

THIRD YEAR RADIOLOGY WORKSHOP 2008 - 2009

Time	Monday 1:15 - 5 pm Tuesday 9 am – 12 pm
Location	2250 Hayes Street (St. Mary's Medical Center) 4 th Floor, Radiology Learning Lab (next to Parnassus clinic)
Faculty	Eric D. Stamps, DPM Assistant Dean for Clinical Affairs Assistant Professor, Department of Medicine California School of Podiatric Medicine at Samuel Merritt College 450 30th Street, Suite 3714 Oakland, CA 94609 Tel: 510-869-8730 Fax: 510-869-6282 E-mail: ESTamps@samuelmerritt.edu Cell: 415-332-0887
Goals	To become confident reading plain film radiographs, MRI's and CT scans and diagnostic ultrasound images in a group setting. To become confident identifying and interpreting foot and ankle pathology on radiographs, MRI and CT scans. To describe radiographic images logically with attention to detail.
Attendance	Mandatory. One unexcused absence constitutes a failure of the rotation.
Grading Policy	Pass/Fail based on attendance, overall mastery of the rotation objectives and a practical exam to be given at the end of the rotation. <i>A failure in any one of these areas will result in a failure of the rotation.</i>
Attire	Clinical attire (includes scrubs + white coat)
What to Bring	Articulated foot skeleton model A copy of the rotation goals and objectives (this handout) Anatomy/radiography text
Policy on Learning Disabilities	Samuel Merritt College will make reasonable accommodation for students with documented disabilities. Students with physical, learning, or psychological disability, who believe that they may need accommodation in the Simulation Center rotation, are encouraged to contact the Director of Academic and Disability Support Services and Dr. Stamps as soon as possible.

Teaching Method

A problem-based learning format and the Socratic method are used to convey the information covered in this syllabus. Students are expected to have familiarity with the material covered **before** it is discussed in class, so prior review of Radiology II notes and other resources is strongly encouraged.

A complete schedule of topics will be posted on Blackboard 1 to 2 weeks prior to the start of each 2 month rotation.

Required texts

Christman, RA: *Foot and Ankle Radiology*. St. Louis, Missouri, Churchill Livingstone, 2003. A detailed synopsis of foot and ankle radiology and radiography, written for the podiatric medical student. ★★☆☆

Helms, CA: *Fundamentals of Skeletal Radiology*. 3rd ed. Philadelphia, Saunders, 2004. A humorous, succinct introduction to the most important things you need to know about skeletal radiology. Excellent chapters on lytic bone tumors and MRI of the foot and ankle. ★★☆☆

Manchester, Crim, Rosenberg: *Diagnostic and Surgical Imaging Anatomy: Knee, Ankle, Foot*, Published by Amirsys. The best MRI anatomy text that I have found so far. ★★☆☆

Additional Resources

Berquist, TH: *Radiology of the Foot and Ankle*, 2nd Edition. New York, Raven Press, 2000. A good combination of photos and explanatory text that is the best overall foot and ankle radiology text on the market. ★★☆☆

Klippel, JH et. al: *Primer on the Rheumatic Diseases*, 12th ed, The Arthritis Foundation, 2001. A must read and a good deal for about \$40. ★★☆☆

McKinnis, L: *Fundamentals of Orthopedic Radiology*. Philadelphia, FA Davis Company, 1997. Written by a physical therapist, this text has the best chapters I have seen on the fundamentals of reading radiographs and the radiology of fracture. ★☆☆

Resnick, D: *Bone and Joint Imaging*. 2nd ed. Philadelphia, Saunders, 1996. A detailed classic by the ultimate authority on skeletal radiology. ★★☆☆

Spouge, AR, Pope TL: *Practical MRI of the Foot and Ankle*, CRC Press, 2000. Everything you need to know about MRI of the foot and ankle. ★★☆☆

Stamps, ED, Radiology II Course Notes, Spring 2008. All lectures are also available on Blackboard.

Radiology On-Line

www.appliedradiology.com

A professional radiology site with an abundance of useful articles and photos.

www.bonetumor.org

Everything you ever wanted to know about bone tumors.

chorus.rad.mcw.edu

A quick list of hundreds of radiographically relevant definitions.

<http://radiology.creighton.edu>

Are you looking for one paragraph summaries of the main radiographic findings in musculoskeletal disease and injury? If so, you should check out this site.

www.MDchoice.com

A general medical reference site.

www.radiologyeducation.com

A site with links to everything radiological. A good place to find teaching files, practice films, MRI basics.

www.vh.org

Virtual Hospital was a comprehensive medical site, but is now a useful list of links, including a link to radiological education websites.

www.worldwidefeet.com

Despite the odd name, this site posts excellent diagnostic ultrasound images, especially the color enhanced images at the University of Michigan link.

