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A NEUROVASCULAR FLAP FOR COVERAGE OF DISTAL PLANTAR DEFECTS

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Ulcers on the sole of the foot are very uncomfortable. A poor blood supply and a tendency to slow healing are common in these patients. Because of its weight-bearing and unique sensory function the glabrous skin of the sole is very specialized. To obtain a functional skin coverage, glabrous skin with a good blood supply and an intact nerve supply may be superior to other methods of soft tissue reconstruction. A neurovascular axial or island flap from the fibular side of the great toe may fulfill this demand with minimal donor site morbidity. Three cases are reported and the literature on the subject is summarized.

Key words: flap coverage; plantar ulcers

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Many procedures for the treatment of defects on the sole have been described (Avellán & Johanson 1963, Snyder & Edgerton 1965, Reiffel & McCarthy 1980). It is well known from hand surgery (Krag & Rasmussen 1975) that a volar, heterodigital neurovascular island flap, which has the characteristics of an axial/arterial flap (McGregor & Morgan 1973, Daniel & Williams 1972), may restore some of the sensibility to an anesthetic finger. This procedure has given rise to the idea of applying the same reconstructive method in the foot, obtaining the benefit of a flap with a defined neural supply and an axial/arterial blood supply from an expendable donor area.

It was considered of interest to describe this procedure in the treatment of distal plantar defects using a neurovascular axial flap from the fibular aspect of the great toe.

METHOD

The ulcer is excised. A flap from the fibular, non-weight-bearing, side of the great toe is raised on its plantar neurovascular bundle. An incision is made between the ulcer and the flap. The neurovascular bundle is dissected for an appropriate distance, permitting the flap to be sutured into position without any tension, if necessary with a drain beneath, being careful not to compress the vessels. Occasionally, the flap may be raised as a conventional transposition flap, if the mobility of an island flap is not needed. The donor site is covered with a full thickness skin graft.

If needed, any pressure points predisposing to the defect should be treated, either surgically or/and conservatively with insoles in the shoes. Such a pressure point will often be one of the metatarsal heads, which then may have to be removed.

CASE REPORTS

Case 1. A 60-year-old female clerk with diabetes mellitus developed a plantar callosity underneath the capitulum of the first metatarsal bone. After initial chiropodic treatment a plantar ulcer, measuring 6 mm in diameter, evolved to a chronic state of almost 1 year's duration. Pedal pulses were present.

The ulcer was found to communicate with the flexor tendon sheath. After excision a neurovascular flap from the fibular side of the great toe was prepared to cover the defect. The donor site was covered with a full thickness skin graft. Healing was uneventful, except that a

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Figure 1. The plantar ulcer of the patient in Case 1. The incisions are outlined.

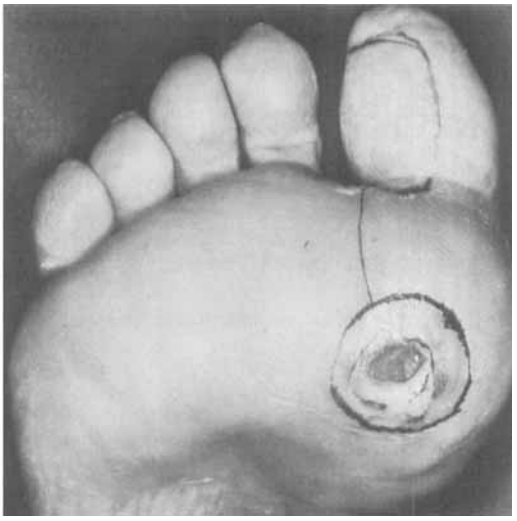

Figure 2. Same patient as Figure 1. A neurovascular island flap from the fibular side of the great toe has been mobilized. The flexor hallucis longus tendon is seen in the defect.

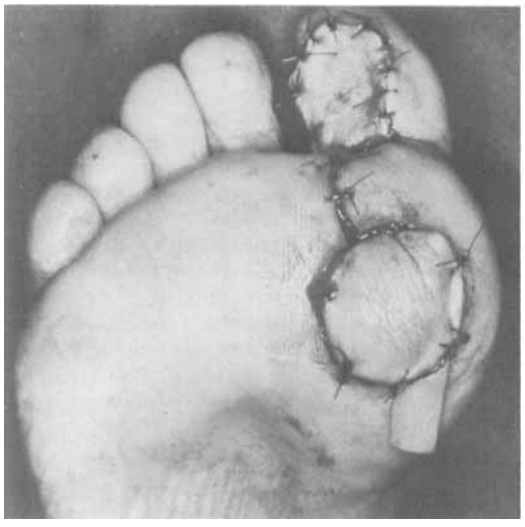

Figure 3. The flap has been sutured in place and a rubber drain has been inserted. The donor site has been covered with a full thickness skin graft.

