



Curriculum in Musculoskeletal Imaging (rev 01/6/11)

Faculty point person: Margaret A. Stull, MD

Diagnostic Radiology Residency: Brooke Army Medical Center

Other teaching faculty in MSK Radiology:

1. Joe Witham, MD (SLH)
2. Jessica Martinez (SLH)
3. Larry Ricci, MD (SLH)
4. Amit Verma (KCVA)
5. Radhika Gupta (KCVA) – adult MRI
6. Jim Brown, MD (CMH) – plain radiographs
7. Joshua Knowlton, MD (CMH) – sports injury
8. Brenton Reading, MD (CMH) – sports injury

Core lecture series in MSK Radiology

Core lectures - Biweekly year round 7:30pm at SLH

1. Traumatology: Osseous and Soft tissue – Basic imaging techniques
2. Traumatology: Osseous and Soft tissue – Advanced imaging techniques
3. Orthopedic Hardware and Complications
4. Musculoskeletal Infections: Osteomyelitis and Soft tissue
5. Arthritis and Rheumatologic Disorders
6. Bone tumors and tumorlike conditions including metastatic disease
7. Soft tissue masses
8. Hematologic Disorders
9. Ischemic Bone Disease
10. Metabolic Bone Disease
11. Endocrine and Hormonal Disorders
12. Soft tissue calcifications
13. Skeletal Dysplasias
14. Sports Injuries – Upper extremity
15. Sports Injuries – Lower extremity

This curriculum is supplemented by the following interdisciplinary lectures:

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|---------------------------|--------------------|
| 1. Biweekly Monday | Case conferences |
| 2. Biweekly Thursday noon | Journal club |
| 3. Monthly | Rheumatology |
| 4. Monthly | Surgical pathology |
| 5. Monthly | Cancer conference |

General overview

Radiology resident rotations in MSK Imaging will include at least 4 months during residency. Rotations will occur at St. Luke's Hospital of Kansas City and Truman Medical Center. The specific goals include objectives required for every level of training with graded supervision by the attending faculty. All aspects of MSK imaging will be incorporated into the residency, including MSK cross-sectional imaging (CT, MRI, and Ultrasound), Nuclear Medicine (Bone scan, Gallium scan, WBC scan) and Interventional procedures (joint injections, aspirations, biopsies, tumor ablation).

Resident responsibilities:

1. Residents work directly with the attending MSK radiologist and are involved in the daily conduct of the service.
 - At the beginning of every work day, the resident should be familiar with the patient schedule and anticipate needs for any procedures.
 - The resident will check requisitions to evaluate the appropriateness of requested study or if other exams need to be performed.
 - Clinical information should be obtained prior to protocoling MR and CT scans as well as prior to scheduling biopsies or other interventional procedures.
 - Absent clinical indication or seemingly inappropriate requests will be clarified and discussed with the referring physician/service.
2. The resident assigned to the MSK rotation is expected to be available for consultation by the imaging technologists, clinicians and other health care professionals during regular office hours except during conference times, when attending faculty will cover.
3. Examinations should be checked by the resident before the patient leaves the department if requested to do so by the supervising faculty.
4. Questions should be referred to the supervising faculty to which the resident is assigned.
5. Preliminary reports may be written for emergency room studies and patients who are going to clinic appointments on the same day of the examination when appropriate. This is communicated to attending radiologist and documented in the final report with name, date and time of such a communication.
6. Review of cases with the supervising faculty will be conducted as many times in the day as necessary to keep an efficient work flow.
7. All studies should be dictated by the end of every working day.
8. The resident will check his/her reports prior to final verification by supervising faculty.

Staff responsibilities:

1. Supervising faculty should be available at all times for any questions or consultations needed by the resident.
2. Supervising faculty should review all cases with the resident before the end of the day.
3. Supervising faculty should provide the resident with constructive feedback in any problem areas encountered during the rotation as well as through rotation evaluations.
4. Supervising faculty should sign resident-generated reports in a timely manner and inform the resident of any major changes he/she made.

Resident evaluation: UMKC faculty use on line electronic evaluations, which are based on the 6 ACGME core competencies. Residents are also evaluated by 1-2 technologists and 10 patients while on each month of MSK Imaging rotation. See the resident handbook for further details.

