Orthopaedic Surgery in Infancy and Childhood

Fourth edition

ALBERT BARNETT FERGUSON, JR., B.A., M.D.

Silver Professor of Orthopaedic Surgery and Chairman, Department of Orthopaedic Surgery, University of Pittsburgh

Chief of Orthopaedic Service, University of Pittsburgh Medical Center

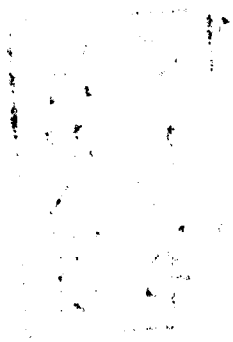
Senior Staff—Children's Hospital, Presbyterian–University Hospital, Pittsburgh

Active Staff—Allegheny General Hospital, Pittsburgh

Chief Consultant—Veteran's Hospital (Oakland), Pittsburgh

Consultant—Mercy Hospital, St. Francis Hospital, St. Margaret's Hospital, Montefiore Hospital, Pittsburgh

Williams and Wilkins Company, Baltimore



Made in the United States of America

Library of Congress Cataloging in Publication Data

Ferguson, Albert Barnett, 1919–
Orthopaedic surgery in infancy and childhood.

1. Pediatric orthopedia. I. Title. [DNLM: 1. Orthopedics. 2. In infancy and childhood. WS270 F3520 1975]
RJ480.F47 1974 617'.3 74–5311
ISBN 0–683–03166–X

Composed and printed at the Waverly Press, Inc., Mt. Royal and Guilford Aves. Baltimore, Md. 21202, U.S.A.

Contributors

Mary Williams Clark, B.A., M.D.

Assistant Professor of Orthopaedic Surgery, University of Pittsburgh. Director of Physical Medicine Services, Children's Hospital of Pittsburgh. Assistant Chief, Rehabilitation Medicine, Health Center Hospital of Pittsburgh. Associate Staff, Children's Hospital, Presbyterian-University Hospital, Pittsburgh

William Fielding Donaldson, B.A., M.D., F.A.C.S.

Clinical Professor of Orthopaedic Surgery, University of Pittsburgh. Senior Staff—Children's Hospital Presbyterian-University Hospital, St. Francis Hospital, Shadyside Hospital, Pittsburgh. Attending Staff, Veteran's Hospital, (Oakland) Pittsburgh. Consultant, St. Margaret's Hospital, Home for Crippled Children, Pittsburgh.

William Thomas Green, Jr. B.A., M.D., F.A.C.S.

Assistant Professor, Department of Orthopaedic Surgery, University of Pittsburgh. Associate Staff, Children's Hospital, Presbyterian-University Hospital, Pittsburgh. Consultant, Veteran's Hospital (Oakland), John J. Kane Hospital, Pittsburgh

Ronald Carl Hillegass, B.A., M.D.

(Formerly) Assistant Professor of Orthopaedic Surgery, University of Pittsburgh. Attending Staff, Roger Williams Hospital, Rhode Island Hospital, Providence Rhode Island

James Henry McMaster, B.A., M.D.

Assistant Professor of Orthopaedic Surgery, University of Pittsburgh. Associate Staff, Children's Hospital, Presbyterian-University Hospital, Pittsburgh. Consultant, Veteran's Hospital, (Oakland) Pittsburgh. Director of Orthopaedic Research Laboratory, University of Pittsburgh

John A. Ogden, B.A., M.D.

Assistant Professor of Orthopaedic Surgery, Yale University Medical School. Director, Orthopaedic Section Human Growth and Development Unit, Yale University. Attending Staff, Yale-New Haven Hospital, Newington Children's Hospital, Connecticut. Consultant, Veteran's Hospital, West Haven, Connecticut

Frank H. Stelling III, M.D., F.A.C.S.

