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Assessment of Flap Viability and Complication in Free Flap Reconstruction of Lower Third Leg and Foot Defects

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Abstract

Background:
Composite defects of the lower third leg and foot present significant reconstructive challenges due to limited local tissue availability, poor vascularity, and the frequent presence of exposed bone, tendon, or implants. Free flap reconstruction has become the preferred method for achieving durable coverage in this region yet flap viability and complication patterns may vary depending on patient factors, defect characteristics, flap type, and recipient vessels. Evidence from Bangladesh is limited despite the increasing burden of lower limb trauma and oncologic resections requiring microsurgical reconstruction.

Objective:
This study evaluated flap viability and early postoperative complications following free flap reconstruction of distal lower limb defects in a tertiary hospital setting.

Methods:
This prospective observational study was conducted in the Departments of Orthopedics and Burn & Plastic Surgery at Sylhet M.A.G. Osmani Medical College Hospital, Bangladesh, from July 2015 to June 2017. Eleven patients with composite defects of the lower third leg or foot requiring free flap coverage were consecutively enrolled. Data on patient demographics, comorbidities, defect etiology and site, flap type, flap size, and recipient vessels were collected prospectively. All free flaps were performed using standard microsurgical techniques, with postoperative monitoring following institutional protocols. Flap outcomes were categorized according to the Srikant classification. Minor complications included wound infection and partial graft loss, while major complications required surgical intervention. Descriptive statistics were used for analysis.

Results:
All 11 free flaps demonstrated complete survival, resulting in a flap viability rate of 100%. According to the Srikant classification, 72.7% of flaps achieved Grade 1 outcomes, 18.2% achieved Grade 2 outcomes, and 9.1% were Grade 3, reflecting partial non-critical losses. No cases of Grade 4 or Grade 5 flap failure occurred. Minor complications were observed in 18.2% of cases, and one major complication (9.1%) required secondary surgical management. The anterolateral thigh (ALT) flap was most commonly used (72.7%), while the anterior tibial artery served as the primary recipient vessel (81.8%). Neither flap type nor vessel choice showed a clear association with flap loss due to the overall high survival rate.

Conclusion:
Free flap reconstruction demonstrated excellent viability and low complication rates in patients with composite defects of the lower third leg and foot. The consistent success across flap types and recipient vessels highlights the reliability of microsurgical reconstruction in this region.

Keywords: Free flap, Microsurgery, Lower limb, Reconstruction

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Introduction:

Composite soft-tissue defects of the lower third leg and foot represent one of the most complex challenges in reconstructive surgery. This region is anatomically vulnerable due to limited soft-tissue coverage, minimal local flap options, and a relatively poor vascular network compared with other parts of the lower limb.[1] As a result, injuries in this area frequently expose bone, tendon, or implants, necessitating robust and reliable coverage to prevent infection, preserve limb function, and avoid amputation. Conventional options such as skin grafts, local rotation flaps, and cross-leg flaps are often insufficient because they cannot provide the vascularity or tissue bulk required for durable reconstruction.[2] With the evolution of microsurgery, free flap reconstruction has become the preferred technique for managing these demanding defects, offering well-vascularized tissue capable of restoring coverage and facilitating eventual functional rehabilitation.[3]In recent years, there has been a global rise in high-energy trauma, particularly road traffic accidents, which account for a major proportion of distal lower limb defects requiring microsurgical reconstruction.[4,5] Tumor excisions, chronic infections, and sequelae of orthopedic procedures also contribute significantly. The complexity of these injuries makes flap viability and complication assessment crucial, as compromised vascularity, wound contamination, and comorbidities may predispose patients to flap loss or delayed healing. Although modern microsurgical techniques have improved outcomes substantially, flap-related complicationssuch as partial necrosis, vascular thrombosis, infection, and graft lossremain significant concerns.[6]The anterolateral thigh (ALT) flap has emerged as a workhorse flap for lower extremity reconstruction due to its long pedicle, large skin paddle, and low donor-site morbidity.[7] However, the type of flap is only one factor influencing flap success. Recipient vessel selection also plays an important role in flap viability. In the distal third of the leg and foot, the anterior tibial and posterior tibial arteries are commonly used, but trauma-related vessel damage may complicate anastomosis and affect perfusion.[8] Recent studies emphasize the need for careful vessel assessment and tailored flap selection to reduce complications and improve flap survival.[9] Despite substantial global literature, there is limited information from Bangladesh regarding flap viability and complications in lower leg and foot reconstruction. This lack of data is important due to differences in patient demographics and resources. Understanding flap outcomes is therefore essential for guiding clinical decision-making, improving patient safety, and benchmarking local performance against international standards. The study aims to evaluate flap viability and complications after free flap reconstruction in these areas.

