DuVries'

Surgery of the foot

DuVries'
Surgery of the foot

Editor
VERNE T. INMAN, M.D., Ph.D.

THIRD EDITION
with 1,041 *illustrations*

The C. V. Mosby Company
SAINT LOUIS 1973

THIRD EDITION

Printed in the United States of America

Distributed in Great Britain by Henry Kimpton, London

Library of Congress Cataloging in Publication Data

DuVries, Henri L
DuVries' Surgery of the foot.

Bibliography: p.
1. Foot—Surgery. I. Inman, Verne Thompson, 1905- ed. II. Title. III. Title: Surgery of the foot. [DNLM: 1. Foot diseases—Surgery. WE 880 D987s 1973]
RD563.D94 1973 617'.585 73-16
ISBN 0-8016-2332-4

Contributors

Edwin G. Bovill, Jr., M.D.

Professor of Orthopaedic Surgery, Vice Chairman, Department of Orthopaedic Surgery, University of California, San Francisco; Chief, Department of Orthopaedic Surgery, San Francisco General Hospital, San Francisco

Michael W. Chapman, M.D.

Assistant Professor of Orthopaedic Surgery, University of California, San Francisco; Assistant Chief, Department of Orthopaedic Surgery, San Francisco General Hospital, San Francisco

Henri L. DuVries, D.P.M., M.D.

Assistant Clinical Professor of Orthopaedic Surgery (retired), University of California, San Francisco; Chief of Foot Surgery, Highland General Hospital, Oakland; Member, Senior Surgical Staff, Samuel Merritt Hospital, Oakland; Clinical Professor of Surgery, California College of Podiatric Medicine, San Francisco

James M. Glick, M.D.

Assistant Clinical Professor of Orthopaedic Surgery, University of California, San Francisco; Associate Professor of Physical Education and Team Physician, California State University, San Francisco; Active Staff, Mount Zion Hospital and Medical Center, Ralph K. Davies Medical Center, and Unity Hospital, San Francisco

Verne T. Inman, M.D., Ph.D.

Professor of Orthopaedic Surgery and Director, Biomechanics Laboratory, University of California, San Francisco

S. William Levy, M.D.

Clinical Professor of Dermatology, University of California, San Francisco; Active Staff, Children's Hospital and Adult Medical Center, and Mount Zion Hospital and Medical Center, San Francisco; Dermatologic Consultant to the United States Army, Letterman General Hospital, San Francisco; Courtesy Staff, Ralph K. Davies Medical Center, San Francisco

Roger A. Mann, M.D.

Assistant Clinical Professor of Orthopaedic Surgery, University of California, San Francisco; Assistant Surgeon, Shriners Hospital for Crippled Children, San Francisco; Consultant to the Foot Surgery Clinic, University of California, San Francisco; Consultant in Foot Surgery, Highland General Hospital, Oakland.

James M. Morris, M.D.

Associate Professor of Orthopaedic Surgery, University of California, San Francisco; Active Staff, University of California Hospitals, San Francisco; Consultant, Laguna Honda Hospital, San Francisco

William R. Murray, M.D.

Professor of Orthopaedic Surgery, Vice Chairman, Department of Orthopaedic Surgery, and Chief, Orthopaedic Surgery Clinic, University of California, San Francisco; Chief, Orthopaedic Service, University of California Hospitals, San Francisco; Orthopaedic Consultant, Rheumatic Disease Group, University of California, San Francisco, and Langley Porter Neuropsychiatric Institute, San Francisco

Stanford F. Pollock, M.D.

Assistant Clinical Professor of Orthopaedic Surgery, University of California, San Francisco; Research Associate, Veterans Administration Hospital, San Francisco; Active Staff, Mills Memorial Hospital, San Mateo

Robert L. Samilson, M.D.

Associate Clinical Professor of Orthopaedic Surgery, University of California, San Francisco; President, American Orthopaedic Foot Society; President-elect, American Academy for Cerebral Palsy; Active Staff, Children's Hospital and Adult Medical Center, University of California Hospitals, and Hahnemann Hospital, San Francisco; Consultant, Child Development Center of Children's Hospital and Adult Medical Center, and Sunshine School, San Francisco

F. Scott Smyth, Jr., M.D.

Assistant Clinical Professor of Orthopaedic Surgery, University of California, San Francisco; Active Staff, Mills Memorial Hospital and Chope Hospital, San Mateo, and Peninsula Hospital, Burlingame

Elmer E. Specht, M.D.

