Section: Miscellaneous

Original Research Article

TURNOVER DISTALLY BASED PERONEUS BREVIS MUSCLE FLAP FOR LOWER 1/3 LATERAL AND CENTRAL SOFT TISSUE DEFECT RECONSTRUCTION

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Received *: 28/01/2025*
Received in revised form *: 20/03/2025*
Accepted *: 05/04/2025*

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DOI: 10.70034/ijmedph.2025.2.79

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (2); 445-450

ABSTRACT

Background: Soft tissue reconstruction of the distal one-third of the leg is a significant challenge due to the region's poor vascularity, limited soft tissue, and close proximity to bone and tendons. Free tissue transfer, while considered the gold standard, may not be feasible in patients with comorbidities or poor vascular status. The turnover distally based peroneus brevis muscle flap has emerged as a reliable, local alternative for coverage of small to medium-sized defects in the lateral and central lower leg.

Materials and Methods: This prospective study included 18 patients with soft tissue defects in the lower third of the leg, managed using the turnover distally based peroneus brevis muscle flap. Parameters recorded included patient demographics, comorbidities, etiology of the defect, anatomical site, defect size, chronicity, operative times, complications, management, and postoperative hospital stay. All flaps were covered with split-thickness skin grafts and patients were followed for flap viability and functional outcome.

Results: The mean patient age was 60.2 years, with a male predominance (66.7%). Common comorbidities included diabetes mellitus (38.9%) and hypertension (27.8%). Most defects were due to wound gaping following orthopedic internal fixation (72.2%), primarily involving the lateral malleolus (83.3%). The average defect size was 37.6 cm². Mean tourniquet time was 36.7 minutes, and average operative duration was 63.4 minutes. Flap survival was 100%, with no total losses. Partial skin graft loss occurred in 27.8% of cases; one required regrafting, while others healed conservatively. Mean hospital stay was 7.2 days, with no donor site morbidity observed.

Conclusion: The turnover distally based peroneus brevis muscle flap is a reliable, safe, and efficient reconstructive option for lateral and midline defects of the lower third of the leg. It offers excellent outcomes with minimal morbidity, especially in patients where microsurgical procedures are contraindicated or impractical. Its consistent anatomy, ease of harvest, and suitability for comorbid patients make it an ideal addition to the reconstructive surgeon's armamentarium.

Keywords: Peroneus brevis muscle flap, lower third leg defect, soft tissue reconstruction, turnover flap, local flap, orthopedic wound complications, Achilles tendon coverage, flap surgery in diabetic foot.

INTRODUCTION

Soft tissue defects of the distal third of the leg remain a significant reconstructive challenge due to limited local tissue availability, tenuous vascular supply, and the anatomical proximity of tendons, bones, and orthopedic implants. These defects most commonly arise from trauma, chronic ulceration, tumor resections, or postoperative wound complications. Management often necessitates flap coverage due to exposure of vital structures, and traditional options such as skin grafting alone are

inadequate in these settings. While free flaps remain the gold standard, especially in large or composite defects, their application is often limited in patients with comorbidities like diabetes, peripheral vascular disease, or atherosclerosis due to technical complexity, cost, prolonged surgical time, and the need for microsurgical expertise.[1–2]

In the search for safer and simpler reconstructive alternatives, local muscle flaps have gained prominence. Among them, the peroneus brevis muscle flap offers a dependable solution for small to medium defects in the lower third of the leg. This muscle, located in the lateral compartment and deep to the peroneus longus, has a segmental vascular supply from the peroneal artery, allowing its use as a distally based flap³. Anatomically, the muscle's consistent distal pedicle located within 6 cm of the lateral malleolus permits reliable turnover into adjacent defects, including those over the lateral malleolus, Achilles tendon, and midline posterior tibia.[4–5] Classified as a Mathes-Nahai type IV muscle, it can be harvested with minimal functional deficit as its synergist, the peroneus longus, compensates for foot eversion and plantarflexion.[6]

The turnover distally based configuration of the flap enhances its arc of rotation, especially suitable for central posterior and lateral defects. Numerous clinical series have demonstrated excellent survival rates, low donor site morbidity, and favorable aesthetic outcomes with this flap, even in medically compromised patients.[7–9] Unlike fasciocutaneous or perforator flaps, the muscle bulk helps obliterate dead space and resist infection, particularly in wounds with chronic osteomyelitis or tendon exposure.[10]

Despite its many advantages, the peroneus brevis flap remains underutilized in lower limb reconstruction. Most available literature includes limited sample sizes or is restricted to lateral defects. There is a paucity of comprehensive data on its application in midline posterior or complex central defects. Given the increasing burden of trauma and diabetic foot complications in low-resource and comorbid populations, there is a pressing need to validate simpler, robust reconstructive techniques. This study was undertaken to evaluate the reliability, technical feasibility, and outcomes of the turnover distally based peroneus brevis muscle flap for reconstruction of lateral and central lower third leg soft tissue defects.

