Skills Stations
Knee and Lower Extremity Exam and Injections, Anesthetic Blocks

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Burden of Musculoskeletal Disease/ Arthritis

- 1 of 5 adults have doctor diagnosed arthritis
  - 46 million Americans, 300,000 children
  - 19 million Americans reported arthritis attributable ADL limitations
  - 8 million with work limitations

- Clinical burden
  - 30 Million ambulatory visits
  - 750,000 hospitalizations

- Projection in 2030 due to aging, obesity
  - 25% of adult population
  - 67 million Americans with doctor diagnoses arthritis
  - 25 million with arthritis attributable ADL limitations

- Critical role of primary care physicians in eval, diagnosis
The Skeletal System

- Gives form to the body
- Protects vital organs
- Consists of 206 bones
- Designed to permit motion of the body
- Acts as a framework for attachment of muscles
- Metabolic reservoir for calcium and phosphorus
Principal Joints of the Body

- Acromioclavicular
- Ankle (tibia-fibula and talus)
- Atlas and axis
- Atlas and occipital
- Calcaneocuboid
- Carpometacarpal
- Elbow (humerus, radius, and ulna)
- Facet (cervical, thoracic, lumbar, sacral)
- Femur and tibia
- Hip bone and femur
- Humerus and ulna
- Intercarpal (proximal, distal, intracarpal)
- Intermetacarpals
- Intermetatarsals
- Interphalangeal
- Knee (femur, tibia, and patella)
- Mandible (jaw) and temporal
- Metacarpophalangeal
- Metatarsophalangeal
- Pubic bones
- Radioulnar (distal, middle, proximal)

- Radius-ulna and carpals (wrist)
- Ribs, heads of
- Ribs, tubercles and necks
- Sacrococcygeal
- Sacroiliac
- Shoulder (humerus and scapula)
- Symphysis
- Sacroiliac
- Scapula and humerus
- Sternoclavicular
- Sternocostal
- Subtalar
- Talus and calcaneus
- Talus and navicular
- Tarsometatarsal
- Tibia-fibula and talus (ankle)
- Tibiofibular
- Vertebral arches
- Vertebral bodies
- Wrist (radius-ulna and carpals)
The Planes of the Body

- Anterior
- Posterior
- Midaxilllary
- Midline
- Midclavicular line

Directional terms
- Right and left
- Superior and inferior
- Lateral and medial
- Proximal and distal
- Superficial and deep
- Ventral and dorsal
- Palmer and planter
- Apices and bilateral
MSK Injuries and Pain

• History: Mechanism of injury
  – How did it happen?
  – When did it happen?
  – Where does it hurt?

• Interfering with
  – Activities of daily living?
  – Quality of life?

• Physical exam

• Imaging and labs

• Differential diagnosis

• Time for a specialist evaluation
  – Visible deformity, ie swelling
  – Decreased function
  – Limping with pain
  – Increasing or significant pain
Physical Exam Elements

- Inspection

- Bony palpation
  - Anterior
  - Medial
  - Lateral
  - Posterior

- Soft tissue palpation
  - Anterior
  - Medial
  - Lateral
  - Posterior

- Joint stability

- Range of motion
  - Active
  - Passive

- Neurological examination
  - Muscle
  - Sensation
  - Reflex

- Special tests
  - Examination of one up, one down
Every Life Deserves World Class Care
Anatomy
Anatomy

Normal Hip

Arthritic Hip
Physical Exam Elements

**INSPECTION**

**BONY PALPATION**

*Anterior Aspect*
- Anterior Superior Iliac Spines
- Iliac Crest
- Iliac Tubercle
- Greater Trochanter
- Pubic Tubercles

*Posterior Aspect*
- Posterior Superior Iliac Spines
- Greater Trochanter
- Ischial Tuberosity
- Sacroiliac Joint (S2)