Interpreting x-rays: Review of normal films

Vocabulary

bipartite, brachymetatarsia, cornuate navicular, cortical, cyma line, diaphysis, epiphysis, effusion, enostosis, Kager's triangle, metaphysis, osteopenia, radiolucent, radioopaque, soft tissue envelope, Steida's process, trabeculation.

Goals

- To readily identify normal radiographic anatomy, including normal variants, on radiographs of the foot and ankle.
- To be able to critique the quality of a radiograph.
- To develop the correct technique and rationale to obtain weight-bearing radiographs of the foot and ankle.

Objectives

- Identify the different views used in the foot and ankle including: AP (DP), MO, LO, lateral, plantar axial, calcaneal axial, Harris-Beath of the foot; AP, mortise, lateral of the ankle
- Describe the position of the foot and/or ankle when taking each view
- Know how to scan an x-ray for quality assurance
- Recognize over and under exposure of a radiograph
- Identify the normal anatomy visible on each view
- Identify the location of ligamentous, tendinous and muscular insertions on every radiographically visible bone.
- Distinguish the 1st MCJ from the 2nd MCJ on a lateral view
- Differentiate the posterior facet from the middle facet on a calcaneal axial view
- "Calculate" and identify decreased bone density on an AP view
- Identify the following normal variants: bipartite sesamoid, fused DIPJ accessory sesamoids
- Identify the following normal supernumerary bones on a foot radiograph: accessory navicular type I, II and III, os tibiale externum, os peroneum, os subfibulare, os subtibiale, os supratolare, os talonaviculare dorsale, os trigonum, os vesalianum.

Trauma

Vocabulary avulsion, bone callus, closed fracture, capital fragment, comminuted, complete fracture, delayed union, incomplete fracture, non-union, oblique, open fracture, osteochondral, pathological fracture, pseudoarthrosis, spiral fracture, stress fracture, transverse fracture

Goal To appropriately describe changes in bone and soft associated with trauma.

Objectives

- Describe a fracture using the following descriptive points:
 1. Open or closed?
 2. Extent
 3. Fracture line
comminuted, transverse, oblique, spiral, longitudinal
 4. Anatomic site
 5. Fracture position
Alignment, displacement, distraction, compaction, foreshortening
 6. Associated abnormalities
- Identify a stress fracture
- Identify a pathologic fracture
- Describe the appropriate circumstances and purpose of ankle stress films
- Define a delayed union, a non-union and a pseudoarthrosis

The Arthritides

Degenerative Joint Disease (Osteoarthritis)
Rheumatoid Arthritis
Crystal deposition diseases (Gout, CPPD)
Seronegative spondyloarthropathies
Collagen vascular diseases

Vocabulary

acro-osteolysis, ankylosis, arthritis mutilans, bamboo spine, birefringent, Bouchard's nodes, boutonniere, chondrocalcinosis, deviation, eburnation, enthesiopathy, erosion, Heberden's nodes, hyperemia, hyperuricemia, juxtaarticular, loose body, Martel's sign, nodules, osteophyte, pannus, periosteal reaction, psoriasis, sausage toe, subchondral, swan-neck, synovitis, tophi, sclerosis, whiskering

Goals

- Gain familiarity with the pathophysiology and radiographic changes found in DJD, RA, the crystal deposition diseases, seronegative spondyloarthropathies, and collagen vascular diseases
- Create a reasonable differential diagnosis based on radiographic changes, pattern of distribution and patient demographics

Objectives

- List five radiographic findings that are consistent with the development of OA and identify them on film
- Describe the distribution of OA
- Differentiate primary from secondary osteoarthritis
- Describe the radiographic stages of hallux limitus
- Describe the relationship between synovial inflammation and radiographic change in RA
- Describe the distribution of RA
- Identify fusiform swelling, marginal erosion, subluxation, juxtaarticular osteopenia, and ankylosis
- Describe the etiology of gouty arthritis
- Identify rat-bit erosions, tophi, overhanging edge (Martel's) sign
- Describe the distribution of gout, and the reason for this pattern
- Describe the hallmark of CPPD
- Describe the common manifestations of the seronegatives
- Differentiate reactive arthritis (formerly Reiter's Syndrome), psoriatic arthritis and ankylosing spondylitis by age of onset, pattern of distribution and gender affected.
- Identify acroosteolysis, ill-defined calcaneal spur, bamboo spine, and pencil-and-cupping
- List the potential radiographic findings in SLE
- List three radiographic findings in scleroderma

Neuropathic Osteoarthropathy

Osteomyelitis

Septic Arthritis

Soft tissue infection

Vocabulary

Brodie's abscess, cellulitis, Charcot's arthropathy, cloaca, coalescence, Codman's triangle, involucrum, monoarthropathy, neuroarthropathy, osteolysis, polyarthropathy, rocker bottom, sequestrum

Goals

- To understand the etiology, course and radiographic changes of neuropathic arthropathy.
- To identify the radiographic changes seen in osteomyelitis and septic arthritis.
- Using history, labs and imaging studies, distinguish neuroarthropathy from osteomyelitis.