MATERIALS AND METHODS

This study is a prospective observational in nature conducted on 18 patients with lower one-third leg soft tissue defects, who underwent reconstruction using a turnover distally based peroneus brevis muscle flap. The study was carried out over a period of 12 months, from January 2024 to December 2024, at a tertiary care plastic surgery unit. Patients were selected based on the presence of small to medium-sized soft tissue defects involving the lateral malleolus, posterior midline (Achilles tendon), or central lower third leg, in whom conventional free flap surgery was contraindicated or not preferred due to comorbid conditions or patient refusal.

Inclusion criteria included patients aged 40–80 years with either acute or chronic post-traumatic or infective soft tissue defects involving exposed bone, tendon, or implant in the lower third of the leg. Both males and females were included irrespective of comorbidities like diabetes mellitus, hypertension, ischemic heart disease, or COPD. Exclusion criteria involved large defects requiring free flap reconstruction, patients with unstable joint fixation, or absence of palpable distal peroneal artery signals.

The surgical technique involved raising a distally based turnover flap of the peroneus brevis muscle through a standard lateral approach. After tourniquet application and identification of the distal pedicle within 6 cm from the lateral malleolus, the muscle was mobilized from proximal to distal and rotated to cover the defect. The flap was then covered with a split-thickness skin graft in all cases. The donor site was primarily closed. Care was taken to preserve the peroneus longus and superficial peroneal nerve.

Data was collected on demographics (age, sex), comorbidities (DM, HTN, IHD, smoking), defect etiology (trauma, ulcer, post-op wound gape), location and size of the defect, chronicity (acute vs chronic), tourniquet time, and total operative duration. Postoperative variables included complications (e.g., graft loss), secondary procedures (e.g., regrafting), and duration of hospital stay. Patients were followed up for assessment of flap take, complications, and wound healing. Functional preservation of foot movement and gait was observed clinically during follow-up.

All surgeries were performed by the same operating surgeon under spinal or general anesthesia, with antibiotic prophylaxis and standard perioperative care.

RESULTS

Table 1: Demographic and Clinical Profile of Patients (n = 18)

Variable	Category	Number of Patients (%)
Age (years)	Mean ± SD	60.2 ± 9.8
	Range	40 – 77
Sex	Male	12 (66.7%)
	Female	6 (33.3%)
Comorbidities	Diabetes Mellitus (DM)	7 (38.9%)

	Hypertension (HTN)	5 (27.8%)
	Ischemic Heart Disease (IHD)	1 (5.6%)
	COPD/Smoker	2 (11.1%)
	Obesity	1 (5.6%)
	No Comorbidities	5 (27.8%)
Aetiology	RTA with ORIF wound gaping	13 (72.2%)
	Charcot joint/ulcer	2 (11.1%)
	Tendoachilles repair wound	2 (11.1%)
	Pott's fracture	1 (5.6%)
Chronicity	Acute	14 (77.8%)
	Chronic	4 (22.2%)

Table 2: Defect Characteristics and Operative Details

Variable	Category	Number of Patients / Value
Defect Size (cm²)	Mean ± SD	37.6 ± 10.4
	Range	15 – 60
Tourniquet Time (minutes)	Mean ± SD	36.7 ± 2.7
	Range	32 – 40
Total Operative Time (min)	Mean ± SD	63.4 ± 6.3
	Range	58 – 84

Table 3: Postoperative Complications and Management

Complication Type	Number of Patients (%)	Management Approach
No Complications	13 (72.2%)	Not Applicable
Partial Graft Loss <50%	3 (16.7%)	Conservative (dressings)
Partial Graft Loss >50%	1 (5.6%)	Regrafting
Total Flap Loss	0	—
Donor Site Morbidity	0	—

Table 4: Hospital Stay Post Surgery

Duration of Stay (Days)	Number of Patients (%)
≤ 7 days	12 (66.7%)
8–10 days	4 (22.2%)
>10 days	2 (11.1%)
Mean Stay	**7.2 ± 2.2 days**

