

## **Reconstruction of the heel with chronic ulceration with flexor digitorum brevis myocutaneous flap**

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*Summary* The management of chronic non-healing plantar ulcers on the heel in leprosy is a difficult and challenging task. It represents a defect on the heel, the reconstruction of which has been an enigma to most reconstructive surgeons, the problem being compounded by plantar anaesthesia and intrinsic paralysis inherent in leprosy. Recent advances in closure of heel defects by flexor digitorum brevis myocutaneous flap, as presented in this article have been applied by us to the chronic non-healing ulcers on the heel in leprosy. Surgical anatomy and the technique of flap elevation is described in brief. The short-term evaluation up to 1½ years following the operation has shown its value in durability, weight bearing and prevention of recurrent ulceration.

### **Introduction**

In leprosy, total recovery from plantar anaesthesia and intrinsic paralysis is generally unlikely due to the very nature of the disease. At the same time it is not possible to avoid the stress and strain of locomotion. Although damage due to all these factors can be minimized by health education and care of the feet, it is not uncommon to see the occurrence and chronicity of plantar ulcers on the heel.

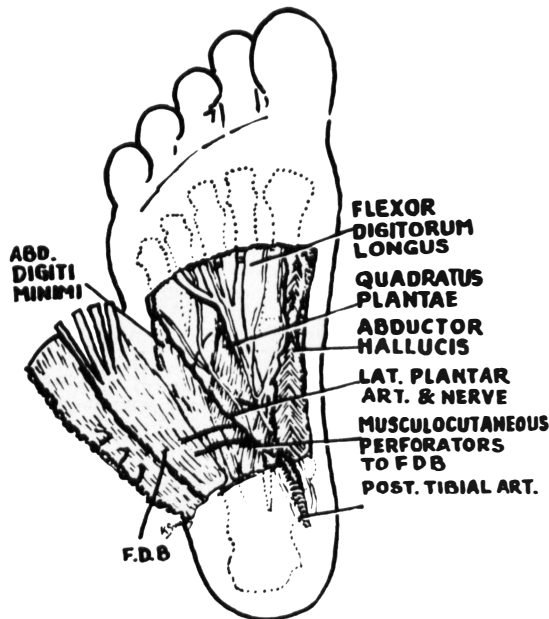
The uncomplicated chronic ulcer is diagnosed by its appearance (punched out, heaped up with hyperkeratotic margin, floor covered with thin slough or pale granulation, and discharging thin seropurulent material) and absence of any active infection in the bones and joints as seen clinically and in radiographs.<sup>1</sup> While infection can be controlled, the major contribution of reconstructive surgery is in providing adequate local tissue which will be able to bear stress and strain. The ideal tissue is the fibrofatty layer as found in the normal foot.

In a comparative study<sup>2</sup> it was also observed that no form of distant sole replacement was satisfactory. The local transposition of the specialized plantar skin was preferred. Another study<sup>3</sup> mentions that transposition flap elevated superficial to plantar fascia requires 'delay' owing to precarious blood supply, thus produce fibrosis and scars tend to violate the weight-bearing area.

To provide an additional blood supply one study<sup>4</sup> described the neurovascular island which not only requires sacrifice of a toe but provides a small skin area with a long scar in the centre of the foot. In another study<sup>3</sup> an arterialized myocutaneous island flap has been used incorporating the abductor hallucis muscle and the medial plantar artery. One study<sup>5</sup> has used the flexor digitorum brevis muscle flap with skin graft in 5 cases, but have also used flexor digitorum brevis as myocutaneous island flap in a difficult heel reconstruction. Our design of flexor digitorum brevis myocutaneous flap is similar to that of Curtin's<sup>6</sup> 'delayed' local transposition flap. By incorporating muscle there is no need to 'delay' the flap. The muscle fills the 'gap' between calcaneus and the skin, thus eliminating the dead space providing the most important substitute for the fibrofatty layer which bears the stress and strain of locomotion.

