

The Basic Principles of External Skeletal Fixation

Leonid Nikolaevich Solomin
Editor

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Third Edition

Editor

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ISBN 978-3-031-91017-3 ISBN 978-3-031-91018-0 (eBook)
<https://doi.org/10.1007/978-3-031-91018-0>

1st edition: © Springer-Verlag Italia 2008

2nd edition: © Springer-Verlag Italia 2012

3rd edition: © The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2026

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This book edition is devoted to our pupils

Preface

The first edition of *Basic Principles of External Fixation* was published in Russian in 2005, in English in 2008, and in Chinese in 2012. The second edition was published in English in 2012, in Russian in 2014, and in Chinese in 2019.

This third edition has significant differences in structure and content. Firstly, it is now not restricted to the original title of “External Fixation” but has expanded considerably to encompass the changes in techniques and devices of the last decade. A significant number of chapters is devoted to the technique of acute correction of deformities with internal fixation, the combined and sequential use of external and internal fixation, and distraction with internal devices.

The focus of this edition is Limb Lengthening and Reconstruction Surgery (LLRS), which is a sub-specialty of traumatology and orthopedics. This field is expanding continually and has become a dominant area for the treatment of patients with congenital and acquired deformities of the upper and lower extremities, irrespective of whether the pathology arises from bones, joints, soft tissues, or any combination of those. LLRS is based on the Ilizarov method and its modern-day application, with the rational use of external and internal fixation, osteotomies, and operations on soft tissues (► Chap. 2). In many ways, the expansion of the title of the book “Ilizarov, LLRS and AO principles in a common framework for trauma and limb reconstruction” is connected to this.

Unlike the second edition, which has 3 parts and 36 chapters, the third edition has 7 parts, which comprise 142 chapters. Each chapter is independent and self-contained; the reader is able to become acquainted with the book by starting with any of them. Where portions of a chapter require greater explanation, the necessary cross-references are provided. To facilitate ease of use and to enable the reader to become familiar quickly, each chapter follows a system of headings that are consistent throughout: Learning Objectives, Keywords, Pearls/Pitfalls, Questions/Answers for Self-Assessment, and Further Reading.

For the reader who has little prior exposure to the concepts around external fixation, it is highly recommended that they become familiar with all the information presented in the 27 chapters of Part 1 “Basic Concepts of External Fixation.” This foundation is key to a better understanding of all subsequent six parts of this edition, which cover more advanced external skeletal fixation, limb lengthening, and reconstruction surgery. Comprehension and clear recollection of this information will not only aid in the understanding of subsequent chapters but prevent misinterpretation of the more complex concepts and subsequent incorrect application of surgical technique.

Part 2, “Acute Trauma,” comprises 28 chapters. There is information on external fixation assisted nailing and plating (EFAN/EFAP) for the treatment of fractures, the use of tubular and ring frames for damage control orthopedics (DCO) where there is interim use of external fixation prior to definitive internal or more elaborate external fixation in fractures. ► Chapters 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, and 52 cover definitive external fixation in fracture treatment: principles of constructing and mounting individual ring frames; implementation of these principles for fractures of all long bones, large joints, hands, and feet. ► Chapters 53, 54, and 55 describe in detail the use of external fixation for open fractures, including those associated with gunshot injuries. In order to solve the problem of large soft tissue defects that arise from trauma or from resection surgery, various approaches from microsurgical techniques to that of using the artificial deformity creation (ADCr) method are presented. The final chapter of Part 2 is devoted to the specifics of using external fixation for fractures in children and adolescents.

Part 3, “Basic Principles of Deformity Correction,” comprises ► Chaps. 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, and 88. The information needed for the analysis of upper and lower extremity long bone deformities and planning of correction is provided; this includes how to perform acute or gradual corrections using Ilizarov hinges together with ring external fixators. Particular attention is paid to the individualized construction and mounting of frames. The techniques of using external fixation in the spine, pelvis, hand, midfoot, and hindfoot for deformities, as well as when used for changing the shape and length of legs for aesthetic reasons, are given. Detailed information on the sequential and combined use of external and internal fixation is also given: e.g., external fixator assisted nailing/plating (EFAN/EFAP), Lengthening Over a Nail/Lengthening Along with a Plate (LON/LAP), sequential external fixation and nailing/plating (SEFaN/SEFaP) including lengthening and then nailing/plating (LATN/LATP).

