

# Reconstruction of Soft Tissues of the Postamputation Lower Leg Stump with a Free Anterolateral Thigh Flap for Optimal Prosthesis

Pawel Szychta, MD, PhD, DSc\*†  
 Sławomir Stępniewski, MD, PhD†  
 Henryk Witmanowski, MD, PhD,  
 DSc†

**Summary:** Patients without proper covering of the bone stump with soft tissues after below-knee amputation have limited opportunities for prosthesis. The resulting high degree of disability severely restricts their proper functioning in social and professional life. The commonly used significant reduction of the bone length for local coverage limits rehabilitative options to the less comprehensive prosthesis. We aimed to describe a delayed reconstruction with soft tissues of the lower leg stump using free anterolateral thigh flap as an alternative surgical method allowing for optimal prosthesis. A 20-year-old patient was consulted because of right lower leg stump, covered only with a skin graft following posttraumatic amputation. Previously, the patient had ineffective attempts of using a prosthesis. He asked to determine the possibility of recovering the functionality of the lower limb. We performed reconstruction of soft tissues of the stump with a free anterolateral thigh flap. Postoperatively, the patient achieved good coverage of the remaining part of the tibia with a thick layer of soft tissues, allowing the subsequent adequate forming of the stump. Therefore, a fixed prosthesis with the dynamic foot could be implemented. A significant increase in physical activity contributed to a full return to the patient's professional and private life. In conclusion, the free anterolateral thigh flap provides a robust amount of good-quality tissues for supportive function of the lower limb stump. The resulting adaptation of the stump to numerous modern prosthetic devices significantly increases the range of physical activity and contributes to the full return of the patient to their professional and private life. (*Plast Reconstr Surg Glob Open* 2024; 12:e5905; doi: [10.1097/GOX.0000000000005905](https://doi.org/10.1097/GOX.0000000000005905); Published online 11 June 2024.)

**T**ranssection of the lower limb, whether posttraumatic or a consequential surgical intervention, precipitates a significant diminution in supportive, locomotor, and aesthetic functions, markedly deteriorating the patient's quality of life.<sup>1</sup> Nonetheless, it constitutes a pivotal phase in multifaceted surgical treatment, wherein prosthetic integration can substantially restore limb functionality.<sup>2</sup> Individuals with lower limb stumps, through advanced prosthetic solutions, can efficaciously resume professional pursuits, partake in athletic endeavors, and

attain a semblance of the social autonomy previously thought unattainable.

Within this surgical milieu, the Ghormley procedure traditionally facilitates adequate soft tissue coverage, an imperative for successful prosthesis assimilation.<sup>3</sup> However, complexities arising from the injury's nature frequently impede immediate coverage. Here, a delayed free anterolateral thigh (ALT) flap procedure was initially described in a preliminary report and short-term follow-up as a novel and innovative technique.<sup>4</sup>

In our report, a delayed ALT flap technique emerges as a comprehensive alternative, enhancing the scope of reconstruction, emphasized by the ensured integrity of the targeted postoperative care, thereby optimizing prosthesis integration for individuals post below-knee amputation.

From \*Dr Szychta Clinic, Gdansk, Poland; and †Department of Plastic, Reconstructive and Aesthetic Surgery, Collegium Medicum, Nicolaus Copernicus University, Bydgoszcz, Poland.

Received for publication December 18, 2023; accepted April 29, 2024.

Copyright © 2024 The Authors. Published by Wolters Kluwer Health, Inc. on behalf of The American Society of Plastic Surgeons. This is an open-access article distributed under the terms of the [Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 \(CCBY-NC-ND\)](https://creativecommons.org/licenses/by-nc-nd/4.0/), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

DOI: [10.1097/GOX.0000000000005905](https://doi.org/10.1097/GOX.0000000000005905)

Disclosure statements are at the end of this article, following the correspondence information.

Related Digital Media are available in the full-text version of the article on [www.PRSGlobalOpen.com](http://www.PRSGlobalOpen.com).

