

Chapter 1

PHYSIATRY, PHYSICAL MEDICINE, AND REHABILITATION: HISTORICAL DEVELOPMENT AND MILITARY ROLES

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INTRODUCTION

Physical medicine and rehabilitation (PMR) has long been intimately associated with the military. In fact, the medical treatment required for war casualties during the conflagrations of World War I and World War II provided the primary stimulus for the extensive growth and development in the field of rehabilitation. The vast experience gained in rehabilitating the many wartime casualties educated military medical officers to the tremendous positive impact of rehabilitation on the care of all patients, not just soldiers. Indeed, the basic tenets of exercise, early range-of-motion exercise, and early mobilization and training, which underwent development and worked well during wartime, still hold true today. To a great extent, the medical spe-

cialty within PMR, Physiatry, owes its birth to the pioneering military medical officers who helped established it as a medical specialty in 1947.¹⁻³ Other rehabilitation professionals, physical therapists, and occupational therapists, also trace their beginnings to the military.

The purpose of this chapter is to summarize the historical development of physiatry and to define the role of PMR in the modern military. Historical support and recent experience will provide the basis for recommending that physiatrists and other rehabilitation professionals be utilized at large medical centers during conflict and peacetime, and at corps level theater hospitals during a major sustained conflict.

HISTORY OF PHYSIATRY

The field of physiatry dates back to the two major wars of the 20th century. Its development was in direct response to the considerable need for wounded soldiers to recuperate and return to duty. Initially, physiatry had close ties to the burgeoning application of physical modalities in the care of injured patients. The name physiatrist (pronounced fiz-ee-at'-rist) is derived from the Greek words *physis*, pertaining to physical phenomena, and *iatreia*, referring to healer or physician.⁴ Thus, the physiatrist is a physician who employs physical agents.

During World War I, extensive utilization of "physical reconstruction services" was instituted to improve the functional restoration of injured soldiers. In 1917, Major Frank B. Granger, U.S. Army Medical Corps, was designated director of the physiotherapy service of the reconstruction division. Under his leadership, reconstruction units were set up in 35 general hospitals and 18 base hospitals throughout the United States.¹ Commanders were enthusiastic about the program because many injured soldiers could return to full duty status on discharge from the hospital.

Physicians who practiced physical therapy in the 1920s helped develop the field. Radiologists, strangely enough, were the first group to use physical measures to treat patients, and the first organization for physicians using physical agents was the American College of Radiology and Physiotherapy.⁵ However, by 1938 it was obvious that physical therapy physicians had distinctly different interests from the radiologists, and at this time the name of

the official journal, *Archives of Physical Therapy, X-ray and Radium*, was changed to *Archives of Physical Therapy*. In 1945, the journal became simply *Archives of Physical Medicine*.⁵ Later, it became the *Archives of Physical Medicine and Rehabilitation*, the premiere journal in the field of rehabilitation. Those dedicated and enlightened physicians who implemented physical therapy as part of their treatment during these early years promoted, encouraged, developed, and established the field of rehabilitation medicine. The military history of physical reconstruction⁶ illustrates well how occupational aides and physiotherapy aides worked together with physicians in rehabilitating wounded soldiers. Several books were published during and after World War I that described this early rehabilitation.⁶⁻⁸ These texts described approaches employed in different countries to meet the overwhelming vocational needs of returning soldiers. The U.S. Army system was patterned after those of its allies—Great Britain, France, and Italy—who already had well developed systems for reconstruction. The German army had already perfected its physical reconstruction programs at this time, also.⁶

In the U.S. Army, certain military hospitals were designated as reconstruction centers. Colonel Frank Billings, Medical Corps officer, was chief of the reconstruction division during World War I. He described this program as "continued treatment of patients to the degree of complete physical and functional restoration as is consistent with the nature of their several disabilities."^{6(p42)} Following World War I, the reconstruction organization de-

creased in size substantially. During the peacetime years between World War I and World War II, army physical therapy and occupational therapy departments continued to operate, albeit on a smaller scale, due to the vision and foresight of medical officers who advocated and supported these activities.¹ Many of these physical therapy physicians were from Europe and Scandinavia, where hydrotherapy or spa therapy enjoyed great respectability.⁵ In 1938, a handful of physicians who practiced physical therapy in the United States founded the Society for Physical Therapy Physicians. These physicians included Dr. John S. Coulter, from Northwestern University Medical Center, Dr. Frank H. Krusen, of the Mayo Clinic, and Dr. Walter J. Zeiter, from the Cleveland Clinic. In 1939, the term “physiatrist” was proposed by Dr. Krusen who recognized the word’s similarity to psychiatry and, therefore, suggested its current pronunciation.

The field of physiatry developed rapidly in response to social and medical cataclysms. Between 1939 and 1941, the demand for physiatrists in military hospitals far exceeded the availability. Many army physicians were sent to Rochester, Minnesota, for 3 months of training in physical therapy under Dr. Krusen at the Mayo Clinic.⁵ These physiatrists were referred to as “90-day wonders.” The focus of physical medicine was broadened from restoration of ambulation and strength alone to comprehensive rehabilitation of the individual—mentally, emotionally, vocationally, and socially.

