
Contents

1	Vascular Deficiency	1
1.1	Introduction	1
1.2	Vascular Anatomy of the Physis	1
1.2.1	Epiphyseal Arteries	2
1.2.2	Metaphyseal and Intramedullary Arteries	4
1.2.3	Periosteal Arteries	9
1.2.4	Normal Physeal Growth	9
1.2.5	Normal Physiologic Physeal Closure	9
1.2.6	Premature Physeal Closure	10
1.3	Vascular Deficiency Due to Reduced Quantity	10
1.3.1	Arterial Disruption	11
1.3.2	Arterial Ligation	14
1.3.3	Arterial Catheterization	14
1.3.4	Arterial Injection	18
1.3.5	Fluid Extravasation in Soft Tissues	18
1.3.6	Interosseous Infusion	18
1.3.7	Compartment Syndrome	18
1.3.8	Diaphyseal Fracture	18
1.3.9	Periosteal Stripping	27
1.3.10	Joint Dislocation	27
1.3.11	Extremity Traction	27
1.3.12	Fixation Bandages	27
1.3.13	Developmental Dislocation of the Hip	29
1.3.14	Perthes Disease	31
1.3.15	Transplantation of the Physis	32
1.4	Vascular Deficiency Due to Reduced Quality	32
1.4.1	Sickle Cell Anemia	33
1.4.2	Thalassemia Major (Cooley's Anemia)	40
1.4.3	Meningococcemia	40
1.4.4	Purpura Fulminans	41
1.4.5	Other Conditions	42
1.5	Physeal Cupping	42
1.6	Author's Perspective	46
	References	47

2	Disuse	53
2.1	Introduction	53
2.2	Tuberculosis	53
2.3	Poliomyelitis	54
2.4	Diaphyseal Fracture	57
2.5	Developmental Dislocation of the Hip	61
2.6	Perthes Disease	61
2.7	Osteomyelitis	61
2.8	Slipped Capital Femoral Epiphysis	61
2.9	Chemically Induced Immobilization	62
2.10	Author's Perspective	62
	References	62
3	Infection	65
3.1	Introduction	65
3.2	Metaphyseal Osteomyelitis	65
3.2.1	The Organism	65
3.2.2	Age of the Patient	66
3.2.3	Pathogenesis	66
3.2.4	Pathologic Anatomy	70
3.2.5	The Bone Involved	77
3.2.6	Diagnosis	77
3.2.7	Treatment of Infection	77
3.2.8	Treatment of Physeal Arrest	79
3.2.9	Stimulation of Growth	80
3.2.10	Metaphyseal-Equivalent Osteomyelitis	80
3.3	Epiphyseal Osteomyelitis	83
3.3.1	Acute	83
3.3.2	Subacute	84
3.3.3	Epiphyseal Disappearance and Regeneration	84
3.4	Physeal Chondritis	86
3.5	Transphyseal Osteomyelitis	86
3.6	Subacute Osteomyelitis	94
3.7	Chronic Osteomyelitis	95
3.8	Chronic Recurrent Multifocal Osteomyelitis	95
3.9	Septic Arthritis	96
3.9.1	Monoarticular Septic Arthritis	97
3.9.2	Multiarticular Septic Arthritis	106
3.10	Author's Perspective	109
	References	109

4	Tumor	115
4.1	Introduction	115
4.2	Benign Bone Tumors	115
4.2.1	Solitary Bone Cyst	115
4.2.2	Aneurysmal Bone Cyst	122
4.2.3	Osteochondroma	125
4.2.4	Enchondroma	140
4.2.5	Chondroblastoma	141
4.2.6	Giant Cell Tumor	142
4.2.7	Langerhan's Cell Histiocytosis	142
4.2.8	Osteoid Osteoma and Osteoblastoma	143
4.2.9	Focal Fibrocartilaginous Dysplasia	144
4.2.10	Fibrous Dysplasia of Bone	144
4.2.11	Miscellaneous	145
4.2.12	Author's Perspective	149
4.3	Malignant Bone Tumors	151
4.3.1	Osteosarcoma	151
4.3.2	Ewing Sarcoma	158
4.3.3	Chondrosarcoma	159
4.3.4	Lymphoma of Bone	159
4.3.5	Author's Perspective	159
4.4	Soft Tissue Tumors	159
4.5	Tumor Induced Rickets	161
	References	163
5	Metabolic	173
5.1	Introduction	173
5.2	Nutrition	173
5.2.1	General Nutritional Deprivation	173
5.2.2	Vitamin A Deficiency	174
5.2.3	Vitamin A Excess	174
5.2.4	Vitamin C Deficiency (Scurvy)	174
5.2.5	Vitamin D Deficiency (Rickets)	175
5.3	Endocrine	176
5.3.1	Slipped Capital Femoral Epiphysis (SCFE)	176
5.4	Medications	181
5.4.1	Aminonucleoside	181
5.4.2	Bisphosphonates	182
5.4.3	2-Butoxyethanol	182
5.4.4	Calcitriol	182
5.4.5	Corticosteroids	183
5.4.6	Deferoxamine	183
5.4.7	Etretinate	183
5.4.8	Isotretinon (13-cis-Retinoic Acid)	186
5.4.9	Papain	186

