

# Contents

*Foreword* vii  
*Preface to the First Edition* ix  
*Preface* xi  
*Acknowledgments* xiii

## Part I

---

### INTRODUCTION TO ORTHOPAEDIC IMAGING 1

#### Chapter 1

---

**The Role of the Orthopaedic Radiologist** 3  
Suggested Readings 11

#### Chapter 2

---

### Imaging Techniques in Orthopaedics 13

**Choice of Imaging Modality** 13  
**Imaging Techniques** 13  
    Conventional Radiography 13  
    Magnification Radiography 14  
    Stress Views 14  
    Scanogram 14  
    Fluoroscopy and Videotaping 14  
    Digital (Computed) Radiography 14  
    Tomography 15  
    Computed Tomography 16  
    Arthrography 21  
    Angiography 22  
    Myelography 22  
    Diskography 25  
    Ultrasound 25  
    Scintigraphy (Radionuclide Bone Scan) 28  
        *Diphosphonates* 31  
        *Gallium-67* 32  
        *Indium* 33  
        *Nanocolloid* 35  
        *Immunoglobulins* 35  
        *Chemotactic Peptides* 35  
        *Iodine* 36  
        *Gadolinium* 36

PET, PET/CT, and PET/MRI 37  
Magnetic Resonance Imaging 37

Suggested Readings 53

#### Chapter 3

---

### Histology, Formation, and Growth of Bone and Articular Cartilage 55

Bone: Histology, Formation, and Growth 55  
Articular Cartilage: Histology, Formation, and Growth 62  
Suggested Readings 67

## Part II

---

### TRAUMA 69

#### Chapter 4

---

### Imaging Evaluation of Trauma 71

#### Imaging Modalities 71

Radiography and Fluoroscopy 71  
Computed Tomography 71  
Scintigraphy 71  
Ultrasound 71  
Arthrography 71  
Myelography and Diskography 71  
Angiography 71  
Magnetic Resonance Imaging 71

#### Fractures and Dislocations 79

Diagnosis 79  
    *Radiographic Evaluation of Fractures* 79  
    *Indirect Signs as Diagnostic Clues* 92  
    *Radiographic Evaluation of Dislocations* 99  
Monitoring the Results of Treatment 99  
    *Fracture Healing and Complications* 101  
    *Other Complications of Fractures, Dislocations,  
    and Traumatic Insults to the Bones and Soft Tissues* 107

#### Stress Fractures 123

#### Injury to Soft Tissues 134

**Sports Injuries 136**

## Upper Extremity 140

*Weight Lifter Pectoralis* 140*Little League Shoulder* 140*Golfer's Elbow* 140*Tennis Elbow* 141*Little League Elbow* 141*Baseball Pitcher's Elbow* 141*Goalkeeper's Elbow* 141*Oarsman's Wrist* 143*Cyclist's Wrist* 143*Gymnast's Wrist* 144*Boxer's Fracture* 144*Skier's Thumb* 144*Bowler's Thumb* 144

## Lower Extremity 144

*Sports Hernia* 144*Runner's Knee (Iliotibial Band Friction Syndrome)* 144*Jumper's Knee* 144*Tennis Leg* 144*Shin Splints* 144*Footballer's Ankle (Athlete's Ankle)* 144*Snowboarder's Fracture* 148*Turf Toe* 148**Practical Points to Remember 148****Suggested Readings 149****Chapter 5****Upper Limb I: Shoulder Girdle 151****Trauma to the Shoulder Girdle 151**

Anatomic–Radiologic Considerations 151

Injury to the Shoulder Girdle 167

*Fractures About the Shoulder* 167*Dislocations in the Glenohumeral Joint* 176*Impingement Syndrome* 187*Rotator Cuff Tear* 191*Injury to the Cartilaginous Labrum* 193*Injury to the Glenohumeral Ligaments* 201*Miscellaneous Abnormalities* 201**Compressive and Entrapment Neuropathies of the Shoulder 208**

Suprascapular Nerve Syndrome 208

Quadrilateral Space Syndrome 208

Parsonage-Turner Syndrome (Idiopathic Brachial Plexopathy, Neuralgic Amyotrophy) 210

Serratus Anterior Paralysis (Scapular Winging) 210

**The Postoperative Shoulder 211****Practical Points to Remember 215****Suggested Readings 215****Chapter 6****Upper Limb II: Elbow 218****Trauma to the Elbow 218**

Anatomic–Radiologic Considerations 218

Injury to the Elbow 223

*Fractures About the Elbow* 223*Osteochondritis Dissecans of the Capitellum* 240*Dislocations in the Elbow Joint* 243*Injury to the Soft Tissues* 245