Part 4, “Non-unions and Defects,” comprises 14 chapters (► Chaps. 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, and 103). For clarity and in accordance with the classifications used, a term “non-union with bone loss” is excluded. Nonunions and bone defects are considered as fundamentally different pathologies that require different approaches to treatment. Correspondingly, limb shortening is considered both as a component of deformity and as a bone defect. ► Chapter 91 describes the use of external fixation for of long bone pseudarthroses. ► Chaps. 93, 94, 95, 96, and 97 explain in detail how to build and mount individualized frames for the various options in bone transport. ► Chapter 98 discusses issues related to bone transport over the nail and along a plate (BTON/BTAP). ► Chapters 100, 101, and 102 cover various aspects of the treatment of patients with bone defects in or near the knee joint; ► Chapter 103 relates to limb reconstruction associated with the treatment of bone tumors.

As noted the use of external fixation for fractures in children are presented in ► Chap. 56. Part 5, “Children and Adolescents” (► Chaps. 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, and 114), provides features of the analysis, planning, and correction of deformities in patients of this age. Particular attention is paid to special conditions: post-traumatic deformities, Blount’s disease, osteochondromatosis, Ollier’s disease, radial club hand, congenital pseudoarthrosis of tibia, fibular hemimelia, and achondroplasia. Pelvic reconstructions in the treatment of hip dysplasia are discussed in ► Chap. 114.

Part 6, “Large Joint Pathology,” comprises 14 chapters (► Chaps. 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, and 129). ► Chapters 116 and 117 describe how individualized large joint ring frames are planned and mounted. The technique of joint distraction of the hip, ankle, and subtalar joint are discussed in ► Chaps. 118 and 128. For those patients with hip disorders but in whom there are contraindications to hip arthroplasty, the Ilizarov pelvic support osteotomy procedure, presented in ► Chap. 119, can improve the extremity function significantly. If a hip arthroplasty is prevented by a previous hip dislocation and subsequent proximal migration of the femur, a gradual distal transfer of the entire femur, before the hip replacement procedure (► Chap. 120) is undertaken, can be used. In cases where, as a result of contractures, soft tissue releases do not provide the necessary joint range of motion, the use of hinged frames can solve this problem (► Chaps. 127 and 129). The corrections of periprosthetic deformities of the hip and knee, as well as periarticular and intra-articular “osteotomies around the knee,” are presented in ► Chaps. 121, 122, 124, 125, and 126. The techniques related to elbow, wrist, and hip fusions are discussed in ► Chaps. 123 and 129.

Part 7, “Orthopedic Hexapods” (► Chaps. 130, 131, 132, 133, 134, 135, 136, 137, and 138), instructs on the use of a software-based frame for long bone deformities, including multiapical and complex midfoot and hindfoot deformities. Specific chapters are devoted to the treatment of patients with knee or ankle joints stiffness, as well as on hexapod-based lengthenings or hexapod-based bone transports performed over a nail.

This third edition, alike the two previous editions, is aimed for the clinician who wishes to step up from novice user of external fixation to an advanced proponent of the art. The coverage provided by this edition is wide-ranging and detailed so much so the authors hope that the book will be useful to both beginners and experts in the fields of trauma and LLRS.

The first edition of this book was dedicated to our parents, and the second edition to our teachers. We dedicate this third edition to our pupils and to those who will perpetuate this surgical art and write the fourth edition.

