Jordanian Royal
Medical Services
الخدمات الطبية الملكية
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Muscloskeletal radiology Subspecialty Training Curriculum In King Hussein Medical CenterAmman – Jordan

Introduction:

This curriculum outlines the training requirements for specialist fellowship training in musculoskeletal (MSK) imaging.

The subspecialty of musculoskeletal imaging can be broadly defined as the study of the application, performance and interpretation of all imaging techniques/procedures relevant to the investigation and management of bone, joint, soft tissue and spinal disorders in adults and children.

The goals of subspecialty training in musculoskeletal imaging are to provide the trainee with the opportunity to develop diagnostic, procedural, and technical skills essential to the performance of diagnostic imaging in that subspecialty, including:

- To gain knowledge in the technical aspects of imaging.
- To gain clinical experience in interpretation of images.
- To achieve competence allowing independent performance of this subspecialtyand to consistently interpret the results of musculoskeletal investigations accurately and reliably. Where appropriate, trainees should also be capable of providing a comprehensive and safe interventional diagnostic and therapeutic service.

The goals are achieved through:

- knowledge of the relevant embryological, anatomical, pathophysiological and clinical aspects of diseases affecting the musculoskeletal system
- an in-depth understanding of the major imaging techniques relevant to the musculoskeletal system
- an in-depth knowledge of the indications, contra-indications, complications and limitations of surgical, medical and radiological interventions and procedures
- clinical knowledge relevant to medical and surgical management of musculoskeletal diseases such that the trainee may confidently discuss the appropriate imaging strategy for the clinical problem with the referring clinician
- detailed knowledge of current developments in the specialty
- an understanding of the value of a multidisciplinary approach to diagnosis and management in musculoskeletal disorders
- direct practical exposure with appropriate graded supervision in all forms of musculoskeletal imaging and intervention
- competence in the selection, performance and reporting of musculoskeletal imaging investigations and image-guided intervention

Eligibility criteria for Training:

- Must be board certified
- Is licensed to practice medicine in the country/ies of training
- Must have completed one year of radiology practice
- Provides written permission from the sponsoring body allowing him/her to undertake full time training for the full two year programme
- Provides two letters of recommendation from the institute where he last worked .

Timetable for Training:

- The length of the programme is two years.

- Training guidelines and the curriculum are specified below

Examination Process:

- The examination is held once a year .
- The format of the exam : One hour oral examination by a panel of experts The candidate is allowed three chances at passing the exam

Setup for the Training:

Formal rotations are highly desirable where the trainee spends defined periods dedicated to a specific modality that should be arranged by the fellowship director.

Methods of Training:

Lectures

- Individual interpretation session of representative cases (a teaching file).
- Daily self-studies of course materials and reference textbooks or papers (acquiring knowledge of basic principles, applied anatomy, pathophysiology, diagnostic criteria, and clinical applications).
- Daily interpretation sessions
- Weekly conferences with faculty (discussion of current cases, Q&A, differential diagnosis).
- Individual skill assessment (performing a procedure under direct supervision).

Methods of evaluation of Trainees:

1. On-going evaluation: (under the supervision of the Fellowship Director)
   - Performance and interpretation skills assessment by the training personnel (monthly).
   - Interpretation skills assessment using case reviews (monthly).
   - The trainee's professionalism, attitude to work, team work, responsibility and adherence to ethical principles in medical practice will be included in the assessment

2. Final evaluation of proficiency in interpretation subspecialty certification examination):
   - Individual consultants should provide written evaluation of trainees who have completed formal rotations in musculoskeletal imaging. The evaluations will be collected and endorsed by the fellowship director
   - After finishing training, the trainee should pass the exit examination
   - Evaluation forms required for a CME activity filled out by the trainee upon course completion

Methods of Upgrading Knowledge/CME:

- During the training course, trainees are required to perform self- studies of selected textbooks and papers, and participate in weekly discussions with faculty of current cases.
- Trainees are expected to participate in research and audit.
- The trainee is expected to present 10 full case conferences/lectures during each year of training. S/he is required to demonstrate ability to instruct and teach junior colleagues and medical students
- The trainee is expected to be cognizant of radiation protection guidelines and practice
- Upon completion of the coursetrainees are expected to prepare for the Arab Board certification examination in musculoskeletal imaging

Leave / Vacation:

