nasogastric
NIDDM . . . . . . . . . .noninsulin dependent diabetes mellitus
NKA . . . . . . . . . . . .no known allergies
NKDA . . . . . . . . . . . .no known drug allergies
nn . . . . . . . . . . . .nerve
NPO . . . . . . . . . . . .nothing by mouth
NSA . . . . . . . . . . . .no significant abnormality
NSAID . . . . . . . . . .nonsteroidal anti-inflammatory drug
NSR . . . . . . . . . . . .normal sinus rhythm
NWB . . . . . . . . . . . .non-weight bearing
O2 . . . . . . . . . . . .oxygen
OA . . . . . . . . . . . .osteoarthritis
OB . . . . . . . . . . . .obstetrics
OKC . . . . . . . . . . . .open kinetic chain
OOB . . . . . . . . . . . .out of bed
OPP . . . . . . . . . . . .open packed position
ORIF . . . . . . . . . . . .open reduction, internal fixation
OT . . . . . . . . . . . .occupational therapy
P + A . . . . . . . . . . . .percussion and auscultation
P + PD . . . . . . . . . . . .percussion + postural drainage
P . . . . . . . . . . . . .after
PA . . . . . . . . . . . .posterior-anterior
PAC . . . . . . . . . . . .premature atrial contraction
PAO2 . . . . . . . . . . . .alveolar oxygen
PaO2 . . . . . . . . . . . .peripheral arterial oxygen content
PAP . . . . . . . . . . . .pulmonary artery pressure
PCL . . . . . . . . . . . .posterior cruciate ligament
PD . . . . . . . . . . . .postural drainage
PDR . . . . . . . . . . . .Physicians’ Desk Reference
PE . . . . . . . . . . . .pulmonary embolus
PEEP . . . . . . . . . . . .positive end expiratory pressure
PERLA . . . . . . . . . .pupils equal reactive to light accommodation
PF . . . . . . . . . . . .plantar flexion
PFT . . . . . . . . . . . .pulmonary function tests
PID . . . . . . . . . . . .pelvic inflammatory disease
PIP . . . . . . . . . . . .proximal interphalangeal
PMH . . . . . . . . . . . .past medical history
PNF . . . . . . . . . . . .proprioceptive neuromuscular facilitation
P.O. . . . . . . . . . . .by mouth
POD . . . . . . . . . . . .post-op day
PR ............... pulse rate
PRE .............. progressive resistive exercises
prn .............. as necessary
PROM ............. passive range of motion
PSIS ............. posterior superior iliac spine
pt ............... patient
PTB ............... patellar tendon bearing
PTFL .............. posterior talofibular ligament
PVC .............. premature ventricular contraction
PVD .............. peripheral vascular disease
PWB .............. partial weight bearing
Px ............... problem
q2° ................ every two hours
R .................. right
RA ................ rheumatoid arthritis
RBC .............. red blood count/cells
RCL .............. radial collateral ligament
RHD .............. rheumatic heart disease
RLQ .............. right lower quadrant
r/o ............... rule out
ROM .............. range of motion
ROS .............. review of systems
RPE .............. rate of perceived exertion
RR ............... respiratory rate
RUQ .............. right upper quadrant
RV ............... residual volume
Rx ............... treatment
ś .................. without
S .................. supervision
S1 ................ first heart sound
S2 ................ second heart sound
SAQ ................ short arc quad
SBQC .............. small base quad cane
SC ................ straight cane
SC ................ sternoclavicular
SCI ................ spinal cord injury
SCM ............... sternocleidomastoid
SGOT ............ serum glutamic-oxaloacetic transaminase
SI ................ sacroiliac
SLB ............... short leg brace
SLP ............... speech & language pathology
SLR ......... straight leg raises
SOAP ......... subjective, objective, assessment, plan
SOB ......... short of breath
s/p ......... status post
SPC ......... single-point cane
STG ......... short-term goal
SV ......... stroke volume
SWD ......... short wave diathermy
Sx ......... symptoms
S & S ......... signs and symptoms
TB ......... tuberculosis
TBI ......... traumatic brain injury
TENS ......... transcutaneous electrical neuromuscular stimulation
TE ......... therapeutic exercise
TFCC ......... triangular fibrocartilage complex
TFL ......... tensor fascia latae
TFM ......... transverse friction massage
THL ......... transverse humeral ligament
THR ......... total hip replacement
tid ......... three times daily
TKE ......... terminal knee extension
TKR ......... total knee replacement
TLC ......... total lung capacity
TMJ ......... temporomandibular joint
TOS ......... thoracic outlet syndrome
TPR ......... temperature, pulse, respiration
TPR ......... total peripheral resistance
TTP ......... tender to palpation
TTWB ......... toe touch weight bearing
TURP ......... transurethral resection of prostate
TV ......... tidal volume
TVH ......... total vaginal hysterectomy
Tx ......... treatment or traction
UCHD ......... usual childhood disease
UCL ......... ulnar collateral ligament
UE ......... upper extremity
ULNT ......... upper limb neurodynamic test(s)
UMN ......... upper motor neuron
URI ......... upper respiratory infection
US ......... ultrasound
UTI ......... urinary tract infection
UV = ultraviolet
VC = vital capacity
VMO = vastus medialis obliquus
V/O = verbal order
VPC = ventricular precontraction
VS = vital signs
VTO = verbal telephone order
WBAT = weight bearing as tolerated
WBC = white blood count/cells
WBTT = weight bearing to tolerance
WBQC = wide-base quad cane
WC = wheelchair
WFL = within functional limits
WNL = within normal limits
WP = whirlpool
XCT = chemotherapy
XRT = radiation therapy
yo = years old
1° = primary
2° = secondary
< = less than
> = greater than
↑ = increase
downward arrow = decrease
∥ = parallel
Interpretation of Statistics

Sensitivity

- True positive rate
- Proportion of patients who have a pathology that the test identifies as positive
- SnNout = Sensitivity, a Negative test rules out the diagnosis
- Calculation = a/(a+c)

Specificity (SpPin)

- True negative rate
- Proportion of patients who have a pathology that the test identifies as negative
- SpPin = Specificity, a Positive test rules in the diagnosis
- Calculation = d/(b+d)

<table>
<thead>
<tr>
<th>Truth/Gold Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Present</strong></td>
</tr>
<tr>
<td>(+) Test</td>
</tr>
<tr>
<td>(–) Test</td>
</tr>
<tr>
<td>a + c</td>
</tr>
</tbody>
</table>
**Anatomy**

- Middle scalene muscle
- Anterior scalene muscle
- Brachial plexus
- Clavicle
- Coracoid process
- Pectoralis minor muscle
- 1st rib
- 2nd rib
- 3rd rib
- 4th rib
- 5th rib
- Cervical vertebrae
- Subclavian artery and vein

**Spaces**

- **Scalene triangle**
- **Costoclavicular space**
- **Coracopectoral space**

**Clavicle**

**Subclavian artery and vein**

**Cervical vertebrae**

**Brachial plexus**

**Coracoid process**

**Pectoralis minor muscle**

**Clavicle (cut)**

**Brachial plexus**

**Coracopectoral space**
**Medical Red Flags**

- **Pericarditis**
  - Sharp anterior chest & shoulder pain
  - ↑ temp, HR, RR

- **Cardiac ischemia**
  - Neck, jaw, left arm, & chest pain
  - SOB
  - Palpitations
  - ↑ BP
  - Syncope

- **Pulmonary pathology**
  - Neck, shoulder, mid-thorax pain
  - Cough
  - Fever
  - Shallow & ↑ RR

- **Sources of right shoulder/scapula pain**
  - Gallstones—8Fs
    - Fertile = 3rd trimester of pregnancy
    - Female
    - Fat
    - Forty
    - Fair
    - Food–fatty intake
    - Family history
    - Flatulence
  - Peptic ulcer (lateral border of scapula)
  - Diaphragm
  - Liver abscess, hepatic tumor

- **Sources of left shoulder pain**
  - MI
  - Diaphragm
  - Ruptured spleen
  - Pancreas
## Shoulder Pain & Disability Index (SPADI)

### Pain Scale: How severe is your pain?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>At its worst?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>When lying on the involved side?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>Reaching for something on a high shelf?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>Touching the back of your neck?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>Pushing with the involved arm?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
</tbody>
</table>

### Disability Scale: How much difficulty do you have...

<table>
<thead>
<tr>
<th>Activity</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washing your hair?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>Washing your back?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>Putting on an undershirt or pullover sweater?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>Putting in a shirt that buttons down the front?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>Putting on your pants?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>Placing an object on a high shelf?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>Carrying a heavy object of 10 pounds?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>Removing something from your back pocket?</td>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pain Scale Score:</th>
<th>Disability Scale Score:</th>
<th>Total Score:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scoring: Summate the scores &amp; divide by the number of scores possible.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If an item is deemed not applicable, no score is calculated.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple the total score by 100.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The higher the score, the greater the impairment.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. During the past week, to what extent has your arm, shoulder, or hand problem interfered with your normal social activities with family, friends, neighbors, or groups? (hand (golf, hammering, tennis, etc.).)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Recreational activities in which you take some force or impact through your arm, shoulder, or hand (golf, hammering, tennis, etc.).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Use a knife to cut food</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Wash your back</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Carry a shopping bag or briefcase</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Do heavy household chores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Open a tight or new jar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Quick DASH (Disabilities of the Arm, Shoulder, & Hand)**

Please rate your ability to do the following activities in the last week by circling the number below the appropriate response.
**Quick DASH (Disabilities of the Arm, Shoulder, & Hand) — cont'd**

<table>
<thead>
<tr>
<th>Slightly</th>
<th>Moderately</th>
<th>Limited</th>
<th>Unable</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

8. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder, or hand problem?

9. Arm, shoulder, or hand pain

10. Tingling (pins & needles) in your arm, shoulder, or hand

11. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder, or hand?

**Quick DASH Score**

\[
\text{Quick DASH Score} = \left(\frac{\text{sum of responses}}{\text{number of responses}} - 1\right) \times 25
\]

A Quick DASH score cannot be calculated if more than 1 item is not answered.
Referral Patterns

Muscle Pain Referral Patterns

Supraspinatus

Infraspinatus
Subscapularis

Teres Minor  Biceps Brachii
## Palpation Pearls

### Rotator Cuff Muscles

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supraspinatus</strong></td>
<td>With UE back in maximal extension &amp; IR, palpate from the supraspinatus fossa to the tendon anterior to a-c joint</td>
</tr>
<tr>
<td><strong>Infraspinatus</strong></td>
<td>In prone on elbows, palpate posterior-lateral of acromion (just inferior to inferior angle of acromion)</td>
</tr>
<tr>
<td><strong>Subscapularis</strong></td>
<td>In side-lying, maneuver the relaxed UE to allow you to slide your thumb under the axillary/lateral border of the scapula</td>
</tr>
<tr>
<td><strong>Teres Minor</strong></td>
<td>In prone on elbows, palpate just inferior to infraspinatus</td>
</tr>
</tbody>
</table>

![Diagram of Shoulder Muscles](image-url)

- **Acromion process**
- **Supraspinatus tendon**
- **Coracoid process**
- **Subscapularis tendon**
- **Biceps tendon**
- **Long head of biceps**
- **Short head of biceps**
- **Teres major muscle**
- **Long head of triceps**
- **Lateral head of triceps**
- **Infraspinatus muscle**
- **Teres minor muscle**

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Rotational Lack

- Reach overhead (left figure) as far as possible down the back & mark the most inferior point of the fingers.
- Reach up the back as far as possible (right figure) & mark the most superior point of the fingers.
- Measure distance between the marks. This is the rotational lack.

Apley Scratch Test for Quick Screen

3 components:

1. Hand to opposite shoulder
2. Hand behind back to opposite scapula
3. Hand behind back to inferior angle of opposite scapula
### Capsular Patterns

<table>
<thead>
<tr>
<th>Location of Capsular Tightness</th>
<th>Restrictions in Motion</th>
<th>Mobility Deficits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posterior capsule</td>
<td>↓ Horizontal adduction, IR, &amp; end range flexion</td>
<td>• Weak ER&lt;br&gt;• Poor scapular stability</td>
</tr>
<tr>
<td></td>
<td>↓ Posterior glide</td>
<td></td>
</tr>
<tr>
<td>Posterior-inferior capsule</td>
<td>↓ Elevation, IR, &amp; horizontal adduction</td>
<td></td>
</tr>
<tr>
<td>Posterior-superior capsule</td>
<td>↓ IR</td>
<td></td>
</tr>
<tr>
<td>Anterior-superior capsule</td>
<td>↓ End range flexion &amp; extension, ↓ ER &amp; horizontal abduction</td>
<td>• Weak RC&lt;br&gt;• (+) NTPT&lt;br&gt;• Night pain</td>
</tr>
<tr>
<td>Anterior capsule</td>
<td>↓ Abduction, extension, ER, &amp; horizontal adduction</td>
<td></td>
</tr>
</tbody>
</table>

### Osteokinematics of the Shoulder

<table>
<thead>
<tr>
<th>Normal ROM</th>
<th>OPP</th>
<th>CPP</th>
<th>Normal End-feel(s)</th>
<th>Abnormal End-feel(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation 165°–170°</td>
<td>55°–70° abduction</td>
<td>Maximal abduction &amp; ER</td>
<td><strong>Flexion</strong> = elastic, firm – bony contact&lt;br&gt;<strong>Abduction</strong> = elastic&lt;br&gt;<strong>Scaption</strong> = elastic&lt;br&gt;<strong>IR/ER</strong> = elastic/firm&lt;br&gt;<strong>Horiz add</strong> = soft tissue&lt;br&gt;<strong>Extension</strong> = firm&lt;br&gt;<strong>Horiz abd</strong> = firm/elastic</td>
<td>Empty = subacromial bursitis&lt;br&gt;Hard capsular = frozen shoulder&lt;br&gt;Capsular = ER &gt; abduction &gt; IR</td>
</tr>
<tr>
<td>IR/ER 180° total</td>
<td>30° horizontal abduction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scapulo-Humeral Rhythm 2:1 (120°:60°)</td>
<td>Maximal abduction &amp; ER</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Arthrokinematics for Shoulder Mobilization

<table>
<thead>
<tr>
<th>Glenohumeral Joint</th>
<th>Concave surface: Glenoid fossa</th>
<th>Convex surface: Humeral head</th>
<th>To facilitate elevation: Humeral head spins posterior</th>
<th>To facilitate abduction: Humeral head rolls superior &amp; glides inferior/posterior</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To facilitate IR: Humeral head rolls posterior &amp; glides anterior</td>
<td>To facilitate horizontal adduction: Humeral head rolls medial &amp; glides lateral on glenoid</td>
<td>To facilitate ER: Humeral head rolls anterior &amp; glides posterior</td>
<td></td>
</tr>
<tr>
<td>Sternoclavicular Joint</td>
<td>Convex surface: Medial clavicle</td>
<td>Concave surface: Disk &amp; manubrium</td>
<td>To facilitate elevation: Lateral clavicle rolls upward &amp; medial clavicle glides inferior on disk &amp; manubrium</td>
<td>To facilitate depression: Lateral clavicle rolls downward &amp; medial clavicle glides superior on disk &amp; manubrium</td>
</tr>
<tr>
<td></td>
<td>Concave surface: Medial clavicle &amp; disk</td>
<td>Convex surface: Manubrium</td>
<td>To facilitate retraction: Medial clavicle &amp; disk rolls &amp; glides posterior on manubrium</td>
<td>To facilitate protraction: Medial clavicle &amp; disk rolls &amp; glides anterior on manubrium</td>
</tr>
</tbody>
</table>
Force Couples of the Shoulder

- Elevation = trapezius, rhomboid, SA
- Upward rotation = upper/lower trapezius & SA
- Abduction = supraspinatus, subscapularis, & deltoid
- Downward rotation = lower trapezius, latissimus, & pectoralis minor
- Stabilization of the humeral head = RC & long head of biceps
## Neuromuscular Relationships of the Cervical Spine

<table>
<thead>
<tr>
<th>Root</th>
<th>Nerve</th>
<th>Muscle</th>
<th>Sensation</th>
<th>Reflex</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3–4</td>
<td>Spinal accessory</td>
<td>Trapezius</td>
<td>∅</td>
<td>∅</td>
</tr>
<tr>
<td>C5</td>
<td>Dorsal scapular</td>
<td>Levator scapula</td>
<td>∅</td>
<td>∅</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rhomboids</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C5–6</td>
<td>Lateral pectoral</td>
<td>Pectoralis major</td>
<td>∅</td>
<td>∅</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pectoralis minor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C5–6</td>
<td>Subscapular</td>
<td>Subscapular</td>
<td>∅</td>
<td>∅</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teres major</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C5–6</td>
<td>Long thoracic</td>
<td>Serratus anterior</td>
<td>∅</td>
<td>∅</td>
</tr>
<tr>
<td>C5–6</td>
<td>Suprascapular</td>
<td>Supraspinatus</td>
<td>Top of</td>
<td>∅</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Infraspinatus</td>
<td>shoulder</td>
<td></td>
</tr>
<tr>
<td>C5–6</td>
<td>Axillary</td>
<td>Deltoid</td>
<td>Deltoid</td>
<td>∅</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teres minor</td>
<td>Anterior</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>shoulder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C5–7</td>
<td>Musculocutaneous</td>
<td>Coracobrachialis</td>
<td>Lateral</td>
<td>Biceps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Biceps &amp; brachialis</td>
<td>forearm</td>
<td></td>
</tr>
<tr>
<td>C5–T1</td>
<td>Radial</td>
<td>Triceps</td>
<td>Dorsum</td>
<td>Triceps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrist ext/finger flex</td>
<td>of hand</td>
<td></td>
</tr>
<tr>
<td>C6–7</td>
<td>Thoracodorsal</td>
<td>Latissimus dorsi</td>
<td>∅</td>
<td>∅</td>
</tr>
</tbody>
</table>
# Brachial Plexus—Roots, Muscles, & Function

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Root</th>
<th>Muscle</th>
<th>Function</th>
</tr>
</thead>
</table>
| Radial | C5–8, T1 | Anconeus, brachioradialis, ECRL, ECRB, extensor digitorum, APL, ECU, extensor indices, extensor digiti minimi | ■ Weak supination, wrist extensors, finger flexors, thumb abductors  
■ Weak grip due to loss of wrist stabilization |
| Median | C6–8, T1 | Pronator teres, FCR, palmaris longus, FDS, FPL, pronator quadratus, thenar eminence, lateral 2 lumbricales | ■ Weak pronation, wrist flexion & RD  
■ Weak thumb flexion & abduction  
■ Weak grip & pinch  
■ Ape hand |
| Ulnar | C7–8, T1 | FCU, palmaris brevis, hypothenar eminence, adductor pollicis, medial 2 lumbricales, interossei | ■ Weak wrist flexion & UD  
■ Weak 5th finger flexion  
■ Weak finger abd/adduction  
■ Benediction sign |

## Special Tests

### Neural Tissue Provocation Tests

■ See Alerts/Alarms–page 14.
Shoulder Tests

**EMPTY CAN TEST**
*Purpose:* Test supraspinatus muscle  
*Position:* Seated  
*Technique:* Elevate UE 30°–45° in plane of the scapula with IR, resist elevation  
*Interpretation:* + test = reproduction of pain &/or weakness  
*Statistics:* Pain: sensitivity = 44%–100% & specificity = 50%–99%  
Weakness: sensitivity = 77% & specificity = 68%


**FULL CAN TEST**
*Purpose:* Test supraspinatus muscle  
*Position:* Seated  
*Technique:* Elevate UE 30°–45° in plane of the scapula with ER, resist elevation  
*Interpretation:* + test = reproduction of pain &/or weakness  
*Statistics:* Pain: sensitivity = 66% & specificity = 64%  
Weakness: sensitivity = 77% & specificity = 74%


**DROPPING SIGN**
*Purpose:* Test infraspinatus muscle  
*Position:* Seated  
*Technique:* Shoulder at side with 45° of IR & 90° elbow flexion, resist ER  
*Interpretation:* + test = reproduction of pain &/or weakness  
*Statistics:* Sensitivity = 20%–42% & specificity = 69%–100%

**SHOULDER**

**HORNBLOWER’S (PATTE TEST)**
Purpose: Test teres minor muscle
Position: Seated
Technique: Shoulder in 90° abd & elbow flexed so that the hand comes to the mouth (blowing a horn)
Interpretation: + test = reproduction of pain &/or inability to maintain UE in ER

**RENT SIGN**
Purpose: Diagnosis RC tears
Position: Seated with UE in full ext & clinician’s hand under the flexed elbow
Technique: Stand behind pt with fingertips in the anterior margin of the acromion; IR/ER UE & palpate for an eminence & a rent; compare bilaterally
Interpretation: + test = presence of a palpable defect in RC
Statistics: Sensitivity = 95% & specificity = 96%

**GERBER’S LIFT-OFF SIGN**
Purpose: Test subscapularis muscle
Position: Seated
Technique: Hand in the curve of lumbar spine, resist IR
Interpretation: + test = reproduction of pain &/or weakness; inability to lift off
Statistics: Sensitivity = 62%–89% & specificity = 98%–100%; tears >75% are often required to produce a + test

**BELLY PRESS OR NAPOLEON SIGN**

**Purpose:** Test subscapularis muscle

**Position:** Seated with hand on belly

**Technique:** Press the hand into belly

**Interpretation:** + test = reproduction of pain &/or inability to IR; substitution may result in UE elevation or wrist flexion

**Statistics:** Sensitivity = 25%–40% & specificity = 98%; tears >50% are often required to produce a + test


---

**BEAR-HUG TEST**

**Purpose:** Test subscapularis muscle

**Position:** Seated with palm of hand on opposite shoulder (elbow in front of body)

**Technique:** Resist IR by attempting to pull hand off the shoulder

**Interpretation:** + test = inability to hold the hand against the shoulder or weakness >20% of contralateral UE

**Statistics:** Sensitivity = 60% & specificity = 92%; tears of 30% can be detected with this test

---

**HAWKINS/KENNEDY TEST**

**Purpose:** Test for impingement

**Position:** Seated

**Technique:** Place shoulder in 90° of flexion, slight horizontal adduction, & maximal IR

**Interpretation:** + test = shoulder pain due to impingement of supraspinatus between greater tuberosity against coracoacromial arch

**Statistics:** Sensitivity = 72%–92% & specificity = 25%–66%
**NEER’S TEST**

*Purpose:* Test for impingement  
*Position:* Seated  
*Technique:* Passively take UE into full shoulder flexion with humerus in IR  
*Interpretation:* + test = pain may be indicative of impingement of the supraspinatus or long head of the biceps  
*Statistics:* Sensitivity = 68%–95% & specificity = 25%–68%

**IMPINGEMENT RELIEF TEST**

*Purpose:* Confirm impingement  
*Position:* Seated  
*Technique:* Perform an inferior glide of GH joint while elevating UE to Neer position  
*Interpretation:* + test = reduction or no pain when elevation is accompanied by an inferior glide

**SULCUS SIGN**

*Purpose:* Assess for inferior instability or AC px  
*Position:* Sitting with shoulder in neutral & elbow flexed to 90°  
*Technique:* Palpate shoulder joint line while using proximal forearm as a lever to inferiorly distract humerus  
*Interpretation:* + test = ≥ 1 finger-width gap @ the shoulder joint line or AC joint

**APPREHENSION TEST**

*Purpose:* Assess for anterior instability  
*Position:* Supine  
*Technique:* Abduct the shoulder to 90° & then begin to ER  
*Interpretation:* + test = pain or apprehension by the client to assume this position for fear of shoulder dislocation
**Jerk Test**

**Purpose:** Assess posterior instability

**Position:** Sitting with UE in IR & flexed to 90°

**Technique:** Grasp client’s elbow & load the humerus proximal while passively moving the UE into horizontal adduction

**Interpretation:** + test = a sudden jerk/clunk as the humeral head subluxes posteriorly; a second jerk/clunk may occur when the UE is returned to the abducted position

**Statistics:** Sensitivity = 73% & specificity = 90%

**Speed’s Test**

**Purpose:** Assess for biceps tendonitis or labrum problem

**Position:** Seated with shoulder elevated 75°–90° in the sagittal plane, elbow extended, & forearm supinated

**Technique:** Resist elevation

**Interpretation:** + test = pain with biceps tendonitis & sense of instability with labral px

**Statistics:** Sensitivity = 9%–100% & specificity = 61%–87%

**Biceps Load Test**

**Purpose:** Assess labrum

**Position:** Supine in 90°–120° of shoulder abduction & 90° of elbow flexion

**Technique:** Load the biceps by resisting elbow flexion/supination

**Interpretation:** + test = biceps tugs on labrum (SLAP) & reproduces pain

**Statistics:** Sensitivity = 91% & specificity = 97%
PAIN PROVOCATION TEST
Purpose: Assess labrum
Position: Supine in 90° shoulder abduction & 90° elbow flexion
Technique: Traction the biceps by passively taking the forearm into maximal pronation
Interpretation: + test = biceps will tug on labrum & reproduces the pain in the superior region of the joint line (superior labrum)
Statistics: Sensitivity = 17%–100% & specificity = 90%

CRANK TEST
Purpose: Assess labrum
Position: Seated with UE elevated to 160° & elbow flexed to 90°
Technique: Administer compression down the humerus while performing IR/ER
Interpretation: + test = pain or clicking
Statistics: Sensitivity = 39%–91% & specificity = 67%–93% (greater accuracy than MRI)

KIM TEST
Purpose: Assess labrum
Position: Seated with UE elevated to ~130° in the plane of the scapula & the elbow flexed to 90°
Technique: Apply a compressive force thru the humerus
Interpretation: + test = pain or clicking
Statistics: Sensitivity = 80%–82% & specificity = 86%–94%
O'BRIEN'S TEST
Purpose: Assess for labrum or AC joint problem
Position: Seated with UE in 90° of elevation, 10° of horiz add, & maximal IR (pronation)
Technique: Resist elevation in IR then repeat in ER (supination)
Interpretation: + test = pain in IR > ER; pain “inside” shoulder is labrum & pain “on top” of shoulder is AC
Statistics: Sensitivity = 47%–100% & specificity = 41%–98%

YERGASON'S TEST
Purpose: Assess THL
Position: Seated with shoulder in neutral, elbow flexed to 90°, & forearm supinated
Technique: Resist elbow flexion with supination
Interpretation: + test = pain with tenosynovitis; clicking or snapping with torn THL (with resistance from pronation to supination)
Statistics: Sensitivity = 9%–37% & specificity = 86%–96%
AC SHEAR TEST
Purpose: Assess for AC sprain
Position: Seated; UE at side
Technique: Clinician interlaces fingers & surrounds the AC joint; squeezing the hands together compresses the AC joint
Interpretation: + test = pain or excessive mov’t is indicative of damage to the AC ligaments
Statistics: Sensitivity = 100% & specificity = 97%

CORACOCLAVICULAR LIGAMENT TEST
Purpose: Assess CC ligament
Position: Side-lying on the unaffected side
Technique: Place affected UE behind back, palpate CC ligament while stabilizing clavicle; pulling inferior angle of scapula away from ribs to stress the conoid portion; pulling medial border of scapula away from the ribs stresses the trapezoid portion
Interpretation: + test = pain

CROSS-BODY ADDUCTION TEST
Purpose: Assess for AC
Position: Seated
Technique: Shoulder flexed to 90°, horizontally adduct the UE
Interpretation: + test = pain @ AC joint
Statistics: Sensitivity = 100% & specificity = 97%
Thoracic Outlet Syndrome (TOS) Compression Sites

- Anterior scalene muscle
- Middle scalene muscle
- Brachial plexus
- 1st rib
- 2nd rib
- 3rd rib
- 4th rib
- 5th rib
- Clavicle
- Subclavian artery and vein
- Cervical vertebrae

**Scalene triangle**
- Clavicle (cut)

**Costoclavicular space**
- Brachial plexus

**Coracopectoral space**
TOS Tests
“Rule of the Thumb” = Rotation of the head follows the direction of the thumb

**ADSON’S TEST**
Purpose: Assess for TOS @ scalene triangle
Position: Seated
Technique: While palpating radial pulse, move UE into abd, ext, & ER, then client rotates head toward the involved side, takes a deep breath & holds it
Interpretation: + test = absent or diminished radial pulse with symptoms reproduced
Statistics: Specificity = 74%–89%

**WRIGHT’S HYPERABDUCTION TEST**
Purpose: Assess for TOS @ coracoid/rib & under pectoralis minor
Position: Seated
Technique: While palpating radial pulse, passively abduct UE to 180° in ER, have client take a deep breath & hold it
Interpretation: + test = absent or diminished radial pulse with symptoms reproduced
Statistics: Pulse: sensitivity = 70% & specificity = 53%
Pain: sensitivity = 90% & specificity = 29%

**MILITARY BRACE (COSTOCLAVICULAR) TEST**
Purpose: Assess for TOS @ 1st rib & clavicle
Position: Seated
Technique: While palpating radial pulse, retract shoulders into extension & abduction with the neck in hyperextension (exaggerated military posture)
Interpretation: + test = absent or diminished radial pulse or symptoms reproduced
**ALLEN’S TEST**

**Purpose:** Assess for TOS @ pectoralis minor

**Position:** Seated

**Technique:** In 90° shoulder abduction & 90° elbow flexion, turn head away, take a deep breath & hold it

**Interpretation:** + test = absent or diminished radial pulse with symptoms reproduced

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**ROOS’ TEST—Elevated Arm Stress Test (EAST)**

**Purpose:** Assess for TOS

**Position:** Seated with UEs at 90° of shoulder abduction, ER, & elbow flexion.

**Technique:** Open & close hands repeatedly for 3 minutes

**Interpretation:** + test = reproduction of symptoms or sensation of heaviness of the UEs (record time of onset of symptoms)

