

## Contents

<i>Foreword</i>	xxiii
<i>Preface</i>	xxvii
<i>Acknowledgments</i>	xxix
<b>1 Embryology and Anatomy of the Hip Joint</b>	<b>1</b>
<i>K. Mohan Iyer</i>	
1.1 Embryology of the Hip Joint	1
1.1.1 The Fibrous Capsule	3
1.1.2 The Acetabular Labrum	3
1.1.3 Ligament of the Head of the Femur	3
1.1.4 The Iliofemoral Ligament	3
1.2 Anatomical Relations of the Hip Joint	4
1.3 Movements of the Hip	4
1.4 Applied Anatomy	5
1.5 Blood Supply of the Hip Joint	6
1.5.1 Anatomy of the Blood Supply	6
1.5.2 Changes with Age	7
<b>2 Biomechanics of the Hip Joint</b>	<b>9</b>
<i>Ram Ravishankar</i>	
2.1 Functional Anatomy	10
2.1.1 Bony Structure	11
2.1.2 Articular Cartilage	12
2.1.3 Acetabular Labrum	13
2.1.4 Capsule, Ligaments, and Musculature	13
2.2 Kinematics and Kinetics	15
2.2.1 Forces Acting on the Hip Joint	16
2.2.2 Biomechanics Applied to Total Hip Arthroplasty	23

## viii | Contents

2.2.3	Pathological Biomechanics of the Hip	26
2.2.3.1	Dysplastic hips, coxa vara, and coxa valga	26
2.2.3.2	Femoroacetabular impingement	28
2.2.3.3	Labral tears, capsular laxity, and chronic instability	29
<b>3</b>	<b>Clinical Examination of the Hip Joint</b>	<b>33</b>
	<i>K. Mohan Iyer</i>	
3.1	Inspection	33
3.2	Palpation	34
3.3	Range of Motion	35
3.3.1	Active Range of Movements	36
3.3.2	Passive Range of Movements	36
3.4	Neurological Examination	37
3.4.1	Muscles	37
3.4.2	Sensory Testing	38
3.5	Special Tests	39
3.5.1	Trendelenburg's Test	39
3.5.2	Limb Length Discrepancy	39
3.5.2.1	True limb length discrepancy	40
3.5.2.2	Apparent limb length discrepancy	40
3.5.3	Ober's Test	40
3.5.4	Important Tests for Congenital Dislocation of the Hip	40
3.5.4.1	Ortolani click	40
3.5.4.2	Telescoping	41
3.5.4.3	Adduction contracture	41
3.5.5	Proximal Focal Femoral Deficiency	41
3.5.5.1	Treatment	41
<b>4</b>	<b>Imaging of the Hip Joint</b>	<b>43</b>
	<i>Rajesh Botchu and Ram Vaidhyanath</i>	
4.1	Introduction	43
4.1.1	Anteroposterior Pelvic Radiograph	45
4.1.2	Lateral View	46
4.1.3	Frog Leg Lateral View	47
4.1.4	Judet View	47

4.1.5	Acetabulum	47
4.2	MRI Anatomy of the Hip	49
4.2.1	Muscles and Tendons	51
4.3	Labrum	57
<b>5</b>	<b>Disorders of the Hip in Children and Adolescents</b>	<b>59</b>
	<i>K. Vinodh, Sughran Banerjee, K. Mohan Iyer, Vijaya Kumar Kempanna, Robert Jennings, and Sharad Goyal</i>	
5.1	Septic Arthritis of the Hip in Infants and Children	59
5.1.1	Epidemiology	60
5.1.2	Aetiopathology	61
5.1.3	Causative Organisms	62
5.1.4	Clinical Features	63
5.1.5	Investigations	64
5.1.6	Imaging Studies	64
5.1.7	Joint Aspiration	68
5.1.8	Differential Diagnosis	69
5.1.9	Treatment	70
5.1.9.1	Antibiotics	71
5.1.10	Prognosis	72
5.2	Complications and Treatment of Complications in Children	72
5.2.1	Chondrolysis	74
5.2.2	Dislocation with Capital Femoral Epiphysis Intact	75
5.2.2.1	Sequelae related to AVN of the CFE and growth plate damage	76
5.2.2.2	Treatment options for Hunka types	78
5.2.3	Ilizarov's Reconstruction	83
5.3	DDH or Congenital Dislocation of the Hip Joint	86
5.3.1	Incidence	86
5.3.2	Pathology	87
5.3.3	Diagnosis	87
5.3.4	Graf Angles	88
5.3.4.1	Measurements	88
5.3.5	Management	89
5.3.5.1	Birth to 6 months	89
5.3.5.2	6–18 months	90

