Chapter

Introductory Chapter: General Remarks Regarding Limb Amputations

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1. Introduction

Developments of microsurgical techniques allows reimplantation in patients with severed hands, legs, and fingers (**Figures 1** and **2**). And flap transfer techniques have also allowed reconstruction of bone and soft tissue defects in the extremities following malignant neoplasm resection and severe open fractures (**Figures 3** and **4**) [1].

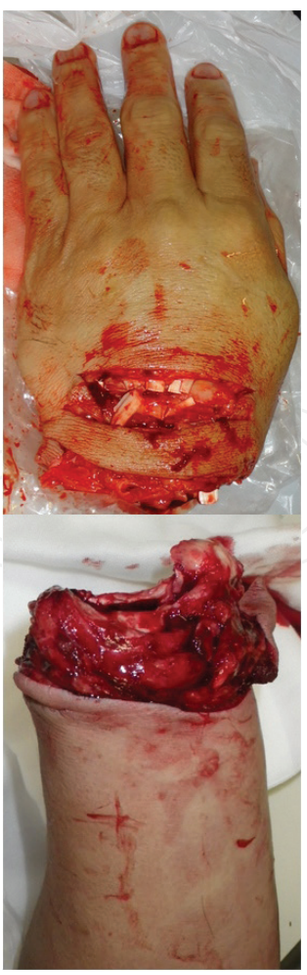

Figure 1.
The photograph shows a severed hand following an accident.

Figure 2.
The photograph shows re-plantation of the severed hand.

Figure 3.
The photograph shows a Gustilo-Anderson IIIC bone-exposing fracture of the left fibula and tibia with severe abrasion of the skin and muscles.

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Figure 4.
The patient could walk 1-year after surgery.

As result, previously non-salvageable limbs have been salvaged. However, there are many patients who require limb amputation. Circumstances of limb amputation may vary, including war wound, infections and animal bites, and traffic accidents and various diseases [2, 3].

In this chapter, I describe general remarks regarding limb amputations, which may help to better understand the following chapters.

2. Types and incidence of amputation.

Although the term "amputation" is usually used for the removal of a limb, the removal of other prominent parts of the body, such as the ear, nose, breast, and penis, is also called amputation [4, 5]. However, the population of limb amputees is largest, and an estimated 1.6 million persons were living with the loss of a limb in the USA in the year 2005 [6]. Males are more likely to require limb amputation (a male to female ratio of 1.6–3.9:1), because males are more outgoing and are more prone to trauma, and peripheral artery disease [7]. Lower limb amputation is six–seven times more frequent than upper limbs one [8].

3. Causes

Before 2004, trauma accounted for most amputations in the majority of hospitals, followed by malignancies [9]. Although trauma is still the most predominant indication

for amputation in developing countries, peripheral arterial disease with or without diabetes mellitus is now the most common cause of amputation in the developed countries [2, 3].

3.1 Peripheral arterial disease

Limb loss is most often due to peripheral arterial disease (54–82%); the estimated increase in the rate of dysvascular amputations was 27%. On the other hand, rates of trauma- and cancer-related amputations both declined by approximately half [10]. Peripheral arterial disease affects the distal vessels and results in occlusion, which is one of the major causes of ulcer development and a risk factor for amputation (**Figure 5**).

These patients often require challenging distal revascularization surgery or angioplasty to avoid limb amputation. Revascularization is the only way to prevent major amputation of an ischemic foot, and the ulcer healing rate after revascularization ranges from 46 to 91% [11].

3.2 Diabetes mellitus

Patients with diabetes are likely to develop infections, because of the alteration of immune defense mechanisms due to the hyperglycemic environment [12]. Furthermore, more than 50% of patients by diabetes mellitus are complicated with peripheral arterial disease [2].

Once a diabetic foot develops infection, it progresses rapidly and requires the removal of all necrotic tissue (**Figure 6**).