**Statistics:** Sensitivity = 82%–84 & specificity = 30%–100%;

---

<table>
<thead>
<tr>
<th>Combination of TOS tests</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adson’s + Wright’s (pain)</td>
<td>79</td>
<td>76</td>
</tr>
<tr>
<td>Adson’s + Roos’</td>
<td>72</td>
<td>82</td>
</tr>
<tr>
<td>Adson’s + Hyperabd (pain)</td>
<td>72</td>
<td>88</td>
</tr>
<tr>
<td>Adson’s + Wright’s (pulse)</td>
<td>54</td>
<td>94</td>
</tr>
<tr>
<td>Wright’s (pain) + Roos’</td>
<td>83</td>
<td>47</td>
</tr>
<tr>
<td>Wright’s (pain) + Hyperabd (pain)</td>
<td>83</td>
<td>50</td>
</tr>
<tr>
<td>Wright’s (pulse) + Hyperabd (pulse)</td>
<td>63</td>
<td>69</td>
</tr>
</tbody>
</table>
## TOS—Differentiation Between Vascular & Neural Components

<table>
<thead>
<tr>
<th>Vascular Components</th>
<th>Neural Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>(+) Adson’s, Wright’s, Allen’s, Roos’, military press test</td>
<td>Muscle weakness</td>
</tr>
<tr>
<td>Hand or arm edema</td>
<td>Pain with SB of C-spine</td>
</tr>
<tr>
<td>Discoloration or UE claudication</td>
<td>Sensory changes along a neurological distribution, i.e., radial or ulnar nerve</td>
</tr>
<tr>
<td>Change in skin temperature or texture</td>
<td>(+) Neural tissue provocation tests</td>
</tr>
<tr>
<td>Difference of &gt;20 mm Hg in DBP between UEs</td>
<td>Poor tolerance of cold &amp; activity</td>
</tr>
<tr>
<td>Test</td>
<td>Shoulder</td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
</tr>
<tr>
<td>Ulnar PIN</td>
<td>(-)</td>
</tr>
<tr>
<td>Median PIN</td>
<td>(-)</td>
</tr>
<tr>
<td>Elbow Provocation</td>
<td>Shoulder arm pain, intermittent neck, C-disc, TOS</td>
</tr>
<tr>
<td>Ulnar Nerve EMG</td>
<td>Shoulder</td>
</tr>
<tr>
<td>Median Nerve EMG</td>
<td>Shoulder</td>
</tr>
<tr>
<td>Ulnar Nerve CT</td>
<td>Shoulder</td>
</tr>
<tr>
<td>Median Nerve CT</td>
<td>Shoulder</td>
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<tr>
<td>Ulnar Nerve MRI</td>
<td>Shoulder</td>
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<tr>
<td>Median Nerve MRI</td>
<td>Shoulder</td>
</tr>
<tr>
<td>Ulnar Nerve Ultrasound</td>
<td>Shoulder</td>
</tr>
<tr>
<td>Median Nerve Ultrasound</td>
<td>Shoulder</td>
</tr>
<tr>
<td>Ulnar Nerve Nerve Conduction Study</td>
<td>Shoulder</td>
</tr>
<tr>
<td>Median Nerve Nerve Conduction Study</td>
<td>Shoulder</td>
</tr>
</tbody>
</table>

**Possible Tests**

- Allen's
- Roos' elbow pressure
- Phalen's
- Mills
- Tinel's (elbow, wrist, axilla, median)
- NTPT
- Adson's
- Spurling's
- CTS, intercostal, military NTPT
- Phalens'
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Breast Cancer</strong></td>
<td>■ Palpable mass/nodule in breast tissue</td>
</tr>
<tr>
<td></td>
<td>■ Nipple discharge, retraction, &amp; local skin dimpling</td>
</tr>
<tr>
<td></td>
<td>■ Erythema, local rash</td>
</tr>
<tr>
<td></td>
<td>■ Confirmed with mammogram; biopsy</td>
</tr>
<tr>
<td><strong>Thoracic Outlet Syndrome</strong>—results from compression of any one of many sites 2° postural or muscular imbalances or osseous anomalies. May be due to vascular (only 5%–10%) or neural compression; locations of compression include: sternocostovertebral space, scalene triangle, costoclavicular space, &amp; coracopectoral space; most common in middle-aged female or after surgery</td>
<td>■ Kyphotic posture &amp; forward head</td>
</tr>
<tr>
<td></td>
<td>■ Awakened @ night with pins &amp; needles in hand</td>
</tr>
<tr>
<td></td>
<td>■ Poorly localized aching pain</td>
</tr>
<tr>
<td></td>
<td>■ Tenderness in the suprascapular fossa</td>
</tr>
<tr>
<td></td>
<td>■ Pain with carrying heavy objects</td>
</tr>
<tr>
<td></td>
<td>■ (+) Tests: NTPT, Adson’s, Wright’s, military brace, Roos’ &amp; Allen’s</td>
</tr>
<tr>
<td></td>
<td>■ DBP &gt; 20 mm Hg difference between arms</td>
</tr>
<tr>
<td></td>
<td>■ A/P x-ray needed to r/o cervical rib (very rare)</td>
</tr>
<tr>
<td></td>
<td>■ EMG results are controversial</td>
</tr>
<tr>
<td></td>
<td>■ Need to r/o CTS, radiculopathy, pronator syndrome</td>
</tr>
<tr>
<td></td>
<td>■ Prominent acromion, flattened shoulder silhouette, prominent humeral head</td>
</tr>
<tr>
<td></td>
<td>■ Injured posture: shoulder IR &amp; slightly abducted, elbow flexed, forearm pronated, UE supported by contralateral limb</td>
</tr>
<tr>
<td></td>
<td>■ Sharp, stabbing pain, muscle guarding, humeral head is palpable anteriorly or inferiorly in the armpit</td>
</tr>
<tr>
<td></td>
<td>■ (+) Tests: Apprehension test &amp; sulcus sign</td>
</tr>
<tr>
<td></td>
<td>■ X-ray—Hill-Sachs lesion may be visible in A/P view with UE in IR; Bankart lesion in Garth view</td>
</tr>
<tr>
<td></td>
<td>■ Need to r/o humeral neck fracture in elderly</td>
</tr>
<tr>
<td><strong>Glenohumeral Dislocation</strong>—anterior is most common (90%); mechanism is FOOSH</td>
<td>■ Palpable mass/nodule in breast tissue</td>
</tr>
<tr>
<td></td>
<td>■ Nipple discharge, retraction, &amp; local skin dimpling</td>
</tr>
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<tr>
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<td>■ Confirmed with mammogram; biopsy</td>
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<tr>
<td>Pathology/Mechanism</td>
<td>Signs/Symptoms</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Clavicular Fracture</strong>—results from a fall on the shoulder or a direct blow to the clavicle</td>
<td>■ Can’t raise arm&lt;br&gt;■ Visual deformity &amp; TTP&lt;br&gt;■ Confirmed with x-ray</td>
</tr>
<tr>
<td><strong>Acromioclavicular Sprain</strong>—may result from a fall on the acromion &amp; FOOSH&lt;br&gt;See “Acromioclavicular Sprain Grades” on page 82.</td>
<td>■ Pain &amp; crepitus on palpation &amp; visual deformity&lt;br&gt;■ (+) Tests: Cross body adduction, O’Brien’s, AC shear, &amp; sulcus/AC tx&lt;br&gt;■ Confirmed with bilateral A/P x-ray in ER with &amp; without a 10–15 lb weight (stress films)&lt;br&gt;■ Need to r/o impingement</td>
</tr>
<tr>
<td><strong>Labral Tear</strong>—may result from FOOSH, traction force on the shoulder, or a strong biceps contraction</td>
<td>■ Pain with IR &amp; adduction&lt;br&gt;■ Weakness with abduction &amp; flexion&lt;br&gt;■ Client reports a sense of instability&lt;br&gt;■ (+) Tests: Speed’s test, O’Brien’s, biceps load, pain provocation, &amp; crank&lt;br&gt;■ Confirmed with CT or MRI; CT double contrast is more accurate than MRI</td>
</tr>
<tr>
<td><strong>Subacromial Bursitis</strong>—chronic irritation resulting from trauma or poor biomechanics; may occur in middle-aged or older clients after an unusual bout of activity; hx of tendonitis</td>
<td>■ Swift onset of severe pain; localized to deltoid insertion&lt;br&gt;■ Noncapsular end-feel with no limitation in rotation (position of choice is adduction)&lt;br&gt;■ If bursitis exists in isolation (not common) then passive ROM is painful (noncontractile structure) &amp; resistive motions are not painful (except in 50°–130° range where the contracting tendon compresses the bursa)&lt;br&gt;■ (+) Tests: Hawkins/Kennedy, Neer’s &amp; Impingement relief&lt;br&gt;■ Subacromial bursa warm &amp; TTP (position UE into passive extension to palpate bursa)&lt;br&gt;■ Imaging is of little value unless calcification has occurred; need to r/o RC tear &amp; impingement</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Bicipital Tendonitis</strong>—chronic irritation resulting from trauma or poor biomechanics Forward head contributes to abnormal scapulo-humeral rhythm</td>
<td>Pain ↑ @ night; TTP localized to biceps tendon @10° of IR (places tendon directly anterior &amp; ~6 cm below acromion) Active elevation results in a painful arc; crepitus (+) Speed’s test; (−) Yergason for click but painful X-ray: bicipital groove view will reveal medial wall angle, spurs, degenerative changes; caudal tilt view will reveal spurring Often associated with RC impingement</td>
</tr>
<tr>
<td><strong>Calcific Tendonitis</strong>—cyclic problem of calcification = deposition &amp; resorption with unknown etiology (may be related to tissue hypoxia) Occurs in ♀ &gt; ♂; R &gt; L; 40–50 yo</td>
<td>↓ ROM with painful arc 70°–110° &amp; sensation of catching when going thru ROM (+) Speed’s test During deposition: chronic mild-moderate discomfort, throbbing unrelieved by rest During resorption: acute ↑ in pain; sharp &amp; localized Confirmed by A/P film in neutral Need to r/o impingement &amp; adhesive capsulitis</td>
</tr>
<tr>
<td><strong>Rotator Cuff Strain</strong>—results from mechanical compression OR tensile overload (eccentric microtears); partial thickness tears occur 25–40 yo &amp; full thickness tears &gt;60 yo RC has limited resiliency for self-repair Contributing factors: Posture—forward head influences GH alignment Antero-inferior capsule tightness = ↓ ER Posterior capsule tightness = ↑ superior &amp; anterior translation of humeral head</td>
<td>Painful arc with UE motion; night pain; deep ache Crepitus Weakness: abduction +/or ER; protective shoulder hike (+) Special tests depending on muscle involved—empty/full can (supraspinatus), lift-off or belly press/Napoleon (subscapularis), hornblowers (teres minor), dropping sign (infra-spinatus); (+) O’Brien’s test Strength imbalance (ER MMT should be 60%–70% of IR)</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supraspinatus Impingement—</td>
<td>- X-ray may be normal with small tears; partial tears = superior humeral displacement may be evident with ER; full-thickness tear = narrowed acromiohumeral interval &amp; osteophytes on anterior/inferior acromion</td>
</tr>
<tr>
<td>results from a progressive</td>
<td>- Diagnostic ultrasound is reliable for tears &gt; 1 cm</td>
</tr>
<tr>
<td>loss of humeral depressor</td>
<td>- Arthrography with contrast = Geyser’s sign (painful)</td>
</tr>
<tr>
<td>mechanism (infraspinatus,</td>
<td>- MRI is noninvasive but CT double contrast is more accurate than MRI for full thickness RC tears</td>
</tr>
<tr>
<td>subscapularis, teres minor,</td>
<td>- Microtrauma results from IR during overhead tennis stroke, swim, throwing; shoulder instability; tight pectoralis minor or weak lower trap</td>
</tr>
<tr>
<td>&amp; long head of biceps)</td>
<td>&amp; SA allows tipping of scapula with shoulder elevation to ↓ subacromial space to impingement</td>
</tr>
<tr>
<td>2° overuse, cervical px,</td>
<td>- Pain (especially when sleeping on affected side)</td>
</tr>
<tr>
<td>postural px, abnormal</td>
<td>- Painful arc (60°–120° of elevation)</td>
</tr>
<tr>
<td>biomechanics, or structural</td>
<td>- Pain &amp; weakness in supraspinatus &amp; biceps</td>
</tr>
<tr>
<td>px with acromion</td>
<td>- “Catching” with flexion in IR</td>
</tr>
<tr>
<td>Microtrauma results from IR</td>
<td>- Pain referral pattern = deltoïd insertion &amp; anterior/proximal humerus</td>
</tr>
<tr>
<td>during overhead tennis stroke,</td>
<td>- Little to no TTP</td>
</tr>
<tr>
<td>swim, throwing; shoulder</td>
<td>- ROM ↓ IR &amp; horizontal adduction</td>
</tr>
<tr>
<td>instability; tight pectoralis</td>
<td>- Posterior capsule tightness; pain with PROM</td>
</tr>
<tr>
<td>minor or weak lower trap</td>
<td>- (+) Tests: Neer’s, Hawkins-Kennedy, Speed’s, empty/full can, &amp; Yocum</td>
</tr>
<tr>
<td>&amp; SA allows tipping of scapula</td>
<td>- X-rays may reveal ↓ joint space, arthritis, calcific tendonitis, hooked acromion; early dx is via MRI</td>
</tr>
<tr>
<td>with shoulder elevation to ↓</td>
<td>- Should r/o RC tear, TOS, labral tear, &amp; calcific tendonitis</td>
</tr>
<tr>
<td>subacromial space to</td>
<td></td>
</tr>
<tr>
<td>impingement</td>
<td></td>
</tr>
</tbody>
</table>

**Coracoid Impingement**—subacromial arch boundaries = acromion, coracoid, & coracoacromial ligament; houses supraspinatus, long head of biceps, subacromial bursa, coraco-humeral ligament; hooked acromion; results from repetitive tasks with UE IR; poor posture

- Dull pain in the front of the shoulder provoked by flexion & IR OR abduction & IR
- Weak downward rotators of scapula
- Forward head & kyphosis influences GH alignment
- (+) Tests: Neer’s, Hawkins-Kennedy, & impingement relief

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<table>
<thead>
<tr>
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</tr>
</thead>
</table>
| Adhesive Capsulitis—self-limiting disorder of unknown etiology; high incidence in DM & associated with old Colles fx; proliferation of collagen results in thickening of inferior capsule & loss of capsular folds; most common in ♀ 40–70 yo | ■ X-ray will detect ↓ joint space & hooked acromion  
■ Should r/o RC tear, TOS, labral tear, & calcific tendonitis |

**See “Stages & Presentation of Adhesive Capsulitis” on page 83.**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Presentation</th>
</tr>
</thead>
</table>
| Normal | Acromion to clavicle space should be ~ 0.3–0.8 cm  
Inferior clavicle to coracoid distance should be 1.0–1.3 cm |
| 1st degree injury | AC joint space >0.8 cm & pain with horizontal adduction & elevation; (+) AC shear test |
| 2nd degree injury | AC joint space 1.0–1.5 cm & CC distance increased by 25%–50% |
| 3rd degree injury | AC joint space >1.5 cm & CC distance increased by >50% with a step deformity |
## Stages & Presentation of Adhesive Capsulitis

<table>
<thead>
<tr>
<th>Stage</th>
<th>Clinical Findings</th>
<th>Arthroscopic Findings</th>
<th>Intervention</th>
</tr>
</thead>
</table>
| I—Freezing | • Continual increase in pain (before end-range)  
• ↓ A & PROM                      | Erythematous, fibrinous pannus over the synovium in the axillary fold                  | Least aggressive:  
• Modalities  
• Gentle AROM–Codman’s  
• Grade I & II mobilizations |
| II—Frozen | • ↓ pain  
• ↓ A & PROM  
• Impaired GH accessory & physiological mov’t  
• Impaired SH rhythm              | Thickened synovium with adhesions developing across the folds                        | Moderately aggressive:  
• Modalities  
• AROM  
• Gentle PROM  
• Grade III & IV mobilizations    |
| III—Thawing | • Pain with stretching only, ↑ accessory & physiological motion, return of SH rhythm & ADLs | Loss of joint space, humeral head is compressed against glenoid, & axillary fold is reduced by 50% | Most aggressive:  
• Modalities  
• PROM  
• Grade III & IV mobilizations  
• PREs                              |
Anatomy

Acromion process

Biceps brachii tendon

Long head of biceps

Coracobrachialis muscle

Short head of biceps

Biceps brachii tendon

Medial head of triceps brachii

Long head of triceps brachii

Lateral head of triceps brachii

Medial head of triceps brachii

Triceps brachii tendon
Referral Patterns

Muscle Pain Referral Patterns

- Brachioradialis
- Biceps brachii
- Flexor carpi radialis
- Flexor carpi ulnaris
Muscle Pain Referral Patterns

Extensor carpi ulnaris

Extensor carpi radialis longus

Extensor carpi radialis brevis
Visual Inspection

- Carrying angle of the elbow
  - 10°–15° valgus in ♂
  - 5°–10° valgus in ♀

Palpation Pearls

Wrist Extensor Muscles

Extensor carpi radialis brevis and longus

Extensor digitorum

Extensor carpi ulnaris
Wrist Flexor Muscles

- Pronator teres
- Flexor carpi radialis
- Palmaris longus
- Flexor carpi ulnaris
# Osteokinematics of the Elbow

<table>
<thead>
<tr>
<th>Normal ROM</th>
<th>Opp</th>
<th>CPP</th>
<th>Normal End-feel(s)</th>
<th>Abnormal End-feel(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion &gt;135°</td>
<td>Humero-ulnar</td>
<td>70° flex</td>
<td>full ext full sup</td>
<td>Flexion = soft tissue or bony approximation</td>
</tr>
<tr>
<td></td>
<td>Humero-radial</td>
<td>70° flex</td>
<td>full ext full sup</td>
<td>Extension = bony approximation</td>
</tr>
<tr>
<td>Pronation &amp; Supination 80°–90° each</td>
<td>Superior radio-ulnar</td>
<td>70° flex</td>
<td>5° sup</td>
<td>Supination = ligamentous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>35° sup</td>
<td></td>
<td>Pronation = bony approximation or ligamentous</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Capsular = pronation &amp; supination equally limited</td>
</tr>
</tbody>
</table>

## Arthrokinematics for Elbow Mobilization

### Humero-ulnar
- **Concave surface**: Trochlear notch of ulna
- **Convex surface**: Trochlea of humerus
- **To facilitate flexion**: OKC = radius & ulna roll & glide anterior & medial on humerus
- **To facilitate extension**: OKC = radius & ulna roll & glide posterior & lateral on humerus

### Humero-radial
- **Concave surface**: Radial head
- **Convex surface**: Capitulum of humerus

### Superior/proximal radio-ulnar
- **Concave surface**: Radial notch of ulna
- **Convex surface**: Radial head
- **To facilitate pronation**: Radius spins medially & glides anterior on ulna
- **To facilitate supination**: Radius spins laterally on ulna
## Brachial Plexus–Roots, Muscles, & Function

<table>
<thead>
<tr>
<th>Nerve</th>
<th>Root</th>
<th>Muscle</th>
<th>Functional Deficits</th>
</tr>
</thead>
</table>
| Median| C6–8, T1 | Pronator teres, FCR, palmaris longus, FDS, FPL, pronator quadratus, thenar eminence, lateral 2 lumbricales | ■ Weak pronation, wrist flexion, & RD  
■ Weak thumb flexion & abduction  
■ Weak grip & pinch  
■ Ape hand |
| Ulnar | C7–8, T1 | FCU, palmaris brevis, hypothenar eminence, adductor pollicis, medial 2 lumbricales, interossei | ■ Weak wrist flexion & UD  
■ Weak 5th finger flexion  
■ Weak finger abd/adductor  
■ Benediction sign |
| Radial| C5–8, T1 | Anconeus, brachioradialis, ECRL, ECRB, extensor digitorum, APL, ECU, extensor indicis, extensor digit minimi | ■ Weak supination, wrist extension, finger flexion, thumb abduction  
■ Weak grip due to loss of wrist stabilization |
## Brachial Plexus–Roots, Muscles, Deficits, & Deformities

<table>
<thead>
<tr>
<th>Nerve &amp; Root</th>
<th>Muscles</th>
<th>Functional Deficits</th>
<th>Postural Deformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radial C5–8 T1</td>
<td>Anconeus, brachioradialis, ECRL, ECRB, extensor digitorum, APL, ECU, extensor indicis, extensor digiti minimi</td>
<td>■ Weak supination, wrist ext, finger flex, thumb abd</td>
<td>■ Weak grip due to loss of wrist stabilization</td>
</tr>
<tr>
<td>Median C6–8 T1</td>
<td>Pronator teres, FCR, palmaris long, FDS, FPL, pronator quadratus, thenar eminence, lateral 2 lumbricales</td>
<td>■ Weak pronation, wrist flex, &amp; RD</td>
<td>■ Weak thumb flex &amp; abd</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Weak grip &amp; pinch</td>
<td>■ Ape hand</td>
</tr>
<tr>
<td>Ulnar C7–8 T1</td>
<td>FCU, palmaris brevis, hypothenar eminence, adductor pollicis, medial 2 lumbricales, interossei</td>
<td>■ Weak wrist flex &amp; UD</td>
<td>■ Weak 5th finger flex</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Weak finger abd/add</td>
<td>■ Benediction sign (Bishop’s deformity)</td>
</tr>
</tbody>
</table>

Special Tests

Neural Tissue Provocation Tests

See Alerts/Alarms page 14.

Elbow Tests

**VARUS STRESS**

**Purpose:** Assess LCL/RCL  
**Position:** Elbow slightly flexed, humerus stabilized proximal to elbow (testing in prone enhances stabilization)  
**Technique:** Apply a varus force to joint line to stress LCL  
**Interpretation:** + test = pain or joint gapping/instability

**VALGUS STRESS**

**Purpose:** Assess MCL/UCL  
**Position:** Elbow slightly flexed, humerus stabilized proximal to elbow (testing in prone enhances stabilization)  
**Technique:** Apply a valgus force to joint line to stress MCL  
**Interpretation:** + test = pain or joint gapping/instability

**ACTIVE ELBOW TEST**

**Purpose:** Assess MCL/UCL  
**Position:** Sitting with shoulder in 90° abduction & elbow in full flexion  
**Technique:** Apply a valgus force to elbow to take shoulder into full ER & while maintaining valgus force, quickly extend the elbow  
**Interpretation:** + test = medial elbow pain between 120° & 70° of elbow motion
**PRONATOR TERRIS TEST**

**Purpose:** Assess for median nerve entrapment  
**Position:** UE relaxed in supported position  
**Technique:** Resist pronation of forearm  
**Interpretation:** + test = pain along the palmar aspect of digits 1, 2, & 3 (median nerve distribution)

**MILL’S TEST**

**Purpose:** Assess for lateral epicondylitis  
**Position:** UE relaxed, elbow extended  
**Technique:** Passively stretch into wrist flexion & pronation  
**Interpretation:** + test = pain @ lateral epicondyle or proximal musculotendinous junction of wrist extensors

**COZEN’S SIGN**

**Purpose:** Assess for lateral epicondylitis  
**Position:** UE relaxed, elbow extended  
**Technique:** Resist supination & wrist extension OR resist middle finger extension (extensor digitorum)  
**Interpretation:** + test = pain @ lateral epicondyle or proximal musculotendinous junction of wrist extensors
**PASSIVE TEST**

**Purpose:** Assess for medial epicondylitis  
**Position:** UE relaxed, elbow extended  
**Technique:** Stretch into wrist extension & supination  
**Interpretation:** + test = pain @ medial epicondyle or proximal musculotendinous junction of wrist flexors

**RESISTIVE TEST**

**Purpose:** Assess for medial epicondylitis  
**Position:** UE relaxed, elbow extended  
**Technique:** Resist pronation & wrist flexion  
**Interpretation:** + test = pain @ medial epicondyle or proximal musculotendinous junction of wrist flexors

**WARTENBERG’S TEST**

**Purpose:** Assess for ulnar nerve entrapment  
**Position:** UE relaxed in supported position  
**Technique:** Resist 5th digit adduction  
**Interpretation:** + test = weakness of 5th digit adductors

**POSTEROLATERAL or ROTATORY INSTABILITY**

**Purpose:** Assess for elbow instability  
**Position:** Elbow extended  
**Technique:** Apply an axial load with a valgus stress & supination  
**Interpretation:** + test = elbow subluxes with extension & relocates with flexion
**Tinel’s Test**

**Purpose:** Assess ulnar nerve

**Position:** Elbow in slight flexion

**Technique:** Tap groove between olecranon & lateral epicondyle

**Interpretation:** + test = pain & tingling in the distribution of ulnar nerve (4th & 5th digits)

**Statistics:** Sensitivity = 28% & specificity = 23%

---

**Differential Diagnosis**

<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Elbow Dislocation (posterior)</strong>—</td>
<td>Pain, inability to flex elbow, deformity, tenderness</td>
</tr>
<tr>
<td>common in children &amp; young adults</td>
<td>Confirmed by x-ray</td>
</tr>
<tr>
<td>due to a FOOSH</td>
<td>Need to r/o fx &amp; check distal pulses</td>
</tr>
<tr>
<td></td>
<td><strong>Beware</strong> of possible development of myositis ossificans in brachialis muscle</td>
</tr>
<tr>
<td><strong>Radial Head Subluxation</strong>—common</td>
<td>Child will autosplint in pronation &amp; flex</td>
</tr>
<tr>
<td>in children 2–4 yo resulting from</td>
<td>Radial head is TTP &amp; child reports wrist discomfort from ↑ pressure from radial</td>
</tr>
<tr>
<td>a child being picked up or swung by</td>
<td>head being displaced distally</td>
</tr>
<tr>
<td>the hand or forearm &amp; creating a</td>
<td>X-ray if fx is suspected</td>
</tr>
<tr>
<td>distraction force</td>
<td>Reduction process = thumb in cubital fossa to serve as a fulcrum, supinate &amp;</td>
</tr>
<tr>
<td></td>
<td>flex the forearm (will “pop” in)</td>
</tr>
<tr>
<td><strong>MCL Sprain</strong>—elongation/tear of</td>
<td>Acute trauma may experience a “pop”</td>
</tr>
<tr>
<td>ligament(s); common in throwing</td>
<td>TTP @ medial joint line</td>
</tr>
<tr>
<td>athletes 2° valgus stress</td>
<td>Valgus instability</td>
</tr>
<tr>
<td></td>
<td>Confirm with MRI; need to r/o avulsion</td>
</tr>
</tbody>
</table>

*Continued*
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
</table>
| **Olecranon Bursitis**—“student’s elbow”—may result from direct trauma or repetitive UE activity | ■ Defined mass at the olecranon that is warm, thick, & “gritty” to palpation  
■ ↓ Elbow extension with nonspecific TTP  
■ MRI used to confirm |
| **Humerus & Radial Head Fracture**—results from a FOOSH | ■ Need to r/o avulsion & RCL/UCL sprain |
| **Ulnar Neuritis**—results from repetitive activity or trauma | ■ AP & lateral plain film to confirm  
■ Weak UD, 4th & 5th finger flexion  
■ Pain with elbow flexion  
■ (+) Tests: Tinel’s, Wartenberg’s, & NTPT  
■ Paresthesia into forearm & 5th digit  
■ Need to r/o C-spine pathology & TOS |
| **Osteochondritis Dissecans**—results from repetitive valgus stresses, such as throwing or gymnastics or frequent compressive forces (avascularity of subchondral bone = Panner’s disease) | ■ Confirm with MRI  
■ Lateral elbow pain with ↓ elbow extension  
■ Catching/locking of the elbow; pain with UE WB  
■ Crepitus with pronation/supination  
■ X-ray, MRI, CT are helpful in identifying a loose body |
| **Reflex Sympathetic Dystrophy or Complex Regional Pain Syndrome**—may be linked to previous trauma but a large percentage have no precipitating factor | ■ Abnormal reflexes; varied manifestations of pain, burning, & edema  
■ Nerve adhesions = (+) NTPT (movement is painful)  
■ Vasomotor instability & trophic changes span from warm, redness over dorsum of MP & IP joints, & excessive moisture to cold temperature, pallor, & dryness of hand  
■ Osteoporosis  
■ MRI may or may not be helpful |

*Continued*
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avulsion/Stress Fracture of Medial Epicondyle = “Little League Elbow”—2° repetitive throwing motion; seen in teenagers with acceleration of UE with elbow flexion &amp; valgus stress</td>
<td>■ Progressive pain &amp; TTP @ medial epicondyle  &lt;br&gt; ■ ↓ ROM  &lt;br&gt; ■ (+) Valgus stress test  &lt;br&gt; ■ Confirm with x-ray or MRI</td>
</tr>
<tr>
<td>Medial Epicondylitis—“Golfer’s Elbow”—insidious onset 2° to repetitive forces on the elbow; effects pronator teres &amp; FCR</td>
<td>■ Pain with resisted wrist flexion &amp; UD &amp;/or passive stretching into wrist extension &amp; supination with RD  &lt;br&gt; ■ TTP at proximal musculotendinous jctn of wrist flexors &amp; pronators  &lt;br&gt; ■ (+) Passive &amp; resistive tests  &lt;br&gt; ■ MRI may confirm diagnosis &amp; r/o fx or avulsion</td>
</tr>
<tr>
<td>Lateral Epicondylitis—“Tennis Elbow”—overuse or microtrauma to lateral musculature; may result from a small racket grip, a racket that is too stiff or heavy, or a small sweet spot; usually involves ECRB</td>
<td>■ Morning stiffness  &lt;br&gt; ■ Pain with resisted wrist extension, supination, &amp; RD OR passive stretching into wrist flexion, pronation, &amp; UD  &lt;br&gt; ■ (+) Tests: Cozen’s &amp; Mill’s  &lt;br&gt; ■ TTP at proximal musculotendinous junction of wrist extensors &amp; supinators  &lt;br&gt; ■ MRI may confirm diagnosis &amp; r/o fx or avulsion</td>
</tr>
</tbody>
</table>
Anatomy

- Extensor pollicis longus tendon
- Abductor pollicis longus tendon
- Adductor pollicis muscle
- Opponens pollicis muscle
- First lumbrical muscle
- First dorsal interosseous muscles
- Long extensor tendon
- Extensor pollicis longus tendon
- Extensor pollicis brevis tendon
- Abductor pollicis brevis muscle
Medical Red Flags

- Digital clubbing
- Acute pulmonary abscess
- Pulmonary malignancy
- Cirrhosis
- Heart disease
- Ulcerative colitis
- COPD

- Spoon nails
  - Anemia
  - Thyroid px
  - Syphilis
  - Rheumatic fever

- Eggshell nails = thinning/semitransparent = syphilis

- Nail inflammation, infection, biting

- Paresthia in glove distribution
  - DM
  - Lead/mercury poisoning

- Hand tremor
  - Parkinsonism
  - Hypoglycemia
  - Hyperthyroidism
  - ETOH
  - MS

- Causes of CTS
  - Hx of statins (cholesterol drugs: Zocor or Lipitor)
  - Liver disease
  - Hypothyroidism
  - Gout
  - DM
  - Pregnancy/oral contraceptives
  - B₆ vitamin deficiency
Rheumatoid Hand Functional Disability Scale That Assesses Functional Handicap

Answer the following questions regarding your ability without the help of any assistive devices:

Answers to the questions:  
0 = Yes, without difficulty  
1 = Yes, with a little difficulty  
2 = Yes, with some difficulty  
3 = Yes, with much difficulty  
4 = Nearly impossible to do  
5 = Impossible

- Can you hold a bowl?
- Can you seize a full bottle & raise it?
- Can you hold a plate full of food?
- Can you pour liquid from a bottle into a glass?
- Can you unscrew the lid from a jar opened before?
- Can you cut meat with a knife?
- Can you prick things well with a fork?
- Can you peel fruit?
- Can you button your shirt?
- Can you open & close a zipper?
- Can you squeeze a new tube of toothpaste?
- Can you hold a toothbrush efficiently?
- Can you write a short sentence with a pencil or ordinary pen?
- Can you write a letter with a pencil or ordinary pen?
- Can you turn a round door knob?
- Can you cut a piece of paper with scissors?
- Can you pick up coins from a table top?
- Can you turn a key in a lock?

