International Surgery Journal
Parvin R et al. Int Surg J. 2025 Mar;12(3):265-270
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: https://dx.doi.org/10.18203/2349-2902.isj20250553

Original Research Article

Anterolateral thigh free flap: a superior solution for reconstruction of complex soft tissue defects in the distal leg and foot

Romana Parvin[1]*, M. Shahin[2], Mohd Fazle Rubby[2], M. Toriqul Islam[3], Mohammad Abul Kalam Azad[2], M. Shahidul Islam Farhad[4]

[1]Department of Burn Plastic and Reconstructive Surgery, Enam Medical College Hospital, Dhaka, Bangladesh
[2]Department of Burn Plastic and Reconstructive Surgery, National Institute of Burn and Plastic Surgery, Dhaka, Bangladesh
[3]Department of Burn and Plastic Surgery, Khulna Medical College Hospital, Khulna, Bangladesh
[4]Department of Urology, Shaheed Suhrawardy Medical College Hospital, Dhaka, Bangladesh

Received: 19 December 2024
Revised: 21 January 2025
Accepted: 24 January 2025

***Correspondence:**
Dr. Romana Parvin,
E-mail: romanacomc1675@gmail.com

ABSTRACT

Background: Large soft tissue defects in the lower leg and foot pose significant challenges due to exposed critical structures. This study evaluates the effectiveness of the anterolateral thigh free flap for reconstructing these complex defects. The aim of the study was to assess the effectiveness of the anterolateral thigh free flap in reconstructing complex soft tissue defects in the distal leg and foot.
Methods: This prospective observational study was conducted in the department of plastic surgery at Ibn Sina Medical College Hospital, Bangladesh, from July 2022 to December 2023, involving 30 patients with complex soft tissue defects in the distal leg and foot. Participants provided informed consent, and data collected included demographics, smoking status, comorbidities, and surgical details. The ALT flap procedure included debridement, flap design, elevation, and microsurgical techniques. Postoperative care involved monitoring, splint use, and antithrombotic prophylaxis. Outcomes were analyzed using SPSS 23.
Results: Most patients undergoing ALT free flap reconstruction were male (83.33%), with a mean age of 34.83 years. Trauma was the main cause (83.34%), affecting the lower leg (36.67%). Musculocutaneous perforators (66.67%) and the posterior tibial artery (66.66%) were common. Donor site closure used split-thickness skin grafts (60.00%). Complications included wound dehiscence, partial flap necrosis, and venous congestion (6.67% each), 73.34% had excellent outcomes.
Conclusions: The anterolateral thigh free flap is highly effective for reconstructing complex soft tissue defects in the distal leg and foot, resulting in excellent functional and aesthetic outcomes for the majority of patients.

Keywords: Anterolateral thigh flap, Distal leg reconstruction, Free flap reconstruction, Lower extremity defects, Soft tissue repair

INTRODUCTION

Large soft tissue defects in the lower third of the leg and foot pose considerable challenges for reconstructive surgeons, as these injuries frequently expose critical structures like blood vessels, nerves, tendons, joint spaces, or bones.[1,2] The foot, essential for maintaining posture and ensuring stable interaction with the ground during walking, plays a crucial role in human function.[3] Reconstructing these defects is vital for restoring both function and appearance, though it remains a complex process.[4] Recent advancements in reconstructive surgery, particularly the development of free flap techniques, have revolutionized the options for covering soft tissue defects

in the lower extremity.[5] Among the various free flaps, the anterior lateral thigh (ALT) free flap has gained popularity in Asia for its versatility and ability to address a wide range of defects.[6]

Conventional reconstruction methods, such as skin grafts, local flaps, and musculocutaneous flaps, have limitations when addressing complex defects in the distal leg and foot.[7-10] These techniques are often hindered by issues like limited mobility, unreliable perfusion, and restricted size.[11] As a result, they are not always sufficient for covering large or distal defects, necessitating the need for more advanced solutions. Free tissue transfer has become the standard procedure for reconstructing these challenging defects since the 1980s.[12] Given the shortcomings of traditional methods, the need for more reliable and versatile techniques, such as the ALT free flap, has become evident for achieving optimal functional and aesthetic outcomes in lower extremity reconstruction.