## x | Contents

5.3.5.3	18–30 months	90
5.3.5.4	>4 years old	91
5.4	The Irritable Hip	93
5.4.1	Symptoms of the Irritable Hip	93
5.4.2	Management	94
5.4.3	Key Points to Remember	95
5.5	Coxa Vara	95
5.5.1	Treatment	96
5.5.2	Epiphyseal Coxa Vara	96
5.5.3	Diagnosis	97
5.5.4	Differential Diagnosis	97
5.5.5	Prognosis	97
5.5.6	Treatment	98
5.5.6.1	Early cases with a minimal slip	98
5.5.6.2	Cases with displacement	98
5.5.6.3	Treatment of the healed case in a young adult	99
5.5.6.4	Treatment of older cases with arthritis	99
5.6	Femoral Anteversion	99
5.6.1	Diagnosis	100
5.6.2	Treatment	101
5.7	Slipped Capital Femoral Epiphysis	101
5.7.1	What Is It?	101
5.7.2	Introduction	102
5.7.3	Who Are at Most Risk?	102
5.7.4	Risk Factors	103
5.7.5	Aetiology	103
5.7.6	Pathology	105
5.7.7	Classification	105
5.7.8	Clinical Features	107
5.7.9	Physical Examination	107
5.7.10	Investigations	107
5.7.10.1	CT scan	110
5.7.10.2	Ultrasound scan	110
5.7.10.3	Bone scan	110
5.7.10.4	MRI scan	110
5.7.11	Treatment	110

5.7.11.1	Osteotomies	113
5.7.12	Complications	114
5.7.12.1	Valgus slip	115
5.8	Legg–Calvé–Perthes Disease	115
5.8.1	Epidemiology	116
5.8.2	Risk Factors	117
5.8.3	Aetiology	117
5.8.4	Pathogenesis	119
5.8.5	Classification	119
5.8.5.1	Catterall classification	119
5.8.5.2	Salter–Thompson classification	120
5.8.5.3	Herring lateral pillar classification	120
5.8.5.4	Waldenstrom’s radiographic stages	121
5.8.5.5	Stulberg classification	121
5.8.6	Clinical Features with Physical Examination	122
5.8.7	Differential Diagnosis	122
5.8.8	Investigations	123
5.8.9	Treatment	124
5.8.9.1	Nonoperative management	124
5.8.9.2	Indications for nonoperative management	124
5.8.9.3	Operative management	124
5.8.9.4	Types of residual deformity	127
5.8.10	Late Complications of the Disease	128
5.8.11	Natural Course of the Disease	128
5.8.12	Prognosis	128
<b>6</b>	<b>Injuries around the Hip Joint, Including Periprosthetic Fractures</b>	<b>139</b>
	<i>K. Mohan Iyer, Vijaya Kumar Kempanna, Sharad Goyal, Shibu Krishnan, and Gurdeep Singh Biring</i>	
6.1	Fractures of the Neck of the Femur in Children	139
6.1.1	Classification of Femoral Neck Fractures	140
6.1.2	Treatment	142
6.2	Fractures of the Neck of the Femur in Adults	145
6.2.1	Introduction	145
6.2.2	Risk Factors	145