Score:  

Scoring: Summate all scores—the higher the score, the greater the disability

Text rights not available.
## Severity of Symptoms & Functional Status in Carpal Tunnel Syndrome

The following questions refer to your symptoms for a typical 24-hour period during the past 2 weeks. Circle 1 answer for each question.

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
<th>Question</th>
<th>Options</th>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>How severe is the hand or wrist pain you have at night?</strong></td>
<td>1. No pain 2. Mild pain 3. Moderate pain 4. Severe pain 5. Very severe pain</td>
<td><strong>How often did hand or wrist pain wake you up during a typical night in the past 2 weeks?</strong></td>
<td>1. Never 2. 1 time 3. 2–3 times 4. 4–5 times 5. More than 5 times</td>
<td><strong>Do you typically have pain in your hand or wrist during the daytime?</strong></td>
<td>1. No pain 2. Mild pain 3. Moderate pain 4. Severe pain 5. Very severe pain</td>
</tr>
<tr>
<td><strong>How often do you have hand or wrist pain during the daytime?</strong></td>
<td>1. Never 2. 1 time 3. 2–3 times 4. 4–5 times 5. More than 5 times</td>
<td><strong>How long, on average, does an episode of pain last during the daytime?</strong></td>
<td>1. Never have pain 2. Less than 10 minutes 3. 10–60 minutes 4. More than 60 minutes 5. Constantly</td>
<td><strong>Do you have numbness (loss of sensation) in your hand?</strong></td>
<td>1. No numbness 2. Mild numbness 3. Moderate numbness 4. Severe numbness 5. Very severe numbness</td>
</tr>
<tr>
<td><strong>How often did hand numbness or tingling wake you up during a typical night in the past 2 weeks?</strong></td>
<td>1. Never 2. 1 time 3. 2–3 times 4. 4–5 times 5. More than 5 times</td>
<td><strong>Do you have difficulty with the grasping &amp; use of small objects, such as keys or pencils?</strong></td>
<td>1. No difficulty 2. Mild difficulty 3. Moderate difficulty 4. Severe difficulty 5. Very severe difficulty</td>
<td><strong>Scoring:</strong> Summate the scores &amp; divide by 11. The higher the mean score, the more severe the impairment.</td>
<td><strong>Score:</strong> ________________</td>
</tr>
</tbody>
</table>

Referral Patterns

Muscle Pain Referral Patterns

- Flexor digitorum
- Pronator teres
- Flexor pollicis longus
- 1st dorsal interossei
Abductor digiti minimi & 2nd dorsal interossei

Opponens pollicis

Adductor pollicis
Pathologic Observations

- Swan neck: MCP & DIP flexion with PIP hyperextension
- Boutonnière: MCP & DIP extension with PIP flex (ruptured central extension tendon)
- Mallet: flexion of DIP (avulsion)
- Dupuytren’s: flexion of 4th & 5th digits
- Ganglion cyst: defined mass on dorsum of hand
- Pill-rolling tremor: Parkinsonism
- Liver flap: asterixis = flapping tremor resulting from the inability to maintain wrist extension with the forearm supported in a flexed position

- When fist is clenched, all fingers should point to the scaphoid
- Heberden node = DJD of DIP
- Bouchard node = DJD of PIP
- Swan neck = MCP & DIP flexion with PIP hyperextension
- Boutonnière = MCP & DIP extension with PIP flex (ruptured central extension tendon)
- Mallet finger = flexion of DIP (avulsion)
- Dupuytren’s contracture = flexion of 4th & 5th digits
- Ganglion cyst = defined mass on dorsum of hand
- Pill-rolling tremor = Parkinsonism
- Liver flap = asterixis = flapping tremor resulting from the inability to maintain wrist extension with the forearm supported in a flexed position
Palpation Pearls

Trapezoid
Trapezium
Scaphoid
Capitate
Lunate
Hamate
Pisiform
Triquetrum
Wrist Extensor Muscles

Extensor carpi radialis brevis and longus

Extensor digitorum

Extensor carpi ulnaris
Wrist Flexor Muscles

- Pronator teres
- Flexor carpi radialis
- Palmaris longus
- Flexor carpi ulnaris
Edema Assessment

Figure-8 Method to Assess Hand Edema (Palmar Surface)

1. Start distal to the lateral styloid process; go medial across the palm of the hand to the 5th MCP joint

2. Over the knuckles to the 2nd MCP joint

3. Across the palm to the medial styloid process

4. Around the back of the wrist to the lateral styloid process
Figure-8 Method to Assess Hand Edema (Dorsal Surface)

1. Start distal to the medial styloid process; go lateral across the back of the hand to the 2nd MCP joint

2. Over the palmar aspect of the MCP joints to the 5th MCP joint

3. Across the back of the hand to the lateral styloid process

4. Around the front of the wrist to the medial styloid process

Sensory Testing

2-Point Discrimination
Use a Disk-criminator to assess the minimal distance at which the client can distinguish the presence of 2 stimuli. The client should be able to distinguish 4 out of 5 or 7 out of 10 trials.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt;6 mm</td>
</tr>
<tr>
<td>Fair</td>
<td>6–10 mm</td>
</tr>
<tr>
<td>Poor</td>
<td>11–15 mm</td>
</tr>
</tbody>
</table>

Semmes-Weinstein Monofilament Test
With client’s eyes closed, clinician applies a perpendicular force to each test location beginning with the lowest monofilament. Record the number of the monofilament that the client feels before or just as the monofilament bends.

Test locations:
- Base of palm/wrist
- Between central palm & distal palm crease
- Between distal palm crease & web of finger
- Between web of finger & PIP joint
- Between PIP joint & DIP joint
- Between DIP joint & fingertip

Normal Values:

<table>
<thead>
<tr>
<th>Monofilament #</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.44–2.83</td>
<td>Normal sensation</td>
</tr>
<tr>
<td>3.22–4.56</td>
<td>Diminished light touch</td>
</tr>
<tr>
<td>4.74–6.10</td>
<td>Minimal light touch</td>
</tr>
<tr>
<td>6.10–6.65</td>
<td>Poor localization</td>
</tr>
</tbody>
</table>
## Osteokinematics of the Wrist & Hand

<table>
<thead>
<tr>
<th>Joint</th>
<th>Normal ROM</th>
<th>Normal End-feel(s)</th>
<th>Abnormal End-feel(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiocarpal</td>
<td>60°–80° flex</td>
<td>Flex = firm/ligamentous/elastic</td>
<td>Capsular = pronation &amp; supination equally restricted</td>
</tr>
<tr>
<td></td>
<td>60°–70° ext</td>
<td>Ext = firm/ligamentous/elastic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20°–30° RD/UD</td>
<td>RD = bony</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>UD = firm/bony</td>
<td></td>
</tr>
<tr>
<td>CMC thumb</td>
<td>70° abd</td>
<td>Elastic</td>
<td>Capsular = abd &gt; ext</td>
</tr>
<tr>
<td></td>
<td>45°–50° flex</td>
<td>Ext = elastic/capsular/ligamentous</td>
<td></td>
</tr>
<tr>
<td>MCP 2–5</td>
<td>90° flex</td>
<td>Flex = elastic/bony/ligamentous</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Abd = firm/ligamentous</td>
<td></td>
</tr>
<tr>
<td>MCP thumb</td>
<td>75°–90° flex</td>
<td>Flex = bony/firm/ligamentous/elastic</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ext = firm/elastic</td>
<td></td>
</tr>
<tr>
<td>IPs 2–5</td>
<td>100° PIP flex</td>
<td>PIP flex = firm/bony/elastic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>80° DIP flex</td>
<td>PIP ext = firm/ligamentous/elastic</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DIP flex = firm/ligamentous/elastic</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DIP ext = firm/ligamentous/elastic</td>
<td></td>
</tr>
</tbody>
</table>
### Arthrokinematics for Wrist & Hand Mobilization

<table>
<thead>
<tr>
<th>Surface Description</th>
<th>Movement Details</th>
<th>Movement Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Concave surface:</strong> Radius &amp; radioulnar disk</td>
<td>To facilitate wrist flexion: Proximal carpal rolls anterior &amp; glides posterior on radius with distal carpal rolling posterior on the proximal carpal</td>
<td>To facilitate extension: Proximal carpal rolls posterior &amp; glides anterior &amp; on radius with distal carpal rolling posterior &amp; gliding anterior on the proximal carpal</td>
</tr>
<tr>
<td><strong>Convex surface:</strong> Proximal carpals</td>
<td>To facilitate radial deviation: Proximal carpal rolls lateral &amp; glides medial on radius with distal carpal rolling lateral &amp; gliding medial on the proximal carpal</td>
<td>To facilitate ulnar deviation: Proximal carpal rolls medial &amp; glides lateral on radius with distal carpal rolling medial &amp; gliding lateral on the proximal carpal</td>
</tr>
<tr>
<td><strong>Concave surface:</strong> Ulnar notch of radius</td>
<td>To facilitate pronation: Radius rolls &amp; glides medially over the ulna</td>
<td>To facilitate supination: Radius rolls &amp; glides laterally over the ulna</td>
</tr>
<tr>
<td><strong>Convex surface:</strong> Head of ulna</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Continued*
<table>
<thead>
<tr>
<th>Concave surface: Trapezii</th>
<th>To facilitate thumb flexion: Metacarpal rolls &amp; glides medial on trapezium</th>
<th>To facilitate thumb extension: Metacarpal rolls &amp; glides lateral on trapezium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convex surface: Metacarpal</td>
<td>To facilitate thumb abduction: Metacarpal rolls proximal &amp; glides distal on trapezium</td>
<td>To facilitate thumb adduction: Metacarpal rolls distal &amp; glides proximal on trapezium</td>
</tr>
<tr>
<td>Concave surface: Base of proximal phalanx</td>
<td>To facilitate flexion: Proximal phalanx rolls &amp; glides anterior on metacarpal</td>
<td>To facilitate extension: Proximal phalanx rolls &amp; glides posterior on metacarpal</td>
</tr>
<tr>
<td>Convex surface: Head of metacarpal</td>
<td>To facilitate thumb flexion: Distal phalanx rolls &amp; glides anterior on the proximal phalanx</td>
<td>To facilitate thumb extension: Distal phalanx rolls &amp; glides posterior on the proximal phalanx</td>
</tr>
<tr>
<td>Concave surface: Base of proximal phalanx Convex surface: Head of distal phalanx</td>
<td>To facilitate flexion: Distal phalanx rolls &amp; glides anterior on the proximal phalanx</td>
<td>To facilitate extension: Distal phalanx rolls &amp; glides posterior on the proximal phalanx</td>
</tr>
</tbody>
</table>

**Strength & Function**

**Muscle Function**

- Dorsal interossei = “divide” or separate fingers
- Palmar interossei & lumbricales = “pull” fingers together
- Flexor digitorum superficialis test = with finger in extension, isolate PIP flexion
- Flexor digitorum profundus test = with finger in extension, isolate DIP flexion
- Lumbrical test = flex MCP with IPs extended
Power grips:
- Cylindrical grip = FDP, FDS, FPL, FPB, OP, lumbricales, palmar interossei
- Spherical grip = FDP, FDS, FPL, FPB, OP, lumbricales, dorsal interossei
- Hook grip = FDS, FDP

Tools to Evaluate Grip Strength

- Hand-held dynamometer
- Jamar device—power grip in various positions
- Pinch meter:
  - Tip-to-tip = anterior interosseous nerve
  - Pad-to-pad = median nerve
  - 3-jaw chuck = ulnar nerve
- BP cuff inflated to 20 mm Hg; squeeze & assess pressure change

Objective Tests to Assess Hand Function

- Minnesota Rate of Manipulation Test
- Minnesota Manual Dexterity Test
- Purdue Pegboard Test
- Modified Moberg Pick-up Test

Quantitative Measure of Ulnar Impaction

- Assess grip in supinated & pronated wrist positions
- If grip ratio of supination:pronation is
  - = 1, there is no ulnar impaction
  - >1, ulnar impaction is present
### Nerve & Root

<table>
<thead>
<tr>
<th>Nerve &amp; Root</th>
<th>Muscles</th>
<th>Functional Deficits</th>
<th>Postural Deformity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radial C5–8 T1</td>
<td>Anconeus, brachioradialis, ECRL, ECRB, extensor digitorum, APL, ECU, extensor indicis, extensor digiti minimi</td>
<td>■ Weak supination, wrist ext, finger flex, thumb abd  ■ Weak grip due to loss of wrist stabilization</td>
<td></td>
</tr>
<tr>
<td>Median C6–8 T1</td>
<td>Pronator teres, FCR, palmaris long, FDS, FPL, pronator quadratus, thenar eminence, lateral 2 lumbricales</td>
<td>■ Weak pronation, wrist flex &amp; RD  ■ Weak thumb flex &amp; abd  ■ Weak grip &amp; pinch  ■ Ape hand</td>
<td></td>
</tr>
<tr>
<td>Ulnar C7–8 T1</td>
<td>FCU, palmaris brevis, hypothenar eminence, adductor pollicis, medial 2 lumbricales, interossei</td>
<td>■ Weak wrist flex &amp; UD  ■ Weak 5th finger flex  ■ Weak finger abd/add  ■ Benediction sign (Bishop’s deformity)</td>
<td>Claw hand = median &amp; ulnar</td>
</tr>
</tbody>
</table>

Special Tests

Neural Tissue Provocation Tests

See Alerts/Alarms page 14.

Wrist & Hand Tests

**CLAMP SIGN**

**Purpose:** Assess for scaphoid fx  
**Position:** Wrist in pronation & extension  
**Technique:** Grasp web space of the thumb between clinician’s thumb & index finger & gently stress the wrist into UD  
**Interpretation:** + test = pain in the anatomical snuff box  
**Statistics:** Sensitivity = 52% & specificity = 100%

**WATSON’S TEST (Scaphoid shift maneuver)**

**Purpose:** Assess for scaphoid instability  
**Position:** Supinated in neutral  
**Technique:** From the radial side, the clinician uses his thumb on the palmar side & index finger on dorsal side to apply pressure to the distal scaphoid while moving the wrist from UD to RD  
**Interpretation:** + test = removal of pressure will produce a palpable click & dorsal wrist pain

**FINKELSTEIN’S TEST**

**Purpose:** Assess for de Quervain’s syndrome  
**Position:** Form a fist around the thumb  
**Technique:** Ulnarly deviate the wrist  
**Interpretation:** + test = pain along EPB & APL
WRIST VARUS TEST

**Purpose:** Assess RCL

**Position:** Stabilize radius/ulna proximal to wrist in neutral position

**Technique:** Apply a varus stress to the wrist

**Interpretation:** + test = joint line pain or gapping/instability

![WRIST VARUS TEST Image](image)


WRIST VALGUS TEST

**Purpose:** Assess UCL

**Position:** Stabilize radius/ulna proximal to wrist in neutral position

**Technique:** Apply a valgus stress to the wrist

**Interpretation:** + test = joint line pain or gapping/instability

![WRIST VALGUS TEST Image](image)

PHALANX VARUS/VALGUS TEST

**Purpose:** Assess MCL & LCL

**Position:** With finger(s) in neutral, stabilize the proximal phalanx

**Technique:** Apply a varus/valgus stress via the distal phalanx

**Interpretation:** + test = joint line pain or gapping/instability

PHALEN’S TEST

**Purpose:** Assess for CTS

**Position:** Hands relaxed

**Technique:** Maximally flex the wrists so the dorsal surfaces of the hands are in full contact with each other; hold for up to 1 minute

**Interpretation:** + test = numbness or tingling into the median nerve distribution

**Statistics:** Sensitivity = 34%–93% & specificity = 48%–93%
**REVERSE PHALEN’S TEST** (Prayer Sign)

**Purpose:** Assess for CTS  
**Position:** Hands relaxed  
**Technique:** Maximally extend the wrists so the palms of the hands are in full contact with each other; hold for up to 1 minute  
**Interpretation:** + test = numbness or tingling into the median nerve distribution  
**Statistics:** Sensitivity = 88% & specificity = 93%

**FLICK MANEUVER**

**Purpose:** Assess for CTS  
**Position:** Hands relaxed  
**Technique:** Vigorously shake the hands repeatedly  
**Interpretation:** + test = paresthesia into the median nerve distribution  
**Statistics:** Sensitivity = 37% & specificity = 74%

**TINEL’S SIGN**

**Purpose:** Assess for CTS  
**Position:** UE supported in supination  
**Technique:** Tap the volar surface of the wrist  
**Interpretation:** + test = tingling into the median nerve distribution  
**Statistics:** CTS: Sensitivity = 27%–79% & specificity = 65%–98%
FROMENT’S SIGN
**Purpose:** Assess for adductor pollicis weakness 2° ulnar nerve paralysis  
**Position:** Client holds a paper between thumb & index finger  
**Technique:** Clinician tries to tug the paper away  
**Interpretation:** + test = flexion of thumb DIP via FPL will result if the adductor pollicis muscle is impaired by an ulnar nerve px

WARTENBERG’S TEST
**Purpose:** Assess ulnar nerve for entrapment at the elbow  
**Position:** UE relaxed in a supported position  
**Technique:** Resist 5th digit adduction  
**Interpretation:** + test = weakness of the 5th digit adduction

MURPHY’S SIGN
**Purpose:** Assess for lunate dislocation  
**Position:** Make a fist  
**Technique:** Observe alignment of MC joints  
**Interpretation:** + test = 3rd MCP is level with 2nd & 4th, (normally 3rd MCP should project beyond 2nd & 4th)

ALLEN’S TEST
**Purpose:** Test for occlusion of radial or ulnar artery  
**Position:** Hand relaxed, supported in supination  
**Technique:** Clinician compresses both radial & ulnar arteries at the wrist while client clenches hand several times to drain blood out. With client’s hand open, clinician releases pressure on the radial artery—normal hand coloration should return in <5 seconds. Repeat & release ulnar artery  
**Interpretation:** + test = difference between the 2 vessels with respect to refill time or taking >5 seconds for coloration of tissue to return to normal

<table>
<thead>
<tr>
<th>Wrist tests</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flick + Phalen’s</td>
<td>49</td>
<td>62</td>
</tr>
<tr>
<td>Flick + Tinel’s</td>
<td>46</td>
<td>68</td>
</tr>
<tr>
<td>Phalen’s + Tinel’s</td>
<td>41</td>
<td>72</td>
</tr>
</tbody>
</table>
**TFCC LOAD TEST**

**Purpose:** Assess TFCC

**Position:** Wrist in ulnar deviation

**Technique:** Apply a longitudinal load through the 5th metacarpal bone to the TFCC

**Interpretation:** + test = pain @ TFCC

**Statistics:** Sensitivity = 100%

---

**TFCC PRESS TEST/ SUPINATED LIFT TEST**

**Purpose:** Assess TFCC

**Position:** Elbow flexed at 90° & forearm supinated

**Technique:** Client is asked to lift up against resistance (like lifting a table via wrist flexion)

**Interpretation:** + test = compression with UD will ↑ pain @ TFCC

**Statistics:** Sensitivity = 100%
### Differential Diagnosis

<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
</table>
| Colles’ or Smith’s Fracture—distal radial fractures 2° FOOSH with extreme wrist extension; common in adults >50 yo, whereas children = greenstick or epiphyseal growth plate | ■ TTP in anatomical snuffbox  
■ Edema & ecchymosis  
■ Structural deformity with limited ROM  
■ Confirmed via PA, oblique & lateral x-rays (Colles’ fx = distal fragment angles dorsal & Smith’s fx = distal fragment angles palmar) |
| Dupuytren’s Contracture—flexion contracture with thickening of palmar fascia of 4th & 5th digits; etiology is unknown (if associated with DM, may involved 3rd & 4th digits), epilepsy, & (+) family hx; most common in ♂ >40 yo | ■ Nodule in the palmar aponeurosis of the ulnar side & tightening of the natatory ligament  
■ Usually no pain but MCPs are unable to extend  
■ May reappear again weeks or years later  
■ Confirmed with CT or MRI |
| Trigger Finger—results when the demand for manual dexterity & fist clenching tasks exceed the lubricating capacity of the synovial fluid; ↑ incidence in DM & people >40 yo | ■ Tender nodules in flexor tendon @ MC head that moves with the tendon  
■ No active finger flexion  
■ Finger locks in flexion in AM; extension only can be performed passively & there is slight pain with clicking/grating when passively moved  
■ Diagnosis confirmed with CT or MRI |
| De Quervain’s Syndrome—tenosynovitis of the abductor pollicis longus & extensor pollicis brevis > extensor pollicis longus; insidious onset related to pinching or grasping tasks | ■ No numbness, tingling, or edema  
■ AROM of thumb is painful  
■ Pain radiates into distal radial forearm  
■ Pulses are normal  
■ (+) Finkelstein’s test  
■ Confirmed with CT or MRI; should r/o gout |
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
</table>
| **Carpal Tunnel Syndrome (CTS)**—an overuse injury related to repetitive trauma; occurs in ♀ > ♂; may occur during pregnancy | ■ Thenar atrophy but no swelling or trophic changes  
■ Night-time numbness of hand (median nerve pattern)  
■ Thumb weakness & loss of opposition/abduction—specifically APB (beware of substitution of APL, innervated by the radial nerve)  
■ (+) Tests: Phalen’s, Reverse Phalen’s, Flick, Neural provocation, & Tinel sign; (–) TOS  
■ Normal pulses (radial & ulnar arteries do not pass through tunnel)  
■ Sensation of palm is spared  
■ Need to r/o C-spine problem  
■ Confirmed with CT or MRI |
| **Pronator Syndrome**—compression of the median nerve via pronator muscle | ■ Client c/o “heaviness” in the UE  
■ Pain with overpressure into pronation (median nerve distribution)  
■ (–) Phalen’s & Tinel’s sign, ↓ NCV  
■ TTP over pronator teres (~4 cm distal to cubital crease)  
■ Mimics CTS but there is no night pain or weakness  
■ Confirmed with MRI or CT |
| **Gamekeeper’s Thumb**—ulnar collateral ligament injury 2° a forceful radial deviation of the thumb | ■ Localized pain & swelling  
■ TTP @ UCL  
■ (+) Valgus stress  
■ Confirmed with MRI, need to r/o fx & avulsion |
| **Triangular Fibro Cartilage Complex (TFCC)**—injury is the result of forceful rotation of forearm or FOOSH in pronation | ■ (+) Tests: Load & Press test  
■ >1 grip ratio of supination:pronation  
■ TTP @ TFCC  
■ Confirmed with MRI or arthrogram |
| **Ganglion Cyst**—most common mass in the wrist, etiology unknown, may be associated with repetitive motions | ■ Defined round mass in the wrist  
■ May be painful with motion or compression  
■ Not revealed on x-ray, MRI, CT |

Continued
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
</table>
| **Lunate Dislocation**—results from FOOSH | ■ (+) Murphy’s sign  
■ TTP @ lunate with localized swelling  
■ Painful wrist ROM  
■ May cause paresthesia if median nerve is involved  
■ Confirmed with x-ray, need to r/o fx |
| **Tendon Rupture**—results from trauma | ■ Edema & TTP are tendon specific  
■ Failure to actively move a joint:  
  ■ EPL = no thumb IP ext (mallet finger)  
  ■ FPL = no thumb IP flex  
  ■ ED = no isolated long finger ext (mallet finger)  
  ■ FDP = no DIP flexion (jersey finger)  
  ■ FS = no PIP flexion  
■ Confirmed with MRI or CT; need to r/o fx or avulsion |
| **Raynaud’s Syndrome**—cold-induced reflex digital vasoconstriction & ischemia | ■ Pallor, cyanosis then redness of digits (cyclic)  
■ (–) TOS test(s)  
■ Clear C-spine  
■ ROM, strength, & sensation = WNL  
■ Confirmed via Doppler |
| **Complex Regional Pain Syndrome**—etiology unknown, may occur after trauma See stages next page. | ■ Hyperalgesia & hyperhydrosis  
■ Capsular tightness & stiffness  
■ Muscle atrophy & osteoporosis  
■ Trophic changes & edema  
■ Vasomotor instability |
| Stage 1 | • Burning, aching, tenderness, joint stiffness  
|         | • Swelling, temperature changes  
|         | • ↑ nail growth & ↑ hair on hands |
| Stage 2 | • ↑ Pain, swelling, joint stiffness  
|         | • Pain becomes less localized  
|         | • Change in skin color & texture |
| Stage 3 | • Pain radiates all the way up the arm  
|         | • ↓ NCV  
|         | • Muscle atrophy |
Ligaments of the neck

Cruciform ligament
- Superior longitudinal fibers
- Transverse ligament of atlas
- Inferior longitudinal fibers

Atlas (C1)
- Alar ligament
- Tectorial membrane

Axis (C2)

Muscles of the neck & face (lateral view)

- Lateral pterygoid muscle
- Medial pterygoid muscle
- Masseter muscle (cut)
- Hyoid bone
- Thyrohyoid muscle
- Omohyoid muscle
- Sternohyoid muscle
- Sternocleidomastoid muscle
- Sternius muscle
- Levator scapulae muscle
- Trapezius muscle
- Acromion process
- Scalene muscles
- Clavicle
- Sternum
- Digastric muscle
- Stylohyoid muscle
- Sternohyoid muscle
- Thyrohyoid muscle
- Omohyoid muscle
Deep muscles of the neck & back

- Longissimus capitis muscle
- Splenius capitis muscle
- Semispinalis capitis muscle
- Serratus posterior superior muscle
- Iliocostalis muscle
- Longissimus muscle
- Spinalis muscle
- Erector spinae muscle:
  - Iliocostalis muscle
  - Longissimus muscle
  - Spinalis muscle
- Serratus posterior inferior muscle
- Internal abdominal oblique muscle
- Iliac crest of pelvis
- Rectus capitis posterior minor muscle
- Superior obliquus capitis muscle
- Rectus capitis posterior major muscle
- Inferior obliquus capitis muscle
- Spinalis thoracis muscle
- Longissimus thoracis muscle
- Iliocostalis lumborum muscle
- Transverse abdominis muscle
Superficial muscles of the neck & back

- Sternocleidomastoid muscle
- Trapezius muscle
- Spine of scapula
- Deltoid muscle
- Teres minor muscle
- Teres major muscle
- Infraspinatus muscle
- Latissimus dorsi muscle
- External oblique muscle
- Erector spinae muscles
- Iliac crest of pelvis
- Gluteus medius muscle
- Gluteus maximus muscle
- Serratus posterior inferior muscle
- External oblique muscle
- Internal oblique muscle
Abdominal muscles

Ligaments of the pelvis

### Spine Medical Red Flags

- Individuals <20 & >55 yo with persistent night pain, change in B&B control, (B) LE signs, PMH of CA, nonmechanical pain, SED rate >25
- Mid-thoracic pain = MI, GB
- Pain from 6th–10th thoracic vertebra = peptic ulcer
- History of prostate CA
- Pulsing LBP = vascular problem (aortic aneurysm)
- Faun’s beard = spina bifida
- Café au lait spots = neurofibromatosis
- Upper back/neck pain that ↑ with deep breathing, coughing, laughing & ↓ with breath holding; recent hx may include fever URI, flu, MI = pericarditis
- Enlarged cervical lymph nodes, severe pruritus, irregular fever = Hodgkin’s disease
- Pain at McBurney’s point = ⅓–½ the distance from (R) ASIS to umbilicus; tenderness = appendicitis