The anterolateral thigh (ALT) free flap has become a highly adaptable and dependable solution for addressing various defects, including those in the head, neck, trunk, and upper limbs, owing to its rich blood supply that aids in healing.[13,14] Its flexibility is particularly advantageous in lower extremity reconstructions, where it can be customized to fit different types of defects.[15] The ALT flap can be harvested with varying tissue components, such as skin, fat, or muscle, based on the specific needs of the defect.[16] This versatility makes it suitable for both superficial and deep tissue repairs, making it ideal for complex and extensive defects. It has also shown effectiveness in treating post-traumatic fractures, degloved foot dorsum, and other challenging areas, resulting in excellent functional and aesthetic outcomes.[17] The ALT flap's popularity is further fuelled by its long vascular pedicle, low donor site morbidity, and the option for a two-team approach that reduces operative time. Additionally, its potential to incorporate a sensory component, like the lateral femoral cutaneous nerve, increases its utility in specialized reconstructions.[18]

Although the ALT flap has proven effective in many reconstructions, further research is needed to fully assess its outcomes, especially for distal leg and foot reconstructions. While it has been widely used for various complex defects in the lower extremities, there is limited research specifically evaluating its success in the context of the foot and distal leg. Most studies have focused on relatively distal defects, but comprehensive evaluations of its effectiveness for more specific foot reconstructions are lacking. Additional evidence is necessary to confirm the ALT flap as the preferred method for these types of defects, addressing gaps in the current understanding of its long-term results and the most effective techniques for its use in this particular area. The purpose of the study to evaluate the effectiveness of the anterolateral thigh free flap in reconstructing complex soft tissue defects in the distal leg and foot.

Objective

The aim of the study was to assess the effectiveness of the anterolateral thigh free flap in reconstructing complex soft tissue defects in the distal leg and foot.

METHODS

This prospective observational study was conducted in the department of plastic surgery at Ibn Sina Medical College Hospital, Bangladesh, from July 2022 to December 2023. A total of 30 patients with complex soft tissue defects in the distal leg and foot were enrolled in the study.

Inclusion criteria

Patients aged up to 70 years. Patients with defects in the distal leg and foot. Patients who underwent ALT free flap reconstruction.

Exclusion criteria

Patients with a history of peripheral vascular disease. Patients with a history of severe acute illness. Patients unwilling to participate in the study.

Written informed consent was obtained from all participants, ensuring confidentiality and voluntary participation. Before surgery, detailed interviews and clinical examinations, including relevant laboratory investigations, were conducted to gather demographic data. All patients were operated on under spinal anesthesia. Initial debridement and wound measurements were performed, and the ALT flap was designed according to defect dimensions. The flap elevation, dissection, and donor site closure were meticulously carried out, followed by recipient vessel dissection and microsurgical arteriorrhaphy and venorrhaphy. Postoperative care included frequent monitoring, use of a splint, and antithrombotic prophylaxis. Data collection encompassed demographic variables, surgical details, and postoperative outcomes, which were systematically recorded and analyzed using SPSS 23.

RESULTS

The age distribution shows that 4 patients (13.33%) were under 20 years, 9 patients (30.00%) were between 20-29 years, 6 patients (20.00%) were between 30-39 years, and 11 patients (36.67%) were over 39 years. The mean age of the patients was 34.83 years with a standard deviation of 12.93 years. Regarding gender, 25 patients (83.33%) were male, and 5 patients (16.67%) were female. Among the participants, 5 patients (16.67%) reported a history of smoking, while 25 patients (83.33%) were non-smokers. The study also documented comorbidities, with 7 patients (23.33%) diagnosed with diabetes mellitus, 2 patients (6.67%) with hypertension, and 1 patient (3.33%) with hypothyroidism.