**SOFT TISSUE PALPATION**

*Zone I — Femoral Triangle*
*Zone II — Greater Trochanter*
*Zone III — Sciatic Nerve*
*Zone IV — Iliac Crest*
*Zone V — Hip and Pelvic Muscles*

**RANGE OF MOTION**

- Active Range of Motion Tests
- Passive Range of Motion Tests
- Flexion (Thomas Test) — 120°
  - Extension ________ 30°
  - Abduction ________ 45°–50°
  - Adduction ________ 20°–30°
  - Internal Rotation ____ 35°
  - External Rotation ___ 45°

**NEUROLOGIC EXAMINATION**

- Muscle Testing
- Sensation Tests

**SPECIAL TESTS**

- Trendelenburg Test
- Tests for Leg Length Discrepancy
  - True Leg Length Discrepancy
  - Apparent Leg Length Discrepancy
- Ober Test for Contraction of the Iliotibial Band
- Thomas Test for Flexion Contracture
- Tests for Congenital Dislocation of the Hip
- Ortolani Click
- Telescoping
- Adduction Contracture

**EXAMINATION OF RELATED AREAS**

- Rectal Examination
Physical Exam Elements

Flexion 135 degrees

Lack of contracture, lumbar spine flat

Hip contracture, unable to extend fully

Extension 30 degrees

Physical Examination of the Spine and Extremities, Hoppenfeld.
Physical Exam Elements

Abduction 45-50 degrees  Adduction 20-30 degrees

External rotation 45 degrees  Internal rotation 35 degrees

Testing ER / IR in flexion

Physical Examination of the Spine and Extremities, Hoppenfeld.
Differential

- Degenerative lumbar disk disease
- Lumbar disk herniation
- Trochanteric bursitis
- Muscle strain, tendonitis or strain
- Femoral acetabular impingement
- Labral tear
- Hip osteoarthritis
- Hip osteonecrosis
- Infection
- Transient osteoporosis
- Tumor of the pelvis or spine
- Fracture
- Snapping hip (ITB over greater trochanter)
- Internal derangement of the knee
Trochanteric Bursitis

• Inflammation of bursa
  – Fluid filled sac near a joint
  – Lateral aspect of hip at greater trochanter

• Symptoms
  – Pain at lateral hip or thigh or buttock
  – Worse when lying on the affected side, getting up from deep chair, getting out of car, walking up stairs
  – Pain to direct palpation

• What causes trochanteric bursitis?
  – Injury to the lateral area of the greater trochanter
  – Repetitive stress and overuse
  – Soft tissue stress such as poor posture, prolonged periods in one position, leg length inequality, spine problems, spurs
  – Inflammatory arthritis and other metabolic challenges

AAOS website at http://orthoinfo.aaos.org/topic.cfm?topic=a00409
Trochanteric Bursitis Treatment

• Most cases improve without any treatment over a few weeks
  – Reducing pain, inflammation, preserving mobility, preventing recurrence

• Physical therapy for range of motion exercises
  – Graduated approach

• Assistive device, aka cane

• Avoid the activities that could have cause the bursitis, shoe wear

• RICE - rest, ice, compression, elevation

• Nonsteroidal anti-inflammatory drugs

• Corticosteroid injections

• Surgery, when other treatments are not effective.
  – Failure of conservative measures
  – Recurrence
  – Fever and area is red, swollen or warm

AAOS website at http://orthoinfo.aaos.org/topic.cfm?topic=a00409
Hip Injections

• Hip joint
  – Best accomplished in radiology suite
  – Fluoroscopy for guidance

• Injections
  – Skin prep, sterile drape, sterile gloves, needle, syringes, drug, local, dressing
  – Localize and prep
  – Open steriley
  – Quick insertion
    – Down to bone
    – Aspirate
  – Insert local and drug
  – Band-aid
Impact of Obesity and Knee OA

• Knee OA and obesity among most common chronic conditions of adults ages 50-84

• Substantial loss of quality-adjusted life-years to knee OA and obesity – 86 million lost with Black and Hispanic women with disproportionate losses.

