Resident Core Curriculum
Musculoskeletal Radiology

INTRODUCTION

- **The key elements for learning musculoskeletal radiology are:**
  - Daily exposure to a high volume of imaging examinations and procedures which the resident is directly responsible for (with close supervision).
  - Attendance and participation in musculoskeletal imaging conferences.
  - Dedication to reading an organized core of material on musculoskeletal radiology. The suggested readings cover core MSK topics, and should be achievable over the course of the month.

DAILY WORK

- The resident is an essential part of the musculoskeletal imaging service and not an observer. He/she is directly responsible for, and an integral part of, all activities relating to MSK imaging and is expected to act accordingly.
- The resident will interpret radiographs as well as cross-sectional imaging studies during each of their rotations, in a ratio proportional to their level of experience.
- There are primary and secondary musculoskeletal topics for the resident to focus on during each rotation. Focus areas for CT and MR interpretation are defined for each rotation as well.

CONFERENCES

- Resident conferences will be given by the musculoskeletal radiology faculty and fellows as a part of the departmental early morning and noon conference schedule. These sessions will be divided between didactic lectures, covering a "core curriculum" of topics, and case conferences in which a variety of cases will be presented to simulate board exams and daily practice.

GENERAL OBJECTIVES

- To become competent in interpreting musculoskeletal imaging studies and performing basic image-guided musculoskeletal procedures.

SPECIFIC OBJECTIVES
ROTATION 1 (First Year)

Hospital East: MSK reading room.

Primary Focus: Radiography and Trauma CT

Radiography
  Skeletal anatomy
  Fractures: recognition, description
  Osseous and soft tissue infection
  A focal osseous lesion

CT/MRI
  Spine trauma (CT)
  Pelvic / extremity fractures (CT)
  MR of osseous trauma (observe)

Cognitive Objectives

At the end of the first MSK rotation, a radiology resident should be able to:

1. Dictate a succinct, precise and coherent radiology report
2. Describe pertinent normal anatomy in a MSK radiograph
3. Establish a diagnosis and provide an appropriate description of a fracture involving either the peripheral or axial skeleton
4. Discuss the imaging findings of septic arthritis, osteomyelitis, and metastatic diseases
5. Discuss the most common modalities used in MSK imaging, the indications and contraindications, and complications of the following:
   1. Radiographs & fluoroscopy
   2. MSK scintigraphy
   3. Arthrography
   4. DEXA
   5. Ultrasound
   6. MSK Biopsy
   7. CT
   8. MR

Affective Objectives

At the end of the first MSK rotation, a radiology resident should be able to:
1. Project a professional image
2. Demonstrate empathy and respect towards patients, referring clinicians, radiology personnel, and colleagues
3. Function as a consultant to clinicians for radiographic evaluation of MSK trauma and orthopedic follow-up.
4. Participate actively in the MSK division’s academic program (e.g. teaching medical students on the rotation)

**ROTATION 2 (Second Year)**

**Fontaine: MSK Reading Room (545 Building)**

**Primary Focus:** Radiography; Introduction to MRI and procedures

**Radiography**
- Arthritis
  - Hardware: normal appearance and complications

**MRI**
- Spine, knee, pelvis/hips

**Procedures**
- Fluoro-guided injections: shoulder

**Cognitive Objectives**

At the end of the second MSK rotation, a radiology resident should be able to:

Discuss the imaging findings and, if indicated, provide an appropriate differential diagnosis for:

1. Articular diseases
2. Orthopaedic hardware: normal appearances
3. Orthopaedic hardware: complications

**Affective Objectives**
At the end of the second MSK rotation, a radiology resident should be able to:

1. Consolidate the objectives of the first rotation
2. Function as a consultant for MSK imaging studies and for recommending appropriate additional imaging examinations

**ROTATION 3 (Third Year)**

**Fontaine: MSK Reading Room (545 Building)**

**Primary Focus:** MSK MRI; radiographs; additional procedures

**Radiography**
- Orthopaedic, sports medicine, rheumatology exams
- Primary and metastatic bone tumors
- Metabolic bone disease

