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Use of the medial adipofascial flap of the leg for coverage of full-thickness burns exposing the tibial crest

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Abstract

Bone exposure constitutes a frequent and difficult problem in burn patients. Where free flaps remain indicated in tibial osteomyelitis, a pedicled fascial or adipofascial flap provides an excellent alternative for coverage of simple tibial crest exposure. In fact, the adipofascial tissue of the anteromedial aspect of the leg can be mobilized over the whole length of the tibia. It is vascularized by the saphenous artery and the posterior tibial artery perforators. This pattern of blood supply allows a wide range of use for any size of burn defect in this area. Therefore, this local pedicled flap provides an excellent solution for coverage of the exposed tibia after severe burns.

Keywords: Adipofascial flap; Burn; Perforator

1. Introduction

Exposure of a tibial crest in a burned leg represents a difficult situation that requires flap coverage. Free flap transfer represents a difficult procedure in a burned area due to the characteristics of the local tissue. If possible, a local flap will be preferable. Unfortunately, local cutaneous or fasciocutaneous flaps are often unavailable because of the burned surrounding skin.

In this article, we describe a flap, including the adipofascial tissue of the anteromedial aspect of the leg, to deal with this problem. It can be used to cover an area between the tibial tuberosity and the heel, and due to the flexibility to harvest this flap, it is useful in multiple clinical situations. It depends on a rich vascular supply based on the saphenous artery and the posterior tibial artery perforators. We present the anatomical basis of this flap, illustrated by three case reports.

2. Anatomy

The soft tissues situated between the tibial crest, the tibial tuberosity, the medial malleolus, and the mid-calf are highly vascularized due to two different blood supplies. Firstly, the saphenous artery, which is a terminal branch of the descending genicular artery. It enters the fatty tissue surrounding the fascia at the medial side of the knee. Selective injection of this artery, in fresh human cadavers, with iodinized contrast material, confirmed an excellent blood supply of the anteromedial soft tissues of the leg (Fig. 1). Secondly, five to seven perforating branches of the posterior tibial artery supply the same area. These perforators are located on a line drawn between the tibial tuberosity and the medial malleolus, with the largest perforators located around the medial malleolae. X-ray examination of the harvested cadaver flaps confirmed the direct connection between these two systems. This vascular pattern allows a design of different flaps based on these two supplies.

3. Operative technique

3.1. Saphenous pedicled flap

An incision is made from the medial condyle to the anterior tibial crest and the skin is elevated superficially. The saphenous pedicle, which is located under the tendon of the sartorius muscle, must not be exposed. The base of the flap should be as large as 5 cm at the level of the medial side of the knee. The fatty tissue is incised along the tibial border until the deep fascia is encountered. Then, the outline of the flap is incised distally and posteriorly. The dissection is continued in a plane under the deep fascia, starting distally, to the medial side of the knee.

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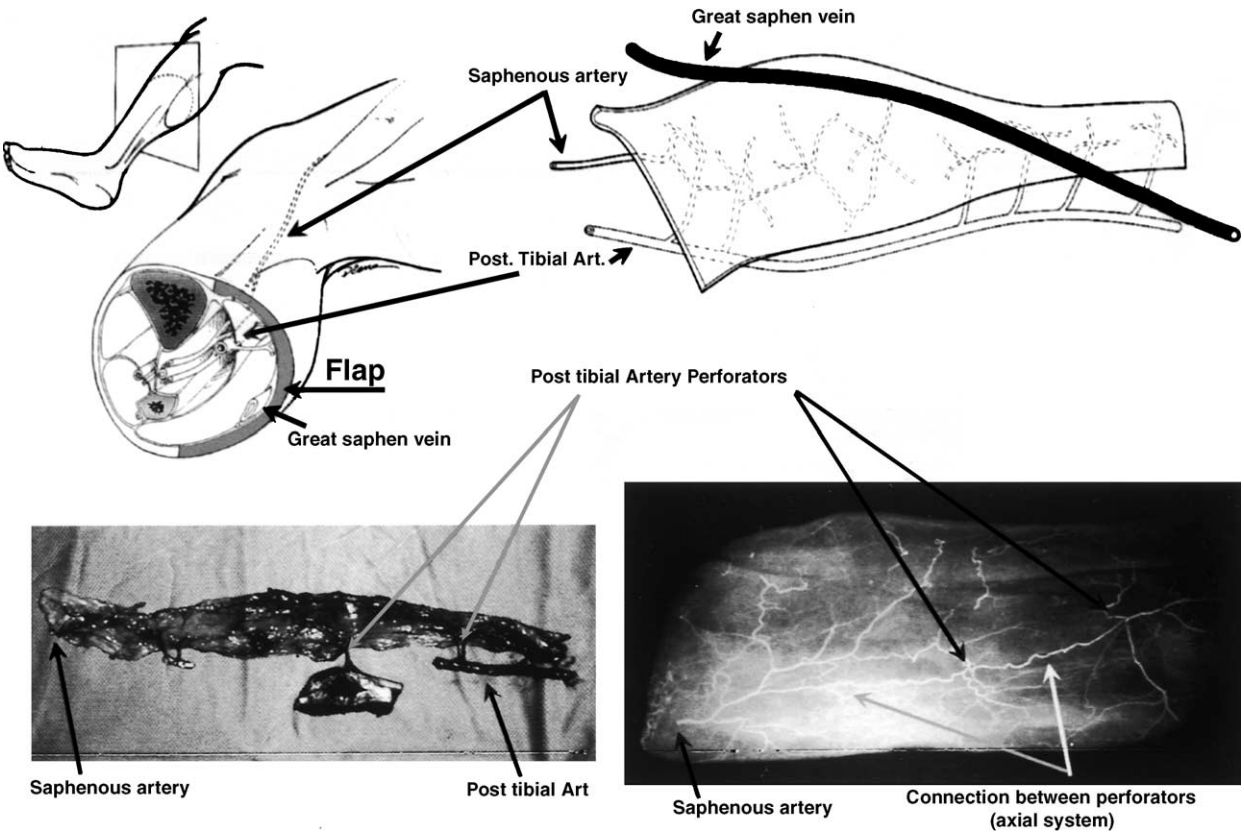