• Estimated total loss per person Quality-adjusted life years: 1857 with knee OA, 3501 with both

• Reversing obesity prevalence to that of 10 years ago would improve life expectancy by 7,812,120 QALY and would avert:
  — 178,071 cases of Coronary heart disease
  — 889,872 cases of DM
  — 111,206 total knee replacements
Inflammatory Arthritis of the Knee

• Acute monoarthritis
  – Infection, crystal (gout and pseudogout), trauma, hemorrhage, RA, PsA

• Subacute and chronic monoarthritis
  – RA, OA, mechanical, AVN, chronic infection, sarcoid, malignancy, PVS

• Polyarthritis
  – RA, PsA, Reactive, Inflammatory bowel disease, Infection (Viral incl. hepatitis, GC), sarcoid, etc

• Importance of early diagnosis, role of history, PE and synovial fluid analysis

• Coexisting pathology
  – RA and infection, crystal and infection
Anatomy

• Anatomy of the knee
  – Modified hinge joint
  – Subcutaneous
  – Used a lot every day

• Bending the knee
  – Standing
  – Walking
  – Stairs
Right knee shown. LCL indicates lateral collateral ligament; ACL, anterior cruciate ligament; PCL, posterior cruciate ligament; and MCL, medial collateral ligament.
Knee Injuries and Pain

• My knee pops and grinds

• No consequence *unless*
  – It hurts
  – It locks
  – It swells
Knee Injuries and Pain

• Evaluation goals
  – History
    – What happened?
  – Examination
    – Where is the pain?
    – What is the dysfunction?
    – Alignment?
  – Imaging
    – Plain x-rays with weight bearing views
  – Diagnosis
    – Assessing the damage
  – Treatment
    – Options
    – Risks and benefits
    – Re-evaluation of recommendation

Physical Examination of the Spine and Extremities, Hoppenfeld.
Physical Exam Elements

• Inspection
  – Standing and supine
  – Gait rhythm and pattern
  – Symmetry
  – Alignment
  – Soft Tissue
    – Atrophy
  – Bone
    – Femur
    – Tibia
    – Fibula
    – Patella

• Swelling
  – Obscure normal contour
  – Slightly flexed to increase volume
  – Swelling (generalized)
    – Bursal
    – Prepatellar, infraprepatellar, pes anserine
  – Effusion (localized)
    – Intraarticular effusion
    – Patella float, fluid milk down
Physical Exam Elements

**INSPECTION**

**BONY PALPATION**
- Medial Aspect
  - Medial Tibial Plateau
  - Tibial Tubercle
  - Medial Femoral Condyle
  - Adductor Tubercle
- Lateral Aspect
  - Lateral Tibial Plateau
  - Lateral Tubercle
  - Lateral Femoral Condyle
  - Lateral Femoral Epicondyle
  - Head of the Fibula
  - Trochlear Groove and Patella

**SOFT TISSUE PALPATION**
- Zone I — Anterior Aspect
- Zone II — Medial Aspect
- Zone III — Lateral Aspect
- Zone IV — Posterior Aspect

**TESTS FOR JOINT STABILITY**
- Collateral Ligaments
- Cruciate Ligaments

**RANGE OF MOTION**
- Active Range of Motion
- Passive Range of Motion
  - Flexion ________ 135°
  - Extension ________ 0°
  - Internal Rotation __ 10°
  - External Rotation __ 10°

**NEUROLOGIC EXAMINATION**
- Muscle Testing
- Extension
- Flexion
- Internal and External Rotation
- Sensation Testing
- Reflex Testing
  - Patellar Reflex: L2, 3, 4

**SPECIAL TESTS**
- McMurray Test
- Apley’s Compression and Distraction Tests
- Reduction Click
- “Bounce Home” Test
- Patella Femoral Grinding Test
- Apprehension Test for Patellar Dislocation and Subluxation
- Tinel Sign
- Knee Joint Effusion Tests