Table 1: Demographic and clinical characteristics of patients undergoing ALT free flap reconstruction (n=30).

Variables		Frequency	Percentage
Age (in years)	<20	4	13.33
	20-29	9	30.00
	30-39	6	20.00
	>39	11	36.67
	Mean±SD	34.83±12.93	
Gender	Male	25	83.33
	Female	5	16.67
Smoking	Yes	5	16.67
	No	25	83.33
Comorbidities	Diabetes mellitus (DM)	7	23.33
	Hypertension (HTN)	2	6.67
	Hypothyroidism	1	3.33

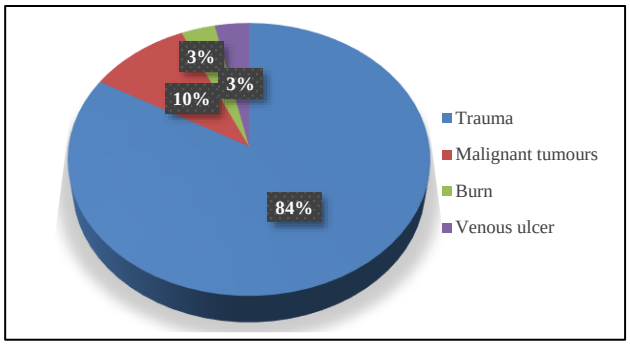

Figure 1: Etiological causes of soft tissue defects in patients undergoing ALT free flap reconstruction (n=30)

Trauma was the most common cause, affecting 25 patients (83.34%). Malignant tumors were identified as the cause in 3 patients (10.00%), while burn injuries and venous ulcers accounted for 1 patient each (3.33%).

Table 2: Distribution of soft tissue defect sites in patients undergoing ALT free flap reconstruction (n=30).

Site of defect	Frequency	Percentage
Lower one third of the leg	11	36.67
Sole and heel (left/right)	9	30.00
Dorsum of foot (left/right)	8	26.67
Middle one-third of the leg	2	6.66

Table 3: Intraoperative variables in patients undergoing ALT free flap reconstruction (n=30).

Intraoperative variables		Frequency	Percentage
Type of perforators	Musculocutaneous	20	66.67
	Septocutaneous	10	33.33
Recipient vascular bundles	Posterior tibial	20	66.66
	Anterior tibial	8	26.67
	Arteria dorsalis pedis	2	6.67
Arterial anastomosis	End to end	26	86.67
	End to side	4	13.33
Donor site closure	Split thickness skin graft	18	60.00
	Primary closure	12	40.00

Table 4: Postoperative complications observed in patients undergoing ALT free flap reconstruction (n=30).

Postoperative complications		Frequency	Percentage
Donor site	Wound dehiscence	2	6.67
Recipient site	Total flap necrosis	0	0.00
	Partial flap necrosis	2	6.67
	Congestion	2	6.67

The lower one-third of the leg was the most common site, observed in 11 patients (36.67%). Defects in the sole and heel accounted for 9 cases (30.00%), while the dorsum of the foot was affected in 8 cases (26.67%). The middle one-third of the leg was the least affected site, noted in 2 patients (6.66%) (Table 2).

Regarding the type of perforators, musculocutaneous perforators were predominant, identified in 20 cases (66.67%), while septocutaneous perforators were noted in 10 cases (33.33%). The posterior tibial artery served as the recipient vascular bundle in 20 cases (66.66%), followed by the anterior tibial artery in 8 cases (26.67%) and the arteria dorsalis pedis in 2 cases (6.67%). Arterial anastomosis was primarily end-to-end in 26 cases (86.67%), with end-to-side anastomosis performed in 4 cases (13.33%). Donor site closure was achieved with split-thickness skin grafts in 18 patients (60.00%) and primary closure in 12 patients (40.00%).