Bursitis 254

**Compressive and Entrapment Neuropathies of the Elbow 254**

Pronator Teres Muscle Syndrome 254

Supinator Muscle Syndrome 255

Cubital Tunnel Syndrome 255

**Practical Points to Remember 255****Suggested Readings 257****Chapter 7****Upper Limb III: Distal Forearm, Wrist, Hand, and Fingers 258****Distal Forearm 258**

Anatomic–Radiologic Considerations 258

Injury to the Distal Forearm 258

*Fractures of the Distal Radius* 258*Injury to the Soft Tissue at the Distal Radioulnar Articulation* 273**Wrist and Hand 277**

Anatomic–Radiologic Considerations 277

Injury to the Wrist 280

*Fractures of the Carpal Bones* 280*Kienböck Disease* 297*Hamatolunate Impaction Syndrome* 302*Dislocations of the Carpal Bones* 302*Carpal Instability* 316

Injury to the Bones of the Hand 316

*Bennett and Rolando Fractures* 316*Boxer's Fracture* 318

Injury to the Soft Tissue of the Hand 318

*Carpal Tunnel Syndrome* 318*Guyon Canal Syndrome* 320*Anterior Interosseous Nerve Syndrome* 320**Fingers 322**

Normal Anatomy of the Fingers 322

Injury to the Bones and Soft Tissues of the Fingers 326

*Gamekeeper's Thumb* 326*Avulsion Fractures of the Fingers* 326*Flexor Pulley System Rupture (Climber's Finger)* 327*de Quervain Syndrome* 327*Tendon and Ligament Tears* 329**Practical Points to Remember 333****Suggested Readings 333****Chapter 8****Lower Limb I: Pelvic Girdle, Sacrum, and Proximal Femur 335****Trauma to the Pelvic Girdle 335**

Anatomic–Radiologic Considerations 335

Injury to the Pelvis and Acetabulum 336

*Classification of Pelvic Fractures* 336*Fractures of the Pelvis* 342*Fractures of the Acetabulum* 345*Injuries of the Acetabular Labrum* 347*Femoroacetabular Impingement Syndrome* 347

Injury to the Sacrum 347

**Trauma to the Proximal Femur 355**

- Fractures of the Proximal Femur 355
  - Intracapsular Fractures* 355
  - Extracapsular Fractures* 359
- Dislocations in the Hip Joint 364

**Tendon and Muscle Lesions 370****Compressive and Entrapment Neuropathies 370**

- Piriformis Syndrome 372
- Iliacus Syndrome 372
- Obturator Neuropathy 373
- Lateral Femoral Cutaneous Neuropathy (Meralgia Paresthetica) 373
- Morel-Lavallée Lesion (Closed Degloving Injury) 374
- Sports Hernia 374
- Stress and Insufficiency Fractures 374

**Practical Points to Remember 375****Suggested Readings 375****Chapter 9****Lower Limb II: Knee 377****Trauma to the Knee 377**

- Anatomic–Radiologic Considerations 377
- Injury to the Knee 385
  - Fractures About the Knee* 385
  - Sinding-Larsen-Johansson Disease* 397
  - Osgood-Schlatter Disease* 400
  - Injuries to the Cartilage of the Knee* 403
  - Injury to the Soft Tissues About the Knee* 417

**The Postoperative Knee 441**

- Surgical Management of Meniscal Tears 441
- Anterior Cruciate Ligament Reconstruction 441
- Cartilage Repair 441

**Practical Points to Remember 456****Suggested Readings 456****Chapter 10****Lower Limb III: Ankle and Foot 458****Trauma to the Ankle and Foot 458**

- Anatomic–Radiologic Considerations 458
  - Imaging of the Ankle and Foot* 458
- Injury to the Ankle 467
  - Fractures About the Ankle Joint* 467
  - Injury to the Soft Tissues About the Ankle Joint and Foot* 483
- Injury to the Foot 493
  - Fractures of the Foot* 493
  - Complications* 508
  - Dislocations in the Foot* 508

**Miscellaneous Painful Soft-Tissue Abnormalities of the Ankle and Foot 520**

- Tarsal Tunnel Syndrome 520
- Sinus Tarsi Syndrome 520
- Posterior Tibialis Tendon Dysfunction 521
  - Chronic Tendinosis of the Posterior Tibialis Tendon* 521
  - Tears of the Posterior Tibialis Tendon* 521
  - Painful Accessory Navicular Bone Syndrome* 521

## Peroneal Tendinopathies 525

- Peroneus Brevis Split Tear* 525
- Peroneus Longus Tendinosis and Tear* 525
- Peroneal Tendon Dislocation* 525
- Painful Os Peroneum Syndrome* 525