Objectives

- Discuss the differences between the historical French and German theories of neuropathic joint breakdown
- Describe and identify the radiographic findings of each stage of Charcot's arthropathy: developmental (soft tissue swelling, debris formation, subluxation/dislocation, fragmentation), coalescence (sclerosis, rounding of fragments), and reparative (resorption, joint formation).
- Differentiate history and clinical findings for infection vs. acute Charcot's arthropathy
- Choose appropriate laboratory and/or imaging studies for a suspected Charcot joint vs. infection vs. osteomyelitis. Include CBC with differential, ESR, gram stain, culture and sensitivity, aspiration, biopsy, nuclear medicine, magnetic resonance imaging
- Identify periosteal reaction, osteolysis, sequestrum, involucrum, Codman's triangle, gas in tissue. Describe the pathophysiology of these changes.
- Discuss the radiographic changes seen with a septic joint

Bone Tumors

Vocabulary

Codman's triangle, cortical expansion, eccentric, expansile, geographic, hair-on-end, malignant, matrix, moth-eaten, onion-skinning, periostitis, permeative, soap-bubbly, sunburst, zone of transition

Goals

- To be able to categorize a bone tumor as more or less aggressive based on its radiographic appearance.
- To recognize the morphology of the more common bone tumors.

Objectives

- Differentiate a narrow from a wide zone of transition
- Identify geographic, moth-eaten, and permeative patterns of bone destruction
- Identify expansive, eccentric and "soap bubble" tumors
- Identify onion-skinning, sunburst and hair-on-end periosteal bone formation
- Radiographically assess a tumor as aggressive or less aggressive
- Identify the general characteristics of the following tumors: unicameral bone cyst, enchondroma, aneurysmal bone cyst, fibrous dysplasia, non-ossifying fibroma, osteochondroma, Ewing's sarcoma, synovial sarcoma, osteosarcoma, chondrosarcoma, giant cell tumor, osteoid osteoma, eosinophilic granuloma.
- Identify bone tumors that are polyostotic, that are found in growing bone, that occur only in mature bone.
- Identify the soft tissue tumors that may erode bone (PVNS, GCTTS).

Metabolic Diseases

Osteonecrosis (Avascular Necrosis)

Tarsal Coalitions

Vocabulary

Ainhum, bridge, crescent sign, fragmentation, Hawkin's sign, ischemia, synchondrosis, syndesmosis, synostosis.

Goals

- To become familiar with the radiographic changes that occur with metabolic disease.
To become familiar with the radiographic manifestations of osteonecrosis
- To recognize the most common osteochondroses seen in the lower extremity.
- To recognize the radiographic changes associated with tarsal coalition.

Objectives

- Describe the general radiographic characteristics of the following: acromegaly, Paget's disease of bone, hypertrophic pulmonary osteoarthropathy, rickets, osteomalacia, heavy metal poisoning, anemia, melorrrheostosis, osteopoikilosis, hemophilia, Sudeck's atrophy, osteopetrosis, osteogenesis imperfecta, DISH
- Identify the diseases/conditions that produce periostitis
- Identify the radiographic findings in AVN, including collapse, sclerosis, reactive cortical thickening, spotty lucency
- Identify Hawkin's sign and describe its significance
- Order appropriate views and imaging studies to visualize different coalitions
- Identify the primary and secondary radiographic signs of a C-N bar and a TC bridge (coalition)
- Identify the changes seen on a Harris-Beath view with a T-C coalition

Advanced Imaging

CT and MRI

Vocabulary

longitudinal relaxation, mobile proton density, repetition time (TR), spin echo, T1 weighting, T2 weighting, time to echo (TE), transverse relaxation.

Goals

- To be able to identify normal anatomy and basic pathology in MRI and CT studies of the lower extremity.
- To gain familiarity with basic MR imaging principles.
- To understand the advantages and limitations of each imaging modality.

