

Reverse sural flap cover within a ring fixator

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The ring fixator is an ideal apparatus to treat infected gap nonunion of the tibia and to correct deformity in multiple planes. However soft tissue problems may arise during transport and at docking. Although various options such as free flaps, neurocutaneous flaps, fasciocutaneous flaps and cross leg flaps are available for flap cover, this is always done prior to application of a ring fixator. The versatility of the sural flap in terms of coverage of leg defects, ease of performing flap cover as well as its reliability and safety is well known. We describe an alternate way of treating soft tissue problems which occur at the lower third of the leg while being treated on an Ilizarov frame. We describe the surgical procedure followed in raising the flap and its anterior transposition within the Ilizarov frame in two patients.

Keywords: sural flap ; flap through Ilizarov frame ; vesatile flap.

INTRODUCTION

Treatment of tibial soft tissue defects in the lower third is challenging. The options available are free flaps, neurocutaneous flaps, fasciocutaneous flaps and cross leg flaps (1,2,6,14). Large defects of the lower third of the leg and hind foot can be effectively covered with the sural fasciocutaneous flap (3,12,17). The versatility, reliability and safety of this flap in covering lower third leg defects is well known (8,12). Composite free tissue transfer can give good results when bone and soft tissue reconstruction is required (19).

The Ilizarov fixator is useful for osseous regeneration in situations where there is bone loss due to fracture or infection (5,15). When large areas of bone are exposed soft tissue cover of such an area will reduce the amount of bone to be lengthened and also provide adequate vascularity to the underlying bone. Also soft tissue loss over bone has to be covered to prevent osteomyelitis.

In the distal tibia, free flaps were the preferred flaps for covering large soft tissue defects (7). Local fasciocutaneous flaps described by Ponten have decreased the need for muscular and free flaps in reconstruction (16). However in the presence of a ring fixator it is difficult to perform free flaps and fasciocutaneous flaps. Neurocutaneous flaps are based on the association between blood vessels accompanying superficial sensory nerve and deeply situated major arteries. They can be used to cover large defects since they have anastomosis with large arteries through septocutaneous perforators (4,10). The sural flap is one such flap which is reliable and has been used extensively in lower third of the leg coverage (1).

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Flap cover becomes cumbersome and difficult in the presence of an Ilizarov frame and hence traditionally, flap cover is done prior to ring fixation (13). However we describe the use of a reverse sural artery flap in one patient after an unexpected immediate complication after ring fixation and in another patient after soft tissue problems during docking. In these patients the flaps were performed with the fixator in place. We have described the surgical procedure followed in raising the flap and its anterior transposition within the Ilizarov fixator.

Operative technique [Flap cover]

The surgery for flap cover was performed in the prone position. The connecting rods on the posterior aspect of the rings were temporarily removed after replacing them with connecting rods anteriorly to provide both adequate exposure and working space for flap elevation posteriorly. Care was taken not to lose the stability and alignment of the fracture. The sural artery and the distal perforators from the peroneal artery were marked with permanent ink marker on the leg with a hand held Doppler probe, prior to skin preparation. The area of the soft tissue defect was marked out on the posterior upper calf.

After a tourniquet was applied, the flap was raised and transferred anteriorly around the medial side and sutured to the margins of the anterior skin defect. Following flap cover the connecting rods were changed to the original position.

Based on sensitivity, antibiotics were given for 48 hours. The flap was monitored daily in the first week. During each dressing passive mobilization of the ankle was done. Thereafter the patients were followed up as outpatients. Sutures were removed at two weeks. Flap division was done at three weeks for one patient.

Illustrative cases

Two patients were treated with reverse sural flap for soft tissue loss while on a Ilizarov frame. The first patient, a 25-year-old male, presented with an infected non union of the left tibia of one year duration. He underwent debridement, fibulotomy and ring stabilization of the left leg for the 28° anterior and

17° lateral angulation with no shortening (fig 1). There was anterior skin necrosis and loss of 8 × 5 cm skin with exposure of the non union site 10 days after surgery (fig 2). He underwent reverse sural artery fasciocutaneous flap cover and flap division three weeks later (figs 3, 4). The flap settled completely within two weeks of flap division and the fracture healed in six months, at which time the Ilizarov frame was also removed (fig 5).

