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Case Series

Use of dorsalis pedis artery flap in coverage of distal lower leg defects

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ABSTRACT

Soft tissue defect in the distal one third of leg have always posed a challenge for reconstructive surgeons. Such wounds are difficult to manage due the tenuous blood supply, limited subcutaneous cover over the tendons and bones. The aim of our study is to investigate the outcome of Dorsalis pedis artery flap for the coverage of such defects. In the present study, we share our clinical experience with the use of dorsalis pedis artery flap for the coverage of defect in the distal one third leg. This is a series of 4 cases where dorsalis pedis artery flap was used to cover lower one third defect. One case had focal squamous cell carcinoma due to long standing post burns contracture in distal one third of leg anteriorly. Other 3 cases had chronic non healing ulcer in the malleolar region. Patient outcome was assessed according to patients' age distribution, duration of surgery, hospital stay, and post-operative complications. All 4 patients had excellent outcome with no major donor site complications, infection, and graft loss. Donor site was closed with split thickness skin graft. One patient developed a minor raw area over the dorsum of foot which healed secondarily. Although a potential risk in applying this flap is insufficient venous drainage, no problems with blood inflow or outflow were encountered in the present case series. The flaps survived, and the patient had good postoperative outcome. Hence dorsalis pedis flap can be used for the coverage of the distal foot as a good option.

Keywords: Dorsalis pedis artery flap, Lower limb reconstruction, Diabetic foot, Pedicled flap, Local flaps, Lower limb defect

INTRODUCTION

Distal lower leg soft tissue reconstruction is a challenge to the plastic surgeons. Local flaps, cross leg flap, and free flap are among many possible reconstructive options for this region.[1,2] Local flap includes random pattern flaps, fasciocutaneous flaps, reverse sural fasciocutaneous flap, and muscle flap.[3-5] High failure rates are noted in random pattern flaps. Limitation of cross-leg flap is difficulty of immobilizing both legs for 3 weeks, joint stiffness and donor site cosmetic deformity in normal leg. Muscle flap leads to functional deficit. Free flap is costly which needs a well-equipped microsurgical set up and expertise and also with significant donor site morbidity, long operating time and high anaesthesia risk.[6-8] Coverage of foot and ankle defects can be done by dorsalis pedis artery (DPA) flap.[9] DPA may have to be lengthened by graft if to be used for coverage of ankle or malleolar or Achilles tendon defects.[10] In this series, we have used DPA flap for coverage of distal lower leg defects without any lengthening of the artery by using graft. This flap is used when other options for coverage of these type of defect are burned out and posterior tibial artery is patent. This flap is advantageous due to its wide arc of rotation, reliability and its use as sensory flap. Major problem of long-term donor site morbidity associated with this flap can be decreased with meticulous dissection.

In this series we performed 4 cases of DPA flap for lower 1/3rd defects at our institute.

Inclusion criteria

All patients with small to medium sized ankle and lower leg defects. Intact and preserved dorsum of foot. Adequate patency of dorsalis pedis artery and posterior tibial artery are confirmed pre operatively with a hand held doppler were included.

Exclusion criteria

All patients having soft tissue defect involving the dorsum of foot. Absence/ poor patency of dorsalis pedis artery, Injury or poor flow in posterior tibial artery were excluded.

Informed written consent was taken in all cases prior to surgery. Preoperatively dorsalis pedis artery was identified with 8 MHz hand held doppler probe on bedside which was confirmed with duplex imaging system. According to defect size and location, planning and marking of flap was done. Surgery was performed under spinal anaesthesia, tourniquet control and loupe magnification.