## Baxter Neuropathy 526

## Morton Neuroma 526

## Plantar Fasciitis 526

## Impingement Syndromes 527

**Practical Points to Remember 530****Suggested Readings 530****Chapter 11****Spine 532****Introduction 532****Cervical Spine 532**

- Anatomic–Radiologic Considerations 532
- Injury to the Cervical Spine 542
  - Fractures of the Occipital Condyles* 546
  - Occipitocervical Dislocations* 546
  - Fractures of the C1 and C2 Vertebrae* 547
  - Fractures of the Mid and Lower Cervical Spine* 555
  - Locked Facets* 558

**Thoracolumbar Spine 562**

- Anatomic–Radiologic Considerations 562
- Injury to the Thoracolumbar Spine 568
  - Fractures of the Thoracolumbar Spine* 568
  - Fracture–Dislocations* 578
  - Spondylolysis and Spondylolisthesis* 579
  - Transitional Lumbosacral Vertebra* 584
  - Injury to the Diskovertebral Junction* 584
- Orthopaedic Management 597

**Practical Points to Remember 599****Suggested Readings 600****Part III****ARTHRITIDES 601****Chapter 12****Clinical, Imaging, and Pathologic Evaluation of the Arthritides and Arthropathies 603****Radiologic Imaging Modalities 603**

- Conventional Radiography 603
- Magnification Radiography 603
- Tomography and Computed Tomography 603
- Scintigraphy 603
- Ultrasound 611
- Magnetic Resonance Imaging 611

**The Arthritides 611**

- Diagnosis 611
  - Clinical Information* 611
  - Pathology* 620
  - Imaging Features* 622

- Management 638
  - Medical Treatment* 638
  - Radiotherapy* 638
  - Orthopaedic Treatment* 638
  - Complications of Surgical Treatment* 647

**Practical Points to Remember** 671

**Suggested Readings** 671

## Chapter 13

---

### Degenerative Joint Disease 673

#### Osteoarthritis 673

- Osteoarthritis of the Large Joints 673
  - Osteoarthritis of the Hip* 673
  - Osteoarthritis of the Knee* 691
  - Osteoarthritis of Other Large Joints* 695
- Osteoarthritis of the Small Joints 695
  - Primary Osteoarthritis of the Hand* 695
  - Secondary Osteoarthritis of the Hand* 695
  - Osteoarthritis of the Foot* 704

#### Degenerative Diseases of the Spine 708

- Clinical Features 708
- Pathology 709
- Osteoarthritis of the Synovial Joints 709
- Degenerative Disk Disease 711
- Spondylosis Deformans 711
- Diffuse Idiopathic Skeletal Hyperostosis 714
- Complications of Degenerative Disease of the Spine 717
  - Degenerative Spondylolisthesis* 717
  - Spinal Stenosis* 718

#### Neuropathic Arthropathy 721

**Practical Points to Remember** 723

**Suggested Readings** 724

## Chapter 14

---

### Inflammatory Arthritides 725

#### Erosive Osteoarthritis 725

- Clinical Features 725
- Pathology 725
- Imaging Features 725
- Differential Diagnosis 725
- Treatment 729

#### Rheumatoid Arthritis 729

- Adult Rheumatoid Arthritis 729
  - Rheumatoid Factors* 730
  - Clinical Features* 730
  - Imaging Features* 730
  - Complications of Rheumatoid Arthritis* 753
- Rheumatoid Nodulosis 755
- Juvenile Idiopathic Arthritis 758
  - Still Disease* 758
  - Polyarticular Juvenile Idiopathic Arthritis* 758
  - Juvenile Idiopathic Arthritis with Pauciarticular Onset (Oligoarthritis)* 758
  - Arthritis with Entesitis* 758

- Juvenile Psoriatic Arthritis* 758
- Imaging Features of JIA* 758
- Macrophage Activation Syndrome* 762
- Treatment of Rheumatoid Arthritis* 762

#### Seronegative Spondyloarthropathies 763

- Ankylosing Spondylitis 763
  - Clinical Features* 763
  - Pathology* 763
  - Imaging Features* 763
  - Treatment* 768
- Reactive Arthritis (Reiter Syndrome) 768
  - Clinical Features* 768
  - Imaging Features* 768
  - Treatment* 768
- Psoriatic Arthritis 770
  - Clinical Features* 770
  - Imaging Features* 775
  - Treatment* 775
- Enteropathic Arthropathies 778
- Undifferentiated Spondyloarthritis 778
- SAPHO Syndrome 778