## CASE REPORT

In our outpatient facility, a 20-year-old patient presented 5 months subsequent to a right lower leg trauma, presenting with an 8-cm proximal third of the tibial stump, initially managed with a skin graft after a crush injury. (See figure, **Supplemental Digital Content 1**, which displays the patient after posttraumatic amputation of the right lower leg, incomplete soft tissue coverage of the bone in the stump. <http://links.lww.com/PRSGO/D288>.) The defect spanned 15 cm × 14 cm. A history of unsuccessful prosthetic fittings, due primarily to insufficient soft tissue coverage, significantly disrupted the patient's socioprofessional existence. Discomfort in fitting prosthetics and bearing weight, attributed to pain at bony prominences and load-bearing areas, necessitated an alternative approach. Given the constraints associated with local flap options, a resolution was made to undertake integumentary reconstruction using an ALT flap, noted for its minimal donor site morbidity and optimal healing propensity.<sup>5,6</sup>

Preoperative angiography revealed compromised ipsilateral popliteal vessels with normal vascularity otherwise noted in adjacent areas, though distal arteries of the affected lower leg remained elusive. (See figure, **Supplemental Digital Content 2**, which displays the angiography of the right lower limb, showing impaired vascularity at the right knee level. <http://links.lww.com/PRSGO/D289>.) The pedicled flap was deemed unsuitable due to a mismatch between defect location and perforator positioning, resulting in insufficient pedicle length. The reconstructive process involved harvesting a 14 cm × 12 cm fasciocutaneous ALT free flap from the ipsilateral thigh with the patient in prone position, predicated on the descending circumflex femoral artery perforator. A split-thickness skin graft from the right buttock was utilized for donor site coverage. Microsurgical anastomosis with the patient in supine position involved connecting the flap's pedicle to the right popliteal vascular stumps end-to-side, necessitated by the intraoperative inaccessibility of the more distal posterior tibial artery. The extensive procedure culminated in robust tibial coverage with a substantial layer of soft tissue, conducive to the development of a well-structured stump amenable to a dynamic foot prosthesis fitting. The patient's convalescence concluded with discharge 14 days postoperation.

Despite the cosmetic imperfections at the donor site, the functional benefits were deemed substantial. Postoperative care was critical, involving the use of an elastic band and stump stocking to shape the stump into a cylinder or truncated cone, minimize swelling, and prevent contractures. The patient engaged in a comprehensive rehabilitative program, initially focusing on knee joint extension and progressively incorporating a full range of motion exercises. To acclimate the tissue to prolonged pressure, the flap underwent conditioning through various techniques such as upright resistance, sponge rubbing, and water massages, enhancing vascularity and tissue resilience. Twelve weeks postsurgery, the patient was refitted with a prosthesis.

At the long-term 5-year follow-up, the flap exhibited neither atrophy nor redundancy. (See figure, **Supplemental**

**Digital Content 3**, which displays the state after covering the stump of the right lower leg with free ALT flap. <http://links.lww.com/PRSGO/D290>.)

The patient reported extensive periods of standing and active prosthesis utilization, spanning 40 hours weekly, devoid of discomfort. Despite the absence of nerve anastomosis, a retention of protective sensation was noted, with the patient capable of discerning pain upon deep pressure and differentiating thermal variations.

## DISCUSSION

In addressing lower limb amputations, reconstructing the postamputation lower leg stump stands as an indispensable stride toward restoring patient mobility, enhancing life quality, and facilitating effective prosthesis utilization. The case delineated herein demonstrates significant surgical evolution with the application of a free ALT flap, offering a superior soft tissue envelope crucial for prosthetic accommodation.<sup>4</sup>

The free ALT flap is selected for its ability to create a supportive and adaptable soft tissue envelope around the lower leg stump, which is essential for the successful fitting and comfortable use of a prosthesis.<sup>7</sup> This method allows for the preservation of limb length, provides a thick layer of soft tissue coverage over the bone, and facilitates the formation of a stump that can accommodate a dynamic foot prosthesis, thereby enhancing the patient's physical activity and enabling a full return to professional and private life. The ALT flap's adaptability, minimal donor site morbidity, and effective integration into the patient's anatomy make it the optimal choice for creating a functional stump that integrates seamlessly with diverse prosthetic configurations.