Flap elevation technique

The distal incision is made. First dorsal metatarsal artery and branches of deep peroneal nerve to the first webspace are divided. Branches of superficial peroneal nerve are similarly identified laterally and divided. Dissection continues from distal to proximal in a plane just deep to deep peroneal nerve and first dorsal metatarsal artery. This is a plane deep to extensor hallucis brevis tendon and just above peritenon of all extensor tendons. Tendon of extensor hallucis brevis is detached and tendon and muscle should be included in the flap as muscle passes between dorsalis pedis, first dorsal metatarsal artery and overlying skin. This dissection is continued proximally up to proximal head of metatarsal. At that level, deep perforating branch of dorsalis pedis artery is encountered and ligated. The medial incision is then made and medial side of flap elevated with greater saphenous vein and dorsal venous arch included in flap. The dissection proceeds just over tendon of extensor hallucis longus, preserving peritenon to that tendon. As dissection proceeds from medial to lateral over tarsal bones, dorsalis pedis artery is easily identified and traced down the deep perforating branch. At this level, dorsalis pedis artery, first dorsal metatarsal artery, and deep perforating branch should all be clearly demonstrated. Deep branch is then divided and the rest of the skin incision completed. Usually, great saphenous vein is the larger and more dominant vein draining this flap and is selected for venous drainage. In unusual situations when the lesser saphenous is the dominant vein it is dissected and prepared for use as venous drainage for flap. With upper incision completed, extensor retinaculum is opened and dorsalis pedis artery, its two venae comitantes, and nerves are identified. Flap elevation continues from distal to proximal. Extensor hallucis brevis muscle is divided at level of the extensor digitorum longus tendon to second toe. Flap is now isolated on vascular pedicle. Proximal dissection of the vessels and nerves is continued until desired Length of vascular pedicle is obtained.

Island flap

The pedicle is dissected in subdermal plane and then subcutaneous tunnel is made and used for inset of the flap, other option is to divide the skin between pedicle and defect to be covered rather than passing the flap beneath the skin bridge. If necessary, this incision can be left unsutured and grafted with donor defect.

Extension of pedicle length

The pedicle of this flap can be extended by proximal dissection into the distal leg. Once extensor retinaculum has been divided, the anterior tibial artery accompanying veins, and deep peroneal nerve may be dissected up into the distal leg to extend the pedicle length.

Transposition (tunnel)

Standard flap is rotated 90 to 180 degrees to reach ankle and posterior plantar defects. Reverse flow flap is rotated 180 degrees to reach the distal foot defect. A tunnel is frequently used to reach the site of planned flap inset.

Flap inset

The fascial deep surface of flap is initially sutured into the defect. The flap skin edges are then sutured to the cutaneous margins of the defect.

Donor site closure

It is essential to preserve the peritenon of the exposed tendons on the dorsum of the foot once this flap is elevated. A split-thickness skin graft is always necessary for closure of the donor defect.

CASE SERIES

Case 1

A 65-year-old male, with history of raw area over right lower limb since 1 year. Patient had history of burns 20 years back. The raw area was approx. 2×2×1 cm over lateral malleolus.

Case 2

A 55-year-old male, with history of post infectious raw area over left lateral malleolus. Patient is a known case of diabetes and had a chronic non healing ulcer over left lateral malleolus since 4 months. The raw area was approx. 9×5×1 cm over lateral malleolus with exposed bone.

Case 3

A 50 years old male patient with history of infection over medial malleolus and debridement was done. Patient is a known case of diabetes. Defect was approx. 7×5×1 cm with exposed bone.

Case 4

A 50 years old male patient with history of infection over lateral malleolus and debridement was done. Defect was approx. 9×8×1 cm with exposed bone joint space.

Figure 1: Pre operative photographs.

Figure 2: Post operative photograph.

Figure 3: Final photograph.

Figure 4: Intraoperative photograph.

Figure 5: Intraoperative photograph.

Figure 6: Immediate post-operative photograph.

Figure 7: Immediate post-operative photograph.

Figure 8: Post-operative photograph.

Figure 9: Post-operative photograph.

Figure 10: Preoperative defect photograph.

Figure 11: Immediate postoperative photograph.

Figure 12: Immediate post-operative photograph.

Figure 13: Immediate post-operative photograph.

Figure 14: Pre and post operative photograph.