### Surgical anatomy

The flexor digitorum brevis (Figure 1) takes its origin from the medial process of the calcaneus and the plantar aponeurosis. It is a flat muscle traversing the mid-plantar region, gaining insertion in the middle phalanges of the 2nd, 3rd, 4th and 5th toes through 4 separate tendons. The musculotendinous part is at the centre of the instep. The flexor digitorum brevis muscle is bordered by the abductor hallucis muscle medially and the abductor digiti minimi laterally. It is

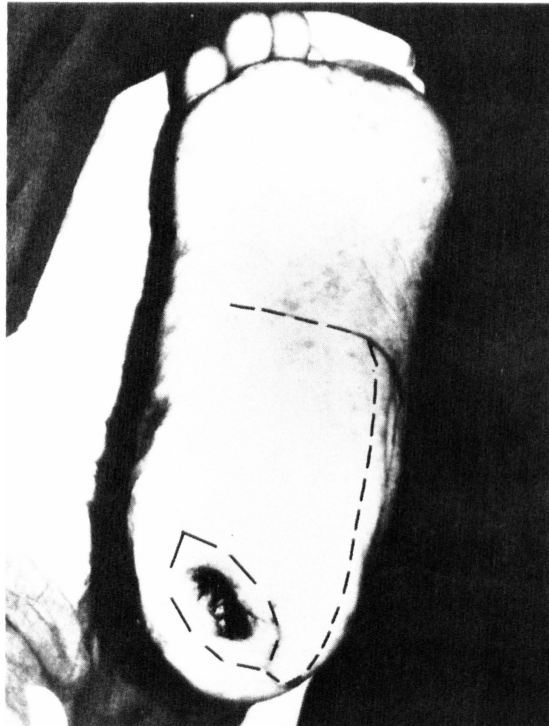


**Figure 1** Schematic representation of the flexor digitorum brevis muscle and its relations.

intimately related to the quadratus plantae on its superior surface (deep surface during dissection of flap) but is easily separated from it by the presence of a thin areolar tissue. It derives its major blood supply from the lateral plantar artery, pedicles of which enter the muscle in its proximal third. There are also minor pedicles from the lateral plantar artery distally and a small pedicle from the medial plantar artery. The lateral plantar nerve supplies the musculocutaneous unit proximally, and a large sensory branch from the lateral plantar nerve supplies the area of the mid-plantar region of the foot.

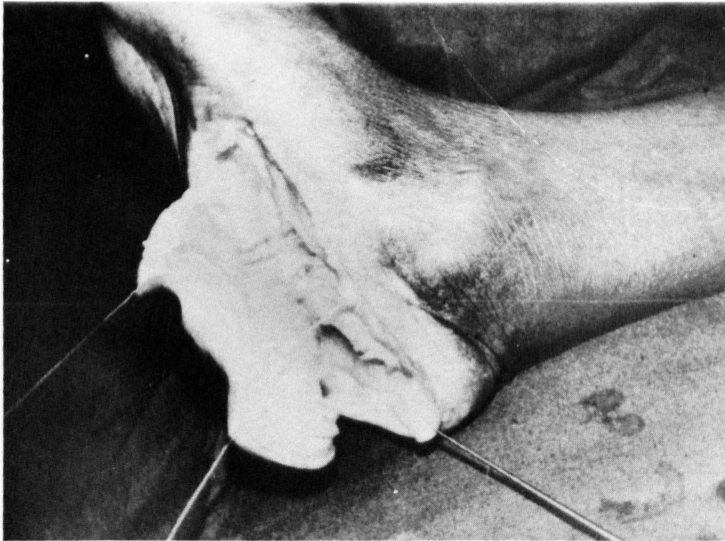
### **Technique**

The operation is carried out under spinal anaesthetic or general anaesthetic, with a tourniquet applied to the thigh, the ulcer on the heel is palpated to find the extent of induration and its fixity. A generous mass of hyperkeratotic callus skin and fibrosis is excised, down to the calcaneus. If there is a projecting spur from calcaneus it is osteotomised and excised till a smooth bony surface is obtained. This liberal excision creates the true defect on the heel for which the flap is marked out as shown in Figure 2. The dissection to raise the flap starts distally where the