MSK Imaging - Rotation 1 – Goals and Objectives

I. Patient care:

- (a) Residents are required to complete an on line Patient Care, Radiation Safety module at least biannually.
- (b) The resident should have knowledge of indications for the examinations requested. When the reason for the examination is not clear, the resident should effectively communicate with the patient or referring physician until this is clarified.
- (c) The resident should be familiar with available medical records and how to access them for purposes of patient care.
- (d) All studies should be reviewed with supervising faculty attending.
- (e) Preliminary reports should be made available to all referring clinicians if needed prior to final review of cases. If there is a significant discrepancy between the preliminary reading and final reading, the resident should notify the referring clinician immediately.

II. Medical Knowledge:

At the end of the rotation, the resident should be able to:

- (a) Discuss basic bone physiology.
- (b) List and describe the basic principles of evaluation of MSK imaging studies.
- (c) Describe appropriate work-up of MSK disorders if radiographs are negative; state whether the patient should undergo CT, MRI, nuclear imaging, etc.
- (d) Arrange MSK studies in an orderly fashion for review and interpretation.
- (e) Recognize commonly used radiographic projections in MSK radiology.
- (f) State indications for CT, MRI, Ultrasound, bone scans and arthrography (including MR arthrography).
- (g) State indications for IV or intra-articular contrast on MRI and CT studies of MSK disorders.
- (h) Identify, with a high level of accuracy, most types of skeletal fractures.
- (i) Describe the stages of fracture healing and identify stages of bone healing on radiographs.
- (j) Identify normal musculoskeletal structures and some normal variants.
- (k) Identify normal vs. abnormal skeletal structures (esp. on bone survey).
- (l) Establish bone age on the basis of radiographic findings.
- (m) Make preliminary review of plain radiographs and discuss findings with the radiologist, then dictate as directed.
- (n) Dictate films with assistance of the radiologist.
- (o) Assist the technologist in preparation of the patient for fluoroscopic examination (e.g., arthrograms, etc.)

III. Practice Based Learning and Improvement:

- (a) Residents are required to complete an on line Fluoroscopic Procedures and Radiation Safety module at least biannually.
- (b) The resident should demonstrate evidence of independent reading and learning through the use of printed and electronic sources.
- (c) Follow-up of abnormal or interesting studies should be accomplished through communication with the referring physician and/or patient medical records.
- (d) Residents should assist with preparation and presentation of cases for interdisciplinary conferences when requested by the attending physician.
- (e) The resident should be competent in using the PACS and Powerscribe systems in the daily accomplishment of the work load and instruct others in its use.

IV. Interpersonal Communication Skills:

- (a) The resident should be able to communicate effectively results of studies to referring clinicians whenever needed. For emergent studies, reports to referring clinicians should be made in a timely manner.
- (b) The resident should be able to effectively convey the findings of examinations through accurate dictation of reports.
- (c) Residents should discuss fluoroscopic procedures and study results with the patient and family when requested to do so by supervising faculty.

V. Professionalism:

- (a) Residents are required to complete an on line professionalism module at least biannually.
- (b) Recognize limitations in personal knowledge and skills, being careful to not make decisions beyond the level of personal competence.
- (c) Residents should be able to explain the nature of the examination or findings in an examination to the patient and family when needed.
- (d) Residents should observe ethical principles when recommending further work-up for cases.
- (e) Promptness and availability at work are expected of every resident.
- (f) Residents should dress appropriately at work, wearing a name badge at all times.
- (g) Technologists and other health workers should be treated with respect as part of the health care team.
- (h) Patient confidentiality should be observed at all times.

VI. System Based practice:

- (a) Residents should be familiar with departmental procedures necessary in the performance of the examination.
- (b) Residents should learn appropriate language to be used in communicating to clinicians through reports or consultations so proper management decisions can be made.
- (c) Proper dictations should be made with indications, technique, findings and conclusions
- (d) Residents should dictate and correct their reports in a timely fashion to avoid delay in patient disposition.
- (e) Residents should assist in facilitating examinations whenever possible.
- (f) Resident should recognize the role that nuclear medicine plays in the management of patient's illness and make proper recommendations when needed.
- (g) Residents are encouraged to make suggestions to improve methods and systems utilized in radiology should be made whenever appropriate.

Reading list: Focus on normal anatomy and trauma.