Dr. Howard A. Rusk was a lieutenant colonel in the U.S. Army Medical Corps during World War II and he reintroduced active rehabilitation into U.S. Army Air Corps hospitals. Rusk noted that during convalescence, deconditioning and boredom were rampant.⁹ He also noted that on discharge many soldiers could not return to duty and frequently required readmission to medical care. In his own words,

I began to realize that military medicine was different from civilian medicine. From a military point of view, you were either a patient or a soldier. If you were a soldier, it meant you got full duty with whatever that involved, perhaps a 10-mile hike with full pack. . . . It seemed obvious to me that men did not get ready for full duty by playing blackjack or listening to the radio.^{9(p463)}

Rusk introduced early ambulation and exercise following surgery. Aided by Bernard Baruch, he persuaded President Franklin D. Roosevelt to establish a rehabilitation program in the army air corps. Soon other branches of the military followed

suit.¹⁰ In 1943, seven convalescent hospitals were established.⁹ “Here,” Rusk stated, “men were treated, not diseases.” During this time, scientific studies began to appear that indicated that early activity had far greater benefits than prolonged bed rest. In fact, in 1944 at the 94th annual session of the American Medical Association, there was a symposium entitled “The Abuse of Rest in the Treatment of Disease.”⁵ Soon, other military services adopted Rusk’s concepts and after World War II, he referred to rehabilitation as “the third phase of medical care.” This helped to clarify and to also defuse any possible misunderstanding or animosity about physiatry taking over some aspects of other specialties.

During World War II, several events propelled physical medicine forward. First, a noted philanthropist, Bernard Baruch, formed and financed the Baruch Committee. This committee, chaired by Dr. Ray Lyman Wilbur, was to develop ways to expand the field of physical medicine and maximize its contribution to the care of injured soldiers and sailors.⁵ The committee was composed of subcommittees on education, teaching, research, public relations, rehabilitation, hydrology, occupational therapy, prevention, and body mechanics. The insightful work of the Baruch Committee members (which included Dr. Krusen; Lieutenant Colonel Benjamin A. Strickland, Jr., U.S. Army Medical Corps; Charles F. Behrens, U.S. Navy Medical Corps; and Dr. Rusk, to name a few) produced a blueprint for the organized growth, development, and promotion of physiatry. Five recommendations from this committee were: (1) the establishment of teaching and academic research centers at selected medical schools; (2) the establishment of residencies and fellowships in PMR; (3) promotion of teaching and research; (4) promotion of wartime and postwar physical rehabilitation; and (5) the development of an American Board of Physical Medicine under the auspices of the American Medical Association, Council on Medical Education, and the Advisory Board for Medical Specialties.

The Baruch Committee awarded funds to develop physiatry programs at selected universities. Perhaps one of the committee’s greatest contributions was to award fellowships to selected physicians, enabling them to receive intensive training in PMR. These individuals included many of the early leaders in physiatry and provided a cadre of well trained academicians to direct residencies and PMR programs.⁵

Around 1945, a section on Physical Medicine and Rehabilitation was established in the American

Medical Association. By February 1947, the requirements for a specialty board were met and the American Board of Physical Medicine (ABPM) was recognized by the American Medical Association Advisory Council for Medical Specialties. Initially, the American Board of Medical Specialties saw no difference between the specialty of physical medicine and that of rehabilitation. Yet during World War II, these factions had been distinct, with the rehabilitation concept and its team approach to care including corrective therapists, occupational therapists, vocational education specialists, and recreation personnel organized under the team physiatrist. Because both factions were included in the ABPM, this continued the competition that had been spawned in the 1930s between physical medicine factions and those championing rehabilitation. In 1949, the ABPM, with guidance from the Advisory Board of Medical Specialties, became the American Board of Physical Medicine and Rehabilitation (ABPM&R),⁵ which it remains to this day, and this quelled the discord between these factions.

The next impetus to the growth of physiatry was the polio epidemic of the late 1940s and 1950s.¹¹ The many patients afflicted with this disease required extensive rehabilitation, with joint, range-of-motion, and other exercises; gait training; activities of daily living (ADL) training; along with orthotic bracing. Concentration of interest in these areas due

to tremendous patient needs stimulated PMR to cultivate research, education, and patient care activities, thus advancing the body of rehabilitation knowledge and experience.¹¹

Through the 1950s, 1960s, 1970s, and 1980s, continued research, resident training, and greater recognition by other medical specialties firmly established physiatry as a vital, patient-care specialty. The concept of an interdisciplinary team establishing concurrent goals was pioneered by physiatrists and therapists and is now being emulated in other medical and surgical specialties. Legislation during this time (the Vocational Rehabilitation Act Amendments in 1954, the Hill-Burton Act Amendments including special programs for construction of rehabilitation facilities, and the enactment of Medicare and Medicaid in 1965) recognized the need for rehabilitation. The more recent Americans with Disabilities Act of 1990 (Public Law No. 101-336, July 26, 1990), clearly promotes the rehabilitation philosophy in protecting the rights of the disabled. Perhaps the strongest recognition of PMR as a scientific medical specialty was the establishment of the National Center for Medical Rehabilitation Research within the National Institutes of Health. The influential efforts of Dr. Justus F. Lehmann along with many others, led to creation of this landmark institution which solely supports PMR research.¹⁰

PHYSICAL MEDICINE AND REHABILITATION

Physiatrists are specialty-trained physicians educated through medical school, a year of internship, and three years of residency, then certified by specialty board certification in Physical Medicine and Rehabilitation. Whereas many other medical and surgical specialties have procedures or organ systems that, to a large extent, govern their interventions and define their specialty, physiatry crosses many disciplines. The physiatrist is concerned with the functional restoration of the patient, in addition to the care of medical and surgical needs. Both the army and the civilian sectors accept the role of the physiatrist as a consultant to the primary care team, such as an orthopedic service at a major military hospital, and as the primary physician on a rehabilitation unit.

