

Musculoskeletal Imaging

This exam content tests the candidate's knowledge and skills related to the clinical practice of musculoskeletal radiology. The domain encompasses radiographic, fluoroscopic, ultrasound, CT and MRI imaging of bone, joint and soft tissue.

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Domain Critical Concepts

1. Distinguish benign from malignant bone lesions and recognize common lesions in both categories
2. Trauma
 - a. Recognize and characterize fractures including pathologic and stress/insufficiency fracture
 - b. Recognize and characterize traumatic injuries to muscles, tendons, ligaments and cartilage
3. Recognize manifestations of soft tissue and bone infection
4. Recognize normal musculoskeletal anatomy and congenital variants
5. Recognize normal appearance of and common complications of orthopedic hardware
6. Recognize and differentiate MSK manifestations of common hematologic endocrine and metabolic disorders
7. Procedures – understand how to access large and intermediate joints (hip, shoulder, wrist and ankle) and recognize normal and abnormal arthrogram
8. Recognize and differentiate common arthropathies
9. Recognize ligament, cartilage and tendon abnormalities of shoulder, elbow, hip, knee and ankle

Domain Blueprint

1. Trauma: 20%-25%
 - a. Fractures/dislocations
 - b. Fracture complications
 - c. Myotendinous
 - d. Ligament
 - e. Neurovascular
 - f. Articular
 - g. Fragility
2. Infection: 5%-10%
 - a. Osseous
 - b. Soft tissue

- c. Joints
- d. Spine
- 3. Neoplasms: 10%-15%
 - a. Osseous, benign
 - b. Osseous, malignant
 - c. Soft tissue, benign
 - d. Soft tissue, malignant
 - e. Tumor-like/sclerosing bone disease
 - f. Metastases and myeloma
 - g. Treatment monitoring
 - h. PVNS
 - i. Treatment complications
- 4. Metabolic: up to 5%
 - a. Hyperparathyroidism/Renal osteodystrophy
 - b. Osteoporosis
 - c. Rickets/osteomalacia
 - d. Hypertrophic osteoarthopathy – primary and secondary
- 5. Marrow: up to 5%
 - a. Osteonecrosis
 - b. Hemoglobinopathies
 - c. Marrow infiltration
 - d. Marrow conversion
- 6. Post-operative: up to 5%
 - a. Spine
 - b. Implants
 - c. Prosthesis
 - d. Internal derangement
- 7. Congenital: up to 5%
 - a. Foot deformities
 - b. Coalitions
 - c. Normal variants
 - d. Dysplasias
- 8. Arthritis: 15%-20%
 - a. Osteoarthritis
 - b. Inflammatory
 - c. Connective tissue disease
 - d. Crystal
 - e. Neuropathic
- 9. Paget disease: up to 5%

Domain Overview

- 1. Imaging Techniques—Indications and Limitations
 - 1. Musculoskeletal modalities
 - 1. Considerations for musculoskeletal modalities
 - 1. Appropriateness, limitations, contraindications, and safety issues
 - 2. Protocols, standard positioning, technique
 - 3. Indications for contrast with MRI and CT

4. Artifacts and pitfalls
2. Interventional musculoskeletal procedures
 1. Types
 1. Arthrography
 2. Joint aspiration and injection
 3. Percutaneous biopsy
 4. Therapeutic procedure
 2. Considerations for musculoskeletal procedures
 1. Appropriateness, limitations, contraindications, and safety issues
 2. Universal protocol
 3. Approach and technique
 4. Injectate (composition and amount)
 5. Laboratory studies
 6. Complications
 3. Dual-energy X-ray Absorptiometry (DEXA)
 1. Indications and follow-up
 2. WHO classification
 3. DEXA positioning
 4. DEXA artifacts and pitfalls
2. Normal/Normal Variants
 1. Musculoskeletal anatomy pertinent to the various imaging modalities
 2. Primary and secondary ossification centers and sequence of ossification
 3. Physiologic radiolucencies and radiodensities
 4. Physiologic bowing
 5. Sesamoids, accessory ossicles, and related syndromes
 6. Accessory muscles
 7. Tug lesions
 8. Cortical desmoid
 9. Dorsal defect of the patella
 10. Glenoid labrum variants
3. Congenital Anomalies and Dysplasias
 1. Lower extremity
 1. Developmental hip dysplasia
 2. Discoid meniscus
 3. Talipes equinovarus
 4. Metatarsus adductus
 5. Pes cavus and planus
 6. Tarsal coalition
 7. Proximal focal femoral deficiency
 8. Protrusio acetabuli
 9. Acetabular version
 10. Patella baja and alta
 2. Upper extremity
 1. Madelung deformity
 2. Congenital dislocation of the radial head
 3. Carpal coalition
 4. Sprengel deformity