Assistant Professor of Orthopaedic Surgery, University of California, San Francisco; Diplomate, American Board of Orthopaedic Surgery and American Board of Pediatrics

Foreword

Almost fifteen years have elapsed since Dr. DuVries' book on the foot emerged to fill a serious breach in the surgical literature. This it has done nobly and well to provide in a much neglected subject an important guide and reference work for the diagnosis, treatment, and management of pedal disabilities. Foot disabilities not only physically cripple but, even when minor, are among the most psychologically aggravating of disorders, interrupting and irritating men and women in their daily pursuits.

Therefore, it is a great privilege to welcome the third edition. In it the reader will find not only an extensive revision but a new emphasis with the addition of discussions on biomechanics, replacing the anatomic section more fully treated in standard basic texts. The change in emphasis recognizes that the foot is a complex mechanism that participates in the total harmony of the motion of the lower extremity, and is necessary for the fuller understanding of surgical procedures and their prognostic evaluation. In addition, the ankle as the joint of transition from leg to foot of necessity has been given consideration as an integral part affecting many of the problems of the foot. The volume will, I am sure, continue to advance the surgery of the foot as a practical treatise enriched in its new dimension.

J. B. deC. M. Saunders
M.D., LL.D., D.Sc., F.R.C.S.(E)
Regents Professor
University of California, San Francisco

Preface to third edition

When I accepted the job of editing the third edition of *Surgery of the Foot,* I was under the impression that few changes in the book were indicated except that some of the material needed to be updated. However, as I became more familiar with the contents I began to feel that some radical changes should be made. I discussed these changes with my fellow orthopaedists and questioned them, and podiatrists as well, as to what should and should not be incorporated in the new edition. I asked myself and consulted others as to who the purchasers of the third edition of this book would be and what material they would want and need covered in this revision.

Some interesting items evolved from these questions. Orthopaedists and podiatrists felt that they already possessed a good working knowledge of the anatomy of the foot but were woefully lacking in their understanding of the mechanics of the foot. Therefore, purely descriptive anatomy was deleted, and a discussion of the biomechanics of the foot was substituted.

The foot is not an isolated part of the locomotor system and must function through its attachment to the rest of the leg. In particular, definite relationships exist between the foot and the ankle, each affecting the other. Therefore, a discussion of the mechanics of the ankle as it influences the behavior of the foot, together with surgical procedures on the ankle, was added.

But the foot is not only a part of the whole locomotor system, it is a part of the whole body as well and is affected by systemic diseases and disabilities of the rest of the body. I have therefore included chapters on systemic diseases.

My responsibility as editor of the book led me also to take the liberty of rearranging much of the material in the body of the text. Discussions of the clinical disorders were separated from description of the surgical procedures necessary to correct the disorders.

The reason behind this separation of material seemed compelling, since many different surgical procedures have been employed for the same disability, and similar procedures have been employed for different pathologic conditions. Thus, I felt that the third edition could not be simply a book of surgical recipes for specific disorders. Instead, *all* the major surgical procedures performed on the ankle joint (such as open reduction, internal fixation of fractures, ligamentous repairs, arthrodeses, arthrotomies, synovectomies, and stabilization procedures) are discussed in the beginning section of Chapter 19, followed by a discussion of *all* of the major procedures

performed on the talus (for example, talectomies and reconstructive procedures), those on the subtalar joint, the calcaneus, and so forth, down through the toes and nails. Procedures that are specific to specific disorders, such as treatment of a ganglion by excision and treatment of hallux rigidus by cheilectomy, will be found in the text preceding Chapter 19. Moreover, to make the book a good reference text, a short historical review of all the various procedures is given, so that surgeons who wish to learn the basic assumptions that led to the development of a particular surgical procedure or who wish to know the details of that procedure can find this information by means of the bibliography. The list of references is being enlarged to provide ready access to the pertinent literature.