The second patient, a 30-year-old lady, was referred to us three months after injury with an infected type IIIB open tibia fracture on the left side. There was a 15 × 10 cm anterolateral skin loss with 8 cm of exposed necrotic tibia (fig 6). After debridement, necrectomy and ring stabilization of the left leg, there was a 12 cm gap in the tibia. A proximal tibial corticotomy was done for bone transport (fig 7). At the end of bone transport the docking site was exposed with a soft tissue loss of 6 × 3 cms anteriorly which was covered with a reverse sural artery flap (fig 8). Eighteen months from Ilizarov stabilization the fracture healed and the fixator was removed (fig 9).

DISCUSSION

Soft tissue problems can occur in the leg while on a ring fixator. Local fasciocutaneous flaps either proximally based or distally based are simple and straightforward to cover small areas. However in the presence of an external fixator like an Ilizarov ring, it is difficult to rotate and cover a large defect especially in the lower third of the leg where the muscle bellies continue as tendons, with the Ilizarov wires in place. We describe the use of the sural artery flap to address this in the lower third of the leg, without dismantling the ring.

Although we have reported only two cases and larger numbers are required to establish this as a reliable technique, the reverse sural flap is often unaffected by the Ilizarov fixator. Use of free flaps with an Ilizarov fixator is difficult due to conflict with plastic surgical access (11).

In a study by Tukiainen *et al*, after free flap cover a unilateral frame was used for distraction of bone due to fear of injury to the vascular pedicle by an Ilizarov frame (18). The area of soft tissue loss was



Fig. 1. — Pre operative AP radiograph of both bones of the left leg of patient one showing 28 degrees angulation.

not mentioned. Tukiainen *et al* had to change to Ilizarov fixator in one patient at the end of bone transport to improve stability and union. We decided to do reverse sural flap cover using unaffected posterior proximal skin, since the soft tissue loss occurred at the same level the wires were inserted, making it difficult to do either a proximally based or distally based fasciocutaneous flap. Moreover the skin adjacent to the soft tissue defect was also scarred due to the previous two failed surgeries in patient one and distracted skin in patient two. The reverse sural flap is often unaffected by the Ilizarov fixator. Applying Ilizarov wires in the safe corridor



Fig. 2. — Post of photograph of patient one showing anterior skin loss exposing bone.

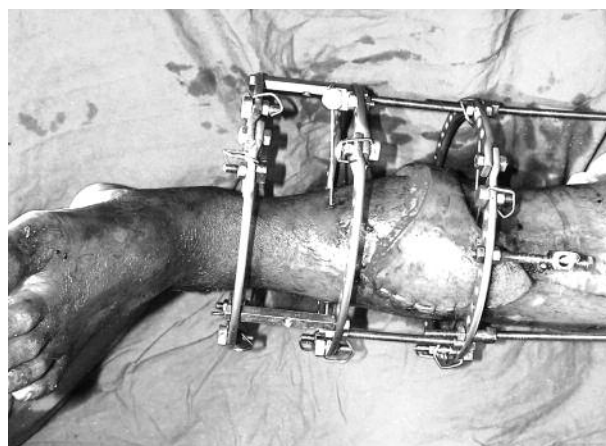


Fig. 3. — Photograph of patient one showing sural flap cover done for skin necrosis.

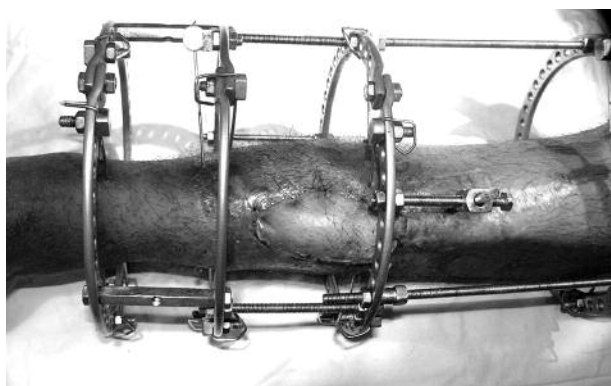


Fig. 4. — Photograph of patient one showing divided flap on Ilizarov frame.