1. Manaster et al. Diagnostic and Surgical Imaging Anatomy: Musculoskeletal. Amirsys. 2006.
2. Greenspan. Orthopedic Imaging. A Practical Approach. 4th Edition. Lippincott Williams & Wilkins. 2004.
3. Bohndorf K et al. Musculoskeletal Imaging. A Concise Multimodality Approach. Thieme. 2001.
4. Keats & Anderson. Atlas of Normal Roentgen Variants that may simulate disease. 8th Edition. Mosby. 2007.
5. Rogers L. Radiology of Skeletal Trauma, 3rd Edition. Churchill Livingstone. 2001.
6. Manaster, May & Disler. Musculoskeletal Imaging, 3rd Edition: The Requisites. Mosby. 2007.
7. ACR MSK Radiology teaching file disc.
8. www.RSNA.org
9. www.radiologyassistant.nl/en
10. www.e-anatomy.org
11. www.acr.org
12. <http://www.radiologyassistant.nl/en/>
13. <http://www.learningradiology.com>

MSK Radiology - Rotation 2

General overview:

Radiology resident rotations in MSK Imaging will include at least 4 months during residency. Rotations will occur at St. Luke's Hospital of Kansas City and Truman Medical Center. The specific goals include objectives required for every level of training with graded supervision by the attending faculty. All aspects of MSK imaging will be incorporated into the residency, including MSK cross-sectional imaging (CT, MRI, and Ultrasound), Nuclear Medicine (Bone scan, Gallium scan, WBC scan) and Interventional procedures (joint injections, aspirations, biopsies, tumor ablation).

Resident responsibilities:

1. Residents work directly with the attending MSK radiologist and are involved in the daily conduct of the service.
 - At the beginning of every work day, the resident should be familiar with the patient schedule and anticipate needs for any procedures.
 - The resident will check requisitions to evaluate the appropriateness of requested study or if other exams need to be performed.
 - Clinical information should be obtained prior to protocoling MR and CT scans as well as prior to scheduling biopsies or other interventional procedures.
 - Absent clinical indication or seemingly inappropriate requests will be clarified and discussed with the referring physician/service.
2. The resident assigned to the MSK rotation is expected to be available for consultation by the imaging technologists, clinicians and other health care professionals during regular office hours except during conference times, when attending faculty will cover.
3. Examinations should be checked by the resident before the patient leaves the department if requested to do so by the supervising faculty.
4. Questions should be referred to the supervising faculty to which the resident is assigned.
5. Preliminary reports may be written for emergency room studies and patients who are going to clinic appointments on the same day of the examination when appropriate. This is communicated to attending radiologist and documented in the final report with name, date and time of such a communication.
6. Review of cases with the supervising faculty will be conducted as many times in the day as necessary to keep an efficient work flow.
7. All studies should be dictated by the end of every working day.
8. The resident will check his/her reports prior to final verification by supervising faculty.

Staff responsibilities:

1. Supervising faculty should be available at all times for any questions or consultations needed by the resident.
2. Supervising faculty should review all cases with the resident before the end of the day.
3. Supervising faculty should provide the resident with constructive feedback in any problem areas encountered during the rotation as well as through rotation evaluations.
4. Supervising faculty should sign resident-generated reports in a timely manner and inform the resident of any major changes he/she made.

Resident evaluation: UMKC faculty will use on line software to complete electronic evaluations, which are based on the 6 ACGME core competencies. Residents are also evaluated by 1-2 technologists and 10 patients while on each month of MSK Imaging rotation. See the resident handbook for further details.

MSK Imaging – Rotation 2 – Goals and Objectives

I. Patient care:

- (a) Residents are required to complete an on line Patient Care, Radiation Safety module at least biannually.
- (b) The resident should have knowledge of indications for the examinations requested. When the reason for the examination is not clear, the resident should effectively communicate with the patient or referring physician until this is clarified.
- (c) The resident should be familiar with available medical records and how to access them for purposes of patient care.
- (d) All studies should be reviewed with supervising faculty attending.
- (e) Preliminary reports should be made available to all referring clinicians if needed prior to final review of cases. If there is a significant discrepancy between the preliminary reading and final reading, the resident should notify the referring clinician immediately.