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Contents

Part 1 Basic Concepts of External Fixation

1	Introduction	5
	<i>Leonid Solomin</i>	
2	Short Historical Background	7
	<i>Stuart Green and Leonid Solomin</i>	
3	External Fixation: Main Terminology.....	29
	<i>J. Spence Reid, Vajara Phiphobmongkol, Andrey Volna, and Leonid Solomin</i>	
4	Spectrum of External Fixation.....	55
	<i>Leonid Solomin, J. Spence Reid, and Austin T. Fragomen</i>	
5	Basic Science of Fracture Healing	89
	<i>J. Spence Reid</i>	
6	Basic Science of Distraction Osteogenesis.....	101
	<i>J. Spence Reid</i>	
7	Features of Distraction Osteogenesis in Combined and Sequential Use of External Fixation and Nailing.....	113
	<i>Elena Shchepkina and Leonid Solomin</i>	
8	A Comprehensive Designation of External Fixation (CDEF)	153
	<i>Leonid Solomin and Vajara Phiphobmongkol</i>	
9	Biomechanical Principles of External Fixation: Bone Components	167
	<i>Leonid Solomin and Andrey Volna</i>	
10	Biomechanical Principles of External Fixation: Bone Fragment Reduction	177
	<i>Leonid Solomin</i>	
11	Biomechanical Principles of External Fixation: Bone Fragment Fixation	211
	<i>Leonid Solomin and Selvadurai Nayagam</i>	
12	Biomechanical Principles of External Fixation: Contradictions.....	239
	<i>Leonid Solomin and Selvadurai Nayagam</i>	
13	Atlas of Safe Zones and Optimal Positions: Principles for Development and Usage.....	247
	<i>Leonid Solomin</i>	
14	Atlas of Safe Zones and Optimal Positions: The Upper Arm	257
	<i>Leonid Solomin and Roman Injushin</i>	
15	Atlas of Safe Zones and Optimal Positions: The Ulna	269
	<i>Leonid Solomin and Pavel Kulesh</i>	

16	Atlas of Safe Zones and Optimal Positions: The Radius	283
	<i>Leonid Solomin and Pavel Kulesh</i>	
17	Atlas of Safe Zones and Optimal Positions: The Femur	297
	<i>Leonid Solomin and Maxim Andrianov</i>	
18	Atlas of Safe Zones and Optimal Positions: The Tibia.....	309
	<i>Leonid Solomin and Dmitry Mykalo</i>	
19	Atlas of Safe Zones and Optimal Positions: Foot	323
	<i>Leonid Solomin and Konstantin Ukhanov</i>	
20	Atlas of Safe Zones: Pelvis.....	349
	<i>Leonid Solomin and Alexey Runkov</i>	
21	Equipment and Instruments for Tubular Frame Construction.....	357
	<i>Vladimir Khominets, Igor Belenkiy, Denis Davydov, Leonid Brizhan, Gennadii Sergeev, and Leonid Solomin</i>	
22	Techniques Used for the Tubular Frame Mounting	369
	<i>Igor Belenkiy, Gennadii Sergeev, Vladimir Khominets, Denis Davydov, Leonid Brizhan, and Leonid Solomin</i>	
23	Equipment and Instruments for Ring Frame Construction.....	381
	<i>Leonid Solomin</i>	
24	Techniques Used in the Ring Frame Mounting.....	397
	<i>Leonid Solomin</i>	
25	Bases of Preoperative Preparation and X-Ray Examination	443
	<i>Leonid Solomin and Vladimir Popov</i>	
26	Postsurgical Management	469
	<i>Leonid Solomin and Ekaterina Zakharyan</i>	
27	Complications and Solutions	491
	<i>Leonid Solomin</i>	

Part 2 Acute Trauma

28	External Fixation for Acute Trauma: Introduction	541
	<i>Leonid Solomin</i>	
29	External Fixator-Assisted Nailing/Plating in Fractures Treatment	543
	<i>Alexander Chelnokov and Leonid Solomin</i>	
30	External Fixator-Assisted Nailing in Periprosthetic Femoral Fractures.....	597
	<i>Alexander Chelnokov, Igor Piven, and Dmitry Bekreev</i>	
31	Principles of Tubular Frames Construction and Mounting	617
	<i>Leonid Solomin and Vladimir Khominets</i>	