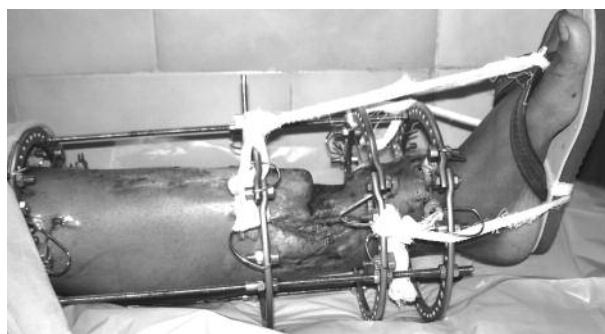


Fig. 7. — Photograph of patient 2 after debridement, split skin graft, Ilizarov stabilization and bone transport.



Fig. 5. — Photograph showing healed flap and bone after Ilizarov removal in patient one.

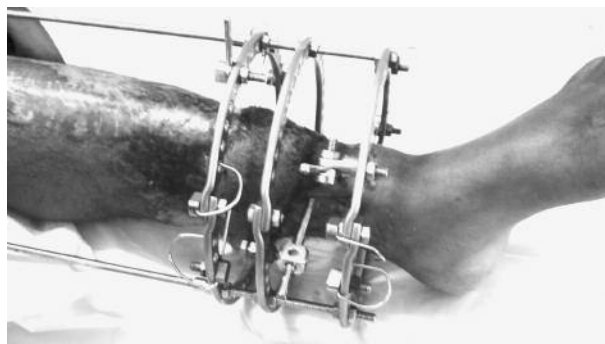


Fig. 8. — Photograph of patient 2 after docking of transport bone and reverse sural flap cover done through Ilizarov ring.

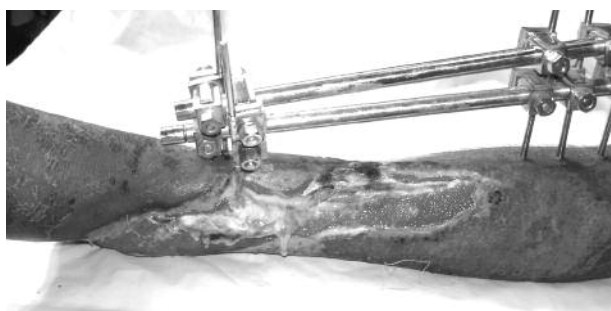


Fig. 6. — Pre op photograph of patient 2 showing exposed necrotic tibia and tendons.



Fig. 9. — Photograph of patient 2 standing on both legs at final follow up.

avoids the superficial sural neurovascular bundle. Also placing the wires away from posterior calf skin can be advantageous to raise a large flap. In patient two, performing the flap at the time of docking meant that the soft tissue problem which arose could be sorted at the time of docking.

Unilateral fixators can be used for simultaneous flap cover and limb lengthening. In an unstable fracture with poor bone apposition the Ilizarov fixator is biomechanically superior to hybrid external fixators (9,20). The Ilizarov technique may also be used in combination with flap surgery. Ring placement can precede or follow soft tissue coverage (7). Difficulty in performing free flaps through the ring is obvious due to pin placement and difficult access to recipient vessels in scarred tissue. We selected the Ilizarov frame because one patient required multiplanar correction of an angular deformity and another patient required long segment bone transport. Moreover soft tissue problems occurred after Ilizarov surgery.

The reliability of the sural artery flap use with an Ilizarov fixator proves the reliability in reconstruction using this flap. This technical note describes how the sural fasciocutaneous flap can be easily raised through an Ilizarov ring and can be transposed anteriorly to cover soft tissue defects in the lower third of the leg without losing the stability of the construct.

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