## xii | Contents

6.2.3	Bony Trabeculae of the Proximal Femur (Singh Index)	146
6.2.4	Mechanism of Injury	147
6.2.5	Epidemiology	148
6.2.6	Fracture Classification	148
6.2.6.1	Intracapsular fractures	148
6.2.6.2	Extracapsular fractures	150
6.2.7	Clinical Presentation	155
6.2.8	Diagnosis	155
6.2.9	Management of Femoral Neck Fractures	156
6.2.9.1	Assessment and Management in the Emergency Department	156
6.2.10	Definitive Treatment of Intracapsular Femoral Neck Fracture	156
6.2.10.1	Nondisplaced intracapsular femoral neck fracture	156
6.2.10.2	Displaced intracapsular femoral neck fracture in the elderly	158
6.2.10.3	Displaced intracapsular femoral neck fracture in young adults	161
6.2.11	Treatment of Intertrochanteric Hip Fractures	162
6.2.11.1	Extramedullary devices	163
6.2.11.2	Intramedullary device	164
6.2.11.3	Arthroplasty	165
6.2.12	Treatment of Subtrochanteric Hip Fractures	166
6.2.12.1	Cephalomedullary nail	166
6.2.12.2	Fixed-angle blade plate	167
6.2.12.3	Atypical subtrochanteric fractures	167
6.2.13	Complications of Femoral Neck fractures	167
6.2.14	Stress Fractures of the Femoral Neck	168
6.2.14.1	Diagnosis	168
6.2.14.2	Treatment	168
6.2.15	Secondary Prevention of Fragility Fractures	169
6.3	Dislocations and Fractures of the Hip Joint	169
6.4	Periprosthetic Fractures of the Hip Joint	171
6.4.1	Introduction	171
6.4.2	Epidemiology	172
6.4.2.1	Risk factors	172

6.4.3	Classification of Periprosthetic Fractures	173
6.4.3.1	Fractures based on anatomical site	173
6.4.3.2	Fractures based on timing	174
6.4.4	Investigations	177
6.4.5	Treatment	177
6.4.5.1	Nonoperative treatment	177
6.4.5.2	Surgical management of periprosthetic acetabular fractures	177
6.4.5.3	Surgical considerations in the management of periprosthetic femoral fractures	178
<b>7</b>	<b>The Adult Hip and Its Disorders</b>	<b>193</b>
	<i>K. Mohan Iyer</i>	
7.1	Osteoarthritis of the Hip Joint	193
7.1.1	Pathology	194
7.1.2	Symptoms	194
7.1.3	Treatment	195
7.1.3.1	Local treatment	195
7.1.3.2	Operative treatment	196
7.1.3.3	Surgical procedures	196
7.1.3.4	Prostheses	198
7.2	Rheumatoid Arthritis of the Hip Joint	201
7.2.1	Juvenile Rheumatoid Arthritis	202
7.3	Tuberculosis of the Hip Joint	203
7.3.1	Pathology	203
7.3.2	Symptoms	204
7.3.3	Signs	204
7.3.4	Radiological Examination	205
7.3.5	Diagnosis	205
7.3.5.1	Differential diagnoses	206
7.3.6	Prognosis	207
7.3.7	Treatment	207
7.3.7.1	General treatment	207
7.3.7.2	Local treatment	207
7.3.7.3	Stage of convalescence	209
7.3.7.4	Operative treatment	209
7.3.7.5	Arthrodesis	210