- The trainee is entitled to three weeks of annual leave per year
- One week of educational leave is available per year to attend courses/scientific meetings

Core Curriculum:

During the training period it is recommended that the trainee obtains experience in the following:

• **Plain Radiography (6 months)including:**
– primary care examinations
– trauma cases
– rheumatological disorders
– general and paediatricorthopaedics

• **MRI (8 months):**
– the use of MRI for the primary diagnosis of benign and malignant pathology
– staging of tumours involving the musculoskeletal system
– detection of direct extension and metastatic spread of musculoskeletal tumours
– demonstration of spinal anatomy and pathology
– demonstration of joint anatomy and pathology
– the investigation of rheumatological disorders
– the investigation of trauma and sports injuries

6 months to include the following rotations □
Ultrasonography including:
– joints
– soft tissues
– orthopaedic and sports injuries – where appropriate, Doppler studies
• **CT:**
– the use of CT for the primary diagnosis of benign and malignant pathology
– staging of tumours involving the musculoskeletal system
– detection of direct extension and metastatic spread of musculoskeletal tumours
– the investigation of rheumatological disorders
– the investigation of trauma and sports injuries
• **Nuclear Medicine including PET & SPECT**
• **Fluoroscopic procedures including arthrography**

Trainees should acquire knowledge in the following **interventional procedures**:
• biopsy of bone and soft tissue lesions
• arthrography
• image-guided tumour ablation procedures
• facet joint and periroot injections
• discography
• CT myelography
• vertebroplasty& vertebral augmentation

One month rotation in orthopaedics& rheumatology
One month elective

Regardless of the imaging technique or procedure concerned, the supervising trainer must be satisfied that the trainee is clinically competent, as determined by an in-training performance assessment, and can consistently interpret the results of investigations accurately and reliably and formulate correct management plans. The trainee should become familiar with providing analgesia and/or sedation where required, as well as the necessary continuous monitoring required to perform this safely.
The trainee should be aware of local and national guidelines on consent, and be capable of obtaining informed patient consent for practical procedures.

Core contents:

I. Aspects of Basic Science Related to the Musculoskeletal System

A. Histogenesis of developing bone

1. Intramembranous ossification

2. Endochondral ossification

3. Remodeling

B. Bone anatomy

1. Cellular constituents

a. Osteoblasts

b. Osteoclasts

2. Non cellular constituents

a. Organic matrix

b. Inorganic matrix

II. Techniques Relevant to Musculoskeletal Radiology

A. Radiography

1. Routine views

2. Specialized views - Indications for obtaining specialized views

B. Computed tomography

C. Magnetic resonance imaging

D. Fluoroscopy

E. Ultrasonography

F. Densitometry

G. Nuclear scintigraphy

H. Measurement and Evaluation Techniques

1. Scoliosis

2. Leg length

3. Lower extremity mechanical axis determination

4. Anteversion

5. Bone age determination

L. Interventional procedures 1.

General considerations

a. Consent

b. Pre-procedure planning 2. Arthrography

a. Shoulder

b. Hip (including prosthesis evaluation)

c. Wrist

3. Aspiration and injections

4. Percutaneous biopsy

III. Normal Features and Variants

A. Sequence of ossification

B. Physiologic radiolucencies

1. Pseudotumorhumerus

2. Pseudocyst calcaneus

C. Vascular channels

1. Nutrient canal in phalanx or long bone cortex

2. Vertebral body

3. Scapula

4. Iliac bone

D. Normal sulci
1. Preauricular sulcus (paraglenoid fossa)
2. Rhomboid fossa
E. Supracondylar process
F. Dorsal defect of patella
G. Epiphyseal ossification from multiple centers - Bipartite patella
H. Irregular epiphyseal ossification
1. Femoral condyle
2. Femoral head
3. Other
I. Periosteal reaction of infancy
J. Physiologic bowing
K. Transverse (growth) line
L. Vacuum joint
M. Sesamoids and accessory ossicles
N. Accessory muscles
O. Tug lesions
1. Cortical desmoid

IV. Congenital and Developmental Abnormalities of the Spine

A. Osodontoideum
B. Klippel-Feil
C. VACTERL association
D. Vertebral anomaly
1. Fusion
2. Segmentation
E. Spinal dysraphism
F. Diastematomyelia
G. Caudal regression syndrome
H. Schmorl node
I. Scheuermann disease
J. Limbus vertebra
K. Scoliosis