32	Tubular Frames for Temporary Fixation: Long Bones	631
	<i>Vladimir Khominets, Leonid Solomin, and Artem Komarov</i>	
33	Tubular Frames for Temporary Fixation: Large Joints and Pelvis	643
	<i>Leonid Solomin, Vladimir Khominets, and Artem Komarov</i>	
34	Principles of Ring Frame for Temporary Fixation Construction and Mounting	659
	<i>Leonid Solomin</i>	
35	Ring Frames for Temporary Fixation: Long Bones	675
	<i>Leonid Solomin and Fanil Sabirov</i>	
36	Ring Frame for Temporary Fixation: Large Joints and Pelvis	693
	<i>Leonid Solomin and Konstantin Korchagin</i>	
37	Transition from Temporary External Fixation to Definitive Internal or External Fixation in Fractures Treatment	715
	<i>Leonid Solomin, Alexander Chelnokov, and Roman Mytsykov</i>	
38	Principles of Classic Ring Frame Construction for Fracture Reduction and Definitive Fixation	763
	<i>Leonid Solomin</i>	
39	Principles of Constructing an MT-Based Ring Frame for Fracture Reduction and Definitive Fixation	785
	<i>Leonid Solomin</i>	
40	Mounting Principles of Ring Frames for Fractures Reduction and Definitive Fixation	805
	<i>Leonid Solomin</i>	
41	Ring Fixator for Definitive Fracture Fixation: Upper Arm (11-, 12-, and 13-).....	831
	<i>Leonid Solomin</i>	
42	Ring Fixator for Definitive Fracture Fixation: Forearm (2U and 2R).....	867
	<i>Leonid Solomin and Pavel Kulesh</i>	
43	External Fixation in Hand Injury	897
	<i>Natalia Shikhaleva and Mikhail Danilkin</i>	
44	Ring Fixator for Definitive Fracture Fixation: Femur, General Data	931
	<i>Leonid Solomin</i>	
45	Ring Fixator for Definitive Fracture Fixation: Proximal Femur Fractures (31A)	941
	<i>Leonid Solomin</i>	
46	Ring Frame for Definitive Fracture Fixation: Femur Shaft Fractures (32A, 32B, and 32C)	953
	<i>Leonid Solomin</i>	

47	Ring Fixator for Definitive Fracture Fixation: Femur Distal Part (33A, 33B, 33C)	983
	<i>Leonid Solomin</i>	
48	Ring Fixator for Definitive Fracture Fixation: Tibia and Fibula, General Data	997
	<i>Leonid Solomin</i>	
49	Ring Fixator for Definitive Fracture Fixation: Tibia and Fibula Proximal Part (41A, 41B, 41C)	1007
	<i>Tracy J. Watson and Leonid Solomin</i>	
50	Ring Fixator for Definitive Fracture Fixation: Tibia and Fibula Shaft (42-)	1031
	<i>Leonid Solomin</i>	
51	Ring Fixator for Definitive Fracture Fixation: Tibia and Fibula Distal Part (43- and 44-)	1063
	<i>Leonid Solomin</i>	
52	Ring Fixator for Definitive Fracture Fixation: Foot.....	1099
	<i>Leonid Solomin</i>	
53	External Fixation for Open Fractures and Severe Soft Tissue Injuries: General Principles	1119
	<i>Alexander Lerner and Leonid Solomin</i>	
54	Artificial Deformity Creation in Treatment of Fractures with Large Soft Tissue Defect	1131
	<i>Alexander Lerner, Konstantins Plotnikovs, and Leonid Solomin</i>	
55	Open Fracture Management Using Ilizarov Apparatus Combined with Flap Surgery	1159
	<i>Qinglin Kang, Jia Xu, and Rui Zhang</i>	
56	External Fixation in Children and Adolescents at Acute Trauma	1187
	<i>Lev Lapidus and Anatoli Korobeinikov</i>	

Part 3 Basic Principles of Deformity Correction

57	External Fixation in Deformity Correction: Introduction	1203
	<i>Leonid Solomin</i>	
58	Lower Limb Reference Lines and Angles (RLAs)	1211
	<i>Leonid Solomin and Viktor Vilenskii</i>	
59	X-Ray Analysis: Is There a Deformity or Not?.....	1235
	<i>Leonid Solomin</i>	
60	Basics of Planning Long Bone Deformity Correction	1253
	<i>Leonid Solomin and Evgeniy Golovenkin</i>	