**EXAMINATION OF RELATED AREAS**

Physical Examination of the Spine and Extremities, Hoppenfeld.
Right knee shown. Examination maneuvers include the Lachman, anterior drawer, lateral pivot shift, Apley compression, and McMurray tests. Lachman test, performed to detect anterior cruciate ligament (ACL) injuries, is conducted with the patient supine and the knee flexed to 20° to 30°. The anterior drawer test detects ACL injuries and is performed with the patient supine and the knee in 90° of flexion. The lateral pivot shift test is performed with the patient supine, the hip flexed 45°, and the knee in full extension. Internal rotation is applied to the tibia while the knee is flexed to 40° under a valgus stress (pushing the outside of the knee medially). The Apley compression test, used to assess meniscal integrity, is performed with the patient prone and the examiner's knee over the patient's posterior thigh. The tibia is externally rotated while a downward compressive force is applied over the tibia. The McMurray test, used to assess meniscal integrity, is performed with the patient supine and the examiner standing on the side of the affected knee. See “Function” section of text for full explanation of all examinations.
Differential

Essentials of Musculoskeletal Care, AAOS, 1997
Knee Injuries and Pain

- Growth plates are weaker than ligaments.
Knee Sprains and Strains

• Range of motion
  – Extension 0 degrees
    – Some patients may have 5 degrees of hyperextension
  – Flexion 120 degrees
  – Minimal rotation 10 degrees

• Quadriceps muscle
  – Pain with forced extension
  – Lack of extension
Knee Sprains and Strains

• Medial collateral ligament
  – Pain with valgus stress
Meniscal Tears

- Normal
- Torn
- Resected
Meniscal Tears MR Imaging
Anterior Cruciate Ligament Injuries

- Direct blow to knee
- Non-contact injury
- Landing on straight leg
- Making abrupt stops
- “Back seat” skiing

Solomon et al, JAMA 286: 1610, 2001
Anterior Cruciate Ligament Tear

Normal ACL  Chronic ACL tear  Reconstructed ACL

Probe

AAOS, 2009
Anterior Cruciate Ligament Injuries

• When to reconstruct
  – Failed non operative care
  – Stability during exam
  – Stability during activities

• Lengthy rehab process
  – Specific protocol varies by physician
  – Commitment to participating
  – Exercise program…..forever

Solomon et al, JAMA 286: 1610, 2001
PF Patient Evaluation and Selection

• History
  – Trauma
  – Dislocation
  – Activities: stair descent and climbing

• Physical examination
  – Alignment and stability
  – Patella mobility
  – Patella inhibition testing
  – PF crepitus
  – Tracking
  – Squat
  – Lack of MFC LFC pain, MJL, LJL pain
  – Rule out pes anserine bursitis, patellar tendinitis, prepatellar bursitis, instability
Evaluation of the Arthritic Knee

• History = Knee Pain
  – Severity and acuity of pain
  – Impact of pain and symptoms on daily life
  – Impact of pain and symptoms on lifestyle

• Physical Exam
  – Deformity
    – Correctable?
  – Laxity
    – Need for greater constraint

• Radiographs
  – Bilateral weight bearing AP, tunnel, lateral, sunrise views
Knee Arthritis
Aspiration – How to do it

Every Life Deserves World Class Care
Aspirations and Injections

• Sterile procedure
  – Drape it out
  – Wear sterile gloves
  – Have an assistant
  – Everything available before prep
  – 10ml syringe with 18 gauge or >

• Prep
  – Make the spot
  – Time out
  – Antiseptic with circular motion outward
  – Have injections ready
    – Single use vials
  – Superficial anesthetic
    – Spray ethyl chloride or inject local
Knee Injections

• Glucocorticoids (steroids)
  – Mainstay of non-operative treatment
  – Strong anti-inflammatory
  – Changes synovial fluid characteristics
  – Side effects
    – Infection
    – Detrimental cartilage surfaces changes
    – Systemic adrenal function suppression
    – Decreased hypoglycemia stress response