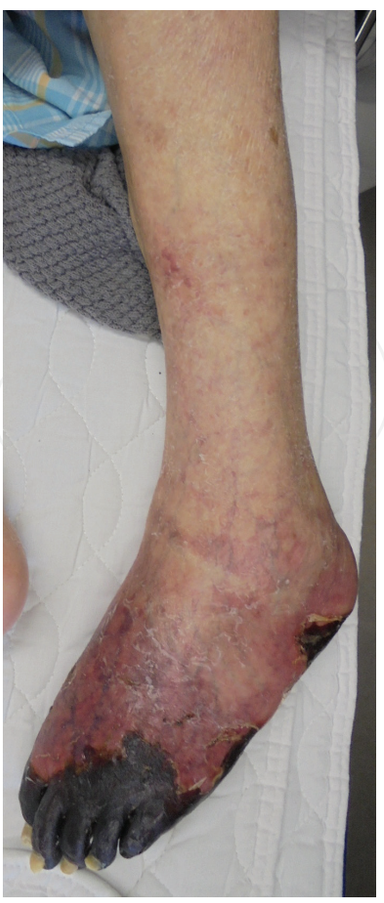

Figure 5.
The photograph shows an ischemic foot due to peripheral arterial disease of the left leg, which required below-knee amputation.

Figure 6.
The photograph shows diabetic gangrene on the right sole, which required transverse tarsal (Chopart) amputations.

These patients are common in developing countries, and extremity amputations associated with diabetes mellitus accounted for most indications (57.0%) in northeast Nigeria [13]. Thus, diabetes prevention, detection, and management should be prioritized in any attempt to reduce the current incidence of amputation [3]

3.3 Infection

Necrotizing fasciitis and myositis are life-threatening infections with associated mortality rates of 10–20% [14]. Especially, *Vibrio vulnificus* and group A streptococci often cause aggressive and fatal gangrene and necrotizing

Figure 7.
The photographs show a patient with group a streptococci infection of the bilateral upper lower limbs, which led to streptococcal toxic shock syndrome.

Figure 8.
Intraoperative photographs show immediate amputation of the left arm and the complete removal of the infected skin of the right arm and chest.

myofasciitis, and a reported 23% of patients die of vibrio, and 20–34% die of group A *streptococci* infection [15]. Regarding surgical intervention, early and appropriate debridement to reduce infection is recommended to achieve infection control. Thus, surgical debridement including limb amputation should be considered in the early stage.

Patients with group A *streptococci* infection can develop streptococcal toxic shock syndrome (STSS). When STSS is complicated by myositis, multiple limb amputations should be considered, and the reported mortality rate is 80–100% [16] (**Figures 7** and **8**).

3.4 Trauma

Treatment of patients with severe injury with vasculopathy of the extremities, such as trauma-related amputation and Gustilo-Anderson type IIIC fracture, is challenging, because it often requires the resurfacing of tissue defects as well as preservation of functional blood flow to distal areas [1]. Previously, patients with these severe limb injuries underwent amputation. Now, most severed limbs can be replanted, and vascular and soft tissue defects can be reconstructed, owing to the development of microsurgical techniques [17]. Therefore, indications for limb amputation due to injuries are now limited.

3.5 Neoplasm

Malignant bone and soft tissue tumors are rare conditions, but a delay in diagnosis or the misinterpretation of data can have limb- and life-threatening consequences. Although a tissue defect following oncologic resection can be reconstructed using a flap transfer technique, hand and leg salvage cannot always be achieved, because radical surgery sometimes requires the removal of important organs such as the bone, arteries, and nerves [17] (**Figure 9**).

Figure 9.
The photograph shows squamous cell carcinoma on the left leg invading the tibia, which required above-knee amputation.

Conflict of interest statement

There are no conflicts of interest, including financial, consultant, institutional, and other relationships that might lead to a perceived bias.

Financial disclosure and products

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Ethical considerations

The procedures followed were in accordance with the ethical standards of our institutional committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 1983.

Patients in our manuscript were additionally informed about the patient's ethical rights by the author and agreed that the patient's illustrative material, including face, could be used for the aim of the medical study and also agreed to the photos being published in a medical journal.

This manuscript has not previously been presented at any meeting. This article is original and has not previously been published.

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