JPRS Journal of Plastic and Reconstructive Surgery
https://doi.org/10.53045/jprs.2023-0023
https://j-prs.jp/index.html

Case Report

Toe Fillet Flap Wound Coverage for a Multiple-ray Amputation Wound: A Case Report

Benjamin Chung[1)], Manzhi Wong[2)] and Jack Kian Ch'ng[1)]

1) Department of Vascular Surgery, Singapore General Hospital, Singapore, Singapore
2) Department of Plastic, Reconstructive and Aesthetic Surgery, Singapore General Hospital, Singapore, Singapore

Abstract
Ray amputation wounds caused by diabetic foot gangrene are often left to heal by secondary intention. They can be large and take a prolonged time to heal, exposing patients to complications and risk of recurrent infection. A 77-year-old male with diabetes and peripheral vascular disease presented to our institution with left 2nd-5th toe gangrene. He underwent a successful left lower limb angioplasty with good flow to the digital arteries. Left 2nd-5th toe ray amputation was performed, with the excess viable skin of the left second toe preserved as a digital fillet flap for wound coverage. The patient was discharged on postoperative day 1. Healing was complicated by a stitch sinus, but the wound completely healed with good epithelialization at 4 months postoperatively. This case report demonstrates the utility of the toe fillet flap in the coverage of ray amputation wounds in patients with diabetes and peripheral vascular disease.

Keywords
toe fillet flap, diabetic foot, ray amputation, peripheral vascular disease

J Plast Recontr Surg 2024; 3(3): 110-114
https://doi.org/10.53045/jprs.2023-0023

Introduction

Diabetic foot ulcers (DFUs) pose a heavy burden on patients and the healthcare system[1)]. Forefoot amputations or multiple-ray amputations for DFUs can result in considerably large open wounds. There is a commonly exposed bone, which comes with the risk of development of osteomyelitis. Wound healing is commonly achieved via secondary intention—this results in a prolonged healing time of weeks to months, despite the use of adjuncts like negative pressure wound therapy (NPWT).

A fillet flap is an axial pattern flap that can function as a local composite-tissue transfer. This is particularly useful for the reconstruction of defects whereby there is adjacent viable tissue in what is known as the "spare parts" concept[2)]. Digital fillet flaps are harvested from nonfunctioning or unsalvageable digits[3)].

There is limited literature regarding the use of fillet flaps in the treatment of diabetic and ischemic foot ulcers, with most publications restricted to case series and case reports.

We report a case where a fillet flap from the second toe was used to achieve immediate soft-tissue coverage after ray amputations of the second to fifth toe.

Case Report

A 77-year-old male with a history of diabetes and peripheral vascular disease (PVD) presented at our institution with a 1-month history of left third and fourth toe gangrene. He previously had an ischemic left shin ulcer that healed well with regular dressings following successful angioplasty. On physical examination, there was gangrene over his left third and fourth toes and duskiness of his fifth toe (**Figure 1A**). His second toe was largely viable. The dorsalis pedis pulse was palpable.

The patient underwent a successful repeat left lower limb angioplasty 3 days later. Preangioplasty angiogram showed multisegmental areas of 50%-75% stenosis in the patient's anterior tibial artery (**Figure 1B**). Angioplasty was performed with 2.5-3.0 mm balloon dilatation catheters. Postangioplasty images showed completion outflow present in the anterior tibial artery with good arterial flow into the digital

Corresponding author: Jack Kian Ch'ng, chng.jack.kian@singhealth.com.sg
Received: May 23, 2023, Accepted: November 20, 2023, Advance Publication by J-STAGE: February 16, 2024

Figure 1. (A) Appearance of the patient's left foot at presentation with gangrene over the third and fourth toes and lateral part of the second toe. (B) Preangioplasty images showing multisegmental stenosis of the patient's anterior tibial artery (red arrow).

Figure 2. (A) Postangioplasty angiography showing good arterial flow into the second toe digital artery (black arrow). (B) Postangioplasty angiography showing good arterial outflow of the posterior tibial artery and run off via the medial plantar arch.

artery of the left second toe (**Figure 2A**), as well as completion outflow present in the posterior tibial artery with distal runoff via the medial plantar arch (**Figure 2B**).