Chief Surgeon, Shriners Hospital for Crippled Children, Greenville Unit, Greenville, South Carolina. Associate Clinical Professor of Orthopaedic Surgery, Medical University of South Carolina. Assistant Clinical Professor of Orthopaedic Surgery, Duke University School of Medicine. Chairman, Education, Orthopedic Department, Greenville Hospital System

Charles S. Stone, B.S., M.D.

Clinical Instructor of Orthopaedic Surgery, University of Pittsburgh. Associate Staff, Children's Hospital, Presbyterian-University Hospital, St. Francis Hospital, St. Margaret's Hospital, West Penn Hospital, Shadyside Hospital, Pittsburgh

Harold Edward Swensen, B.S., M.D.

Clinical Assistant Professor of Orthopaedic Surgery, University of Pittsburgh. Associate Staff, Children's Hospital, Presbyterian-University Hospital, West Penn Hospital, Pittsburgh. Consultant, Magee-Womens Hospital, Western Psychiatric Hospital, Pittsburgh

H. Andrew Wissinger, B.S., M.D., F.A.C.S.

Clinical Associate Professor of Orthopaedic Surgery, University of Pittsburgh. Senior Staff, Children's Hospital, Presbyterian-University Hospital, St. Francis Hospital, St. Margaret's Hospital, Pittsburgh. Associate Director, Child Amputee Clinic of Pittsburgh. Consultant, State Crippled Children's Program of Pennsylvania. Consultant, Western State School and Hospital of Canonsburg, Pennsylvania

Preface to the first edition

This volume is the outgrowth of that period in life when the subject matter of orthopaedic surgery was laboriously amassed by running from text to text and article to article. Excellent though so many volumes are, none of them appeared to have gathered under one cover details regarding the many odd syndromes encountered in the practice of orthopaedic surgery dealing with infants and children. Pediatricians and residents have often indicated by their questions that they were undergoing a similar experience.

No syndrome, photograph or roentgenogram is presented which was not personally seen by the author. No feature of disease is reiterated which has not been a feature in our own experience.

Obviously no text arises without roots in the past, and the excellent volumes of Colonna, Howorth, Mercer, Platt, Wiles, Fairbank, Shands, Campbell, Luck, Smillie and DePalma have also served as references. This text does not include a consideration of fractures, for the subject is adequately covered in Walter Blount's recent book, *Fractures in Children.*

If clarity in visualizing these syndromes has been achieved, it is a reflection of the teaching of Joseph Barr, William T. Green and Albert B. Ferguson, Sr. They are not responsible for what others may deem as errors, however.

Certain areas in the book have been done by others. Frank Stelling has contributed his knowledge of reconstruction of the hand to the section on the upper extremity. Scoliosis is the work of William Donaldson of Pittsburgh. John Donaldson of Pittsburgh has added the chapter on the neck. Robert Klein encompasses rickets and scruvy from the metabolic point of view. Albert Ferguson, Sr., writes of defective formation of bone from cartilage. All these authors are deserving of my humble thanks in enabling a sound production of a book on orthopaedic surgery in the infant and childhood years.

The Children's Hospital of Pittsburgh is blessed with men of selfless spirit whose help has been invaluable. This is particularly true of Bertram Girdany, George Fetterman and Thomas Brower; although no one failed to respond when called upon. The pleasant and productive atmosphere of this hospital is a reflection of its guiding spirit and medical director, Edmund McCluskey.

The manuscript has been typed, retyped and retyped again by my secretary, already overloaded with budgets, bills, and records. This type of dedication is typical of Mary Cosgrove.

My children and my wife, Louise, have taken night work, which deprived them of companionship, with good spirit. My wife's patient understanding is not found often in this world—without it such an arduous task could not be completed.

The drawings are the result of the talents of Margaret Croup except for those accompanying the section on the upper extremity. The photographs and roentgenogram reproductions were done by Albert Levine and James Stark. The patient cooperation exhibited by these worthy individuals has been a source of pleasure and has eased the task immeasurably.