Physical and cognitive limitations can occur as a result of disease and injuries. The physiatrist addresses the functional and vocational limitations resulting from a soldier's primary injuries. These limitations include muscle and joint contractures, deconditioning due to immobility, ambulation, and

ADL impairments, and vocational (military service) impediments. The physiatrist possesses special knowledge of the pathophysiology of disease processes and the functional consequences that impact the patient. In addition, the physiatrist has a broad working knowledge of physical therapy, occupational therapy, and other interventions initiated by the rehabilitation team that can overcome patients' functional problems. Physicians who know the prognosis, the treatments required, and the current precautions regarding limitations of activities that allow healing of injuries, are in the best position to direct the team. For these reasons, a physiatrist, or other primary physician, coordinates the rehabilitation care team.

Rehabilitation services also encompass those professionals who utilize their special training in the prevention and treatment of disability. These include physiatrists, physical therapists, and occupational therapists. In the military, the development of physical therapy and occupational therapy is intimately related to that of physical medicine

and rehabilitation (physiatry). World War I saw the beginnings of physical therapy and occupational therapy. World War II witnessed dramatic expansion of these disciplines born from the necessity to care for vast numbers of war-injured soldiers. The roles of physical therapists and occupational therapists will be briefly discussed as they relate to the PMR team. However, the military specific functions of these professionals are described in other chapters in this textbook. Historical roles during conflict and evidence that strongly supports the vital role of PMR in the military will be presented.

The Rehabilitation Team

The rehabilitation team in the army is typically composed of physicians, physical therapists, occupational therapists, and therapy technicians. The team may also include speech therapists, psychologists, social workers, and nurses. This is referred to as “interdisciplinary team management.” In contrast to conventional multidisciplinary care where each specialist forms his or her own diagnoses and set of goals, the interdisciplinary team establishes common goals that all members of the team adopt and implement with the injured soldier. This concept is crucial and provides the best possible rehabilitative care. The importance of close cooperation between physician and therapist was clearly underscored in World War II, when physical therapy was incorporated into the orthopedic sections in all hospitals.¹² Shands and Cleveland, of the OTSG in Washington, DC, stated that: “...the closer the cooperation between the chiefs of orthopedic surgery and physical therapy, the quicker and more satisfactory was their [the patients’] rehabilitation.”¹²⁽⁴⁶⁰⁾ This continues to be true today in the modern military and civilian sectors.

The rehabilitation team may greatly vary in composition depending on the combat situation, the military mission, and the needs of the military. For example, in an evacuation hospital in Vietnam, a team was composed of physical therapy aides and a physiatrist.¹³ In contrast, at Walter Reed Army Medical Center, during the Persian Gulf War in 1991, the rehabilitation teams included nurses, psychologists, physical therapists, occupational therapists, prosthetists, orthotists, and social workers, with physiatrists and primary care physicians directing the rehabilitative efforts.¹⁴

The rehabilitation team in the British Royal Air Force during World War II consisted of a medical officer responsible for all aspects of care and

rehabilitation of patients charged to him,¹⁵ one physical training instructor, and one masseuse. They cared for about 50 patients. A sergeant assisted the team and a sports officer coordinated a variety of athletic activities (golf, tennis, swimming, and volleyball). These activities served to strengthen the recuperating wounded casualty and had “considerable remedial value.”¹⁵

Rehabilitation: Not Just the Department of Veterans Affairs

It is a common misconception that rehabilitative care should be relegated mostly to the Department of Veterans Affairs (VA) Hospital system. This argument has been made in the past, but the historical record indicates that rehabilitative care must begin as early as possible in conjunction with military medical and surgical care. It is then continued throughout the injured soldier’s recuperation after transfer to a VA hospital and until maximum functional restoration is achieved, including return to gainful employment or full military service.

At the beginning of the United States’ participation in World War II, only the VA was responsible for rehabilitation of the casualty. It soon became apparent, particularly with respect to war-injured amputees, that the VA could not possibly handle the enormous workload.¹⁶ Therefore, the army assumed responsibility for the rehabilitation of amputees and established amputation centers at large military hospitals in the United States.

The concept of early intervention with rehabilitation was recognized even during World War I. In the book *Problems of War and Reconstruction: The Redemption of the Disabled*, the authors stated that

Again it has been amply demonstrated that the process of restoration, if it is to achieve the fullest measure of success, must be initiated early in the period of convalescence, and must be continuous and uninterrupted, sustaining the man with the inspiration of hope at every moment in his progress back from the front line first aid station, through the base and convalescent hospitals, on board the transport that brings him home from overseas, and during hospital convalescence after his return, until his restoration, physical, functional and vocational, is completed and he is fully established in a suitable employment.¹⁷

The thrust of PMR care in military hospitals is early intervention aimed at preventing complications of immobility that later hamper full rehabilitation. Rehabilitation, when instituted as soon

as injuries allow, prevents devastating joint contractures, deconditioning, and the psychological trauma of prolonged convalescence. Contractures develop after three weeks of immobilization, and significant deconditioning also occurs in this short time.¹⁸ If soldiers were to wait until they reached a VA facility before getting rehabilitative care, their full functional potential most likely could not be reached. In many cases, if soldiers develop anklosed joints, deconditioning, decubitus ulcers, deep venous thromboses, or other complications of immobility related to not being mobilized and exercised early, they will continue to be impaired despite later rehabilitative efforts by the VA. Additionally the psychological trauma and adjustment to a new disability is lessened with such occupational interventions as hobbies and crafts, which focus a soldier's attention and fill the long hours spent recuperating. For these reasons, rehabilitative care must be available for the injured soldier within a short period of time following injury. The military is charged with providing vital rehabilitative care to injured soldiers, beginning at evacuation hospitals and in medical holding companies where range-of-motion exercise and strengthening exercises can

be initiated, and continuing after evacuation to medical centers or prior to returning to duty.