5.4.10	¹⁵³ Sm-Ethylenediaminetetramethylene Phosphonate (¹⁵³ Sm-EDTMP)	186
5.4.11	Tetracycline	186
5.5	Chemotherapy	187
5.6	Chronic Renal Failure	188
	References	190
6	Neural	195
6.1	Introduction	195
6.2	Peripheral Nerve Injury	195
6.2.1	Peripheral Denervation	195
6.2.2	Brachial Plexus Palsy	196
6.2.3	Lumbar Sympathetic Ganglionectomy	196
6.3	Spinal Cord Injury	196
6.3.1	Spinal Cord Traumatic Injury	196
6.3.2	Spinal Cord Nontraumatic Injury	198
6.4	Brain Injury	206
6.4.1	Physcal Growth in Hemiplegic Patients	206
6.4.2	Physcal Disruption in Quadriplegic Patients	207
6.5	Congenital Insensitivity to Pain	208
	References	216
7	Cold Injury (Frostbite)	219
7.1	Introduction	219
7.2	Human Involvement	219
7.2.1	Clinical Aspects	219
7.2.2	Imaging Evaluation	219
7.2.3	Differential Diagnosis	220
7.2.4	Epidemiology	220
7.2.5	Pathological Mechanisms	222
7.2.6	Management	223
7.3	Animal Research	223
7.4	Author's Perspective	223
	References	223
8	Heat Injury (Burns)	225
8.1	Introduction	225
8.2	Human Involvement	225
8.2.1	Clinical Aspects	225
8.2.2	Pathological Mechanism	225
8.2.3	Management	226

8.3	Animal Research	226
8.4	Author's Perspective	227
	References	227
9	Electric Injuries	229
9.1	Introduction	229
9.2	Electric Current	229
9.2.1	Clinical Aspects	229
9.2.2	Roentgenographic Studies	229
9.2.3	Pathological Mechanism	229
9.2.4	Management	230
9.3	Lightning	230
9.4	Diathermy, Microwave	231
9.5	Author's Perspective	231
	References	231
10	Compression	233
10.1	Introduction	233
10.2	Continuous Compression – Human Involvement	233
10.2.1	Pathophysiologic Mechanism of Injury	233
10.2.2	Continuous Active Compression	234
10.2.3	Continuous Passive Compression	236
10.3	Continuous Compression – Animal Research	246
10.3.1	Pathophysiologic Mechanism of Injury	246
10.3.2	Histologic Studies	250
10.3.3	Amount of Compression	250
10.3.4	Duration of Compression	250
10.3.5	Direction of Pressure Applied	250
10.3.6	Periosteal Tether	251
10.3.7	Staples	251
10.3.8	Transphyseal Threaded Screws and Pins	251
10.3.9	Crossed Smooth Metallic Pins	252
10.3.10	Biodegradable Screws and Crossed Pins	252
10.3.11	Absorbable Filament	253
10.3.12	Surgical Bone Lengthening	253
10.3.13	Spine Fusion	253
10.3.14	Tensioned Soft Tissue Grafts	253
10.3.15	Compensatory Growth	253
10.4	Acute Compression – Human Involvement	253
10.4.1	The Concept	253
10.4.2	The Compression Concept Challenged	256
10.4.3	Clinical Support for the S-H Type 5 Compression Injury Concept	256

10.4.4	Alternative Mechanisms	257
10.4.5	Clinical Opposition to or Evidence Against the S-H Type 5 Compression Injury Concept	260
10.4.6	New Classifications	262
10.5	Acute Compression – Animal Research	262
10.5.1	Animal Studies Supporting the Compression Concept . . .	262
10.5.2	Animal Studies Refuting the Compression Concept	262
10.6	Author’s Perspective	263
	References	264
11	Distraction	271
11.1	Introduction	271
11.2	Human Involvement	271
11.2.1	The Procedure	271
11.2.2	Results	272
11.3	Animal Research	276
11.4	Author’s Perspective	277
	References	278
12	Stress	281
12.1	Introduction	281
12.2	Mechanism of Injury	281
12.3	Evaluation	283
12.4	Management	287
12.5	Complications	287
12.6	Author’s Perspective	287
	References	287
13	Irradiation	289
13.1	Introduction	289
13.1.1	Radiation Terminology	289
13.1.2	Radiation Effects	289
13.1.3	Side Effects and Complications	290
13.2	Diagnostic Irradiation	291
13.3	Therapeutic Irradiation; Extremities	291
13.3.1	Dose and Age Effects	296
13.3.2	Physes Involved	296
13.3.3	Side Effects	297
13.3.4	Multimodality Therapy	297
13.3.5	Management	297
13.3.6	Slipped Epiphyses	298

