The Basic Principles of External Skeletal Fixation

Leonid Nikolaevich Solomin
Editor

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Third Edition

Springer

Editor
Leonid Nikolaevich Solomin, MD, PhD
Professor of Orthopedic Surgery
Vreden National Medical Research Center
of Traumatology and Orthopedics
St. Petersburg, Russia

Honourable Professor of National Ilizarov Medical
Research Centre for Traumatology and Ortopaedics
Kurgan, Russia

Head of Functional Scientific & Clinical Group
of External Fixation
St. Petersburg, Russia

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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.

Prof. Leonid Nikolaevich Solomin
St. Petersburg, Russia

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Supplementary Information