The importance of early rehabilitation of the injured soldier was stressed during World War II in a report by the special exhibit committee on Physical Medicine (a subcommittee of the American Medical Association, under the chairmanship of Dr. Frank H. Krusen) where it was written

Delay in inaugurating rehabilitation procedures is the most frequent cause of failure. If there is too much delay in instituting a program of rehabilitation, muscular atrophy, fixation of joints, and mental depression may progress to a point at which complete restoration becomes impossible.^{4(p497)}

The role of military PMR with its various disciplines (physiatry, physical therapy, and occupational therapy) will vary depending on the current United States situation involving armed conflict; the needs of the military; the tactical situation; and the types, locations, and numbers of casualties being sustained. The remainder of this chapter will provide a historical framework on which to base recommendations for the various roles of physiatrists in the modern military.

PHYSICAL MEDICINE IN THE COMBAT THEATER

The U.S. Army medical corps' mission is "conserving the fighting force"; physiatrists, physical therapists, and occupational therapists greatly enhance and support that goal. The necessities of war demand that the rehabilitation teams in the combat theater be mobile and responsive to the needs of the hospital to which they are attached and, ultimately, to the field command. It must be remembered that the physiatrist is a trained physician and when necessary, due to the tactical needs of the unit, can provide advanced trauma life support, triage casualties, and care for medical problems (diarrhea, hepatitis, pneumonias, minor surgical injuries, and so forth) that frequently occur in army troops. In addition, physiatrists are recognized experts in the care of patients with musculoskeletal injuries. Because musculoskeletal problems frequently occur in active soldiers, a physiatrist can provide forward care for these specific problems. This allows the orthopedists to focus their energies on the many surgical needs of soldiers who sustained war injuries.

At an evacuation hospital during the Vietnam War, physiatrist Dr. Carl Hertzman provided unique insight into the abilities of a rehabilitation team composed of a physiatrist and two physical therapy technicians. The physiatrist and therapy aides sup-

ported the surgical subspecialists, primarily orthopedics, and demonstrated that "physical therapy in a combat theater is of considerable value."^{13(p114)} Hertzman understood the enormous need for early rehabilitation of those casualties who did not have fractures or other injuries precluding return to duty. In Vietnam, many casualties sustained severe soft tissue injuries from fragment wounds that required extensive tissue debridement. In these casualties, contractures could develop rapidly, leading to marked disability and inability to return to duty. In addition, deconditioning and muscle weakness occurred to such an extent that "within days" severe impairment could result. With proper rehabilitation at an evacuation hospital, 80% of casualties with soft tissue extremity wounds were returned to duty without disability.

Interventions at the evacuation hospital, as described by Hertzman,¹³ encompassed three major areas: (1) prevention and correction of disability for those soldiers returning to active duty; (2) early rehabilitation for those casualties who would be evacuated; and (3) proper diagnosis and rehabilitation for the many musculoskeletal complaints, cervical neck pain, lower back pain, and other ailments.

Early treatment while the casualty was at bed rest included fabrication of bivalved casts for the ankle and knee, thereby preventing contractures. Early ambulation was instituted whenever possible, minimizing contractures, weakness, and orthostatic hypotension. Of paramount importance was early initiation of range-of-motion exercise to joints, along with conditioning exercises. The soft tissue injuries to the thigh and calf were particularly prone to producing contractures. Through early range-of-motion exercise—first performed by the physiatrists or technicians, then later performed by the soldier after proper instruction—joint mobility was maintained. Muscles immobilized for a prolonged period can lose 7% of their strength per week and up to 50%

after 1 month, but early rehabilitation with isometric and isotonic exercises can prevent this muscle wasting.¹⁸ Hertzman¹³ incorporated exercises to strengthen deconditioned and injured muscles.

Modern military medicine, using intervention strategies, saved many casualties during the Vietnam War, with a high percentage of soldiers returned to active duty. Curtis¹⁹ reported that of the 75,000 patients seen at Da Nang Naval Hospital (a corps level hospital) between 1966 and 1970, 87% of the wounded who required hospitalization returned to duty. This implies that at the corps level hospitals in the theater of combat, rehabilitation specialists can improve the physical condition of injured soldiers expected to return to duty.

PHYSICAL MEDICINE AND REHABILITATION AT MEDICAL CENTERS

This section examines the rehabilitative efforts at medical centers in the continental United States during wartime. The literature concerning rehabilitation of the war injured soldier^{1,2,4,14,20-23} provides unique insight into the accomplishments of PMR.

World War II

The birth of physical medicine occurred in World War I and greatly expanded in World War II. During World War II, army hospitals utilized PMR services with gratifying results both in large continental United States (CONUS) hospitals and in dispensaries in India and Burma.¹ Beginning with the advent of hostilities in December 1941, new officers who had been involved with physical medicine as civilians were assigned to large army hospitals. The Mayo Clinic and Northwestern University were asked to expand their training of officers in physical medicine.¹ A team of medical officers skilled in physical therapy was sent to smaller hospitals to train technicians in physical therapy techniques.