Fig. 1. Anatomical basis of the medial adipofascial flap of the leg.

3.2. Posterior tibial artery perforator flap

The posterior tibial artery is marked behind the medial malleolus, and a line is drawn between this point and the anterior tibial tuberosity. Perforating vessels are located on this line by a Doppler study. The flap can be harvested in an antegrade or retrograde manner. The incision is performed 1 cm medial to the tibial crest. The dissection is continued subcutaneously along the entire medial side of the lower leg, leaving enough fatty tissue to prevent too much damage of the skin vascularization. Then, the deep fascia is incised and raised until the middle of the calf. The intermuscular septa are divided, but the perforators are preserved. Once the "pivot" perforator is selected, in an antegrade or retrograde manner, the flap is tailored in a U design and transposed or folded into the defect. If possible, the flap is positioned so that the deep fascia lies superficial and the subcutaneous tissue faces the recipient site. The exposed fascial surface can then be skin-grafted.

4. Case reports

4.1. Case 1

A 60-year-old patient was referred to the burn center following an extensive flame burn of the lower limbs. Because of the extension and the depth of the burns, an amputation of the left leg was urgently performed at mid-thigh level. The right lower leg was excised and grafted, the first and second toe had to be amputated, as they were gangrenous.

Graft take was insufficient on a small area of the non-bearing part of the sole of the foot, but it was successfully grafted in a second time. However, the right tibial shaft remained exposed in the middle third. A medial adipofascial flap of the leg, reversibly supplied by the posterior tibial perforators was raised (Fig. 2). The flap was sutured over the tibial defect with the deep fascia lying superficial and the subcutaneous tissue in contact with the recipient site. The fascia was subsequently covered with a split thickness skin graft and the donor site was closed primarily. After 7 days, the dressings over the skin graft were removed and we obtained good graft take (90%).

4.2. Case 2

A 55-year-old man presented with frostbite of both lower legs after a period of unconsciousness in the snow. During surgery, an amputation of the forefoot had to be performed because of extensive necrosis of the heel and Achilles tendon. Below knee, amputation was suggested to be a better option, but it was refused by the patient. There was a full-thickness defect on the posterior part of the heel,