### Risk Factors for Chronicity of Spinal Dysfunction

- Total work loss secondary LBP
- Numbness & paraesthesia in the same distribution
- Previous LBP
- Smoker
- Depression
- Personal px–alcohol, marital, financial
- Poor fitness
- Adversarial legal proceedings
- Radiating LE pain
- Low job satisfaction
## Toolbox Tests

### Neck Disability Index For Chronic Pain

<table>
<thead>
<tr>
<th>Pain Intensity</th>
<th>Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>_ I have no pain at the moment</td>
<td>_ I can do as much as I want to</td>
</tr>
<tr>
<td>_ The pain is very mild at the moment</td>
<td>_ I can only do my usual work but not more</td>
</tr>
<tr>
<td>_ The pain is moderate at the moment</td>
<td>_ I can do most of my usual work, but not more</td>
</tr>
<tr>
<td>_ The pain is fairly severe at the moment</td>
<td>_ I cannot do my usual work</td>
</tr>
<tr>
<td>_ The pain is very severe at the moment</td>
<td>_ I can hardly do any usual work at all</td>
</tr>
<tr>
<td>_ The pain is the worst imaginable at the moment</td>
<td>_ I can’t do any work at all</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Personal Care (washing, dressing, etc.)</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>_ I can look after myself normally w/o causing extra pain</td>
<td>_ I can concentrate fully when I want to with no difficulty</td>
</tr>
<tr>
<td>_ I can look after myself normally but it causes extra pain</td>
<td>_ I can concentrate fully when I want to with slight difficulty</td>
</tr>
<tr>
<td>_ It is painful to look after myself &amp; I am slow &amp; careful</td>
<td>_ I have a fair degree of difficulty concentrating when I want</td>
</tr>
<tr>
<td>_ I need some help but manage most of my personal care</td>
<td>_ I have a lot of difficulty concentrating when I want</td>
</tr>
<tr>
<td>_ I need help every day in most aspect of self care</td>
<td>_ I have a great deal of difficulty concentrating when I want</td>
</tr>
<tr>
<td>_ I cannot get dressed, wash with difficulty &amp; stay in Bed</td>
<td>_ I cannot concentrate at all</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lifting</th>
<th>Driving</th>
</tr>
</thead>
<tbody>
<tr>
<td>_ I can lift heavy weights without extra pain</td>
<td>_ I can drive my car without neck pain</td>
</tr>
<tr>
<td>_ I can lift heavy weights but it gives extra pain</td>
<td>_ I can drive my car as long as I want with slight neck pain</td>
</tr>
<tr>
<td>_ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are on a table</td>
<td>_ I can drive my car as long as I want with moderate neck pain</td>
</tr>
<tr>
<td>_ Pain prevents me from lifting heavy weights but I can manage if they are conveniently placed</td>
<td>_ I can’t drive my car as long as I want because of moderate neck pain</td>
</tr>
<tr>
<td>_ I can lift only very light weights</td>
<td>_ I can hardly drive at all because of severe neck pain</td>
</tr>
<tr>
<td>_ I cannot lift or carry anything at all</td>
<td>_ I can’t drive my car at all</td>
</tr>
</tbody>
</table>

*Continued*
## Neck Disability Index For Chronic Pain—cont’d

### Reading
- __I can read as much as I want with no pain in my neck__
- __I can read as much as I want with slight pain in my neck__
- __I can read as much as I want with moderate pain in my neck__
- __I can’t read as much as I want because of moderate pain in my neck__
- __I can hardly read at all because of severe pain in my neck__
- __I cannot read at all__

### Recreation
- __I am able to engage in all my recreational activities with no neck pain__
- __I am able to engage in all my recreational activities with some neck pain__
- __I am able to engage in most but not all of my usual recreational activities because of neck pain__
- __I am able to engage in a few of my usual recreational activities with some neck pain__
- __I can hardly do any recreational activities because of neck pain__
- __I can’t do any recreational activities at all__

### Headache
- __I have no headaches at all__
- __I have slight headaches which come infrequently__
- __I have moderate headaches which come infrequently__
- __I have moderate headaches which come frequently__
- __I have severe headaches which come infrequently__
- __I have headaches almost all the time__

### Sleeping
- __I have no trouble sleeping__
- __My sleep is slightly disturbed (<1-hr sleep loss)__
- __My sleep is mildly disturbed (1- to 2-hr sleep loss)__
- __My sleep is moderately disturbed (2- to 3-hr sleep loss)__
- __My sleep is greatly disturbed (3- to 5-hr sleep loss)__
- __My sleep is completely disturbed (5- to 7-hr sleep loss)__

### Score:

**Scoring:** The items are scored in descending order with the top statement = 0 & the bottom statement = 5. All subsections are added together for a cumulative score. The higher the score, the greater the disability.

### Oswestry Low Back Pain Questionnaire

#### Pain Intensity

<table>
<thead>
<tr>
<th>Pain Intensity</th>
<th>__ I can tolerate the pain without using pain killers</th>
<th>__ The pain is bad but I manage without pain killers</th>
<th>__ Pain killers give complete relief from pain</th>
<th>__ Pain killers give moderate relief from pain</th>
<th>__ Pain killers give very little relief from pain</th>
<th>__ Pain killers have no effect on the pain; I don't use them</th>
</tr>
</thead>
<tbody>
<tr>
<td>Even when I take tablets, I have &gt; 2 hours sleep</td>
<td>__ I can stand as long as</td>
<td>want but it given me extra pain</td>
<td>__ I can stand as long as</td>
<td>want without extra pain</td>
<td>__ I can tolerate the pain without using pain killers</td>
<td>__ The pain is bad but</td>
</tr>
<tr>
<td>Even when I take tablets, I have &gt; 4 hours sleep</td>
<td>__ I can sleep well only by using tablets</td>
<td>__ Pain does not prevent me from sleeping well</td>
<td>__ Pain prevents me from standing for &lt; 1 hour</td>
<td>__ Pain prevents me from standing for &lt; 1/2 hour</td>
<td>__ Pain prevents me from standing for &lt; 10 minutes</td>
<td>__ Pain prevents me from standing at all</td>
</tr>
<tr>
<td>Even when I take tablets, I have &gt; 6 hours sleep</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
<td>__</td>
</tr>
</tbody>
</table>

#### Standing

| Standing | __ I can stand as long as | want but it given me extra pain | __ I can stand as long as | want without extra pain | __ I can tolerate the pain without using pain killers | __ The pain is bad but | manage without pain |
|----------|-----------------------------------------------------|-----------------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|-----------------------------------------------------|
| Even when I take tablets, I have > 2 hours sleep | __ I can sleep well only by using tablets | __ Pain does not prevent me from sleeping well | __ Pain prevents me from standing for < 1 hour | __ Pain prevents me from standing for < 1/2 hour | __ Pain prevents me from standing for < 10 minutes | __ Pain prevents me from standing at all |
| Even when I take tablets, I have > 4 hours sleep | __ | __ | __ | __ | __ | __ |
| Even when I take tablets, I have > 6 hours sleep | __ | __ | __ | __ | __ | __ |

#### Personal Care (washing, dressing, etc.)

<table>
<thead>
<tr>
<th>__ I can look after myself normally without using tablets</th>
<th>__ I can look after myself normally but it causes extra pain</th>
<th>__ I can look after myself after my self normally with extra help</th>
</tr>
</thead>
<tbody>
<tr>
<td>__ I can look after myself after my self normally with extra help</td>
<td>__ I can look after myself after my self normally with extra help</td>
<td>__ I can look after myself after my self normally with extra help</td>
</tr>
<tr>
<td>__ I can look after myself after my self normally with extra help</td>
<td>__ I can look after myself after my self normally with extra help</td>
<td>__ I can look after myself after my self normally with extra help</td>
</tr>
</tbody>
</table>

#### Pain

<table>
<thead>
<tr>
<th>Pain Intensity</th>
<th>__ I stay in bed</th>
<th>__ I cannot get dressed, wash with difficulty</th>
<th>__ I need help every day in most aspect of self care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain Intensity</td>
<td>__ I stay in bed</td>
<td>__ I cannot get dressed, wash with difficulty</td>
<td>__ I need help every day in most aspect of self care</td>
</tr>
<tr>
<td>Pain Intensity</td>
<td>__ I stay in bed</td>
<td>__ I cannot get dressed, wash with difficulty</td>
<td>__ I need help every day in most aspect of self care</td>
</tr>
</tbody>
</table>

In every section, please mark the one response that most closely describes your problem.
### Oswestry Low Back Pain Questionnaire—cont’d

#### Lifting
- I can lift heavy weights without extra pain
- I can lift heavy weights but it gives extra pain
- Pain prevents me from lifting heavy weights off the floor, but I can manage if they are on a table
- Pain prevents me from lifting heavy weights but I can manage if they are conveniently placed
- I can only lift very light weights
- I cannot lift or carry anything at all

#### Walking
- Pain does not prevent me walking any distance
- Pain prevents me walking more than 1/4 mile
- Pain prevents me walking more than 1/2 mile
- Pain prevents me walking more than 1 mile
- Pain prevents me walking more than 1/2 mile
- I can only walk using a stick or crutches
- I am in bed most of the time and have to crawl

#### Sex Life
- My sex life is normal and causes no extra pain
- My sex life is nearly normal but causes some extra pain
- My sex life is severely restricted by pain
- My sex life is nearly absent because of pain
- My sex life is very painful
- My sex life is nearly absent because of pain

#### Social Life
- My social life is normal and gives me no extra pain
- My social life is nearly normal but increases the degree of pain
- My social life is normal but increases the degree of pain
- Pain has restricted my social life to my home
- Pain has restricted my social life but I do not go out as often
- My social life is normal but increases the degree of pain
- Pain has no significant effect on my social life
Oswestry Low Back Pain Questionnaire—cont’d

**Sitting**

<table>
<thead>
<tr>
<th>Item</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can sit in any chair as long as I like</td>
<td>0</td>
</tr>
<tr>
<td>I can only sit in my favorite chair as long as I like</td>
<td>1</td>
</tr>
<tr>
<td>Pain prevents me sitting more than 1 hour</td>
<td>2</td>
</tr>
<tr>
<td>Pain prevents me sitting more than 1⁄2 hour</td>
<td>3</td>
</tr>
<tr>
<td>Pain prevents me sitting more than 10 minutes</td>
<td>4</td>
</tr>
<tr>
<td>Pain prevents me sitting at all</td>
<td>5</td>
</tr>
</tbody>
</table>

Score: The items are scored in descending order with the top statement = 0 & the bottom statement = 5. The sum of the score is multiplied by 2.

Score: The items are scored in descending order with the top statement = 0 & the bottom statement = 5. The sum of the score is multiplied by 2.

**Traveling**

<table>
<thead>
<tr>
<th>Item</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can travel anywhere without extra pain</td>
<td>0</td>
</tr>
<tr>
<td>I can travel anywhere but it gives me extra pain</td>
<td>1</td>
</tr>
<tr>
<td>I can travel anywhere but it gives me extra pain &amp; it gives me extra pain</td>
<td>2</td>
</tr>
<tr>
<td>Pain is bad but I manage journeys over 2 hours</td>
<td>3</td>
</tr>
<tr>
<td>Pain restricts me to journeys over 1 hour</td>
<td>4</td>
</tr>
<tr>
<td>Pain restricts me to journeys over 1⁄2 hour</td>
<td>5</td>
</tr>
</tbody>
</table>

Score: The items are scored in descending order with the top statement = 0 & the bottom statement = 5. The sum of the score is multiplied by 2.

Results:

= crippled: 80%–100% = bed bound or symptom magnification
= severe disability: 60%–80% = severe disability
= moderate disability: 40%–60% = moderate disability
= minimal disability: 20%–40% = minimal disability
= minimal disability: 0–20% = minimal disability

Ransford Pain Drawings

Indicate where your pain is located & what type of pain you feel at the present time. Use the symbols below to describe your pain. Do not indicate areas of pain which are not related to your present injury or condition.

/// Stabbing  XXX Burning
000 Pins & Needles  == = Numbness
Ransford Scoring System

- Unreal drawings (score 2 points for any of the following)
  - Total leg pain
  - Front of leg pain
  - Anterior tibial pain
  - Back of leg & knee pain
  - Circumferential thigh pain
  - Lateral whole leg pain
  - Bilateral foot pain
  - Circumferential foot pain
  - Anterior knee & ankle pain
  - Scattered pain throughout while leg
  - Entire abdomen pain

- Drawings with “expansion” or “magnification” of pain (1–2 points)
  - Back pain radiating into iliac crest, groin, & anterior perineum
  - Pain drawn outside of diagram

- Additional explanations, circles, lines, arrows (1 point each)
- Painful areas drawn in (score 1 for small areas & 2 for large areas)

**Interpretation:** A score of 3 or more points is thought to represent a pain perception that may be influenced by psychological factors

**Score:**
**Short Form McGill Pain Questionnaire**

*Instructions*: Read the following descriptions of pain and mark the number which indicates the level of pain you feel in each category according to the following scale:

<table>
<thead>
<tr>
<th>Category</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throbbing</td>
<td>1-4</td>
</tr>
<tr>
<td>Shooting</td>
<td>1-4</td>
</tr>
<tr>
<td>Stabbing</td>
<td>1-4</td>
</tr>
<tr>
<td>Sharp</td>
<td>1-4</td>
</tr>
<tr>
<td>Cramping</td>
<td>1-4</td>
</tr>
<tr>
<td>Gnawing</td>
<td>1-4</td>
</tr>
<tr>
<td>Hot-Burning</td>
<td>1-4</td>
</tr>
<tr>
<td>Aching</td>
<td>1-4</td>
</tr>
<tr>
<td>Heavy</td>
<td>1-4</td>
</tr>
<tr>
<td>Tender</td>
<td>1-4</td>
</tr>
<tr>
<td>Splitting</td>
<td>1-4</td>
</tr>
<tr>
<td>Tiring-Exhausting</td>
<td>1-4</td>
</tr>
<tr>
<td>Sickening</td>
<td>1-4</td>
</tr>
<tr>
<td>Fearful</td>
<td>1-4</td>
</tr>
<tr>
<td>Punishing-Cruel</td>
<td>1-4</td>
</tr>
</tbody>
</table>

**Total Score: ____________________________**

The higher the score, the more intense the pain.

---

**Present Pain Intensity Index**

*Instructions*: Use the descriptors below to indicate your current level of pain.

0 = No Pain
1 = Mild
2 = Discomforting
3 = Distressing
4 = Horrible
5 = Excruciating
## Referral Patterns

### Cutaneous Pain Referral Patterns from the Viscera

<table>
<thead>
<tr>
<th>Viscera</th>
<th>Segmental Level</th>
<th>Referral Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharynx</td>
<td></td>
<td>Ipsilateral ear</td>
</tr>
<tr>
<td>Heart</td>
<td>T1–5</td>
<td>Sternum, neck</td>
</tr>
<tr>
<td>Bronchi-lungs</td>
<td>T2–4</td>
<td>Shoulder, pect, arm L&gt;R</td>
</tr>
<tr>
<td>Esophagus</td>
<td>T5–6</td>
<td>Neck, arms, sternum (level of the nipple)</td>
</tr>
<tr>
<td>Gastric</td>
<td>T6–10</td>
<td>Lower thoracic to upper abdomen</td>
</tr>
<tr>
<td>GB</td>
<td>T7–9</td>
<td>Upper abdomen (epigastric area), lower scapula, T/L</td>
</tr>
<tr>
<td>Pancreas</td>
<td>T8–9</td>
<td>Upper lumbar, upper abdomen</td>
</tr>
<tr>
<td>Kidneys</td>
<td>T10–L1</td>
<td>Upper lumbar, umbilical area</td>
</tr>
<tr>
<td>Bladder</td>
<td>T11–12</td>
<td>Lower abdomen, lower lumbar, groin</td>
</tr>
</tbody>
</table>

## Headaches

<table>
<thead>
<tr>
<th>Type of Pain</th>
<th>Possible Etiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute</td>
<td>Trauma, infection, impending CVA</td>
</tr>
<tr>
<td>Chronic</td>
<td>Eye strain, ETOH, inadequate ventilation</td>
</tr>
<tr>
<td>Severe &amp; intense</td>
<td>Meningitis, aneurysm, brain tumor</td>
</tr>
<tr>
<td>Throbbing/pulsating</td>
<td>Migraine, fever, hypertension, aortic insufficiency</td>
</tr>
<tr>
<td>Constant</td>
<td>Muscle contraction/guarding</td>
</tr>
<tr>
<td>AM pain</td>
<td>Sinusitis (with discharge), ETOH, hypertension, sleeping position</td>
</tr>
<tr>
<td>Afternoon pain</td>
<td>Eye strain, muscle tension</td>
</tr>
<tr>
<td>Night</td>
<td>Intracranial disease, nephritis</td>
</tr>
<tr>
<td>Forehead</td>
<td>Sinusitis, nephritis</td>
</tr>
<tr>
<td>Temporal</td>
<td>Eye or ear px, migraine</td>
</tr>
<tr>
<td>Occipital</td>
<td>Herniated disk, eye strain, hypertension</td>
</tr>
<tr>
<td>Parietal</td>
<td>Meningitis, constipation, tumor</td>
</tr>
<tr>
<td>Face</td>
<td>Sinusitis, trigeminal neuralgia, dental px, tumor</td>
</tr>
<tr>
<td>Stabbing pain</td>
<td>With ear fullness, tinnitus, vertigo = otitis media</td>
</tr>
<tr>
<td>Severe pain</td>
<td>With fever, (+) Kernig’s sign = meningitis</td>
</tr>
<tr>
<td>Severe, sudden pain</td>
<td>With ↑ BP = subarachnoid hemorrhage</td>
</tr>
<tr>
<td>Intermittent pain</td>
<td>With fluctuating consciousness = subdural hematoma</td>
</tr>
</tbody>
</table>
Dermatomes

Muscle Pain Referral Patterns

Scalenes

Sternocleidomastoid

Trapezius
Latissimus dorsi

Quadratus Lumborum

Gluteus maximus
### Palpation Pearls

#### Landmarks

<table>
<thead>
<tr>
<th>Vertebral Level</th>
<th>Identification Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>1 fingerwidth below mastoid process</td>
</tr>
<tr>
<td></td>
<td>2 fingerwidths below occipital protuberance</td>
</tr>
<tr>
<td>C2</td>
<td>Angle of the mandible</td>
</tr>
<tr>
<td></td>
<td>3 fingerwidths below occipital protuberance</td>
</tr>
<tr>
<td>C3–4</td>
<td>Posterior to hyoid bone</td>
</tr>
<tr>
<td>C7</td>
<td>Base of neck (prominent posterior spinous process)</td>
</tr>
<tr>
<td>T2</td>
<td>Superior angle of scapula &amp; jugular notch</td>
</tr>
<tr>
<td>T7</td>
<td>Inferior angle of the scapula</td>
</tr>
<tr>
<td>T10</td>
<td>Xiphoid process</td>
</tr>
<tr>
<td>T12</td>
<td>12th rib</td>
</tr>
<tr>
<td>L3</td>
<td>Posterior to umbilicus</td>
</tr>
<tr>
<td>L4</td>
<td>Iliac crest</td>
</tr>
<tr>
<td>S2</td>
<td>Level of PSIS</td>
</tr>
<tr>
<td>Tip of coccyx</td>
<td>Ischial tuberosities</td>
</tr>
</tbody>
</table>
- **Anterior neck muscles** (medial & anterior to lateral & posterior) = sternal branch of SCM, sternohyoid, clavicular branch of SCM, subclavian vein, anterior scalene, subclavian artery, brachial plexus, middle scalene, posterior scalene, levator scapula
- **Posterior neck muscles** (medial to lateral) = rectus capitis, semispinalis, splenius capitis, longissimus capitis
- **Posterior thoracic & lumbar spine** (medial to lateral) = spinalis, longissimus, iliocostalis

### Pathology & Compensatory Strategies That Influence Limb Length

<table>
<thead>
<tr>
<th>Lengthen of LE</th>
<th>Shortening of LE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior rotation of SI</td>
<td>Posterior rotation of SI</td>
</tr>
<tr>
<td>Extension of hip</td>
<td>Hike/flex hip; IR of hip</td>
</tr>
<tr>
<td>ER of hip</td>
<td>Circumduct LE</td>
</tr>
<tr>
<td>Supination of foot</td>
<td>Flexion of the knee</td>
</tr>
<tr>
<td></td>
<td>Varus/valgus of knee</td>
</tr>
<tr>
<td></td>
<td>Pronation of foot</td>
</tr>
</tbody>
</table>

### ROM

#### Cervical Normal Ranges

<table>
<thead>
<tr>
<th>Motion</th>
<th>Segment(s)</th>
<th>Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>FB/BB</td>
<td>Suboccipital (nod)</td>
<td>20°–25°</td>
</tr>
<tr>
<td></td>
<td>Mid-cervical</td>
<td>30°–35°</td>
</tr>
<tr>
<td>SB</td>
<td>Suboccipital (primarily A/A)</td>
<td>20°</td>
</tr>
<tr>
<td></td>
<td>Mid-cervical</td>
<td>25°</td>
</tr>
<tr>
<td>Rot</td>
<td>Suboccipital</td>
<td>35°</td>
</tr>
<tr>
<td></td>
<td>Mid-cervical</td>
<td>45°</td>
</tr>
</tbody>
</table>
### Thoracic Normal Ranges

<table>
<thead>
<tr>
<th>Motion</th>
<th>Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>FB</td>
<td>20°–40°</td>
</tr>
<tr>
<td>BB</td>
<td>15°–30°</td>
</tr>
<tr>
<td>SB</td>
<td>25°–30°</td>
</tr>
<tr>
<td>Rot</td>
<td>5°–20°</td>
</tr>
</tbody>
</table>

### Lumbar Normal Ranges

<table>
<thead>
<tr>
<th>Motion</th>
<th>Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>FB</td>
<td>greatest @ L4–5 40°–60°</td>
</tr>
<tr>
<td>BB</td>
<td>20°–25°</td>
</tr>
<tr>
<td>SB</td>
<td>greatest @ L3–4 15°–35°</td>
</tr>
<tr>
<td>Rot</td>
<td>greatest @ L4–S1 5°–20°</td>
</tr>
</tbody>
</table>

**Assessment Methods for Lumbar ROM:**

- **Schober’s Test** = find L4 & mark 5 cm above & 10 cm below. Have client FB & measure distance between 2 points; Normal > 5 cm increase.

- **Modified Schober’s Test** = initial landmark is a mark between the PSIS & then marks at 5 & 10 cm above. Measure the distance between the points to reflect the amount of flexion at each lumbar region.

- **Inclinometer** = (BROM) in standing – place 1 inclinometer on the sacrum & 1 inclinometer over T12 spinous process. Have client FB & the amount of lumbar flexion is calculated by subtracting the sacral angles from the T12 angles.
### Basic Principles

- Hip motion is coupled with innominate motion
- Lumbar motion is coupled with sacral motion
- Nutation means “to nod” = anterior tilt in sagittal plane
- Counternutation = posterior tilt in sagittal plane

<table>
<thead>
<tr>
<th>Joint motion</th>
<th>Innominate</th>
<th>Sacrum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip flexion</td>
<td>Ipsilateral posterior rotation</td>
<td>∅</td>
</tr>
<tr>
<td>Hip extension</td>
<td>Ipsilateral anterior rotation</td>
<td>∅</td>
</tr>
<tr>
<td>Hip IR</td>
<td>Ipsilateral IR or Inflare</td>
<td>∅</td>
</tr>
<tr>
<td>Hip ER</td>
<td>Ipsilateral ER or Outflare</td>
<td>∅</td>
</tr>
<tr>
<td>Lumbar FB</td>
<td>Anterior rotation</td>
<td>Nutation then counternutation</td>
</tr>
<tr>
<td>Lumbar BB</td>
<td>Slight posterior rotation</td>
<td>Nutation</td>
</tr>
<tr>
<td>Lumbar rotation</td>
<td>Ipsilateral posterior rotation &amp; contralateral anterior rotation</td>
<td>Nutates ipsilaterally</td>
</tr>
<tr>
<td>Lumbar SB</td>
<td>Ipsilateral anterior rotation &amp; contralateral posterior rotation</td>
<td>Ipsilateral SB ipsilateral &amp; contralateral SB contralateral</td>
</tr>
</tbody>
</table>
### Arthrokinematics for Spine Mobilization

<table>
<thead>
<tr>
<th>Joint</th>
<th>Concave surface:</th>
<th>To facilitate FB:</th>
<th>To facilitate BB:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanto-occipital joint</td>
<td>Superior atlas facet</td>
<td>Occiput rolls anterior &amp; glides</td>
<td>Occiput rolls posterior &amp; glides</td>
</tr>
<tr>
<td></td>
<td>Occiput</td>
<td>posterior</td>
<td>anterior</td>
</tr>
<tr>
<td>Atlantoaxial joint</td>
<td>Inferior atlas facet</td>
<td>Atlas pivots on axis</td>
<td>Atlas pivots on axis</td>
</tr>
<tr>
<td></td>
<td>Superior axis facet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Intracervical segments</td>
<td>Facets are oriented @ 45° in horizontal &amp; frontal planes</td>
<td>Inferior facet of superior vertebrae glides up &amp; FW on superior facet of inferior vertebrae</td>
<td>Inferior facet of superior vertebrae glides down &amp; back on superior facet of inferior vertebrae</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>To facilitate rotation:</td>
<td>To facilitate rotation:</td>
</tr>
<tr>
<td></td>
<td>Inferior facet of superior vertebrae</td>
<td>Inferior facet of superior vertebra</td>
<td>Inferior facet of superior vertebra</td>
</tr>
<tr>
<td></td>
<td>glides posterior &amp; inferior on ipsilateral side &amp; anterior &amp; superior on contralateral side</td>
<td>glides posterior &amp; inferior on ipsilateral side &amp; anterior &amp; superior on contralateral side</td>
<td>glides inferior &amp; posterior &amp; on ipsilateral side &amp; superior &amp; anterior on contralateral side</td>
</tr>
<tr>
<td>*Intracervical segments</td>
<td>Facets are oriented @ 45° in horizontal &amp; frontal planes</td>
<td>To facilitate protraction: Craniocervical segments extend while mid-low cervical segments flex</td>
<td>To facilitate retraction: Craniocervical segments flex while mid-low cervical segments extend</td>
</tr>
</tbody>
</table>

*Continued*
**Thoracic & Lumbar**

<table>
<thead>
<tr>
<th>Thoracic facets are oriented in the frontal plane</th>
<th>Lumbar facets are oriented in the sagittal plane</th>
<th><strong>To facilitate flexion:</strong> Inferior facet of superior vertebra glides up &amp; FW on superior facet of inferior vertebra</th>
<th><strong>To facilitate extension:</strong> Inferior facet of superior vertebra glides down &amp; BW on superior facet of inferior vertebra</th>
</tr>
</thead>
</table>

**To facilitate rotation:** Inferior facet of contralateral superior vertebra compresses against superior facet of inferior facet & inferior facet of ipsilateral superior vertebra separates from superior facet of inferior vertebra

**To facilitate SB:** Inferior facet of superior vertebra slides up on the contralateral side of SB & down on the ipsilateral side of the SB motion

*Left SB & left rotation are coupled motions in the cervical spine.*

**Right rotation & left SB are coupled motions in the lumbar spine.*
## Posture

### Cervical

- ↑ FH = ↑ compression forces on anterior, lower c-vertebra & posterior facets; levator scapula can help to resist these stresses but may result in MTrP or adaptive shortening
- Shoulder protraction may result from GH or AC instability

### Swayback (↑ kyphosis & ↓ lordosis)

- Alters the resting position of the scapula & alters the GH rhythm
- Tight hip extensors
- Weak hip flexors or lower abdominals
- Generalized ↓ strength
- Genu recurvatum = ↑ stress on posterior knee & compression of anterior knee
- Posterior pelvic tilt
- ↑ stress/elongation of anterior hip joint & posterior t-spine
- Shortening of posterior hip ligaments & anterior t-spine ligaments
- Forward head & shoulders

### Lordosis

- Tight hip flexors or back extensors
- Weak hip extensors or abdominals
- Anterior pelvic tilt
- ↑ shear forces on lumbar vertebra
- ↑ compression forces on lumbar facets
- Stress & elongation of anterior spinal ligaments
- Narrowing of L-intervertebral foramen

### Flatback (↓ kyphosis & ↓ lordosis)

- Forward head, posterior pelvic tilt, knee flexion
- Tight hip extensors
- Weak hip flexors & back extensors
- Compressive forces in posterior hip jt, anterior L-spine & posterior T-spine
## Neuromuscular Relationships

<table>
<thead>
<tr>
<th>Motion Segment</th>
<th>Nerve Root</th>
<th>Myotome</th>
<th>Dermatome</th>
<th>Reflex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occ–C1</td>
<td>C1</td>
<td>ϕ</td>
<td>Skull vertex</td>
<td>ϕ</td>
</tr>
<tr>
<td>C1–2</td>
<td>C2</td>
<td>Neck flexion—Rectus capitis &amp; SCM</td>
<td>Temple, forehead, occiput</td>
<td>ϕ</td>
</tr>
<tr>
<td>C2–3</td>
<td>C3</td>
<td>Neck SB—Trapezius &amp; Splenius capitis</td>
<td>Cheek, neck</td>
<td>ϕ</td>
</tr>
<tr>
<td>C3–4</td>
<td>C4</td>
<td>Shoulder elevation—Levator scapula &amp; Trapezius</td>
<td>Clavicle &amp; upper scapula</td>
<td>ϕ</td>
</tr>
<tr>
<td>C4–5</td>
<td>C5</td>
<td>Shoulder abd—Deltoid, Supra/infraspinatus, Biceps</td>
<td>Anterior arm—shoulder to base of 1st digit</td>
<td>Biceps</td>
</tr>
<tr>
<td>C5–6</td>
<td>C6</td>
<td>Elbow flex/Wrist ext—Biceps, ECRL, ECRB, Supinator</td>
<td>Anterior arm to lateral forearm, 1st &amp; 2nd digit</td>
<td>Brachioradialis</td>
</tr>
<tr>
<td>C6–7</td>
<td>C7</td>
<td>Elbow ext/Wrist flex—Triceps, FCU, FCR</td>
<td>Lateral forearm, 2nd, 3rd, &amp; 4th digits</td>
<td>Triceps</td>
</tr>
<tr>
<td>C7–T1</td>
<td>C8</td>
<td>Thumb ext/UD—EPL, EPB, FCU, ECU</td>
<td>Medial arm &amp; forearm to 4th &amp; 5th digits</td>
<td>Triceps</td>
</tr>
<tr>
<td>T1–2</td>
<td>T1</td>
<td>ϕ</td>
<td>Medial forearm to base of 5th digit</td>
<td>ϕ</td>
</tr>
<tr>
<td>T2–3</td>
<td>T2</td>
<td>ϕ</td>
<td>Pectoralis &amp; mid-scapula to medial upper arm &amp; elbow</td>
<td>ϕ</td>
</tr>
</tbody>
</table>

