Volume 4, Issue 6, June 2026 ISSN (E): 2938-3765

ANATOMICAL AND MORPHOLOGICAL CHANGES IN THE STUMP OF THE SHIN AFTER AMPUTATION AND THEIR IMPORTANCE FOR MODERN PROSTHETICS

Khojanazarova Saulehan Jubatirovna
Candidate of Medical Sciences, Associate Professor of the Department of Medical Anatomy of the Tashkent State Medical University Academy
mail: saulexojanazarova1968@gmail.com tel : +998 94 653 72 13

Saipova Zamira Oybekovna
Student of the Medical Faculty of the Tashkent State Medical University Academy
mail : wittrokmichelle @ gmail . com tel : +998 97 764-23-45

Abstract
Lower limb amputation remains a pressing issue in traumatology, orthopedics, and rehabilitation. Despite advances in treatment for vascular pathologies, diabetes, and the consequences of trauma, the number of patients requiring prosthetics remains high. This review systematizes literature data on the anatomical and morphological changes in the tibia stump tissues after amputation and their impact on the functional characteristics of the prosthesis. This work is based on an analysis of domestic and international sources examining the transformation of the bone, vascular, nervous systems, and soft tissues. Theoretical conclusions are compared with practical aspects of modern prosthetics, documented during a visit to a specialized facility. It has been established that bone remodeling, microcirculatory disorders, neuroma formation, phantom pain syndrome, and soft tissue changes are key factors determining the condition of the stump. Scientific consensus indicates that taking these characteristics into account when designing prostheses reduces the risk of complications and improves the effectiveness of rehabilitation.

Keywords: Lower limb amputation, lower leg stump, prosthetics, morphological changes, neuroma, phantom pain, microcirculation, rehabilitation.

Introduction

Lower limb amputation remains a significant social and medical problem in traumatology, orthopedics, and rehabilitation medicine. Despite advances in the treatment of vascular diseases, diabetes complications, trauma, and other causes, the incidence of lower limb amputations remains high. In Russian and international literature, the main causes of amputations include complications of diabetes, peripheral arterial disease, mechanical trauma, infections, and malignant tumors.

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

Materials and Methods:

An analytical review of publications on the anatomical and morphological remodeling of tibia stump tissues and their implications for prosthetics was conducted. Sources included specialized publications on normal anatomy, traumatology, orthopedics, and medical rehabilitation. Data obtained during a visit to a prosthetic and orthopedic facility and a rehabilitation center were used to verify the theoretical principles. The technological stages of lower limb prosthesis manufacturing are discussed, including taking a plaster cast, molding, and custom fitting the socket.

In recent years, researchers have focused not only on improving prosthetic design but also on studying the morphological changes in the stump after amputation. Analysis of published data indicates that amputation triggers a complex chain of reactions in bones, blood vessels, nerves, and soft tissues.

Key factors influencing stump function and rehabilitation outcomes include bone remodeling, microcirculation disorders, neuroma formation, muscle atrophy, and cicatricial changes. Most researchers emphasize that the effectiveness of a prosthesis depends not only on its technical characteristics but also on the anatomical condition of the stump. The condition of the bone surface, soft tissues, vascular, and nervous systems influences load distribution within the socket, patient comfort, and the risk of complications.

Thus, morphological study of the stump is important in both theoretical and practical aspects for specialists in anatomy, orthopedics, and medical rehabilitation. The purpose of this review is to analyze the current literature on the anatomical and morphological changes of the tibia stump after amputation and assess their significance for prosthetic fitting and rehabilitation.

1. Modern concepts of anatomical features of the leg stump after amputation

An analysis of modern research demonstrates that the anatomical condition of the lower leg stump after amputation is a critical factor influencing the success of prosthetic replacement and the effectiveness of rehabilitation. Most authors view the stump as an independent system comprising bones, muscles, vessels, nerves, and soft tissues, which undergo significant morphological changes in the post-amputation period.

Anatomical data indicate that the stump is formed by the tibia and fibula. Bone remodeling is driven by changes in mechanical loading, blood supply, and bone metabolism. The literature emphasizes maintaining the integrity of the bone cut, the absence of osteophytes, and proper periosteal preparation as necessary conditions for the formation of a functional stump.

The muscular component also plays a significant role. After amputation, there is a restructuring of the functional load of the calf muscles, followed by atrophy, the degree of which varies depending on the level of amputation, the surgical technique used, and the rehabilitation regimen.

Particular importance is attached to the vascular system, which determines the stump's ability to heal and withstand mechanical stress. Blood supply is provided by branches of the anterior and posterior tibial arteries, as well as a well-developed collateral network. Literary sources indicate that the development of adequate collateral circulation is one of the key factors in successful stump adaptation.

The peripheral nervous system has attracted attention due to regeneration processes following nerve severance, including the formation of neuromas and the development of chronic pain. Most researchers emphasize the importance of preserving the integrity of peripheral nerves not only for maintaining sensation but also for successful prosthetic replacement.