Advanced microsurgical techniques pivotal to the ALT flap's transfer, coupled with a strategic emphasis on limb length conservation, mirror significant advancements in postamputation limb reconstruction, reflecting a nuanced appreciation of the functional and psychological ramifications of limb loss.<sup>8</sup> Opting for delayed reconstruction permitted comprehensive stump and patient preparation, enhancing outcomes in terms of pain alleviation, tissue stability, and overall functionality.<sup>9</sup>

The case further illuminates an encompassing management strategy involving delayed reconstruction with the ALT flap, accompanied by a postoperative regimen tailored to the patient's long-term functional requisites and the initial injury's particularities. Rigorous stump management, combined with rehabilitative exercises and sensory re-education, underscores a holistic patient care approach, substantially contributing to the ultimate success of the prosthetic fitting and augmenting patient mobility and comfort.<sup>10</sup>

Conclusively, the presented case of lower leg amputation stump reconstruction utilizing a free ALT flap exemplifies the successful application of intricate reconstructive techniques, significantly augmenting prosthetic outcomes. This case imparts novel insights by showcasing the merits of delayed ALT flap reconstruction, underscoring the criticality of limb length preservation, and emphasizing the

comprehensive postoperative care necessary for optimal stump conditioning, with long-term outcome assessment. These contributions are invaluable to the existing body of literature, offering guidance and motivation for ameliorating amputation and prosthetic outcomes in analogous scenarios.

**Pawel Szychta, MD, PhD, DSc**  
 Dr Szychta Clinic chirurgiaplastyczna.pl  
 Gdansk, Poland  
 e-mail: pawel.szychta@chirurgiaplastyczna.pl

#### DISCLOSURE

*The authors have no financial interest to declare in relation to the content of this article.*

#### REFERENCES

1. Amtmann D, Morgan SJ, Kim J, et al. Health-related profiles of people with lower limb loss. *Arch Phys Med Rehabil.* 2015;96:1474–1483.
2. Soltanian H, Garcia RM, Hollenbeck ST. Current concepts in lower extremity reconstruction. *Plast Reconstr Surg.* 2015;136:815e–829e.
3. Wasiak K, Paczkowski PM, Garlicki JM. Surgical results of leg amputation according to Ghormley's technique in the treatment of chronic lower limb ischaemia. *Acta Chir Belg.* 2006;106:52–54.
4. Kadam D. Secondary reconstruction of below knee amputation stump with free anterolateral thigh flap. *Indian J Plast Surg.* 2010;43:108–110.
5. Aggarwal A, Singh H, Mahendru S, et al. A case series of flow-through free anterolateral thigh flap to augment the vascularity of ischaemic limbs with soft tissue defect. *Indian J Plast Surg.* 2016;49:35–41.
6. Lee YC, Chen WC, Chou TM, et al. Anatomical variability of the anterolateral thigh flap perforators: vascular anatomy and its clinical implications. *Plast Reconstr Surg.* 2015;135:1097–1107.
7. Highsmith MJ, Kahle JT, Miro RM, et al. Prosthetic interventions for people with transtibial amputation: systematic review and meta-analysis of high-quality prospective literature and systematic reviews. *J Rehabil Res Dev.* 2016;53:157–184.
8. Boutwell E, Stine R, Gard S. Shock absorption during transtibial amputee gait: Does longitudinal prosthetic stiffness play a role? *Prosthet Orthot Int.* 2016;41:178–185.
9. Silverman AK, Neptune RR. Three-dimensional knee joint contact forces during walking in unilateral transtibial amputees. *J Biomech.* 2014;47:2556–2562.
10. Lee Childers W, Prilutsky BI, Gregor RJ. Motor adaptation to prosthetic cycling in people with trans-tibial amputation. *J Biomech.* 2014;47:2306–2313.