V. Congenital Anomalies and Dysplasias

A. Lower Extremity:
1. Developmental dysplasia of the hip
2. Blount disease
3. Discoid meniscus 4. Foot deformities
a. Tarsal coalition
b. Talipesequinovarus (clubfoot)
c. Pes planus
d. Pes cavus
e. Metatarsus adductusvarus
f. Vertical talus
g. Rocker-bottom foot
5. Syndactyly
6. Polydactyly
7. Congenital pseudoarthrosis
8. Fibular hemimelia
9. Proximal femoral focal deficiency

B. Upper Extremity
1. Madelung deformity
2. Congenital dislocation of the radial head
3. Carpal coalition
4. Syndactyly
5. Polydactyly
6. Sprengel deformity
7. Radial clubhand
8. Thrombocytopenia absent radius syndrome (TAR)
C. Trunk
1. Pectusexcavatum 2.
Pectuscarinatum
3. Poland syndrome
D. Diffuse or Multifocal Anomalies and Dysplasias
1. Achondroplasia
2. Osteogenesisimperfecta 3. Sclerosing osseous dysplasias
a. Osteopoikilosis
b. Melorheostosis
c. Osteopathiastriata
d. Mixed sclerosing bone dystrophy
4. Osteopetrosis
5. Cleidocranial dysplasia (dysostosis)
6. Amniotic band syndrome
7. Pyknodysostosis
8. Syndromic connective tissue disorders
a. Ehlers-Danlos syndrome
b. Marfan syndrome 9. Neurofibromatosis
10. Cerebral palsy
11. Muscular dystrophies
12. Congenital insensitivity to pain
13. Mucopolysaccharidosis (general findings)
14. Tuberous sclerosis
15. Trisomy 21 (Down syndrome)
16. Turner syndrome 17. Advanced dysplasias
a. Chondrodysplasiapunctata (stippled epiphyses)
b. Diaphyseal dysplasia
c. Dysplasia epiphysealishemimelica
d. Metaphyseal dysplasia
e. Multiple epiphyseal dysplasia
f. Spondyloepiphyseal dysplasia 18. Advanced diffuse disease, other
a. Arthrogryposis multiplex congenita b. Endosteal hyperostosis
c. Fibrodysplasia (myositis) ossificansprogressiva
d. Idiopathic osteolysis
e. Macrodystrophialipomatosa
f. Pachydermoperiostosis
g. Thanatophoric dwarfism
h. Nail-patella syndrome
i. Chondroectodermal dysplasia

VI. Infection

A. Basic concepts 1.
Routes of spread
a. Hematogenous
b. Spread from a contiguous source
c. Direct implantation 2. Pre-disposing factors
B. Osteomyelitis 1.
Sites of localization
a. Infants
b. Children
c. Adults
d. Intravenous drug users 2. Terminology
a. Sequestrum
b. Involucrum
c. Cloaca
d. Brodie abscess
e. Sclerosing osteomyelitis
f. Multifocal C. Septic arthritis
1. Bacterial
2. Tuberculous
3. Lyme disease
D. Soft Tissue
1. Abscess
2. Cellulitis
3. Myositis
4. Gas gangrene
5. Necrotizing fasciitis
E. Organisms
1. Bacterial
2. Tuberculous
3. Fungal
4. Syphilis
5. Rubella
6. Leprosy
7. Lyme disease
8. Bacillary angiomatosis
9. Parasitic infection
10. Hydatid disease
11. Cysticercosis

VII. Neoplasm/Tumor-like Conditions

A. General principles
1. Patient age 2.
Description
a. Size
b. Location
c. Aggressiveness/growth pattern
d. Internal characteristics
e. Involvement of adjacent structures
f. Specific to bone lesions (i) Margin (zone of transition)
(ii) Pattern of osteolysis