## xiv | Contents

7.3.7.6	Secondary operations	211
7.4	Metabolic and Nutritional Disorders	211
7.5	Haemophilia	213
7.5.1	Treatment	216
7.5.2	Clinical Manifestations of Bleeding	217
7.5.2.1	Acute haemarthrosis	217
7.5.2.2	Chronic haemarthrosis	217
7.5.2.3	Treatment	217
7.5.3	Fractures in Haemophilia	217
7.5.4	Surgery in Haemophiliacs	218
7.6	Paget's Disease of the Hip Joint	218
7.6.1	Treatment	219
7.7	Meralgia Paresthetica	219
7.8	Bursitis in the Hip Region	219
7.8.1	Trochanteric Bursitis (Subgluteal Bursa)	219
7.8.1.1	Treatment	220
7.8.2	Psoas Bursitis	220
7.8.2.1	Treatment	221
7.8.3	Snapping Hip	221
7.9	Avascular Necrosis of the Hip Joint	222
7.9.1	Staging	223
7.9.2	Clinical Features	223
7.9.3	Investigations	224
7.9.4	Treatment	224
<b>8</b>	<b>Total Hip Arthroplasty</b>	<b>227</b>
	<i>Sharad Goyal, Edward A. O. Lindisfarne, David Ball, and Ardeshir Bonshahi</i>	
8.1	Primary Total Hip Arthroplasty	228
8.1.1	History	228
8.1.1.1	Chronology	228
8.1.2	Indications	230
8.1.3	Symptoms of Hip Pathology	231
8.1.4	Signs of Hip Pathology	233
8.1.5	Radiographic Features of Degenerative Hip Joint Disease	233
8.1.6	Investigations	234
8.1.7	Treatment	234



8.1.7.1	Initial management	234
8.1.7.2	Medical management	235
8.1.7.3	Surgical management	235
8.1.8	Components of Hip Replacement	235
8.1.9	Types of Hip Replacements	236
8.1.9.1	Cemented joint replacement	236
8.1.9.2	Cementless or uncemented joint replacement	237
8.1.9.3	Hybrid replacement	237
8.1.10	Types of Materials Used in Joint Replacement Surgery	237
8.1.11	Surgical Approaches	241
8.1.11.1	Transgluteal (Hardinge) approach	241
8.1.11.2	Posterior approach	242
8.1.11.3	Charnley approach	242
8.1.11.4	Minimally invasive technique	243
8.1.11.5	Anterior supine intermuscular approach	243
8.1.12	Complications	244
8.2	Revision Hip Arthroplasty	247
8.2.1	Introduction and the Burden of Revision Hip Surgery	247
8.2.2	Indications for Revision Surgery	249
8.2.3	Mechanisms of Failure	249
8.2.3.1	Aseptic loosening	249
8.2.3.2	Septic loosening	254
8.2.3.3	Stem fracture	256
8.2.3.4	Ceramic-bearing fractures	257
8.2.3.5	Dislocation	258
8.2.3.6	Periprosthetic fractures and revision surgery	259
8.2.3.7	Failure of resurfacing hip arthroplasty	261
8.2.4	Evaluation of the Failed Hip Replacement	262
8.2.5	Classifications of Bone Loss	263
8.2.6	Surgical Approaches	264
8.2.7	Removal of Implants	267
8.2.7.1	Removal of uncemented acetabular cups	267

8.2.7.2	Removal of cemented acetabular cups	268
8.2.7.3	Removal of cemented femoral stems and cement	268
8.2.7.4	Removal of uncemented femoral stems	270
8.2.8	Acetabular Reconstruction: Management of Bone Loss	270
8.2.8.1	Impaction bone grafting	270
8.2.8.2	Impaction bone grafting of the acetabulum	270
8.2.8.3	Revision of uncemented acetabular components	271
8.2.9	Femoral Reconstruction	273
8.2.9.1	Cemented femoral revision	273
8.2.9.2	Uncemented femoral revision	274
8.2.10	Single-Stage or Two-Stage Revision for Infection	275
8.2.11	Complications and Outcomes of Revision Surgery	278
8.2.12	Revision Hip Arthroplasty: Case Example	280
8.2.12.1	Revision procedure	281
<b>9</b>	<b>Girdlestone Arthroplasty</b>	<b>311</b>
	<i>K. Mohan Iyer</i>	
9.1	Technique	312
9.1.1	Position of the Patient	312
9.1.2	Exposure	312
9.2	Postoperative Management	313
<b>10</b>	<b>Osteotomies around the Hip Joint</b>	<b>315</b>
	<i>K. Mohan Iyer</i>	
10.1	Biomechanics of the Hip Joint	315
10.2	Classification of Osteotomies around the Hip Joint	316
10.2.1	Classification Based on Indications	316
10.2.2	Classification Based on Location	316
10.2.3	Classification Based on Relief of Pain	317
10.2.4	Classification Based on Neurologic Conditions	317
10.3	Salter's Osteotomy	317