*Continued*
<table>
<thead>
<tr>
<th>Motion Segment</th>
<th>Nerve Root</th>
<th>Myotome</th>
<th>Dermatome</th>
<th>Reflex</th>
</tr>
</thead>
<tbody>
<tr>
<td>T3–5</td>
<td>T3–5</td>
<td>∅</td>
<td>Upper thorax</td>
<td>∅</td>
</tr>
<tr>
<td>T5–7</td>
<td>T5–7</td>
<td>∅</td>
<td>Costal margins</td>
<td>∅</td>
</tr>
<tr>
<td>T8–12</td>
<td>T8–12</td>
<td>∅</td>
<td>Abdominal &amp; lumbar regions</td>
<td>∅</td>
</tr>
<tr>
<td>T12–L1</td>
<td>L1</td>
<td>Iliacus</td>
<td>Back to trochanter &amp; inguinal region</td>
<td>∅</td>
</tr>
<tr>
<td>L1–2</td>
<td>L2</td>
<td>Psoas, iliacus, &amp; adductors</td>
<td>Back to mid-anterior thigh to knee</td>
<td>Cremasteric</td>
</tr>
<tr>
<td>L2–3</td>
<td>L3</td>
<td>Quads</td>
<td>Back &amp; upper buttock to distal anterior thigh &amp; knee</td>
<td>Adductor</td>
</tr>
<tr>
<td>L3–4</td>
<td>L4</td>
<td>Anterior tibialis</td>
<td>Medial buttock to lateral thigh, medial tibia &amp; big toe</td>
<td>Patella</td>
</tr>
<tr>
<td>L4–5</td>
<td>L5</td>
<td>Extensor hallicus longus</td>
<td>Posterior lateral thigh, lateral leg, dorsum of foot, &amp; toes 1, 2, 3</td>
<td>Tib posterior, Med hamstrings</td>
</tr>
<tr>
<td>L5–S2</td>
<td>S1–2</td>
<td>Gluteals, hamstrings, peroneals, gastroc-soleus</td>
<td>Posterior thigh &amp; leg, lateral foot &amp; heel</td>
<td>Achilles</td>
</tr>
<tr>
<td>S2–3</td>
<td>S3</td>
<td>∅</td>
<td>Groin, medial thigh to knee</td>
<td>∅</td>
</tr>
<tr>
<td>S3–4</td>
<td>S4</td>
<td>Bladder &amp; rectum</td>
<td>Perineum &amp; genitals</td>
<td>∅</td>
</tr>
</tbody>
</table>
**SLUMP TEST**

**Purpose:** Assess neural mobility  
**Position:** Sitting with trunk in slumped posture  
**Technique:** While sustaining neck flexion, sequentially add knee extension of 1 LE & then dorsiflexion; repeat with other LE  
**Interpretation:** + test = reproduction of symptoms; compare bilaterally  
**Statistics:** Sensitivity = 83% & specificity = 55%

**SPURLING’S TEST/ CERVICAL QUADRANT SIGN**

**Purpose:** Assess nerve roots & IVF  
**Position:** Seated  
**Technique:** Stand behind client with clinician’s fingers interlocked on top of head & compress (axial load) with c-spine in slight extension & lateral flexion  
**Interpretation:** + test = referred or reproduction of pain; implicates a variety of structures related to compromise of the IVF  
**Statistics:** Sensitivity = 30%–60% & specificity = 74%–100%
**CERVICAL FORAMINAL DISTRACTION TEST**

**Purpose:** Assess cervical mobility, foraminal size, & nerve root impingement  
**Position:** Supine or sitting  
**Technique:** Clinician imparts a controlled distraction force of the C-spine to ↑ the IVF space & decompress the facet jts  
**Interpretation:** + test = ↓ or centralization of symptoms implies an effective means of intervention; pain = spinal ligament tear, annulus fibrosis tear/inflammation, large disk herniation, muscle guarding  
**Statistics:** Sensitivity = 40%–44% & specificity = 90%–100%

**VERTEBRAL ARTERY TEST**

**Purpose:** Test for integrity of internal carotid arteries  
**Position:** Supine  
**Technique:** Place hands under client’s occiput to passively extend & SB C-spine then rotate to ~45° & hold x 30 sec; engage client in conversation while monitoring pupils & affect; repeat with rotation to opposite direction  
**Interpretation:** + test = occlusion of vertebral artery inhibits normal blood flow & may result in nausea, dizziness, diplopia, tinnitus, confusion, nystagmus, unilateral pupil changes
**ALAR LIGAMENT TEST**

**Purpose:** Assess alar ligament integrity

**Position:** Supine

**Technique:** While palpating spinous process (SP) of C2, slightly SB head

**Interpretation:** Under normal conditions, (R) rotation & SB tightens (L) alar ligament & flexion tightens both. Thus, the SP should move immediately in the contralateral direction to SB (+) test = a delay in SP movement of C2 may indicate pathology of the alar ligament (most common in client’s with RA)

**TRANSVERSE LIGAMENT TEST**

**Purpose:** Assess transverse portion of cruciform ligament

**Position:** Supine with head cradled in the clinician’s hands

**Technique:** Anterior & posterior glides are used to locate the anterior arches of C2. Once identified, the C2 arches are stabilized posteriorly with the clinician’s thumbs & the client’s occiput is lifted with the cupped hands to translate the head forward. This glides the head & C1 anterior on C2. Hold for 15-30 seconds

**Interpretation:** + test = Vertigo, nystagmus, paresthesia into face or UE & indicates A-A instability 2° pathology of transverse ligament
LATERAL & AP RIB COMPRESSION

**Purpose:** Assess ribs for fx

**Position:** Supine

**Technique:** With clinician’s hands on the lateral aspect of the rib cage, compress bilaterally; repeat with hands on the front & back of the chest

**Interpretation:** + test = pain due to rib fracture or costochondral separation

RIB MOTION TEST

**Purpose:** Assess costal mobility

**Position:** Supine

**Technique:** Palpate AP mov’t of ribs as client inhales/exhales

**Interpretation:** During inspiration, ribs 1–6 should ↑ in AP dimension, while ribs 7–10 should ↑ in lateral dimension via bucket handle action & ribs 8–12 should ↑ in lateral dimension via caliper action; + test = inhibited rib movement with exhalation suggests an elevated rib; inhibited rib movement with inhalation suggests a depressed rib

BEEVOR’S SIGN

**Purpose:** Assess abdominal musculature

**Position:** Supine with knees flexed & feet on mat

**Technique:** Head & shoulders are raised off the mat while movement of the umbilicus is observed

**Interpretation:** Umbilicus should remain in a straight line. + test depends on direction of movement. Movement distally = weak upper abdominals, movement proximally = weak lower abdominals, movement up & (R) = weak muscles in (L) lower quadrant, movement down & (L) = weak muscles in the (R) upper quadrant
QUADRATUS TEST

**Purpose:** Assess quadratus lumborum muscle strength

**Position:** Ipsilateral side-lying on elbow

**Technique:** Lift ipsilateral hip to align back & lower extremities

**Interpretation:** + test = inability to lift hip = weakness

STANDING / SITTING FORWARD FLEXION TEST

**Purpose:** Assess mobility of ilium or sacrum

**Position:** Standing or sitting

**Technique:** Palpate PSIS while client slowly FB with LE straight & hands reaching toward the floor

**Interpretation:** Segmental movement should begin with L-spine, then sacrum, & then innominate; (+) test = asymmetrical movement with the pathologic side being the one that moves more

**Statistics:** Sensitivity = 17% & specificity = 79%

GILLET’S MARCH TEST

**Purpose:** Assess innominate mobility

**Position:** Standing

**Technique:** While clinician palpates inferior aspect of (R) PSIS with 1 thumb & medial sacral crest (S2 @ the level of the PSIS) with 1 thumb, client is asked to flex the (R) hip to 90°–120°; repeat other side

**Interpretation:** Normal = L-spine (L) SB & (R) rotation should be accompanied by (R) innominate rotating posterior & sacrum rotating (L); + test = asymmetrical PSIS movement, pop/click, or reproduction of pain

**Statistics:** Sensitivity = 8%–43% & specificity = 68%–93%
SUPINE TO SIT TEST
Purpose: Assess position of the ilium
Position: Supine with both LEs extended
Technique: Palpate medial malleolus as client performs a long sit-up (Be careful not to rotate the trunk while sitting up)
Interpretation: + test = a short-to-long leg position = posterior ilium rotation; a long-to-short leg position = anterior ilium rotation
Statistics: Sensitivity = 44% & specificity = 64%

LUMBAR QUADRANT TEST
Purpose: Assess nerve roots & IVF
Position: Standing or sitting
Technique: Assist the client in extending spine & SB ipsilaterally with rotation contralaterally & then apply overpressure through the shoulders; repeat to other side
Interpretation: + test = radicular symptoms are due to nerve root compression whereas local pain incriminates the facet joints

PRONE KNEE BENDING
Purpose: Assess neural mobility
Position: Basic test position = prone with hips extended
Technique: Add each of the following motions to implicate a specific nerves.
Interpretation: + test = reproduction of symptoms

<table>
<thead>
<tr>
<th>Modification for nerve bias</th>
<th>Nerve implicated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee flexion</td>
<td>Femoral nerve (L2–4)</td>
</tr>
<tr>
<td>Hip adduction with knee flexion</td>
<td>Lateral femoral cutaneous nerve</td>
</tr>
<tr>
<td>Hip abduction, ER, knee extension, &amp; ankle dorsiflexion &amp; eversion</td>
<td>Saphenous nerve</td>
</tr>
</tbody>
</table>
**SLR TEST**

**Purpose:** Assess neural mobility

**Position:** Basic SLR test position = hip flexion, adduction, IR with knee extended

**Technique:** Add each of the following motions to implicate specific nerves

<table>
<thead>
<tr>
<th>Modification for nerve bias:</th>
<th>Nerve implicated:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dorsiflexion</td>
<td>Sciatic nerve</td>
</tr>
<tr>
<td>Dorsiflexion, eversion, &amp; toe extension</td>
<td>Tibial nerve</td>
</tr>
<tr>
<td>Dorsiflexion &amp; inversion</td>
<td>Sural nerve</td>
</tr>
<tr>
<td>Plantarflexion &amp; inversion</td>
<td>Common peroneal nerve</td>
</tr>
</tbody>
</table>

**Interpretation:** + test = reproduction of symptoms

**Statistics:** Sensitivity = 76%–96% & specificity = 10%–45%
**STOOP TEST**

**Purpose:** Differentiate neurogenic vs. vascular intermittent claudication

**Position:** Standing

**Technique:** Client walks briskly until symptoms appear & then flexes forward or sits

**Interpretation:** + test = if symptoms are quickly relieved with FB, claudication is neurogenic; can also perform on a stationary bike

**SI POSTERIOR COMPRESSION TEST** (Anterior Gapping)

**Purpose:** Assess for SI pathology

**Position:** Supine with clinician’s hands crossed over client’s pelvis on ASISs

**Technique:** Apply a lateral force to the ASISs through the hands

**Interpretation:** + test = reproduction of SI joint pain

**Statistics:** Sensitivity = 7%–69% & specificity = 69%–100%

**SI POSTERIOR GAPPING TEST** (Compression of iliac crests)

**Purpose:** Assess for SI pathology

**Position:** Side-lying

**Technique:** Apply a downward force through the anterior aspect of the ASIS to create posterior gapping of the SI

**Interpretation:** + test = reproduction of SI joint pain

**Statistics:** Sensitivity = 4%–60% & specificity = 81%–100%

**HOOVER TEST**

**Purpose:** Assess malingering

**Position:** Supine

**Technique:** Hold client’s heels of (B) LEs in clinician’s hands, ask client to lift 1 leg out of a hand

**Interpretation:** + test = client does not lift the leg & there is no downward force exerted by the contralateral limb
### SI Cluster Tests

<table>
<thead>
<tr>
<th>Description</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing flexion, PSIS palpation, supine to long-sit, &amp; prone knee flexion</td>
<td>82</td>
<td>88</td>
</tr>
<tr>
<td>Distraction, thigh thrust, Gaenslen’s, compression, &amp; sacral thrust</td>
<td>91</td>
<td>78</td>
</tr>
<tr>
<td>Thigh thrust, distraction, sacral thrust, &amp; compression</td>
<td>88</td>
<td>78</td>
</tr>
</tbody>
</table>

### Waddell Nonorganic Signs

<table>
<thead>
<tr>
<th>Sign</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tenderness</strong>—superficial or nonanatomic</td>
<td>Tenderness is not related to a particular structure. It may be superficial (tender to a light pinch over a wide area) or deep tenderness felt over a wide area (may extend over many segmental levels).</td>
</tr>
<tr>
<td><strong>Simulation tests</strong>—axial loading in rotation</td>
<td>These tests give the client the impression that diagnostic tests are being performed. Slight pressure (axial loading) applied to the top of the head or passive rotation of the shoulders &amp; pelvis in the same direction produces c/o LBP</td>
</tr>
<tr>
<td><strong>Distraction tests</strong>—SLR</td>
<td>A (+) clinical test (SLR) is confirmed by testing the structures in another position. By appearing to test the plantar reflex in sitting, the examiner may actually lift the leg higher than that of the supine SLR</td>
</tr>
<tr>
<td><strong>Regional disturbances</strong>—weakness or sensory</td>
<td>When the dysfunction spans a widespread region of the body (sensory or motor) that cannot be explained via anatomical relationships. This may be demonstrated by the client “giving way” or cogwheel resistance during strength testing of many major muscle groups or reporting diminish sensation in a nondermatomal pattern (stocking effect).</td>
</tr>
<tr>
<td><strong>Overreaction</strong></td>
<td>Disproportionate responses via verbalization, facial expressions, muscle tremors, sweating, collapsing, rubbing affected area, or emotional reactions.</td>
</tr>
</tbody>
</table>

**Note:** Any positive test in 3 or more categories results in an overall Waddell Score.
### Differential Diagnosis

<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Torticollis</strong>—7 forms of congenital</td>
<td>■ Symptoms appear @ 6–8 weeks of age</td>
</tr>
<tr>
<td>torticollis &amp; other causes include</td>
<td>■ ↓ Contralateral rotation &amp; ipsilateral SB (unilateral)</td>
</tr>
<tr>
<td>hemivertebra, cervical pharyngitis</td>
<td>■ Firm, nontender swelling about the size of an adult thumb nail</td>
</tr>
<tr>
<td>(major cause in 5–10 yo), JRA, trauma</td>
<td>■ (–) x-ray</td>
</tr>
<tr>
<td></td>
<td>■ Complications include visual issues &amp;/or reflux</td>
</tr>
<tr>
<td><strong>Cervical Sprain</strong>—trauma or prolonged</td>
<td>■ Localized pain; TTP; protective muscle guarding</td>
</tr>
<tr>
<td>static positioning</td>
<td>■ MTrP in cervical, shoulder, &amp; scapular regions</td>
</tr>
<tr>
<td></td>
<td>■ ↓ Cervical ROM &amp; stiffness with activity</td>
</tr>
<tr>
<td></td>
<td>■ Headache &amp; postural changes—forward head, kyphosis</td>
</tr>
<tr>
<td></td>
<td>■ Screen for alar &amp; transverse ligament px</td>
</tr>
<tr>
<td></td>
<td>■ Clear vertebral arteries</td>
</tr>
<tr>
<td></td>
<td>■ Normal DTRs &amp; (–) x-ray</td>
</tr>
<tr>
<td><strong>Cervical Strain</strong>—single traumatic</td>
<td>■ Pain with contraction &amp; with stretching</td>
</tr>
<tr>
<td>event or cumulative trauma; most often</td>
<td>■ Pain with prolonged sitting, walking, standing</td>
</tr>
<tr>
<td>occurs in 20–40 yo who have faulty</td>
<td>■ TTP &amp; protective muscle guarding</td>
</tr>
<tr>
<td>posture, overweight, deconditioning</td>
<td>■ Pain appears several hours after injury; headache</td>
</tr>
<tr>
<td></td>
<td>■ ↓ Contralateral SB &amp; rotation (AROM &lt;PROM)</td>
</tr>
<tr>
<td></td>
<td>■ Clear vertebral arteries</td>
</tr>
<tr>
<td></td>
<td>■ Normal DTRs</td>
</tr>
<tr>
<td></td>
<td>■ (–) special tests &amp; (–) x-rays</td>
</tr>
</tbody>
</table>

*Continued*
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cervical Stenosis</strong>—most common 30–60 yo; ♂ &gt; ♀; can be congenital or developmental, onset is gradual</td>
<td>■ Unilateral or bilateral symptoms usually span several dermatomes</td>
</tr>
<tr>
<td></td>
<td>■ ↑ Pain with cervical BB &amp; ↓ with cervical FB</td>
</tr>
<tr>
<td></td>
<td>■ Pain relieved with rest</td>
</tr>
<tr>
<td></td>
<td>■ Loss of hand dexterity, LOB &amp; unsteady gait</td>
</tr>
<tr>
<td></td>
<td>■ (+) Quadrant test</td>
</tr>
<tr>
<td></td>
<td>■ LMN signs at the level of the stenosis &amp; UMN signs below the level of stenosis</td>
</tr>
<tr>
<td></td>
<td>■ X-rays reveal spondylitic bars &amp; osteophytes &amp; ossification of PLL &amp; Ligamentum Flavum</td>
</tr>
<tr>
<td><strong>Cervical Spondylosis</strong>—↑ onset with aging but may be accelerated by cumulative trauma, poor body mechanics, postural changes, or previous disk injury; most common @ C5–7</td>
<td>■ ↑ Pain with activity &amp; stiffness @ rest</td>
</tr>
<tr>
<td></td>
<td>■ Limited A &amp; PROM; crepitus</td>
</tr>
<tr>
<td></td>
<td>■ (+) Compression/distraction test</td>
</tr>
<tr>
<td></td>
<td>■ ↓ Disk height on x-ray; need to r/o osteophytes</td>
</tr>
<tr>
<td><strong>Cervical Disk Pathology (most common level is C5–6)—usually the result of repetitive stresses on the neck as a result of poor posture or muscle imbalances; most common in 30–50 yo</strong></td>
<td>■ (+) NTPT—median nerve with contralateral cervical SB, cervical rotation &lt;60° &amp; cervical FB &lt;50°</td>
</tr>
<tr>
<td></td>
<td>■ (+) Tests: compression, distraction, shoulder depression &amp; Spurling’s maneuver</td>
</tr>
<tr>
<td></td>
<td>■ Sensory changes in the respective dermatome</td>
</tr>
<tr>
<td></td>
<td>■ X-rays are of little value</td>
</tr>
<tr>
<td></td>
<td>■ CT &amp; MRI used to differentiate nucleus pulposus from annulus fibrosis</td>
</tr>
<tr>
<td><strong>Cervical Facet Syndrome</strong>—occurs as a result of isolated or cumulative trauma, DDD, aging, or postural imbalances</td>
<td>■ Pain with hyperextension &amp; rotation of c-spine</td>
</tr>
<tr>
<td></td>
<td>■ Muscle guarding &amp; stiffness</td>
</tr>
<tr>
<td></td>
<td>■ Poor movement patterns but no weakness</td>
</tr>
<tr>
<td></td>
<td>■ Paresthesia but no changes in DTRs</td>
</tr>
<tr>
<td></td>
<td>■ Possible (+) NTPT; (+) Quadrant test</td>
</tr>
<tr>
<td></td>
<td>■ (–) X-ray</td>
</tr>
</tbody>
</table>

Continued
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
</table>
| **Brachial Plexus Lesion (Plexopathy, Burner, Stinger)**—occurs from stretching or compression of C-spine or forceful depression of shoulder | ■ Sharp & burning pain in UE  
■ Numbness/pins & needles present in UE  
■ Transient muscle weakness & ↓ DTR  
■ Provocation test = ipsilateral cervical SB with compression OR contralateral SB (stretch)  
■ (+) NTPT  
■ Confirmed with myelogram |
| **Rib Fracture**—mechanism is a direct blow; cough in a frail person | ■ (+) Tests: AP & lateral rib compression  
■ TTP & pain with deep inspiration  
■ (+) X-ray is difficult to assess immediately after injury |
| **Costochondritis**—may be due to trauma, infection, arthritis, or surgery | ■ Localized pain in anterior chest wall  
■ TTP; pain ↑ with cough that may radiate into UE |
| **Compression Fracture**—most common in T11–L2, may be related to trauma or osteoporosis | ■ Acute pain with adjacent muscle guarding  
■ Limited BB & rotation  
■ (+) X-ray |
| **Spondylosis / Arthrosis**—degenerative changes that usually effects C5–6, C6–7, L4–5 of clients >60 yo | ■ Onset is slow; pain is unilateral & ↑ with prolonged postures  
■ Pain ↑ with BB & ↓ with FB but usually does not radiate  
■ Confirmed with x-ray; osteophytes, ↓ joint space, & narrow IVF may be present |
| **Spondylolysis**—traumatic fractures of pars or stress fractures due to repeated or sustained extension, seen in young athletes 2° repetitive trauma (ski jumping, gymnastics); may have a structural predisposition | ■ Pain primarily with extension  
■ Intermittent neurologic signs & symptoms  
■ Oblique x-ray reveals fracture of pars interarticularis without slippage (Scottie dog with a collar) |

*Continued*
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
</table>
| **Spondylolisthesis**—vertebral subluxation or slippage 2° a long history of LB trauma Retrolisthesis = not common but presents with flexion symptoms | ■ L5 nerve entrapment → sciatica  
■ Morning stiffness; difficulty getting OOB  
■ ↑ Pain with trunk extension  
■ Poor neuromuscular control—“Hitching sign” = 2-step process of moving from FB & BB via 1st extending lumbar spine into lordosis & then extending hip  
■ Palpable step deformity in WB, gone in NWB  
■ (+) Tests: PIVM & compression test  
■ A/P & lateral x-ray confirms dx |
| **Lumbar Disk Pathology**—usually the result of repetitive stresses on the LB using improper body mechanics or excessive force posterior/lateral > lateral; most common in 30–50 yo  
**Note:** See “Lumbar Disk Posturing & Pain” on page 173. | ■ *Posterior-lateral HNP:*  
■ 1st sign is LBP that slowly diminishes to leg pain  
■ LB flexion 2° ↑ disk pressure  
■ (+) Thecal signs (pain with sneezing & coughing)  
■ (+) SLR; ↓ lumbar lordosis  
■ Lateral shift in standing that ↓ in supine  
■ *Lateral HNP:*  
■ No LBP; LE symptoms consistent with level of injury  
■ ↑ Pain with standing & walking; ↓ with sitting  
■ (–) SLR  
■ Standard x-rays are of little value because they may only detect pre-existing degenerative changes; MRI, CT scan, myelogram & discogram are used for diagnosis |
| **Lumbar Sprain**—usually results from a combination of forward bending with rotation or SB; common in people <30 yo | ■ Unilateral LBP  
■ Pain with SB away & rotation toward affected side  
■ Referred pain limited to gluteals & thigh regions  

Continued
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| **Lumbar Facet Syndrome**—occurs as a result of isolated or cumulative trauma, DDD, aging, or postural imbalances | ■ Pain referred to gluteals or thigh  
■ Muscle guarding  
■ Pain primarily with compression; morning stiffness  
■ Pain ↓ with FB  
■ Pain ↑ with BB & ipsilateral SB; difficulty standing straight  
■ X-ray may show osteophytes (spondylosis) |
| **Lumbar Stenosis**—progressive, irreversible, & insidious onset of narrowing of the spinal canal; history of LBP × several years; occurs mostly in people over 50 yo; ♂ > ♀ | ■ Dull ache across LS region when standing & walking  
■ ↓ Pain when leaning forward, walking uphill, with pillow under knees, knees to chest, or sitting in flexion  
■ Usually (B) pain into buttocks & proximal thigh  
■ Nocturnal pain & cramping  
■ Paresthesia that ↑ with BB & WB  
■ (-) Tests: SLR & femoral nerve test  
■ Postural changes: ↓ Lumbar lordosis & LE flexion  
■ No change in B&B or pulses  
■ LMN signs at level of lesion, UMN signs below level of lesion (ataxia, reflex hyperactivity (3+), (+) stoop test, & proprioceptive deficits)  
■ X-ray may show osteophytes or ossification of PLL & ligamentum flavum; CT scan may show bony encroachment of spinal canal; MRI confirms clinical findings; myelogram will show amount of constriction of thecal sac |

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<th>Signs/Symptoms</th>
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</table>
| **Trochanteric Bursitis**—may result from contralateral gluteus medius weakness or a change/↑ in activity level; direct trauma | ■ Pain into buttock & lateral thigh  
■ Pain worse at night & with activity  
■ TTP over greater trochanter  
■ Possible “clicking” with AROM & pain with resisted hip abduction  
■ Check for leg length discrepancy  
■ (–) X-ray |
| **Piriformis Syndrome**—most commonly due to repeated compressive forces or may result from a change/↑ in activity level; ♀ > ♂ | ■ Piriformis TTP  
■ Ipsilateral LB, buttock, & referred LE pain  
■ Pain & weakness with resisted abduction/ER of thigh  
■ Pain with stretch into hip flexion, adduction & IR  
■ (–) X-ray; need to r/o sprain/strain or HNP |
| **Ischiogluteal Bursitis**—may result from a change/↑ in activity level | ■ Pain into buttock & posterior thigh that is worse in sitting  
■ TTP over ischial tuberosity  
■ (+) Tests: SLR & Patrick test  
■ (–) X-ray |
| **Ankylosing Spondylitis (Marie Stümpell's disease)**—involves anterior longitudinal ligament & ossification of disk & thoracic zygapophyseal joints; most common in 15–40 yo; ♂ > ♀ | ■ Postural changes:  
■ Cervical hyperextension  
■ Thoracic kyphosis  
■ ↓ Lumbar lordosis  
■ Hip & knee flexion contractures  
■ Night pain & ↓ rib expansion  
■ ↑ SED rate  
■ 5 screening questions:  
■ Morning stiffness > 30 minutes  
■ Improvement with exercise  
■ Onset of back pain before 40 yo  
■ Slow onset  
■ Symptoms >3 months  
4+ positive questions is highly correlated with AS |
**Pathology/Mechanism**

**Osteoporosis**—results from insufficient formation or excessive resorption of bone; occurs with ↑ age, low body fat, low Ca++ intake, high caffeine intake, bed rest, alcoholism, steroid use

**Signs/Symptoms**

- Dowager’s hump (dorsal kyphosis)
- Loss of height (2–4 cm/fracture)
- Acute regional back pain (low thoracic/high lumbar)
- Pain radiating anterior along costal margins
- Fragile skin
- X-ray does not show bone loss but will reveal fx
- Bone scan needed for confirmation

---

### Vascular vs. Neurological Claudication

<table>
<thead>
<tr>
<th>Vascular Signs &amp; Symptoms</th>
<th>Neurogenical Signs &amp; Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primarily affects people &gt;40 yo</td>
<td>Population</td>
</tr>
<tr>
<td>Bilateral—hip, thigh, &amp; buttock to calf</td>
<td>Pain location</td>
</tr>
<tr>
<td>Cramping, aching, squeezing</td>
<td>Pain description</td>
</tr>
<tr>
<td>Pain is present regardless of spinal position</td>
<td>Positional response</td>
</tr>
<tr>
<td>Pain brought on by physical exertion (walking, particularly uphill) &amp; relieved within minutes of rest</td>
<td>Response to activity</td>
</tr>
<tr>
<td>↓ LE pulses; color &amp; skin changes</td>
<td>Pulses &amp; skin</td>
</tr>
<tr>
<td>No burning or sensation changes</td>
<td>Sensation</td>
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- Vascular Signs & Symptoms
  - Primarily affects people >40 yo
  - Bilateral—hip, thigh, & buttock to calf
  - Cramping, aching, squeezing
  - Pain is present regardless of spinal position
  - Pain brought on by physical exertion (walking, particularly uphill) & relieved within minutes of rest
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- Neurogenical Signs & Symptoms
  - Population
  - Pain location
  - Pain description
  - Positional response
  - Response to activity
  - Pulses & skin
  - Sensation

Lumbar Disk Posturing & Pain

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<thead>
<tr>
<th>Posturing</th>
<th>PAIN</th>
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<tbody>
<tr>
<td></td>
<td>Herniation medial to nerve root</td>
</tr>
<tr>
<td>Ipsilateral list (medial pain behavior)</td>
<td>↓ Pain</td>
</tr>
<tr>
<td>Contralateral list (lateral pain behavior)</td>
<td>↑ Pain</td>
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</tbody>
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Prognosis of a Lumbar Disk Herniation