Methods:

This prospective observational study was conducted in the Departments of Orthopaedics and Burn & Plastic Surgery at Sylhet M.A.G. Osmani Medical College Hospital, Bangladesh from July 2015 to June 2017 after ethical approval. Patients presenting with composite soft-tissue defects of the lower third of the leg or foot requiring free flap reconstruction were consecutively enrolled using a convenience sampling approach. Patients with defects amenable to simpler coverage, such as skin grafts or local flaps, absence of palpable distal arterial pulses, and medical unfitness or refusal to undergo microsurgical reconstruction were excluded. Demographic details, etiology of defects, anatomical site, flap type, flap size, recipient vessels, and comorbidities were recorded using a structured questionnaire. All surgeries were performed by the same reconstructive team using standard microsurgical techniques. End-to-end arterial anastomosis was performed in all cases, and postoperative monitoring followed institutional microsurgical protocols. Flap viability and complications were assessed daily during hospitalization. Outcomes were graded using the Srikant classification system, which categorizes flaps based on complete success, partial non-critical loss, partial critical loss, or complete failure. Minor complications included wound infection and partial graft loss, whereas major complications required additional surgical intervention. Data analysis was performed using SPSS version 21, with results presented descriptively as frequencies and percentages.

Results

Most patients were aged 51–60 years (45.5%), with 72.7% being male. Only two patients had significant comorbidities—diabetes and hypertension—affecting wound healing and complications (Table-I).

Table-I: Demographics and comorbidities of the participants (N=11)

Variable	no. (%)
Age (years)	
20–30	1(9.1)
31–40	3(27.3)
41–50	2(18.2)
51–60	5(45.5)
Sex	
Male	8(72.7)
Female	3(27.3)
Comorbidities	
Diabetes mellitus	1(9.1)
Hypertension	1(9.1)

Table-II outlined the causes and locations of composite defects and the types of free flaps used for repair. Most defects were from road traffic accidents (63.6%), with the lower leg mostly affected (36.4%). The anterolateral thigh (ALT) flap was the most commonly used for reconstruction (72.7%) making it the preferred reconstructive option due to its versatility and reliable vascularity. The anterior tibial artery was used in 81.8% of cases, while the posterior tibial artery was used in 18.2%. The anterior tibial artery's features make it ideal for lower limb reconstruction. Vascular selection affects flap viability and potential complications.

Table-II: Defect characteristics, flap selection and recipient vessels used for microvascular anastomosis (N=11)

Variable	no. (%)
Cause of Defect	
Road traffic accident	7(63.6)
Tumor excision	3(27.3)
Assault	1(9.1)
Exposed implant	1(9.1)
Defect Site	
Lower leg	4(36.4)
Foot dorsum	2(18.2)
Heel	1(9.1)
Sole & dorsum	3(27.3)
Sole	1(9.1)
Flap Type	
ALT	8(72.7)
Rectus abdominis	1(9.1)
Gracilis	1(9.1)
Latissimus dorsi	1(9.1)
Recipient Vessel	
Anterior tibial artery	9(81.8)
Posterior tibial artery	2(18.2)

All 11 flaps had complete survival. Partial non-critical flap loss happened in 27.3% of patients, with no critical losses. Minor complications occurred in 18.2% of cases, and one patient had a major complication. No amputations were needed (Table-III).

Table-IV revealed the Srikant classification system to categorize flap outcomes. Grade 1 outcomes, indicating complete success, occurred in 72.7% of cases. Grades 2 and 3, showing partial losses needing management, were 18.2% and 9.1%, respectively. No critical losses were reported.