I wish to express my appreciation to the members of the Department of Orthopaedic Surgery who have contributed chapters to this revised edition: to Dr. Charles D. Noonan, Associate Professor of Radiology, and Dr. Ronald J. Stoney, Assistant Professor of Surgery, for consultant services; to the residents in Orthopaedic Surgery who reviewed and described some of the surgical procedures; and to my editor, Mrs. Eleanor Haas, who not only worked very hard to make this book a success, but also contributed valuable insights. Finally, I wish to thank Dr. Henri L. DuVries for his continuing concern and important contributions to the work. I might add that if anyone has a copy of the first edition, he should keep it. It is an invaluable record of one man's lifelong experience with surgery of the foot.

Verne T. Inman

Preface to first edition

This book has been written in response to a continuing request by my students and colleagues that I draw together into one place of reference the fundamentals and the recommendations contained in my lectures and clinical demonstrations over a span of 30 years. As Frederic Wood Jones commented, "It is probably the experience of most teachers of anatomy that the student is generally better acquainted with the intimate structure of the hand than with that of the foot."* My friends among orthopaedic surgeons agree that the teaching of their specialty does not allot sufficient time to problems of the foot. They will forgive, therefore, and perhaps welcome as an adjunct to teaching, the elementary portions of the contents and the didactic approach.

Extreme disabilities of the foot, such as the talipes deformities, have received studious attention in published reports. They have on that account been given only a cursory nod of recognition here. This book is directed toward the commoner disabilities, which have been sparsely considered in medical writing and which have been widely neglected in teaching and practice.

*Jones, F. W.: Structure and function as seen in the foot, London, 1944, Baillière, Tindall & Cox, Ltd., p. 3.

The expanding awareness of the diversity of pathologic changes in the feet and of the complexities of treatment represents an advance since the days when all foot disabilities were always attributed to so-called fallen arches and when a prescription of arch supports satisfied the diagnostician that nothing further could be done about the patient whose feet continued to hurt.

This far from definitive effort of mine has reached the printed page through the encouragement and helpfulness, advice, and direction of so many of my friends and colleagues that I hesitate to name them lest by inadvertence one should be overlooked. If that happens, my deepest regret! Certainly I must mention my friends of long standing; Dr. August F. Daro; Dr. William M. Scholl, who turned his collection of photographs and anatomic models over to me for study and selective use and who has been otherwise helpful in so many ways; Dr. Ernest Nora, Sr., a constant friend since our medical school days, who reviewed the chapter on Tumors, Cysts, and Exostoses; so many on the Staff of Columbus Hospital; Dr. Carlo Scuderi, who reviewed the first rough material and then introduced me to my patient and cooperative publishers; Dr. Edwin Hirsch, who made the photographic

facilities of St. Luke's Hospital* available to me; Dr. Karl A. Meyer, my former professor in medical school, who wrote the Foreword as a final expression of years of encouragement. Dr. Edward L. Compere crowned my effort by writing the Introduction, having first reviewed some of the material in its early stages and, later, all in its final form.

Special credit should be given to Miss Ethel H. Davis for superbly editing and organizing the manuscript.

It is tempting to list those who gave me direction in one way or another: Dr. Peter A. Rosi, Dr. Charles N. Pease, Dr. Joseph P. Cascino, Dr. Steven O. Schwartz, Dr. Caesar Portes, Dr. Abe Rubin, and Dr. Harold Wheeler. The skill of my artists, Miss Edith Hodgson, Miss Gloria Jones, and Dr. Allen Whitney, must not go unsung. And to all, mentioned or not, in the measure of their interest, my gratitude!

Only wives whose husbands have attempted the writing of books and the husbands who have known the stamina of their wives during the process can appreciate how much meaning there is in my dedication to Frances DuVries.

*Now Presbyterian-St. Luke's Hospital.

Henri L. DuVries, D.P.M., M.D.
1959

Prefatory note to third edition

I am deeply indebted to Dr. Verne T. Inman for his diligent editing, his original contributions, and the extensive qualitative changes he made in the revision of this text.

It has been very gratifying to observe the tremendous interest and progress the healing arts have made in recent years in both the care and knowledge of the diseases and deformities of the human foot—disorders that, although they have comprised a most common human ailment, have been practically ignored in the past. This marked advancement is evidenced within the fields of orthopaedic surgery and podiatry, and in the quality of training that is presently offered in the colleges of podiatry.