**Factors that can influence a (+) outcome:**
- (-) Crossed SLR test
- No leg pain with spinal extension
- Large extrusion or sequestration
- (+) Response to corticosteroids
- No spinal stenosis
- Progressive recovery of neurological deficits in first 12 weeks
- Limited psychosocial issues
- Self-employed
- Motivated
- >12 years of education
- Good fitness level
- No Waddell’s signs

**Factors that can influence a (-) outcome:**
- (+) Crossed SLR test
- Leg pain with spinal extension
- Contained herniation
- (-) Response to corticosteroids
- Presence of spinal stenosis
- Progressive neurological deficit
- Cauda equine syndrome
- Overbearing psychosocial issues
- Worker’s compensation
- Unmotivated
- <12 years of education
- Illiterate
- >3 Waddell’s signs
### Differential Diagnosis of Sacroiliac Dysfunctions

**ILA = Inferior Lateral Angle**  
**LOA = Left Oblique Angle**  
**ROA = Right Oblique Angle**  
**MTA = Middle Transverse Axis**  

<table>
<thead>
<tr>
<th>MTA on LOA</th>
<th>RoA on ILA</th>
<th>Spine Flexion Test</th>
<th>Spinal Spring Test</th>
<th>Sacral Base Test</th>
<th>Differential Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>base on LOA</td>
<td>base with ext</td>
<td>Convex</td>
<td>Shallow</td>
<td>(+)</td>
<td>Sacral Torsion</td>
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**ILA = Inferior Lateral Angle**  
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## Differential Diagnosis of Iliosacral Dysfunctions

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<th>Diagnosis</th>
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</thead>
<tbody>
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<td>Muscle imbalances</td>
<td>Innominate, Anterior, Posterior</td>
<td>Sitting with long leg lengths, short TFL</td>
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### Differential Diagnosis of Iliosacral Dysfunctions—cont’d

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<tr>
<th>ASIS = Anterior Superior Iliac Spine</th>
<th>SFT = Standing Flexion Test</th>
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<tbody>
<tr>
<td>PSIS = Posterior Superior Iliac Spine</td>
<td>TTP = Tender To Palpation</td>
</tr>
<tr>
<td>SFT = Standing Flexion Test</td>
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<td>Supine to sit = long</td>
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**Ligaments of the jaw**

- Sphenomandibular ligament
- Zygomatic arch
- Joint capsule
- Lateral (temporomandibular) ligament
- Stylohyoid ligament
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Referral Patterns

Muscle Pain Referral Patterns

Masseter

Sternocleidomastoid

Scalene muscle
Digastric

Temporalsis  Medial & lateral pterygoid
Palpation Pearls

- **SCM**—in supine, find mastoid process & move toward the clavicular notch, have client raise head & slightly rotate to opposite side
- **Scalenes**—stringy muscle above the clavicle between the SCM & traps; to confirm identification, palpate in the general area & have client inhale deeply & scalenes should be in the middle of the triangle
- **Masseter**—palpate the side of the mandible between the zygomatic arch & the angle of the mandible, have client clench the jaw
- **Suprahyoids**—palpate under the tip of the chin & resist mandibular depression or have the client swallow to confirm identification
- **Anterior digastric**—palpate extraorally inferior to body of the mandible
- **Posterior digastric**—palpate extraorally posterior to the angle of the mandible
- **Medial pterygoid**—palpate intraorally along medial rim of the mandible
- **Lateral pterygoid**—palpate intraorally along superior, posterior aspect behind 3rd maxillary molar

**ROM**

- **Mandibular depression (opening)**—35–50 mm (2–3 knuckles) is functional
- **C-deviation** = hypomobility toward side of deviation (lateral pterygoid tension or disk pathology)
- **S-deviation** = muscle imbalance or displacement of condyle around disk
- **Mandibular elevation (closing)**—palpate quality of movement to resting position
- **Mandibular protrusion** = 6–9 mm; must take into account the starting position if there is an overbite or underbite present
- **Mandibular retrusion** = 3–4 mm
- **Mandibular lateral excursion** = 10–15 mm
### Osteokinematics of the TMJ

<table>
<thead>
<tr>
<th>Motion</th>
<th>Normal End-feel(s)</th>
<th>Abnormal End-feel(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening/Closing</td>
<td>Open = tissue stretch/elastic</td>
<td>Hard = osseous abnormality</td>
</tr>
<tr>
<td></td>
<td>Closed = bone-to-bone</td>
<td></td>
</tr>
<tr>
<td>Protrusion/retrusion</td>
<td>Tissue stretch/elastic</td>
<td>Springy = disk displacement</td>
</tr>
<tr>
<td>Lateral excursion</td>
<td>Tissue stretch/elastic</td>
<td>Capsular = shortening of periarticular tissues</td>
</tr>
</tbody>
</table>

### Arthrokinematics of TMJ

<table>
<thead>
<tr>
<th>Motion</th>
<th>Concave surface: Mandibular fossa Mandibular condyle &amp; disk</th>
<th>Convex surface: Mandibular condyle &amp; disk</th>
<th>To facilitate opening: Condyles rotate anterior for the first 25°, then anterior &amp; inferior gliding of condyle &amp; disk completes the last 15° of movement</th>
<th>To facilitate closing: Condyles &amp; disk roll posterior &amp; glide medially &amp; superior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening &amp; closing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protrusion &amp; retraction</td>
<td>Concave surface: Mandibular fossa Mandibular condyle &amp; disk</td>
<td>Convex surface: Mandibular condyle &amp; disk</td>
<td>To facilitate protrusion: Disk &amp; condyle move down &amp; FW</td>
<td>To facilitate retraction: Disk &amp; condyle move up &amp; BW</td>
</tr>
<tr>
<td>Lateral excursion</td>
<td>Concave surface: Mandibular fossa Mandibular condyle &amp; disk</td>
<td>Convex surface: Mandibular condyle &amp; disk</td>
<td>To facilitate lateral excursion: (R) excursion = (L) condyle &amp; disk glide anterior; while (R) condyle spins around vertical axis (L) excursion = (R) condyle &amp; disk glide anterior; while (L) condyle spins around vertical axis</td>
<td></td>
</tr>
</tbody>
</table>
CLEAR CRANIAL NERVES – see “Alerts/Alarms” tab page 13.

AUSCULTATION—used to identify poor joint kinematics or joint/disk damage; place stethoscope over TMJ, just anterior to tragus of ear, and clinician listens for presence of joint sounds; very sensitive to finding a problem but not specific in the identification of the structure.

Interpretation:
- Opening click = click as condyle moves over posterior aspect of disk in an effort to restore normal relationship; disk is anterior to condyle; the later the click, the more anterior the disk
- Reciprocal click = in opening, the disk reduces as the condyle moves under the disk & in closing, a second click is heard as the condyle slips posteriorly & the disk becomes displaced anteriorly

LATERAL POLE

Purpose: Assess soft tissues of TMJ
Position: Face client with clinician’s index fingers palpating lateral pole of TMJ
Technique: Open & close mouth several times
Interpretation: + test = ↑ or reproduction of symptoms incriminating LCL or TMJ ligament

EXTERNAL AUDITORY MEATUS

Purpose: Assess posterior disk
Position: Face client, clinician inserts little fingers into client’s ears
Technique: While applying forward pressure with fingers, client opens & closes mouth repeatedly
Interpretation: + test = ↑ or reproduction of symptoms
Statistics: Sensitivity = 43% & specificity = 75%

DYNAMIC LOADING

Purpose: To mimic TMJ loading to differentiate between TMJ & muscle pain
Position: Sitting with roll of gauze between molars on 1-side
Technique: Client bites down on gauze roll
Interpretation: Compression occurs on contralateral side & distraction on ipsilateral side of gauze; + test = ↑ or reproduction of symptoms @ TMJ
### Differential Diagnosis

<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
</table>
| **Inflammation**—may be the result of acute or repetitive trauma, prolonged immobilization or surgery | ■ Capsular tightness with ↓ opening  
■ Pain with or without movement  
■ Need to r/o disk displacement |
| **Disk Displacement**—may be related to poor posture, trauma, excessive opening, muscle imbalance (anterior displacement is most common) | ■ Muscle guarding  
■ Localized TTP  
■ Headache  
■ Confirmed with MRI |
| **TMJ Arthritis**—gradual onset, poor kinematics or repeated trauma of the TMJ that leads to joint erosion | ■ Pain, stiffness, crepitus, clicking, grinding  
■ ↓ ROM (deviation toward involved side)  
■ Headache  
■ Hearing loss & dizziness  
■ Confirmed with x-ray or MRI; need to r/o disk problem |

*Disk can result in clicking or locking. Locked open = disk is anterior and with opening there is a click with the disk being displaced posterior, then the joint is locked in the open position; locked closed = disk is anterior to the condyle so anterior translation is limited & opening is reduced.*
Anatomy of the Hip

Muscles of the hip

- Iliac crest of pelvis
- Gluteus medius muscle
- Gluteus maximus muscle
- Femur
- Piriformis muscle
- Superior gemellus muscle
- Sacrotuberous ligament
- Obturator internus muscle
- Inferior gemellus muscle
- Quadratus femoris muscle
- Gluteus minimus muscle

Palpation Pearls

Femoral triangle

- Superior border = inguinal ligament
- Lateral to medial = sartorius, femoral nerve, femoral artery, femoral vein, great saphenous vein, pectineus muscle, & adductor longus muscle
- Piriformis – find mid-point between PSIS & coccyx, piriformis runs from this point lateral to greater trochanter
Medical Red Flags

- Pain @ McBurney’s point = $\frac{1}{3}$ – $\frac{1}{2}$ the distance from (R) ASIS to umbilicus; tenderness = appendicitis
- Blumberg’s sign = rebound tenderness for visceral pathology—in supine select a site away from the painful area, place your hand perpendicular to the abdomen & push down deep & slow; lift up quickly; (–) = no pain; (+) = pain on release
- Psoas test for pelvic pathology = supine, SLR to 30° & resist hip flexion; (+) test for pelvic inflammation or infection in lower quadrant abdominal pain; hip or back pain is a (–) test

Constitutional symptoms

- Enlarged inguinal lymph nodes
- Hip pain in men 18–24 years old of unknown etiology should be screened for testicular CA

Systemic causes of hip pain
- Bone tumors
- Crohn’s disease
- Inflammatory bowel or pelvic inflammatory disease
- Ankylosing spondylitis
- Sickle cell anemia
- Hemophilia
- Urogenital problems

Neuromusculoskeletal causes of hip pain
- LB &/or SI
- OA or stress fx
- Hernia
- Muscle weakness
- Sprain/strain
- Labral tear

Screen for a sports hernia
- Palpation of marble-sized lump along the path of the inguinal ligament
- Pain with exertion, cough, menstruation
- Radiating pain into groin, ipsilateral thigh, flank, or lower abdomen
- Pain with cutting, turning, striding out
**Western Ontario & McMaster Universities Osteoarthritis Index (WOMAC)**

**Instructions:** Please rate the activities in each category according to the following scale of difficulty:
0 = none; 1 = slight; 2 = moderate; 3 = very; 4 = extremely

<table>
<thead>
<tr>
<th><strong>Pain</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td></td>
</tr>
<tr>
<td>Stair climbing</td>
<td></td>
</tr>
<tr>
<td>Nocturnal</td>
<td></td>
</tr>
<tr>
<td>Rest</td>
<td></td>
</tr>
<tr>
<td>Weight bearing</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Stiffness</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning stiffness</td>
<td></td>
</tr>
<tr>
<td>Stiffness occurring later in the day</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Physical Function</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Descending stairs</td>
<td></td>
</tr>
<tr>
<td>Ascending stairs</td>
<td></td>
</tr>
<tr>
<td>Rising from sitting</td>
<td></td>
</tr>
<tr>
<td>Standing</td>
<td></td>
</tr>
<tr>
<td>Bending to floor</td>
<td></td>
</tr>
<tr>
<td>Walking on flat surface</td>
<td></td>
</tr>
<tr>
<td>Getting in/out of car</td>
<td></td>
</tr>
<tr>
<td>Going shopping</td>
<td></td>
</tr>
<tr>
<td>Putting on socks</td>
<td></td>
</tr>
<tr>
<td>Lying in bed</td>
<td></td>
</tr>
<tr>
<td>Taking off socks</td>
<td></td>
</tr>
<tr>
<td>Rising from bed</td>
<td></td>
</tr>
<tr>
<td>Getting in/out of bath</td>
<td></td>
</tr>
<tr>
<td>Sitting</td>
<td></td>
</tr>
<tr>
<td>Getting on/off toilet</td>
<td></td>
</tr>
<tr>
<td>Heavy domestic duties</td>
<td></td>
</tr>
<tr>
<td>Light domestic duties</td>
<td></td>
</tr>
</tbody>
</table>

**Total Score**

*Scoring:* Summate the scores of each item for the total score. The higher the score, the more severe the disability.

## HARRIS Hip Score

Select the descriptor for each section that best describes your current condition

### Pain—44 possible points
- None or ignores it: 44
- Slight, occasional, no compromise in activities: 40
- Mild pain, no effect on average activities, moderate pain with unusual activities, may take aspirin: 30
- Moderate pain, tolerable but makes concessions, some limitation of ordinary activity, occasional pain medicine stronger than aspirin: 20
- Marked pain, serious limitation of activity: 10
- Totally disabled, crippled, pain in bed, bedridden: 0

### Function/Gait—33 possible points

#### Distance Walked
- Unlimited: 11
- 4–6 blocks: 8
- 2–3 blocks: 5
- Indoors only: 2
- Unable to walk: 0

#### Limp
- None: 11
- Slight: 8
- Moderate: 5
- Severe: 0

#### Support
- None: 11
- Cane for long walks: 7
- Cane most of the time: 5
- One crutch: 3
- Two canes: 2
- Two crutches: 0
- Not able to walk: 0

*Continued*
HARRIS Hip Score—cont’d

Select the descriptor for each section that best describes your current condition

**Function/Activities—14 possible points**

<table>
<thead>
<tr>
<th>Stairs</th>
<th>Normally without rail</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normally with rail</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>In any manner</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Unable to do stairs</td>
<td>0</td>
</tr>
<tr>
<td>Shoes &amp; Socks</td>
<td>With ease</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>With difficulty</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Unable</td>
<td>0</td>
</tr>
<tr>
<td>Sitting</td>
<td>Comfortable in ordinary chair 1 hr</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>On a high chair for ½ hr</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Unable to sit comfortably</td>
<td>0</td>
</tr>
<tr>
<td>Enter Public Transportation</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**Deformity—4 points for each of the following present**

- <30° flexion contracture
- <10° adduction contracture
- <10° abduction contracture
- <3.2 cm leg-length discrepancy

**ROM**

<table>
<thead>
<tr>
<th>Flexion</th>
<th>0–45° (1.0 point per degree)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+ 0.6 points/degree from 45°–90°</td>
</tr>
<tr>
<td></td>
<td>+ 0.3 points/degree from 90°–110°</td>
</tr>
<tr>
<td>Abduction</td>
<td>0–15° (0.8 points per degree)</td>
</tr>
<tr>
<td></td>
<td>+ 0.3 points/degree from 15°–20°</td>
</tr>
<tr>
<td>ER (in ext)</td>
<td>0–15° (0.4 points per degree)</td>
</tr>
<tr>
<td>Adduction</td>
<td>0–15° (0.2 points per degree)</td>
</tr>
</tbody>
</table>

**Total Score**

Scoring: The higher the total score, the lower the level of disability.

Referral Patterns

Muscle Pain Referral Patterns

Gluteus maximus  Piriformis  Tensor fascia latae

Iliopsoas
### Osteokinematics of the Hip

<table>
<thead>
<tr>
<th>Normal ROM</th>
<th>OPP</th>
<th>CPP</th>
<th>Normal End-feel(s)</th>
<th>Abnormal End-feel(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion = 100°–120° Ext = 15° Abduction = 40°–45° IR = 30°–40° ER = 40°–50°</td>
<td>30° flexion 30° abd &amp; slight ER</td>
<td>max ext, IR, abd</td>
<td>Flexion &amp; Add = elastic or tissue approx SLR = elastic Ext &amp; Abd = elastic/firm IR &amp; ER = elastic/firm</td>
<td>Capsular = IR &gt; Ext &gt; Abd</td>
</tr>
</tbody>
</table>

### Arthrokinematics for Hip Mobilization

| Concave surface: acetabulum | To facilitate hip flexion: Femur spins posterior | To facilitate hip extension: Femur spins anterior |
| Convex surface: femoral head | To facilitate hip abduction: Femur spins lateral & glides medial | To facilitate hip adduction: Femur spins medial & glides lateral |
| | To facilitate hip IR: Femur rolls medial & glides lateral on pelvis | To facilitate hip ER: Femur rolls lateral & glides medial on pelvis |

### Special Tests

**THOMAS TEST**

**Purpose:** Assess for tight hip flexors  
**Position:** Supine with lumbar spine stabilized & involved LE extended  
**Technique:** Flex contralateral hip to the abdomen  
**Interpretation:** + test = flexion of the involved hip or lumbar spine indicates tight hip flexors
ELY’S TEST
Purpose: Assess for tight rectus femoris
Position: Side-lying or prone, hip in extension
Technique: Flex knee
Interpretation: + test = limited knee flexion with hip extension or inability to maintain hip extension when knee is flexed

OBER’S TEST
Purpose: Assess for tight ITB
Position: Side-lying with involved hip up
Technique: Extend the involved hip & allow LE to drop into adduction
Interpretation: + test = LE fails to adduct

IMPINGEMENT TEST
Purpose: Assess for labral tears & femoroacetabular impingement
Position: Supine
Technique: Simultaneously flex, adduct & ER hip to end range
Interpretation: + test = reproduction of pain
Statistics: Kappa = 0.58
**SCOUR TEST**

**Purpose:** Assess for labral tear  
**Position:** Supine, flex hip to 90°  
**Technique:** IR/ER hip with abd/adduction while applying a compressive force down the femur  
**Interpretation:** + test = clicking, grinding or pain due to arthritis, acetabular labrum tear, avascular necrosis, or osteochondral defect  
**Statistics:** Sensitivity = 75%–79% & specificity = 43%–50%

**ANTERIOR LABRAL TEST**

**Purpose:** Assess for labral tear  
**Position:** Supine in PNF D2 flexion (hip in full flex, ER & abd)  
**Technique:** Resist movement into ext IR & add (D2 extension)  
**Interpretation:** + test = reproduction of pain or click

**POSTERIOR LABRAL TEST**

**Purpose:** Assess for labral tear  
**Position:** Supine in flexion with adduction, & IR (similar to PNF D1 pattern but with IR)  
**Technique:** Resist movement into ext, abduction, & ER (similar to D1 extension but with ER)  
**Interpretation:** + test = reproduction of pain or click
**LOG ROLL TEST**

**Purpose:** Assess for iliofemoral ligament laxity

**Position:** Supine with LEs extended

**Technique:** Roll the LE into maximal ER by applying a medial to lateral force through the thigh

**Interpretation:** + test = excessive ER as compared to the contralateral LE

**Statistics:** Kappa = 0.61

---

**FABER TEST (PATRICK’S)**

**Purpose:** Assess hip/SI & labral pathology

**Position:** Supine - passively flex, abduct & ER the hip (figure-4 position) so that the lateral malleolus of the involved LE is on the knee of the uninvolved LE

**Technique:** Apply overpressure to flexed knee

**Interpretation:** + test = hip pain 2° to OA, osteophytes, intracapsular fx, or LBP 2° SI px; tightness without pain is a (−) test; pain experienced assuming this position may indicate a problem with the sartorius muscle Labral pathology may be suspected if lateral aspect of the knee is >4cm from the surface & asymmetrical

**Statistics:** Kappa = 0.63; sensitivity = 41%–77%; specificity = 88%–100%

---

**TRENDELENBURG’S TEST**

**Purpose:** Assess for weakness of gluteus medius

**Position:** Standing on involved LE

**Technique:** Flex the contralateral LE; iliac crest on WB side should be lower than the NWB side

**Interpretation:** + test = dropping of the NWB limb is 2° to abductor weakness (common in epiphyseal problem, Legg-Calve-Perthes, MD)
**PIRIFORMIS TEST**

**Purpose:** Assess for tight piriformis

**Position:** Supine or contralateral side-lying

**Technique:** Flex hip to 70°–80° with knee flexed & maximally adduct LE (apply a downward force to the knee)

**Interpretation:** + test = pain in buttck & sciatica; IR stresses superior fibers; ER stresses inferior fibers

---

**ORTOLANI’S TEST**

**Purpose:** Assess for congenital hip dislocation

**Position:** Supine fix hips & knees @ 90° of flexion; clinician’s thumbs are on the infant’s medial thigh & fingers on the lateral thigh

**Technique:** Firmly traction the thigh while gently abducting the leg so that femoral head is translated anterior into the acetabulum

**Interpretation:** + test = reduction of the hip; an audible “clunk” may be heard

---

**BARLOW’S TEST**

(Opposite of the Ortolani Test)

**Purpose:** Assess for hip dysplasia

**Position:** Supine 90/90; clinician’s thumbs are on the infant’s medial thigh & fingers on the lateral thigh

**Technique:** Apply a posterior force thru the femur as the thigh is gently adducted

**Interpretation:** + test = the examiner’s finger that is on the greater trochanter will detect a palpable dislocation
### Differential Diagnosis

<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ITB Friction Syndrome</strong>—repetitive</td>
<td>- Pain with downhill running; sense of knee instability</td>
</tr>
<tr>
<td>stress &amp; excessive friction 2° tight</td>
<td>- (+) Tests: Ober’s, Noble’s, &amp; Renne’s</td>
</tr>
<tr>
<td>ITB, pronation with IR of tibia, genu</td>
<td>- Pain @ 30° of knee flexion in WB results in ambulating stiff legged to avoid flexion</td>
</tr>
<tr>
<td>varum, cycling with cleat in IR</td>
<td>- TTP over lateral femoral epicondyle</td>
</tr>
<tr>
<td>Proximal problem = hip syndrome</td>
<td>- Visible &amp; palpable snapping</td>
</tr>
<tr>
<td>Distal problem = runner’s knee</td>
<td>- (-) X-ray; MRI &amp; US may confirm diagnosis</td>
</tr>
<tr>
<td></td>
<td>- Need to r/o trochanteric bursitis &amp; osteochondritis</td>
</tr>
<tr>
<td><strong>Greater Trochanteric Bursitis</strong>—</td>
<td>- Deep, aching, diffuse pain from greater trochanter to distal lateral thigh &amp; groin</td>
</tr>
<tr>
<td>biomechanical or overuse problem;</td>
<td>- TTP on ITB &amp; pain when rolling on hip when sleeping</td>
</tr>
<tr>
<td>repetitive inside kicks in soccer</td>
<td>- ROM = WNL except abduction may be limited by pain</td>
</tr>
<tr>
<td>result in forceful adduction and</td>
<td>- No snapping but palpable crepitus may be present</td>
</tr>
<tr>
<td>compression of bursa; contusions</td>
<td>- (+) Tests: Ober’s &amp; Patrick’s/ FABER</td>
</tr>
<tr>
<td></td>
<td>- (-) X-ray (needed to r/o femoral neck stress fx)</td>
</tr>
<tr>
<td></td>
<td>- MRI &amp; US may confirm diagnosis</td>
</tr>
<tr>
<td><strong>Apophysitis</strong>—pelvic fx 2° strenuous</td>
<td>- TTP &amp; weakness with resisted muscle contraction @ ASIS, AllS, PSIS, PIIS—depending on muscle involved</td>
</tr>
<tr>
<td>muscle contraction in skeletally</td>
<td>- (+) X-ray for avulsion</td>
</tr>
<tr>
<td>immature child</td>
<td></td>
</tr>
</tbody>
</table>

*Continued*
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
</table>
| Piriformis Syndrome—may result from muscle contracture, trauma, prolonged sitting | ■ Dull ache in buttocks  
■ Pain ↑ with sitting & walking & ↓ in supine  
■ Pain with resisted hip ext & passive IR with adduction  
■ (–) X-ray needed to r/o stress fx; MRI needed to r/o spine pathology (LS root lesion, spinal stenosis, SI problem) |
| Iliopsoas Bursitis/Tendonitis—irritation & inflammation 2° overuse or unaccustomed activity | ■ Pain in medial groin/thigh with hip flexion & extension  
■ Audible snapping when moving from hip flex to ext  
■ Screen for McBurney’s point & rebound tenderness  
■ (–) X-ray; need to r/o avulsion fx  
■ Confirmed by MRI or US |
| Hip Pointer—can result from direct trauma to iliac crest or ASIS resulting in a contusion | ■ TTP @ iliac crest/ASIS  
■ Pain with resisted hip flexion & stretching into hip extension  
■ Pain with ambulation & hip abduction  
■ Screen for McBurney’s point & rebound tenderness  
■ (–) X-ray; need to r/o fx & avulsion |
| Labral Tear—damage to fibrocartilage via degeneration due to repetitive hip ER or the application of an external rotatory force to the hip while in hyperextension & hyperabduction; highly associated with hip dysplasia; anterior hip pain is correlated to weak gluteals & abdominals 2° excessive anterior femoral translation | ■ Pain with prolonged sitting, getting in/out of a car, putting on shoes/socks, & twisting activities  
■ ↑ Anterior hip pain with hyperext & ER  
■ Pain with resisted SLR (anterior lesion)  
■ Often associated with weak gluteals  
■ ↓ Hip ROM; clicking/catching from flexion to extension  
■ (+) Tests: FABER, impingement, Scour & labral tests  
■ Screen for osteoid osteoma & testicular CA in ♂  
■ MRI with contrast is best dx test (is often inconclusive) |
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
</table>
| **Avulsion Fracture**—injury results from violent muscle contraction | ▪ May hear a “pop”  
▪ Pain with stretch & contraction; TTP @ apophysis  
▪ (+) Tests: Thomas’ & Ely’s  
▪ May need CT or MRI if x-ray is inconclusive  
▪ Need to r/o strain & slipped capital femoral epiphysis |
| **Femoral Neck Stress Fracture**—gradual onset with history of endurance tasks  
**Beware** of eating disorders, amenorrhea, & osteoporosis | ▪ Groin pain with activity  
▪ TTP @ greater trochanter  
▪ (+) FABER test  
▪ May need CT or MRI if x-ray is inconclusive  
▪ Need to r/o trochanteric bursitis & osteoid osteoma |
| **Degenerative Joint Disease**—usually occurs >55 yo in ♀ > ♂ (3:2) | ▪ Aching pain during WB => groin, medial thigh & knee  
▪ Loss of movement & function  
▪ Trendelenburg  
▪ (+) FABER test  
▪ X-ray reveals narrow joint space, spurring & osteophytes; can r/o fx & necrosis |
| **RA**—systemic disorder with bilateral WB symptoms | ▪ Aching pain during WB => groin, medial thigh & distal knee; loss of movement & function 2° pain  
▪ Trendelenburg  
▪ (+) Tests: Thomas’, Ely’s & FABER  
▪ X-ray = bilateral demineralization of femoral head; joint space narrowing; migration of femoral head into acetabulum |

*Continued*
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Slipped Capital Femoral Epiphysis</strong>—imbalance of growth &amp; hormones that weakens the epiphyseal plate; may be 2° ↑ wt gain; occurs in 10–16 yo ♂ 2x &gt; ♀</td>
<td>■ Gradual onset of unilateral hip, thigh &amp; knee pain&lt;br&gt;■ ↓ Hip IR; hip positioned in flexion, abd, ER&lt;br&gt;■ Quadriceps atrophy&lt;br&gt;■ Antalgic gait &amp; ↓ limb length&lt;br&gt;■ AP x-ray needed to identify widening of physis &amp; ↓ ht of epiphysis; lateral view = epiphyseal displacement&lt;br&gt;■ Need to r/o muscle strain &amp; avulsion</td>
</tr>
<tr>
<td><strong>Legg-Calvé-Perthes (LCPD) Disorder</strong>—idiopathic osteonecrosis of capital femoral epiphysis; associated with (+) family history &amp; breech birth. Onset occurs over 1–3 months between 4–13 yo; occurs unilaterally; ♂ &gt; ♀</td>
<td>■ Hip or groin pain (thigh resulting in antalgic gait&lt;br&gt;■ (+) Trendelenburg&lt;br&gt;■ ↓ ROM (ext, IR &amp; abd); &gt;15° hip flexion contracture&lt;br&gt;■ Leg length inequality; thigh atrophy&lt;br&gt;■ Bone scan or MRI needed for early detection, x-rays may appear normal for several weeks, 1st sign (~4 wks) is radiolucent crescent image parallel to the superior rim of the femoral head&lt;br&gt;■ Need to r/o JRA &amp; hip inflammation</td>
</tr>
<tr>
<td><strong>Osteoid osteoma</strong>—benign tumor found in long bones; etiology unknown</td>
<td>■ Vague hip pain @ night&lt;br&gt;■ ↑ Pain with activity &amp; ↓ with aspirin&lt;br&gt;■ ↓ ROM &amp; quad atrophy&lt;br&gt;■ May be apparent on x-ray but confirmed by MRI or CT&lt;br&gt;■ Need to r/o trochanteric bursitis, femoral neck stress fx</td>
</tr>
<tr>
<td><strong>Myositis Ossificans</strong>—calcium deposits 2° contusion to the thigh</td>
<td>■ Localized pain&lt;br&gt;■ Limited knee flexion&lt;br&gt;■ Palpation of a calcific mass</td>
</tr>
</tbody>
</table>

*Continued*
# Hip Pathology/Mechanism and Signs/Symptoms

<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
</table>
| **Hip Dislocation**—may result from a breech birth, trauma, or when the hip is in a weakened state after a THR | ■ (+) Tests: Ortolani’s & Barlow’s  
■ (+) X-ray (associated with torticollis) |
| **Congenital**                           | ■ Shortened limb, positioned in flexion & abduction                           |
| **Posterior Traumatic (MVA)**            | ■ Groin & lateral hip pain  
■ Shortened limb, positioned in flexion, adduction & IR                      |
| **Anterior Traumatic (forced abduction)**| ■ Groin pain & tenderness  
■ Positioned in extension & ER if superior/anterior  
■ Positioned in flexion, abduction & ER if inferior/anterior                 |
Medical Red Flags

- **Night pain** = tumor or infection
- **Cellulitis**
  - Recent hx of skin trauma
  - Pain, swelling, warmth
  - Advancing erythema with reddish streaks
  - Chills, fever, weakness
- **DVT risk**
  - Immobilization
  - Surgery
  - Fracture or trauma
  - Oral contraceptives
  - CHF, CA, DM
  - Pregnancy
- **DVT Clinical presentation**
  - Leg pain & tenderness
  - ↑ Circumference > 1.2 cm
  - Tissue warm & firm to palpation
  - ↑ Pain with BP cuff inflated to 160 mm Hg
  - (+) Homans’ sign

Imaging

**Ottawa Knee Rule**

X-ray series is only required if the patient presents with any of the following criteria:
- >55 years old
- Isolated tenderness of the patella
- Tenderness of the head of the fibula
- Inability to flex >90°
- Inability to bear weight (4 steps) both immediately after injury & in emergency department (regardless of limping)

**Statistics:**
- Adults: Sensitivity = 98%–100% & specificity = 19%–54%
- Children: Sensitivity = 92% & specificity = 49%
Western Ontario & McMaster Universities Osteoarthritis Index (WOMAC)

Instructions: Please rate the activities in each category according to the following scale of difficulty:
0 = none; 1 = slight; 2 = moderate; 3 = very; 4 = extremely

<table>
<thead>
<tr>
<th>Pain</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td></td>
</tr>
<tr>
<td>Stair climbing</td>
<td></td>
</tr>
<tr>
<td>Nocturnal</td>
<td></td>
</tr>
<tr>
<td>Rest</td>
<td></td>
</tr>
<tr>
<td>Weight bearing</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stiffness</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning stiffness</td>
<td></td>
</tr>
<tr>
<td>Stiffness occurring later in the day</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical Function</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Descending stairs</td>
<td></td>
</tr>
<tr>
<td>Ascending stairs</td>
<td></td>
</tr>
<tr>
<td>Rising from sitting</td>
<td></td>
</tr>
<tr>
<td>Standing</td>
<td></td>
</tr>
<tr>
<td>Bending to floor</td>
<td></td>
</tr>
<tr>
<td>Walking on flat surface</td>
<td></td>
</tr>
<tr>
<td>Getting in/out of car</td>
<td></td>
</tr>
<tr>
<td>Going shopping</td>
<td></td>
</tr>
<tr>
<td>Putting on socks</td>
<td></td>
</tr>
<tr>
<td>Lying in bed</td>
<td></td>
</tr>
<tr>
<td>Taking off socks</td>
<td></td>
</tr>
<tr>
<td>Rising from bed</td>
<td></td>
</tr>
<tr>
<td>Getting in/out of bath</td>
<td></td>
</tr>
<tr>
<td>Sitting</td>
<td></td>
</tr>
<tr>
<td>Getting on/off toilet</td>
<td></td>
</tr>
<tr>
<td>Heavy domestic duties</td>
<td></td>
</tr>
<tr>
<td>Light domestic duties</td>
<td></td>
</tr>
</tbody>
</table>

Total Score

Scoring: Summate the scores of each item for the total score. The higher the score, the more severe the disability.