(iii) Periosteal reaction
(iv) Soft tissue mass
(v) Matrix/calcification 3. Biopsy planning/techniques
a. Compartment anatomy
b. Limb salvage approach
c. Specific site to biopsy
B. Osseous lesions (within bone)
1. Benign
a. Cartilaginous
(i) Enchondroma
(a) Multiple (Ollier disease)
(b) Maffucci syndrome
(ii) Osteochondroma - Multiple hereditary exostoses
(iii) Chondromyxoid Fibroma
(iv) Chondroblastoma
(v) Chondroma - Periosteal (surface, juxtacortical) b. Fibrous
(i) Fibroxanthoma (non-ossifying fibroma)
(a) Fibrous cortical defect
(b) Benign fibrous histiocytoma
(ii) Fibrous dysplasia - McCune-Albright
(iii) Chondromyxoid fibroma
(iv) Desmoplastic fibroma
(v) Osteofibrous dysplasia (ossifying fibroma) c. Osteogenic
(i) Enostosis (bone island) - Multiple
(ii) Osteoma - Multiple
(iii) Osteoid osteoma (iv) Osteoblastoma d. Lipoid (i) Lipoma
(ii) Liposclerosingmyxofibrous tumor
(LSMFT)
e. Vascular
(i) Hemangioma - Multiple (Osler-Weber-
Rendu)
(ii) Hemophilic pseudotumor
(iii) Lymphangioma
(iv) Glomus tumor
(v) Hemangiopericytoma (vi) Gorham disease f. Other
(i) Unicameral bone cyst (simple bone cyst)
(ii) Aneurysmal bone cyst
(a) Primary
(b) Secondary
(ii) Giant cell tumor of bone
(iii) Langerhans cell histiocytosis (eosinophilic granuloma)
(iv) Chordoma
(v) Intraosseous ganglion
(vi) Reactive lesions
(a) Giant cell reparative granuloma
(b) Bizarre parosteal osseous proliferation
(BPOP)
(c) Epidermoid inclusion cyst 2. Malignant
a. Primary

(i) Cartilaginous - Chondrosarcoma
(a) Central
(b) Peripheral
(c) Dedifferentiated
(d) Mesenchymal
(e) Clear cell
(ii) Fibrous
(a) Fibrosarcoma
(b) Malignant fibrous histiocytoma
(iii) Osteogenic - Osteosarcoma
(a) Conventional
(b) Surface
- Periosteal
- Parosteal
- High grade surface
(c) Telangiectatic
(d) Low grade central
(iv) Vascular
(a) Angiosarcoma
(b) Hemangioendothelioma
(v) Other
(a) Chordoma
(b) Multiple myeloma (plasmacytoma)
(c) Ewing sarcoma
(d) Primitive neuroectodermal tumor
(PNET)
(e) Adamantinoma
(f) Lymphoma
(g) Leukemia
(1) chloroma
b. Secondary (i)
Radiation
(ii) Paget disease
(iii) Metastatic
(a) Common primary tumors
(1) Blastic
(2) Lytic
(3) Aneurysmal/expansile
C. Extra-osseous/soft tissue lesions
1. Benign
a. Fibrous (i)
Fibroma
(ii) Fibromatosis
(iii) Desmoid
(iv) Elastofibroma b. Neural (i) Neurofibroma (ii) Schwannoma
(iii) Neurofibromatosis
(iv) Neuroma
(v) Lipomatosis of nerve (fibrolipomatous

hamartoma) (vi) Post-
resection neuroma
(vii) Morton neuroma
c. Cartilaginous - soft tissue chondroma
d. Vascular
(i) Hemangioma
(ii) Hemangioendothelioma
(iii) Glomus tumor
(iv) Vascular malformations (v) Lymphangioma
e. Lipoid (i)
Lipoma
(ii) Angiolipoma
(iii) Hibernoma
(iv) Lipoblastoma f. Muscle (i) Rhabdomyoma
(ii) Leiomyoma
g. Dermal/subcutaneous (i)
Sebaceous cyst
(ii) Dermatofibroma
(iii) Granuloma annulare (iv) Granular cell tumor h. Other
(i) Myxoma
(ii) Giant cell tumor of tendon sheath
(iii) Pigmented villonodular synovitis
(iv) Ganglion
2. Malignant
a. Primary (i)
Fibrosarcoma
(ii) Malignant fibrous histiocytoma (high-grade undifferentiated pleomorphic sarcoma)
(iii) Synovial sarcoma
(iv) Rhabdomyosarcoma
(v) Malignant peripheral nerve sheath tumor
(vi) Epithelioid sarcoma
(vii) Liposarcoma
(a) Myxoid
(b) Well-differentiated
(c) Dedifferentiated
(viii) Dermatofibrosarcomaprotuberans
(ix) Alveolar soft part sarcoma
(x) Myxofibrosarcoma
(xi) Soft tissue osteosarcoma
(xii) Kaposi sarcoma
(xiii) Melanoma b. Secondary (i) Metastasis (ii) Leukemia
(iii) Lymphoma
(iv) Soft tissue extension of bone lesions