II. Medical Knowledge:

At the end of the rotation, the resident should be able to:

- (a) Name and describe common types of bone and joint trauma, other than fractures, (i.e., sports injuries)
- (b) Establish bone age on the basis of radiographic findings.
- (c) Name and differentiate between the various forms of arthritis, including laboratory and clinical findings of each type.
- (d) State the radiographic features that distinguish aggressive and nonaggressive bone lesions (patterns of osteolysis and periostitis)
- (e) Name and describe clinical, pathological and radiological features of congenital and acquired bone pathologies.
- (f) Name and describe clinical, pathological and radiological features of metabolic bone diseases.
- (g) Describe radiographic features of inflammatory bone and joint disorders.
- (h) Identify the following categories of bone pathology on imaging studies:
 - i. inflammatory/infectious processes
 - ii. tumor and tumor-like conditions
 - iii. congenital and acquired diseases
 - iv. metabolic disorders
 - v. trauma
- (i) Describe normal findings and complications in patients with joint replacements.
- (j) Demonstrate increasing skill in quality and quantity of dictation of MSK images.
- (k) Demonstrate decision-making and value judgement skills: at the end of the rotation, the resident should be able to review radiographs and clinical history, and then make a decision about appropriateness of additional imaging and patient management.
- (l) Add to knowledge base through continued reading of films and case reviews.
- (m) Perform image guided procedures with the assistance of the radiologist.
- (n) Dictate films with assistance of the radiologist.

III. Practice Based Learning and Improvement:

- (a) Residents are required to complete an on line Fluoroscopic Procedures and Radiation Safety module at least biannually.

- (b) The resident should demonstrate evidence of independent reading and learning through the use of printed and electronic sources.
- (c) Follow-up of abnormal or interesting studies should be accomplished through communication with the referring physician and/or patient medical records.
- (d) Residents should assist with preparation and presentation of cases for pediatric interdisciplinary conferences when requested by the attending physician.
- (e) The resident should be competent in using the PACS and Powerscribe systems in the daily accomplishment of the work load and instruct others in its use.

Interpersonal Communication Skills:

- (a) Residents should be able to communicate effectively results of studies to referring clinicians whenever needed. For emergent studies, reports to referring clinicians should be made in a timely manner.
- (b) The resident should be able to effectively convey the findings of examinations through accurate dictation of reports.
- (c) Residents should discuss fluoroscopic procedures and study results with children and their families when requested to do so by supervising faculty.

Professionalism:

- (a) Residents are required to complete an on-line professionalism module or other professionalism at least biannually.
- (b) Recognize limitations in persona skill and knowledge, always making sure dictations and consultations are check by the radiologist in charge.
- (c) Recognize limitations in personal knowledge and skills, being careful to not make decisions beyond the level of personal competence.
- (d) Residents should be able to explain the nature of the examination or findings in an examination to patients and their families when needed.
- (e) Residents should observe ethical principles when recommending further work-up for cases.
- (f) Promptness and availability at work are expected of every resident.
- (g) Residents should dress appropriately at work, wearing a name badge at all times.
- (h) Technologists and other health workers should be treated with respect as part of the health care team.
- (i) Patient confidentiality should be observed at all times.

System Based practice:

- (a) Residents should be familiar with departmental procedures necessary in the performance of the examination.
- (b) Residents should learn appropriate language to be used in communicating to clinicians through reports or consultations so proper management decisions can be made.
- (c) Proper dictations should be made with indications, technique, findings and conclusions
- (d) Residents should dictate and correct their reports in a timely fashion to avoid delay in patient disposition.
- (e) Residents should assist in facilitating examinations whenever possible.
- (f) Resident should recognize the role that nuclear medicine plays in the management of patient's illness and make proper recommendations when needed.
- (g) Residents are encouraged to make suggestions to improve methods and systems utilized in radiology should be made whenever appropriate.

Reading list: Focus on arthritides, inflammatory/infectious processes, tumor and tumor-like conditions, metabolic bone disorders, congenital and acquired disorders, advanced imaging of bone and joint trauma.

1. Resnick, Sang and Pretterklieber. Internal Derangements of Joints, 2nd Edition. Saunders. 2007.
2. Resnick and Kransdorf. Bone and Joint Imaging, 3rd Edition. Elsevier. 2004.