**MRI**
- Spine, knee, pelvis/hips, shoulder, bone/soft tissue tumors

**Procedures**
- Fluoro-guided injections: shoulder, hip, small joint

**Cognitive Objectives**

At the end of the third MSK rotation, a radiology resident should be able to:

1. Protocol MR imaging studies based on the clinical information
2. Interpret with competence MR imaging studies of the spine, shoulder, pelvis, knee, bone/soft tissue lesions
3. Provide an appropriate differential diagnosis for a solitary bone lesion
4. Recognize the imaging findings in common metabolic bone diseases
5. Perform fluoro-guided injections of the major joints

**Affective Objectives**

At the end of the third MSK rotation, a radiology resident should be able to:

1. Act as a consultant on all types of MSK imaging studies
2. Participate actively in the teaching of junior residents, other residents, interns, and
medical students

**ROTATION 4 (Third/Fourth Year)**

**Fontaine: MSK Reading Room (545 Building)**

**Primary Focus**

*All aspects of MSK imaging.*

**Cognitive Objectives**

At the end of the fourth MSK rotation, a radiology resident should be able to:

1. Interpret with confidence all types of MSK radiographs
2. Recognize common types of intra-articular pathology in the major joints on cross-sectional imaging studies
3. Comfortably perform image-guided injections of the major joints

**Affective Objectives**

At the end of the fourth MSK rotation, a radiology resident should be able to:

1. Act as a consultant on MSK imaging studies
2. Participate actively in the teaching of junior residents, other residents, interns, and medical students

**RESOURCES**

**Teachers**

- Dr. Mark Anderson is responsible for the organization and supervision of the Musculoskeletal Radiology Rotation.
- The teaching of musculoskeletal radiology is done by Doctors Bennett Alford, Mark Anderson, Michele Barr, Michael Fox, Cree Gaskin, Theodore Keats, and the musculoskeletal imaging fellows. Pediatric musculoskeletal radiology will be taught by both the pediatric and musculoskeletal radiologists. CT and MRI of the spine will be taught by both neuroradiologists and musculoskeletal radiologists.

**Bibliography**
The sections listed refer to the following texts:

- **Greenspan**: Orthopedic Radiology, A Practical Approach. Adam Greenspan. Lippincott
- **Helms**: Fundamentals of Skeletal Radiology. Clyde Helms, W.B. Saunders.
- **Brower**: Arthritis in Black and White. Ann Brower. W. B. Saunders

**Required Reading:**

**Rotation 1**

- **General** Helms (entire text – it’s small!)
- **Trauma** Resnick 789-905
  - Greenspan Chapters 2-8
- **Infection** Resnick 713-719

**Rotation 2**

- **Arthritis** Brower (entire text)
  - Resnick 519-541 (“Target” approach)
- **Hardware** Selected readings

- **MR** Helms & Major - Ch.13,14

**Rotation 3**

- **Tumors** Resnick 1109-1264
  - Helms – review “Don’t touch” lesions
- **Metabolic** Resnick 541-589 and 602-623
- **Osteonecrosis** Resnick 1067-1109
Rotation 4

Internal Derangement  Resnick  905-995

LEARNING TECHNIQUES

Daily Work

Daily work starts no later than 8:30 AM and finishes not earlier than 5:00 PM.

- Interpretation/dictation of musculoskeletal examinations
- Reports: Edit and sign reports by the end of the day.
- The staff radiologist and/or fellow is available at all times for consultation.

Procedures

- Residents (Rotations 2-4) will participate in fluoroscopy-guided procedures at Fontaine under direct supervision of the MSK faculty member or fellow covering the section.

Consultation

- Throughout the day, the resident should actively assist any referring physicians or radiology colleagues who enter the reading room for a consultation. The MSK faculty or fellow covering the service will provide back-up if necessary.

Conferences

- In addition to attending the ongoing resident conferences in the radiology department, the residents rotating on MSK imaging are expected to participate in certain MSK Conferences that are held during their time on the service. They are also welcome and encouraged to attend any of these conferences during the year.

