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Case Report

Medial Plantar Artery Flap for Soft Tissue Coverage of Heel Defect: A Case Report

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ABSTRACT

Background: Numerous flap options exist for providing soft tissue coverage for defects on the heel region. This study presents a case where a bone-exposed wound on the left heel region was successfully reconstructed using a medial plantar artery flap.
Case Report: A 16-year-old girl presented with a necrotic wound on the left heel region with calcaneus, malleolus, and talus fractures following trans-ankle external fixation on her left leg. After debridement and necrotomy, the wound revealed exposed calcaneus and implant. A medial plantar artery flap was dissected, preserving its vascularization. The flap was then carefully transferred to the wounded area and sutured appropriately. A skin graft harvested from the ipsilateral femoral region was used to cover the donor site.
Discussion: This case demonstrates the efficacy of the medial plantar artery flap as a local flap option for heel defect coverage. It is a relatively easy-to-perform procedure that provides a strong and thin skin flap. Moreover, it offers a favorable cosmetic outcome for the patient, as the surgical scar can be be relatively easy to hide with footwear. However, limitations of the medial plantar artery flap include its size and depth constraints, as well as loss of vascularization from a medial plantar artery on the plantar region.
Conclusion: The medial plantar artery flap is a feasible option as a local flap for the heel region. It is relatively easy to perform, provides a strong thin skin flap, and can results in a preferable cosmetic outcome.

Keywords: Heel; Surgical procedure; Traffic accident; Wound and injuries

INTRODUCTION

There is a wide range of flap options to consider for defect coverage in the heel region. These include free flaps (e.g., free latissimus dorsi musculocutaneous flap transfer, free temporal fascia flap, and free abdominal perforator flap) and local flaps (e.g., medial pedis flap, lateral calcaneal flap, reverse flow peroneal flap).[1] Ideally, flaps should be easily obtainable, dependable, and demonstrate a strong track record of success while causing minimal complications at the donor site. vailability in surgical facilities, cost-involved, and patient factors, including aesthetic factors, can also affect the choice of the best flap to use.[2] Local flap design can sometimes offer simpler and more cost-effective coverage for covering a defect in the lower extremities compared to free flaps.[3]

The medial plantar flap has been successfully used for soft tissue lesion reconstruction in the foot, showcasing its adaptability and effectiveness in challenging cases, even in the presence of bone exposure wounds.[4] Its advantages in various aspects, both during and after surgery, make it a preferred choice for foot soft tissue reconstruction when patient conditions allow.[5] With the proper procedure, a medial plantar artery flap can be successfully created as a local flap and may provide a good cosmetic outcome, considering the surgery scar can be relatively easy to hide with footwear. Based on these considerations, we present a case of a bone-exposed necrotic wound on the left heel region reconstructed with soft tissue coverage using a medial plantar artery flap.

CASE REPORT

A 16-year-old girl presented to Abdul Rivai Hospital in Berau, Indonesia, following a motorcycle versus motorcycle accident. Upon thorough examination, the patient was diagnosed by the surgeon with a talus, calcaneus, and medial malleolus open fracture grade IIIB (Gustillo-Anderson classification) (Figure 1). Then, the patient received debridement and trans ankle external fixation. Subsequently, the patient underwent debridement and trans ankle external fixation. Two months later, she was referred to Abdoel Wahab Sjahranie Hospital in Samarinda, Indonesia, due to persistent pain in her left foot since the accident. The patient did not have nausea and vomiting symptoms. The patient had no prior surgical history, except for two previous operations on her legs prior to the referral. Notably, the patient reported a drug allergy to metronidazole.

At Abdoel Wahab Sjahranie Hospital, the patient's vital signs were within the normal range upon admission. A general physical examination, including the head, chest, and abdomen, yielded normal results. During the physical examination, a necrotic wound was observed on the left heel region, with trans-ankle external fixations present on her left leg (Figure 2). The patient's ankle range of motion was limited. Complete blood count and blood electrolytes were within the normal range.