The publishers and particularly Dick Hoover have been patient and have exhibited the skills of their profession with consummate ease.

Great care and effort have been used to duly credit thoughts, drawings and photographs whose origin might in any way be elsewhere. Should any omission have arisen, it is entirely inadvertent and not by conscious design.

The regional arrangement of the text will, we hope, make reference easy and invite a return visit.

A. B. F., Jr.

Preface to the fourth edition

There have been a number of objectives for this fourth edition. The illustrations, particularly those relating to surgical technique, have been increased in number, improved in quality, and made more informative. Information relating to any particular syndrome has been enlarged, with new information developed in greater depth and heavily referenced. Completeness has been a goal and all areas and types of disease and the relevant therapy increased in its coverage.

In addition, specific new material has been added, especially important here are "Developmental Anatomy" by John Ogden, specific scoliosis subjects by Charles Stone and William T. Green, Jr., the "Lower Extremity in Myelodysplasia" by Andrew Wissinger, "Hemophilia" by Ronald Hillegass, and "Amputations" by Mary Williams Clark.

Areas of recent interest and development such as congenital dislocation of the hip have been largely rewritten. New operations developed and followed by the author such as the treatment of plantar-flexed talus, dislocated hips and many others are included.

The fundamental approach to children's orthopaedics in a growing, maturing child is emphasized throughout.

The drawings, which are beautifully executed, are the work of Ron Filer, who very clearly grasps the principle being protrayed. Ann Eakins has taken great care with the photography, assuring that each illustration would clearly tell the message involved.

Mary Cosgrove has organized, typed and retyped and researched for material and is an indispensable part of the book's development.

With the help of many people this book is maturing into a valuable reference and text and is aimed to satisfy both the beginner and the highly trained orthopaedic surgeon. It it hoped that those who read it find it valuable.

Table of contents

CHAPTER 1

Orthopaedic Treatment of Childhood Disability

The child is a growing, maturing individual, a fact that must be kept in mind in the treatment phases of orthopaedic disability.

Braces must be used to enlarge, not limit, a child's horizon. All aspects of the child's development must be given attention at a time when the tendency is to rivet the attention on the single aspect of a deformity or loss of function under treatment. If treatment is always thought of in terms of total function of the child, these things can be brought into proper perspective. Surgical decisions are accurately made when the contribution of the surgical procedure to the total function of the child is ascertained. Decisions for long term hospitalization or physiotherapy must be made only after being weighed against the removal of the child from an area where emotional and intellectual development can be served. The rapid improvement in function occasionally possible with surgery is a point in its favor if it returns the child to a growth environment with greater opportunity to take part in it.

Many procedures fail because of a poor concept of what is necessary to make them work and increase the child's function. The procedure includes the postoperative period and the type of cast, traction, or physical therapy, the return home with adequate instruction for the parents and child, and the follow-up in the years following so that maximum function is achieved.

Factors which tend to make a deformity recur, such as growth, must be considered in on-going care. Unbalanced muscle pull and diseased tissue must be corrected or the limb braced until they can be corrected. The natural vigor of the child's tissues aids in regeneration of tissues if protection of the area is continued sufficiently long. During this period the hobbling effect of the treatment must be minimized so that the child can still take part in learning activities of all types.

GROWTH AFFECTING SKELETON

Many orthopaedic diseases may represent the development of a congenital abnormality. The variation usually appears in the specific age group in which the particular portion of the skeleton normally is differentiated. Growth may affect the degree of development of an abnormality such as scoliosis. The effect of growth on the development of deformity in the presence of unbalanced musculature of the limb is a very important underlying consideration in orthopaedics. The growing child with one muscle group dominating another, as in poliomyelitis, must be braced; but the unbraced adult with the same clinical picture does not necessarily develop a deformity.

Some understanding of human skeletal growth and its effects is essential to an understanding of orthopaedic disease.

