Lateral Supramalleolar Flap for Coverage of Ankle and Foot Defects in Children

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ABSTRACT

The lower part of the leg, the ankle and the foot, is a difficult region to cover especially with exposure of bones or tendons. There are many options for covering soft tissue defect in these areas. The supramalleolar flap is an interesting procedure. The lateral supramalleolar flap was used in 8 cases for the reconstruction of skin defects of the ankle, heel, and foot that compromised the Achilles tendon and the osteoarticular system. Of the 8 patients, 5 were males and 3 were females, with an average age of 6.4 (range 2 to 10) years. The skin defect was secondary to trauma in all cases. The mean follow-up period was 31 (range 19 to 47) months; at the last follow-up visit, the region had been successfully covered in all cases. No necrosis of the flap was reported. The donor site morbidity was minimal. The lateral supramalleolar flap is an interesting surgical technique to salvage the lower extremity in children because this flap has a large skin paddle and a wide rotation arc and is based on a secondary vascular axis.

When the perforating branch of the dorsal peroneal artery is preserved, the arterial blood comes in an anterograde manner from the ascendant vessels and in a retrograde manner from the distal anastomoses. When the perforating branch of the dorsal peroneal artery is ligated, the arterial blood supply flows in a retrograde manner from the distal anastomoses.

Fig. 1. Vascular anatomy of lateral supramalleolar (LSM) flap: 1, peroneal artery; 2, anterior tibial artery; 3, perforating branch of peroneal artery; 4, lateral collateral artery (descending branch of perforating artery); 5, cutaneous branch artery (ascending branch of perforating artery); and 6, anterolateral malleolar artery.
Dissection of the descending branch of the peroneal artery provides a wide rotation arc that reaches the distal area of the foot.

Surgical Technique

The patient is positioned supine. A pillow is placed under the ipsilateral buttock so that the lateral aspect of the leg is better exposed. The surgical procedure is performed with the patient under general anesthesia. A pneumatic tourniquet is placed around the thigh. The pivotal point is marked on the groove between the tibia and the fibula, 5 cm above the tip of the lateral malleolus. The axis of the flap is represented by a line drawn in the midline from the anterior tibial crest to the posterior margin of the fibula. The outline of the flap is designed to include the pivotal point. The size of the flap is adapted to the skin defect after debridement.

An incision of the anterior margin of the flap is made and proceeds distally up to the sinus tarsi. Proximally, the incision should not exceed the middle third of the leg. It should intersect the skin and the underlying fascia incorporating the pedicle. The dissection is continued under the fascia until the perforating branch and superficial peroneal nerve, which is divided and its proximal end buried in the muscles. The postural incision is completed, and the flap is raised in a retrograde position. Homeostasis is achieved using a bipolar coagulator. The flap is checked for viability after the tourniquet is released. A wide subcutaneous tunnel is created for the passage of the flap. The flap is brought through this tunnel and sutured loosely into place. The donor site is closed primarily when the flap area is small, using fine absorbable stitches over a suction drain. We use a free skin graft if primary closure is impossible. The surgical principles for children are the same as those for adults.

Results

The follow-up period for the 8 patients ranged from 19 to 47 months postoperatively. The soft tissue defects were completely and successfully covered for all the children. In 7 cases, we used the island flap and in 1 case, a peninsular flap. Only 1 flap developed partial superficial necrosis. After excision, the soft tissue defect healed spontaneously. After the procedure, no venous congestion or infection was reported. All the patients were able to leave the hospital within a very short period after surgery (4-day average). No significant donor site morbidity was present, and the patients had no complaints related to sacrifice of the superficial peroneal nerve.

After a follow-up of 31 (range 19 to 47) months, no pain or dorsal foot anesthesia had developed. In all cases, we had a good cosmetic result with a satisfactory skin match. None of the patients had problems wearing shoes.

Case 1

A 5-year-old female had a soft tissue defect in the heel with exposure of the Achilles tendon and calcaneal bone (Fig. 2). A supramalleolar island flap was used, and the lesion was successfully repaired. The donor site was closed primarily (Fig. 3). At the last follow-up visit, she had had no complications and was able to wear normal footwear (Fig. 4).

Case 2

A 6-year-old male had a soft tissue defect on the inside of the ankle with a medial malleolus exposition after a motorcycle accident (Fig. 5). The bone exposure was repaired with a 4 × 6-cm supramalleolar flap 6
days after the trauma. The free skin graft was used for the donor site. At 20 months of follow-up, he had a normal gait, and the bone had healed well (Fig. 6).

**Discussion**

The reconstruction of the lower extremities that have compromised tendon, bone, and joint remains a challenge for orthopedic and plastic surgeons. Since the first description of the fasciocutaneous flap by Ponten in 1981 (2), several flaps have been described to cover skin and soft tissue defects of the lower third of the leg and foot. Two types of distal pedicle flaps are commonly used to cover the distal area of the lower limb. These are the sural flap and the LSM flap; these flaps do not sacrifice a major vascular axis (3). Valenti et al (2), Voche et al (3), and Demiri et al (4) suggested raising the LSM flap on a distally based fasciocutaneous pedicle for 3 reasons: to reduce the skin size of the donor site, to avoid skin grafting over the tendinous area, and to avoid producing a “dog ear.”

Venous congestion is a special complication in the distally based flap from the lower extremity. This complication occurs with the LSM
Venous congestion seems to be related to compression of the pedicle by a hematoma or a lack of elasticity in the skin over the roof of the tunnel. According to Nakajima et al. (6) and Voche et al. (3), the mechanism of venous congestion is valvular incompetency. The communicating channels and bypasses between the concomitant veins is another mechanism proposed by Vergara-Amador (7) and Chang et al. (5). We avoided this type of complication by using a wide tunnel and good hemostasis.

Resection of the superficial peroneal nerve can cause painful neuroma and anesthesia over the dorsum of the foot, although these have been well tolerated (8). Burying the proximal cut section of this nerve prevents the occurrence of a painful neuroma. The healing of the donor site was good in our patients, because they were all children, and the skin graft healed well in all cases. Demiri et al. (4) preferred grafting the donor site secondarily after granulation because the results were much better than primary skin grafting.

The distally based sural flap constitutes the main local alternative technique for covering similar skin defects of the ankle, heel, and foot (3, 4, 7). Touam et al. (8) in a comparative study concluded that the distally based sural flap is much more reliable, and the LSM flap should be used only when the sural flap is contraindicated. The sural flap cannot be raised with an antegrade flow. Furthermore, it does not reach far enough for distal skin defects (9). Its main advantages compared with the LSM flap are the ease of dissection, the small area of anesthesia of the foot, and less venous congestion.

We consider that coverage of the medial malleolar area, Achilles tendon, and distal area of the foot using the LSM flap is better than other techniques, such as the sural flap. We agree with most investigators (3, 4, 8, 10) that covering the weight-bearing zone of the heel is better done with a flap that provides tissue with a similar texture and sensate skin. Thus, for heel coverage, we remain faithful to the medial plantar flap.

In conclusion, despite the popularity of the sural artery flap, we believe that the LSM flap is a better alternative for coverage of a wide range of soft tissue defects of the lower extremity in children.

References