Alternatives in soft tissue reconstruction of the ankle and foot

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Reconstruction of soft tissue defects of the ankle and foot still presents a challenge. This is related to both the lack of large soft tissue flaps in this part of the body suitable for transfer to adjacent injured areas and to of the unique characteristics of the soft tissues of the sole of the foot. Microsurgery has solved some of these problems with the transfer of soft tissue from more distal areas. Several small arterialized and sometimes innervated flaps from the intrinsic tissues of the foot are also available for reconstruction of defects of limited size. The present report assesses 49 flaps, 15 local and 34 microsurgical transfers which were performed in 46 patients. The results suggest that there are several effective alternatives for coverage of soft tissue defects of the ankle and foot.

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Despite the advances in reconstructive surgery during the last two decades reconstruction of soft tissue defects of the ankle and foot remains a difficult problem. Soft tissue defects in this region of the body present a reconstructive dilemma for two reasons. First, the foot and ankle lack large muscle bellies that could be used for coverage of the injured part. Second, the soft tissues of the sole of the foot are unique in that they are able to withstand weight bearing and resist shearing forces. This study reviews our experience in dealing with this problem in 46 patients.

Patients and methods

46 patients, 33 men and 13 women, with an average age of 37 (2–78) years presented with soft tissue defects of the ankle and foot (Table 1). The weight bearing surface of the foot was involved in 24 patients. Trauma was the cause of the soft tissue defect in 33 patients, while vascular insufficiency was implicated as the reason for their problem in 9 patients. One patient presented with an unstable scar on the plantar surface of the heel due to previous irradiation, while another had his heel pad ressected because of a melanoma. The remaining 3 patients had neurotrophic changes due to congenital spina bifida in 2 or to traumatic paraplegia (Bostnick 1976).

49 flaps, 15 local and 34 free vascularized tissue transfers were performed for reconstruction of the soft tissue injuries. 2 patients had both a free and a local flap for coverage of their defects, while in another patient with involvement both malleoli two different local flaps, the abductor hallucis brevis and the abductor digiti minimi, were used (Tables 2 and 3).

Results

Two free flaps were lost during the immediate postoperative period because of venous thrombosis in one and arterial and venous thrombosis in the other. A skin graft was eventually used for coverage of the defect following decortication of the underlying exposed bone. Partial superficial skin loss was noted in a local fasciocutaneous flap, which however healed spontaneously without compromising the final result.

Follow-up for these patients ranged from 2 to 8 years. During this period, 3 overweight patients who had soft tissue defects on the plantar surface of the heel reconstructed with free muscle flaps covered with skin grafts developed ulcerations. Further tailor-

Table 1. Location of the soft tissue defect

Ankle	8
Malleoli	5
Dorsum of the foot	5
Posterior	7
Plantar surface of the heel	17
Plantar surface of the forefoot	7

Table 2. Choice of local flaps

Fasciocutaneous flaps		10
Dorsalis pedis	2	
Medial plantar	2	innervated
Lateral calcaneal	6	
Muscle flaps		4
Extensor digitorum brevis	2	
Abductor digiti minimi	1	
Abductor hallucis brevis	1	
Myocutaneous flap		1
Flexor digitorum brevis	1	
Total		15

Table 3. Choice of free flaps

Fasciocutaneous flaps		7
Deltoid	5	innervated
Scapular	1	
Radial forearm	1	innervated
Muscle flaps		26
Lattissimus dorsi	15	
Rectus abdominis	8	
Gracilis	3	
Myocutaneous flap		1
Total		34

ing of the free flap and properly fitted footwear to minimize the shearing forces during weight bearing and walking, solved the problem. Although the remaining patients had no problems related to the soft tissue coverage of their foot, adjustment of the footwear was necessary in most of them.

Discussion

With the development of microsurgery large soft tissue flaps can be transferred from one part of the body to the other, thus, allowing even extensive defects to be effectively covered. The heel pad and the sole of the foot, however, have not yet found an adequate replacement and their loss may permanently affect the patient, because of intractable ulcerations. Whenever possible sensation should be restored and for this purpose local innervated fasciocutaneous flaps are ideal for coverage of defects of limited size (McCraw 1979).

The lateral calcaneal flap has been very useful in our hands for reconstruction of posterior heel defects (Lister 1978, Grabb and Argenta, 1981; Figure 1). Although the dorsalis pedis flap may provide excellent innervated coverage, we prefer not to use it because of the potential problems at the donor site (McCraw and Furlow 1975). Instead, we find the extensor digitorum brevis muscle flap extremely useful as it does not violate the skin coverage of the dorsum of the foot (Ger 1970; Figure 2). The small flaps of the intrinsic muscles of the foot give an attractive solution to the reconstruction of defects around the ankle and the malleoli (Ger 1975, Ger 1976).