We performed debridement and necrotomy on the left heel region, revealing a wound exposing the calcaneus bone and implant. To stabilize the patient's bone fractures, we opted for the open reduction internal fixations (ORIF) procedure as a replacement for the external fixations (Figure 3). Additionally, a medial plantar artery flap procedure was performed to cover the patient's defect. Notably, both the ORIF and medial plantar artery flap procedures were completed in a single-stage surgery.

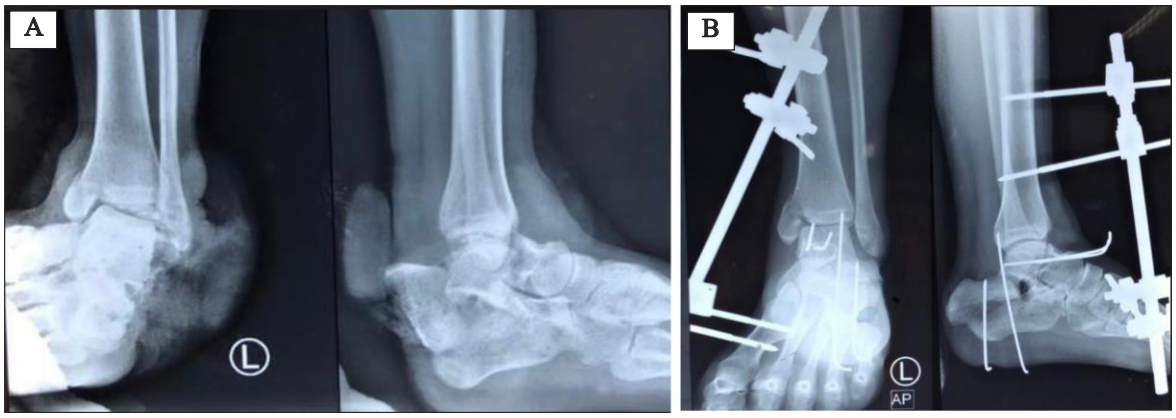

Figure 1. Ankle X-ray patient after the accident, two months before the flap procedure. (A) Anterior view (left) and medial view (right) of the ankle X-ray pre-external fixation. (B) Anterior view (left) and medial view (right) of the ankle X-ray post-external fixation.

Figure 2. Anterior view (top) and posterior view (bottom) of the patient's heel region with necrotic wound and intact external fixation on the left leg.