Objectives

- Describe the ideal uses for MRI and CT
- List contraindications/precautions of each modality
- Explain how an artifact may be created on CT
- Explain the general difference between T1 and T2 weighted images
- Describe how an MRI signal is produced
- Develop a systematic approach to interpreting an MRI and CT study
- Identify all of the normal anatomic structures on an MRI and CT of the foot, ankle and leg
- Identify the following pathology on MRI: tarsal coalition, Achilles tendon rupture, inflammation, osteonecrosis, ligament tear
- Identify and describe a calcaneal fracture on CT

Pediatric Foot and Ankle

Vocabulary equinovarus, Kite's angle, Meary's angle, osteochondroses, pes, talipes

Goal To become familiar with the normal and pathological anatomy of the pediatric foot and ankle.

Objectives

- Discuss the normal ossification of the bones of the foot, including epiphyses, apophyses, closure of growth plates, and approximation of age
- Determine the approximate age of a patient based on a foot/ankle radiograph
- Identify the following osteochondroses: Legg-Calves-Perthes, Osgood-Schlatter's, Blount's, Diaz, Kohler's, Iselin's, Freiberg's, Sever's
- Describe the radiographic findings seen in clubfoot (talipes equinovarus)
- Describe Kite's angle and Meary's angle
- Identify the following conditions: brachydactyly, megadactyly, arthrogryphosis, metatarsus adductus, talipes equinovarus
- Define the following fracture types: greenstick, torus, plastic bowing
- Describe the pattern of physal ossification of the distal tibia

Arteriography

Vocabulary

Organic occlusion, run off

Goal

To be able to accurately interpret a lower extremity arteriogram.

Objectives

- Identify all of the major vessels on a lower extremity arteriogram, from the abdominal aorta to the posterior tibial artery.
- Identify an organic occlusion on an arteriogram.

Diagnostic Ultrasound (DUS)

Vocabulary Near field, far field, hyperechoic, hypoechoic, anechoic, echogenic

Goals

- To locate and recognize normal foot and ankle structures using diagnostic ultrasound.
- To recognize foot and ankle pathology using diagnostic ultrasound
- To become familiar with DUS equipment

- To develop the correct technique and rationale to obtain weight-bearing radiographs of the foot and ankle.

Objectives

- Describe the DUS appearance of the following structures: tendon, muscle, ligament, bone, articular cartilage, peripheral nerve, fluid.

- Identify the following soft tissue pathology on DUS:
 - Achilles tendonitis
 - Ankle sprain
 - Bursitis
 - Calcaneal exostosis
 - Cystic mass
 - Intermetatarsal neuroma
 - Plantar fascial tear
 - Plantar fascial thickening
 - Posterior tibial tendonitis

Appendix A: The X-ray Report

Guidelines Use a “top-down,” focused approach: fully describe the most important finding(s), then proceed to discuss the less important radiographic findings (i.e., incidental findings, positional deformities unrelated to the area of concern, etc.).

What goes in must come out: If you mention a finding, be sure to include that finding in your assessment.

Example Outline

1. Problem #1
 - a. Soft tissue, joint space, bone, alignment
2. Problem #2
 - a. Soft tissue, joint space, bone, alignment

Impression

1. Problem #1: impression with supporting evidence
2. Problem #2: impression with supporting evidence

Example Asymmetrical joint space narrowing left 1st MPJ with a medial 2mm osteophyte and a 4mm dorsal osteophyte. Para-articular eburnation and multiple subchondral cyst formation (1 to 3 mm diameter) are also present. The 1st metatarsal protrusion distance is +5 mm and there is metatarsus primus elevatus present. Generalized bone mineralization is normal. Cortical margins are sharp.

A 6 mm x 4 mm longitudinal density is present in the distal 1/3 of the left 5th metatarsal diaphysis. Small bony projections ring the density.

The left 5th DIPJ joint space is obliterated and there is adduction of the digit at the level of the PIPJ. There is normal adjacent soft tissue volume and density.

Impression

1. Narrowing, left 1st MPJ: consistent with stage III hallux limitus which may be secondary to both a long first metatarsal and metatarsus primus elevatus.
2. Bony density left 5th metatarsal: consistent with an enostosis (bony island)
3. Narrowing, left 5th DIPJ: consistent with ankylosis of the DIPJ (normal variant)

Appendix B: X-ray Report Terminology

Soft Tissue	Density (increased, decreased, gas) Volume Calcifications (monckeberg's, phleboliths) Retained foreign body
Articulations	Congruent Deviated Subluxed Dislocated Narrowing/effusion Subchondral sclerosis Osteophytic lipping Bony fragmentation Osteochondral dissolution and fragmentation Intra-articular detritus
Bone	Shape Size Hypoplastic Number Cortex Cortical irregularity Sharp cortical margins Erosions, osteolysis Mineralization Patchy demineralization Generalized osteopenia Juxta-articular osteopenia