# Lysholm Knee Rating System

Which items below best describe your knee function today?

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Limp</strong></td>
<td>None</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Slight or periodic</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Severe &amp; constant</td>
<td>0</td>
</tr>
<tr>
<td><strong>Support</strong></td>
<td>None</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Cane or crutch needed</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Weight bearing impossible</td>
<td>0</td>
</tr>
<tr>
<td><strong>Locking</strong></td>
<td>None</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Catching sensation but no locking</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Locking occasionally</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Locking frequently</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Locked joint at examination</td>
<td>0</td>
</tr>
<tr>
<td><strong>Instability</strong></td>
<td>Never gives way</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Rarely during physical activity</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Frequently during physical activity</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Occasionally during daily activity</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Often during daily activity</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Every step</td>
<td>0</td>
</tr>
<tr>
<td><strong>Pain</strong></td>
<td>None</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Intermittent during strenuous activity</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Marked during strenuous activity</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Marked with walking &gt;2 km (1.2 miles)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Marked with walking &lt;2 km (1.2 miles)</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>0</td>
</tr>
<tr>
<td><strong>Swelling</strong></td>
<td>None</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>After strenuous activities</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>After ordinary activities</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>0</td>
</tr>
</tbody>
</table>
### Lysholm Knee Rating System—cont’d

Which items below best describe your knee function today?

<table>
<thead>
<tr>
<th>Stairs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No problem</td>
<td>10</td>
</tr>
<tr>
<td>Slight problem</td>
<td>6</td>
</tr>
<tr>
<td>One step at a time</td>
<td>2</td>
</tr>
<tr>
<td>Impossible</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Squatting</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No problem</td>
<td>5</td>
</tr>
<tr>
<td>Slight problem</td>
<td>4</td>
</tr>
<tr>
<td>Not &gt;90° knee flexion (halfway)</td>
<td>2</td>
</tr>
<tr>
<td>Impossible</td>
<td>0</td>
</tr>
</tbody>
</table>

### Total Score

**Scoring:** Summate the scores of each category. The higher the score, the greater the functional abilities.


### Referral Patterns

**Muscle Pain Referral Patterns**

- Rectus femoris
- Vasti muscles
Palpation Pearls

- **Adductor tubercle** = attachment of adductor magnus; start on medial femoral condyle & move proximal between the vastus medialis & hamstring tendons, as the femur dips in, a small point is palpable & often tender

- **Lateral collateral ligament** = cross leg so ankle is on contralateral knee (figure-4 position); LCL is palpable at the joint line just proximal to fibular head (firm, pencil-thickness structure)

- **Common peroneal nerve** = posterior lateral knee between biceps femoris tendon & lateral gastroc muscle belly

- **Popliteus** = “unlocker” of the knee; deep muscle only the tendon is palpable; follow the tibial tuberosity medially around the knee to the posterior aspect & the popliteus tendon is deep to the gastroc/soleus\n
- **Q-angle** = the angle created by the intersection of a line from the ASIS to the mid-patella & a line from the mid-patella to the tibial tuberosity. Normal (supine) = 13°–18° for ♀ & 10°–15° for ♂
**Strength & Function**

- Concentric Quad to Hamstring ratio = 5:3 (i.e., hamstrings should be 60%–65% of quads)
- Quad:Hamstring ratio should approach 5:4 at the conclusion of ACL rehabilitation
- Quad:Hamstring ratio should approach 5:2 at the conclusion of PCL rehabilitation
### Osteokinematics of the Knee

<table>
<thead>
<tr>
<th>Normal ROM</th>
<th>OPP</th>
<th>CPP</th>
<th>Normal End-feel(s)</th>
<th>Abnormal End-feel(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion &gt;130° Rotation = 10°</td>
<td>25° flexion</td>
<td>Maximal extension &amp; tibial ER</td>
<td>Flexion = tissue approximation Extension = elastic/firm SLR = elastic</td>
<td>Springy block = displaced meniscus Boggy = ligamentous pathology</td>
</tr>
</tbody>
</table>

- Femoral condyles begin to contact the patella inferior @ 20° of knee flexion; progresses superior @ 90° & medial/lateral @ 135° of knee flexion
- Structures attached to medial meniscus = MCL & semimembranosus
- Structures attached to lateral meniscus = PCL & popliteus

### Arthrokinematics for Knee Mobilization

**Concave surface:** Tibial plateau

**Convex surface:** Femoral condyles

<table>
<thead>
<tr>
<th>To facilitate knee extension:</th>
<th>OKC = Tibia rolls &amp; glides anterior on the femur</th>
<th>CKC = Femur rolls anterior &amp; glides posterior on tibia</th>
</tr>
</thead>
<tbody>
<tr>
<td>To facilitate knee flexion:</td>
<td>OKC = Tibia rolls &amp; glides posterior on the femur</td>
<td>CKC = Femur rolls posterior &amp; glides anterior on the tibia</td>
</tr>
</tbody>
</table>
**LACHMAN’S TEST**

**Purpose:** Assess for ACL laxity  
**Position:** Supine with knee in 0-30° of flexion (hamstrings relaxed)  
**Technique:** Stabilize distal femur & translate proximal tibia forward on the femur  
**Interpretation:** + test = >5 mm of displacement or a mushy, soft end-feel; beware of false (−) test due to hamstring guarding, hemarthrosis, posterior medial meniscus tear  
**Statistics:** Sensitivity = 63%–99% & specificity = 90%–99%

**PRONE LACHMAN’S TEST**

**Purpose:** Assess for ACL laxity  
**Position:** Prone with knee flexed to 30°, LE supported & hamstrings relaxed  
**Technique:** Palpate anterior aspect of the knee while imparting an anterior force to posterior-proximal aspect of tibia  
**Interpretation:** + test = >5 mm of displacement or a mushy, soft end-feel  
**Beware** of false (−) test due to hamstring guarding, hemarthrosis, posterior medial meniscus tear
ANTERIOR DRAWER TEST
Purpose: Assess for ACL laxity
Position: Supine with foot stabilized on table, knee flexed to 80°–90° & hamstrings relaxed
Technique: Translate proximal tibia anterior on the femur
Interpretation: + test = >5mm of anterior displacement; snap or palpable jerk with anterior drawer indicates meniscus px
Beware: Translation may appear excessive with PCL injury if tibia starts from a more posterior position
Statistics: Sensitivity = 22%–95% & specificity = 78%–97%

POSTERIOR DRAWER TEST
Purpose: Assess for PCL laxity
Position: Supine with knee flexed to 90° & foot on table
Technique: Translate proximal tibia posteriorly on distal femur
Interpretation: + test = >5 mm of posterior displacement
Statistics: Sensitivity = 86%–90% & specificity = 99%

SAG or GODFREY’S TEST
Purpose: Assess for PCL laxity
Position: Supine 90/90, support LEs
Technique: Compare the level of the tibial tuberosities
Interpretation: + test = posterior displacement of the tibial tuberosity is greater in the involved lag
Statistics: Sensitivity = 79% & specificity = 100%
**CLARKE’S TEST; GRIND TEST; ZOHLER’S TEST**

**Purpose:** Assess for chondromalacia or patella malacia

**Position:** Supine with knee in extension, clinician compresses quads at the superior pole of the patella to resist patella movement

**Technique:** Client contracts quads against resistance

**Interpretation:** + test = inability to contract without pain

---

**VARUS TEST**

**Purpose:** Assess for LCL laxity

**Position:** Supine; knee in full extension & then repeat @ 30° flexion

**Technique:** Cup knee with heel of clinician’s hand @ medial joint line; use fingers of other hand to palpate lateral joint line; apply a varus stress to the knee through the palm of the medial hand & the forearm/elbow of the lateral hand

**Interpretation:** + test = pain or excessive gapping of the joint when compared with the contralateral side

**Statistics:** Sensitivity = 25%

---

**VALGUS TEST**

**Purpose:** Assess for MCL laxity

**Position:** Supine; knee in full extension & then repeat @ 30° flexion

**Technique:** Cup knee with heel of clinician’s hand @ lateral joint line; use fingers of other hand to palpate medial joint line; apply a valgus stress to the knee through the palm of the lateral hand & the forearm/elbow of the medial hand

**Interpretation:** + test = pain or excessive gapping of the joint when compared to the contralateral side

**Statistics:** Sensitivity = 86%–96%
APLEY’S TEST
Purpose: Assess meniscus (nonspecific for location of meniscal tear)
Position: Prone, knee flexed to 90°; clinician grasps foot & calcaneus
Technique: While applying a downward force through the heel, rotate the tibia internally & externally
Interpretation: + test = pain, popping, snapping, locking, crepitus
Statistics: Sensitivity = 13%–58% & specificity = 80%–93%

McMURRAY’S TEST
Purpose: Assess meniscus
Position: Supine, with 1 of clinician’s hands to the side of the patella & the other grasping the distal tibia
Technique: From a position of maximal flexion, extend the knee with IR of the tibia & a varus stress then returns to maximal flexion & extend the knee with ER of the tibia & a valgus stress
Interpretation: + test = pain or snapping/clicking with IR incriminates the lateral meniscus & ER incriminates the medial meniscus; if pain, snapping, or clicking occur with the knee in flexion, the posterior horn of the meniscus is involved & if the pain, snapping, or clicking occurs with increasing amounts of knee extension, the anterior meniscus is involved
Statistics: Sensitivity = 16%–67% & specificity = 57%–98%
**THESSALY’S TEST**

**Purpose:** Assess for meniscal tears  
**Position:** Standing on the involved LE with the knee flexed @ 5°  
**Technique:** Clinician holds pt’s outstretched arms & rotates internally then externally 3x; repeat @ 20° of knee flexion  
**Interpretation:** + test = Pt experiences locking or catching  
**Statistics:** At 5°: Sensitivity = 66%–81% & specificity = 91%–96% and at 20°: Sensitivity = 89%–92% & specificity = 96%–97%

---

**PATELLA APPREHENSION (FAIRBANK’S) TEST**

**Purpose:** Assess for subluxing patella  
**Position:** Supine or seated, 30° knee flexion, quads relaxed  
**Technique:** Clinician carefully pushes patella laterally  
**Interpretation:** + test = Pt feels patella about to dislocate & contracts quads to keep this from happening  
**Statistics:** Sensitivity = 32%–39% & specificity = 86%

---

**PATELLA TILT TEST**

**Purpose:** Assess for ITB tightness/patella mobility  
**Position:** Relaxed in supine with knee in extension  
**Technique:** Clinician attempts to lift the lateral border of patella  
**Interpretation:** + test = inability to lift the lateral border of the patella above the horizontal
**NOBLE’S TEST**
**Purpose:** Assess ITB irritation  
**Position:** Supine, start @ 90/90  
**Technique:** Apply pressure over the lateral femoral condyle while extending the knee  
**Interpretation:** + test = pain or clicking @ lateral femoral condyle @ 30° of knee flexion

**OBER’S TEST**
**Purpose:** Assess for tight ITB  
**Position:** Side-lying with involved hip up  
**Technique:** Extend the hip & allow LE to drop into adduction  
**Interpretation:** + test = LE fails to adduct past anatomic neutral

**RENNE’S TEST**
**Purpose:** Assess ITB irritation  
**Position:** Standing  
**Technique:** Apply pressure over the lateral femoral condyle with AROM of the knee  
**Interpretation:** + test = pain or clicking @ lateral femoral condyle @ 30° of knee flexion
**PIVOT SHIFT TEST**
**Purpose:** Assess A/L instability  
**Position:** Supine  
**Technique:** Knee is taken from full extension to flexion with a valgus stress  
**Interpretation:** + test = sudden reduction of the anteriorly subluxed lateral tibial plateau

**STUTTER TEST**
**Purpose:** Assess for medial plica irritation  
**Position:** Sitting with knee flexed over the edge of the table  
**Technique:** Slowly extend knee with a finger placed lightly in contact with the center of the patella  
**Interpretation:** + test = patella stutters as knee moves into extension

**PATELLAR BOWSTRING TEST**
**Purpose:** Assess medial plica  
**Position:** Supine  
**Technique:** Medially displace patella while flexing/extending knee with tibia IR  
**Interpretation:** + test = palpable clunk

**WILSON’S TEST**
**Purpose:** Assess for osteochondritis of medial femoral condyle  
**Position:** Supine with knee flexed to 90°  
**Technique:** Extend the knee with IR of the tibia  
**Interpretation:** + test = pain at 30° of flexion in IR that ↓ if the tibia is ER; should r/o meniscal px
<table>
<thead>
<tr>
<th>Differential Diagnosis</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
</table>
| **Baker’s Cyst**—defect in the posterior capsule that is influenced by chronic irritation | • Golf ball–size swelling at semimembranosus tendon or medial gastroc muscle belly; best palpated in full knee extension  
• Stiff & tender with limited knee ROM  
• MRI may be helpful; need to r/o DVT & tumor |
| **Shin Splints/Anterior**—an overuse syndrome of tibialis anterior, extensor hallucis longus, & extensor digitorum longus attributed to running on unconditioned legs, soft tissue imbalance, alignment abnormalities, & excessive pronation to accommodate rearfoot varus | • Pain & tenderness over anterior tibialis  
• Pain with resisted dorsiflexion & inversion  
• Pain with stretching into plantarflexion & eversion  
• Callus formation under 2nd metatarsal head & medial side of distal hallux  
• Tight gastroc/soleus  
• Soreness with heel walking  
• (–) X-ray, needed to r/o stress fx |
| **Shin Splints/Posterior**—an overuse syndrome of flexor hallucis longus & flexor digitorum longus; rapid & excessive pronation to compensate for rearfoot varus; result is ↑ stress on tibialis posterior to decelerate pronation | • Callus formation under 2nd> 3rd> 4th MT head & medial side of distal hallux  
• Pain & soreness over distal 1/3–2/3 of posterior/medial shin & posterior medial malleolus  
• Hypermobile 1st MTP  
• Pain with resisted MTP & plantarflexion  
• Pain with stretching into dorsiflexion & eversion  
• (–) X-ray, needed to r/o stress fx |

Continued
Compartment Syndrome—a progression of shin splints resulting in a loss of microcirculation in shin muscle; ♂ > ♀, R > L

Beware: This is an emergency situation

- ↑ Soft tissue pressures via fluid accumulation
- Ischemia of extensor hallucis longus
- Skin feels warm & firm
- Pain with stretch or AROM; foot drop
- Most reliable sign is sensory deficit of the dorsum of foot in 1st interdigital cleft
- Pulses are normal until the end & then surgery within 4–6 hours is required to prevent muscle necrosis & nerve damage
- Confirmed with MRI & pressure assessment

Bursitis—mechanical irritation

- Prepatella = common in sport = falling on knee or maintaining quadruped position (housemaids knee)
- Infrapatella = clergyman bursitis = kneeling (mechanical irritation)
- Pes anserine = prevalent in long-distance running or middle-aged females with OA of the knee

- Localized radiating heat
- Localized egg-shaped swelling
- Radiating pain 2–4 cm below the involved bursa
- Crepitus
- Discomfort with A & PROM
- Diagnosis confirmed with MRI

Popliteus Tendonitis—results from overuse, downhill running, activities with sudden stops

- Posterior lateral knee pain at the end of a workout or running downhill (just posterior to LCL)
- Crepitus over tendon
- Discomfort sitting with legs crossed & initiating flexion against resistance from full extension
- MRI may be helpful; need to r/o ITB, biceps tendonitis

Continued
<table>
<thead>
<tr>
<th><strong>Pathology/Mechanism</strong></th>
<th><strong>Signs/Symptoms</strong></th>
</tr>
</thead>
</table>
| **Jumper’s Knee** = patella tendonitis (most common in skeletally immature) 2° traction overuse injury such as jumping, kicking, running or degenerative process 2° microtrauma | ■ TTP at patella tendon insertion & pain with resisted knee extension  
■ Localized crepitus & swelling  
■ ↑ Q-angle  
■ Need to r/o Osgood-Schlatter’s, SLJ, & bursitis  
■ Confirmed with MRI |

**ITB Friction Syndrome**—repetitive stress & excessive friction 2° tight ITB, pronation with IR of tibia, genu varum, cycling with cleat in IR  
Proximal px = hip syndrome  
Distal px = runner’s knee  
| ■ Pain with downhill running  
■ Pain @ 30° of knee flexion in WB results in ambulating stiff legged to avoid flexion  
■ TTP over lateral femoral condyle  
■ (+) Tests: Ober’s, Noble’s, & Renne’s  
■ (–) X-ray  
■ Need to r/o trochanteric bursitis & osteochondritis  
■ MRI & US may confirm diagnosis |

**Plica Syndrome**—injury results from direct trauma or a significant ↑ in unaccustomed activity (presence of medial plica is more common than a lateral plica)  
| ■ Pain over medial femoral condyle; palpable cords along medial condyle, pain at superomedial joint line  
■ Reports of clicking/snapping, locking, “giving way”  
■ Full ROM but pain at end range flexion  
■ False (+) McMurray (pseudolocking)  
■ (+) Tests: Stutter, plica, theatre sign & bowstring  
■ Need to r/o patellofemoral tracking px  
■ X-ray is not helpful, MRI is only noninvasive procedure that shows plica  
■ Arthroscope may reveal an avascular fibrotic edge of the plica |

*Continued*
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chondromalacia (patellofemoral syndrome—PFS)</strong></td>
<td>- Anterior knee pain; pain with stairs; crepitus</td>
</tr>
<tr>
<td></td>
<td>- VMO atrophy; weak hip ER</td>
</tr>
<tr>
<td></td>
<td>- ↑ Knee valgus, ↑ Q-angle</td>
</tr>
<tr>
<td></td>
<td>- (+) Tests: Theater, Clarke’s, &amp; Fairbank’s/apprehension</td>
</tr>
<tr>
<td></td>
<td>- Confirmed via MRI</td>
</tr>
<tr>
<td><strong>Patella Subluxation</strong></td>
<td>- Effusion shuts down VMO</td>
</tr>
<tr>
<td></td>
<td>- (+) Tests: Patella tilt &amp; patella apprehension</td>
</tr>
<tr>
<td></td>
<td>- Tenderness along medial patella border</td>
</tr>
<tr>
<td></td>
<td>- Sitting @ 90/90, patella points lateral &amp; superior (grasshopper eyes)</td>
</tr>
<tr>
<td></td>
<td>- Client c/o knee giving way or clicking when cutting away from affected leg</td>
</tr>
<tr>
<td></td>
<td>- ↑ Q-angle</td>
</tr>
<tr>
<td></td>
<td>- X-ray may reveal osteochondral fragments or fx; multiple views are needed to evaluate all articular surfaces</td>
</tr>
<tr>
<td><strong>Patella Fracture</strong></td>
<td>- Pain &amp; “dome” effusion; palpable defect</td>
</tr>
<tr>
<td></td>
<td>- Unable to extend knee</td>
</tr>
<tr>
<td></td>
<td>- Confirmed with x-ray</td>
</tr>
<tr>
<td><strong>LCL Sprain</strong></td>
<td>- Warm &amp; swollen lateral knee</td>
</tr>
<tr>
<td></td>
<td>- TTP @ knee joint line (palpate in figure-4 position)</td>
</tr>
<tr>
<td></td>
<td>- ROM may not be effected</td>
</tr>
<tr>
<td></td>
<td>- (+) Varus stress test</td>
</tr>
<tr>
<td></td>
<td>- Confirmed with MRI or arthrogram with contrast</td>
</tr>
<tr>
<td></td>
<td>- (-) X-ray but needed to r/o avulsion or epiphyseal plate injury; Varus stress film may show ↑ joint gapping</td>
</tr>
<tr>
<td>Pathology/Mechanism</td>
<td>Signs/Symptoms</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| **MCL Sprain**—injury results from  | ■ Flexion limited to 90° & knee extension lag present  
| valgus stress resulting in over-    | ■ If deep fibers are torn, knee joint rapidly fills with blood  
| stretching or tearing of the MCL    | ■ (+) Valgus stress test  
|                                     | ■ TTP @ knee joint line (possible palpable defect)  
|                                     | ■ Confirmed with MRI or arthrogram with contrast  
|                                     | ■ (–) X-ray but needed to r/o avulsion or epiphyseal plate injury; valgus stress film may show ↑ joint gapping |
| **ACL Sprain**—injury results from  | ■ Audible pop with immediate swelling (<2 hrs)  
| twisting while changing directions, | ■ Intense pain at posterior lateral tibia  
| deceleration with valgus & ER,      | ■ Unstable in WB  
| hyperflexion of the knee with foot  | ■ (+) Tests: Anterior drawer, Lachman’s, & pivot shift  
| in plantarflexion                   | ■ KT1000/2000 anterior displacement >5 mm  
|                                     | ■ (–) X-ray (except for avulsion); MRI is study of choice  
|                                     | ■ Bloody arthrocentesis  
| **PCL Sprain**—injury results from  | ■ Minimal swelling; ecchymosis may appear days later  
| dashboard blow to anterior shin     | ■ Tenderness in popliteal fossa & pain with kneeling  
| with knee flexed @ 90° or falling on| ■ Pt may be able to continue to play  
| the knee with foot plantarflexed    | ■ (+) Tests: Posterior drawer, posterior Lachman’s, & SAG/dropback/Godfrey’s  
|                                     | ■ (–) X-ray (except for avulsion); MRI is study of choice  
|                                     | ■ Bloody arthrocentesis  
<p>|                                     | Continued |</p>
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
</table>
| **Meniscus Tear**—injured via rotatory forces while WB or hyperextension of knee; medial femoral/lateral tibial rotation injures medial meniscus & lateral femoral/medial tibial rotation injures lateral meniscus.  
*Common types of tears:*  
Children = longitudinal & peripheral tear  
Teenagers = bucket handle tear | ■ (-) Varus/valgus stress  
■ Pain at end range flexion/extension & WB  
■ Gradual swelling over 1-3 days; ecchymosis  
■ Joint line tenderness  
■ (+) Tests: McMurray’s & Apley’s (unreliable in children)  
■ Anterior horn locks in extension, posterior in flexion, medial in 10°–30° of flexion, lateral >70° of flexion  
■ X-ray may r/o fx, tumor, osseous loose bodies  
■ MRI may reveal pseudotear; confirm with arthrogram using contrast |
| **DJD**—result of aging, poor biomechanics or repetitive trauma | ■ Joint line crepitus  
■ ↓ Terminal knee extension 2° to edema (quad atrophy)  
■ ↓ Stance time during gait  
■ “Gelling” phenomenon = ↑ viscosity of synovial fluid 2° to inflammation  
■ Anteriomedial knee pain & stiffness with immobility  
■ X-ray will reveal narrow joint space, spurring, osteophytes |
| **Osgood-Schlatter’s Disease**—tibial apophysitis that may occur from rapid growth of femur resulting in avulsion of proximal tibial physis; may have a genetic predisposition; 8–15 yo, ♂ > ♀ | ■ Intermittent aching pain at tibial tubercle & distal patellar tendon  
■ Enlarged tibial tuberosity  
■ Tight quads & hamstrings resulting in ↓ AROM  
■ Effusion results in knee extensor lag  
■ (+) Ely test  
■ (+) X-ray for avulsion of tibial tuberosity (lateral view)  
■ Need to r/o avascular necrosis |

*Continued*
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sinding-Larsen Johansson (SLJ)</strong>—results from a traction force on the patella tendon 2° chronic extensor overload; 10–14 yo ♂</td>
<td>■ Anterior knee pain &amp; TTP at distal pole of the patella with knee extension</td>
</tr>
<tr>
<td></td>
<td>■ Antalgic gait</td>
</tr>
<tr>
<td></td>
<td>■ ↓ Knee ROM</td>
</tr>
<tr>
<td></td>
<td>■ X-ray (lateral view)= fragmentation of inferior patella pole</td>
</tr>
<tr>
<td><strong>Myositis Ossificans</strong>—calcification in a muscle due to trauma, painful hematoma develop rapidly &amp; calcification occurs in 2–3 wks; ossification occurs in 4–8 wks; may be neurogenic after a SCI or TBI</td>
<td>■ Warm &amp; TTP over involved site</td>
</tr>
<tr>
<td></td>
<td>■ ↓ ROM</td>
</tr>
<tr>
<td></td>
<td>■ Pain with contraction of involved muscle</td>
</tr>
<tr>
<td></td>
<td>■ Confirmed with x-ray after 2–3 weeks; earlier with MRI</td>
</tr>
<tr>
<td><strong>Heterotropic Ossification</strong>—ossification between rather than within strained muscle fibers resulting from direct trauma</td>
<td>■ ↓ ROM</td>
</tr>
<tr>
<td></td>
<td>■ Weakness of involved muscle</td>
</tr>
<tr>
<td></td>
<td>■ TTP, swelling, &amp; hyperemia</td>
</tr>
<tr>
<td></td>
<td>■ Confirmed with x-ray after 2–3 weeks; earlier with MRI</td>
</tr>
<tr>
<td><strong>Osteochondritis Dissecans</strong>—lesions of subchondral bone of insidious onset; possible trauma vs preexisting abnormalities of epiphyses; most common in posterolateral medial femoral condyle; 10–18 yo ♂ &gt; ♀</td>
<td>■ Knee effusion</td>
</tr>
<tr>
<td></td>
<td>■ Crepitus with knee flexion/extension &amp; effusion</td>
</tr>
<tr>
<td></td>
<td>■ Poorly localized knee pain</td>
</tr>
<tr>
<td></td>
<td>■ Antalgic gait</td>
</tr>
<tr>
<td></td>
<td>■ (+) Wilson’s test</td>
</tr>
<tr>
<td></td>
<td>■ May have TTP over medial femoral condyle with knee flexion</td>
</tr>
<tr>
<td></td>
<td>■ X-ray may not help; need MRI or bone scan</td>
</tr>
</tbody>
</table>
Ankle & Foot Anatomy

Medial view of ankle ligaments

- Deltoid ligament
- Achilles tendon (cut)
- Deltoid ligament
- Sustentaculum tali
- Tibialis anterior tendon
- Tibialis posterior tendon
- Plantar calcaneonavicular ligament
- First metatarsal bone
- Dorsal talonavicular ligament
- Dorsal cuneonavicular ligaments
- Dorsal tarsometatarsal ligaments
- Posterior talofibular ligament
- Anterior talofibular ligament
- Anterior tibiofibular ligament
- Calcaneofibular ligament
- Interosseous talocalcaneal ligament
- Dorsal metatarsal ligaments
- Dorsal cuneocuboid ligament
- Dorsal cuboideonavicular ligament
- Bifurcate ligament
- Long plantar ligament
- Peroneus longus tendon
- Peroneus brevis tendon
- Superior peroneal retinaculum
- Inferior peroneal retinaculum
- Calcaneal (Achilles) tendon (cut)