At the donor site, the most common complication was wound dehiscence, occurring in 2 cases (6.67%). Complications at the recipient site included partial flap necrosis (2 cases, 6.67%) and venous congestion (2 cases, 6.67%), while no cases of total flap necrosis were reported.

Table 5: Patient outcomes following ALT free flap reconstruction (n=30).

Patient outcome	Frequency	Percentage
Excellent	22	73.34
Satisfactory	4	13.33
Poor	4	13.33

Figure 2: First patient- A) preoperative; B) after flap harvesting; C) after flap inset; D) on the 21st postoperative day; E) after 3 months.

Figure 3: Second patient- A) preoperative; B) after flap harvesting; C) after flap inset; D) on the 21st postoperative day; E) after 3 months.

The majority of patients achieved excellent outcomes, with 22 cases (73.34%) reflecting optimal functional and aesthetic results. Satisfactory outcomes were reported in 4 cases (13.33%), while poor outcomes were observed in 4 cases (13.33%).

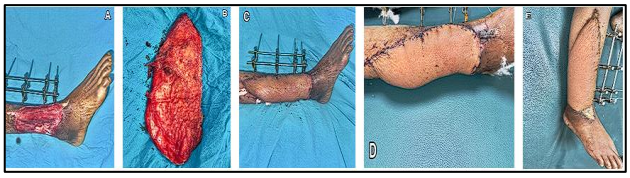

Figure 4: Third patient- A) preoperative, B) after flap harvesting, C) after flap inset, D) on the 21st postoperative day, E) after 3 months.

Figure 5: Fourth patient- A) preoperative, B) after flap harvesting, C) after flap inset, D) on the 21st postoperative day, E) after 3 months.

DISCUSSION

This study underscores the effectiveness and outcomes of anterolateral thigh (ALT) free flap reconstruction in managing complex soft tissue defects of the distal leg and foot at a tertiary care hospital in Bangladesh. The ALT free flap, known for its versatility and low donor site morbidity, remains a cornerstone in reconstructive microsurgery. Our findings highlight its adaptability in addressing various defect etiologies, with a focus on trauma-related injuries and patients with comorbidities. The study further emphasizes the importance of meticulous surgical planning and postoperative care in optimizing functional and aesthetic outcomes while minimizing complications.

In this study, the majority of patients undergoing ALT free flap reconstruction were male (83.33%) with a mean age of 34.83 years, aligning with Fahmy et al who noted a similar gender prevalence due to higher trauma risks in males.[19] A notable portion of patients were over 39 years (36.67%), consistent with Hamid et al findings.[20] Smoking (16.67%) and comorbidities such as diabetes mellitus (23.33%) and hypertension (6.67%) were significant factors, echoing Fahmy et al emphasis on their impact on surgical outcomes.[19] These patterns underscore the need for patient-specific considerations, such as optimizing surgical techniques and postoperative care, particularly for male patients and those with relevant comorbidities.

Trauma was identified as the most common cause of complex soft tissue defects, affecting 83.34% of patients in this study. This finding is consistent with the results

reported by Abdel et al, who also found a high incidence of trauma-related soft tissue defects.[21] Additionally, malignant tumors were responsible for 10% of the cases, while burn injuries and venous ulcers each accounted for 3.33%. These patterns highlight the predominant role of trauma in such defects and the need for targeted preventive measures and tailored treatment strategies to address the specific etiologies in reconstructive surgery.

The lower one-third of the leg emerged as the most common site for soft tissue defects in this study, observed in 36.67% of patients, aligning with Hamid et al findings which also highlighted this area as particularly vulnerable.[20] Defects in the sole and heel accounted for 30% of cases, and the dorsum of the foot was affected in 26.67% of patients. The middle one-third of the leg was the least affected site, noted in 6.66% of cases. These patterns suggest a higher incidence of defects in weight-bearing and pressure-prone areas, underscoring the need for targeted surgical interventions and preventive measures tailored to these specific regions.