3. Brower AC. Arthritis in Black and White. WB Saunders.
4. Stoller's Atlas of Orthopedics and Sports Medicine. Lippincott Williams & Wilkins. 2007.
5. Stoller. Magnetic Resonance in Orthopaedics and Sports Medicine. Lippincott Williams & Wilkins. 3rd Edition. 2007.
6. Kransdorf & Murphey. Imaging of Soft tissue tumors. 2nd Edition. Lippincott Williams & Wilkins. 2006.
7. Bohndorf K et al. Musculoskeletal Imaging. A Concise Multimodality Approach. Thieme. 2001.
8. Keats & Anderson. Atlas of Normal Roentgen Variants that may simulate disease. 8th Edition. Mosby. 2007.
9. Rogers L. Radiology of Skeletal Trauma. Churchill Livingstone.
10. Manaster, May & Disler. Musculoskeletal Imaging, 3rd Edition: The Requisites. Mosby. 2007.
11. ACR MSK Radiology teaching file disc.
12. www.RSNA.org
13. www.radiologyassistant.nl/en
14. www.e-anatomy.orgwww.acr.org
15. <http://www.radiologyassistant.nl/en/>

MSK Radiology – Rotation 3 and optional 4, 5, or 6

General overview

Radiology resident rotations in MSK Imaging will include at least 4 months during residency. Rotations will occur at St. Luke's Hospital of Kansas City and Truman Medical Center. The specific goals include objectives required for every level of training with graded supervision by the attending faculty. All aspects of MSK imaging will be incorporated into the residency, including MSK cross-sectional imaging (CT, MRI, and Ultrasound), Nuclear Medicine (Bone scan, Gallium scan, WBC scan) and Interventional procedures (joint injections, aspirations, biopsies, tumor ablation).

Resident responsibilities:

1. Resident work directly with the attending MSK radiologist and are involved in the daily conduct of the service.
 - At the beginning of every work day, the resident should be familiar with the patient schedule and anticipate needs for any procedures.
 - The resident will check requisitions to evaluate the appropriateness of requested study or if other exams need to be performed.
 - Clinical information should be obtained prior to protocoling MR and CT scans as well as prior to scheduling biopsies or other interventional procedures.
 - Absent clinical indication or seemingly inappropriate requests will be clarified and discussed with the referring physician/service.
2. The resident assigned to the MSK rotation is expected to be available for consultation by the imaging technologists, clinicians and other health care professionals during regular office hours except during conference times, when attending faculty will cover.
3. Examinations should be checked by the resident before the patient leaves the department if requested to do so by the supervising faculty.
4. Questions should be referred to the supervising faculty to which the resident is assigned.
5. Preliminary reports may be written for emergency room studies and patients who are going to clinic appointments on the same day of the examination when appropriate. This is communicated to attending radiologist and documented in the final report with name, date and time of such a communication.
6. Review of cases with the supervising faculty will be conducted as many times in the day as necessary to keep an efficient work flow.

7. All studies should be dictated by the end of every working day.
8. The resident will check his/her reports prior to final verification by supervising faculty.

Staff responsibilities:

1. Supervising faculty should be available at all times for any questions or consultations needed by the resident.
2. Supervising faculty should review all cases with the resident before the end of the day.
3. Supervising faculty should provide the resident with constructive feedback in any problem areas encountered during the rotation as well as through rotation evaluations.
4. Supervising faculty should sign resident-generated reports in a timely manner and inform the resident of any major changes he/she made.

Resident evaluation: UMKC faculty will use on line software to complete electronic evaluations, which are based on the 6 ACGME core competencies. Residents are also evaluated by 1-2 technologists and 10 patients while on each month of MSK Imaging rotation. See the resident handbook for further details.

MSK Imaging – Rotation 3 (optional 4-6) – Goals and Objectives

I. Patient care:

- (a) Residents are required to complete an on line Patient Care, Radiation Safety module at least biannually.
- (b) The resident should have knowledge of indications for the examinations requested. When the reason for the examination is not clear, the resident should effectively communicate with the patient or referring physician until this is clarified.
- (c) The resident should be familiar with available medical records and how to access them for purposes of patient care.
- (d) All studies should be reviewed with supervising faculty attending.
- (e) Preliminary reports should be made available to all referring clinicians if needed prior to final review of cases. If there is a significant discrepancy between the preliminary reading and final reading, the resident should notify the referring clinician immediately.