**Practical Points to Remember** 781

**Suggested Readings** 782

## Chapter 15

---

### Miscellaneous Arthritides and Arthropathies 784

#### Connective Tissue Arthropathies 784

- Systemic Lupus Erythematosus 784
  - Clinical Features* 784
  - Pathology* 784
  - Imaging Features* 784
  - Treatment* 786
- Scleroderma 787
  - Clinical Features* 787
  - Pathology* 787
  - Imaging Features* 787
  - Treatment* 789
- Polymyositis and Dermatomyositis 789
  - Clinical Features* 789
  - Pathology* 790
  - Imaging Features* 791
  - Treatment* 795
- Mixed Connective Tissue Disease 795
- Vasculitis 795

#### Metabolic, Endocrine, and Crystal Deposition Arthropathies and Arthritides 801

- Gout 801
  - Clinical Features* 801
  - Hyperuricemia* 801
  - Examination of Synovial Fluid* 802
  - Pathology* 803
  - Imaging Features* 803
  - Differential Diagnosis* 803
  - Treatment* 813

Calcium Pyrophosphate Dihydrate Crystal Deposition Disease	813
<i>Clinical Features</i>	813
<i>Pathology</i>	813
<i>Imaging Features</i>	813
<i>Differential Diagnosis</i>	813
Calcium Hydroxyapatite Crystal Deposition Disease	819
<i>Clinical Features</i>	819
<i>Imaging Features</i>	820
<i>Treatment</i>	820
Hemochromatosis	820
<i>Clinical Features</i>	820
<i>Pathology</i>	821
<i>Imaging Features</i>	821
<i>Treatment</i>	821
Wilson Disease	821
<i>Clinical Features</i>	821
<i>Imaging Features</i>	822
<i>Treatment</i>	824
Alkaptonuria (Ochronosis)	824
<i>Clinical Features</i>	824
<i>Imaging Features</i>	824
<i>Treatment</i>	826
Hyperparathyroidism	826
<i>Clinical Features</i>	826
<i>Pathology</i>	826
<i>Imaging Features</i>	826
<i>Treatment</i>	826
Actomegaly	826
<b>Miscellaneous Conditions</b>	<b>827</b>
Amyloidosis	827
<i>Clinical Features</i>	827
<i>Pathology</i>	827
<i>Imaging Features</i>	827
<i>Treatment</i>	827
Multicentric Reticulohistiocytosis	827
<i>Clinical Features</i>	827
<i>Imaging Features</i>	827
<i>Pathology</i>	829
<i>Treatment</i>	829
Sarcoidosis	829
<i>Clinical Features</i>	829
<i>Pathology</i>	830
<i>Imaging Features</i>	830
<i>Treatment</i>	830
Hemophilia	830
<i>Imaging Features</i>	830
Jaccoud Arthritis	833
Arthritis Associated with AIDS	833
Infectious Arthritis	834
<b>Practical Points to Remember</b>	<b>836</b>
<b>Suggested Readings</b>	<b>836</b>