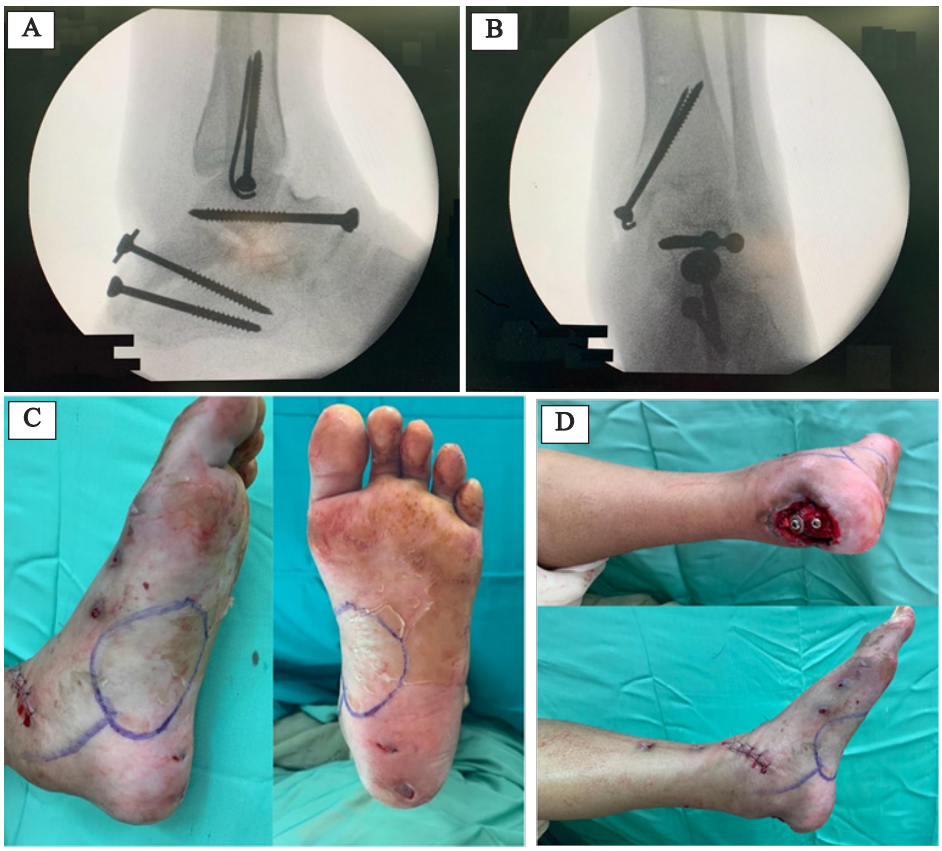

Figure 3. The patient's left leg after the ORIF procedure and wound debridement. (A) Medial view and (B) Posterior view of ankle C-arm X-ray of the patient's left leg after ORIF procedure. (C) Medial view (left) and inferior view (right) of the patient's marked flap donor site. (D) Posterior view (top) and medial view (bottom) of the patient's left leg.

Prior to initiating the flap procedure, the site for flap harvesting was marked (Figure 3). The surgical process commenced with the patient positioned supine under spinal anesthesia. The injured limb was elevated, exsanguinated, and a tourniquet was applied to the proximal aspect of the injured leg. The flap was dissected distally and medially towards the posterior border of the medial malleolus, exposing the medial plantar artery, its accompanying nerves, and the posterior tibial artery. The medial plantar artery was ligated distally to the flap. Subsequently, the medial plantar artery along with the nerve bundles to the overlying fascia and skin were dissected proximally beneath the plantar aponeurosis. This involved meticulous separation of the mid-sole cutaneous branches from the fascicles supplying three and one-half toes. The flap was then elevated from distal to proximal in the plane between the plantar fascia and the first layer of muscles. Fascial connections to the gap among the underlying muscles (specifically, the abductor hallucis muscle, flexor digitorum brevis muscle, abductor digiti minimi muscle, and flexor digitorum brevis muscle) were dissected. Upon complete liberation of the pedicle, with its intact vascular connections from the medial plantar artery (Figure 4), the tourniquet was released. After meticulous hemostasis, the flap was carefully transferred to the injured area and sutured into position.[7] A skin graft harvested from the ipsilateral femoral region was utilized to cover the donor site (Figure 5).

After surgery, the patient remained hospitalized for five days. The five-day postoperative examination revealed favorable wound healing progression and viable flap tissue, with no signs of necrosis or infection. One year after the surgery, the patient exhibited no significant sensory disorders in the left plantar pedis region. The Lower Extremity Functional Scale (LEFS) assessment yielded a score of 64, indicating minimal functional limitations or normal function. The patient expressed satisfaction with the outcome of the operation (Figure 6).