II. Medical Knowledge:

At the end of the rotation, the resident should be able to:

- (a) Describe fractures, rheumatologic disorders, soft tissue and bone tumors, infectious processes, congenital and metabolic disorders affecting the musculoskeletal structures. Discuss in detail the pathophysiology of these disorders and be able to formulate appropriate differential diagnoses.
- (b) Advise referring physicians on when imaging modalities such as radiography, tomography, CT, nuclear medicine studies and MRI should be used to evaluate specific musculoskeletal disorders. Discuss their relative strengths and weaknesses.
- (c) Describe the technique and application of conventional arthrography and MR or CT arthrography as well as how to interpret arthrograms of the shoulder, elbow, wrist, hip and knee. Show proficiency in performing arthrograms and joint injections/aspirations.
- (d) Discuss the physics of radiography, CR and DR, as it pertains to bone and soft tissue.
- (e) Discuss the basic physics of magnetic resonance imaging and understand technical variables for differing MR scan protocols including the principles behind different pulse sequences, time to repetition, time to echo, coil implementation, spacing, scan time and causes of artifacts.
- (f) Recognize normal and abnormal cross sectional anatomy of the musculoskeletal structures in all three (sagittal, axial and coronal) imaging planes. Recognize the normal appearance of different components of soft tissue (such as fat, fibrous tissue, muscle) and bone (cortical and medullary) on various pulse sequences.

- (g) Recognize abnormalities such as internal derangement of joints, tumor, infectious processes and metabolic disorders affecting the musculoskeletal system.
- (h) Use contrast administration (IV, intra-articular) appropriately for joint imaging and soft tissue tumor imaging.
- (i) Add to knowledge base in all areas of musculoskeletal radiology through continued study, review of ACR cases and film reading.
- (j) Perform fluoroscopic exams except when complications are anticipated.
- (k) Participate in performance and interpretation of interventional procedures under faculty supervision.
- (a) Dictate films nearly independently with little assistance from the radiologist.

III. Practice Based Learning and Improvement:

- (a) Residents are required to complete an on line Fluoroscopic Procedures and Radiation Safety module at least biannually.
- (b) The resident should demonstrate evidence of independent reading and learning through the use of printed and electronic sources.
- (c) Follow-up of abnormal or interesting studies should be accomplished through communication with the referring physician and/or patient medical records.
- (d) Residents should assist with preparation and presentation of cases for pediatric interdisciplinary conferences when requested by the attending physician.
- (e) The resident should be competent in using the PACS and Powerscribe systems in the daily accomplishment of the work load and instruct others in its use.

IV. Interpersonal Communication Skills:

- (a) Residents should be able to communicate effectively results of studies to referring clinicians whenever needed. For emergent studies, reports to referring clinicians should be made in a timely manner.
- (b) The resident should be able to effectively convey the findings of examinations through accurate dictation of reports.
- (c) Residents should discuss fluoroscopic procedures and study results with children and their families when requested to do so by supervising faculty.

V. Professionalism:

- (a) Residents are required to complete an on line professionalism module at least biannually.
- (b) At the end of the rotation, the resident should be able to make preliminary decisions on all matters of film interpretation and consultation, recognizing and obtaining assistance with situations that require the expertise of the radiologist.
- (c) Recognize limitations in personal knowledge and skills, being careful to not make
- (d) decisions beyond the level of personal competence.
- (e) Residents should be able to explain the nature of the examination or findings in an examination to patients and their families when needed.
- (f) Residents should observe ethical principles when recommending further work-up for cases.
- (g) Promptness and availability at work are expected of every resident.
- (h) Residents should dress appropriately at work, wearing a name badge at all times.
- (i) Pediatric radiology technologists and other health workers should be treated with respect as part of the health care team.
- (j) Patient confidentiality should be observed at all times.

VI. System Based practice:

- (a) Residents should be familiar with departmental procedures necessary in the performance of the examination.

- (b) Residents should learn appropriate language to be used in communicating to clinicians through reports or consultations so proper management decisions can be made.
- (c) Proper dictations should be made with indications, technique, findings and conclusions
- (d) Residents should dictate and correct their reports in a timely fashion to avoid delay in patient disposition.
- (e) Residents should assist in facilitating examinations whenever possible.
- (f) Resident should recognize the role that nuclear medicine plays in the management of patient's illness and make proper recommendations when needed.
- (g) Residents are encouraged to make suggestions to improve methods and systems utilized in radiology should be made whenever appropriate.

Reading list: Focus on filling in gaps in knowledge and study by taking cases in an oral board format.
Review material learned on previous rotations in MSK radiology.

