

Distally Based Peroneus Brevis Muscle Flap for Treatment of Distal Third Lower Extremity Defects in the Multimorbid Patient Population



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Statement of Purpose

The purpose of this case series and literature review is to examine the viability of the distal based peroneus brevis muscle flap (DBPM) for limb salvage attempts in high-risk patients with multiple comorbidities.

Literature Review

Chronic distal lower extremity defects are difficult to treat given their multifactorial nature and generalized association with patients who have multiple comorbidities (multimorbid). Multimorbidity is defined as the presence of three or more chronic disease processes¹. The distally based peroneus brevis muscle flap (DPBM) was first described by Mathes and Nahai in 1997 and later Eren et al presented the first clinical series in 2001 for the application of distal lower extremity wounds^{2,3}.

The DPBM is indicated for coverage of small to moderate size full thickness defects in the distal third of the lower extremity. This particular flap receives segmental blood supply from the perforators off the anterior tibial artery and peroneal artery proximally and from the peroneal artery distally⁵⁻⁷.

Traditionally used as a method of defect coverage in the post-traumatic setting, the DPBM was originally employed in patients without significant comorbidities, and has been^{2,3,5,6,8,9}. Barr and colleagues described the DPBM as an unreliable option for defect coverage in patients with PAD¹⁰. Recently, Nguyen and Rodriguez reported successful outcomes of the distally based peroneus brevis flap in 17 high risk patients with diabetes mellitus and peripheral vascular disease¹¹.

Methods

Prior to beginning our study, Institutional Review Board (IRB) approval was obtained before data collection. We retrospectively analyzed patients who underwent a distal base peroneus brevis muscle flap for treatment of a chronic non-healing distal 1/3 leg wound with/without osteomyelitis from January 2018 to July 2023. All surgeries were performed by a single surgeon (A.Q.). Four patients were found to have had the DBPM for limb salvage during this time and were included. For each patient we analyzed the patient's demographics, ASA score, previous surgical interventions, and post operative results (Table 1).

Surgical Technique

Defects were initially debrided of non-viable tissue to the level of tendon and/or bone. A sterile doppler was used to confirm distal perforator location, posterior and anterior to the fibula. A linear skin incision was made along the lateral aspect of the leg overlying the lateral compartment. The peroneus brevis muscle was then dissected from its soft tissue and bony attachment and proximal segmental perforators were ligated. The peroneus brevis muscle belly was detached from the proximal fibula insertion and meticulously dissection from the fibula. The muscle belly was then rotated distally to achieve defect coverage (Figure A). The distal perforator was identified with a doppler and the muscle is examined for any early necrosis. The muscle flap was secured into the defect utilizing absorbable suture (Figure B). We then applied a dermal matrix graft over the muscle flap and applied negative pressure wound therapy at -75mmHg. A static, offloading external fixator was then applied to the lower leg to immobilize the ankle and hindfoot (Figure C).



Figure A: The DBPM being lifted and transposed towards the wound defect. Figure B: The results after transposition of the DBPM. Figure C: The final construct with the external fixator and wound vac application. Figure D: The healed wound defect at 50 weeks post operatively.

Table 1: Patient Demographics

	Age	Sex	Body Mass Index	Medical Comorbidities	Tobacco use Status	ASA Score	Contralateral Amputation (BKA/AKA)	Prior Vascular Intervention	Vessel Run Offs (PT/AT/Peroneal)	Number of Previous Wound Treatments	Duration of Wound Present Before Surgery (weeks)	Wound Location	Defect Surface Area (cm ²)	Tissue Depth
Patient 1	60	Male	29.7	DM2, HLD, HTN, PVD, pancreatitis	Current	3	No	Yes	PT/Peroneal	2	216	Lateral Calcaneus	28	Bone
Patient 2	58	Male	25.9	DM2, HLD, HTN, PVD, prostate cancer, peripheral neuropathy	Former	3	No	Yes	PT/AT/Peroneal	2	45	Posterior ankle	24.48	Tendon
Patient 3	65	Male	28.2	DM2, PVD, HTN, HLD, CHF, sleep apnea, peripheral neuropathy	Former	3	No	No	PT/AT/Peroneal	3	40	Posterior ankle	28.35	Tendon
Patient 4	59	Male	21.8	DM2, CKD, PVD, DVT, HTN, HLD, iron deficiency anemia, seizures, peripheral neuropathy	Former	4	BKA	Yes	PT/Peroneal	3	29	Posterior ankle	16.5	Tendon/Bone

Results

Four patients met inclusion criteria, with an average age of 60.5 years. Average follow-up was 34 months. All patients classified as multimorbid, and all had PVD and DM. Average defect size was 24.33 cm² at the time of reconstruction. There was a 100% rate of limb preservation at final follow up, with zero flap failures. The most common complication was distal flap necrosis. Average time in an external fixator was 11 weeks (Table 2).

Table 2: Patient Results

	Type of Skin Product Placed Over Muscle	Flap Failure	Partial Flap Necrosis	Time to Split Thickness Skin Graft (days)	Number of Repeat Debridements	External Fixator Related Complication	Time to External Fixator Removal (weeks)	Time to Full Weight Bearing (weeks)	Follow Up Duration (months)	Limb Preservation at Final Follow-Up
Patient 1	Extracellular matrix graft	No	Superficial distal flap	14	3	No	8	14	60	Yes
Patient 2	Extracellular matrix graft	No	Superficial distal flap	21	3	No	13	28	13	Yes
Patient 3	Extracellular matrix graft	No	Superficial flap	14	2	No	8	18	37	Yes
Patient 4	Extracellular matrix graft	No	No	21	4	Yes, broken pins/threaded rods	15	50	26	Yes

Analysis and Discussion

Treatment options for distal-third lower extremity defects are often limited, specifically in high-risk, multimorbid patients. Posterior ankle/calcaneus defects are among the most challenging for surgeons to manage, because of their multifactorial etiology. Muscle flap coverage is often indicated in soft defects with exposed tendon or bone, with or without underlying osteomyelitis. The distally based peroneus brevis muscle flap has proven to be a reliable flap option for soft tissue defect coverage in the distal third of the lower extremity¹¹⁻¹³. Currently, there is limited published data evaluating outcomes of the distally based peroneus brevis flap in multimorbid, high-risk patients. Shubert et al reported the outcomes of distally based peroneus brevis flap in ten elderly, multimorbid patients. The average age was 72.6 years, with a mean number of 8 pre-existing comorbidities and a minimum ASA status of III. They reported no major or minor complications and achieved successful reconstruction in all patients⁹. Nguyen and Rodriguez reported outcomes of the distally based peroneus brevis flap in 17 high risk patients with DM and PVD with non-healing calcaneal wounds. All muscle flaps were augmented with a static external ring fixator and 100% flap survival was achieved¹¹.

Our series included 4 multimorbid patients who underwent orthoplastic reconstruction with a DPBM and static external fixator for treatment of a chronic limb threatening condition. There were zero flap failures, with the most common complication being distal flap necrosis. All patients maintained successful limb preservation and were independently ambulatory at final follow-up.

The decision to pursue limb preservation when faced with a limb threatening condition should be based on patient-specific factors. Surgeons must consider the physiologic consequences of major lower extremity amputation when guiding treatment options, especially in elderly and multimorbid patients as proximal amputation is associated with significantly increased morbidity, loss of independence and poor quality of life¹⁴⁻¹⁶. In conclusion, orthoplastic reconstruction featuring a distally based peroneus brevis muscle flap may offer utility in treating distal-third lower extremity defects in multimorbid patients who are otherwise at high risk for limb loss.

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