## Part IV

### TUMORS AND TUMOR-LIKE LESIONS 839

#### Chapter 16

#### Imaging Evaluation of Tumors and Tumor-like Lesions 841

##### Classification of Tumors and Tumor-like Lesions 841

##### Imaging Modalities 841

    Conventional Radiography 841

    Computed Tomography 841

    PET and PET/CT 843

    Arteriography 844

    Myelography 844

    Magnetic Resonance Imaging 851

    Skeletal Scintigraphy (Radionuclide Bone Scan) 853

    Interventional Procedures 856

##### Tumors and Tumor-like Lesions of Bone 856

    Diagnosis 856

*Clinical Information* 856

*Choice of Imaging Modality* 856

*Radiographic Features of Bone Lesions* 857

    Pathology 871

*Stains* 871

*Immunohistochemistry* 871

*Electron Microscopy* 874

*Genetics of Bone Tumors* 874

    Management 874

*Monitoring the Results of Treatment* 874

*Complications* 880

##### Soft-Tissue Tumors 880

##### Practical Points to Remember 893

##### Suggested Readings 893

#### Chapter 17

#### Benign Tumors and Tumor-like Lesions I: Bone-Forming Lesions 895

##### Benign Bone-Forming (Osteoblastic, Osteogenic) Lesions 895

    Osteoma 895

*Clinical and Imaging Features* 895

*Pathology* 895

*Differential Diagnosis* 895

    Osteoid Osteoma 895

*Clinical and Imaging Features* 895

*Pathology* 897

*Differential Diagnosis* 897

*Complications* 901

*Treatment* 901

    Osteblastoma 901

*Clinical and Imaging Features* 901

*Pathology* 916

*Differential Diagnosis* 923

*Treatment* 923

##### Practical Points to Remember 925

##### Suggested Readings 925

## Chapter 18

---

### Benign Tumors and Tumor-like Lesions II: Lesions of Cartilaginous Origin 927

#### Benign Chondroblastic Lesions 927

Enchondroma (Chondroma) 927

*Clinical and Imaging Features* 927

*Pathology* 930

*Differential Diagnosis* 936

*Complications* 936

*Treatment* 937

Enchondromatosis, Ollier Disease, and Maffucci Syndrome 937

*Clinical and Imaging Features* 937

*Pathology* 939

*Complications* 939

Osteochondroma 939

*Clinical and Imaging Features* 939

*Pathology* 942

*Complications* 943

*Treatment* 943

Multiple Osteocartilaginous Exostoses 947

*Clinical and Imaging Features* 947

*Complications* 949

*Treatment* 949

Bizarre Parosteal Osteochondromatous Proliferation 956

*Clinical and Imaging Features* 956

*Pathology* 961

*Treatment* 961

Chondroblastoma 961

*Clinical and Imaging Features* 961

*Pathology* 963

*Treatment and Complications* 963

Chondromyxoid Fibroma 968

*Clinical and Imaging Features* 968

*Pathology* 968

*Differential Diagnosis* 971

*Treatment* 971

**Practical Points to Remember** 971

**Suggested Readings** 973

## Chapter 19

---

### Benign Tumors and Tumor-like Lesions III: Fibrous, Fibrousseous, and Fibrohistiocytic Lesions 975

#### Fibrous Cortical Defect and Nonossifying Fibroma 975

*Clinical and Imaging Features* 975

*Pathology* 975

*Complications and Treatment* 975

#### Benign Fibrous Histiocytoma 975

*Clinical and Imaging Features* 975

#### Periosteal Desmoid 981

*Clinical and Imaging Features* 981

*Pathology* 981

*Differential Diagnosis* 981

#### Fibrous Dysplasia 983

Monostotic Fibrous Dysplasia 983

*Clinical and Imaging Features* 983

*Pathology* 983

Polyostotic Fibrous Dysplasia 989

*Clinical and Imaging Features* 989

*Pathology* 996

*Complications* 996

#### Fibrocartilaginous Dysplasia 996

*Clinical, Pathologic, and Imaging Features* 996

#### Associated Disorders 996

McCune-Albright Syndrome 996

Mazabraud Syndrome 997

#### Osteofibrous Dysplasia 1002

*Clinical, Imaging, and Histopathologic Features* 1002

*Complications and Treatment* 1006

#### Desmoplastic Fibroma 1006

*Clinical and Imaging Features* 1006

*Pathology* 1010

*Treatment* 1010

**Practical Points to Remember** 1014

**Suggested Readings** 1014

## Chapter 20

---

### Benign Tumors and Tumor-like Lesions IV: Miscellaneous Lesions 1016

#### Simple Bone Cyst 1016

*Clinical and Imaging Features* 1016

*Pathology* 1016

*Complications and Differential Diagnosis* 1016

*Treatment* 1016

#### Aneurysmal Bone Cyst 1016

*Clinical and Imaging Features* 1016

*Pathology* 1024

*Complications and Differential Diagnosis* 1024

*Treatment* 1030

#### Solid Variant of Aneurysmal Bone Cyst 1035

*Clinical and Imaging Features* 1035

*Pathology* 1035

*Treatment* 1035

#### Giant Cell Tumor 1035

*Clinical and Imaging Features* 1035

*Pathology* 1036

*Differential Diagnosis* 1046

*Complications and Treatment* 1046

#### Fibrocartilaginous Mesenchymoma 1051

*Clinical and Imaging Features* 1051

*Pathology* 1051

#### Hemangioma 1051

*Clinical and Imaging Features* 1051

*Pathology* 1060

*Differential Diagnosis* 1060

*Treatment* 1060

#### Intraosseous Lipoma 1060

*Clinical and Imaging Features* 1060

*Pathology* 1060

#### Nonneoplastic Lesions Simulating Tumors 1062

Intraosseous Ganglion 1062

Brown Tumor of Hyperparathyroidism 1067

- Langerhans Cell Histiocytosis (Eosinophilic Granuloma) 1067
  - Clinical and Imaging Features* 1067
  - Pathology* 1071
  - Treatment and Prognosis* 1074
- Infantile Myofibromatosis 1074
- Erdheim-Chester Disease (Lipogranulomatosis) 1074
- Medullary Bone Infarct 1076
- Myositis Ossificans 1076