At one week postprocedure, his third and fourth toe gangrene was dry and stable whereas the fifth toe remained dusky. The patch of gangrene over his left second toe was limited to a small area over the lateral side and was well demarcated. The patient underwent a left second-fifth toe ray amputation 12 days after angioplasty. Thorough debridement was performed to excise any unhealthy tissue, and the con-

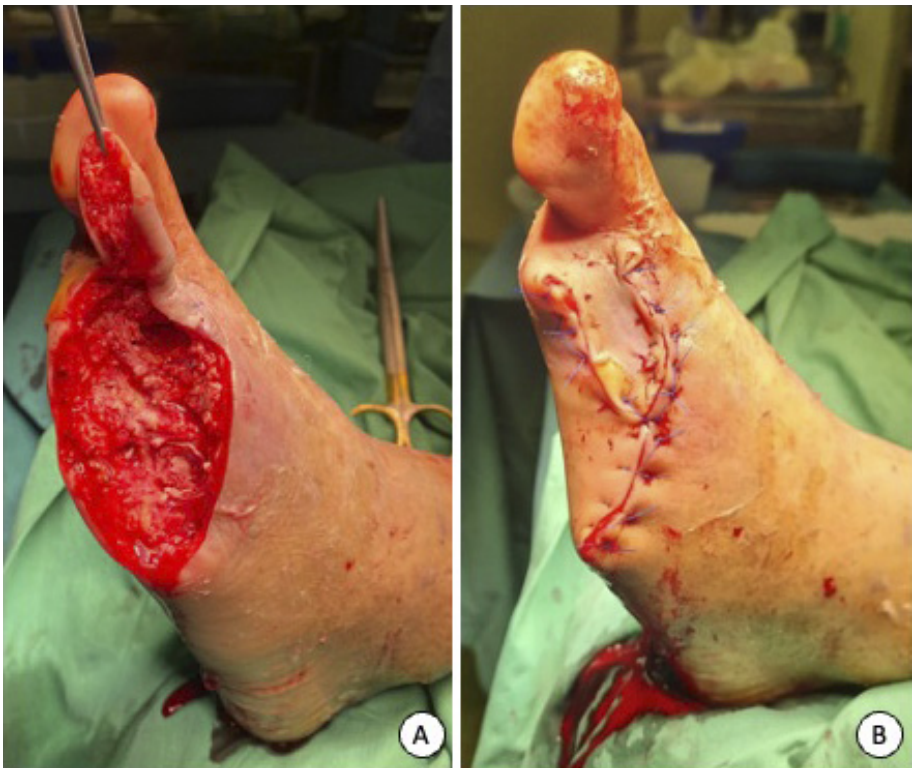

Figure 3. (A) Healthy wound bed following ray amputation and debridement, with a flap harvested using skin from the medial second toe. (B) Appearance of the wound following the second toe fillet flap partial coverage of the medial part of the wound and primary closure of the lateral part of the wound.

Figure 4. Appearance of a fillet flap slightly congested on postoperative day 1.

sequent wound bed was clean with healthy bleeding. The final wound defect size was approximately 7 × 3 cm. As the skin over the left medial second toe was healthy and viable, a decision was made to preserve it as a fillet flap. The digital neurovascular bundles run along the medial and lateral aspects of the toes, and preservation of just one is sufficient for flap survival[4]. The medial soft tissue and skin were elevated and the bony phalanges were filleted out from the skin, with careful preservation of the neurovascular bundle (**Figure 3A**). The fillet flap demonstrated excellent vascularity with good flap edge bleeding after excision. It was then used to cover the medial part of the wound. The lateral part of the wound was closed primarily with prolene sutures without any tension (**Figure 3B**). The skin flap looked slightly congested on postoperative day 1, but the tissue remained viable. The patient was discharged home well on postoperative day 1 (**Figure 4**).

Wound healing was complicated by a stitch sinus noted 6 weeks postoperatively, which was deroofed. Wound swab cultures grew multiple organisms, and this was treated conservatively with culture-directed antibiotics.

On review 4 months postoperatively, the wound had completely healed with good epithelialization (**Figure 5**).

Discussion

A major challenge for clinicians is tackling wound healing following ray amputation(s) for diabetic foot gangrene. Proximal amputation wounds (e.g., transtibial amputations) heal better than ray amputation wounds. However, patients are largely averse to this and ambulation on the native heel and forefoot has been proven to be more reliable than on prostheses. Therefore, in patients in whom continued ambu-

Figure 5. Final result of the wound 4 months postoperatively with complete healing and good epithelialization.

lation is predicted, a ray amputation is an optimal option[5].

There are several indications for a ray amputation, including toe gangrene, osteomyelitis of the metatarsal head and/or proximal phalanx, and gross infection of the toe. A ray amputation involves the excision of the toe and part of the metatarsal, with adequate surgical debridement of septic margins provided that there is good demarcation[6]. Nather and Wong suggested certain criteria to be fulfilled prior to performing ray amputations—these include the presence of one or two palpable pedal pulses, an ankle-brachial index of at least 0.8, and a toe-brachial index of at least 0.7[6].