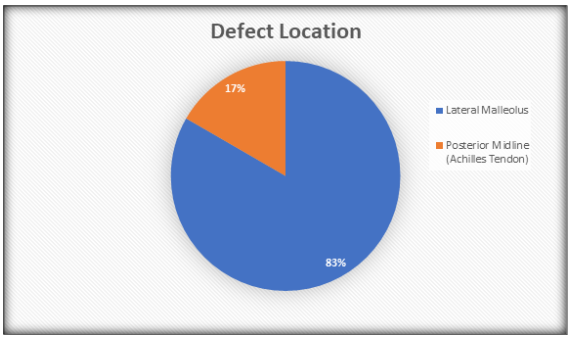

Figure 1: Defect location

A total of 18 patients were included in this prospective case series study, with a mean age of 60.2 ± 9.8 years (range: 40 to 77 years). The majority were male (n=12, 66.7%), and six patients (33.3%) were female. Comorbidities were present in 13 patients (72.2%), with diabetes mellitus being the most common (n=7, 38.9%), followed by hypertension (n=5, 27.8%). One patient had a history of ischemic heart disease with angioplasty, while two had chronic obstructive pulmonary disease and smoking history. Five patients (27.8%) had no reported comorbidities.

The most frequent etiology for soft tissue defects was post-traumatic wound gaping following orthopedic internal fixation (ORIF), seen in 13 patients (72.2%). Other etiologies included non-healing ulcers associated with Charcot's joint (n=2), wound complications following tendoachilles repair (n=2), and a chronic wound following Pott's fracture (n=1). Most defects were classified as acute (n=14, 77.8%), while four were chronic in nature (22.2%).

Regarding defect characteristics, the lateral malleolus was the most commonly involved site (n=15, 83.3%), with three cases (16.7%) involving the posterior midline over the Achilles tendon. The average defect size was 37.6 cm², ranging from 15 to 60 cm². All defects were reconstructed using a turnover distally based peroneus brevis muscle flap, followed by split-thickness skin grafting.

The average tourniquet time was 36.7 ± 2.7 minutes, and the mean total operative duration was 63.4 ± 6.3 minutes. There were no instances of total flap loss. Thirteen patients (72.2%) had uneventful recoveries with complete graft take. Partial graft loss was observed in five patients (27.8%). Among these, one patient experienced graft loss exceeding 50% and required regrafting, while the remaining four had less than 50% loss, managed conservatively with regular dressings. There were no cases of donor site morbidity, joint instability, or long-term functional impairment reported during early follow-up.

The mean duration of hospital stay following surgery was 7.2 ± 2.2 days. Most patients (66.7%) were discharged within one week. Four patients (22.2%) required 8 to 10 days of inpatient care,

while two patients (11.1%) stayed more than 10 days, primarily due to comorbidities or regrafting.

These results support the reliability, ease, and safety of the turnover distally based peroneus brevis muscle flap in managing small to medium-sized lower third leg soft tissue defects, especially in patients with comorbidities or unsuitable for free tissue transfer.

Figure 2: Surgical exposure of PL retracted to reveal PB muscle beneath; marked for turnover

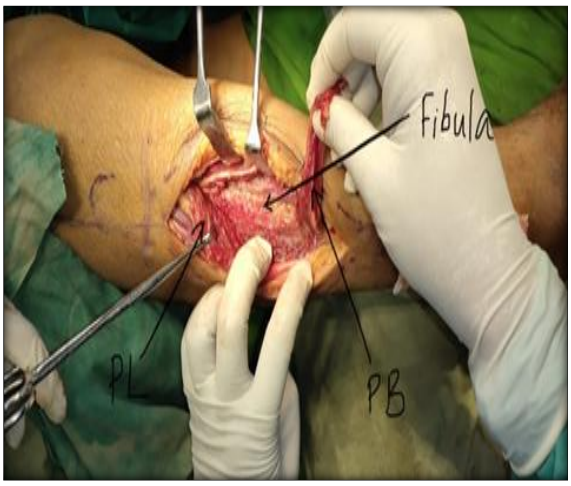

Figure 3: Intraoperative identification of Peroneus Brevis (PB), Peroneus Longus (PL), and fibula; PB isolated for flap harvest

Figure 4: PB muscle flap mobilized and rotated to cover lateral malleolus defect; donor and recipient beds visible

Figure 5: PB flap rotated and inset into defect; proximal donor site and distal recipient site visible

Figure 6: Grafted PB flap inset over lateral malleolus defect with drain in situ

Figure 7: Long-term result showing stable grafted flap over defect site and well-healed donor incision line

DISCUSSION

A total of 18 patients were included in this prospective study, with a mean age of 60.2 years and a male predominance of 66.7%. This aligns with previous literature where elderly male patients are frequently affected by complex lower limb wounds requiring reconstructive intervention, particularly after orthopedic surgeries or chronic wound evolution[1]. The predominance of comorbidities—especially diabetes mellitus (38.9%) and hypertension (27.8%)—in our cohort reflects the well-established challenge of managing soft tissue healing in patients with compromised vascular status.[2–3] These patients are often unsuitable for microsurgical free flaps due to poor vessel quality, increased perioperative risk, or prolonged operative time requirements.[4]