My profound gratitude also goes to the faculty of the University of California School of Medicine in San Francisco for their extensive contributions to this edition. Much credit must be given to Eleanor Haas for her splendid editing of the manuscript, and to the artist Mark Mikulich for his excellent drawings, photographs, and x-ray illustrations.

Henri L. DuVries, D.P.M., M.D.
Oakland, California

Contents

Part one

Part one

1

Biomechanics of the foot and ankle

Verne T. Inman
Roger A. Mann

The initial chapters of this text on surgery will be devoted not to anatomy, as was done in the second edition, but to a discussion of the biomechanics of the foot and ankle. Specific relationships will be emphasized and some methods for functional evaluation of the foot will be presented. These alterations were initiated for several reasons.

First, it has been assumed that the orthopaedic surgeon possesses an accurate knowledge of the anatomic aspects of the foot and ankle. If this knowledge is lacking, textbooks of anatomy are available that depict in detail the precise anatomic structures that comprise this part of the human body. It seems redundant to devote space here to what can only be a superficial review of the anatomy of the foot and ankle.

Second, it seems mandatory that any textbook on surgery of the foot should begin with a discussion of the biomechanics of the foot and ankle as an integral part of the locomotor system. The human foot is an intricate mechanism that functions interdependently with other components of the locomotor system. No text is readily available to the surgeon that clearly enunciates the functional interrelationships of the various parts of the foot. Interference with the functioning of a single part may be reflected in altered functions of the remaining parts. Yet the surgeon is constantly called upon to change the anatomic and structural components of the foot. When so doing, he should be fully aware of the possible consequences of his actions.

Third, wide variations are known to occur in the component parts of the foot and ankle and these variations are reflected in the degree of contribution of each of these parts to the behavior of the entire foot. Depending on the contributions of an individual component, the loss or functional modification of that component by surgical intervention may result in either minimal or major alterations in the functional behavior of adjacent components. An understanding of basic interrelationships may assist the surgeon in explaining to himself why the same procedure performed on the foot of one person produced a satisfactory result while the result was unsatisfactory in another person.

Fourth, by being alert to the mechanical behavior of the foot, the physician may find that some foot disabilities caused by malfunction of a component part can be successfully treated by nonsurgical procedures rather than attacked surgically as has been customary. Furthermore, some operative procedures that fail to achieve completely the desired result can be further improved by minor alterations in the behavior of adjacent components through

shoe modification or the use of inserts. An understanding of the biomechanics of the foot and ankle should, therefore, be an essential aid in surgical decision-making and contribute to the success of postoperative treatment.

THE LOCOMOTOR SYSTEM

The human foot is too often viewed as a semirigid base, the principal function of which is to provide a stable support for the superincumbent body. In reality the foot is poorly designed for this purpose. Standing for prolonged periods of time can result in a feeling of fatigue or can produce actual discomfort in the feet. One always prefers to sit rather than stand. Furthermore, it is far less tiring to walk, run, jump, or dance on normally functioning feet—either barefooted or in comfortable shoes—than it is to stand. It appears, therefore, that the foot has evolved as a dynamic mechanism functioning as an integral part of the locomotor system and should be studied as such rather than as a static structure designed exclusively for support.

Since human locomotion involves all major segments of the body, it is obvious that certain suprapedal movements demand specific functions from the foot and that alterations in these movements from above may be directly reflected below by changes in the behavior of the foot. Likewise, the manner in which the foot functions may be reflected in patterns of movement in the other segments of the body. Therefore, the basic functional interrelationships between the foot and the remainder of the locomotor apparatus must be clearly understood.

To begin a review of the locomotor system, one must recognize that ambulating man is both a physical machine and a biologic organism. The former makes him subject to the physical laws of motion, the latter to the laws of muscular action. All characteristics of muscular behavior are exploited in locomotion; for example, when called upon to perform such external work as initiating or accelerating angular motion around joints, muscles rarely contract at lengths below their resting lengths (Bresler and Berry, 1951; Ryker, 1952; Close and Inman, 1953). When motion in the skeletal segments is decelerated or when external forces work upon the body, activated muscles become efficient. Activated muscles, in fact, are approximately six times as efficient when resisting elongation as they are when shortening to perform external work (Abbott et al., 1952; Asmussen, 1953; Banister and Brown, 1968). In addition, noncontractile elements in muscles and specific connective-tissue structures assist muscular action. Thus, human locomotion is a blending of physical and biologic forces, which compromise to achieve maximal efficiency at minimal cost.