Care for soldiers with hand injuries was greatly improved during this time by establishment of “hand centers” at various military hospitals. Plastic, orthopedic, and neurosurgeons were given special instruction in salvage procedures and in reconstruction of injured hands.²⁰ The importance of early hand rehabilitation was stressed by the famous hand surgeon, Dr. Sterling Bunnell, who served as civilian consultant for hand surgery to the Secretary of War. In his words,

Rehabilitation of an injured hand was always important and frequently difficult. In all patients in whom it was practicable, it was the general rule to

institute early motion and mobilization by activity and steady traction.^{20(p394)}

Bunnell also espoused the importance of occupational therapy and physical therapy, referring to these combined disciplines as “physical medicine.” According to Bunnell,

In the rehabilitation of the injured hand, occupational therapy played an extremely important role. The patient was assigned a job on the basis of his needs, not just to keep him working. The occupational therapist knew the results desired and devoted her efforts to restoration of the special function which had been lost.^{20(p395)}

The Europeans also realized the value of physical medicine and rehabilitation during wartime. Dr. L. Guttmann, neurological surgeon in charge of the Spinal Injuries Center, Stoke Mandeville, Buckinghamshire, England, related the importance of physical therapy in the care of soldiers with paraplegia.²³ Interventions included proper positioning of paralyzed limbs, regular range-of-motion, dressing training, exercises for weak muscles, balance training, wheelchair ambulation, and walking with crutches and braces when feasible. In addition, avocational activities such as wheelchair polo were promoted, to improve the psychological well being of these soldiers.

At the end of the war, Lieutenant Colonel Benjamin Strickland, determined that the staffing goal for physical medicine physicians in the U.S. military should be 33 active duty physiatrists, assuming a permanent army of 850,000.¹ Strickland foresaw the need to train physical and occupational therapists along with enlisted technicians in the

application of rehabilitative treatments. Additionally, the special exhibit committee on Physical Medicine,⁴ underscored the importance of an organized coordinated team of occupational therapists, physical therapists, and other rehabilitation specialists under the direction of a physical medicine specialist. This report stated

Military hospitals have set new standards in physical medicine (coordinated physical therapy, occupational therapy, and rehabilitation) which must be emulated by civilian hospitals. ^{4(p494)}

The committee also highlighted the importance of vocational training and the participation of nurses familiar with the rehabilitation team's approach to care. While World War I established orthopedics as a specialty, it is generally felt that World War II did the same for physical medicine.⁴

Commander Thomas J. Canty²⁴ described amputee care during World War II at the United States Naval Hospital, Mare Island in Vallejo, California, the first Armed Service Amputation Center to be established. Over 2,500 amputees were rehabilitated. Early intervention played an important role, with physical therapists initiating bed exercises and occupational therapists providing arts, crafts, and hobbies as constructive activities during the often long recuperative period. Group support, through round table discussions, helped casualties address psychological issues involved with the new disability; this nurturing group of traumatic amputee soldiers supported each other through shared experiences and feelings. As the soldier improved, aggressive physical training was introduced along with provision of a prosthesis and gait training. Pre-vocational activities (such as driving, dancing, and various sports) were encouraged, thus facilitating the adjustment to a new disability. Canty²⁴ even reported the case of a pilot who lost a leg, was rehabilitated at Mare Island, then returned to flying duty.

The Vietnam War

Documented rehabilitation experience during the Vietnam War provides insight into a medical center's efforts to fully meet the needs of amputees resulting from the war. Fitzsimons General Hospital, for instance, treated over 500 soldiers with major amputations, many with multiple amputations.²⁵ The often complicated rehabilitation included substantial needs for physical therapy, occupational therapy, and prosthetic support; these, along with

the psychological needs of the injured soldier, clearly required an interdisciplinary team approach to care.

Colonel Paul W. Brown,²⁵ Medical Corps, U.S. Army, Fitzsimons General Hospital, Denver, Colorado, reported that prosthetic fitting of amputees was often delayed due to residual limb problems. Because of this, rehabilitation efforts were started early—before transportation to a VA hospital and even before prosthesis fitting—and focused on the “physical and mental conditioning of the patient.” Daily exercise routines were established to strengthen weakened muscles, and functional activities were vigorously addressed to ensure that the amputee could perform the basic ADLs: eating, dressing, bathing, toileting, and personal hygiene. Independence in these basic self-care skills provided the casualty with an important level of control over the environment, and contributed to improved psychological well being.

A unique aspect of care at the Fitzsimons General Hospital was the amputee skiing program. Over 100 amputees treated during 1968 and 1969 learned to ski using adaptive aids.²⁵ These casualties gained confidence and an enhanced sense that even with their disabilities they could find challenges and enjoyment through skiing and other recreational activities. Brown²⁵ described the incredible psychological trauma involved with amputation, and the Fitzsimons program stressed treatment of the whole individual with the goal of returning the soldier to an optimal level of function. The recreational activities had a positive impact on the mental well being of the soldier and were a vital part of the rehabilitation plan.

Amputees accounted for over half of the civilian casualties referred for rehabilitation in a Canadian medical rehabilitation project in Vietnam.²⁶ Eighty-five percent of these Vietnamese casualties had amputations involving the leg; the others had upper extremity and multiple amputations.

The Persian Gulf War

During the 1991 Persian Gulf War, a multicenter study assessed the injury characteristics and functional limitations in the casualty population referred to the army PMR services.¹⁴ The results of this study provide insight into the many needs of the war casualty for early rehabilitation. Data were collected on 222 patients seen at participating medical centers: Walter Reed Army Medical Center in Washington DC; Fitzsimons Army Medical Center in Aurora, Colorado; Madigan Army Medical Center

in Tacoma, Washington; Second General Hospital in Landstuhl, Germany; and 97th General Hospital in Frankfurt, Germany.

Historically, musculoskeletal injuries have been significant problems for soldiers during wartime. Mullins et al²⁷ described the problems encountered with the “low back syndrome” in World War II, where lower back pain was described as one of the most common of all problems encountered. During World War I, General Pershing specifically stated that he wanted “no more men with flat feet, [and] weak backs.”^{27(p93)} These observations reveal that musculoskeletal complaints, particularly lower back pain, were exceptionally common.