Lateral view of ankle ligaments

- Dorsal talonavicular ligament
- Dorsal cuneonavicular ligaments
- Dorsal tarsometatarsal ligaments
- Tibialis posterior tendon
- Tibialis anterior tendon
- Plantar calcaneonavicular ligament
- First metatarsal bone
- Achilles tendon (cut)
- Sustentaculum tali
- Long plantar ligament
- Peroneus longus tendon
- Peroneus brevis tendon
- Superior peroneal retinaculum
- Inferior peroneal retinaculum
- Calcaneal (Achilles) tendon (cut)
Medical Red Flags

- **Paresthesia**—stocking distribution, associated with:
  - DM
  - Lead/mercury poison

- **Gout**
  - Swelling & TTP @ 1st MTP or ankle
  - Pain with A & PROM of foot &/or ankle
  - Hypersensitive to touch

- **Lyme’s Disease**
  - “Bull’s eye” rash (expanding red rings)
  - Flu-like symptoms

- **Bilateral ankle edema** with ↑ BP with hx of NSAIDS use may be the result of renal vasoconstriction

### Complex Regional Pain Syndrome

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Burning, aching, tenderness, joint stiffness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Swelling, temperature changes</td>
</tr>
<tr>
<td></td>
<td>↑ nail growth &amp; ↑ hair on foot/feet</td>
</tr>
<tr>
<td>Stage 2</td>
<td>↑ Pain, swelling, joint stiffness</td>
</tr>
<tr>
<td></td>
<td>Pain becomes less localized</td>
</tr>
<tr>
<td></td>
<td>Change in skin color &amp; texture</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Pain radiates all the way up the leg</td>
</tr>
<tr>
<td></td>
<td>↓ Nerve conduction velocity</td>
</tr>
<tr>
<td></td>
<td>Muscle atrophy</td>
</tr>
</tbody>
</table>
Ottawa Ankle Rules

Radiographic series of the *ankle* is only required if one of the following are present:

- Bone tenderness at posterior edge of the distal 6 cm of the medial malleolus
- Bone tenderness at posterior edge of the distal 6 cm of the lateral malleolus
- Totally unable to bear weight *both* immediately after injury & (for 4 steps) in the emergency department

**Statistics:**
- Adults: Sensitivity = 95%–100% & specificity = 16%
- Children: Sensitivity = 83%–100% & specificity = 21%–50%

Ottawa Foot Rules

Radiographic series of the *foot* is only required if one of the following are present:

- Bone tenderness is at navicular
- Bone tenderness at the base of 5th MT
- Totally unable to bear weight *both* immediately after injury & (for 4 steps) in the emergency department

**Statistics:**
- Adults: Sensitivity = 93-100% & specificity = 12-21%
- Children: Sensitivity = 100% & specificity = 36%
### Toolbox Tests

#### A Performance Test Protocol and Scoring Scale for the Evaluation of Ankle Injuries

<table>
<thead>
<tr>
<th>Subjective Assessment of the Injured Ankle</th>
<th>Can You Walk Normally?</th>
</tr>
</thead>
<tbody>
<tr>
<td>No symptoms</td>
<td>Yes</td>
</tr>
<tr>
<td>Mild symptoms</td>
<td></td>
</tr>
<tr>
<td>Moderate symptoms</td>
<td>No</td>
</tr>
<tr>
<td>Severe symptoms</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Can You Run Normally?</th>
<th>Climb Down Stairs? (2 flights ~ 44 steps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Under 18 seconds</td>
</tr>
<tr>
<td>No</td>
<td>18–20 seconds</td>
</tr>
<tr>
<td></td>
<td>&gt;20 seconds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rising on Heels with Injured Leg</th>
<th>Rising on Toes with Injured Leg</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;40 seconds</td>
<td>&gt;40 seconds</td>
</tr>
<tr>
<td>30–39 seconds</td>
<td>30–39 seconds</td>
</tr>
<tr>
<td>&lt;30 seconds</td>
<td>&lt;30 seconds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Single-limbed Stance with Injured Leg</th>
<th>Laxity of Ankle Joints</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;55 seconds</td>
<td>Stable (5 mm)</td>
</tr>
<tr>
<td>50–54 seconds</td>
<td>Moderate laxity (6–10 mm)</td>
</tr>
<tr>
<td>&lt;50 seconds</td>
<td>Severe laxity (&gt;10 mm)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Injured Leg Dorsiflexion ROM</th>
<th>TOTAL SCORE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥10°</td>
<td>Excellent = 85–100; Good = 70–80; Fair = 55–65; Poor ≤50</td>
</tr>
<tr>
<td>5–9°</td>
<td></td>
</tr>
<tr>
<td>&lt;5°</td>
<td></td>
</tr>
</tbody>
</table>

Scoring: Summate all scores

Mark the horizontal lines below to address each task.

**How severe is your foot pain?**

<table>
<thead>
<tr>
<th></th>
<th>Worse pain</th>
<th>More manageable</th>
<th>No pain</th>
<th>Imagination</th>
<th>So difficult</th>
<th>Unable to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking 4 blocks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking outside</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking in orthotics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking with shoes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking barefoot</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standing with shoes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standing in orthotics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standing in house</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking in the morning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking in the evening</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**How much difficulty do you have:**

<table>
<thead>
<tr>
<th></th>
<th>End of the day</th>
<th>Standing in orthotics</th>
<th>Walking in orthotics</th>
<th>Standing barefoot</th>
<th>Walking with shoes</th>
<th>Standing with shoes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Foot Function Index—cont’d

**How much difficulty do you have:**

<table>
<thead>
<tr>
<th>Activity</th>
<th>So difficult</th>
<th>No difficulty</th>
<th>None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descending stairs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standing tip toe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Getting out of a chair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Climbing curbs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Climbing stairs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking fast</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standing hip toe</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Because of your feet, how much of the time do you:**

<table>
<thead>
<tr>
<th>Activity</th>
<th>All</th>
<th>Stay inside all day</th>
<th>Limit activities</th>
<th>Stay in bed all day</th>
<th>Use assistive device indoors</th>
<th>Use assistive device outdoors</th>
<th>Indoors</th>
<th>Outdoors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Score:**

Summate all scores, exclude items that are not applicable & multiple by 100. The higher the number is, the greater the impairment.

Referral Patterns

Muscle Pain Referral Patterns

Peroneus longus & brevis  Peroneus (Fibularis) tertius

Tibialis anterior
Flexor hallucis longus

Flexor digitorum longus

Extensor digitorum longus

Extensor hallucis longus
Visual Inspection

- **Hammer toe** = hyperextension of MTP & DIP with PIP flexion of toes 2, 3, 4, 5; associated with hallux valgus; pain is worse with shoes on; corns present
- **Hallux valgus** = 1st MTP > 20° valgus angle; 1st & 2nd toe overlap
- **Index plus foot** = 1st MT > 2nd > 3 > 4 > 5
- **Index plus-minus foot** = 1st MT = 2nd MT > 3 > 4 > 5
- **Index minus foot** = 1st MT < 2nd > 3 > 4 > 5
- **Subtalar neutral** = in the prone position with the forefoot passively dorsiflexed & pronated, it is the position in which the head of the talus is felt to be equally spaced from the navicular

Palpation Pearls

- **Dorsalis pedis artery** = on top of foot between 1st & 2nd metatarsals
- **Sustentaculum tali** = small ledge just distal to medial malleolus
- **Peroneal tubercle** = small prominence ~1” distal to lateral malleolus
- **Plantaris** = with knee flexed, palpate medial to posterior aspect of the fibula head, roll over lateral gastroc head and move slightly proximal; palpate for a 1”-wide muscle that runs on an angle from proximal/ lateral to distal/medial
- **Tibialis anterior** = follow down the lateral tibial shaft to the medial aspect of the medial cuneiform
- **Extensor digitorum longus** = while extending the toes, follow the 4 prominent tendons proximal to the ankle—the tendons dive under the extensor retinaculum and emerge proximally as a thicker mass—follow the muscle belly along the tibia between the tibialis anterior and the peroneals (fibularis)
A

Superior view

Phalanges
Metatarsals
1st (medial) cuneiform
2nd (intermediate) cuneiform
3rd (lateral) cuneiform
Cuboid
Navicular
Talus
Calcaneus

B

Inferior view

Distal phalanx
Middle phalanx
Proximal phalanx
5th metatarsal
Sesamoids
1st (medial) cuneiform
2nd (intermediate) cuneiform
3rd (lateral) cuneiform
Cuboid
Navicular
Talus
Calcaneus

230
Extensor digitorum & ext hallucis

Plantaris
Lateral ankle structures

Medial ankle structures
In NWB, a line is constructed to connect the apex of the medial malleolus to the head of the 1st MTP joint. The navicular bone should be in line with these 2 structures. In the standing (WB) position, the navicular should not drop more than 2/3 the distance to the floor.
Figure 8 Method to Assess Ankle Edema

1. Start distal to navicular tuberosity; go medial.
2. Under the arch to the proximal aspect of the head of the 5th metatarsal.

3. Across the anterior tibialis tendon to the distal aspect of the medial malleolus
4. Over the Achilles tendon back to the lateral aspect of the medial malleolus

# Osteokinematics of the Ankle & Foot

<table>
<thead>
<tr>
<th>Normal ROM</th>
<th>OPP</th>
<th>CPP</th>
<th>Normal End-feel(s)</th>
<th>Abnormal End-feel(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plantarflexion 30°–50°</td>
<td>10° PF</td>
<td>Maximal DF</td>
<td>Elastic (tissue stretch) for all planes</td>
<td>Empty = sprain/strain</td>
</tr>
<tr>
<td>Dorsiflexion 20°</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inversion 10°–30°</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eversion 10°–20°</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st Extension 35° MTP</td>
<td>5°–10° extension</td>
<td>Maximal extension</td>
<td>Capsular</td>
<td>Capsular = extension limited</td>
</tr>
<tr>
<td>2-5 MTP</td>
<td>Flexion 75°</td>
<td>Maximal extension</td>
<td>Flex/extension = capsular/elastic</td>
<td>Capsular = flexion limited</td>
</tr>
<tr>
<td></td>
<td>Slight flexion</td>
<td></td>
<td>Abd/adduction = ligamentous</td>
<td></td>
</tr>
</tbody>
</table>
## Arthrokinematics for Ankle & Foot Mobilization

<table>
<thead>
<tr>
<th>Ankle flexion &amp; extension</th>
<th>Concave surface: Distal tibia/fibula</th>
<th>Convex surface: Talus</th>
<th>To facilitate ankle dorsiflexion: OKC—talus rolls anterior &amp; glides posterior on tibia CKC—tibia rolls &amp; glides anterior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ankle inversion &amp; eversion</td>
<td>Concave surface: Anterior calcaneal facet &amp; posterior talus Convex surface: Posterior calcaneal facet &amp; anterior talus</td>
<td></td>
<td>To facilitate inversion: OKC—anterior calcaneal facet rolls &amp; glides medial while posterior calcaneal facet rolls &amp; glides lateral CKC—talus rolls medial &amp; glides lateral on anterior calcaneal facet while talus rolls &amp; glides medial on posterior calcaneal facet</td>
</tr>
<tr>
<td>MTP flexion &amp; extension</td>
<td>Concave surface: Phalanx Convex surface: Metatarsal</td>
<td></td>
<td>To facilitate flexion: Phalanx rolls &amp; glides distal/inferior on metatarsal To facilitate extension: Phalanx rolls &amp; glides proximal/superior on metatarsal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>To facilitate ankle plantarflexion: OKC—talus rolls posterior &amp; glides anterior on tibia CKC—tibia rolls &amp; glides posterior</td>
</tr>
</tbody>
</table>

Concave surface:
- Distal tibia/fibula
- Anterior calcaneal facet & posterior talus
- Phalanx

Convex surface:
- Talus
- Posterior calcaneal facet & anterior talus
- Metatarsal
Special Tests

**ANTERIOR DRAWER**

**Purpose:** Assess for ATF laxity  
**Position:** NWB position in ~ 20° of plantarflexion, stabilize the distal tibia/fibula  
**Technique:** Grasp the posterior aspect of the calcaneus/talus & translate the calcaneus/talus anterior on the tibia/fibula  
**Interpretation:** + test = pain & excessive movement 2° to instability

**TALAR TILT**

**Purpose:** Test for laxity of lateral ankle ligaments—ATF, CF, PTF  
**Position:** NWB—stabilize the lower leg & palpate respective ligament  
**Technique:** Grasp calcaneus to apply a varus stress to displace the talus from the mortise. Should be performed in plantarflexion (ATF), neutral (CF), & dorsiflexion (PTF)  
**Interpretation:** + test = pain or excessive gapping with respect to the contralateral limb

**SQUEEZE TEST**

**Purpose:** Assess for syndesmotic sprain  
**Position:** Supine with knee extended  
**Technique:** Begin at the proximal tibia/fibula & firmly compress (squeeze) the tibia/fibula together, progress distally toward the ankle until pain is elicited  
**Interpretation:** + test = pain at the syndesmosis; the farther from the ankle the pain is elicited, the more severe the sprain

**Note:** Recovery time = 5 + (0.97 x cm from ankle joint that squeeze test is positive) ± 3 days
ANKLE & FOOT STRESS TEST (rotate from heel)

Purpose: Assess for deltoid or syndesmotic sprain
Position: Sitting with lower leg stabilized but syndesmosis not compressed
Technique: Grasp the heel or medial aspect of the foot & ER in plantarflexion (deltoid lig) & then repeat with ER in dorsiflexion (syndesmosis)
Interpretation: + test = pain or gapping as compared to contralateral limb

WINDLASS TEST

Purpose: Assess for plantar fasciitis
Position 1: NWB with knee flexed to 90°
Technique 1: Stabilize the ankle in neutral & dorsiflex the great toe
Interpretation 1: + test = pain along the medial longitudinal arch

Position 2: WB
Technique 2: Standing on a stool with equal weight on both foot & toes hanging over the edge of the stool & dorsiflex the great toe
Interpretation 2: + test = pain along the medial longitudinal arch
**PERONEAL TENDON DISLOCATION**

**Purpose:** Assess for damage to peroneal retinaculum

**Position:** Prone, knee flexed to 90°

**Technique:** Have the client actively plantarflex & dorsiflex the ankle against resistance

**Interpretation:** + test = tendon subluxing from behind the lateral malleolus

---

**THOMPSON’S TEST**

**Purpose:** Assess for Achilles tendon rupture

**Position:** Prone

**Technique:** Passively flex the knee to 90° & squeeze the middle 1/3 of the calf

**Interpretation:** Plantarflexion of the foot should occur; + test = failure to plantarflex

---

**HOMAN’S SIGN**

**Purpose:** Assess for thrombophlebitis of the lower leg

**Position:** Supine

**Technique:** Passively dorsiflex the foot & squeeze the calf

**Interpretation:** + test = sudden pain in the posterior leg or calf

---

**MORTON’S TEST**

**Purpose:** Assess for neuroma

**Position:** NWB

**Technique:** Grasp around the transverse metatarsal arch & squeeze the heads of the metatarsals together

**Interpretation:** + test = pain between 2nd/3rd or 3rd/4th digits that refers to the toes
**BUMP TEST**

**Purpose:** Test for stress fx  
**Position:** NWB—ankle in neutral  
**Technique:** Apply a firm force with the thenar eminence to the heel of the foot  
**Interpretation:** + test = pain at the site of the possible fx

**METATARSAL LOAD**

**Purpose:** Assess for metatarsal fracture  
**Position:** NWB  
**Technique:** Grasp the distal aspect of the metatarsal bone & apply a longitudinal force to load the metatarsal  
**Interpretation:** + test = localized pain as the metatarsal joints are compressed

**TINEL’S TEST**

**Purpose:** Assess for tibial nerve damage  
**Position:** NWB  
**Technique:** Tap over posterior tibial nn (medial plantar nerve), just inferior & posterior to medial malleolus  
**Interpretation:** + test = paresthesia into the foot
## Differential Diagnosis

<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
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</table>
| **Turf Toe**—extreme hyperextension of great toe in CKC position resulting in sprain of plantar capsule & LCL of 1st MTP | [■ Pain with toe extension](#)  
[■ Impairment of push-off, antalgic gait](#)  
[■ Ecchymosis & swelling of 1st MTP joint](#)  
[■ (-) X-ray](#)  
[■ Need to r/o sesamoid & metatarsal head fx](#) |
| **Hallux Valgus (Bunion)**—RA, poor fitting footwear, flat feet | [■ Pain, swelling, great toe valgus >15°](#)  
[■ ↓ ROM of great toe & hammer 2nd toe](#)  
[■ X-ray helpful](#)  
[■ Need to r/o RA](#) |
| **Sesamoiditis**—repetitive high impact sports or direct trauma | [■ Impairment of push-off, antalgic gait, swollen 1st MTP](#)  
[■ TTP, pain with passive dorsiflexion of MTP](#)  
[■ (+) X-ray & MRI](#)  
[■ Need to r/o turf toe & bipartite sesamoid](#) |
| **Stress Fracture**—repetitive stresses occurs ~3 wks after ↑ training; (2nd MT is most common) **Beware** of eating disorders with repetitive stress fx | [■ Deep nagging & localized pain; night pain](#)  
[■ ROM WNL](#)  
[■ (+) Tests: Metatarsal load & bump](#)  
[■ Bone scan & MRI will detect earlier than x-ray](#)  
[■ Therapeutic US in continuous mode will ↑ pain & may aid in dx](#)  
[■ Need to r/o DVT](#) |
| **Hallux Rigidus**—may be associated with osteochondritis (child) or DJD, gout, or RA (adult) | [■ ↓ Dorsiflexion of 1st MTP joint](#)  
[■ Pain & swelling on dorsal aspect of 1st MTP](#)  
[■ Difficulty walking up stairs & uphill](#)  
[■ ER of foot to clear LE during gait](#)  
[■ X-ray will confirm dorsal osteophyte & ↓ joint space](#) |

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<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
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</table>
| Charcot Foot—hypertrophic osteoarthropathy of midfoot in client’s with IDDM | ■ Progressive bone & muscle weakness  
■ ↓ Sensation but minimal to no pain  
■ Profound unilateral swelling  
■ ↑ Skin temp (local); erythema  
■ X-ray looks like osteomyelitis (bone fragments present) |
| Morton’s Neuroma—thickening of interdigital nn (25–50 yo; ♀ > ♂)  
2° high heel shoes, excessive pronation, high arch, lateral compression of forefoot, ↑ wt | ■ Throbbing/burning into plantar aspect of 3rd & 4th MT heads; feels like a pebble is in the shoe  
■ Callus under involved rays  
■ ↑ Pain with WB, (+) Morton’s test  
■ Weak intrinsic muscles  
■ EMG = unreliable  
■ Need to r/o stress fx (MRI with contrast) |
| Plantarfascitis—continuous with gastroc mm; subject to inflammation 2° repetitive stress, poorly cushioned footwear, hard surfaces, ↑ pronation, obesity | ■ Morning pain that ↓ with activity, nodules are palpable over proximal-medial border of plantar fascia  
■ Pain with dorsiflexion & toe extension  
■ ↓ Dorsiflexion due to tight gastroc  
■ Weak foot intrinsics  
■ Sensation & reflexes WNL  
■ (−) EMG; x-ray may show calcaneal spur but there is no correlation between a bone spur & pain of plantarfascitis |
| Tarsal Tunnel—compression of contents of tarsal tunnel (posterior tibial nerve & artery, tibialis posterior, FDL, FHL) may be 2° trauma, weight gain, excessive pronation, or inflammation | ■ Sharp pain into medial/plantar aspect of foot & 1st MTP  
■ Burning, nocturnal pain, swelling  
■ ↑ Pain with walking & passive d-flexion or eversion  
■ Motor weakness & intrinsic atrophy is difficult to detect  
■ DTRs & ROM = WNL  
■ (+) Tinel’s sign just below & behind the medial malleolus  
■ Abnormal EMG; r/o diabetic neuropathy & neuroma |

Continued
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peroneal Tendonitis—structurally</td>
<td>Subluxing tendon = snapping while everting in dorsiflexion; subluxation is</td>
</tr>
<tr>
<td>3 anatomic sites where tendon passes</td>
<td>more common in young athletes 2° to forceful dorsiflexion of inverted foot</td>
</tr>
<tr>
<td>through tunnel/passage with acute</td>
<td>with peroneals contracting</td>
</tr>
<tr>
<td>angulation that can result in irritation</td>
<td>Swelling &amp; ecchymosis inferior to lateral malleolus</td>
</tr>
<tr>
<td>&amp; ↓ vascularization 2° trauma, inversion</td>
<td>X-ray may show avulsion of peroneal retinaculum</td>
</tr>
<tr>
<td>sprains, or direct blow</td>
<td></td>
</tr>
<tr>
<td>Common Peroneal Nerve Palsy</td>
<td>Compromised ankle stability can ↑ risk of sprains</td>
</tr>
<tr>
<td>sitting with legs crossed, compression</td>
<td>Local pain &amp; ecchymosis at the site of external trauma</td>
</tr>
<tr>
<td>during sx, presence of a fabella (20%</td>
<td>Foot drop, ↓ eversion &amp; dorsiflexion</td>
</tr>
<tr>
<td>of population), tight ski boots or</td>
<td>Partial sensory loss</td>
</tr>
<tr>
<td>hockey skates, tx of nerve during</td>
<td>Test = pain with walking on medial borders of foot</td>
</tr>
<tr>
<td>strong inversion &amp; plantarflexion</td>
<td>MRI, EMG/NCV may be helpful</td>
</tr>
<tr>
<td>contraction</td>
<td></td>
</tr>
<tr>
<td>Sever’s Syndrome (Achilles Apophysitis)—</td>
<td>Heel pain, TTP with mediolateral compression of calcaneus</td>
</tr>
<tr>
<td>occurs in 8–16 yo ♂&gt;♀ 2° rapid growth with</td>
<td>↓ Dorsiflexion due to pain; pain with stairs</td>
</tr>
<tr>
<td>stress on epiphysis with jumping or</td>
<td>Radiographs may not be helpful</td>
</tr>
<tr>
<td>athletic events; may occur (B)</td>
<td>Responds well to heel lift (healing takes months)</td>
</tr>
<tr>
<td>Achilles Tendonitis—vascular watershed</td>
<td>Localized tenderness 2–6 cm proximal to Achilles insertion</td>
</tr>
<tr>
<td>is 4.5 cm above tendon insertion &amp;</td>
<td>Early morning stiffness, antalgic gait; pain climbing stairs</td>
</tr>
<tr>
<td>vulnerable to ischemia 2° running hills</td>
<td>Tendon thickening &amp; crepitus with AROM (wet leather)</td>
</tr>
<tr>
<td>(up = stretch &amp; down = eccentric stress),</td>
<td>Palpable Achilles nodule (retrocalcaneal exostosis = pump bump)</td>
</tr>
<tr>
<td>poor footwear, excess pronation (↑</td>
<td>↓ Ankle dorsiflexion with knee extended</td>
</tr>
<tr>
<td>rotational forces); occurs mostly in ♂</td>
<td>MRI to r/o tendon defect &amp; DVT</td>
</tr>
<tr>
<td>30–50 yo</td>
<td></td>
</tr>
</tbody>
</table>

Continued
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
</table>
| **Achilles Tendon Rupture**—<30 yo, injury is 2° direct blow to gastroc or forceful contraction; >30 yo, injury is 2° degeneration (higher incidence in people with type “O” blood) | □ Snap/pop associated with injury  
□ Palpable gap in tendon (hatchet sign) if examined early  
□ Cannot walk on toes, swelling (within 1–2 hrs) & ecchymosis  
□ (+) Thompson's test  
□ MRI confirms diagnosis |
| **Posterior Tibialis Tendonitis**—inflammatory condition due to poor biomechanics or overuse; common in ♀ >40 yo | □ TTP @ medial ankle  
□ Crepitus with AROM  
□ Pain with passive pronation & active supination  
□ Pain with resistive inversion & plantarflexion |
| **Shin Splints/Anterior**—an overuse syndrome of tibialis anterior, ext hallucis longus, & ext digitorum longus attributed to running on unconditioned legs, soft tissue imbalance, alignment abnormalities, & excessive pronation to accommodate rearfoot varus | □ Pain & tenderness over anterior tibialis  
□ Pain with resisted dorsiflexion & inversion  
□ Pain with stretching into plantarflexion & eversion  
□ Callus formation under 2nd metatarsal head & medial side of distal hallux  
□ Tight gastroc/soleus muscle  
□ Soreness with heel walking  
□ (–) X-ray, needed to r/o stress fx |
| **Shin Splints/Posterior**—an overuse syndrome of flexor hallucis longus & flexor digitorum longus | □ Callus formation under 2nd > 3rd > 4th MT head & medial side of distal hallux  
□ Pain & soreness over distal 1/3–2/3 of posterior/medial shin & posterior or medial malleolus  
□ Hypermobile 1st metatarsal  
□ Rapid & excessive pronation to compensate for rearfoot varus; result is ↑ stress on tibialis posterior to decelerate foot  
□ Pain with resisted inversion & plantarflexion  
□ Pain with stretching into dorsiflexion & eversion  
□ (–) X-ray, needed to r/o stress fx |

Continued
<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
</table>
| **Compartment Syndrome**—a progression of shin splints resulting in a loss of microcirculation in shin muscle; ♂ > ♀, R > L **Beware:** Immediate referral is needed (Ice but do not compress) | ■ 5 P’s = paresthesia (toes), paresis (drop foot), pain (anterior tibia), pallor, pulseless  
■ Skin feels warm & firm  
■ Pain with stretch or AROM, foot drop  
■ Severe cramping, diffuse pain & tightness  
■ Most reliable sign is sensory deficit at the dorsum of foot in 1st interdigital cleft  
■ Ischemia of extensor hallucis longus  
■ Pulses are normal until the end & then surgery is needed within 4–6 hours is required to prevent muscle necrosis & nerve damage  
■ ↑ Soft tissue pressures via fluid accumulation  
■ Normal compartment pressure <10 mm Hg  
■ > 20 mm Hg is compromised capillary blood flow  
■ > 30 mm Hg results in ischemic necrosis  
■ (–) X-ray & bone scan; need to r/o tibial stress fx  
■ Confirmed with MRI & pressure assessment |
| **Complex Regional Pain Syndrome**—etiology unknown, may occur after trauma See stages on page 222. | ■ Hyperalgesia & hyperhidrosis  
■ Capsular tightness & stiffness  
■ Muscle atrophy & osteoporosis  
■ Trophic changes & edema  
■ Vasomotor instability |

 Continued
### Pathology/Mechanism

**Syndesmotic Sprain**—injury to anterior and/or posterior inferior tibiofibular ligament 2° hyperdorsiflexion & eversion
See stages below

**Lateral Sprain**—injury to ATF, CF, PTF 2° inversion with plantarflexion
See stages below

### Signs/Symptoms

<table>
<thead>
<tr>
<th>Pathology/Mechanism</th>
<th>Signs/Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>(++) Tests: Squeeze &amp; ER test</td>
<td></td>
</tr>
<tr>
<td>Pain &amp; swelling over ligament/interosseous membrane</td>
<td></td>
</tr>
<tr>
<td>Oblique x-ray may show abnormal widening of joint space</td>
<td></td>
</tr>
<tr>
<td>Recovery time = 5 + (0.97 x cm from ankle joint that squeeze test is positive) ± 3 days</td>
<td></td>
</tr>
<tr>
<td>Need to r/o fx &amp; avulsion</td>
<td></td>
</tr>
<tr>
<td>Rich blood supply = significant swelling within 2 hours</td>
<td></td>
</tr>
<tr>
<td>TTP over involved ligaments, ecchymosis that drains distal</td>
<td></td>
</tr>
<tr>
<td>Varying levels of instability (grade 1–3)</td>
<td></td>
</tr>
<tr>
<td>(++) Tests: Talar tilt &amp; anterior drawer (presence of a dimple just inferior to the tip of the lateral malleolus)</td>
<td></td>
</tr>
<tr>
<td>(--) X-ray for fracture but stress film may show ↑ joint space</td>
<td></td>
</tr>
<tr>
<td>Arthrography is only accurate within 24 hours</td>
<td></td>
</tr>
</tbody>
</table>

### Grades of Ankle Sprains

<table>
<thead>
<tr>
<th>1st degree</th>
<th>2nd degree</th>
<th>3rd degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>No hemorrhage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimal swelling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point tender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No varus laxity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(--) Anterior drawer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(--) Talar tilt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No/little limp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficulty hopping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery 2–10 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some hemorrhage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Localized swelling (↓ Achilles definition)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(+) Anterior drawer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(+) Talar tilt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No varus laxity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(+) Limp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unable to heel raise, hop, run</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery 10–30 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diffuse swelling (no Achilles definition)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tenderness medial &amp; lateral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(+) Anterior drawer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(+) Talar tilt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(+) Varus laxity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NWB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recovery 30–90 days</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
References


Boissannault WG. *Primary Care for the Physical Therapist.* Elsevier Saunders, 2005


Farrell K. APTA Home Study Course, Solutions to Shoulder Disorders, 11.1.6 Adhesive Capsulitis.


Johanson M. APTA Home Study Course, Solutions to Shoulder Disorders, 11.1.4 Rotator Cuff Disorders.


Ludewig P. APTA Home Study Course, Solutions to Shoulder Disorders, 11.1.1 Functional Shoulder Anatomy and Biomechanics.


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Tomberlin J. APTA Home Study Course, Solutions to Shoulder Disorders, 11.1.2 Physical Diagnostic Tests of the Shoulder: An Evidence-based Perspective.


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