In this study, musculocutaneous perforators were predominantly used for ALT free flap reconstruction, identified in 66.67% of cases. The posterior tibial artery was the most commonly utilized recipient vascular bundle, serving 66.66% of cases, consistent with the preferences noted by Abdel et al.[21] The arterial anastomosis was primarily end-to-end in 86.67% of cases, which supports the findings of Hamid et al, who recommended this method for optimal vascular outcomes.[20] Donor site closure was predominantly achieved with split-thickness skin grafts in 60.00% of cases, which mirrors Mohamed et al findings on the effectiveness of this technique for ensuring proper healing and minimizing complications.[22] These patterns highlight the importance of selecting appropriate perforators and recipient vessels, as well as preferred methods for arterial anastomosis and donor site closure, in enhancing the success of ALT free flap reconstructions.

At the donor site, wound dehiscence was the most common complication, occurring in 6.67% of cases, which aligns with Fahmy et al finding.[19] At the recipient site, complications included partial flap necrosis and venous congestion, each affecting 6.67% of cases. Notably, no cases of total flap necrosis were reported. These findings suggest that while complications at both donor and recipient sites can occur, they are relatively minimal, reinforcing the importance of careful postoperative monitoring and management to ensure optimal outcomes following ALT free flap reconstructions.

The majority of patients in this study achieved excellent outcomes (73.34%), reflecting optimal functional and aesthetic results, consistent with the findings of Abdel et al, who also reported high success rates in similar reconstructive procedures.[21] Satisfactory outcomes were observed in 13.33% of cases, and poor outcomes were reported in another 13.33%. These results underscore the effectiveness of ALT free flap reconstruction in achieving favorable patient outcomes, while also highlighting the need for ongoing monitoring and tailored postoperative care to address the cases with less optimal results.

This study had some limitations. The sample size was small. The study's limited geographic scope may introduce sample bias, potentially affecting the broader applicability of the findings. The absence of long-term follow-up data, which may affect the ability to fully assess the durability and performance of the anterolateral thigh free flap reconstruction.

CONCLUSION

This study evaluates the effectiveness of the anterolateral thigh (ALT) free flap in reconstructing complex soft tissue defects in the distal leg and foot. Trauma was the leading cause of defects, with a higher prevalence among male patients. Musculocutaneous perforators and the posterior tibial artery were the most commonly used in the reconstruction. Postoperative complications were generally low, with wound dehiscence at the donor site and partial flap necrosis and venous congestion at the recipient site being the most frequent. Importantly, a significant majority of patients (73.34%) achieved excellent outcomes, highlighting the ALT free flap's efficacy in providing optimal functional and aesthetic results. These findings support the ALT free flap as a reliable option for soft tissue reconstruction in clinical practice.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Noever G, Brüser P, Köhler L. Reconstruction of heel and sole defects by free flaps. Plast Reconstr Surg. 1986;78(3):345-50.
2. Serafin D, Georgiade NG, Smith DH. Comparison of free flaps with pedicled flaps for coverage of defects of the leg or foot. Plast Reconstr Surg. 1977;59(4):492-9.
3. Khurram MF, Ahmad I, Nanda M. Soft tissue reconstruction of foot and ankle defects: free vs pedicled flaps with the use of 6 different flaps in 50 cases of road traffic accidents. Austin J Surg. 2014;1(7):1031.
4. Masia J, Moscatiello F, Pons G, Fernandez M, Lopez S, Serret P. Our experience in lower limb reconstruction with perforator flaps. Ann Plast Surg. 2007;58(5):507-12.
5. Pollak AN, McCarthy ML, Burgess AR, Lower Extremity Assessment Project (LEAP) Study Group. Short-term wound complications after application of