Skeletal Growth

In order to appreciate growth at a given age, two types of studies may be done. Cross sectional studies, to be significant, require a large number of children, but they are more commonly carried out than longitudinal studies because of the time involved in studying one child throughout his growth period. From cross sectional studies, the mean measurement of any particular skeletal attribute is obtained. From longitudinal studies, the rate of change can be determined. Longitudinal studies are quite readily available to the orthopaedist because he usually follows up a patient throughout the growth period when a particular abnormality is present.

There is an exponential fall in the rate of mean gain in standing height for the human being except for two periods. The first delay in this fall is noted between 5½ and 7 years and is called the midgrowth spurt. The second delay is

the adolescent growth spurt between 13 and 15 years (Fig. 1.1).

The growth rates in boys and girls are essentially the same except for the following variations. Boys may be slightly longer at birth, and they may grow slightly faster in the first year. Girls begin their adolescent growth spurt 2 years earlier than boys (at 11 instead of 13 years). During this spurt, they grow faster and larger than boys, but, slowing quickly, they are finally smaller than boys in all dimensions except pelvic width. The boys, commencing their adolescent growth spurt 2 years later, go on to grow for a longer period and to larger dimensions.

Because their growth period is longer, the boys have longer legs. Hormonal influences give the boys wider shoulders and the girls a wider pelvis. In boys there is also a relative increase in the amount of growth of the trunk (sitting height) to that of the legs (Fig 1.2). The tremendous variation in this pattern in any one individual, racial group, or body type is readily evident.

Factors Affecting Growth

Prenatal

The influence of inherited factors is accepted. Such orthopaedic conditions as achondroplasia, spina bifida, dislocation of the hip, and osteogenesis imperfecta in genetic studies have been shown to result from a single gene mutation. The state of health of the mother also obviously affects the developing fetal skeleton.

Postnatal

Environmental and sociologic factors may influence the onset of puberty. Genetic factors

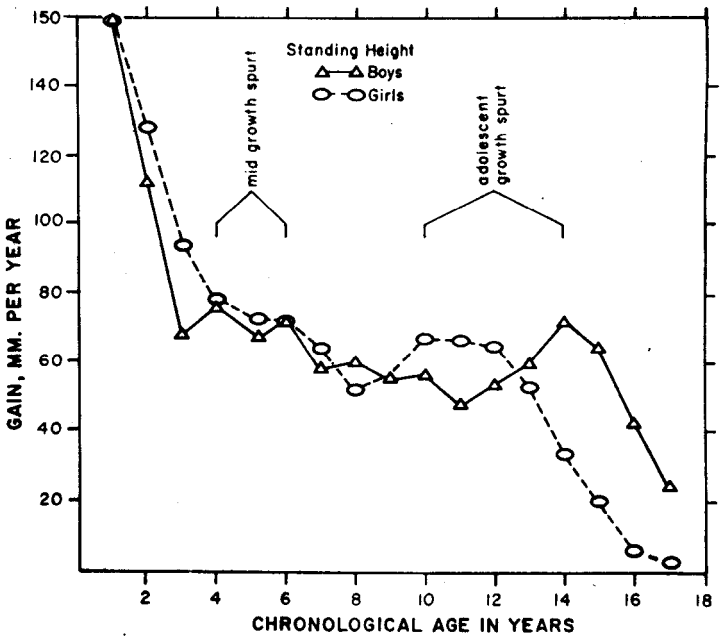


Fig. 1.1. Note the declination in height per year as growth progresses. The two periods during which this rate of decline levels off are known as the midgrowth spurt and the adolescent growth spurt. (This chart and the following one (Fig. 1.2) are reprinted with the permission of J. B. Lippincott Co., from R. Duthie: The significance of growth in orthopaedic surgery, *Clinical Orthopaedics, 14:* 7, 1959. They were prepared from data that originally appeared in K. Simmons: *The British Foundation Study of Child Growth and Development, II. Physical Growth and Development,* Monograph, Society for Research in Child Development, Vol. 9, No. 1, Serial 37, 1944.)