VIII. Trauma (Including Sports Injuries)

A. General principles 1.
Biomechanics of fractures
a. Relationship of force and deformation
b. Mechanisms of direct and indirect loading
c. Relevant anatomy and terminology

d. Fracture / injury patterns and associated injuries
e. Avulsion fracture locations 2. Fracture description
3. Stress injuries (bone and soft tissue)
a. Mechanisms
b. Pathophysiology
c. Epidemiology
d. Imaging diagnosis
e. Implications for treatment
4. Repetitive trauma
a. Tendinosis
b. Enthesophytes
c. Other
5. Soft tissue injuries
a. Grades of muscle tear
b. Grades of ligament tear
c. Myositis ossificans 6. Thermal trauma
a. Burns
b. Cold injury 7. Open fractures
8. Treatment
a. Indications
b. Principles of treatment
c. Casting
d. Hardware - General types and uses
e. Complications- - Hardware failure
f. Bone grafting 9. Fracture healing
a. Pathophysiology
b. Biomechanics
c. Time course 10. Complications
a. Malunion
b. Nonunion
c. Premature physeal closure
d. Osteonecrosis (i) Femoral head
(ii) Scaphoid proximal pole
(iii) Talar dome e.
Infection
f. Compartment syndrome
g. Arthritis
11. Foreign bodies
12. Gunshot wounds
13. Traumatic myonecrosis
B. Trauma in adults
1. Hand
a. Phalanx fracture / dislocation (i)
Intra vs. extra articular
(ii) Volar plate fracture
(iii) Tuft fracture
b. Metacarpal fracture (i)
Bennett vs. Rolando fracture
(ii) Boxer fracture

c. Carpometacarpal dislocation
d. Tendon injuries
e. Pulley injuries
f. Capsular and collateral ligament injuries (i) Gamekeeper (skier) thumb
(ii) Metacarpophalangeal joint
2. Wrist
a. Colles fracture
b. Smith fracture
c. Radial styloid fracture
d. Isolated carpal bone fracture (i) Scaphoid fracture
(a) Significance of blood supply
(b) Osteonecrosis
(c) Non-union
(ii) Triquetral fracture
(iii) Hamate fracture
(iv) Other
e. Complex carpal bone injuries
(i) Perilunate dislocation (ii) Lunate dislocation f. Ligament tears
(i) Interosseous ligaments
(ii) Triangular fibrocartilage complex
(iii) Extrinsic ligaments
g. Chronic carpal instability (i) Dorsal intercalated segment instability
(ii) Volar intercalated segment instability
(iii) Scapholunate advanced collapse h. Distal radioulnar joint injury
i. Carpal tunnel syndrome
j. Ulnar impaction syndrome
3. Forearm
a. Galeazzi fracture/dislocation
b. Monteggia fracture/dislocation
c. Isolated ulna (nightstick) fracture
4. Elbow
a. Radial head fracture
b. Fracture/dislocation
c. Humeral condyle fractures
d. Extensor tendinosis (tennis elbow/lateral epicondylitis)
e. Flexor tendinosis (pitcher's elbow/medial epicondylitis)
f. Ulnar collateral ligament tear
g. Radial collateral ligament tear
h. Biceps avulsion
i. Triceps avulsion 5. Shoulder and scapula
a. Anatomic vs. surgical neck humerus fracture
b. Greater tuberosity humerus fracture
c. Scapular fracture (i) Body (ii) Glenoid
d. Dislocation
(i) Anterior