61	Peculiarities of Lower Limb Deformity Correction Planning in Frontal Plane	1307
	<i>Leonid Solomin</i>	
62	Peculiarities of Lower Limb Deformity Correction Planning in Sagittal Plane.....	1345
	<i>Leonid Solomin</i>	
63	Oblique Plan, Torsion, and Bi-planar Multi-apex Deformities: Features of Correction Planning	1381
	<i>Leonid Solomin</i>	
64	Upper Arm and Forearm Deformities Correction Planning Consideration.....	1407
	<i>Leonid Solomin, Viktor Vilenskii, and Maxim Baushev</i>	
65	Unified Correction Units ("Ilizarov Hinges") for Acute and Gradual Deformity Correction	1445
	<i>Leonid Solomin</i>	
66	External Fixator-Assisted Nailing/Plating (EFAN/EFAP) in Acute Deformity Correction	1493
	<i>Leonid Solomin, Alexander Chelnokov, and John E. Herzenberg</i>	
67	Principles of Ring Frame Construction for Long Bones Deformity Correction and Definitive Fixation	1547
	<i>Leonid Solomin</i>	
68	Principles of Ring Frame Mounting for Deformity Correction and Definitive Fixation	1583
	<i>Leonid Solomin</i>	
69	Features of the Ring Frame for Deformity Correction: Femur	1621
	<i>Leonid Solomin</i>	
70	Features of the Ring Frame for Deformity Correction: Lower Leg.....	1647
	<i>Leonid Solomin</i>	
71	Features of the Ring Frame for Deformity Correction: Upper Arm.....	1671
	<i>Leonid Solomin</i>	
72	Humeral Deformity Correction and Lengthening	1697
	<i>Qinglin Kang and Jia Xu</i>	
73	Features of the Ring Frame for Deformity Correction: Forearm.....	1723
	<i>Leonid Solomin</i>	
74	Lengthening Over the Nail and Along the Plate	1751
	<i>Leonid Solomin, Elena Shchepkina, Ali Baş, Mehmet Kocaoğlu, and F. Erkal Bilen</i>	
75	Sequential External Fixation and Nailing/Plating in Deformity Correction....	1819
	<i>Leonid Solomin, Alexander Chelnokov, and Elena Shchepkina</i>	

76	Conventional Ilizarov and Integrated Techniques versus Internal Distractors in Deformity Correction and Bone Transport.....	1879
	<i>Stephen J. Wallace and S. Robert Rozbruch</i>	
77	Aesthetic Correction of the Lower Extremities: General Information	1895
	<i>Leonid Solomin</i>	
78	Leg Shape Correction	1903
	<i>Leonid Solomin</i>	
79	Aesthetic Lower Extremities Lengthening	1937
	<i>Leonid Solomin</i>	
80	External Fixation in Spinal Deformities Surgery	1981
	<i>Alexander Gubin, Sergey Ryabykh, and Alexander Burtsev</i>	
81	External Fixation in Pelvic Post-traumatic Deformities	1999
	<i>Alexey Runkov, Danil Bliznets, and Leonid Solomin</i>	
82	Considerations for Hand Lengthening and Deformity Correction	2047
	<i>Vladimir Zavarukhin</i>	
83	Phalangeal and Metacarpal Lengthening with Lengthening and Then Plating (LATP) Technique	2077
	<i>Qinglin Kang, Jia Xu, and Rui Zhang</i>	
84	Midfoot and Hindfoot Deformity Correction: General Principles	2087
	<i>Alexander Kirienko and Leonid Solomin</i>	
85	Midfoot and Hindfoot Deformity Correction Planning	2103
	<i>Leonid Solomin, Konstantin Ukhanov, Alexander Kirienko, and John E. Herzenberg</i>	
86	Midfoot and Hindfoot Deformity Correction with Ilizarov Hinges	2133
	<i>Alexander Kirienko and Leonid Solomin</i>	
87	Ankle, Midfoot, and Hindfoot Deformity Correction Using Foot Joints Fusion	2177
	<i>Alexander Kirienko and Leonid Solomin</i>	
88	External Fixation for Charcot Neuroarthropathy of the Foot and Ankle	2203
	<i>Gonzalo F. Bastias, Patricio Fuentes, and Natalio Cuchacovich</i>	