**Practical Points to Remember** 1079

**Suggested Readings** 1079

## Chapter 21

---

### Malignant Bone Tumors I: Osteosarcomas and Chondrosarcomas 1082

#### Osteosarcomas 1082

- Primary Osteosarcomas 1082
  - Conventional Osteosarcoma* 1082
  - Low-Grade Central Osteosarcoma* 1089
  - Telangiectatic Osteosarcoma* 1089
  - Giant Cell-Rich Osteosarcoma* 1090
  - Small Cell Osteosarcoma* 1090
  - Fibrohistiocytic Osteosarcoma* 1094
  - Intracortical Osteosarcoma* 1095
  - Gnathic Osteosarcoma* 1096
  - Multicentric (Multifocal) Osteosarcoma* 1096
  - Surface (Juxtacortical) Osteosarcomas* 1096
  - Soft-Tissue (Extraskeletal) Osteosarcoma* 1104
  - Osteosarcomas with Unusual Clinical Presentation* 1108
- Secondary Osteosarcomas 1109

#### Chondrosarcomas 1113

- Primary Chondrosarcomas 1113
  - Conventional Chondrosarcoma* 1113
  - Clear Cell Chondrosarcoma* 1114
  - Mesenchymal Chondrosarcoma* 1114
  - Myxoid Chondrosarcoma* 1117
  - Dedifferentiated Chondrosarcoma* 1117
  - Periosteal (Juxtacortical) Chondrosarcoma* 1117
- Secondary Chondrosarcomas 1120
- Soft-Tissue (Extraskeletal) Chondrosarcomas 1120

**Practical Points to Remember** 1135

**Suggested Readings** 1136

## Chapter 22

---

### Malignant Bone Tumors II: Miscellaneous Tumors 1138

#### Fibrosarcoma and Malignant Fibrous Histiocytoma 1138

- Clinical Features 1138
- Imaging Features 1138
- Pathology 1138
- Differential Diagnosis 1138
- Complications and Treatment 1140

#### Ewing Sarcoma 1140

- Clinical Features 1140
- Imaging Features 1141
- Pathology 1142
- Differential Diagnosis 1142
- Treatment and Prognosis 1149

#### Malignant Lymphoma 1149

- Clinical Features 1149
- Imaging Features 1149
- Pathology 1149
- Differential Diagnosis 1158
- Treatment and Prognosis 1158

#### Myeloma 1158

- Clinical Features 1158
- Imaging Features 1158
- Pathology 1162
- Differential Diagnosis 1162
- Complications, Treatment, and Prognosis 1167

#### Adamantinoma of Long Bones 1167

- Clinical and Imaging Features 1167
- Pathology 1168
- Treatment and Prognosis 1168

#### Chordoma 1169

- Clinical Features 1169
- Imaging Features 1169
- Pathology 1170
- Complications, Treatment, and Prognosis 1170

#### Primary Leiomyosarcoma of Bone 1170

- Clinical Features 1170
- Imaging Features 1170
- Pathology 1171
- Differential Diagnosis 1171

#### Hemangioendothelioma and Angiosarcoma 1171

- Clinical Features 1171
- Imaging Features 1174
- Pathology 1174

#### Benign Conditions with Malignant Potential 1176

- Medullary Bone Infarct 1176
- Chronic Draining Sinus Tract of Osteomyelitis 1176
- Plexiform Neurofibromatosis 1178
- Paget Disease 1178
- Radiation-Induced Sarcoma 1178

#### Skeletal Metastases 1178

- Clinical Features 1178
- Imaging Features 1180
- Pathology 1181
- Complications 1181

**Practical Points to Remember** 1190

**Suggested Readings** 1191

## Chapter 23

---

### Tumors and Tumor-like Lesions of the Joints 1193

#### Benign Lesions 1193

- Synovial (Osteo)Chondromatosis 1193
  - Clinical Features* 1193
  - Imaging Features* 1193
  - Pathology* 1193
  - Differential Diagnosis* 1193
  - Treatment and Prognosis* 1196
- Pigmented Villonodular Synovitis 1196
  - Clinical Features* 1196
  - Imaging Features* 1200

- Pathology* 1204
- Differential Diagnosis* 1205
- Treatment and Prognosis* 1205
- Synovial Hemangioma 1205
  - Clinical Features* 1205
  - Imaging Features* 1205
  - Pathology* 1206
  - Differential Diagnosis* 1206
  - Treatment and Prognosis* 1206
- Lipoma Arborescens 1206
  - Clinical Features* 1206
  - Imaging Features* 1209
  - Pathology* 1209
  - Differential Diagnosis and Treatment* 1209
- Malignant Tumors 1209**
  - Synovial Sarcoma 1209
    - Clinical Features* 1209
    - Imaging Features* 1209
    - Pathology* 1209
    - Differential Diagnosis* 1209
    - Treatment and Prognosis* 1209
  - Synovial Chondrosarcoma 1209
    - Clinical Features* 1209
    - Imaging Features* 1212
    - Pathology* 1212
    - Differential Diagnosis* 1212
  - Malignant Pigmented Villonodular Synovitis 1212
  - Intraarticular Liposarcoma 1212
- Practical Points to Remember 1218**
- Suggested Readings 1218**