(a) Hill Sachs fracture
(b) Bankart fracture
(c) Recurrence
(ii) Posterior
(a) Reverse Bankart
(b) Neurovascular injuries
(iii) Other - scapulothoracic dissociation e.
Rotator cuff tear
f. Labral injury (i) Patterns of instability (ii) SLAP tear& classification
g. Proximal biceps tear or dislocation
h. Impingement syndrome
(i) Anterior
(ii) Posterior (iii) Coracoid
i. Adhesive capsulitis
6. Clavicle and acromioclavicular joint
a. Grades of acromioclavicular joint separation
b. Clavicle fracture
c. Sternoclavicular fracture / dislocation
d. Post-traumatic osteolysis
7. Skull/face
a. Skull fracture (i)
Base of skull
(ii) Temporal bone
(iii) Sinus fracture
b. Facial bone fracture (i)
Orbit fracture
(a) Blow-out fracture
(b) Blow-in fracture
(c) Rim fracture
(d) Floor fracture
(e) Medial wall fracture
(i) Zygomaticomaxillary fracture
(ii) Complex (LeFort classification)
(iii) Mandible fracture
(iv) Nasal bone fracture
8. Thoracic cage
9. Spine
a. Mechanism of injury (i)
Flexion
(ii) Extension
(iii) Axial load/burst
(iv) Distraction (v) Translation
b. Fracture/ligament injury patterns
c. Column concept/stability
(i) Cervical
(ii) Thoracic
(iii) Lumbar (iv) Sacrum/coccyx
d. Associated neurologic injury
e. Acute disc herniation

10. Pelvis and hip
a. Pelvic fracture patterns (i)
Lateral compression
(ii) Anterior-posterior compression
(iii) Vertical shear
(iv) Complex
b. Acetabular fracture - fracture patterns
c. Hip dislocation - risk of osteonecrosis
d. Femoral neck fracture
e. Intertrochanteric fracture
f. Femoral head fracture
g. Labral injury 11. Femur fracture
12. Knee
a. Femoral condyle fracture
b. Tibial plateau fracture
c. Patella fracture
d. Knee dislocation
e. Patella dislocation
f. Meniscal injury (i) Bucket handle tear
(ii) Parrot-beak tear
(iii) Horizontal oblique tear
(iv) Horizontal cleavage tear
(v) Vertical longitudinal tear
(vi) Radial tear
(vii) Complex tear
(viii) Root tear
(ix) Meniscocapsular separation
(x) Fraying and degeneration
(xi) Displaced fragments (xii) Meniscal cyst g. Ligament injury (i) Anterior cruciate
(ii) Posterior cruciate
(iii) Medial collateral
(iv) Lateral collateral
h. Extensor mechanism injury (i)
Quadriceps tear
(ii) Patellar tendon (ligament) tear
(iii) Retinaculum injury
i. Posterolateral corner injury (i)
Popliteus muscle/tendon
(ii) Arcuate ligament
(iii) Popliteofibular ligament (iv) Fabellofibular ligament j. Articular cartilage injury
k. Overuse injuries
(i) Plica syndrome
(ii) Iliotibial band friction syndrome
(iii) Pes anserine bursitis
13. Ankle
a. Mechanisms of injury
b. Pilon fracture
c. Tilleaux fracture

d. Maisonneuve fracture
e. Ligament injury (i) Anterior talofibular ligament
(ii) Deltoid ligament
(iii) Syndesmotic/anterior tibiofibular ligament f. Talar fracture (i) Dome fracture (ii) Neck fracture
(iii) Lateral process fracture
14. Foot
a. Calcaneal fracture - anterior process fracture
b. Fifth metatarsal base fracture
c. Metatarsal fracture
d. Lisfranc fracture/dislocation
e. Phalanx fracture
f. Cuboid fracture
g. Navicular fracture C. Trauma in children (unique features)
1. Biomechanics of the immature skeleton
2. Growth plate injuries 3. Hand, wrist, and forearm
a. Torus fracture
b. Greenstick fracture
c. Plastic bowing
4. Elbow
a. Radial head subluxation/dislocation
b. Supracondylar fracture
c. Entrapped epicondyle
d. Little leaguer elbow
5. Shoulder - little leaguer shoulder
6. Spine - spondylolysis
7. Hip - slipped capital femoral epiphysis
8. Knee - osteochondritisdissecans 9. Tibia, ankle, and foot
a. Toddler fracture
b. Triplane fracture
c. Juvenile Tilleaux fracture l0. Battered child
a. Reporting statutes
b. Metaphyseal corner fracture
c. Fracture location and patterns

