

SECOND EDITION

**ATLAS OF LIMB PROSTHETICS:
SURGICAL, PROSTHETIC, AND REHABILITATION PRINCIPLES**
American Academy of **Orthopaedic** Surgeons

SECOND EDITION

Atlas of Limb Prosthetics: Surgical, Prosthetic, and Rehabilitation Principles

American Academy of Orthopaedic Surgeons



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FOREWORD

As was true in the first edition of *Atlas of Limb Prosthetics*, the editors' design in this new volume relates the surgical procedure of amputation to the rehabilitation of the amputee. The enlightened surgeon will view an amputation as a reconstructive procedure, and he will measure his success by the degree to which function can be restored to a previously diseased, damaged, or malformed limb. When amputation is performed, however, a new pathology is introduced. It is of the utmost importance that the newly fashioned limb is compatible with optimum prosthetic restoration. The amputee will achieve maximum functional restoration only if a satisfactory union occurs between a well-constructed residual limb and a prosthesis of sound design.

The amputation surgeon is therefore obligated to have some basic knowledge of *kinesiology*, kinetics, and modern prosthetic design. Similarly, the prosthetist and therapist must have basic knowledge of each others' disciplines and of the options available to the surgeon given the clinical situation. The special knowledge possessed by these three key members of the amputee rehabilitation team ideally should overlap and be constantly reinforced and expanded through working and learning together in the clinical setting.

This atlas, written by recognized experts in the field of amputation surgery and rehabilitation, emphasizes the importance of the interdisciplinary care concept and provides a common educational source for those professionals who care for the amputee population. The real value of this text to individual practitioners is the opportunity afforded to acquire basic and useful knowledge in disciplines other than their own. In addition, this volume will certainly be an invaluable resource to students in all of the health care professions that bear on rehabilitation of the amputee. The most important beneficiary of this work, however, will be the individual with congenital or acquired limb loss, whose care will undoubtedly have been improved by those who learn from these pages.

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FOREWORD

The remarkable advances in prosthetic rehabilitation over the past half century are reflected in the growth of literature on this topic. When I began my training as a prosthetist in the 1930s, the only available reference material was a brief handbook prepared by the Ministry of Pensions summarizing the British experience in managing the influx of amputees following World War I.¹

The next major text in this field did not appear until well after World War II, when the American Academy of Orthopaedic Surgeons produced the progenitor to this volume: the two-part *Orthopaedic Appliances Atlas*.^{2,3} *Volume 2: Artificial Limbs* was a landmark publication that introduced the scientific foundation for prosthetic practice, including such innovative concepts as individualized dynamic alignment, biomechanical principles to guide socket design, the use of externally powered or fluid-controlled prostheses, and treatment by a clinic team composed of surgeons, prosthetists, and therapists.

An additional 20 years elapsed before the immediate predecessor to this volume was published, the *Atlas of Limb Prosthetics: Surgical and Prosthetic Principles*.⁴ Although several other texts on prosthetics appeared during those two decades, the *Atlas of Limb Prosthetics* has been widely acknowledged as the definitive work.

The pace of innovation and discovery in prosthetics is reflected in the publication of the present volume, scarcely a decade later. Numerous new chapters highlight recent information on such topics as myoelectric fittings, surgical limb salvage, socket design and componentry, sports and recreational activities, and pediatric management. The new subtitle—*Surgical, Prosthetic, and Rehabilitation Principles*—emphasizes a

focus on individual rehabilitation as well as medical and technical expertise.

Nearly half the contributing authors to this latest edition are prosthetists, therapists, and engineers—reflecting the maturation of the interdisciplinary team since that concept was inaugurated in the original volume more than 30 years ago. In addition to presenting the best in contemporary thinking and the most recent advances in prosthetic technology and management, the second edition reflects the sustained efforts of all members of the rehabilitation team to enable the amputee to enjoy an active, productive, and independent life.

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PREFACE

The present volume is the third generation in a series sponsored by the American Academy of Orthopaedic Surgeons on the subject of prosthetic limbs and the closely related subjects of amputation surgery and amputee rehabilitation. Volume 2 of the *Orthopaedic Appliances Atlas: Artificial Limbs*, published in 1960, was the first compendium specifically designed to be useful to all members of the emerging prosthetic team. Slow but steady progress in prosthetic research, development, and application occurred over the next two decades. This was augmented by the education of teams consisting of amputation surgeons, prosthetists, and therapists given at several major universities. The demonstrated need for an updated version of the *Atlas* led to the publication in 1981 of the first edition of the *Atlas of Limb Prosthetics*, which further reflected the interdisciplinary nature of this vital work.

Over the past decade, explosive growth, fueled by two preeminent forces, has occurred in the field of prosthetics. One has been the progressive availability, through technology transfer, of lighter, stronger, and more durable metal and plastic materials with remarkable ranges of flexibility and fatigue resistance. Progressive prosthetists and engineers were quick to incorporate these materials in new socket and component designs. A second force has been consumer demand for lighter, stronger, more comfortable, and more functional prosthetic devices that can allow a return to the full range of activities enjoyed before limb loss, including participation in active sports and recreation. The amputee of today is no longer a passive consumer of services, but is often well informed on suitable amputation techniques and the latest in prosthetic design, through a nationwide network of support/education groups.

The present edition has attempted to incorporate most of the significant advances of the past decade while retaining desirable features of the previous edition, such as its overall organization and a few classic, but updated chapters. Discussions of therapy and pros-

thetic use-training, which were formerly repeated for each amputation level, now appear as major cohesive chapters in each section to provide greater clarity and to avoid redundancy. The chapter on prevention and correction of complications has been greatly expanded to enhance its practical usefulness.

Because of recent advances in vascular and tumor surgery resulting in limb salvage, a multisectional chapter on the alternatives to amputation has been added. This is of particular importance in the dysvascular or diabetic patient, in whom the opposite limb remains at risk of future amputation.

The reader will note that the recently adopted International Standards Organization (ISO) nomenclature has been used throughout the book to designate both level of amputation and the corresponding prosthesis. The literal translation of these anatomic terms into most languages now makes sense, thereby aiding international communication.

It is hoped that these changes will enhance the book's usefulness to all members of the prosthetic team, including amputation surgeons (whether orthopaedic, vascular, or general), physiatrists, prosthetists, physical and occupational therapists, recreational therapists, bioengineers, rehabilitation nurses, and the amputee consumer.

The support of the Board of Directors of the American Academy of Orthopaedic Surgeons made this work of the Committee on Rehabilitation, Prosthetics, and Orthotics possible and is gratefully acknowledged. Section editors Bertram Goldberg, M.D., and Thomas J. Moore, M.D., consultant Sidney Fishman, Ph.D., Committee Chair David Apple, M.D. and James Ryan of Mosby-Year Book, Inc. contributed greatly to the timely production of this book. A special thanks is due our respective secretaries, Ms. Patsy Bain and Mrs. Susan Cronin.

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