10.4	Pemberton's Osteotomy	318
10.5	Triple Innominate Osteotomy (Steel)	319
10.6	Ganz Osteotomy: Periacetabular Osteotomy	319
10.7	Shelf Procedure (Staheli)	320
10.8	Chiari Osteotomy	320
10.9	Schanz Osteotomy (Low S/T Osteotomy)	321
10.10	Lorenz Bifurcation Osteotomy	321
10.11	Osteotomy for Coxa Vara	322
	10.11.1 Osteotomies for Pain Relief in Osteoarthritis	322
10.12	Femoral Varus Osteotomy	323
10.13	Femoral Valgus Osteotomy	323
10.14	Blount Osteotomy	324
	10.14.1 Blount Abduction Osteotomy	325
	10.14.2 Blount Adduction Osteotomy	325
10.15	Osteotomy to Correct Unstable Intertrochanteric Fractures	325
10.16	Corrective Osteotomies	326
	10.16.1 Oblique Osteotomy	326
10.17	McMurray's Osteotomy	327
10.18	Dickson's High Geometric Osteotomy	327
10.19	Girdlestone Osteotomy	327
10.20	Transtrochanteric Anterior Rotational Osteotomy of Sugioka	328
10.21	Osteotomy in Perthes Disease	328
<b>11</b>	<b>Hip Resurfacing</b>	<b>331</b>
	<i>Michael C. Moss, Sharad Goyal, and Gyanendra Kumar Singh</i>	
11.1	Introduction	331
11.2	Indications	333
11.3	Contraindications	333
	11.3.1 Absolute	333
	11.3.2 Relative	333
11.4	Patient's Perspectives	334
11.5	Theoretical Advantages of Hip Resurfacing	334
11.6	Current Concerns	335
11.7	Answers to Patient's Perspectives	338

## xviii | Contents

11.8	Operative Technique of MoM Implants and Considerations	339
11.9	Assessing a Patient of MoM Hip Resurfacing in the Clinic	340
11.9.1	Investigations	340
11.10	Conclusion	342
<b>12</b>	<b>Minimally Invasive Total Hip Replacement</b>	<b>345</b>
	<i>Dayanand Manjunath and Deepak Shivanna</i>	
12.1	Introduction	345
12.2	Potential Advantages for the Patient	349
12.3	Potential Advantages to Health Care Providers	350
12.4	Patient Selection and Indications	350
12.5	Instruments for Minimally Invasive Surgery	351
12.5.1	Direct Anterior Approach	351
12.5.2	Anterolateral Approach	354
12.5.3	Posterior Approach	354
<b>13</b>	<b>Computer Navigation in Hip Arthroplasty</b>	<b>361</b>
	<i>Wasim Khan</i>	
13.1	Introduction	362
13.2	Limitations of Conventional Alignment Jigs	363
13.3	Types of Computer Navigation Systems	364
13.4	Computer Navigation in Total Hip Arthroplasty	365
13.5	Computer Navigation in Total Hip Resurfacing	367
13.6	Limitations of Computer Navigation Systems	368
13.7	Conclusion	369
<b>14</b>	<b>Neoplastic Conditions around the Hip</b>	<b>373</b>
	<i>Ram Vaidhyanath and Rajesh Botchu</i>	
14.1	Introduction	373
14.2	Osteogenic Tumours	374
14.2.1	Bone Islands	374
14.2.2	Osteoid Osteoma and Osteoblastoma	375
14.2.3	Conventional Osteosarcoma	377
14.2.4	Surface Osteosarcoma	377
14.2.5	Periosteal Osteosarcoma	378
14.2.6	Telangiectatic Osteosarcoma	379