Table-III: Flap viability and postoperative complication profile (n=11)

Parameter	no. (%)
Flap Viability	
Complete survival	11(100)
Partial Non-Critical Loss	
Yes	3(27.3)
No	8(72.7)
Critical Loss / Total Loss	0(0)
Complications	
Minor	2(18.2)
Major	1(9.1)
Amputation	0(0)

Table-IV: Free flap viability categorized by srikant classification (n=11)

Grade	Description	no. (%)
Grade 1	Complete success; uneventful healing	8(72.7)
Grade 2	Partial non-critical loss; minor complication	2(18.2)
Grade 3	Partial non-critical loss; major complication	1(9.1)
Grade 4	Partial critical loss	0(0)
Grade 5	Complete failure/amputation	0(0)

Among the 8 ALT flaps, 25% had complications; rectus abdominis and gracilis flaps had no complications. One latissimus dorsi flap had a major complication (Figure-1)

The anterior tibial artery group had two partial losses and one major complication, while the posterior tibial artery group had one partial loss with no major complications (Figure-2).

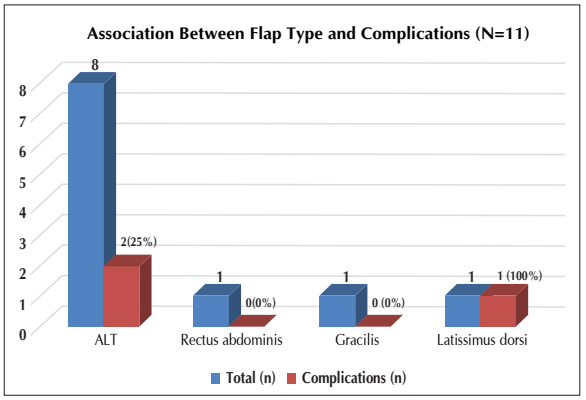

Figure-1: Association between flap type and complications (N=11)

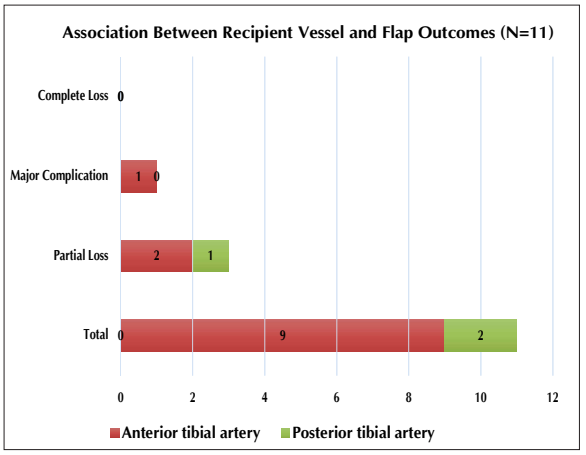

Figure-2: Association between recipient vessel and flap outcomes (N=11)

Discussion:

In this study of free flap reconstruction for lower third leg and foot defects, outcomes were excellent, with 100% flap survival and no complete failures. Most flaps (72.7%) achieved Grade 1 viability per the Srikant classification, while 27.3% had partial non-critical loss (Grades 2–3) reflecting a high level of microsurgical success despite the anatomical challenges associated with distal lower limb reconstruction. The study predominantly included patients aged 51–60 years, demonstrating successful outcomes despite age-related challenges such as reduced vascularity and comorbidities. These findings are consistent with previous studies by Sayed et al and Khouri et al, highlighting high survival rates in middle-aged and older adults undergoing similar procedures.[10,11] Sex distribution reflected a male predominance (72.7%), consistent with trauma-related epidemiology reported across South and Southeast Asia. Previous studies reported male dominance, ranging from 70–85%, largely due to higher exposure to road traffic injuries and occupational hazards.[12]Flap survival was excellent in this study despite demographic risk factors, indicating that sex-related trauma patterns did not negatively impact microsurgical outcomes. The main cause of defects was road traffic accidents (63.6%), followed by tumor excision (27.3%), consistent with findings from Singh et al and Hassan et al in lower limb reconstruction cases.[4,5] Trauma cases often involve contaminated wounds or complex defects, heightening complication risks. However, our study indicates that trauma-associated defects can achieve excellent viability outcomes through careful debridement, meticulous planning, and appropriate flap selection. The anterolateral thigh (ALT) flap, used in 72.7% of cases, consistent with global trends supporting its reliability and versatility for reconstructive option for lower limb defects due to its vascular anatomy, versatility, and low donor-site morbidity.[12,13] The ALT flap demonstrated a low complication rate (25%), with all cases achieving survival. In contrast, the single latissimus dorsi flap case experienced a major complication, consistent with reports that muscle flaps may be more prone to postoperative edema and partial necrosis in the distal lower limb.[14] However, given the small sample size, these associations are descriptive rather than statistically conclusive. Recipient vessel selection was another key factor analyzed. The anterior tibial artery was most commonly used (81.8%), while the posterior tibial artery was used in 18.2%. Importantly, partial losses occurred across both vessel groups, suggesting that vessel choice alone did not dictate complications. This aligns with findings from Bendon et al and Jordon et al, who reported that both anterior and posterior tibial systems can provide adequate perfusion for free flaps, provided the vessels are healthy and not compromised by trauma.[15,16] The absence of complete failure in either group further reinforces that recipient vessel selection should be individualized based on vessel condition and location of the defect.Complication rates in this study were low, with only 18.2% experiencing minor complications and 9.1% experiencing major complications requiring a secondary procedure. No patients required amputation or experienced total flap failure. These

findings compare favorably with reported complication rates of 12–25% in similar lower limb free flap studies from high-volume centers.[17,18] Modern improvements in perforator-based flap harvest, intraoperative perfusion assessment, and postoperative monitoring likely contributed to this high success rate. A notable strength of this study is its consistent surgical technique, with all free flaps performed using end-to-end arterial anastomosis and standardized postoperative care. The uniform protocol likely contributed to the excellent viability outcomes observed.

Limitations:
The sample size was small (n=11), limiting the power to detect meaningful associations between flap type, vessel choice, and complications, also restricts the generalizability of the findings.

Conclusion:
This study demonstratesthat free flap reconstruction is an effective method for treating complex soft-tissue injuries in the lower leg and foot. All flaps in the study survived with no critical loss or total flap failure, proving the reliability of this surgical approach. Although Some patients experienced minor issues, but these were handled without affecting the survival of the flaps or the preservation of the limb. Anterolateral thigh (ALT) flaps were favored for their success in these cases, and both the anterior and posterior tibial arteries were reliable for connecting blood vessels. The results support using free flaps as a safe reconstructive option, even in limited-resource environments. Future research with larger multicenter cohorts and extended follow-up periods is needed to evaluate long-term flap durability and functional restoration.

Reference:

1. Cheema TA, Saleh ES, De Carvalho AF. The distally based sural artery flap for ankle and foot coverage. J Foot Ankle Surg. 2007 Jan-Feb;46(1):40-7. doi: 10.1053/j.jfas.2006. 10.001.
2. Kozusko SD, Liu X, Riccio CA, Chang J, Boyd LC, Kokkalis Z, Konofaos P. Selecting a free flap for soft tissue coverage in lower extremity reconstruction. Injury. 2019 Dec;50 Suppl 5:S32-S39.doi:10.1016/j.injury.2019. 10.045.
3. Fan J, Bi L, Jin D, Wei K, Chen B, Zhang Z, Pei G. Microsurgical techniques used to construct the vascularized and neurotized tissue engineered bone. Biomed Res Int. 2014; 2014:281872. doi: 10.1155/2014/ 281872.
4. Ngunde PJ, Akongnwi ACN, Mefire CA, Puis F, Gounou E, NkfusaiNC,et al. Prevalence and pattern of lower extremity injuries due to road traffic crashes in Fako Division, Cameroon. Pan Afr Med J. 2019 Jan 30;32: 53. doi: 10.11604/pamj.2019.32.53.17514.
5. Granzow JW, Li A, Suliman A, Caton A, Goldberg M, Boyd JB. Bipedicled flaps in posttraumatic lower-extremity reconstruction. J Plast ReconstrAesthet Surg. 2013 Oct; 66(10): 1415-20. doi: 10.1016/j.bjps. 2013. 05.019.
6. KIISKI J. Surgical, Oncological and Reconstructive Outcomes After Complex Oncological Pelvic Resections. https://trepo. tuni.fi/bitstream/handle/10024/122849/978-9 52-03-1654-9.pdf[Accessed on 10th December 2025]
7. Agostini T, Lazzeri D, Spinelli G. Anterolateral thigh flap: systematic literature review of specific donor-site complications and their management. J Craniomaxillofac Surg. 2013 Jan;41(1):15-21. doi: 10.1016/ j.jcms. 2012. 05.003.
8. Cellina M, Gibelli D, Martinenghi C, Oliva G, Floridi C. CT angiography of lower extremities from anatomy to traumatic and nontraumatic lesions: a pictorial review. Emerg Radiol. 2020 Aug;27(4):441-450. doi: 10.1007/s 10140- 020-01770-9.
9. Shen AY, Lonie S, Lim K, Farthing H, Hunter-Smith DJ, Rozen WM. Free Flap Monitoring, Salvage, and Failure Timing: A Systematic Review. J ReconstrMicrosurg. 2021 Mar;37(3):300-308. doi: 10.1055/ s-0040- 1722182.
10. Sayed MAE, Mohammed MA, Elsayed A, Abdelmowla RAA. Microvascular Free Flap: Effect of Nursing Teaching Protocol on Knowledge and Postoperative Complications for Patients Underwent Reconstruction of Lower Extremity. Assiut Sci Nurs J. 2023; 11(40):198–209.doi: 10.21608/asnj.2023. 247994.1710
11. Khouri RK, Shaw WW. Reconstruction of the lower extremity with microvascular free flaps: a 10-year experience with 304 consecutive cases. J Trauma. 1989 Aug;29(8):1086-94.

doi: 10.1097/00005373-198908000-00005.
12. Kozusko SD, Liu X, Riccio CA, Chang J, Boyd LC, Kokkalis Z, Konofaos P. Selecting a free flap for soft tissue coverage in lower extremity reconstruction. Injury. 2019 Dec;50 Suppl 5:S32-S39. doi: 10.1016/j.injury.2019. 10.045.
13. Azoury SC, Stranix JT, Kovach SJ, Levin LS. Lower Extremity Reconstruction: Local Flaps, Free Tissue Transfers. In: Thaller SR, Panthaki ZJ, editors. Tips and Tricks in Plastic Surgery.Cham: Springer International Publishing; 2022: 349–65.doi:10.1007/ 978-3-030-78028-9_21
14. Gatto A, Parisi P, Brambilla L, Simonelli I, Vestri A, Torto FL, et al. Thoracodorsal artery perforator flap, muscle-sparing latissimus dorsi, and descending branch latissimus dorsi: A multicenter retrospective study on early complications and meta-analysis of the literature. J Plast ReconstrAesthet Surg. 2022 Nov;75(11):3979-3996. doi: 10.1016/j.bjps. 2022.06.083.
15. Bendon CL, Giele HP. Success of free flap anastomoses performed within the zone of trauma in acute lower limb reconstruction. J Plast ReconstrAesthet Surg. 2016 Jul;69(7): 888-93. doi: 10.1016/j.bjps. 2016. 02.017.
16. Jordan DJ, Malahias M, Hindocha S, Juma A. Flap decisions and options in soft tissue coverage of the lower limb. Open Orthop J. 2014 Oct 31;8:423-32. doi: 10.2174/18743 25001408010423.
17. Soliman AM, Ayad WM, Sayed AT, Ismail YH. Reconstructive Option Selection for Lower Third Leg Defects. Egypt J Hosp Med. 2019; 74(6):1205–14.doi:10.21608/ ejhm.2019. 26602
18. Bajantri B, Bharathi RR, Sabapathy SR. Wound coverage considerations for defects of the lower third of the leg. Indian J Plast Surg. 2012 May;45(2):283-90. doi: 10.4103/ 0970-0358. 101299.