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## RESEARCH ARTICLE

### Retrograde Internal Medial Plantar Flap

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#### ABSTRACT

Reconstruction of soft tissue defects of the distal foot and ankle remains challenging due to poor vascularization and limited local tissue availability. This report describes two clinical cases managed with a retrograde internal medial plantar flap for coverage of distal plantar defects. The first patient presented with soft tissue loss of the forefoot following trauma, and the second had a medial plantar defect after tumor excision. In both cases, the medial plantar artery and its venae comitantes were preserved as the vascular pedicle. The flap was elevated and rotated in a retrograde manner to cover the defect, while the donor site was grafted with split-thickness skin. Both flaps survived completely without venous congestion or necrosis. Postoperative recovery was uneventful, and full weight-bearing was achieved within four weeks. The reconstructed areas showed durable, stable, and sensate coverage with minimal donor site morbidity. The retrograde internal medial plantar flap is a reliable and technically straightforward option for reconstruction of distal plantar and ankle defects. It offers well-vascularized and sensitive coverage, providing a functional and aesthetic alternative to free flaps, especially in settings with limited microsurgical resources.

#### KEYWORDS

Medial plantar flap, retrograde flow, plantar reconstruction, soft tissue defect, case report, trauma, tumor excision, flap viability, plastic surgery.

#### ARTICLE INFORMATION

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#### 1. Introduction

Covering lower limb tissue loss is a challenging surgical procedure, primarily because of the wide variety of trauma mechanisms and the resulting diversity of clinical presentations, which differ in location, associated injuries, the type of tissue to be reconstructed, urgency of coverage, and available donor sites.

In some cases of very severe trauma, it is necessary to explain to patients that, regardless of the technical advances of the early 21st century, early amputation may sometimes be the best option, allowing rapid rehabilitation.

The challenge lies in finding the most appropriate solution for each patient and type of defect.

The internal plantar flap with retrograde flow is one option that can help avoid amputation.

We present two cases of forefoot tissue loss managed with this salvage flap.

#### 2. Observations

##### 2.1 Patient 1

A 42-year-old woman, married and mother of three, with no significant medical history, presented with a suspicious nevus on the sole of her right foot, opposite the head of the first metatarsal, present for four years.

She initially underwent a biopsy–excision, with pathological analysis confirming a Clark level II acral lentiginous melanoma. A multidisciplinary meeting recommended a wide excision with 2 cm lateral healthy margins, followed by reconstruction using a retrograde internal plantar flap.

After excision, the defect measured 3.2 × 3.1 cm. The flap donor site was skin grafted during the same procedure. The postoperative course was favourable, with a well-vascularised and coloured flap.

The patient underwent regular follow-up, supported by hyperbaric oxygen therapy, and flap weaning was completed after four weeks. Two years later, the patient retained protective sensation in the flap and was able to walk without difficulty.

### **2.2 Patient 2**

A 28-year-old man, with no significant medical history, presented with a 3.4 × 3.5 cm defect opposite the first metatarsophalangeal joint of the right foot.

He had previously undergone hallux valgus surgery, complicated by the development of a pressure sore opposite the head of the first metatarsal due to an overly tight bandage. Coverage was performed with an internal plantar flap in a retrograde fashion. A loose dressing was applied to permit regular monitoring of viability (skin colour and temperature).

Postoperative evolution was favourable, with a well-perfused flap. The donor site graft was performed at three weeks. At three-month follow-up, the flap was healthy and functional.

### **3. Surgical Technique**

Before surgery, the flap is designed along the course of the medial plantar artery, from the internal retromalleolar groove to the medial arch, then to the first intermetatarsal space. The skin flap is marked in the non-weight-bearing region of the medial arch.

The patient is placed supine, with a pneumatic tourniquet applied at the root of the limb.

The procedure begins with dissection and identification of the posterior tibial and medial plantar pedicle to the distal end of the flap. The medial plantar vessels are identified beneath the deep plantar fascia. The tarsal tunnel is opened, exposing the posterior tibial artery and the medial and lateral plantar arteries.

A temporary ligature of the pedicle is performed to confirm retrograde flow after tourniquet release. The flap is then transposed to cover the defect.

### **4. Discussion**

Forefoot defects present a challenge due to poor distal vascularisation and limited soft-tissue coverage [7].

The plantar surface is divided into weight-bearing areas (heel, lateral forefoot, and forefoot) and non-weight-bearing areas (midfoot or instep). The latter is ideal for reconstructing areas requiring hairless, sensate skin.

Reconstruction of plantar soft tissue should employ durable, innervated, and reliable tissue to withstand weight bearing and shoe wear. Skin grafts alone do not provide adequate or durable coverage for weight-bearing areas, as they are prone to breakdown under continuous pressure and shear [6].

Local flap options are limited, apart from free flaps. Cross-foot or cross-leg flaps are generally reserved for exceptional cases.

The retrograde medial plantar flap is a reliable alternative, offering thin, sensate, and durable coverage, with skin texture closely matching the defect (“like-with-like”). It is a single-stage procedure with straightforward postoperative care [7].

Its viability depends on anastomoses between the medial plantar artery and the deep plantar artery, which link the dorsal and plantar circulations [13]. When the medial plantar artery is ligated proximally, the blood flow reverses via the deep plantar arch. The medial plantar nerve runs lateral to the artery and can be preserved to maintain sensation.

In the first case, the medial plantar artery was clamped for 10 minutes intraoperatively to ensure retrograde perfusion. In the second case, Doppler mapping of the medial plantar artery allowed flap mobilisation without pedicle dissection, as described by Koshima et al., when rotation is less than 180° [8].

A reverse-flow flap carries a higher risk of venous congestion due to pedicle torsion. Elevation of the limb for 4–5 days postoperatively and, if needed, leech therapy can help manage venous engorgement [10].

Donor sites are usually covered with split-thickness skin grafts. Any sequelae are mainly aesthetic, as the harvest site lies in a non-weight-bearing region [1]. The retrograde medial plantar flap can cover defects up to approximately  $6 \times 9$  cm [6].

## 5. Conclusion

Reconstruction of tissue loss in the leg and foot remains limited. The main pedicled flaps available are the sural neurovascular flap and the medial plantar flap. The sural neurovascular flap is commonly employed to repair defects in the distal leg and the posterior aspect of the heel [4].

The retrograde plantar flap, on the other hand, is mainly indicated for coverage of tissue loss in the metatarsophalangeal region. This technique requires careful expertise and is particularly suitable for young patients without vascular impairment. It has been performed successfully, with no major complications reported.

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## Appendix

### IMAGES OF THE FIRST PATIENT



Figure 1



Figure 2



*Figure 3*



*Figure 4*



*Figure 5*



*Figure 6*

Figure 1 : Malignant tumour lesion opposite the head of the first metatarsal bone of the right foot

Figure 2 : Outline of the flap and margins of the tumour excision

Figure 3: Dissection and identification of the posterior tibial pedicle

Figure 4 : Proximal ligation of the medial plantar artery

Figure 5 : Inferomedial view of the foot showing the flap

Figure 6 : Progress at 6 months post-op

IMAGES OF THE SECOND PATIENT



*Figure 1*



*Figure 2*



Figure 3



Figure 4



Figure 5

- Figure 1: Lésion of the head of the first metatarsal bone  
Figure 2: Lifting of the flap  
Figure 3: The flap on day 3 post-op  
Figure 4: Coverage of the donor site with a thin skin gra9  
Figure 5: Evolution of the flap 3 months post-op