• Viscosupplementation
  – Anti-inflammatory
  – Stimulates production of hyaluronic acid
  – Analgesic effect
  – Side effects
    – Local reactions (pain, warmth, swelling)

### Injectable Corticosteroids

<table>
<thead>
<tr>
<th>Solubility</th>
<th>Generic Name</th>
<th>Trade Name</th>
<th>Equivalent Dose, mg*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most soluble</td>
<td>Betamethasone sodium phosphate</td>
<td>Celestone</td>
<td>0.6</td>
</tr>
<tr>
<td>Soluble</td>
<td>Dexamethasone sodium phosphate</td>
<td>Decadron</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>Prednisolone sodium phosphate</td>
<td>Hydreltasol</td>
<td>5</td>
</tr>
<tr>
<td>Slightly soluble</td>
<td>Prednisolone tebutate</td>
<td>Hydeltra-T.B.A.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Triamcinolone diacetate</td>
<td>Aristospan Forte</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Methylprednisolone acetate</td>
<td>Depo-Medrol</td>
<td>4</td>
</tr>
<tr>
<td>Relatively insoluble</td>
<td>Dexamethasone acetate</td>
<td>Decadron-LA</td>
<td>0.75</td>
</tr>
<tr>
<td></td>
<td>Hydrocortisone acetate</td>
<td>Hydrocortone</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Prednisolone acetate</td>
<td>Prednalone</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Triamcinolone acetonide</td>
<td>Kenalog</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Triamcinolone hexacetonide</td>
<td>Aristospan</td>
<td>4</td>
</tr>
<tr>
<td>Combination</td>
<td>Betamethasone sodium phosphate—betamethasone acetate</td>
<td>Celestone Soluspan</td>
<td>0.6</td>
</tr>
</tbody>
</table>

*For example, 0.6 mg of betamethasone sodium phosphate is equivalent to 0.75 mg of dexamethasone sodium phosphate, which is equivalent to 5 mg of prednisolone.*  
*Betamethasone acetate is slightly soluble.

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**My knee injection**

- 2 syringes 5cc and 30cc
- 18g needles
- 2cc Aristospan
- 30cc ¼% Marcaine w epi 1:200,000
- Inject 10cc local
- Wait
- Inject aristospan
- Inject rest of local

Ankle

Every Life Deserves World Class Care
Anatomy

- Tibial Plafond
- Medial Malleolus
- Lateral Malleolus
- Talar Dome

Mortise, AP, and Lateral, views
Ankle Anatomy and Sprains

• Mostly sprains from ligamentous structures
  – Inversion most common

High ankle sprain, syndesmosis
Primary ligament to sprain, thinnest
Second ligament to sprain
Essentials of Musculoskeletal Care, AAOS, 1997
Physical Exam Elements

Physical Examination of the Spine and Extremities, Hoppenfeld.

INSPECTION

BONY PALPATION

Medial Aspect
- First Metatarsocuneiform
- Navicular Tubercle
- Head of the Talus
- Medial Malleolus
- Sustentaculum Tali
- Medial Tubercle of the Talus

Lateral Aspect
- Fifth Metatarsal Bone
- Fifth Metatarsophalangeal Joint
- Calcaneus
- Peroneus Tubercle
- Lateral Malleolus

Sinus Tarsi Area
- Dome of the Talus
- Inferior Tibiofibular Joint

Area of the Hindfoot
- Dome of the Calcaneus
- Medial Tubercle

Plantar Surface
- Sesamoid Bones
- Metatarsal Heads

SOFT TISSUE PALPATION

Zone I — Head of the First Metatarsal Bone
Zone II — Navicular Tubercle and Talar Head
Zone III — Medial Malleolus
Zone IV — Dorsum of the Foot between the Malleoli
Zone V — Lateral Malleolus
Zone VI — Sinus Tarsi
Zone VII — Head of the Fifth Metatarsal
Zone VIII — Calcaneus
Zone IX — Plantar Surface of the Foot
Zone X — Toes

