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CHALLENGES IN LOWER LIMB RECONSTRUCTION WITH MICROSURGICAL FLAPS

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Abstract: Lower limb reconstruction with microsurgical flaps is one of the most complex areas of reconstructive surgery, especially in cases of high-energy trauma, extensive infections, previous reconstructive failures, and post-oncological defects. Despite the high success rates reported, this approach is marked by technical, physiological, logistical, and functional challenges that directly impact outcomes. This article discusses in depth the main obstacles involved in this type of reconstruction, including preoperative evaluation, flap selection, vascular management, complications, rehabilitation, and prognostic aspects.

Keywords: Reconstructive microsurgery; Free flaps; Lower limbs; Complex trauma; Reconstructive plastic surgery.

Introduction

Complex lower limb injuries represent a significant problem in surgical practice, especially in trauma and oncology centers. Due to the reduced availability of local tissue, the functional dependence of the limb for walking, and the often compromised vascularization, reconstruction in this region is more challenging when compared to other areas of the body.

The introduction of microsurgery has significantly expanded therapeutic possibilities, allowing the transfer of well-vascularized tissues to extensively injured areas. However, limb salvage should not be understood only as anatomical maintenance, but as functional preservation, which requires complex planning and prolonged follow-up.

Preoperative evaluation and patient selection

General clinical evaluation

Systemic evaluation of the patient is essential for the success of microsurgical reconstruction. Comorbidities such as diabetes mellitus, peripheral vascular disease, chronic renal failure, obesity, and smoking are strongly associated with increased microvascular complications. Prior clinical control of these conditions is critical to the viability of the flap.

Vascular assessment

Detailed analysis of limb vascularization is one of the greatest preoperative challenges. Methods such as portable Doppler, angiotomography, and arteriography aid in the identification of viable recipient vessels, especially in trauma scenarios with occult arterial intima lesions. The absence of at least one functional arterial axis may contraindicate microsurgical reconstruction.

Decision between limb salvage and amputation

In extreme cases, reconstruction may involve multiple surgeries, prolonged hospitalizations, and extensive rehabilitation, with functional results inferior to those obtained with amputation and prosthesis. Prognostic tools and ethical discussion with the patient and family are essential in this decision.

3. Surgical planning and flap selection

3.1 Type of defect

The type, size, and depth of the defect determine the choice of flap. Defects with bone exposure, deep infection, or extensive muscle loss require well-vascularized and often voluminous tissues.

Muscle flaps versus fasciocutaneous flaps

- Muscle flaps: indicated in scenarios of active infection and deep cavities, they favor bacterial control and bone healing, but have greater functional morbidity.
- Fasciocutaneous flaps: such as the anterolateral thigh flap (ALT), they offer good coverage, lower morbidity in the donor area, and better aesthetic adaptation, and are widely used today.

Osteomyocutaneous flaps

In cases of segmental bone loss, flaps such as the free fibula allow for simultaneous bone reconstruction and coverage, but increase surgical complexity and operating time.

Intraoperative technical challenges

Quality of recipient vessels

The presence of thrombosis, vascular spasm, atherosclerosis, or late traumatic injuries makes anastomosis difficult. It is often necessary to explore more proximal vessels, increasing surgical time and the risk of complications.

Type of anastomosis

The choice between end-to-end or end-to-side anastomosis influences the distal flow of the limb. End-to-side anastomoses are often preferred to preserve distal perfusion, but require greater technical skill.

Prolonged surgical time

Microsurgical procedures on the lower limbs often exceed 6 to 8 hours, increasing the risk of hypothermia, bleeding, and anesthetic complications, in addition to impacting the flap thrombosis rate.

Complications and postoperative management

Flap failure

Microvascular thrombosis remains the leading cause of flap loss. Most failures occur within the first 72 hours, requiring intensive monitoring and immediate surgical re-exploration when necessary.

Infection

The high bacterial load in the lower limbs, associated with open fractures and osteomyelitis, significantly increases the risk of infection. The use of targeted antibiotics and serial debridement is often necessary.

Donor site complications

Pain, seroma, infection, and functional deficits may occur, especially in muscle flaps. Functional preservation of the donor site should be considered in planning.

Rehabilitation and functional recovery

Rehabilitation is an integral part of treatment and should be started early, respecting the viability of the flap. Motor physical therapy, gait training, orthopedic adaptation, and psychological support are essential for functional recovery.

Early overload of the reconstructed limb represents a significant risk of late failure, requiring a balance between mobilization and protection of the flap.

Long-term results and quality of life

Although microsurgical success rates are high, functional outcomes vary widely. Many patients have persistent limitations in walking, chronic pain, or the need for secondary surgeries. Still, limb preservation is associated with better body image perception and quality of life compared to amputation in most cases.

Ethical, logistical, and economic considerations

Microsurgical reconstruction requires specialized centers, trained staff, and advanced hospital resources. In health systems with limited resources, access is restricted, raising ethical questions about equity and cost-effectiveness. The therapeutic decision should always consider the patient's social, functional, and psychological context.

Conclusion

Lower limb reconstruction with microsurgical flaps is a highly complex proce-

dure, marked by multiple challenges from initial assessment to final rehabilitation. Success depends on individualized planning, technical mastery, rigorous management of complications, and multidisciplinary action. Despite the difficulties, this approach remains one of the most effective strategies for limb salvage and functional recovery in complex cases.

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