The Persian Gulf War was no exception. At the five reporting centers, musculoskeletal injuries were the most frequently reported diagnoses, followed by nerve injuries, penetrating wounds, then fractures (Table 1-1). Casualties with amputations, burns, brain injuries, and spinal cord injuries were not as common, but these patients required extensive rehabilitative care with physical therapy, occupational therapy, psychological intervention, skilled nursing, and prosthetic and orthotic fabrication.

Fully 44% of all casualties cared for by PMR during the Persian Gulf War had at least one peripheral nerve injury (see Table 1-1). Nerve injuries were

TABLE 1-1
PRIMARY DIAGNOSES IN PERSIAN GULF WAR CASUALTIES REFERRED TO PHYSICAL MEDICINE AND REHABILITATION SERVICES

Primary Diagnosis	Number	Percentage
Musculoskeletal Injuries	126	57
Nerve Injuries	98	44
Penetrating Wounds	72	32
Fractures	62	28
Brain Injuries	17	8
Amputations	15	7
Burn Injuries	13	6
Spinal Cord Injuries	6	3

Adapted with permission from Dillingham TR, Spellman NT, Braverman SE, Zeigler DN, Belandres PV, Bryant PR, Salcedo VL, Schneider RL. Analysis of casualties referred to army physical medicine during wartime. *Am J Phys Med Rehabil.* 1993;72(4): 214–218.

TABLE 1-2
ASSOCIATED NERVE INJURIES

Primary Injury	With Coexistent Nerve Injuries (%)
Penetrating Wounds	66
Amputations	65
Fractures	58
Spinal Cord Injuries	43
Musculoskeletal Injuries	40
Burn Injuries	39

Adapted with permission from Dillingham TR, Spellman NT, Braverman SE, Zeigler DN, Belandres PV, Bryant PR, Salcedo VL, Schneider RL. Analysis of casualties referred to army physical medicine during wartime. *Am J Phys Med Rehabil.* 1993;72(4): 214–218.

closely associated with penetrating wounds, amputations, and fractures (Table 1-2). Well over 60% of all amputees and soldiers with penetrating wounds and over 50% of soldiers with fractures sustained concomitant nerve injuries. This rate is much higher than previous war-related literature would suggest. Omer²⁸ found that 22% of the soldiers seen with arm injuries had peripheral nerve injuries as well. Nelson, Jolly, and Thomas²⁹ described brachial plexus injuries in nine cases that resulted from missile chest wounds. In a series of reports³⁰ describing vascular injuries of wounded soldiers, major nerve injuries were noted in 27.3% of casualties. A similar series by Jacob³¹ describes 99 of 258 vascular trauma victims as having nerve contusions with 14 nerve divisions. The higher percentage of nerve injuries seen in Persian Gulf War casualties may reflect a referral bias, but nonetheless illustrates the need for nerve injury rehabilitation.

Electrodiagnostic evaluations are valuable in defining the extent of nerve injuries and were performed for 41% of the casualties referred to PMR services during the Persian Gulf War. According to the guidelines of the American Association of Electrodiagnostic Medicine, only physicians with special training in electrodiagnostic medicine are qualified to perform these consultations.³² Physiatriests routinely perform electrodiagnostic studies for the army during peacetime, but the Persian Gulf War data documented for the first time the acute need for electrodiagnostic evaluations of injured soldiers during wartime,¹⁴ and there will

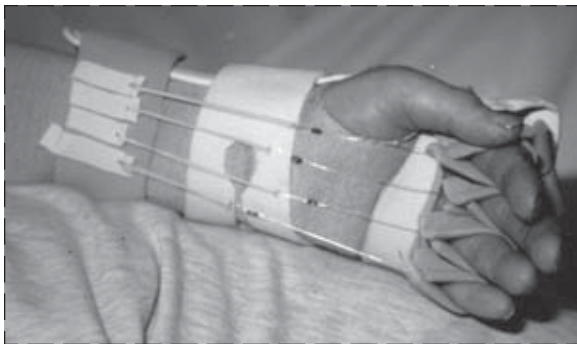


Fig. 1-1. An orthotic used during the Persian Gulf War to improve range-of-motion in the hand of a nerve injured soldier.

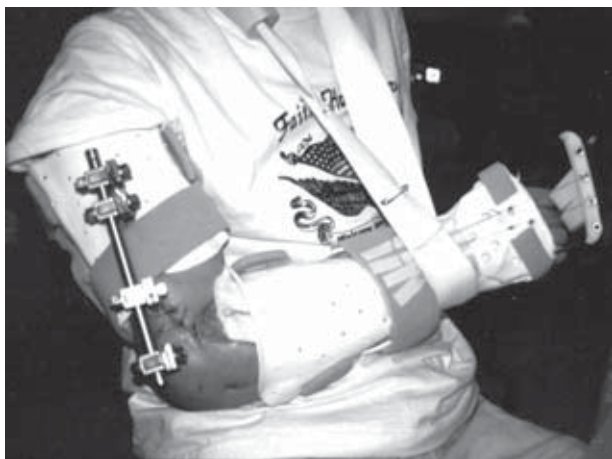


Fig. 1-2. An orthotic used for improving the function of a Persian Gulf War casualty with extensive nerve injuries, a humerus fracture, and a triceps tendon repair. This orthotic provided limited elbow flexion and static stretch to the long finger flexor tendons.

likely be a continued need in future conflicts. The provision of electrodiagnostic consultations at corps level hospitals could enable accurate nerve injury diagnosis in the theater of war without evacuation. Portable commercial electrodiagnostic instruments are available and could be used for this purpose.

