The use of a reverse flow sural fasciocutaneous flap in a patient with multiple trauma: a case report

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ABSTRACT

Provision of soft-tissue coverage for defects in the distal leg and foot is a challenge, especially in patients with multiple injuries and major soft-tissue defects. Major flap reconstruction requires expertise and the results are variable, with high morbidity. We report a case in which a reverse flow sural fasciocutaneous flap was used for treatment of an open fracture-dislocation of the right ankle after repeated debridement in a 64-year-old man with a history of chronic smoking, diabetes mellitus, and hypertension.

Key words: multiple trauma; surgical flaps

INTRODUCTION

Reconstruction of soft-tissue defects in the distal leg or foot is a major challenge, especially in patients with multiple trauma. Muscle and axial flaps are technically demanding, unusable in severely injured limbs, and result in major donor-site morbidity. Free flaps require microvascular expertise, sophisticated equipments, and a lengthy procedure. The reverse flow sural fasciocutaneous flap is a viable option for soft-tissue coverage in the distal leg or foot. We report the use of a reverse flow sural fasciocutaneous flap for an open fracture-dislocation of the ankle in a patient with multiple trauma.

Anatomy

Cutaneous nerves are usually accompanied by small arteries and veins that send perforators to overlying skin. The use of a distally pedicled fasciocutaneous flap (based on the perforators of the peroneal artery) or a sural neurocutaneous flap for the reconstruction of soft-tissue defects in the distal leg and ankle has been associated with a low flap necrosis rate.

The reverse flow sural fasciocutaneous flap is based on the median superficial sural artery. This artery is a branch of the superficial sural artery, originating from the popliteal or sural arteries and...
then following the course of the sural nerve 2 to 3 cm distal to its origin and emitting numerous branches along its suprafascial path towards the skin at the lower leg. The artery descends to the lateral malleolus in about 65% of individuals, or ramifies to a vascular network in the distal third of the leg in the remaining 35%. In both situations, constant anastomoses with 3 to 5 septocutaneous perforators from the peroneal artery ensure good circulation. The success rate of the flap increases when the accompanying arteries of the lesser saphenous vein are included, as these give off cutaneous perforators along its suprafascial course.

The pedicle of this flap is composed of superficial and deep fascias, sural nerve, lesser saphenous vein and accompanying vessels, and the median superficial sural artery. The flap proper includes the skin island, subcutaneous tissue, and the fascias.

Procedure

The patency of the sural artery and its perforators should be confirmed before surgery. The patient is placed in a prone position and the limb is draped without a tourniquet. To outline the pedicle, a flap axis is drawn from midway between the lateral malleolus and the Achilles tendon to the midline of the popliteal fossa. To locate the arc of rotation, a mark is made 5 to 7 cm proximal to the tip of the lateral malleolus, avoiding injury to the slightly distal septocutaneous perforators. Dissection of perforators is not necessary. The size of the defect is measured and a cutaneous island to be transferred is marked out on the middle or distal third of the leg, depending on the length of pedicle necessary to reach the wound. The pedicle is kept centralised with regard to the flap. Skin incision begins over the pedicle, and then the flap, from distal to proximal. The sural nerve and the accompanying short saphenous vein at the proximal end of the flap are identified, ligated, and cut. The flap is dissected from proximal to distal, followed by the pedicle, with an adjacent 1 to 2 cm width of the fascia. The fascia must be included in both the skin island and the pedicle dissection. The flap is transferred via a skin tunnel or skin bridge. The donor-site defect can be closed directly when it is less than 4 cm in diameter; it should be covered with a partial thickness skin graft when it is larger.

CASE REPORT

In February 2007, a 64-year-old man presented with multiple trauma after being hit by a car. He was a chronic smoker with a history of diabetes mellitus, hypertension, Parkinson’s disease, and schizophrenia. His condition was stabilised and he had no severe head or abdominal injuries. The patient had sustained a grade-IIIb open fracture-dislocation of the right ankle, involving both malleoli (Fig. 1), with soft-tissue injury and periosteal stripping around the medial malleolus (Fig. 2a). The circulation of the foot was preserved, with palpable distal pulses. The patient had also sustained a posterior cruciate ligament injury of the right knee, with a closed intercondylar eminence fracture, and a closed extra-articular fracture of the base of the first metacarpal of the left hand.

Emergency lavage, debridement, closed reduction and external fixation for the open fracture-dislocation of the ankle, closed reduction and percutaneous Kirschner wire fixation for the metacarpal fracture, and conservative treatment for the right knee injury were performed. On postoperative day 1, the right medial ankle skin was necrotised, requiring a second debridement, but necrosis and purulent discharge remained (Fig. 2b). The patient was further complicated with a chest infection. On day 3, a third debridement was performed to excise all dead tissue, along with the non-viable medial malleolar fragment. A large soft-tissue defect was created over the medial ankle, exposing the fracture site and the medial ankle mortise (Fig. 2c).