Postamputation diabetic foot wounds are commonly left to heal via secondary intention or by delayed closure. This is associated with high complication rates ranging from 40% to 70%, continual exposure to infection, and prolonged healing time[5]. Factors for poor healing include poor vascularity, pressure injury, poor glycemic control, and concomitant infection[5]. During this period of prolonged healing, there is also a risk of restenosis of the angioplastied vessel, which may further set back the healing process, leading to further deterioration of the wound, with a consequent requirement for repeat procedures[7]. Ahmed et al. showed that primary closure of neuropathic DFUs reduced the duration of wound healing and the frequency of wound dressing change compared to those on conventional wound care[8].

Therefore, we believe that immediate wound coverage is ideal, provided that there is good vascularity, a clean noninfected wound, and possibility of closure without high skin tension. Primary closure may be difficult to achieve following multiple-ray amputations as the resultant defect may be considerably large and there is excessive skin tension. This often necessitates the use of NPWT and second stage skin grafting. Local random flaps have been described as a reconstructive option, including advancement flaps, rotational flaps, transpositional flaps, bilobed flaps, rhomboid flaps, and plantar flaps[9]. Free flaps such as the gracilis flap, latissimus dorsi flap, and anterolateral thigh flap have also been proposed. However, these procedures are more complicated and are associated with a risk of microsurgical failure[10]. A systematic review of free tissue transfer in the management of diabetic foot wounds by O'Connor showed that the major complication rate, e.g., flap loss, amputation, myocardial infarction, and death, was significant at 16%[10].

A toe fillet flap is based on an axial pattern blood supply, unlike random pattern local flaps. This axial pattern blood supply has been proven to be consistent even in patients with diabetes and PVD[3]. Axially based flaps are more reliable, with lower rates of complications such as wound dehiscence and skin die-back[7]. The skin is also sensate and durable, providing a like-for-like reconstruction. Other advantages of this technique include its simplicity and reproducibility, and the short operative time required. A one-stage immediate coverage of exposed critical structures can be achieved with minimal donor morbidity. Unsalvageable or nonfunctional digits are salvaged by utilizing the spare-part concept, instead of being discarded. In the event of flap loss, nonviable tissue can be left to demarcate and are debrided thereafter. A systematic review showed that a toe fillet flap had a high success rate when used for coverage of diabetic and ischemic forefoot ulcers with a mean healing rate of 92.8%[4]. This procedure is most commonly indicated when there is an ulcer associated with osteomyelitis of the same toe or the adjacent toe[4].

One caveat for using the toe fillet flap is that there must be good flow to the digit for it to be utilized as an axial flap. Its use is also limited in very large or more proximal defects. Further clinical trials are warranted to compare fillet flap coverage versus conventional wound therapy for distal amputation wounds.

Author Contributions: Conceptualization: Jack Kian Ch'ng and Manzhi Wong
Project administration and visualization: Jack Kian Ch'ng
Writing—original draft: Benjamin Chung
Writing—review & editing: Benjamin Chung, Manzhi Wong, and Jack Kian Ch'ng
Conflicts of Interest: There are no conflicts of interest.
Consent to Participate: The patients provided their written informed consent to participate in this study.
Consent for Publication: The patients provided their written informed consent to participate in this study.

References

1. Driver VR, Fabbi M, Lavery LA, et al. The costs of diabetic foot: the economic case for the limb salvage team. J Vasc Surg. 2010 Sep;52(3 Suppl):17S−22S.
2. Küntscher MV, Erdmann D, Homann HH, et al. The concept of fillet flaps: classification, indications, and analysis of their clinical value. Plast Reconstr Surg. 2001 Sep;108(4):885−96.
3. Schade VL. Digital fillet flaps: A systematic review. Foot Ankle Spec. 2015 Aug;8(4):273−8.

4. Yammine K, Assi C. A systematic review on the outcomes of the fillet flap in treating diabetic and ischemic forefoot ulcers. Plast Surg (Oakv). 2021 Aug;29(3):178−83.
5. Ammendola M, Sacco R, Butrico L, et al. The care of transmetatarsal amputation in diabetic foot gangrene. Int Wound J. 2017 Feb;14(1):9−15.
6. Nather A, Wong KL. Distal amputations for the diabetic foot. Diabet Foot Ankle. 2013 Jan;4.
7. Schillinger M, Minar E. Restenosis after percutaneous angioplasty: the role of vascular inflammation. Vasc Health Risk Manag. 2005; 1(1):73−8.
8. Ahmed ME, Mohammed MS, Mahadi SI. Primary wound closure of diabetic foot ulcers by debridement and stitching. J Wound Care. 2016 Nov;25(11):650−4.
9. Ramanujam CL, Zgonis T. Use of local flaps for soft-tissue closure in diabetic foot wounds: A systematic review. Foot Ankle Spec. 2019 Jun;12(3):286−93.
10. Fitzgerald O'Connor EJ, Vesely M, Holt PJ, et al. A systematic review of free tissue transfer in the management of non-traumatic lower extremity wounds in patients with diabetes. Eur J Vasc Endovasc Surg. 2011 Mar;41(3):391−9.