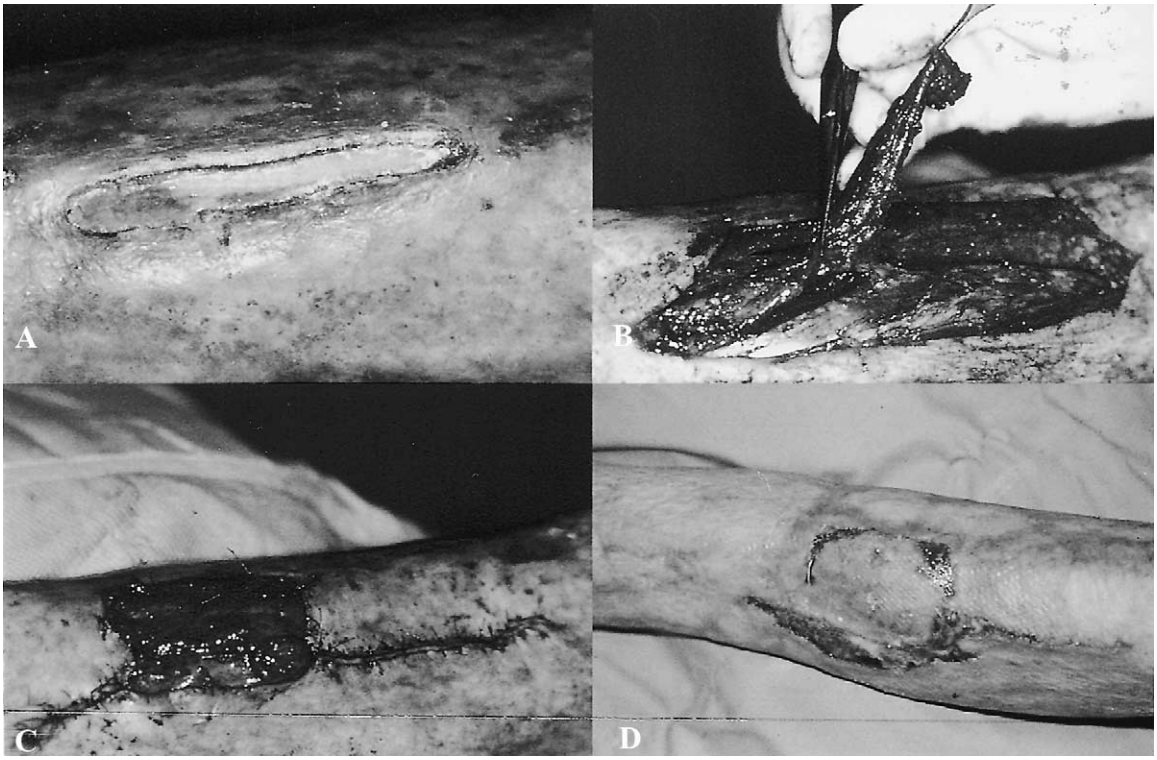

Fig. 2. Tibial crest exposure following a third degree burn treated by an anteromedial adipofascial flap transposition. (A) Preoperative status; (B) adipofascial flap based on a posterior tibial perforator. Peroperative view; (C) flap in place; (D) post-operative result (day 12).

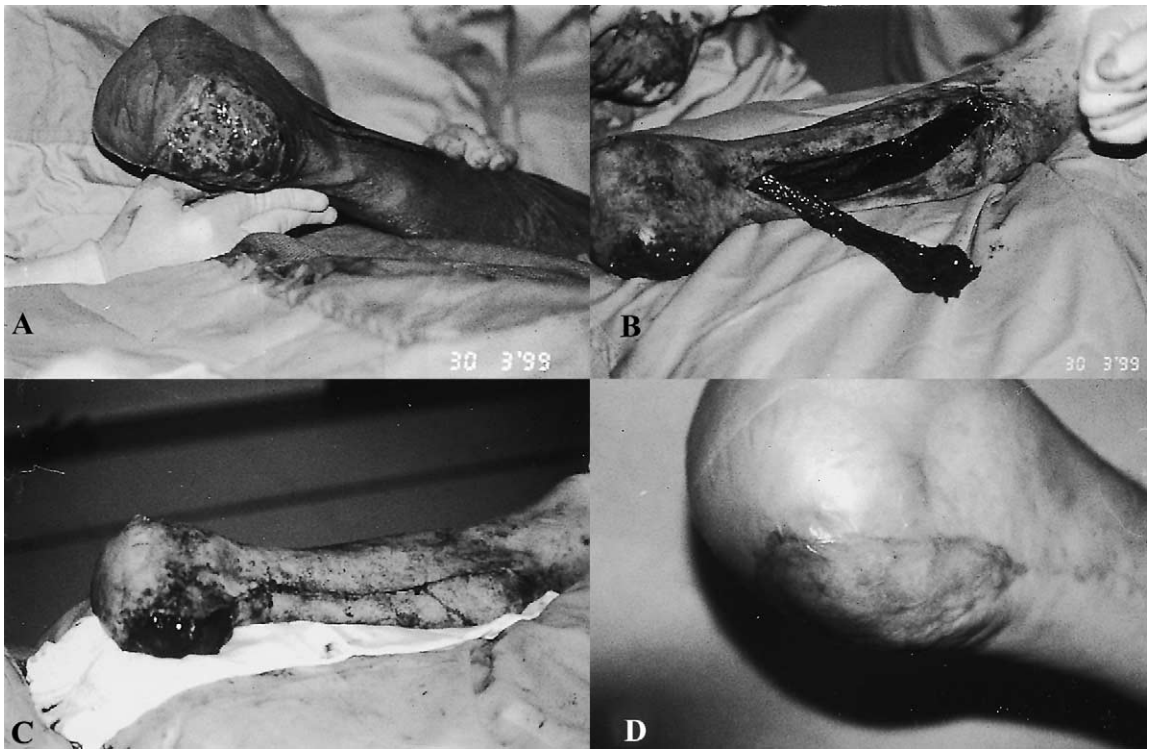

Fig. 3. Heel and Achilles tendon defect following a frostbite treated by a reversed anteromedial adipofascial flap. (A) Preoperative status; (B) adipofascial flap based on a distal posterior tibial perforator. Peroperative view; (C) flap in place; (D) post-operative result.

measuring 6.5–9 cm, with exposed calcaneus bone. A lower leg arteriogram revealed a good perfusion of the peroneal and posterior tibial vessels, and the perforators of the latter were clearly visible. A distally-based anteromedial adipofascial flap, covered by split thickness skin graft (Fig. 3), was performed to close the defect. At 1 year follow-up, the graft is still being stable.

