Frederic Shapiro

Pediatric Orthopedic Deformities

Volume 1

Pathobiology and Treatment of Dysplasias, Physeal Fractures, Length Discrepancies, and Epiphyseal and Joint Disorders

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To my wife. Carol Ann Satler

Preface

The current edition of *Pediatric Orthopedic Deformities: Basic Science, Diagnosis, and Treatment* has been increased to three volumes, updating and expanding the presentation of skeletal deformation in the growing child. It demonstrates throughout how specific biological and mechanical abnormalities can affect normal bone and cartilage development and lead to problematic deformation. The two main premises of the book remain the same however: (1) current orthopedic treatments of growth deformities of the developing skeleton are most effective when based on an understanding of and relationship to the underlying pathobiology and (2) future treatments can be developed best with deeper understanding of and more specific relationships to the underlying pathobiology.

Volume 1, Chap. 1 (Developmental Bone Biology) describes skeletal development as outlined by several investigational approaches including: histology at the light and electron microscopic levels; molecular biology outlining the wide array of gene and molecular controls for skeletal tissue differentiation, 3- and 4-dimensional limb bud axial differentiation and growth, and synthesis of structural macromolecules; mineralization; mechanical–biophysical effects on the developing skeleton; and radiological parameters of growth such as appearance of secondary ossification centers and times and patterns of physeal fusion.

Chapter 2 (Overview of Deformities) is new and describes: founders of the field of pediatric orthopedics, which essentially began with several individuals specifically addressing the major musculoskeletal deformities of the developing child; 34 basic principles regarding pediatric orthopedic deformity; descriptive terminologies for bone and joint deformities; correction of deformities by spontaneous, non-operative and operative means with an overview of each of the clinical methods and techniques used for the treatment groups; a detailed molecular and histological description of biological tissue repair mechanisms for direct, primary, and endochondral cortical bone repair, metaphyseal cancellous bone repair, articular cartilage (full and partial thickness) repair, and physeal cartilage repair; and derangements of the repair process. Tendon, muscle, and peripheral nerve are also discussed regarding structure and injury and repair mechanisms.

Chapter 3 (Skeletal Dysplasias) discusses the skeletal dysplasias concentrating on clinical and radiographic descriptions of the entities, molecular abnormalities, histopathology, the lethal variants, orthopedic deformities by region and by specific disease entities, and orthopedic treatments.

Chapter 4 (Bone and Joint Deformity in Metabolic, Inflammatory, Neoplastic, Infectious, and Hematologic Disorders) reviews entities known to be associated with pediatric orthopedic deformities from the perspective of: the pathobiology of the disorder, the pathoanatomy of deformation, and the principles of medical and orthopedic management. The epiphyseal, metaphyseal, and joint abnormalities are reviewed for: rickets, juvenile rheumatoid arthritis, benign and malignant neoplasms and pyogenic and tuberculous infections (which concentrate at the epiphyseal-metaphyseal regions), and hematologic disorders such as hemophilia.

Chapter 5 (Epiphyseal Growth Plate Fracture-Separations) describes the relationship of these injuries with the possible growth deformities. These represent the main subset of childhood fractures contributing in a major way to limb deformity.

The cell biology and histopathology of growth plate injuries are reviewed, the commonly used pathoanatomic classifications are explained, and the presence or absence of growth sequelae are outlined. Each major physis is reviewed regarding clinical management and results. A pathophysiologic approach is outlined which provides a more dynamic and biological understanding and classification of these injuries at the cell and the tissue level. Imaging modalities beyond plain radiographs, such as magnetic resonance imaging, computerized tomographic scanning, and ultrasound, provide information on blood supply and tissue injury planes, the main determinants of negative growth sequelae. Management is detailed to eliminate, minimize, or if necessary treat transphyseal bone bridges.

Chapter 6 (Lower Extremity Length Discrepancies) outlines: the natural history of specific disorders leading to discrepancies, negative sequelae of discrepancies, methods projecting eventual discrepancies at skeletal maturity, developmental patterns of discrepancies, and techniques and timing for shortening, lengthening. and bone bridge resection. Femoral overgrowth following diaphyseal fractures is reviewed and updated following immediate casting or intramedullary nailing.

Volume 2 will assess regional deformities of the developing lower extremity. The developmental biology and histopathology at each region are stressed and related to treatment interventions. Chapters are devoted to: Developmental Dysplasia of the Hip; Legg-Calve-Perthes disease; Slipped Capital Femoral Epiphysis (and other causes of coxa vara); Degenerative Joint Disease following childhood hip disorders (femoral-acetabular impingement); Developmental Disorders of the Knee; Club Feet (and other deformities of the foot and ankle); and Rotational and Angular Deformities of Femur and Tibia.

Volume 3 will outline the developmental biology and histopathology of the vertebrae, ribs and spinal cord. Chapters will assess: 1. Spinal Deformities including: (a) congenital and idiopathic scoliosis, (b) kyphosis, (c) spondylolisthesis and d) cervical abnormalities; and 2. Neuromuscular Disorders and their spinal, hip, and limb deformities for: (a) cerebral palsy, (b) the muscular dystrophies and structural myopathies, mitochondrial and metabolic myopathies, myotonic disorders, spinal muscular atrophy, Friedreich Ataxia, and the peripheral neuropathies, (c) spinal cord abnormalities of Meningomyelocele, diastematomyelia, transverse myelitis, tethered cord, and syringomyelia, and (d) brachial plexus injuries.

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