IX. Metabolic, Systemic, and Hematologic Disorders

A. Bone physiology
1. Mineralization of bone
2. Calcium homeostasis
3. Bone resorption
4. Bone formation 5. Humoral regulation
a. Parathyroid hormone
b. Calcitonin
c. Vitamin D B. Osteoporosis
1. Disuse
2. Related to aging (postmenopausal, senile)
3. Bone marrow edema (transient, migratory)
4. Complex regional pain syndrome/reflex sympathetic dystrophy
5. Drug induced
a. Steroid

b. Other
6. Idiopathic juvenile osteoporosis
C. Hyperparathyroidism
1. Subperiosteal resorption, acroosteolysis
2. Brown tumor (primary)
D. Rickets and osteomalacia
1. Vitamin D dependent
2. Vitamin D resistant
3. Dietary
4. Gastrointestinal malabsorption
a. Liver disease
b. Anticonvulsant therapy 5. Tumor induced
E. Renal osteodystrophy
1. Secondary hyperparathyroidism
2. Osteomalacia
3. Osteosclerosis
4. Tumoralcalcinosis
F. Systemic and congenital muscular disorders
1. Muscular dystrophy
2. Cerebral palsy
3. Other
G. Pituitary disorder
1. Gigantism
2. Acromegaly
H. Thyroid disorder
1. Hypothyroidism (cretinism)
2. Hyperthyroidism
3. Thyroid acropachy
I. Intoxication, poisoning
1. Heavy metal (lead)
2. Fluorine
3. Hypervitaminosis A
4. Hypervitaminosis D
J. Bone infarction
1. Causes
2. Osteonecrosis (AVN: end of bones) vs. medullary infarction (shaft)
a. Legg-Calve-Perthes disease
b. Others
K. Hematologic disorders
1. Anemia
a. Sickle cell
b. Thalassemia
2. Hemophilia
3. Idiopathic myelofibrosis
4. Marrow reconversion
5. Extramedullary hematopoiesis
L. Multifocal soft tissue calcification
1. Calcification/ossification/periosteal reaction secondary to venous stasis
2. Calcification/ossification secondary to paraplegia

3. Milk-alkali syndrome
M. Multifocal periosteal reaction
1. Hypertrophic osteoarthropathy
a. Primary (pachydermoperiostosis)
b. Secondary (pulmonary, non-pulmonary)
2. Infantile cortical hyperostosis (Caffey disease)
3. Prostaglandin
N. Miscellaneous
1. Paget disease
2. Amyloidosis
3. Effect of pregnancy
4. Sarcoidosis
5. Radiation induced marrow changes
6. Scurvy
7. Hypophosphatasia
8. Mastocytosis
9. Lipid storage diseases
a. Gaucher
b. Xanthoma

X. Joint Disorders A.
Normal anatomy
l. Types of joints
a. Fibrous
b. Cartilaginous
c. Synovial 2. Intervertebral discs
3. Entheses
B. General features
1. Distribution of involvement
2. Soft tissue changes
3. Joint space width
4. Bone density
5. Osteophytes
6. Subchondral cysts
7. Osseous erosions
8. Proliferative new bone
9. Joint deformity
10. Calcification
C. Specific diseases 1.
Osteoarthritis
a. Primary
b. Secondary
c. Erosive (inflammatory) 2. Inflammatory joint diseases
a. Rheumatoid arthritis
b. Psoriatic arthritis
c. Reactive arthritis (Reiter syndrome)
d. Ankylosing spondylitis
e. Enteropathicspondyloarthropathy
f. Juvenile chronic arthritis

g. SAPHO
3. Connective tissue diseases
a. Systemic lupus erythematosus
b. Scleroderma
c. Dermatomyositis and polymyositis 4. Crystal-associated arthropathies
a. Gout
b. Calcium pyrophosphate dihydrate crystal deposition disease
c. Calcium hydroxyapatite deposition disease 5. Neuropathic osteoarthropathy
a. Diabetes mellitus
b. Syringomyelia
c. Other
6. Miscellaneous
a. Hemochromatosis
b. Alkaptonuria (ochronosis)
c. Hemophilic arthropathy
d. Pigmented villonodular synovitis
e. Synovial chondromatosis
f. Osteitiscondensansilii
g. Degenerative disc disease
h. Diffuse idiopathic skeletal hyperostosis
i. Jaccoudarthropathy
j. Arthropathy associated with acquired immune deficiency syndrome*
k. Lipoma arborescens
l. Tumoralcalcinosis

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Qualification Degree: Fellowship in Musculoskeletal Imaging