Figure 4. Healing – 10 weeks later.

minor revision became necessary delaying full recovery for 3 weeks. Weight-bearing was allowed after 8 weeks. Five months postoperatively a minor tendency towards hyperkeratosis in part of the cicatrix was noted. Sensibility remained almost intact. After being fitted with insoles because of a broad forefoot, the patient was able to walk normally. No donor site complaints were noted (see Figures 1–4).

Case 2. A 53-year-old farmer had had a plantar dermoid cyst, underlying the capitulum of the first metatarsal bone, extirpated 3 years previously. Postoperative wound infection developed and a recurrent cyst had to be extirpated 1 year later. Subsequently a hyperkeratotic, painful lesion, measuring 25 × 20 mm, developed. Pedal pulses were present.

The hyperkeratotic lesion was excised and a flap was

transposed to the defect as described. Healing was uneventful and the patient returned to work with full weight-bearing. Six months postoperatively normal sensibility in the flap and the absence of donor site complaints were noted.

Case 3. A 35-year-old shop assistant, 5 days after osteosynthesis of a supracondylar fracture of the femur, developed total occlusion of the femoral artery. Contracture in the lower leg developed despite acute embolectomy and fasciotomy. Postoperatively, pressure ulcers appeared in the heel region and on the plantar aspect of the great toe. Prior to the performance of an Achilles tendon tenotomy and talo-crural arthrodesis the ulcers had to be closed. Pedal pulses were present. Transposition flaps were prepared. The toe-ulcer, in which the flexor tendon was exposed for 15 × 10 mm, was covered by a neurovascular flap as described. Healing was uneventful. Three months postoperatively normal sensibility and absence of donor site complaints were noted. Later, the patient underwent the secondary orthopedic procedures.

DISCUSSION

The conservative treatment of defects in the plantar region is time-consuming and demands the full cooperation of the patient. The risk of superinfection with gangrene, and possibly high level amputation, is always present, the more so because these patients are often elderly arteriosclerotics, possibly with critically decreased blood supply in the lower extremities. If indicated, surgical reconstruction of such defects, using an axial flap rather than a random pattern flap, seems to be the more rational solution to restore functional conditions (McGregor & Morgan 1973).

The glabrous skin of the sole is a very specialized tissue because of its sensory function in combination with its weight-bearing capacity. This should be considered when operating in the plantar region. Hyperkeratosis constitutes a common complication of wound healing in the planta. Avellán & Johanson (1966) stated that "Hyperkeratosis seems to occur as a protective reaction to prevent weight-bearing on a circumscribed area, which consists of, either spread scar tissue, secondarily healed defects or transplants of inferior quality skin". They concluded that a full thickness skin graft from the dorsum of the foot solved the problem of hyperkeratosis. The long-term follow-up by Sommerlad & McGrouther (1978) indicated that not even a full thickness skin graft is the graft of choice. All their patients with a significant area of resurfaced weight-bearing planta had to reduce their physical activity. They furthermore found that none of the types of replacements, i.e. skin grafts or flaps, were satisfactory and most of the patients avoided weight-bearing on the transplanted areas. However, they had not included patients with neurovascular reconstructions.

Curtin (1977) and Reiffel & McCarthy (1980) have stressed the importance of using local tissue in reconstruction of plantar defects. A neurovascular flap can allow reconstitution of soft tissue integrity and protective sensation, which may be very important in avoiding new ulcers in the same area.

Snyder & Edgerton (1965) applied this principle to anesthetic weight-bearing areas using the skin from one or two toes or a plantar island flap. To avoid substantial donor site morbidity Buncke & Colen (1980) used a flap from the first web space without sacrificing the toe. However, their patients had anesthetic feet due to diabetic neuropathy.

We have used the same principle as Buncke & Colen (1980) in patients with intact or nearly intact neurovascular conditions in an attempt to restore as normal functional conditions as possible. The results in our little material fulfill this goal.

We cannot conclude that this procedure is superior to others, but we believe that the method is a good alternative in the treatment of distal plantar defects. Meanwhile, a long-term study is required to evaluate the usefulness and indications of this method.

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