14.2.7	Low-Grade Osteosarcoma	379
14.2.8	Secondary Osteosarcoma	380
14.2.9	Small-Cell Osteosarcoma	380
14.3	Ewing's Sarcoma	381
14.4	Cartilage Tumours	381
14.4.1	Osteochondroma	381
14.4.2	Chondroblastoma	383
14.4.3	Chondrosarcoma	383
14.5	Giant-Cell Tumour	385
14.6	Fibrogenic and Fibrocystic Tumours	386
14.6.1	Fibrous Cortical Defect	386
14.6.2	Desmoplastic Fibroma/Benign Fibrohistiocyoma	387
14.6.3	Malignant Fibrohistiocyoma	387
14.6.4	Aneurysmal Bone Cyst	388
14.6.5	Unicameral Bone Cyst	388
14.6.6	Fibrous Dysplasia	389
14.6.7	Angiosarcoma	390
14.6.8	Haemangioma	391
14.7	Myeloma	392
14.8	Lymphoma	393
14.9	Metastasis	394
14.10	Brown Tumour	395
14.11	Osteomyelitis	395
14.12	Fractures	397
14.13	Stress Fractures	397
14.14	Myositis Ossificans	398
14.14.1	ALVAL	399
14.15	Paget Disease	400
14.16	Soft-Tissue Sarcoma	401
14.17	Chordoma	402
<b>15</b>	<b>Arthroscopy of the Hip</b>	<b>411</b>
	<i>Gurdeep Singh Biring</i>	
15.1	Anatomy	412
15.1.1	Anatomy: Layered Approach to the Hip	414
15.2	Important Aspects of the History	415
15.2.1	Relevant Points in the History	415

## xx | Contents

15.3	Clinical Examination	417
15.4	Imaging of the Hip	422
15.5	Indications/Contraindications for Hip Arthroscopy by Layer	426
15.5.1	Overview	426
15.5.2	Layer 1	426
15.5.2.1	Arthroscopic FAI indications	427
15.5.2.2	Arthroscopic relative and absolute contraindications	429
15.5.3	Layer 2	429
15.5.3.1	Labral tears	429
15.5.3.2	Capsular injuries	432
15.5.3.3	Ligamentum teres tears	433
15.5.4	Layer 3	434
15.5.4.1	Anterior enthesopathy	434
15.5.4.2	Posterior enthesopathy	435
15.5.4.3	Lateral enthesopathy	436
15.5.4.4	Medial enthesopathy	436
15.5.5	Layer 4	437
15.5.5.1	Piriformis syndrome	437
15.5.5.2	Sciatic nerve entrapment	438
15.6	Hip Arthroscopy: The Technical Aspects of the Procedure	439
15.6.1	Patient Positioning	440
15.6.1.1	Supine	440
15.6.1.2	Lateral	441
15.6.2	Equipment	441
15.6.3	Portals	443
15.6.3.1	Central compartment	443
15.6.3.2	Peripheral compartment	444
15.6.3.3	Peritrochanteric compartment	445
15.6.4	Operative Technique	445
15.6.4.1	Anaesthesia	445
15.6.4.2	Equipment	445
15.6.4.3	Prepping and draping	447
15.6.4.4	Portal placement	448
15.6.5	Systematic Arthroscopic Assessment of the Central and Peripheral Compartments	448

15.6.5.1	Central compartment	448
15.6.5.2	Peripheral compartment	449
15.7	Common Interventions	449
15.7.1	Surgical Technique for Labral Tears and FAI	
	Surgery	449
15.7.1.1	Microfracture	451
15.7.1.2	Loose bodies	453
15.7.2	Surgical Technique for Peritrochanteric	
	Space Pathology	453
15.7.2.1	Gluteus medius repair	453
15.7.2.2	ITB release	453
15.7.2.3	Postoperative regime	453
15.8	Specific Protocols	454
15.9	Complications	456
15.9.1	Categories	457
15.10	Revision Surgery	459
15.11	Outcomes Following Primary Surgery	460
15.12	Summary	460
	<i>Index</i>	463