**Figure 2** A chronic ulcer on the heel with markings for flexor digitorum brevis myocutaneous transposition flap.

plantar aponeurosis is incised, immediately below which the tendons of flexor digitorum brevis are seen. It is lifted over an artery with forceps and tested for the movement of the middle phalanges of the lateral 4 toes. Having confirmed it, the tendons are divided by a sharp cut. Proceeding with the medial skin incision and working down, adjacent to the abductor hallucis muscle the flap is raised. We generally prefer to suture the cut ends of the muscle to the dermal edge of the skin to prevent its retraction and bunching. As the flap is being elevated the minor pedicles in its distal part are ligated and divided (Figure 3). The lateral plantar artery and nerve are identified and protected (Figure 1). In our experience, unless the calcaneal origin of the muscle is divided the flap does not move well and transposition is very difficult. So the calcaneal origin of the flexor digitorum brevis is divided carefully while protecting the neurovascular pedicle of the flap. The flap is adjusted to the defect and if necessary a 'back cut' is made at the lateral distal edge of the flap to release the tension. The heel skin with its fibrofatty padding is mobilized. The tourniquet is released and haemostasis established. The flap is sutured in 2 layers over a 'glove' drain. The triangular defect over the distal donor area on plantar aspect skin is grafted with a medium thickness skin graft from the thigh (Figure 4). A firm elastocrepe bandage is applied and the foot is elevated on a Bohler splint. The drainage tube is removed after 48 h. The sutures of the skin graft are removed on the 10th day and the sutures of the flap are removed on the 14th day. The patient is gradually allowed to bear weight after 3



**Figure 3** The flexor digitorum brevis myocutaneous flap dissected out, the distal minor pedicles and a proximal pedicle from medial plantar artery stands out during dissection. In between these are the major pedicles from lateral plantar artery. (In this case it was not necessary to sacrifice any of these pedicles.)

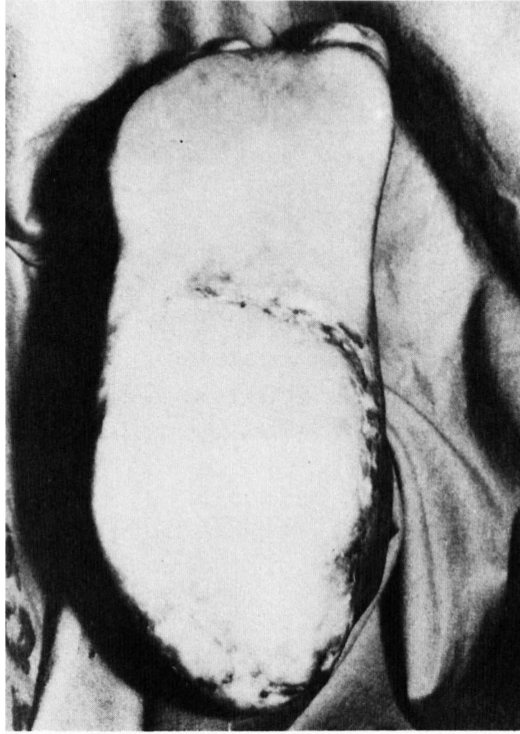


**Figure 4.** The flap in position, and the donor area is skin grafted.

weeks. Customary special chappals with microcellular rubber insole are provided. During the hospitalization and on discharge he is taught and advised to take care of his anaesthetic feet. (No procedure is a substitute for health education in leprosy.)

## **Results**

Six patients were operated by this procedure. The duration of chronicity of ulcers of the heel varied from 6 months to 9 years. In 2 patients the ulcers were recurrent within 3 to 6 months. In 1 patient (1st case) there was wound dehiscence which responded to secondary suturing. Another patient had a loss of skin graft on the donor area and required regrafting. Four patients healed well without any complications. During follow-up it was observed that a skin graft contracts so much that a very narrow area of it is visible after 6 months in the non-weight bearing area (Figure 5). On enquiring in to their walking habits it was found that each patient was travelling an average distance of 1.5–2 km/day.