Man uses a unique and characteristic orthograde bipedal mode of locomotion. This method of locomotion imposes gross similarities in the manner in which all of us walk. However, each of us exhibits minor individual differences that permit us to recognize a friend or acquaintance even when he is viewed from a distance. The causes of these individual characteristics of locomotion are many. Each of us differs somewhat in the length and distribution of mass of the various segments of the body—segments that must be moved by muscles of varying fiber lengths. Furthermore, individual differences occur in the position of axes of movement of the joints, with concomitant variations in effective lever arms. Such factors as these and many more combine to establish in each of us a final idiosyncratic manner of locomotion.

A smoothly performing locomotor system results from the harmonious integration of its many components. This final integration does not require that the specific contribution of a single isolated component be identical in every individual, nor must it even be identical within the same individual. The contribution of a single component varies under different circumstances. Type of shoe, amount of fatigue, weight of load carried, and other such variables can cause diminished functioning

of some components with compensatory increased functioning of others. An enormous number of variations in the behavior of individual components is possible; however, the diversely functioning components, when integrated, are found to be complementary and will produce smooth bodily progression.

Average values of single anthropometric observations are in themselves of little value. The surgeon should be alert to the anthropometric variations that occur within the population, but it is more important for him to understand the functional interrelationships among the various components. This is particularly true in the case of the foot, where anatomic variations are extensive. If average values are the only bases of comparison, it becomes difficult to explain why some feet function adequately and asymptomatically, although their measurements deviate from the average, while others function symptomatically, even though their measurements approximate the average. It appears reasonable, therefore, to use average values only to provide a mathematical reference for demonstrating the extent of possible deviations from these averages. For these reasons, emphasis will be placed upon functional interrelationships and not upon descriptive anatomy.

Human locomotion is a learned process; it does not develop as the result of an inborn reflex. This statement is supported by Popova (1935), who studied the changing gait in growing children. The first few steps of an infant holding onto his mother's hand exemplify the learning process that is necessary to achieve orthograde progression. Scott (1969) of the Canadian National Institute for the Blind noted that congenitally blind children never attempt to stand and walk spontaneously but must be carefully taught. The result of this learning process is the integration of the neuromusculoskeletal mechanisms, with their gross similarities and individual variations, into an adequately functioning system of locomotion. Once a person has learned to walk and has attained maximal growth, there appears to be a built-in regulatory mechanism that will work whether the person is an amputee learning to use a new prosthesis, a long distance runner, or a woman wearing high heels. Ralston (1958) has noted that nature's sole aim with all of us seems to be to achieve a system that will take us from one spot to another with the least expenditure of energy.

THE KINEMATICS OF HUMAN LOCOMOTION

Walking is more than merely placing one foot before the other. During walking all major segments of the body are in motion and displacements of the body occur that can be accurately described.

Vertical displacements of the body

The rhythmic upward and downward displacement of the body during walking is familiar to everyone. It is particularly noticeable when someone is out of step in a parade. These displacements in the vertical plane are obviously a necessary concomitant of bipedal locomotion. When the legs are separated, as during the period of transmission of the body weight from one leg to the other (double weight bearing), the distance between the trunk and the floor must be less than when it passes over a relatively extended leg as it does during midstance. Since the nature of bipedal locomotion demands such vertical oscillations of the body, they should occur in a smooth manner for the conservation of energies. Fig. 1-1 shows that the center of gravity (C.G.) of the body does displace in a smooth sinusoidal path; its amplitude is approximately 4 to 5 cm. (Ryker, 1952; Saunders et al., 1953).

While movements of the pelvis and hip modify the amplitude of the sinusoidal pathway, the knee, ankle, and foot are particularly involved in converting what would be a series of intersecting arcs into a smooth, sinusoidal curve (Saunders et al., 1953). This conversion requires both