## Part V

### INFECTIONS 1221

#### Chapter 24

#### Imaging Evaluation of Musculoskeletal Infections 1223

##### Musculoskeletal Infections 1223

- Osteomyelitis 1223
- Infectious Arthritis 1223
- Cellulitis 1223
- Infections of the Spine 1223

##### Imaging Evaluation of Infections 1223

- Conventional Radiography, Computed Tomography, and Arthrography 1225
- Radionuclide Imaging 1225
- Arteriography, Myelography, Fistulography, and Ultrasound 1228
- Magnetic Resonance Imaging 1228
- Invasive Procedures 1231

##### Monitoring the Treatment and Complications of Infections 1231

##### Practical Points to Remember 1233

##### Suggested Readings 1233

## Chapter 25

### Osteomyelitis, Infectious Arthritis, and Soft-Tissue Infections 1235

#### Osteomyelitis 1235

- Pyogenic Bone Infections 1235
  - Acute and Chronic Osteomyelitis* 1235
  - Subacute Osteomyelitis* 1240
- Nonpyogenic Bone Infections 1240
  - Tuberculous Infections* 1240
  - Fungal Infections* 1242
  - Syphilitic Infection* 1245
- Differential Diagnosis of Osteomyelitis 1245

#### Chronic Recurrent Multifocal Osteomyelitis 1246

#### Infectious Arthritides 1247

- Pyogenic Joint Infections 1247
  - Complications* 1250
- Nonpyogenic Joint Infections 1250
  - Tuberculous Arthritis* 1250
  - Other Infectious Arthritides* 1252

#### Infections of the Spine 1254

- Pyogenic Infections 1254
  - Clinical and Imaging Features* 1254
  - Pathology* 1254
- Nonpyogenic Infections 1254
  - Tuberculosis of the Spine* 1254
  - Coccidioidomycosis of the Spine* 1254
- Soft-Tissue Infections 1264

#### Practical Points to Remember 1268

#### Suggested Readings 1268

## Part VI

### METABOLIC, ENDOCRINE, AND MISCELLANEOUS DISORDERS 1271

#### Chapter 26

#### Imaging Evaluation of Metabolic, Endocrine, and Miscellaneous Disorders 1273

##### Composition and Production of Bone 1273

##### Evaluation of Metabolic and Endocrine Disorders 1273

- Radiologic Imaging Modalities 1273
  - Conventional Radiography* 1273
  - Computed Tomography* 1278
  - Scintigraphy* 1278
  - Magnetic Resonance Imaging* 1278
- Imaging Techniques for Measurement of Bone Mineral Density 1278
  - Radionuclide and X-ray Techniques* 1278
  - Quantitative Ultrasound Technique* 1279

#### Practical Points to Remember 1281

#### Suggested Readings 1282



**Chapter 27****Osteoporosis, Rickets, and Osteomalacia 1283****Osteoporosis 1283**

- Generalized Osteoporosis 1283
- Localized Osteoporosis 1289

**Rickets and Osteomalacia 1289**

- Rickets 1289
  - Infantile Rickets* 1289
  - Vitamin D-Resistant Rickets* 1290
- Osteomalacia 1291
- Renal Osteodystrophy 1293

**Practical Points to Remember 1296****Suggested Readings 1296****Chapter 28****Hyperparathyroidism 1297**

- Pathophysiology 1297
- Physiology of Calcium Metabolism 1297
- Clinical Features 1298
- Imaging Features 1298
- Pathology 1301
- Complications 1304
- Practical Points to Remember 1304
- Suggested Readings 1304

**Chapter 29****Paget Disease 1305**

- Pathophysiology and Clinical Features 1305
- Imaging Features 1305
- Pathology 1309
- Differential Diagnosis 1309
- Complications 1309
  - Pathologic Fractures 1309
  - Degenerative Joint Disease 1309
  - Neurologic Complications 1309
  - Neoplastic Complications 1313

**Orthopaedic and Medical Management 1313****Practical Points to Remember 1327****Suggested Readings 1327****Chapter 30****Miscellaneous Metabolic and Endocrine Disorders 1329****Familial Idiopathic Hyperphosphatasia 1329**

