CARE OF THE COMBAT AMPUTEE
The Coat of Arms
1818
Medical Department of the Army

This book is dedicated to the men and women of the armed forces who have been injured in their service to the United States, and to the men and women of the Department of Defense, Department of Veterans Affairs, and the civilian sector who have met the challenge to provide these heroes and their families with the highest quality of care, promoting unprecedented functional recovery and full participation in society.
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US Army World Class Athlete Program Paralympic sprinter hopeful Sergeant Jerrod Fields, seen here working out at the US Olympic Training Center in Chula Vista, California, won the 100 meters with a time of 12.15 seconds at the 2009 Endeavor Games in Edmond, Oklahoma, on June 13.

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Foreword

Our country’s Warriors—Soldiers, Sailors, Airmen, and Marines—who are wounded or injured as a consequence of their service deserve the highest quality care available. The leadership of the Department of Defense and of the Army have firmly declared that aside from fighting and winning our current conflict, the comprehensive, state-of-the-art care of our wounded, ill, and injured Warriors is the most important mission of the US Military. Despite more destructive weapons and horrific wounds, the men and women of Military Medicine, as a whole, have continuously adapted to changing requirements and have developed comprehensive rehabilitative methods. This approach, combined with the goal of restoring our wounded service members to the highest possible functional level, is resulting in the optimal reintegration of our wounded Warriors and the best opportunity for return to uniformed service and/or productive civilian life. For example, even as this textbook goes to print, elements of the US Army Medical Command in its Warrior Transition Command are developing tools and processes (“Comprehensive Transition Plans”) for tailoring this optimal reintegration for all Soldiers.

Today, service members with amputations receive rapidly progressive rehabilitation. To enhance recovery—and in some respect recapturing lessons learned from rehabilitative care in prior conflicts—three designated military facilities across the continental United States—Walter Reed Army Medical Center in Washington, DC; Brooke Army Medical Center in San Antonio, Texas; and Balboa Naval Medical Center in San Diego, California—maintain multidisciplinary teams of highly trained professionals, each contributing to a decisive continuum of care from the earliest phases of recovery and healing to reintegration into military or civilian life. Comprised of experts from more than a dozen specialties, these teams work together in addressing the rehabilitative, social, family, vocational, and spiritual needs of our service members, while simultaneously incorporating leading-edge technology, innovative research, and collaboration with Department of Veterans Affairs and civilian institutions. Excellent outcomes are being achieved, and the lessons learned from this young, athletic population are providing significant contributions to the healthcare of other service members, as well as civilians with major limb amputations.

More than a decade has elapsed since the previous Textbook of Military Medicine specifically addressed rehabilitative aspects of war injuries. It is fitting that knowledge of the evolution and application of our current approach to rehabilitation for the combat amputee—a collaborative and integrated team approach—be recorded in this latest volume of the series. The publication of this textbook, Care of the Combat Amputee, will serve as a valuable reference for healthcare practitioners in and out of uniform and will further facilitate establishment of best practices in the multidisciplinary spectrum of amputee care.

Accomplished through collaboration among the armed services, the VA, and the civilian sector with a common goal of achieving preeminent medical treatment, comprehensive training, and cutting-edge research, this volume will serve as a milestone in a long tradition of patient care. The book was completed through the tireless efforts of the authors, guided by the exceptional leadership of Colonel Paul F Pasquina, MD, and Rory A Cooper, PhD; the dedicated staff of the Borden Institute; and the Pittsburgh VA Rehabilitation Research and Development Center team, on behalf of service members, veterans, and their families. It is a tribute to the dedication of the men and women who serve our nation and to those who care for our wounded Warriors.

Lieutenant General Eric B. Schoomaker, MD, PhD
The Surgeon General and
Commanding General, US Army Medical Command

Washington, DC
November 2009
Preface

The Department of Veterans Affairs (VA) succeeded the Veterans Administration in 1989. VA operates the nation’s largest integrated healthcare system, providing a broad spectrum of medical, surgical, and rehabilitative care. VA’s vocational rehabilitation and employment programs help veterans with service-connected disabilities achieve maximum independence in daily living, and, to the greatest extent feasible, obtain and maintain employment. Additionally, VA manages the largest medical education and health professions training program in the United States, and VA research has earned an international reputation for excellence in areas such as aging, chronic disease, assistive devices, and mental health. Studies conducted within VA help improve medical care not only for veterans but also for the nation at large. Because 7 in 10 VA researchers are also clinicians, VA is uniquely positioned to translate research results into improved patient care. About 60% of VA employees are veterans, and more than 24% of these are disabled. Three hold the Medal of Honor.

Advances in body armor and battlefield medical care have helped to prevent damage to vital organs and stem blood loss, saving lives of service members injured in Iraq and Afghanistan. At the same time, increasing numbers of service members are experiencing traumatic injuries to their extremities that can result in amputation, followed by the fitting of a prosthetic limb and assistive devices. To meet the challenge of providing the best care possible to veterans with limb amputations at this critical time and for the remainder of their lives, VA and DoD have collaborated at unprecedented levels, as well as working with leading clinicians, prosthetists, and bioengineers from academia and industry.

A central theme of VA–DoD collaboration is the team approach to prosthetics care—in particular, engineers working closely with clinicians to ensure that devices are designed to fit the needs of veterans. Colonel Paul F Pasquina, MD, MC, USA, chair of the Integrated Department of Orthopaedics and Rehabilitation of Walter Reed Army Medical Center and National Naval Medical Center, and Rory A Cooper, PhD, director of the VA Rehabilitation Research & Development Center in Pittsburgh, have assembled experts throughout the diverse range of disciplines that work together to care for military and veteran amputees, from battlefield evacuation and surgery through therapy, rehabilitation, and community reintegration, to create this seminal work in the annals of military and VA medicine. Doctors Pasquina and Cooper are to be commended for their dedication to providing the highest quality of care to veterans with disabilities, and for compiling this outstanding record of the programs, processes, medical care, and technological advances that maximize the opportunities for our combat amputees from Iraq and Afghanistan to lead full and productive lives.