ROTATION PROGRAM

Daily Work

- When rotating on the MSK service, you are responsible for covering and being present in the MSK reading room from 8 AM to 5 PM daily, with the exception of 11:45 to 1:15 PM for lunch and conference. Any absence for other reasons between 8 AM and 5 PM is to be cleared with the attending covering your service that day.
RESIDENT'S EVALUATION

1. After each rotation, the resident will be evaluated by the MSK faculty members they have worked with during their time on the service. The evaluation is based on many parameters including the specific rotation objectives listed above.

ADDENDUM I: Musculoskeletal Pathology Outline

Following completion of 16 weeks of musculoskeletal radiology, residents should be able to discuss:

1. Traumatic osteoarticular lesions of the axial and peripheral skeleton.
   - Classification of fracture type
   - Radiographic findings of a fracture
   - Physiopathology and radiologic correlation of fracture healing
   - Radiographic findings according to anatomic site
2. Articular Disease
   - Classification of articular disease
   - Radiographic findings of articular lesions
   - Physiopathology and radiologic correlation of articular disease:
     - infections
     - inflammatory/immune
     - degenerative
     - neuropathic
     - metabolic and endocrine
     - synovial tumors
3. Benign and malignant bone tumors
   - Classification of bone tumors
   - Radiographic findings of benign and malignant features of bone tumors
     - Characteristics (age, site, location, radiographic findings) of benign and malignant bone tumors
4. Infectious lesions
   - Classification of infections
   - Radiographic and cross-sectional imaging findings of infectious lesions
   - Physiopathology and radiographic correlation of infectious diseases
5. Metabolic and endocrine diseases
   - Classification of osteopenia
   - Radiographic findings of the three forms of diffuse osteopenia
     - Osteoporosis
     - Osteomalacia
     - Hyperparathyroidism
   - Physiopathology and radiographic correlation of diffuse and localized osteopenia
     - Physiopathology and radiographic correlation of endocrine disorders affecting bone
   - Physiopathology and radiographic correlation of hypo and hypervitaminoses
6. Miscellaneous disease entities
   - Paget's disease
   - Reticulo-endothelioses (histiocytosis x/Langerhans cell histiocytosis)
   - Storage Disease (Gaucher's disease)
   - Ischemic Disease (Osteonecrosis, osteochondrosis)
   - Anemias
   - Marrow disease
     - Radiographic findings of these entities
     - Physiopathology and radiographic correlation of these entities
     - Complications and radiographic findings of these entities

7. Soft tissue lesions
   - Classifications of soft tissue lesions
   - Radiographic findings of soft tissue lesions
   - Physiopathology and radiographic correlations of soft tissue lesions

8. Congenital Syndromes
   - Radiographic findings of:
     - Congenital dislocation of the hip
     - Flat foot and club foot
     - Osteochondrodysplasia
       - Failure of growth of tubular bones and spine
         - achondroplasia
         - spondylo-epiphyseal dysplasia
     - Failure of growth and development of cartilage and fibrous tissue
       - dysplasia epiphysialis hemimelica
       - multiple exostoses
       - enchondromatosis
       - fibrous dysplasia
     - Anomaly in density and modeling
       - osteogenesis imperfecta
       - juvenile osteoporosis
       - osteopetrosis
       - osteopoikilosis
       - melorheostosis
       - diaphyseal dysplasia
     - Dysostosis
       - Klippel Feil
       - Sprengel deformity
   - Marfan syndrome
   - Neurofibromatosis
   - Chromosomal anomalies
     - Turner
     - Trisomy-21
ADDITIONAL REFERENCES

Anatomy


Arthrography


CT

DEXA


Emergency Radiology

1. Harris, The Radiology of Emergency Medicine, Williams & Wilkins.

General MSK:


Orthopaedic Hardware


Pediatrics

1. Ozonoff, Pediatric Orthopedic Radiology, W. B. Saunders and Co.

Spine

Technique
Trauma


Tumor

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