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# Rehabilitation After Landmine Injury

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## Introduction

Every landmine injury creates a demand for a host of services, including operative and post-operative care, the provision of mobility aids, physical therapy, vocational training, physiological counseling, and pain management. The vast majority of landmine injuries occur in low-income countries, where such services are not available.

The World Health Organization estimates that approximately 80% of the world's disabled population lives in low-income countries and that less than 2% ever receive rehabilitation services. The continuing number of landmine casualties, about 26,000 per year, creates an enormous demand for rehabilitation services in societies that are often ill-equipped to provide them. The challenge of providing rehabilitation to survivors of landmine injuries lies in developing strategies for service delivery that can be sustained, over the lifetime of the survivors, within the community in which they reside.

The majority of nonfatal, landmine injuries result in transtibial (below-knee) amputations, but transfemoral (above-knee) amputations are also common. Landmine survivors may also suffer damage to the upper extremities, vision, and hearing. The incidence of acute and chronic pain among landmine survivors during recovery has not been quantified. In this chapter, pain management issues are discussed as they arise during the course of treatment and recovery after blast injury.

## The Team Approach to Rehabilitation Service Delivery

The key to effective rehabilitation lies in the effective coordination of operative, postoperative, prosthetic, therapeutic, and family services. This coordination can best be accomplished through application of the "team approach" to rehabilitation, which includes the patient, family, physician, prosthetist, therapist, and others in the rehabilitation process. At present, the team approach to rehabilitation has not been systematically implemented in many low-income, mine-affected countries. This is unfortunate because its absence almost certainly reduces the efficacy of available services. The provision of prosthesis without proper training from a therapist, for example, may result in poor utilization. Proper communication and training during rehabilitation maximize the use of the prostheses or other assistive devices and minimize potential complications.

## Managing Postoperative, Preprosthetic Edema

When amputation of the extremities becomes inevitable because of landmine injury or other causes, postoperative care has a major impact on the eventual functional outcome [1–3]. The corner stone of good postoperative, preprosthetic care is early mobilization. Early mobilization helps to prevent the development of pain, contractures, deep-vein thrombosis, deconditioning, and a variety of other pulmonary, urinary, and gastrointestinal complications that arise from prolonged immobility. Common problems that frustrate attempts to mobilize the patient include pain, edema, delayed wound closure, and the need to immobilize the surgical site to facilitate wound healing. The proper management of edema minimizes pain-inducing tension in the soft issue, reduces the possibility of contracture, expedites wound closure, and prepares the limb for prosthetic fitting.

The postoperative and preprosthetic care of residual limbs used by the Center for International Rehabilitation (CIR), Chicago, is presented here as a model system designed for dealing with the issues of edema and postoperative immobility. Although the resources and techniques used in dealing with these problems differ greatly by region, the CIR model still provides a useful means of outlining some basic issues. To minimize complications and discomfort, the CIR system calls for the use of elastic stockinettes and removable rigid dressings in the postoperative management of various levels of amputations. We are aware that stockinettes may not be available in all instances, but we believe that they facilitate cost-effective management of postoperative complications.

For edematous residual limbs without bony prominences (limbs that have undergone transfemoral amputations), elastic stockinettes of various lengths and sizes may be applied. The stockinettes create a desirable pressure gradient over the limb that reduces swelling. For residual limbs with bony prominences that might suffer from skin breakdown if wrapped with elastic bandages (i.e., limbs that have undergone transtibial amputations or Syme's amputation), a removable rigid dressing may be used. The limited availability of elastic stockinettes and plaster casting material in many mine-affected, low-income countries presents an obvious barrier to the widespread adoption of this model.

### Transfemoral Amputation

Elastic stockinettes may be used to replace traditional gauze bandages following transfemoral amputation. Pull a 15- to 20-cm-wide elastic stockinette with a medial longitudinal cut toward the waistline to cover the soft tissue of the inner thigh. Apply a rope or belt around the waist to suspend the elastic stockinette. Once the proximal end is secured, the distal end is cut to the proper length, twisted about half of a turn, and then folded back up to the thigh. If more distal pressure is needed, another shorter elastic stockinette can be added.

### Transtibial Amputation

When the residual limb is ready for progressive shrinking, a "removable rigid dressing" (RRD) can be applied [4,5]. The RRD has four components: a tube sock or prosthetic stump

sock, a below-the-knee plaster cast, a suspension stockinette, and a supracondylar suspension cuff.

The RRD is worn continuously to prevent swelling and trauma of the residual limb. It is removed for periodic wound inspection and hygiene, monitoring of skin condition before and after weight-bearing exercise, and when the prosthesis is being used.

Depending on the wound condition, mild pressure may be applied to a residual limb covered with an RRD 7–10 days after wound closure without causing discomfort. Weight-bearing exercise may be initiated with a stool or car jack attached to a plywood base once the wound is adequately healed, usually 14 days after surgery. Layers of tube socks may be conveniently added beneath the plaster cast to progressively shrink the residual limb. These layers also allow frequent inspections of the wound and monitoring of the skin's response to weight-bearing exercises.