4.3. Case 3

A 45-year-old patient was referred to the burn unit following a third degree burn of the left leg caused by hot oil. Early excision and skin grafting was performed on the second day. Unfortunately, the excision of the pretibial skin also exposed the tibia crest in an area of 6 cm × 2 cm due to a fourth degree burn. The entire leg was skin-grafted, although we didn't expect graft take over the exposed bone. We had good graft take except over the exposed tibia where even no granulation tissue could be noticed. Subsequently, it was treated for a couple of days by daily dressings before flap coverage. An adipofascial anteromedial flap of the leg, anterogradely supplied was performed to cover the defect. The previously grafted skin of the medial aspect of the leg was sacrificed for flap harvesting. The flap and the donor site were skin-grafted and graft take was estimated 93% for the flap and 97% for the donor site. The results remained stable even 1 year after the intervention.

5. Discussion

Because of the thinness of the pretibial skin, full-thickness burns of the legs frequently expose the tibia. In these situations, healing cannot be achieved either spontaneously, or by skin grafting. Before the advent of microsurgical techniques, these wounds were treated by skin grafting over granulating tissue, induced by cortical shaving. However, this technique does not provide adequate or stable coverage of this area. Moreover, local skin flaps are often unavailable because of the lack of normal surrounding skin.

Perspectives in leg coverage became interesting since the work of Mathes and co-workers [1], Godina [2], and other pioneers. Until now, muscular free flaps are still the golden standard for treatment of refractory tibial osteomyelitis or open fractures [1–4]. Recently, fascial, fasciocutaneous, and neurocutaneous flaps regained popularity and can provide an excellent alternative for coverage of uncomplicated defects of the lower leg [3,5–7].

In burned legs, local conditions make microsurgical procedures extremely difficult and hazardous, decreasing the success of these reconstructions. For this reason, the use of free flaps in this area must be avoided if possible. Moreover, exposed bone secondary to a recent burn, does not initially represent an infectious area comparable to osteomyelitis. Therefore, it does not require muscular coverage and fascial, fasciocutaneous, neurocutaneous or adipofascial pedicled flaps provide an excellent alternative to solve these problems, avoiding microsurgical procedures [5–9].

Adipofascial tissue of the anteromedial aspect of the leg can be safely mobilized over a wide range of tibial or ankle defects. Defects located in the upper third are well-covered by transposition of an adipofascial flap based on the saphenous artery. The middle and lower third of the tibia and the ankle can easily be covered by rotation of an adipofascial flap supplied by the perforator branches of the posterior tibial artery. Recent successful experience in bone, tendinous or hardware coverage makes this kind of flap a workhorse for several authors [8,9]. However, no applications in burned patients have been published as yet.

In contrast with classical cases, the skin overlying the adipofascial flap should be sacrificed if burned or grafted. It is preferable to replace it by a skin graft after flap transfer because subcutaneous dissection of this damaged skin induces necrosis. Because of the previous status of the leg, the aesthetic result will not be altered considerably.

If preserved after tangential excision of the burns, the great saphenous vein in the subcutaneous tissue of the flap provides an extra safety even if the saphenous pedicle is sufficient (Fig. 1). Actually, according to the theories of neurocutaneous flaps [6], the inclusion of the saphenous vein and the surrounding tissues can be considered as an arteriovenous pedicle, and in all cases the venous drainage will be improved.

We think that this flap should be the first flap of choice in exposed tibia after burns because other fascial, fasciocutaneous, or neurocutaneous flaps are unreliable in this specific situation. The superficial veins and median superficial sural artery are quite often damaged after burn excision. As a consequence, the distally-based sural flap [5] is rarely a therapeutical option. The distally-based saphenous island flap [6], is also rarely usable due to the burned surrounding skin. If the exposed bone lies in close proximity of the knee joint, the lateral sural artery fascial flap [7] can provide an alternative for the described adipofascial flap, but it doesn't have the same range of mobilization.

6. Conclusions

The anteromedial adipofascial flaps of the leg provides an excellent alternative to cover the tibial bone exposure even when local conditions are difficult. Due to the presence of multiple pedicles, every kind of defect in the lower leg can be effectively covered because of the reliable anatomy.

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