- Clinical Features 1329
- Imaging Features 1329
- Differential Diagnosis 1329

**Acromegaly 1329**

- Clinical Features 1329
- Imaging Features 1329

**Gaucher Disease 1333**

- Classification and Clinical Features 1333
- Imaging Features 1333
- Complications 1334
- Treatment 1334

**Tumoral Calcinosis 1334**

- Pathophysiology and Clinical Features 1334
- Imaging Features 1337
- Treatment 1337

**Hypothyroidism 1337**

- Pathophysiology and Clinical Features 1337
- Imaging Features 1338
- Complications 1340

**Scurvy 1340**

- Pathophysiology and Clinical Features 1340
- Imaging Features 1340
- Differential Diagnosis 1340

**Practical Points to Remember 1342****Suggested Readings 1342****Part VII****CONGENITAL AND DEVELOPMENTAL ANOMALIES 1343****Chapter 31****Imaging Evaluation of Skeletal Anomalies 1345**

- Classification 1345
- Imaging Modalities 1345
- Practical Points to Remember 1359
- Suggested Readings 1359

**Chapter 32****Anomalies of the Upper and Lower Limbs 1360****Anomalies of the Shoulder Girdle and Upper Limbs 1360**

- Congenital Elevation of the Scapula 1360
- Dentate Scapula 1360
- Madelung Deformity 1360

**Anomalies of the Pelvic Girdle and Hip 1360**

- Congenital Hip Dislocation (Developmental Dysplasia of the Hip) 1360

*Radiographic Features 1366**Measurements 1366**Arthrography and Computed Tomography 1367**Ultrasound 1370**Magnetic Resonance Imaging 1370**Classification 1370**Treatment 1370**Complications 1375***Proximal Femoral Focal Deficiency 1375***Classification and Imaging Features 1375**Treatment 1375***Legg-Calvé-Perthes Disease 1376***Imaging Features 1376**Classification 1378**Differential Diagnosis 1380**Treatment 1380***Slipped Capital Femoral Epiphysis 1380***Imaging Features 1380**Treatment and Complications 1380*

**Anomalies of the Lower Limbs 1385**

- Congenital Tibia Vara 1385
  - Imaging Features and Differential Diagnosis* 1386
  - Classification* 1387
  - Treatment* 1387
- Dysplasia Epiphysealis Hemimelica 1389
  - Imaging Features and Treatment* 1389
- Talipes Equinovarus 1389
  - Measurements and Radiographic Features* 1389
  - Treatment* 1393
- Congenital Vertical Talus 1393
  - Imaging Features* 1393
  - Treatment* 1394
- Tarsal Coalition 1395
  - Calcaneonavicular Coalition* 1395
  - Talonavicular Coalition* 1395
  - Talocalcaneal Coalition* 1397

**Practical Points to Remember 1401**

**Suggested Readings 1402**

**Chapter 33**

---

**Scoliosis and Anomalies with General Affliction of the Skeleton 1404**

**Scoliosis 1404**

- Idiopathic Scoliosis 1404
- Congenital Scoliosis 1404
- Miscellaneous Scolioses 1404
- Imaging Evaluation 1404
  - Measurements* 1404
- Treatment 1409

**Anomalies with General Affliction of the Skeleton 1412**

- Neurofibromatosis 1412
- Osteogenesis Imperfecta 1415
  - Classification* 1416
  - Imaging Features* 1418
  - Differential Diagnosis* 1418
  - Treatment* 1418

- Achondroplasia 1418
  - Clinical Features* 1418
  - Imaging Features* 1418
  - Complications* 1423
  - Differential Diagnosis* 1423
- Mucopolysaccharidoses 1423
- Fibrodysplasia Ossificans Progressiva (Myositis Ossificans Progressiva) 1423
  - Clinical Features* 1423
  - Imaging Features* 1423
  - Pathology* 1424
- Sclerosing Dysplasias of Bone 1424
  - Osteopetrosis* 1426
  - Pyknodysostosis (Pycnodysostosis)* 1433
  - Enostosis, Osteopoikilosis, and Osteopathia Striata* 1436
  - Progressive Diaphyseal Dysplasia (Camurati-Engelmann Disease)* 1439
  - Hereditary Multiple Diaphyseal Sclerosis (Ribbing Disease)* 1440
  - Endosteal Hyperostosis (Hyperostosis Corticalis Generalisata)* 1444
  - Dysosteosclerosis* 1445
  - Pyle Disease* 1446
  - Craniometaphyseal Dysplasia* 1446
  - Melorheostosis* 1446
  - Craniodiaphyseal Dysplasia* 1451
  - Hyperostosis Generalisata with Striations of Bones* 1451
  - Other Mixed Sclerosing Dysplasias* 1451

**Practical Points to Remember 1453**

**Suggested Readings 1454**

*Index* 1456