TESTS FOR ANKLE JOINT STABILITY

RANGE OF MOTION

Active Range of Motion
- Ankle Dorsiflexion — 20°
- Ankle Plantar Flexion — 50°
- Subtalar Inversion — 5°
- Subtalar Eversion — 5°
- Forefoot Adduction — 20°
- Forefoot Abduction — 10°

First Metatarsophalangeal Joint
- Flexion — 45°
- Extension — 70°–90°

Motion of the Lesser Toes

NEUROLOGIC EXAMINATION

Muscle Testing
- Dorsiflexors
- Plantar Flexors

Sensation Tests

Reflex Tests
- Achilles Tendon Reflex (S1)

SPECIAL TESTS

Tests for Rigid or Supple Flat Feet
- Tibial Torsion Test
- Forefoot Adduction Correction Test
- Ankle Dorsiflexion Test
- Homans’ Sign

EXAMINATION OF RELATED AREAS

Physical Examination of the Spine and Extremities, Hoppenfeld.
Physical Exam Elements

Patient movement for range of motion and stability

Palpation points
- ATFL
- CFL
- PTFL
- Syndesmosis
- CC joint
- PT and peroneal tendons
- 5th metatarsal base and shaft
- Malleoli

Plantar flex to expose talar dome

Physical Examination of the Spine and Extremities, Hoppenfeld.
Physical Exam Elements

Anterior drawer test for ATFL

+ Anterior drawer test for ATFL

Inversion test for ATFL and CFL

+ Inversion test for ATFL and CFL
Physical Exam Elements

**Resisted eversion**
To test the strength of the peroneal muscles, stabilize the patient's tibia, and resist the patient's attempt to evert the foot. Weakness indicates injury to the peroneal tendons or a lesion involving the peroneal nerve or S1 nerve root.

**Resisted inversion**
To test the strength of the posterior tibial tendon, stabilize the patient's tibia with the foot flexed, and resist the patient's attempt to invert the foot. To neutralize the inversion force of the tibialis anterior muscle, it is important to keep the foot flexed downward while performing this test. Weakness indicates injury or rupture of the posterior tibial tendon, or a lesion involving the posterior tibial nerve or L5 nerve root.

**Resisted foot dorsiflexion**
To test the strength of the anterior tibial muscle and toe extensors, ask the patient to resist as you push down on the patient's foot. Weakness indicates injury to the anterior tibial tendon or muscle, the toe extensors, or a lesion involving the peroneal nerve or L5 nerve root.

**Anterior drawer test (ankle)**
With the patient's tibia stabilized, grasp the calcaneus and pull forward to demonstrate anterior instability of the talus in the ankle mortise. There will be asymmetrical or excessive motion with chronic ankle ligament laxity and severe acute ankle ligament tears. This view is from the lateral side.

**Varus stress test (ankle)**
With the tibia stabilized, grasp the calcaneus and talus and invert the hindfoot. There will be excessive or asymmetrical motion with chronic ankle ligament laxity and acute severe ligament tears.
Differential

Plantar wart
Morton's neuroma
Lesser metatarsalgia
Midfoot plantar fasciitis
Plantar fibroma
Proximal plantar fasciitis
Ingrowth toenail
Hallux valgus (Bunion)
Hallux rigidus (Dorsal bunion)
Claw toe
Hammer toe
Corn
Phalangeal fracture
Stress fracture
Metatarsal fracture
Ganglion cyst
Bunionette
Bunion
Calcaneus fracture
Fibula fracture
Ankle sprain
Chronic lateral ankle instability
Posterior heel pain
Posterior tibial tendon dysfunction
Tarsal tunnel syndrome
Achilles tendinitis
Posterior heel pain
Posterior heel pain

Essentials of Musculoskeletal Care, AAOS, 1997
Cleveland Clinic

Every life deserves world class care.