The leading cause of soft tissue defects in our study was post-traumatic wound gaping following internal fixation, accounting for 72.2% of cases, primarily affecting the lateral malleolus. This trend is consistent with earlier findings by Mohan et al., who observed similar indications for using the distally based peroneus brevis flap in patients with exposed orthopedic implants.[1] The lateral malleolus region is particularly vulnerable due to its minimal soft tissue envelope and convex contour, making it prone to implant exposure and delayed healing.[2]

Defect size in our series averaged 37.6 cm², which falls within the ideal range reported for peroneus brevis flap coverage.[5] Yang et al. noted consistent vascular pedicles located within 6 cm of the fibular tip, facilitating reliable coverage of defects up to 45 cm²[6]. The mean operative time in our series was 63.4 ± 6.3 minutes—significantly shorter than that typically required for free flaps, which often exceed 4 to 6 hours.[4] Our operative efficiency is consistent with findings from Rao et al., who documented similarly reduced durations when using this flap for lower limb reconstruction.[7]

Postoperative complications were minimal. Thirteen patients (72.2%) had uneventful recoveries, and five patients (27.8%) had partial skin graft loss, with only one requiring regrafting. These figures are comparable to those presented in the review by Mégevand et al., who reported a 21% overall complication rate in a pooled cohort of 222 patients using the peroneus brevis flap.[8] Our regrafting rate of 5.6% is also lower than the 7% reported by Schmidt and Giessler, suggesting that careful flap planning and strict surgical technique significantly influence outcomes.[9]

Importantly, there were no cases of total flap loss or donor site morbidity. This aligns with the work of Lorenzetti et al., who confirmed that preserving the peroneus longus muscle maintains foot eversion and plantarflexion functions.[2] Additional anatomical studies by Giessler and Schmidt have emphasized the consistent motor and vascular supply of the peroneus brevis, making it a highly dependable flap in terms of function preservation.[10]

We also ensured preservation of the superficial peroneal nerve, which may have contributed to the absence of long-term sensory disturbance or foot instability in our patients. The anatomical location and innervation pattern of the flap allow for such preservation when raised carefully, as described in neurovascular safety studies by Bach et al.[11]

Hospital stay post-surgery averaged 7.2 days, with two-thirds of patients discharged within the first week. This contrasts favorably with the longer recovery and monitoring periods typical of free flaps.[4] Our findings are consistent with the results of Fansa et al., who advocated the use of local flaps like the peroneus brevis for their economic advantages, shorter hospitalization, and reduced perioperative risks.[12]

The flap's successful use in Achilles region defects, although less common, further demonstrates its versatility. Case reports and smaller series have previously shown reliable outcomes in midline posterior defects as well.[13–14] Furthermore, Eren et al. were among the first to detail the flap's arc of rotation, reaching as far as the calcaneal tuberosity, supporting our successful outcomes in posterior defects.[15]

The turnover distally based peroneus brevis flap performed exceptionally well in our series, offering a low-complication, high-survival alternative for lower third leg reconstruction, particularly in patients for whom free tissue transfer is not viable. Our results corroborate the existing body of literature and underscore the flap's underutilized potential in everyday reconstructive practice.

CONCLUSION

The turnover distally based peroneus brevis muscle flap has proven to be a simple, safe, and effective technique for the reconstruction of small to medium-sized soft tissue defects in the lower third of the leg, particularly in the lateral malleolus and posterior midline regions. In this study of 18 patients, the flap demonstrated 100% survival with minimal

complications, low donor site morbidity, and preservation of ankle function.

Its anatomical reliability, ease of harvest, short operative duration, and favorable outcomes make it a highly suitable alternative to free tissue transfer, especially in patients with comorbidities such as diabetes mellitus, hypertension, or peripheral vascular disease. Unlike free flaps, it does not require microvascular expertise or prolonged operative time, thereby reducing surgical burden in high-risk or elderly patients.

The flap's ability to provide robust, well-vascularized tissue over exposed bone, tendons, or implants in challenging anatomical zones emphasizes its value in modern limb salvage. The results of this study, in line with previously published literature, reinforce the utility of this underused but highly dependable flap. In resource-limited settings or when patient fitness precludes microsurgical options, the distally based peroneus brevis flap should be considered a first-line option in the reconstructive algorithm for distal leg defects.

Conflict of Interest

The author declares no conflict of interest

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