Nerve injuries in Persian Gulf War casualties required extensive rehabilitative intervention. Treatment of upper extremity nerve injuries accounted for a substantial part of occupational therapy involvement. Custom orthotics (splints) fabricated by occupational therapists, or therapy assistants were used to prevent deformity (Figures 1-1 and 1-2). Edema from lymphatic disruption and immobility was treated aggressively with elastic wrapping, pneumatic compression, and elevation. Strengthen-



Fig. 1-3. An overhead sling assists weak shoulder muscles, allowing this Persian Gulf War casualty to exercise his right arm and hand despite a humeral fracture and peripheral nerve injuries.

ing of the involved muscles, in the case of incomplete injuries, was begun early (Figure 1-3). If the nerve injury was severe, with little chance of improvement, then functional orthotics were fabricated (Figure 1-4), and soldiers were given extensive training in their use and maintenance. Lower extremity nerve injuries were common with the peroneal nerve being most frequently injured. This injury often required orthotics to prevent foot drop (Figure 1-5) and improve ambulation, as well as strengthening, gait training, and range-of-motion exercises.

Amputations occurred in 7% of the casualties, but required considerable rehabilitation. A major goal was the fitting of temporary prostheses (Figures 1-6, 1-7, and 1-8) for both upper and lower extremity



Fig. 1-4. Functional orthotic for a Persian Gulf War veteran with complete median and radial nerve injuries.



Fig. 1-5. A lower extremity ankle foot orthosis on the right leg, used by this Persian Gulf War casualty for toe pickup during ambulation due to a peroneal nerve injury.

amputees. Temporary prostheses enabled amputees to ambulate at the earliest possible time during recuperation (Figure 1-9). Early ambulation provides enormous psychological benefits to the amputee. In the case of traumatic amputations, early ambulation is possible within two weeks following definitive wound closure. Steinbach dealt with Israeli amputees over a 25-year period and felt it a major rehabilitation goal to fit temporary plaster prostheses for these amputees.³³ Steinbach felt that specialized rehabilitation centers delivered optimal amputee care, and that early vocational interven-



Fig. 1-6. A temporary plaster prosthesis fabricated for a below knee amputee, allowing early ambulation while the residual limb healed.



Fig. 1-7. A temporary adjustable thermoplastic prosthesis for an above knee amputee, allowing early ambulation.



Fig. 1-8. A temporary prosthesis for a below elbow amputee, using a clear thermoplastic socket and fiberglass webbing to incorporate the terminal device (hook). This allowed early training and use of the prosthesis.

tion returned most amputees to productive work.³³ Nerve injuries were frequently found in Persian Gulf War amputees.¹⁴ These injuries often involved the contralateral lower extremity, requiring orthotic bracing to overcome weakness, thus complicating functional restoration (Figure 1-10). The literature dealing with war amputees^{1,16,33} supports the need for skilled prosthetists and orthotists at military medical centers.

The care of an amputee is maximized by a rehabilitation team's early intervention. Only 10% of amputees described by Steinbach³³ had phantom pains, whereas amputees from the Persian Gulf War frequently (80%) manifested phantom limb pain.¹⁴ This difference in the prevalence of phantom pain may have been due to the retrospective nature of Steinbach's study, while the specific questioning of Persian Gulf War casualties probably accounts for the higher frequencies of reported phantom pain. Phantom pain and other residual limb pain syndromes can severely impede the soldier's functional rehabilitation and require a comprehensive approach to management involving early prosthetic fitting, medication trials, physical modalities, and



Fig. 1-9. A soldier with bilateral leg amputations ambulates in the parallel bars with a temporary prosthesis.

occasional surgical interventions. The physiatrist possesses special knowledge regarding residual limb pain and can best coordinate this multifaceted treatment.

Although not as common, spinal injuries require a comprehensive rehabilitation approach, which addresses medical issues, functional limitations, and patient education. Adler echoed this need for a team approach to patient care.³⁴ In the United States military, traumatic spinal cord injured patients are stabilized and transferred from military hospitals directly to regional Department of Veterans Affairs Spinal Cord Injury centers.

Burn injuries were diagnosed in only 6% of Persian Gulf War casualties, but were occasionally extensive, requiring considerable rehabilitation (Figure 1-11). Shafir³⁵ and colleagues described the care of 119 burn casualties from the Lebanon War in 1982. The majority (57%) were sustained among tank crews. Psychological support was felt to be quite important to this casualty population. If the Persian Gulf War had involved greater numbers of intense tank battles, it is possible that more burn casualties might have resulted.



Fig. 1-10. A Persian Gulf War amputee ambulates using a crutch, a left above knee prosthesis, and a right ankle foot orthosis due to a coexistent right peroneal nerve injury.



Fig. 1-11. A Persian Gulf War soldier who sustained extensive burns, a left above knee amputation, and nerve injuries in the right leg.

Of the brain injured casualties from the Persian Gulf War, 88% revealed cognitive impairment, requiring additional directed rehabilitation. Brain injured war casualties and their outcomes have been described in previous literature. Groswasser and Cohen³⁶ studied combat head injuries in Israel, comparing the rehabilitation outcomes of brain injured soldiers in the Lebanon War (1983) to those of their counterparts in the Yom Kippur War (1973). In terms of returning to work, the rehabilitation outcomes were better in the Lebanon War, possibly due to faster patient transfer to primary care hospitals, which yielded shorter periods of unconsciousness, and reduced secondary brain injury. Huusko, Nuutila, and Jarho³⁷ reported the excellent outcomes of open cerebellar injuries in Finnish War veterans. Katz, Galatzer, and Kravetz³⁸ described the successful use of sheltered workshops to improve the psychosocial and vocational outcomes in brain injured Israeli war veterans. These studies highlight the need for early rehabilitation of soldiers sustaining brain injuries during war to prevent complications, and initiate early rehabilitation that maximizes the functional outcomes of these soldiers.