DISCUSSION

In this series all patients with lower leg defect were given coverage with DPA flap. All patients were male in age group of 50-60 years. Aetiology of first patient having raw area over right lateral malleolus was that the patient had chronic non healing ulcer since 6 months. Patient also had history of burns 20 years back. This patient had undergone biopsy from wound margin which was suggestive of focal squamous cell carcinoma. Patient underwent resection with adequate margins. This raw area was covered by DPA flap. This patient developed a minor raw area over the donor site proximal margin. The second patient is a known case of diabetes and had history of trivial trauma over left lateral malleolus and then incision and drainage done 4 months ago. Patient had developed chronic non healing ulcer over left lateral malleolus since then. Patient underwent debridement and this raw area was covered by DPA flap. The third patient is a known case of diabetes and had history of pain and swelling 20 days ago and debridement was done 15 days ago, regular dressing was done, as bone was exposed over medial malleolus, raw area was covered with DPA flap. The fourth patient had history of swelling and pain post infection and then debridement was done over right lateral malleolar region, as bone was exposed and joint space was opened, defect was covered with DPA flap. All flaps survived uneventfully except in one where patient developed a raw area over the donor site proximal margin. It was managed conservatively with dressing. In the immediate postoperative period colour, texture and viability of the flaps were good up to the tip of the flaps. There was no donor site morbidity, infection, graft loss, haematoma or venous congestion.

Distal lower leg soft-tissue defects have been a challenge for reconstructive surgeon. The advantages of immediate soft tissue coverage of exposed bones, tendons, nerves, vessels, or osteointegrated implants are noted previously.[11,12] The choice of coverage depends on the size, site, shape, and type of defect. Free flaps are being increasingly used to cover foot and ankle defects; however, in comparison to pedicle flaps, it requires microsurgical expertise, longer operating time and more aggressive monitoring.[13,14] Adipofascial turnover flap for dorsal foot defects is highly reliable, but for limited size of defect, as the ratio of the base area to flap area ranged from 1:3.0 to 1:4.3.[15] DPA is sacrificed otherwise the dorsalis pedis myofascial flap supplied by DPA is useful option for larger defects.[16] DPA flap is not commonly used nowadays due to donor site morbidity and sacrifice of an important vessel of the foot, but can be used in selected patients by meticulous dissection. Reverse flow flaps from the lower leg, including anterior tibial flaps, posterior tibial fasciocutaneous flaps, and peritoneal flaps, provide versatile coverage for dorsal foot defects, sacrificing a major artery is a disadvantage.[17-21] Foot defects coverage can be done with local foot and leg muscle flaps, but disadvantages are limited arc of rotation and coverage of small defect size.[22,23] Russo et al used

dorsalis pedis adipofascial flap on a distal perforator of DPA to cover toes and metatarsal defects, but it was limited to more proximal foot defects.[24] El-Khatib used the dorsalis pedis adipofascial flap on a proximal perforator of DPA.[25] However, its length and arc of rotation were limited, especially for distal foot defects on medially or laterally. The extended dorsalis pedis adipofascial flap was rotated into defect by simply turning it into defect over DPA (arc of rotation), with preservation of main artery and its deep communication. Moreover, raw surface of flap on the recipient site was covered with a split-thickness skin graft in all our cases. For use of this flap to be suitable, the defect should be on one side of the dorsum of the foot (either medial or lateral to the DPA), and artery should be intact. Healthy donor side with no shearing or contusion is a pre-requisite. Furthermore, meticulous dissection and patience are needed for extension of the fascia and to avoid injury to overlying cutaneous flap. So, it is unsuitable for central dorsal defects, especially those affecting the area of the artery, and run-over accidents associated with degloving injuries to the foot skin. Adipofascial flaps are thin and pliable and can be easily brought to the defect, and the donor area can be closed primarily. The hinged multi perforator-based extended dorsalis pedis adipofascial flap covered with a skin graft, with preservation of the main DPA, is a suitable method for reconstructing dorsal foot defects, as it provides optimum functional and aesthetic outcomes with minimal donor site morbidity. Main disadvantages of DPA flap are difficult dissection, sacrifice of a main vascular axis of foot and the donor area always has to be skin grafted. However, if properly planned and meticulously dissected, this flap can reliably be used for soft tissue defect in the distal lower leg.

CONCLUSION

The DPA flap is a reliable flap to cover difficult wound such as distal lower leg. The main advantages of this flap are the reliable blood supply, wide arc of rotation, and its use as a sensory flap.

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