1. Resnick and Kransdorf. Bone and Joint Imaging, 3rd Edition. Elsevier. 2004.
2. Resnick, Sang and Pretterklieber. Internal Derangements of Joints, 2nd Edition. Saunders. 2007.
3. Stoller. Magnetic Resonance in Orthopaedics and Sports Medicine. Lippincott Williams & Wilkins. 3rd Edition. 2007.
4. Kransdorf & Murphey. Imaging of Soft tissue tumors. 2nd Edition. Lippincott Williams & Wilkins. 2006.
5. Bohndorf K et al. Musculoskeletal Imaging. A Concise Multimodality Approach. Thieme 2001
6. Manaster, May & Disler. Musculoskeletal Imaging, 3rd Edition: The Requisites. Mosby. 2007
7. Complete ACR MSK Radiology teaching file disc.
8. www.RSNA.org
9. www.radiologyassistant.nl/en
10. www.e-anatomy.orgwww.acr.org
11. <http://www.radiologyassistant.nl/en/>

Supplemental materials for MSK

Musculoskeletal (MSK) Imaging Rotations

General guidelines

- Inform attending if you will be late or absent
- Review cases prior to read-out with attending
 - Obtain clinical information from electronic record or referring service
 - Must compare and correlate with previous exams – including other modalities (radiographs, CT, MRI, nuclear medicine, US)
 - Must address specific clinical questions on physician request
 - Read about disorder and anatomy
- Check schedule: weekly and daily for image guided procedures
 - Review technique before day of procedure
 - Maintain log of procedures and follow-up results of biopsy or aspiration
 - Dictate addendum with final pathology results for biopsy or FNA

Rotation 1 MSK Imaging

Goals

After completing the first 4-week rotation, the resident will be able to:

- Demonstrate learning of knowledge based objectives and mastery of technical objectives for the first rotation
- Generate accurate and concise radiographic reports
- Communicate effectively with patients, referring clinicians, technologists and supervisory staff
- Understand standard radiographic positioning and anatomy
- Obtain essential patient information pertinent to the imaging study
- Demonstrate knowledge of clinical indications for radiography and indications for urgent computed tomography (CT) and magnetic resonance (MR) scans
- Demonstrate a responsible work ethic
- Participate in quality improvement/ quality assurance activities
- Participate in education of students and interns

Objectives

- **Knowledge based**

- Demonstrate learning of normal radiographic and CT anatomy of axial and appendicular skeleton
- Recognize and accurately describe common fractures and dislocations of appendicular skeleton
- Recognize and describe fractures and dislocations of the cervical, thoracic and lumbar spine. Understand basic mechanisms of injury and distinguish stable from unstable injuries
- Demonstrate learning of pathophysiology and radiology of fracture healing and complications of healing such as delayed union, malunion and nonunion
- Demonstrate learning of radiographic presentation and evaluation of osteomyelitis and septic arthritis
- Recognize and describe complications of orthopedic devices including fracture fixation and spine and arthroplasty hardware
- Demonstrate learning of normal MRI anatomy of knee and shoulder
- Demonstrate learning of normal MRI anatomy of cervical, thoracic, and lumbar spine

- **Technical**

- Dictate clear, detailed, and accurate reports that include all pertinent information as established in the American College of Radiology (ACR) Guidelines for Communication⁴
- Use appropriate nomenclature when reporting radiographic, CT, MR or ultrasound (US) findings of musculoskeletal disease
- Communicate all unexpected or significant findings to the ordering provider and document whom was called and the date and time of the discussion in the report
- Obtain relevant patient history from electronic records, dictated reports, the patient, or by communication with referring provider
- Recognize and describe positioning and anatomy of standard radiographic examinations of the musculoskeletal system
- Effectively provide feedback to radiology technologists regarding quality of exposure and patient positioning
- Recognize when it is appropriate to obtain help from senior residents or faculty when assisting referring clinicians
- Demonstrate responsible, ethical behavior; positive work habits; and professional appearance; and adhere to principles of patient confidentiality
- Participate in discussions with faculty and staff regarding operational challenges and potential system solutions regarding all aspects of radiologic services and patient care

Rotation 2 MSK Imaging

Goals

After completing the second 4-week rotation, the resident will be able to:

- Demonstrate learning of knowledge based objectives and mastery of technical objectives for the second rotation
- Continue to build and improve on skills developed during the first rotation
- Develop skills in protocoling and monitoring CT and MR examinations
- Demonstrate an understanding of the ACR Appropriateness Criteria⁵ and ACR Practice Guidelines and Technical Standards for musculoskeletal imaging⁶
- Participate in the education of junior residents, interns, and medical students
- Perform image guided procedures