Our experience with the medial plantar flap (Figure 3) and the flexor digitorum brevis muscle flap is limited, but the result was very satisfactory in the cases they were used. The disadvantage of placing a skin graft on the donor site over the exposed digital nerves, after elevation and separation of the cutaneous branches that provide sensation to the flap, did not seem to present a clinical problem as long as the

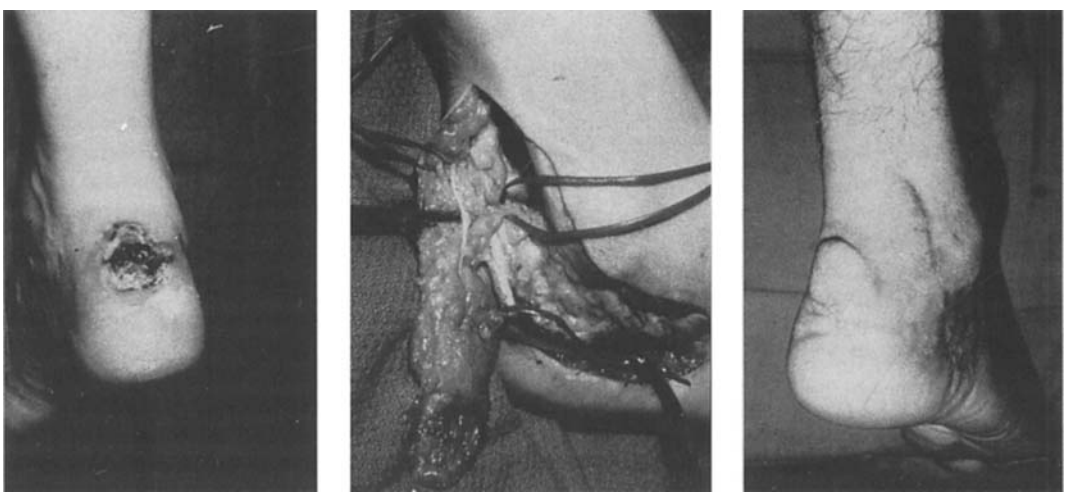

Figure 1. Posterior heel defect (left) reconstructed with the lateral calcaneal sensory flap (middle). Final result was excellent (right).

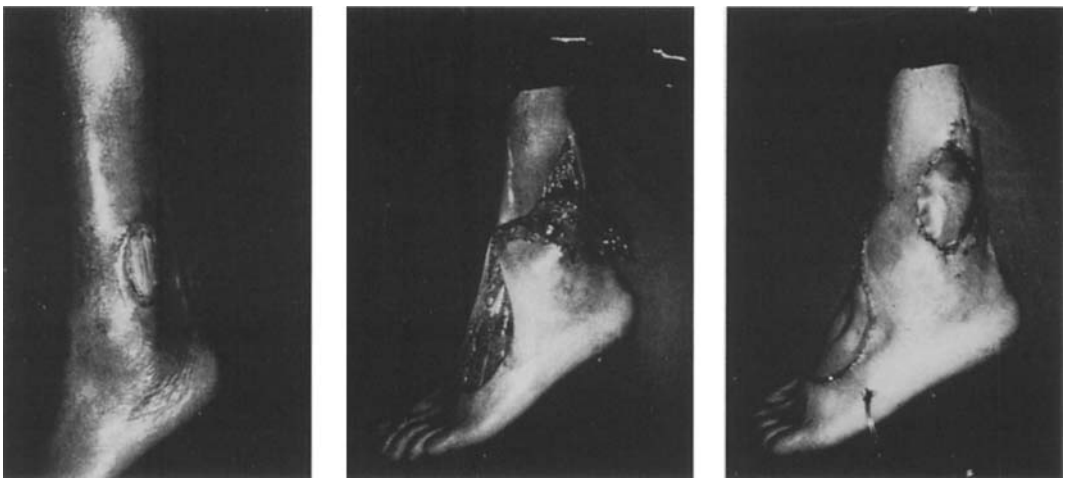

Figure 2. Defect of the lateral malleolus with exposed bone (left) covered with the extensor digitorum brevis muscle flap (middle) and split thickness skin graft (right).

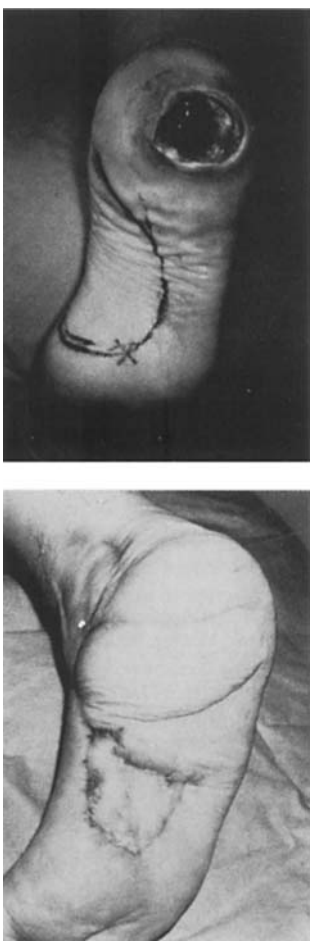

Figure 3. Neurotrophic heel ulcer (top) reconstructed with the medial plantar flap (bottom).