The wound culture grew bacillus species. Early wound coverage was planned to prevent osteomyelitis and septic arthritis. On day 5, when the chest infection had improved, a reverse flow sural flap was used to cover the defect (Fig. 3a). The patient was placed in a prone position and the flap was harvested, after adjustment of the external fixator. An
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8x8-cm fasciocutaneous flap was rotated to cover the defect and the donor site was closed with a partial thickness skin graft (Fig. 3b). The external fixator was retained as the definitive treatment for the ankle fracture and to protect the flap. On day 7, there was a small rim of epidermolysis at the most distal edge. The culture was negative after use of antibiotics and flap coverage. The skin graft over the donor site, flap, and pedicle healed well (Fig. 4). The metacarpal and posterior cruciate ligament avulsion fracture healed with satisfactory function. The external fixator was removed by 8 weeks and the patient was able to walk unaided 3 months later. At the 19-month follow-up, all wounds healed well with minimal donor morbidity.

DISCUSSION

Provision of coverage for soft-tissue defects of the distal leg is a challenge, particularly in patients with multiple trauma and peripheral vascular disease. For open tibiofibular fractures, free flaps are now used less frequently, while skin grafts, delayed primary closure
and secondary intention closure has become more popular.\textsuperscript{12} The use of local flaps remains constant. Soft-tissue revisions have decreased significantly, partly attributable to fewer free flap revisions.\textsuperscript{12} Amputation rates and long-term outcomes have remained constant.\textsuperscript{12}

The fasciocutaneous flap has constant septocutaneous perforators, ensuring perfusion of the flap.\textsuperscript{1,2,13–16} It has low complication and flap failure rates.\textsuperscript{3–10} It can be used to cover soft-tissue defects of the distal leg, ankle, heel, and dorsum of the foot secondary to trauma, tumour or infection, from paediatric\textsuperscript{17} to elderly patients. The flap is durable enough even for heel coverage.\textsuperscript{18} It has also been successful in treating ulcers in limbs with poor circulation, such as diabetic ulcers and chronic venous ulcers,\textsuperscript{19,20} and even for salvage of a failed free tissue transfer.\textsuperscript{21}

The reverse flow sural fasciocutaneous flap does not require scarification of a major artery and can be used in limbs with arterial injury, as long as the peroneal artery is preserved. The operative procedure is not complicated (around 2 hours with minimal experience) and does not require microsurgery. It may be performed as a single-stage procedure, with regional anaesthesia, to enable early coverage of the defect. The large arc of rotation (90°–180°) facilitates reconstruction of the distal leg and foot. The maximum flap size reported is 17x16 cm.\textsuperscript{18}

In a series of 70 sural flaps used for soft-tissue coverage of the distal leg, the overall success rate was 86\% for the flap alone or combined with a skin graft. However, the partial or complete flap necrosis rate was 36\%, which was unfavourable.\textsuperscript{22} Risk factors included patient age of more than 40 years, peripheral artery disease, venous insufficiency, and diabetes mellitus. Tobacco use, chronic alcoholism, and minimal family support are secondary risk factors for flap failure.\textsuperscript{22} In high-risk patients requiring a large flap, a delayed sural flap procedure has been recommended.\textsuperscript{23–25}

In our patient, surgical options were limited because of the large defect. Delayed primary closure was not possible. Healing by secondary intention, with or without delayed skin grafting, was not considered a good option in view of the large defect exposing bone and joint, together with the history of diabetes and chronic smoking. Primary skin grafting might have failed when applied on to bare bones. The use of a free flap was technically demanding and the result may not have been favourable in our patient given his long history of diabetes, hypertension, and chronic smoking. The patient also might not have withstood the lengthy operation under general anaesthesia, given his medical history. The use of a random local flap was not considered, because of the inconsistent and poor circulation over the distal leg and ankle region. The only viable option left was the local pedicled flap. Numerous local pedicled flaps have been described and most are technically demanding and the results variable. We chose the reverse flow sural fasciocutaneous flap in view of the advantages and the satisfactory results documented. Although our patient had risk factors for failure (age >40 years, diabetes mellitus, and chronic smoking), the flap finally healed well without complications.

The major disadvantage of this flap is the scarification of the sural nerve leading to anaesthesia of the lateral foot. However, the long-term disability is minimal in most patients.\textsuperscript{15,16} An insensate flap and the final scar, especially when skin grafting of the donor site is needed, are other drawbacks.\textsuperscript{15} However, poor cosmesis would be a lesser concern in traumatology. For flaps with a width of less than 4 cm, direct closure of the donor site is possible for a cosmetically more acceptable scar.

**CONCLUSION**

Management of soft-tissue defects of the distal leg and foot is always difficult. In cases of open fracture, wound lavage and thorough debridement followed by early wound coverage remains a widely accepted protocol. The advantages of the reverse flow sural fasciocutaneous flap are constant vascular anatomy, a large arc of rotation, preservation of major nerves and arteries, and a relatively fast and simple procedure, especially in patients with multiple trauma. The sacrifice of the sural nerve results in minimal morbidity. This approach provides a reliable alternative to other major reconstructive procedures, even in patients with vascular risk factors.

**REFERENCES**