The functional impairments noted most commonly among Persian Gulf War casualties involved ambulation.¹⁴ Forty-eight percent of casualties had an ambulation impairment with 29% having limitations in one or more of the ADLs. Management of these problems included strengthening of weakened muscles, improving joint range-of-motion exercise, ADL training, prescription of orthotic devices, and gait training (Figures 1-9 and 1-10). Many of the soldiers required special wheelchair adaptations to accommodate fractures and amputations while allowing maximum mobility during recuperation. Walkers, crutches and canes were frequently required in the short term for early mobilization and for long term mobility in cases of severely injured soldiers. ADL limitations were noted frequently, but the duration and magnitude of the problems were not quantified. To overcome these functional limitations, occupational therapists trained the casualties to use assistive devices and employ compensatory strategies for accomplishing ADL.

The majority of referrals to physical medicine and rehabilitation services during the Persian Gulf War came from orthopedics (64%) followed by neurosurgery.¹⁴ This is in keeping with findings from World War II which indicated that two thirds of the casualties in the European theater of operations sustained orthopedic injuries²⁷ and supports the close association between orthopedics and PMR services.

During a prolonged conflict, return of trained soldiers to duty may be of the utmost importance, particularly in the smaller and highly technical military envisioned for the future. In this scenario, the functional restoration of wounded soldiers by PMR could make a tremendous difference. Eldar and Ohry reported in their paper on establishment of rehabilitation systems for war that the British Royal Air Force found it “cost and time effective”^{22(p106)} to rehabilitate injured air crewman instead of training new ones. This was also noted

by Parry³⁹ in the case of certain highly skilled and valued upper extremity amputees who were retained on active duty in the British Royal Air Force. Israeli literature also reports rehabilitation efforts for selected burn casualties resulting in return to full active military duty.²¹

In summary, the experience during the Persian Gulf War in 1991 underscored Physical Medicine and Rehabilitation’s valuable contributions to the optimal care and functional restoration of war injured soldiers.

OCCUPATIONAL THERAPY AND PHYSICAL THERAPY IN THE ARMY

Focus thus far has been primarily on the physiatrist’s role in the military as the rehabilitation team leader. It is important to describe the expertise of other rehabilitation professionals who comprise the typical army rehabilitation teams. Other chapters in this textbook provide detailed descriptions of the training and qualifications of all potential members of the optimal comprehensive PMR team, discuss roles of physical therapists in the army, and clarify the special duties of an army PMR team, which are slightly different from those of their civilian counterparts. In general, these therapists treat functional problems of injured soldiers using strengthening exercises, range-of-motion exercises, orthotics, physical modalities, and gait and ADL training the same as in the civilian sector. When physiatrists are present at medical centers, however, physical therapy and occupational therapy departments are organized with physiatrists. When physiatrists are not available, orthopedic services typically incorporate the therapists.

In wartime and peacetime, there is often a shortage of orthopedists and physiatrists to evaluate and manage all of the musculoskeletal disorders in a concentrated troop population. For this reason, occupational therapists and physical therapists are authorized to function as physician extenders, providing primary evaluation and treatment of common musculoskeletal problems. Optimally, physicians skilled in musculoskeletal diagnosis and treatment are readily available for consultation. If the diagnosis remains unclear, or the treatment proves ineffective, early referral by a therapist to a physiatrist or orthopedist is important.

Occupational therapists also perform the vital function of combat stress control. In a war environment, psychological stress can become a major factor, which depletes the strength of an army. Occupational therapists in the theater of combat and at major medical centers provide support for these psychological casualties by providing structured therapies.

CONCLUSION

The evidence presented provides historical examples of physiatrists’ roles during wartime. Based on this experience, the authors recommend utilization of physiatrists during wartime in the following roles.

Physiatrists should be placed at selected major medical centers in direct supervision of rehabilitation teams, providing early rehabilitative care to injured soldiers. PMR services here should be prepared to support surgical services, especially orthopedics, provide electrodiagnostic evaluations, and provide comprehensive rehabilitative services. Functional limitations, particularly ambulatory ones, require multidisciplinary rehabilitative care including trained prosthetists, occupational therapists, physical therapists, and orthotists. Designated

continental United States medical centers capable of providing comprehensive rehabilitation, similar to the World War II model, can support these services and provide specialized care centers for soldiers requiring extensive rehabilitation. Such an organization functions equally well during wartime and peacetime.

Rehabilitation services at medical centers near troop concentrations also provide valuable peacetime musculoskeletal rehabilitation for soldiers injured during training, speeding their recovery, and optimizing return to duty.

Placement of physiatrists at large corps level hospitals in the combat theater during a prolonged conflict is another wartime role. Here physiatrists assume charge of the rehabilitation team (therapists

or technicians) closely supporting surgeons. In this capacity, physiatrists and therapists reconstitute forces by promoting rehabilitation of those casualties who can be effectively rehabilitated in the combat theater. This strategy also provides early rehabilitation for soldiers being evacuated. Electrodiagnostic evaluations, a major need in the war injured population,

could be provided here by physiatrists using small, portable, commercially available electrodiagnostic instruments. This role is optimal during a protracted military involvement, in which case casualties at corps level theater hospitals can be fully rehabilitated during recovery, preventing deconditioning and contractures, and then returned to duty.

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