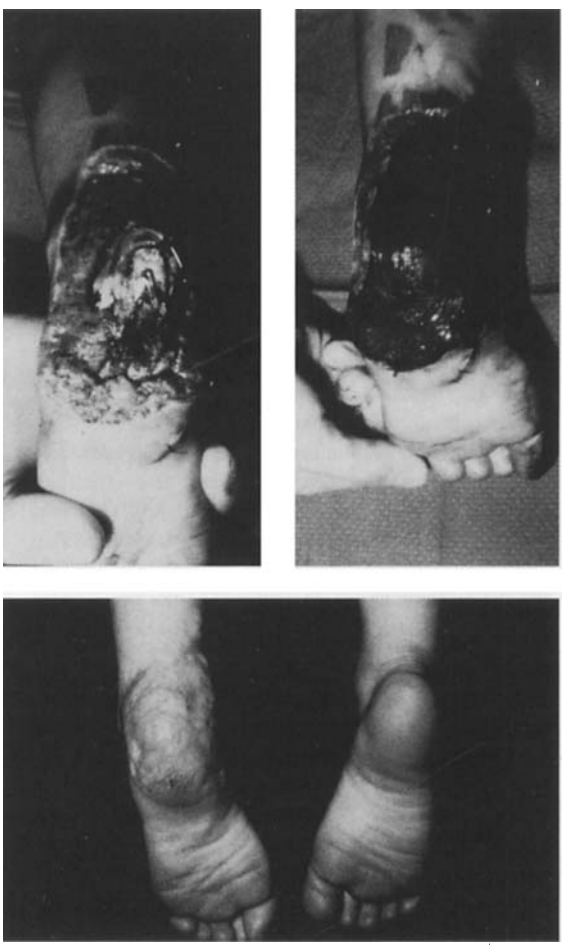

Figure 4. Traumatic heel defect on a 2-year-old child (left). Reconstruction with rectus abdominis free muscle flap and skin grafts (right). The result 3 years post-operatively (bottom).

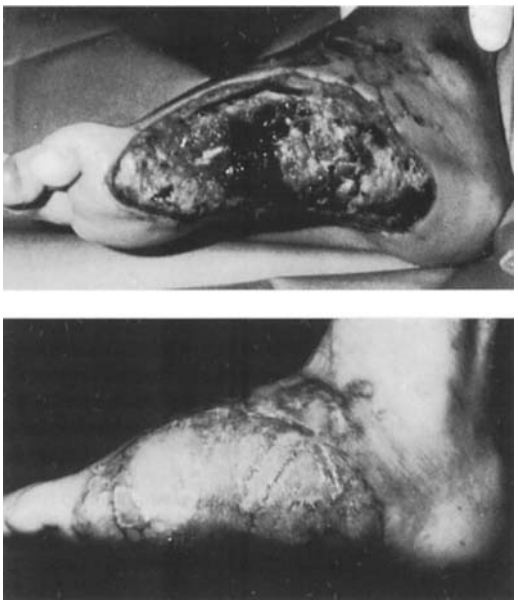

Figure 5. Diabetic patient with extensive defect of the foot (top) covered with free muscle flap and skin grafts (bottom).

dissection was limited to the non-weight-bearing surface of the foot (Shanahan and Gingrass 1979, Reiffel and McCarthy 1980, Harrison and Morgan 1981, Bostwick 1976, Hartrampf et al. 1980).

One has to be extremely cautious in using these local flaps to assure adequate vascularization, because otherwise the reconstructive attempt may fail and the initial problem will be maximized. Use of a local flap in diabetics and vascularly compromised patients is not recommended.

Protective sensation can also be restored by microsurgical transfer of fasciocutaneous flaps (deltoid, dorsalis pedis, radial forearm flap, etc.) This was achieved in 5 of our patients in whom the deltoid flap was transferred to the foot and the cutaneous branch of the axillary nerve was sutured to the sural nerve (Franklin 1984).

In our experience when extensive defects are to be reconstructed muscle flaps covered with skin grafts are preferable to cutaneous flaps. This is because they appear to adhere more closely to the underlying bone (Mathes and Nahai 1982). As the muscle atrophies and loses its initial bulk, further contouring and tailoring of the flap may be required. Adjustment of the footwear and carefully fitted insoles may also be necessary to improve the functional result (Figure 4).

Free tissue transfers for coverage of ankle and foot defects can be successful in many patients even in the presence of vascular impairment (Figure 5). Although flap loss may occur more frequently in such patients compared to healthy individuals with traumatic defects, reconstructive attempts are justified, particularly when the patient is a controlateral amputee (Vlastou et al. 1994).

In conclusion, the choice of the flap that will be used for reconstruction of a defect around the ankle and foot depends on the nature, the exact location, the size of the soft tissue loss and the ability and ingenuity of the surgeon.

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