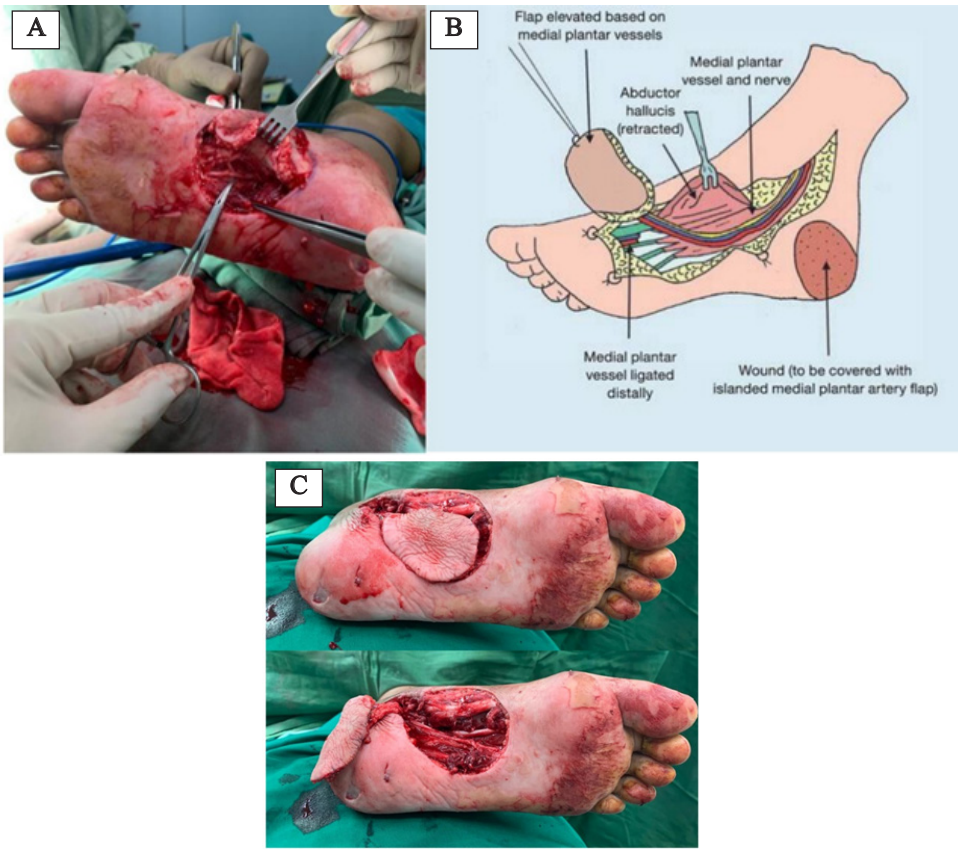

Figure 4. (A) The medial plantar artery flap dissection process. (B) An illustration that was taken from Haq et al (2022)[6], then edited to illustrate the presented case of medial plantar artery procedure. (C) Dissected pedicle at its original position (top) and tissues underneath the flap (bottom) after completed flap dissection

Figure 5. The patient's left leg after the medial plantar artery flap procedure. (A) Donor site (left) and recipient site (right) of the patient. (B) Medial view (top) and posterior view (bottom) of the patient's left leg.

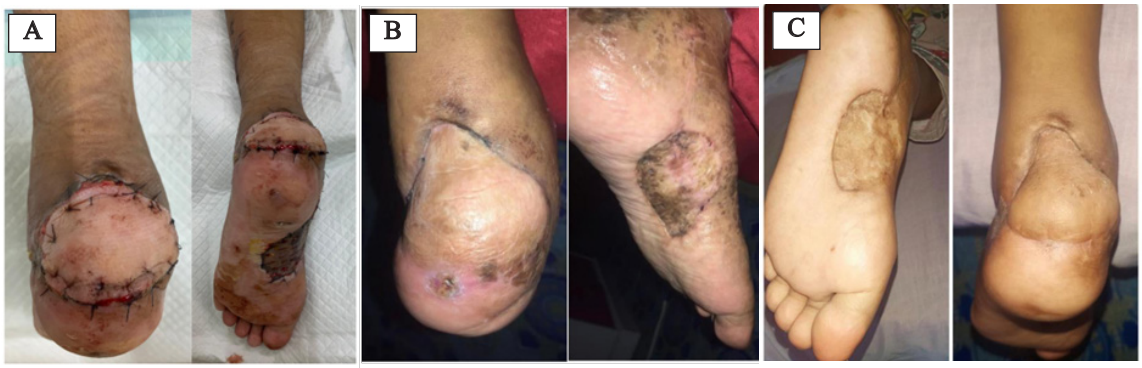

Figure 6. (A) Recipient site (left) and donor site (right) at 5 days postoperative. (B) Recipient site (left) and donor site (right) at 6 months postoperative. (C) Donor site (left) and recipient site (right) at 1 year postoperative.