- 5. Supracondylar process
- 6. Radial ray anomaly
- 7. Ulnar variance
- 3. Spine (see neuroradiology section)
- 4. Diffuse/multifocal
 - 1. Achondroplasia
 - 2. Osteogenesis imperfecta
 - 3. Sclerosing osseous dysplasias
 - 1. Melorheostosis
 - 2. Osteopathia striata
 - 3. Osteopoikilosis
 - 4. Osteopetrosis
 - 5. Cleidocranial dysplasia/dysostosis
 - 6. Neurofibromatosis
 - 7. Cerebral palsy
 - 8. Mucopolysaccharidosis
 - 9. Trisomy 21
 - 10. Macrodystrophia lipomatosa
 - 11. Nail-patella syndrome
 - 12. Wormian bones
 - 13. Thanatophoric dwarf
 - 14. Marfan syndrome
 - 15. Tuberous sclerosis
- 4. Infections (including routes of spread and predisposing factors)
 - 1. Osteomyelitis
 - 1. Demographics
 - 2. Acute vs subacute vs chronic osteomyelitis
 - 3. Features with different imaging modalities
 - 4. Terminology
 - 5. Bacterial vs nonbacterial
 - 6. Congenital syphilis
 - 2. Septic arthritis, bursitis, and tenosynovitis
 - 3. Soft tissue
 - 1. Abscess
 - 2. Cellulitis
 - 3. Pyomyositis
 - 4. Gas gangrene
 - 5. Necrotizing fasciitis
 - 6. Cat-scratch disease
 - 7. Cysticercosis
- 5. Tumors and Tumor-Like Conditions
 - 1. Demographics
 - 2. Imaging features and description
 - 3. Benign and malignant primary bone lesions
 - 1. Cartilaginous tumors
 - 1. Osteochondroma
 - 2. Enchondroma
 - 3. Chondroblastoma

4. Periosteal chondroma
5. Chondromyxoid fibroma
6. Chondrosarcoma
2. Osteogenic tumors
 1. Osteoid osteoma
 2. Osteoblastoma
 3. Osteoma
 4. Osteosarcoma
 5. Conventional osteosarcoma
 6. Telangiectatic osteosarcoma
 7. Parosteal osteosarcoma
3. Fibrohistiocytic tumors
 1. Non-ossifying fibroma
4. Ewing sarcoma
5. Hematopoietic tumors
 1. Plasma cell myeloma (Myeloma)
 2. Solitary plasmacytoma of bone
 3. Primary non-Hodgkin lymphoma of bone
 4. Giant cell tumor of bone
6. Notochordal tumors
 1. Chordoma
7. Vascular tumors
 1. Hemangioma
8. Lipogenic and epithelial tumors
 1. Lipoma
 2. Adamantinoma
9. Tumors of undefined neoplastic nature
 1. Aneurysmal bone cyst (primary and secondary)
 2. Unicameral bone cyst
 3. Fibrous dysplasia
 4. Osteofibrous dysplasia
 5. Langerhans cell histiocytosis
4. Bone metastases
 1. Primary bone tumor vs metastases
 2. Blastic vs. lytic and other differentiating features
5. Tumor syndromes
 1. Enchondromatosis (Ollier and Maffucci)
 2. Polyostotic fibrous dysplasia, McCune-Albright, and Mazabraud
 3. Hereditary multiple osteochondromas
 4. Neurofibromatosis
6. Malignant transformation
 1. Paget
 2. Radiation induced
 3. Tumor syndromes (see above)
7. Benign and malignant soft tissue tumors
 1. Adipocytic tumors
 1. Lipoma
 2. Liposarcoma