**Figure 5.** Post-operative result after 4 months. Note the contraction of the graft.

## **Discussion**

Treatment of chronic non-healing ulcers of the heel is a difficult problem particularly if the ulcer is large with hyperkeratotic and callus margins or if it is associated with periostitis, spur in calcaneum or osteomyelitis. Although in this study no patient had deep seated osteomyelitis, almost all of them had a hard fibrous ring and periostitis. The precarious blood supply due to heavy scarring limited the efficiency of the natural healing process. It is also well established that the fibrofatty layer of the sole is the padding between bony weight-bearing areas and the skin. Its replacement by non-resilient scar tissue which may permit weight-bearing to some extent but does not tolerate stress and strain of walking is the main hindrance in prevention of recurrence. The flexor digitorum brevis myocutaneous flap affords the advantages that it is a well vascularized flap, provides a substitute for fibrofatty layer to take the stress of walking, does not require 'delay' and the scars do not violate the weight-bearing areas of the sole of the foot. The donor area is chiefly non-weight-bearing skin (except in flat foot). The skin graft does not cause any problem as only a thin line remains following graft contraction after 6 months and that too is in a non-weight-bearing area

(except a little area on the lateral edge). This is a single procedure and does not require more than three weeks (maximum) of hospitalization. In leprosy, even if the muscle is paralysed it is vascular and seldom totally fibrosed. However, the quality of plantar skin in front of the ulceration also must be good. The cases with frank osteomyelitis and also with poor tissues in front are unsuitable for this technique.

We will conclude the discussion by contemplating the combining of this procedure with nerve release since the elevation of this flap offers good visualization for medial and lateral plantar nerves. Palande<sup>7</sup> has demonstrated the effectiveness of posterior tibial nerve decompression in prevention of plantar ulcers particularly calcaneal branch for heel ulcers. Shall we extend the decompression of the posterior tibial nerve to its terminal branches, while reconstructing the heel pad is an interesting thought for the future.

## **Conclusion**

The flexor digitorum brevis myocutaneous flap for the treatment of chronic non-healing ulcers on the heel has proved to be viable and a reliable one-stage reconstructive procedure. It replaces the specialized fibrofatty layer of the sole of the foot at the ulcer site and allows normal weight-bearing and also the stress and strain of walking. There has been no recurrence in any of the 6 patients followed up for a period of 4–18 months.

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## **References**

- <sup>1</sup> Shrinivasan H, Dharmendra. Treatment of ulcers in leprosy patients. In *Leprosy*, vol. 1, chap. 11. Ed. Dharmendra Kothari Med Publ House, Bombay, 1978; pp. 611–614.
- <sup>2</sup> Sommerlad BC, McGrouther DA. Resurfacing the sole; long-term follow-up and comparison of techniques. *Br J Plast Surg*, 1978; **31**: 107.
- <sup>3</sup> Harrison DH, Morgan BDG. The instep island flap to resurface plantar defects. *Br J Plast Surg*, 1981; **34**: 315–18.
- <sup>4</sup> Snyder GB, Edgerton MT. The principle of the island neurovascular flap in the management of ulcerated anaesthetic weight-bearing areas of the lower extremity. *Plast & Reconstr Surg*, 1965; **36**: 518–28.

- <sup>5</sup> Hartrampf CR, Scheftan M, Bostwick J. The flexor digitorum brevis muscle island pedicle flap: a new dimension in heel reconstruction. *Plast & Reconstr Surg*, 1980; **66**: 264–70.
- <sup>6</sup> Curtin Sw. Functional surgery for intractable conditions of the sole of the foot. *Plast & Reconstr Surg*, 1977; **59**: 806–11.
- <sup>7</sup> Palande DD, Muthuraj M. Surgical decompression of posterior tibial neurovascular complex in treatment of certain chronic plantar ulcers and posterior tibial neuritis in leprosy. *Int J Lepr*, 1975; **43** (1): 36–40.