flaps for coverage of traumatic soft-tissue defects about the tibia. JBJS. 2000;82(12):1681.
6. Song YG, Chen GZ, Song YL. The free thigh flap: a new free flap concept based on the septocutaneous artery. Br J Plast Surg. 1984;37(2):149-59.
7. Gryskiewicz JM, Edstrom LE, Dibbell DG. The gastrocnemius myocutaneous flap in lower-extremity injuries. J Trauma Acute Care Surg. 1984;24(6):539-43.
8. Vasconez LO, Bostwick III JO, McCraw JO. Coverage of exposed bone by muscle transposition and skin grafting. Plast Reconstr Surg. 1974;53(5):526-30.
9. Mawhinney IN, McCoy GF. The crushed foot. J R Coll Surg Edinb. 1995;40(2):138-9.
10. Ponten B. The fasciocutaneous flap: its use in soft tissue defects of the lower leg. Br J Plast Surg. 1981;34(2):215-20.
11. Rainer C, Schwabegger AH, Bauer T, Ninkovic M, Klestil T, Harpf C, et al. Free flap reconstruction of the foot. Ann Plast Surg. 1999;42(6):595-607.
12. Basheer MH, Wilson SM, Lewis H, Herbert K. Microvascular free tissue transfer in reconstruction of the lower limb. J Plast Reconstr Aesth Surg. 2008;61(5):525-8.
13. Lee N, Roh S, Yang K, Kim J. Reconstruction of hand and forearm after sarcoma resection using anterolateral thigh free flap. J Plast Reconstr Aesth Surg. 2009;62(12):e584-6.
14. Nosrati N, Chao AH, Chang DW, Yu P. Lower extremity reconstruction with the anterolateral thigh flap. J Reconstr Microsurg. 2012;28(04):227-34.
15. Heller L, Kronowitz SJ. Lower extremity reconstruction. J Surg Oncol. 2006;94(6):479-89.
16. Wei FC, Celik N, Chen HC, Cheng MH, Huang WC. Combined anterolateral thigh flap and vascularized fibula osteoseptocutaneous flap in reconstruction of extensive composite mandibular defects. Plast Reconstr Surg. 2002;109(1):45-52.
17. Koshima I, Fukuda H, Yamamoto H, Moriguchi T, Soeda S, Ohta S. Free anterolateral thigh flaps for reconstruction of head and neck defects. Plast Reconstr Surg. 1993;92(3):421-8.
18. Janis JE, Kwon RK, Attinger CE. The new reconstructive ladder: modifications to the traditional model. Plast Reconstr Surg. 2011;127:205S-12S.
19. Fahmy M, El Habaa G, Ayad W, Elgohary H, Abdelmofeed A. Free anterolateral thigh flap for traumatic soft tissue defects of distal third leg and foot comparative study between subfascial and suprafascial dissection. Benha Med J. 2021;38(3):1009-18.
20. Hamid MA, Sultana S, Mukit S, Biswas G. The anterolateral thigh flap for lower leg and foot reconstruction in a tertiary hospital in northern Bangladesh: our observation and outcome. Am J Health Res. 2024;12(6):230-6.
21. Abdel-Khalek AH, Allam AM, Hendy A, AbdelRazek S, Ayad Hashem HS. Clinical evaluation of free anterolateral thigh fap in the reconstruction of major soft tissue defects in the leg and foot. Egypt J Plast Reconstr Surg. 2003;27:173-80.
22. Mohamed AM, Hasanyn MA, Elsayed GY. Outcomes and clinical applications of Free Anterolateral thigh Flap as a reconstructive option for leg and foot defects. Sohag Med J. 2020;24(3):88-93.

Cite this article as: Parvin R, Shahin M, Rubby MF, Islam MT, Azad MAK, Farhad MSI. Anterolateral thigh free flap: a superior solution for reconstruction of complex soft tissue defects in the distal leg and foot. Int Surg J 2025;12:265-70.