Care of the residual limb after a Syme's amputation is similar to that of a transtibial amputation [6]. The RRD for Syme's amputation—a stovepipe-like walking cast made with cotton padding around the concave section and bony prominence— permits removal and reapplication during wound inspection. Tube or prosthetic socks may also be added to help shrink and accommodate changes in the shape and size of the distal residual limb. A rubber heel can be attached for progressive proximal and distal weight bearing after the wound is adequately healed.

## Physical Therapy

As is the case in every other phase of rehabilitation service delivery, the number of well-trained physical therapists in countries where most landmine survivors live is low. Fortunately, physical therapy for amputees can be provided in any setting with a minimum of specialized equipment. Many simple and effective exercises can facilitate postoperative conditioning and pregait and gait training.

## Vocational Training

No area is more important to the amputee, or poses greater challenges to rehabilitation providers, than vocational training. The overall economic environment and reliance on muscle power by low-income countries create significant barriers to economic mainstreaming, but vocational programs should focus on training that will assist with integration, reduce stigmatization, and provide meaningful employment. The focus of such programs will vary widely with geographic, economic, and cultural imperatives, but clearly this is an area that needs substantial development. Many vocational programs in low-income countries currently use a sheltered-workshop model of vocational training.

## Psychological and Peer Counseling

The psychosocial sequelae of landmine injuries are generally recognized as important, but they are poorly defined in the literature on landmine injury. These sequelae have direct implications for effective pain management. Post-traumatic stress disorder (PTSD),

depression, substance abuse, unemployment, and loss of social and familial roles may follow landmine trauma. The scarcity of trained psychologists means that innovative approaches must be developed to address these issues (see Chapter 5). Peer counseling, either through hospital visits or through a regular group meeting, has been widely adopted as part of the rehabilitation process in the United States. The peer counseling offered by various disability groups has been highly successful in many countries and should be further developed in landmine-affected regions.

## Provision of Mobility Aids

It is generally believed that prosthetic technology delivered in low-income countries should be appropriate to the economic, cultural, geographic, and technical infrastructure of the region. This belief is often taken to mean that prosthetic technology must be inexpensive. Although expense is an issue, quality should be maintained and can only be compromised to a point before prosthetics become useless, painful, or traumatizing to the residual limb. Research is desperately needed to develop low-cost, high-quality prosthetics for patients in low-income countries. Efforts to develop such prosthetics should focus on developing affordable, durable designs that result in a reduction in the forces transmitted to the residual limb to decrease pain, increase comfort, and reduce trauma. Research should also be matched by a commitment to provide training to prosthetists and other health care professionals on the proper techniques for the manufacture and fitting of wheelchairs, prostheses, and other mobility aids.

## Prosthetic Components

Prosthetics may be divided into two broad categories. The first encompasses those that are manufactured at local production sites by prosthetic technicians working in the country or region. Examples of these types of systems include the Jaipur limb system and the International Committee of the Red Cross prosthetic system. The Red Cross system is the most comprehensive system of this type, both in its design and in its deployment. The second type of component system involves imported components that have been designed to meet the needs of amputees in a given region. An example of this type includes the Blatchford Atlas system. We do not wish to declare what constitutes appropriate technology, but we do wish to emphasize that quality control and good prosthetic fitting are central to minimizing pain caused by prosthetic components.

## Pain Management and Prosthetic Fitting

Pain experienced by amputees may be classified as intrinsic or extrinsic.

**Intrinsic pain** is caused by the vascular or neuromuscular status of the residual limb itself. The treatment of neuropathic stump pain or phantom pain has been discussed in other chapters. However, it is worth mentioning that remedies such as Capsaicin (which is derived from pepper plants) or acupuncture are worth investigating as they have the potential to be exploited relatively cheaply in many areas of the world.

**Extrinsic pain** comes from external causes, such as prosthetics devices. For transtibial amputees, common extrinsic causes of pain include: excessive end-bearing, uneven pressure on the skin, frictional skin loss, insufficient limb contact with the prosthesis, and excessively snug anteroposterior and mediolateral dimensions. This last problem leads to the so-called “hammocking phenomenon” marked by pressure sores in the popliteal area due to an inappropriately high posterior socket trim line generating pressure in that area with weight bearing or knee bending.

Prosthetic causes of pain associated with transfemoral amputations include excessive pressure on the ischial tuberosity or excessive end bearing, a horizontal bulge of tissue high on the medial aspect of the stump (“adductor roll”), stump constriction or “choking,” malalignment, and a high medial or anterior wall.

There is always the potential for a negative interaction of intrinsic and extrinsic factors. There is a significant prevalence of residual limb dysesthesias (such as allodynia or hyperpathia) that may make any prosthetic intolerable. This can sometimes be managed with medications such as anticonvulsants or antidepressants (see Chapter 4). There is also the more common painful neuroma that may make certain contact points exquisitely sensitive. This can sometimes be managed with drugs, but may require a surgical revision. Stump hardening and callous formation can be a problem for both transfemoral and transtibial amputees.

## Conclusions

The quality and availability of rehabilitation services need to be improved for landmine survivors, and people in low-income countries with amputations and other disabilities. Educational programs that focus on the team approach to rehabilitation should be provided to prosthetists, physical therapists, nurses, and physicians. Such programs should provide for the transfer of clinical skills and technologies that are needed to provide effective services to people with disabilities in their own countries.

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