- 3. Lipomatosis of nerve (fibrolipomatous hamartoma of nerve)
- 2. Fibroblastic/myofibroblastic tumors
 - 1. Nodular fasciitis
 - 2. Fibromatosis
 - 3. Elastofibroma
 - 4. Dermatofibrosarcoma protuberans
 - 5. Fibrosarcoma
- 3. So-called fibrohistiocytic tumors
 - 1. Tenosynovial giant cell tumor (includes localized and diffuse forms of pigmented villonodular synovitis as well as extra-articular giant cell tumor)
- 4. Smooth-muscle tumors
 - 1. Leiomyosarcoma
- 5. Pericytic tumors
 - 1. Glomus
- 6. Skeletal-muscle tumors
 - 1. Rhabdomyosarcoma
- 7. Vascular tumors
 - 1. Hemangioma
 - 2. Lymphangioma
- 8. Nerve sheath tumors
 - 1. Schwannoma
 - 2. Neurofibroma
 - 3. Malignant peripheral nerve sheath tumor
- 9. Tumors of uncertain differentiation
 - 1. Myxoma
 - 2. Synovial sarcoma
- 10. Undifferentiated/unclassified sarcoma
 - 1. Undifferentiated pleomorphic sarcoma (malignant fibrous histiocytoma)
- 8. Non-neoplastic masses
 - 1. Ganglion
 - 2. Geode
 - 3. Morton neuroma
 - 4. Postamputation neuroma
 - 5. Epidermal inclusion cyst
 - 6. Xanthoma of the tendon
- 6. Trauma and Overuse
 - 1. General principles of osseous trauma and overuse
 - 1. Types
 - 1. Closed vs open
 - 2. Pathologic
 - 3. Fatigue
 - 4. Insufficiency
 - 1. Subchondral insufficiency fracture
 - 5. Pediatric
 - 1. Nonaccidental
 - 2. Salter-Harris
 - 3. Greenstick, bowing, and torus

4. Slipped capital femoral epiphysis
2. Relationship of force and deformation to fracture
3. Mechanisms of injury
4. Fracture patterns, bone contusions, and associated injuries
5. Fracture description
6. Fracture healing
7. Complications of fracture healing
8. Fracture eponyms and overuse syndromes
2. Dislocations
3. General principles of soft-tissue trauma and overuse
 1. Tendinosis, tendon tears, and tenosynovitis
 2. Muscle injuries and grading
 3. Ligamentous injuries and grading
 4. Bursitis
 5. Hematomas
 6. Degloving injuries and Morel-Lavallee lesions
 7. Myositis ossificans
 8. Compartment syndrome
 9. Myonecrosis
4. Site-specific entities (should know important fractures and dislocations for all sites)
 1. Shoulder
 1. Labral and ligamentous tears
 1. Bankart and Bankart variants
 2. Superior labrum anterior posterior (SLAP; not including subtypes)
 3. Paralabral cysts
 4. Humeral avulsion glenohumeral ligament (HAGL)
 2. Rotator cuff
 1. Partial vs full-thickness
 2. Acute vs chronic
 3. Tendinopathy (including hydroxyapatite deposition disease/calcific tendinosis)
 3. Acromial-clavicular injuries
 4. Biceps tears and dislocations
 5. Pectoralis major injuries
 6. Adhesive capsulitis
 7. Impingement disorders
 8. Little leaguer shoulder
 2. Elbow
 1. Biceps and triceps tears
 2. Epicondylitis and tears of the common flexor and extensor tendons
 3. Tears of the medial and lateral collateral ligamentous complexes
 4. Osteochondral lesions
 5. Little leaguer elbow
 3. Wrist and hand
 1. Ulnar abutment
 2. Triangular fibrocartilage, scapholunate, and lunatotriquetral ligament tears

3. De Quervain tenosynovitis
4. Intersection syndrome
5. Tendon tears and dislocations
6. Scapholunate advanced collapse
7. DISI, VISI, and perilunate wrist instability
8. Gamekeeper and Stener lesions
4. Spine (see neuroradiology section)
5. Hip
 1. Labral tears and paralabral cysts
 2. Femoroacetabular impingement
 3. Tears of the gluteal and hamstring tendons
 4. Apophyseal injuries
 5. Psoas tendon abnormalities
6. Knee and leg
 1. Meniscus
 1. Normal variants and pitfalls
 2. Types of tears
 3. Parameniscal and Intrameniscal cysts
 2. Tears and abnormalities of the cruciate and collateral ligaments
 3. Posterolateral corner injury
 4. Iliotibial band syndrome
 5. Osteochondral lesions
 6. Patellar tracking disorder
 7. Tennis leg
 8. Tendon tears
 9. Jumper's knee, Sinding-Larsen-Johansson, and Osgood-Schlatter disease
7. Ankle and foot
 1. Plantar fasciitis
 2. Sinus tarsi syndrome
 3. Tendon tears and dislocations
 4. Impingement disorders
 5. Haglund deformity
 6. Ligamentous tears
 7. Osteochondral defect
7. Nerve Entrapment and Associated Disorders
 1. General principles of nerve entrapment
 2. Specific disorders
 1. Suprascapular nerve entrapment
 2. Acute brachial neuritis (Parsonage-Turner)
 3. Quadrilateral space syndrome
 4. Carpal, cubital, and tarsal tunnel syndromes
 5. Sciatic and peroneal nerve entrapment
 6. Radial, median, posterior interosseous, and ulnar nerve entrapment
 7. Obturator and femoral nerve entrapment
8. Metabolic Disorders
 1. Osteoporosis and osteopenia
 2. Hyperparathyroidism
 3. Thyroid acropachy