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

Thus, the functional characteristics of the tibia stump are determined by the complex interaction of the skeletal, muscular, vascular, and nervous systems. This justifies the need for a comprehensive assessment of these components when planning prosthetics and rehabilitation. 2. Anatomical changes in the stump and their significance for modern prosthetics

2.1 Nervous system changes. According to the literature, the most pronounced changes after amputation are observed in the peripheral nervous system. A common occurrence with nerve truncation is the formation of neuromas, which is associated with impaired regeneration and the misdirection of axonal growth in the stump area. This is accompanied by pain, hypersensitivity, and decreased functional activity. The issue of phantom pain is widely discussed in modern research. Most authors consider it to be the result of a combination of peripheral nerve changes and neuroplastic processes in the central nervous system. Despite various proposed mechanisms, there is agreement that phantom pain complicates the rehabilitation process and reduces the effectiveness of prosthetics.

2.2 Vascular Changes. Significant restructuring of the stump vascular bed occurs during the postoperative period. Resection of large vessels leads to impaired microcirculation and tissue perfusion, especially in the early postoperative period. Although the role of collateral circulation in restoring blood flow is recognized, the extent of these processes varies depending on the patient's age, the level of amputation, and the presence of concomitant vascular diseases. Microcirculatory disturbances are clinically significant in patients with diabetes mellitus and obliterating arterial diseases, as tissue perfusion deficiency can cause trophic changes, chronic inflammation, and the formation of non-healing ulcers. These complications complicate the use of the prosthesis.

2.3 Bone Tissue Changes. Bone remodeling is considered a natural physiological process after amputation. Changes in mechanical loading cause remodeling of the tibia, fibula, and the bone surface of the stump. Literary data indicate the formation of localized osteoporosis, osteophytes, and changes in the shape of the distal portion of the stump. Bone overgrowth affects load distribution in the socket and can cause chronic pain during prosthetic use. Therefore, proper surgical preparation of the bone surface is considered an important factor for successful prosthetic restoration.

2.4 Soft tissue changes. Soft tissue condition is a key factor determining the functional capabilities of the stump. Postoperatively, scarring, muscle atrophy, decreased skin elasticity, and the development of hyperkeratosis are observed, significantly altering the pressure distribution between the stump and the socket. Impaired blood supply increases the risk of trophic ulcers and inflammatory complications, limiting the long-term use of the prosthesis. This emphasizes the need for an individualized approach to socket design.

2.5 The Importance of Anatomical Changes for Modern Prosthetics. A literature review indicates that the effectiveness of prosthetics is determined not only by the technical characteristics of the prosthesis but also by the anatomical condition of the stump. The presence of neuromas, bony protrusions, extensive scarring, or vascular abnormalities significantly reduces patient comfort and increases the risk of complications. According to the materials obtained during a study visit to a prosthetic and orthopedic facility, modern prosthetic design involves individual modeling of the socket, taking into account the stump shape, the presence of bony protrusions, the condition of the soft tissues, and load zones. Overall, the literature and practical observations suggest that a comprehensive assessment of morphological changes in the stump is essential for successful prosthetic treatment and rehabilitation after lower limb amputation.

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

Conclusion:

The analysis demonstrates that anatomical and morphological changes in the lower leg stump after amputation affect the nervous, vascular, skeletal systems, and soft tissues, determining the effectiveness of prosthetics. Most researchers agree that neuroma formation, microcirculatory disturbances, bone remodeling, and scarring can complicate prosthetic use and delay rehabilitation. Practical observations made during a study visit to a prosthetic and orthotic facility confirm the importance of custom-designed sockets that take into account the anatomical features of the stump. Therefore, a comprehensive assessment of morphological changes in the stump is essential for successful prosthetic fitting and rehabilitation after lower limb amputation.

References

1. Priorov N.N. Limb amputations and prosthetics. – M.: Medgiz, 1941. – 312 p.
2. Petrov V.G., Zamiladsky Yu.I., Burov G.N., Kurdybaylo S.F. Manufacturing technologies for upper limb prostheses. – St. Petersburg: Hippocrates, 2008. – 288 p.
3. Remizov A.N. Medical and biological physics: a textbook for medical universities. – M.: Higher School, 2003. – 560 p.
4. International Classification of Functioning, Disability and Health (ICF). Geneva: World Health Organization, 2001.
5. Sapin M.R. Human anatomy: textbook. In 2 volumes. – Moscow: GEOTAR-Media, 2021.
6. Prives M.G., Lysenkov N.K., Bushkovich V.I. Human anatomy . - St. Petersburg: SpetsLit, 2019. - 720 p.
7. State Scientific Medical Library of the Ministry of Health of the Republic of Uzbekistan. UzMedLib [Electronic resource]. – Access mode: https://uzmedlib.uz/ (date accessed: 29.06.2026).
8. Materials from a study visit to a prosthetic and orthopedic facility and a rehabilitation center for lower limb prosthetics. – Tashkent, 2026.

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5