Part 4 Non-unions and Defects

89	Long Bone Nonunions and Defects: Introduction	2227
	<i>Leonid Solomin</i>	
90	Universal Long Bone Nonunion Classification (ULBNC) (2nd Edition)	2231
	<i>Leonid Solomin, Anton Semenistyy, Artem Komarov, Gerard A. Sheridan, and S. Robert Rozbruch</i>	

91	Universal Long Bone Defect Classification (ULBDC) (2nd Edition)	2249
	<i>Leonid Solomin, Anton Semenistyy, Artem Komarov, Gerard A. Sheridan, and S. Robert Rozbruch</i>	
92	External Fixation in Long Bone Nonunions	2279
	<i>Leonid Solomin</i>	
93	Cross-Wire Bone Transport: Frame Construction Principles	2317
	<i>Leonid Solomin</i>	
94	Cross-Wire Bone Transport: Frame Mounting Principles	2347
	<i>Leonid Solomin</i>	
95	Oblique-Wire and Cable Bone Transport: Frame Construction Principles	2377
	<i>Leonid Solomin</i>	
96	Cable and Oblique-Wire Bone Transport: Frame Mounting Principles	2401
	<i>Leonid Solomin</i>	
97	Splint and Transverse Fibula Bone Transport	2433
	<i>Leonid Solomin</i>	
98	Bone Transport Over the Nail and Along the Plate (BTON/BTAP)	2451
	<i>Leonid Solomin, Elena Shchepkina, Ali Baş, Mehmet Kocaoğlu, and F. Erkal Bilen</i>	
99	Combined Strained Fixation in Long Bone Defect Treatment	2531
	<i>Leonid Solomin</i>	
100	External Fixation in Knee Joint Bone Defects: Introduction	2561
	<i>Leonid Solomin, Konstantin Korchagin, and Elena Shchepkina</i>	
101	Knee Joint Fusion	2573
	<i>Leonid Solomin, Konstantin Korchagin, and Elena Shchepkina</i>	
102	Reconstructions in Knee Joint Bone Defects	2603
	<i>Leonid Solomin, Konstantin Korchagin, and Elena Shchepkina</i>	
103	Reconstructions in Long Bone Tumor Treatment	2635
	<i>Hiroyuki Tsuchiya and Katsuhiro Hayashi</i>	

Part 5 Children and Adolescents

104	Lower Limb Deformity Correction in Children and Adolescents: General Data	2653
	<i>Viktor Vilenskii and Leonid Solomin</i>	
105	Post-traumatic Deformities in Children and Adolescents	2699
	<i>Mark Eidelman, Khaled Abudalou, and Pavel Kotlarsky</i>	
106	External Fixation and Integrated Techniques in the Treatment of Blount's Disease	2727
	<i>Mark Eidelman, Robbie Schwartz, Khaled Abu Dalu, and Pavel Kotlarsky</i>	

107	Multiple Osteochondromatosis Disease: Treatment with External Fixation ...	2743
	<i>Luigi Lovisetti, Maurizio A. Catagni, and Leonid Solomin</i>	
108	Enchondromatosis Disease: Treatment with External Fixation	2773
	<i>Maurizio A. Catagni</i>	
109	Radial Club Hand	2813
	<i>Qinglin Kang and Yachao Jia</i>	
110	Treatment of Congenital Pseudarthrosis of the Tibia	2827
	<i>Dror Paley and Claire Shannon</i>	
111	Treatment of Congenital Femoral Deficiency	2873
	<i>Dror Paley and Claire Shannon</i>	
112	Lengthening Reconstruction Surgery for Fibular Hemimelia	2927
	<i>Dror Paley and Katherine Miller</i>	
113	Reconstruction Surgery for Achondroplasia	2955
	<i>Konstantin Novikov, Viktor Vilenskii, Oleg Klimov, and Olga Novikova</i>	
114	Hip Reconstruction in the Treatment of Developmental Hip Dysplasia	3021
	<i>Michael Teplenky</i>	