4. Hypothyroidism
5. Scurvy
6. Rickets and osteomalacia
7. Renal osteodystrophy
8. Tumoral calcinosis
9. Calciphylaxis
10. Acromegaly
11. Bisphosphonate-related fractures
12. Intoxication/poisoning
 1. Heavy metal/lead
 2. Hypervitaminosis A and D
 3. Fluorosis
9. Hematologic and Marrow Disorders
 1. Sickle cell and thalassemia
 2. Hemophilia
 3. Myelofibrosis
 4. Extramedullary hematopoiesis
 5. Marrow reconversion
 6. Leukemia and myelodysplasia
 7. Radiation-induced marrow changes
 8. Mastocytosis
 9. Gaucher disease
10. Osteonecrosis and Related Disorders
 1. Osteonecrosis
 1. Etiology
 2. Imaging characteristics
 2. Osteochondritis dissecans
 3. Bone marrow edema syndromes (transient osteoporosis of the hip)
 4. Osteochondroses
 1. Legg-Calve-Perthes
 2. Kienböck
 3. Kohler
 4. Panner
 5. Freiberg
 6. Sever
 7. Scheuermann
 8. Tibia vara (Blount disease)
11. Miscellaneous
 1. Paget disease
 2. Sarcoidosis
 3. Hypertrophic osteoarthropathy (primary and secondary)
 4. Periosteal changes from venous stasis
 5. Infantile cortical hyperostosis/Caffey disease
 6. Complex regional pain syndrome (reflex sympathetic dystrophy)
 7. Muscle infarction
12. Arthropathy
 1. General features
 1. Distribution and demographics

- 2. Imaging findings
- 2. Osteoarthritis (including erosive osteoarthritis)
- 3. Inflammatory
 - 1. Rheumatoid arthritis
 - 2. Psoriatic arthritis
 - 3. Reactive arthritis
 - 4. Ankylosing spondylitis
 - 5. Enteropathic arthritis
 - 6. Juvenile idiopathic arthritis
 - 7. SAPHO syndrome and chronic recurrent multifocal osteomyelitis (CRMO)
- 4. Connective tissue diseases
 - 1. Systemic lupus erythematosus (SLE)
 - 2. Scleroderma
 - 3. Dermatomyositis
 - 4. Polymyositis
- 5. Crystal-associated
 - 1. Gout
 - 2. Calcium pyrophosphate deposition disease (CPPD)
 - 3. Hydroxyapatite deposition disease (HADD)
- 6. Neuropathic
- 7. Miscellaneous
 - 1. Hemochromatosis
 - 2. Pigmented villonodular synovitis
 - 3. Synovial chondromatosis
 - 4. Osteitis condensans ilii
 - 5. Osteitis pubis and pubic instability
 - 6. Degenerative disk disease
 - 7. Diffuse idiopathic sclerosing hyperostosis (DISH)
 - 8. Ossification of the posterior longitudinal ligament
 - 9. Alkaptonuria/ochronosis
 - 10. Lipoma arborescens
 - 11. Post-traumatic osteolysis
 - 12. Scheuermann disease
- 13. Postoperative Imaging
 - 1. Internal and external fixation (including spine)
 - 1. Important types of hardware
 - 2. Appropriate positioning of hardware
 - 3. Complications
 - 1. Infection
 - 2. Loosening
 - 3. Component fracture
 - 2. Arthroplasty
 - 1. Important types
 - 2. Appropriate positioning
 - 3. Complications
 - 1. Infection
 - 2. Loosening, cement fractures, component shift, and subsidence
 - 3. Osteolysis (particle disease)

4. Component (polyethylene liner or prosthesis) wear, breakage, and dislocation
 5. Periprosthetic fracture
 6. Heterotopic ossification
 7. Metallosis
 3. Other postoperative imaging
 1. Normal vs abnormal appearance of the following surgeries:
 1. Anterior cruciate ligament
 2. Meniscus
 3. Vertebral augmentation
 4. Sarcoma resection
 5. Rotator cuff
 6. Glenoid labrum
 7. Osteochondral lesions
14. ACR Appropriateness Criteria Specific to Musculoskeletal Imaging