13.3.7	Osteochondroma (Exostosis)	299
13.3.8	Intentional Physcal Retardation of Extremity Physes	304
13.4	Therapeutic Irradiation; Head and Neck	304
13.5	Therapeutic Irradiation; Trunk	304
13.5.1	Stature Loss	305
13.5.2	Spine Deformity.	305
13.5.3	Etiology and Natural History of Spine Deformity.	305
13.5.4	Incidence of Spine Deformity	310
13.5.5	Prophylaxis	310
13.5.6	Treatment	311
13.5.7	Osteochondroma	311
13.5.8	Correction of Spine Deformity by Irradiation	312
13.6	Therapeutic Irradiation; Total Body	312
13.7	Nuclear Irradiation	312
13.8	Nuclear Imaging	313
13.9	Experimental Irradiation; Extremities.	313
13.9.1	The Effect of Radiation Dose, Fractionation and Age. . . .	313
13.9.2	The Histologic Result	314
13.9.3	Oxygen Effect	314
13.9.4	Local Hormonal Effect	315
13.9.5	Abscopal Effect	315
13.9.6	Compensatory Overgrowth	315
13.9.7	Targeted Radiotherapy	315
13.9.8	Intra-Articular Radiotherapy	315
13.9.9	Radioprotectants	315
13.10	Experimental Irradiation; Head, Neck and Trunk	315
13.11	Conclusions	316
13.12	Author's Perspective	316
	References	316
14	Light Waves	325
14.1	Phototherapy	325
14.2	Ultraviolet	325
14.3	Laser.	325
14.3.1	Human Involvement.	326
14.3.2	Animal Research	328
14.4	Author's Perspective	328
	References	328
15	Sound Waves	329
	References	330

16 Shock Waves	331
16.1 Author's Perspective	332
References	332
17 Atmospheric Pressure	333
17.1 Decreased Atmospheric Pressure	333
17.2 Increased Atmospheric Pressure	333
17.3 Author's Perspective	333
References	333
18 Oxygen	335
References	335
19 Developmental	337
19.1 Introduction	337
19.2 Knee	337
19.3 Ankle	338
19.3.1 Congenital Pseudarthrosis of the Fibula	339
19.3.2 Acquired Pseudarthrosis of the Fibula	343
19.3.3 Multiple Hereditary Osteochondromatosis	343
19.3.4 Neurologic Conditions	346
19.3.5 Scleroderma	347
19.3.6 Tibial Relative Overgrowth Compared to the Fibula	349
19.4 Wrist	349
References	353
20 Surgical	355
20.1 Introduction	355
20.2 Intentional Physeal Arrest – Humans	355
20.2.1 Physeal Arrest to Curtail Slipping of an Epiphysis (1931)	355
20.2.2 Immediate Irreversible Physeal Arrest (1933)	359
20.2.3 Temporary Reversible Physeal Arrest (1945)	361
20.3 Intentional Physeal Arrest – Animal Experiments	364
20.3.1 Resection of the Periphery of the Physis	364
20.3.2 Osteotomy Across the Physis	364
20.3.3 Curettement	364
20.3.4 Burring	364
20.3.5 Intraphyseal Drilling	364
20.3.6 Transphyseal Drilling	365
20.3.7 Longitudinal Smooth Metallic Pins, Wires, and Nails	366
20.3.8 Bone Grafts Across the Physis	366
20.3.9 Staples	366

20.3.10	Transphyseal Threaded Metallic Screws and Pins	366
20.3.11	Crossed Smooth Metallic Pins	366
20.3.12	Biodegradable Pins, Screws, and Filaments	366
20.3.13	Tensioned Soft Tissue Grafts	366
20.4	Unintentional Physeal Arrest – Human Involvement	367
20.4.1	Smooth Nails, Rods, and Prosthetic Stems	367
20.4.2	Smooth Wires and Pins	368
20.4.3	Threaded Pins and Screws	379
20.4.4	Cortical Bone Grafts	379
20.4.5	Osteotomy Across the Physis	379
20.4.6	Drilling Across the Physis	379
20.5	Unintentional Physeal Arrest – Animal Involvement	387
	References	388
21	Unknown	399
21.1	Introduction	399
21.2	Knee	399
21.3	Ankle	399
21.4	Knee and Ankle	408
21.5	Hand	408
21.6	Wrist	410
21.7	Hip	414
21.8	Author’s Perspective	414
	References	416
	Epilogue	417
	Index	419

Physeal Injury Other Than Fracture

Peterson, H.A.

2012, XXV, 428 p. 109 illus., Hardcover

ISBN: 978-3-642-22562-8