Objectives

- **Knowledge Based**
 - Recognize and describe radiographic presentation of Paget disease
 - Demonstrate learning of a systematic approach to arthritis. Be able to describe and differentiate salient radiologic (radiographic, CT and MR) features of common arthropathies including osteoarthritis, inflammatory arthropathy (rheumatoid, psoriatic, reactive, juvenile chronic, and septic), crystal deposition diseases (calcium pyrophosphate deposition, gout, hydroxyapatite deposition), neuropathic arthropathy, connective tissue disease (systemic lupus erythematosus, scleroderma, dermatomyositis), pigmented villonodular synovitis, and synovial chondromatosis
 - Demonstrate a systematic assessment of a solitary lesion of bone and be able to categorize the lesion as aggressive or nonaggressive. Develop an appropriate differential diagnosis based on patient age, lesion location, and lesion characteristics (margin, matrix, periosteal reaction, soft tissue extension). Demonstrate knowledge of systematic, safe and cost effective radiologic work-up of bone lesions including biopsy approach and compartmental anatomy.
 - Recognize and describe common locations of and radiologic manifestations of osteonecrosis.
 - Demonstrate knowledge of MRI safety issues including contraindication to scanning and use of contrast.
 - Demonstrate learning of the use of various pulse sequences and planes of imaging used in MRI of musculoskeletal disorders
 - Demonstrate learning of common knee and shoulder pathology on MRI (meniscal tear, tendon and ligament injury, fracture, chondral disease, rotator cuff tear, and labral pathology)
 - Demonstrate learning of common pathology of the cervical, thoracic, and lumbar spine on MRI
 - Demonstrate learning of the normal MRI anatomy of the hip and ankle
- **Technical**
 - Build and improve on skills acquired during first rotation

- Demonstrate the ability to gather essential and accurate patient information (electronic, personal communication) to appropriately prescribe MRI protocols
- Provide effective and timely feedback and education to CT and MRI technologists regarding quality of examinations
- Demonstrate ability to monitor CT and MRI examinations to ensure the patient is adequately evaluated
- Demonstrate an understanding of indications, contraindications, needle path, risks and post procedural management of CT and US guided procedures including management of complications
- Provide technical and educational guidance to junior residents and students
- Safely perform fluroscopically guided joint injections and aspirations with faculty supervision
- Demonstrate an understanding of indications, contraindications, radiation risks, and post procedural management of fluroscopically guided procedures including management of complications
- Demonstrate an ability to counsel a patient and obtain informed consent before performing a procedure, including a description of the procedure, risks, benefits, and alternatives; and solicit and respond to patient questions without discrimination based on religious, ethnic, sexual, economic, or educational differences
- Maintain a log of all procedures performed including complications

Rotation 3 MSK Imaging

Goals

After completing the third 4-week, the resident will be able to:

- Demonstrate learning of knowledge based objectives and mastery of technical objectives for the third rotation
- Continue to refine skills developed during the first two rotations
- Effectively use information technology to address clinical problems
- Participate in the education of junior residents and medical students
- Become a more independent provider of musculoskeletal radiologic interpretive services
- Manage clinical and technical questions from technical and support staff

Objectives

- **Knowledge based**
 - Recognize radiologic findings and describe pathophysiology of endocrine disease including hyperparathyroidism, renal osteodystrophy, osteomalacia/rickets, hypophosphatasia, hypophosphatemia

- Recognize radiologic findings of hematopoietic and storage diseases including sickle cell anemia, thalassemia, mastocytosis, and Gaucher's disease.
 - Demonstrate systematic approach to relatively common dysplasias and congenital conditions such as achondroplasia, osteogenesis imperfecta, osteopetrosis
 - Demonstrate learning of common pathology of the hip and ankle on MRI
 - Demonstrate learning of anatomy and common injuries/pathology of the elbow and wrist on MRI
- **Technical**
 - Improve and build on skills acquired during the first two rotations
 - Demonstrate the ability to locate, appraise and assimilate evidence from scientific studies related to the performance and interpretation of musculoskeletal imaging
 - Demonstrate the ability to teach a junior colleague how to protocol examinations and plan procedures
 - Demonstrate the ability to assess and prioritize requests for add-on procedures
 - Demonstrate the ability to answer common procedural and policy questions from technologists and support staff

References

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