DISCUSSION

Medial plantar artery flap indications include coverage of medial ankle, plantar, or heel soft tissue; reconstruction of the great toe; and microvascular transfer for defect of the contralateral foot.[8] It can also be utilized as a wound cover for a defect on the plantar forefoot region, calcaneal/ lateral plantar, fingers, and palm-wrist.[1,9]

There are two types of flaps for the heel region: local flap and free flap. Local flap examples include medial pedis flap, lateral calcaneal flap, lateral calcaneal sliding flap, reverse peroneal flap, reverse turn-over fascia flap, reverse flow sural artery flap, and supra malleolar flap. While, free flap examples include free temporal fascia flap, free abdominal perforator flap, and free latissimus dorsi musculocutaneous flap transfer. The primary consideration for addressing the defect in the heel region is the utilization of a local flap. Unfortunately, using a local flap is difficult because of traumatic injuries that can happen to the surrounding tissue.[1] This made many available area options for local flap donor sites are good to have. This case study shows that a medial plantar artery flap is a satisfactory and viable choice for a heel defects. Such as the medial plantar artery flap, the reverse flow sural artery flap can also be used to cover the heel region.[1,4] One of the reverse flow sural artery flap disadvantages is that it can cause sural nerve ligature which doesn't happen with medial plantar artery flap. Sural nerve ligature will cause sensory function loss in the malleolus, the lateral side of the foot, and the fifth toe.[4] Also in this case study, the postoperative scar on the medial plantar and the heel regions were considered less visible thus it had better cosmetic value than the sural flap.

The medial plantar artery flap is a relatively uncomplicated procedure due to the clearly defined vascular anatomy at its donor site. It provides a thin and strong skin flap to its recipient area while causing minimal morbidity in the donor site. Furthermore, this flap has the potential to restore sensation to the donor site.[4] As a local flap, it is a more cost-effective and readily available option compared to free flaps.[3,10] The medial plantar artery flap is recognized as an excellent choice for wound coverage in the weight-bearing skin region.[1,4,13] The presented case in this study shows that it is also an excellent flap for wound coverage on the non-weight-bearing skin region. This flap has even shown good results for diabetic patients. It evidently has a low rate of ulcer recurrence later in life for diabetic neuropathy patients with a present chronic ulcer in the sensory loss area. However, the procedure might only be performed for diabetic patients if there is a good vascular flow to the flap region.[12–14] The surgical scars in the presented case are easily concealed with footwear, leading to high patient satisfaction with the cosmetic and overall outcomes of the surgery. These factors suggest that medial plantar artery flaps should be considered a viable option for wound coverage in the heel region.

The medial plantar artery flap disadvantages include vascularization loss from the medial plantar artery on the plantar region. However, vascularization that is provided by other arteries in the plantar region including postoperative anastomotic networks will still be available. The medial plantar artery flap has limitations in the size and depth of coverage it provides. This can be a disadvantage, as a deep and wide cavity defect might not be fully covered by it. In such cases, larger flaps with more extensive muscle or fasciocutaneous layers should be used. Additionally, the medial plantar artery flap is primarily used for single wound defects in the lower extremities, not for multiple defects.[4]

CONCLUSION

The medial plantar artery flap is a feasible option as a local flap for the heel region. It is relatively easy to perform, provides a strong thin skin flap, and can have a preferable cosmetic outcome.

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