The addition of Care of the Combat Amputee to the Textbooks of Military Medicine series from the Borden Institute, an agency of the US Army Medical Department Center & School, provides comprehensive coverage of current and emerging care of combat amputations. The dedicated personnel working in our nation’s military and veterans’ organizations are making substantial medical, rehabilitative, technical, administrative, and social advances. We all strive to provide the best available care to those most seriously injured in Iraq and Afghanistan. Injuries can change the life of a service member in an instant, but the rebuilding process can take years. The veterans who have left their limbs on the battlefield have done so in the service of all of us. The resilience and spirit of these men and women serve as an inspiration to us all.

Hon. Michael J. Kussman, MD, Brigadier General, US Army (Retired)
Under Secretary for Health, Veterans Health Administration
US Department of Veterans Affairs

Washington, DC
May 2008
Prologue

“As we express our gratitude, we must never forget that the highest appreciation is not to utter words, but to live by them.”

—John Fitzgerald Kennedy

This book represents the cumulative work of some of the world’s best minds in medical, surgical, and rehabilitative care. Dozens of people gave freely of their time in preparing and editing chapters, adding up to thousands of hours of work over a period of about 4 years. Because of the criticality of the topic and its historical impact, the book was written with close collaboration among authors via both e-mail and the Internet. Because face-to-face communication is also essential, we assembled experts within the core topic areas to lead discussion groups in reviewing materials for each chapter in detail. This 3-day meeting was held in September 2007—the first scientific meeting held at the Center for the Intrepid at Brooke Army Medical Center. Throughout the period of Operation Enduring Freedom and Operation Iraqi Freedom, care of combat amputees has made tremendous progress, accompanied by growing collaboration among clinicians and scientists within the Department of Defense and Department of Veterans Affairs. Many individuals from academia, industry, veterans’ service organizations, and the public at large have made important and lasting contributions.

We have attempted to cover the spectrum of issues involved in combat amputee care while remaining focused on the service member or veteran with major limb amputation. The book is intended to serve as a reference for experienced clinicians; a textbook for students, residents, and fellows; and a source for researchers, as well as a historical document for posterity. This work was completed during a time of war, when despite the arrival of new wounded on a nearly daily basis to military and veteran medical centers, new programs were established, benefits were expanded, and medical care improved at a rapid pace, as has been the case during times of war over the centuries.

Topics covered follow the course of care and community reentry of service members with combat-related major limb amputations, from surgical complications and treatments in theater through follow-up care and even multiple revisions. Acute and outpatient rehabilitation is described, including comorbidities, complications, and outcomes. Therapeutic interventions are detailed, and many breakthroughs in active rehabilitation are noted throughout the textbook. Emerging technologies and the processes of fitting prosthetics are presented to the reader. Opportunities for sports and recreation, a critical aspect of successful rehabilitation and community reintegration, are described. Learning to challenge one’s perception of self and master new abilities is often accomplished through these activities. The complex systems and structures for providing medical care and the benefits earned by wounded and injured service members can be difficult to navigate; we have attempted to summarize and clarify these systems. The entire book is thoroughly referenced to the scientific, clinical, and public-policy literature. If successful, this book will serve as a guide for years to come.

It has taken an entire cadre of professionals to create this volume, and it has been completed with a great sense of commitment and honor. There is no greater calling than to help other people, especially those with debilitating injuries. In addition to the authors and editors, a number of other people were critical to seeing this product to completion: Christine Heiner, Joan Redding and other Borden Institute staff, Colonel Martha Lenhart, Paula Stankovic, Colonel (Retired) Charles Scoville, Troy Turner, Colonel (Retired) Rebecca Hooper, Lieutenant Colonel Rachel Evans, and Amy Donovan made critical contributions to keeping the book on track and of the highest quality. Brad Impink, Jen Collinger, Michelle Sporner, Amol Karmarkar, and Garrett Grindle, all graduate students at the University of Pittsburgh, and Sharon Weeks from Walter Reed Army Medical Center provided invaluable assistance in writing, editing, formatting, and coordinating chapters. Several of our colleagues also assisted with reviewing chapters and checking facts, for which we are grateful. We would like to acknowledge Kendra Betz, Cindy Poorman, Lucille Beck, Barbara Sigford, John Milani, and Billie Randolph for their comments. This book was conceptualized under the leadership of Lieutenant General (Retired) Kevin Kiley, MD, during his tenure as Surgeon General of the Army; it was wholeheartedly and seamlessly supported by his successor, Lieutenant General Eric Schoomaker, MD, PhD.

Brigadier General (Retired) Michael Kussman, MD, the Under Secretary for Veterans Health, provided his unwavering commitment to completion of this project. We are both especially very thankful to our wives and families for their love and support, allowing us to take time away from them to complete this volume and to
care for wounded, injured, and ill veterans and active duty soldiers. We also owe a debt of gratitude to Arnold Fisher and the Intrepid Fallen Heroes Fund, for their private donations in support of the Center for the Intrepid, and to Congressional leaders who secured government funding to build the Military Advanced Training Center.

For us this has been a labor of love, and has afforded us a tremendous opportunity to learn, connect with other professionals, expand upon research efforts, and influence policy and practice. Most importantly, we share deeply in the commitment to improve outcomes for wounded service members and their families. It is with a great sense of satisfaction and humility that we present this volume to present and future generations of healthcare professionals.

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