Part 6 Large Joint Pathology

115	External Fixation in Large Joint Pathology: Introduction	3069
	<i>Leonid Solomin</i>	
116	Principles of Ring Frame Construction for Large Joint Pathology	3071
	<i>Leonid Solomin</i>	
117	Principles of Ring Frame for Large Joint Pathology Mounting	3087
	<i>Leonid Solomin</i>	
118	Hip Distraction	3107
	<i>William Dean Terrell and Leonid Solomin</i>	
119	Ilizarov Pelvic Support Osteotomy	3121
	<i>Elena Volokitina and Leonid Solomin</i>	
120	Femur Lowering Before Hip Replacement	3149
	<i>Elena Volokitina and Leonid Solomin</i>	
121	Hip Pre-prosthetic and Peri-prosthetic Deformities	3167
	<i>Rashid Tikhilov, David Pliev, Alexey Myasoedov, Leonid Solomin, Igor Shubnyakov, and Alexey Denisov</i>	
122	Hip Arthroplasty After Ilizarov Pelvic Support Osteotomy	3211
	<i>Elena Volokitina and Denis Kolotygin</i>	

123	Hip Joint Fusion	3233
	<i>Leonid Solomin</i>	
124	Osteotomies Around the Knee.....	3239
	<i>Ronald J. van Heerwaarden, Matthieu Ollivier, and Leonid Solomin</i>	
125	Intra-Articular Corrective Osteotomies Combined with the Ilizarov Technique for the Treatment of Deformities of the Knee.....	3281
	<i>Jia Xu and Qinglin Kang</i>	
126	Knee Pre-prosthetic and Peri-prosthetic Deformities: Implications for Arthroplasty	3307
	<i>Austin T. Fragomen, Kevin Tetsworth, and Leonid Solomin</i>	
127	External Fixation in Knee Joint Contracture Treatment.....	3343
	<i>Leonid Solomin and Saigidula Rokhoev</i>	
128	Ankle and Subtalar Joint Distraction Arthroplasty and Supramalleolar Osteotomy	3377
	<i>Austin T. Fragomen and Leonid Solomin</i>	
129	External Fixation in Elbow and Wrist Pathology	3399
	<i>Leonid Solomin and Yury Soldatov</i>	

Part 7 Orthopedic Hexapods

130	Orthopedic Hexapods: Principles, History, and Indications	3421
	<i>Leonid Solomin, Alexander Utekhin, and Viktor Vilenskii</i>	
131	Ortho-SUV Frame Hardware.....	3439
	<i>Leonid Solomin, Alexander Utekhin, and Viktor Vilenskii</i>	
132	Ortho-SUV Frame Software.....	3485
	<i>Leonid Solomin, Alexander Utekhin, and Viktor Vilenskii</i>	
133	Ortho-SUV Frame in Long Bone Deformity Correction	3647
	<i>Leonid Solomin and Viktor Vilenskii</i>	
134	“Spring Technique” for Correction of Multiapex Deformities Using Hexapod External Fixator	3683
	<i>Leonid Solomin, Eugene Golovenkin, and Fanil Sabirov</i>	
135	Ortho-SUV Frame in Midfoot and Hindfoot Deformity Correction	3753
	<i>Leonid Solomin and Konstantin Ukhonov</i>	
136	Orthopedic Hexapod in Knee Joint Stiffness and Dislocations Treatment....	3809
	<i>Leonid Solomin and Saigidula Rokhoev</i>	
137	Orthopedic Hexapod in Ankle Joint Stiffness and Dislocations Treatment....	3867
	<i>Leonid Solomin</i>	

138	Hexapod-Based Lengthening Over the Nail and Bone Transport Over the Nail	3895
	<i>Leonid Solomin and Elena Shchepkina</i>	
	Supplementary Information	
	Supplement 1: External Fixation: Useful Information for Patients.....	3938
	Supplement 2: A Comprehensive Designation of External Fixation (CDEF)	3987
	Supplement 3: Optimal Positions (OPs) for Wires and Threaded Pins Insertion.....	3993
	Supplement 4: Reference Lines and Angles (RLAs)	3998
	Supplement 5: The Most Important Things About Frame Construction and Mounting .	4013
	Conclusion	4017
	Further Reading	4020
	Index.....	4021