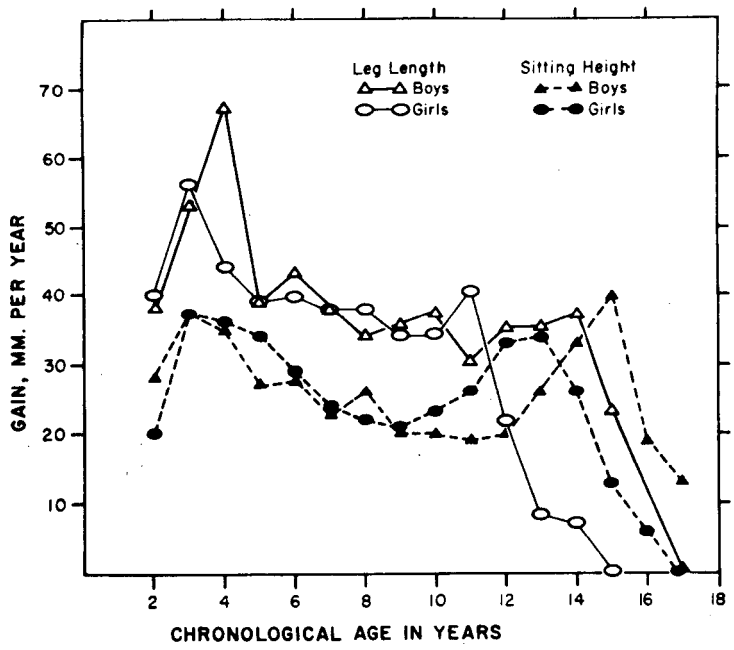


Fig. 1.2 Gain in millimeters per year in sitting height and leg length is contrasted in boys and girls. The later increase in leg length and sitting height of boys is evident.

are also still of importance. The state of health of the individual can result in skeletal dwarfism. Dietary factors are important.

Relation of Growth to Orthopaedic Conditions

The so-called osteochondritides are distinguished by their preference for a specific age group and often for a specific sex. If all cases were considered to occur at a physiologic rather than a chronologic age, their relationship to a specific age might be still more remarkable. Girls, because of their earlier skeletal maturation, would be expected to experience an earlier onset of these diseases, and, in osteochondritis involving the spine and Osgood-Schlatter disease, they do in fact (Fig. 1.3).

Tumors such as osteogenic sarcoma, neuroblastoma, and Ewing's chondrosarcoma and giant cell sarcoma are distinguished by their occurrence in specific age groups.

Scoliosis is a noteworthy anomaly in terms of relating growth to skeletal disease. That the curve in idiopathic scoliosis ceases to progress when spine growth is complete is documented (Fig. 1.4). Paralytic curvatures that have been doing well often develop into severe deformity during the adolescent growth spurt.

Temporary deformities that normally occur during development, such as genu valgus, which appears between the ages of 2 and 4 years and gradually improves thereafter, internal tibial torsion, and anteversion of the hip, are evidence of the influence of growth on the skeleton. The examples are many, for the influence of growth can be seen in most skeletal changes—normal and abnormal—of childhood.

References

1. Crompton, C. W.: Physiological age, a fundamental principle, *Child Develop., 15:* 1, 1944.
2. Duthie, R. B.: The significance of growth in orthopedic surgery, *Clin. Orthop., 14:* 7, 1959.
3. Price, C. H. S.: Osteogenic sarcoma; an analysis of the sex and age incidence, *Brit. J. Cancer, 9:* 558, 1955.
4. Simmons, K., and Todd, T. W.: Growth of well children: analysis of stature and weight, 3 months to 13 years, *Growth, 2:* 93, 1938.