LOCAL FLAP COVERAGE FOR SOFT TISSUE DEFECTS FOLLOWING OPEN REPAIR OF ACHILLES TENDON RUPTURE

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The authors assessed the long term clinical and functional results following local flap coverage (medial plantar flap, peroneal reverse flow island flap, posterior tibial reverse flow flap) in 11 patients who developed wound complications after open repair of a ruptured Achilles tendon. At the latest follow-up, seven patients had achieved a good result, having returned to their pre-injury activities. All patients were able to stand on tiptoes unaided, and were able to walk without aid. In our hands, local flaps are a reliable means of treating skin defects following open repair of subcutaneous ruptures of the Achilles tendon.

INTRODUCTION

The Achilles tendon is the most commonly ruptured tendon in the human body (12). The injury was uncommon until the 1950's (2), but the incidence of Achilles tendon rupture has increased over the past two decades in the Western countries (14, 20, 21, 22).

Although operative repair of a ruptured Achilles tendon is widely practised in active individuals (17, 18), and can give excellent results (30), some authors report the high complication rate as its main disadvantage (4, 6, 13, 28, 29). Arner and Lindholm (1) reported a 24.4% complication rate in 86 operative repairs of Achilles tendon ruptures, including three wound infections. Soldatis *et al* (27) reported two complications, both delayed wound healing, in 23 operatively treated patients. Wound problems should not be unexpected when open repair is used, as the most commonly used longitudinal incision passes through poorly vascularised skin (9).

We observed that even defects smaller than 1 cm in diameter can take a long time to heal. As the Achilles tendon remains exposed to air, they can cause dessication, and secondary adhesions (15). Recent work has outlined the use of free tissue transfer in the management of wound complications following open Achilles tendon repair (3, 11, 14, 31), while we rely more on local flaps (15). We report our experience in the management of 11 patients with defects over the Achilles tendon, treated by local fasciocutaneous and vascular island flaps.

PATIENTS AND METHODS

All the procedures described in this study were performed after local Ethical Committee approval had been granted. Written informed consent was given by all patients included in this study.

Patients : In the period 1990–1997, 11 patients (mean age : 40.7 years, range 28 to 61 years) were referred to the Department of Orthopaedics and Traumatology of the Chinese University of Hong Kong.

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Table I. — Details of patients

	Sex and age	Cause of injury	Interval between primary surgery and referral	Type of flap	Additional augmentation of previous Achilles tendon repair	Functional result
1	M 28	Sports related	8 days	Medial plantar	None	Good
2	M 35	Domestic	7 days	Medial plantar	None	Good
3	M 38	Domestic	11 days	Peroneal reverse flow	Peroneus brevis tendon	Good
4	M 42	Workplace	12 days	Peroneal reverse flow	Peroneus brevis tendon	Fair
5	M 49	Workplace	6 days	Medial plantar	None	Good
6	F 51	Domestic	14 days	Posterior tibial	Plantaris tendon	Fair
7	M-54	Domestic	8 days	Medial plantar	None	Good
8	M 61	Sports related	14 days	Medial plantar	None	Fair
9	M 39	Sports related	6 days	Peroneal reverse flow	Peroneus brevis tendon	Fair
10	M 45	Workplace	7 days	Medial plantar	None	Good
11	M 46	Workplace	12 days	Peroneal reverse flow	None	Good

All patients had undergone open repair of a complete subcutaneous rupture of the Achilles tendon, through a medial or a lateral longitudinal approach (table I). A termino-terminal suture was always performed, and augmented with the tendon of plantaris in two patients. All original operations were performed using a thigh tourniquet and in all instances interrupted sutures were used to close the skin wound. All patients were referred to the unit for salvage of tendon repair and skin cover following wound dehiscence, on average 9 days (range 6 to 14 days) from the primary surgery (table I). Patients had a skin wound defect of at least 2.5 cm in diameter (fig 1, 2 and 3) through which the Achilles tendon was visible. Surgical exploration and wound coverage was performed the day after referral in all cases. At presentation, all patients received intravenous broad spectrum antibiotics after a microbiology swab had been taken. Antibiotics were continued until the day after the operation if no organisms were identified. If a pathogen was identified, the appropriate antibiotic was administered for 7 to14 days after surgery.

Surgical procedure : Surgery aimed to maintain the tendon repair, and to provide coverage of the skin defect with pliable tissue. Patients were positioned prone and no tourniquet was used. Debridement of the wound edges and extension of the original surgical wound was required to assess the previous repair in all patients. After excision of nonviable skin, an elliptical surgical defect with mean dimensions of 3.8 (range 2.5 cm to 6 cm) by 5.4 cm (range 4 cm to 8 cm) overlying the Achilles tendon was created. We used the reverse flow peroneal flap in four patients (fig 1), the posterior tibial reverse flow flap in one patient (fig 2), and the medial plantar skin flap (24) in six patients (fig 3). The choice of flap was determined by available uninjured and scar-free tissue on the donor site, and by the location of the defect. The procedures were performed according to those described in the literature (7, 10, 24, 26, 33). We used the medial plantar flap when no additional reinforcement of the Achilles tendon repair was felt necessary. In two patients, we used the peroneus brevis tendon to reinforce the Achilles tendon repair (26) and the peroneal reverse flow island flap based distally on the peroneal artery (7, 33). In this way, we were able to harvest both the flap and the donor tendon through the same surgical exposure (fig 2a, b, c, d). The posterior tibial reverse flow flap (10) was used in one patient because of a previous scar on the medial plantar area, unrelated to the Achilles tendon tear and surgery. In all cases, the donor area was skin grafted from the ipsilateral thigh.

Post-operative care : Following surgery, the ankle was immobilised in a below-knee plaster of Paris anterior splint to block active dorsiflexion, with the ankle in neutral position for 10 days to allow the skin flap and the donor site skin graft to heal. After this period, active non-weight bearing mobilisation was encouraged and the splint was changed to a synthetic light weight splint. Patients were allowed weight bearing after the return of pain free active plantar flexion (on average 7.6 ± 2.1 weeks following surgery). At that stage, the splint was discarded. Patients were followed-up at three-monthly intervals on an outpatient basis thereafter for a total of two years, when they were discharged from routine outpatient care. Patients were reviewed in a special clinic at

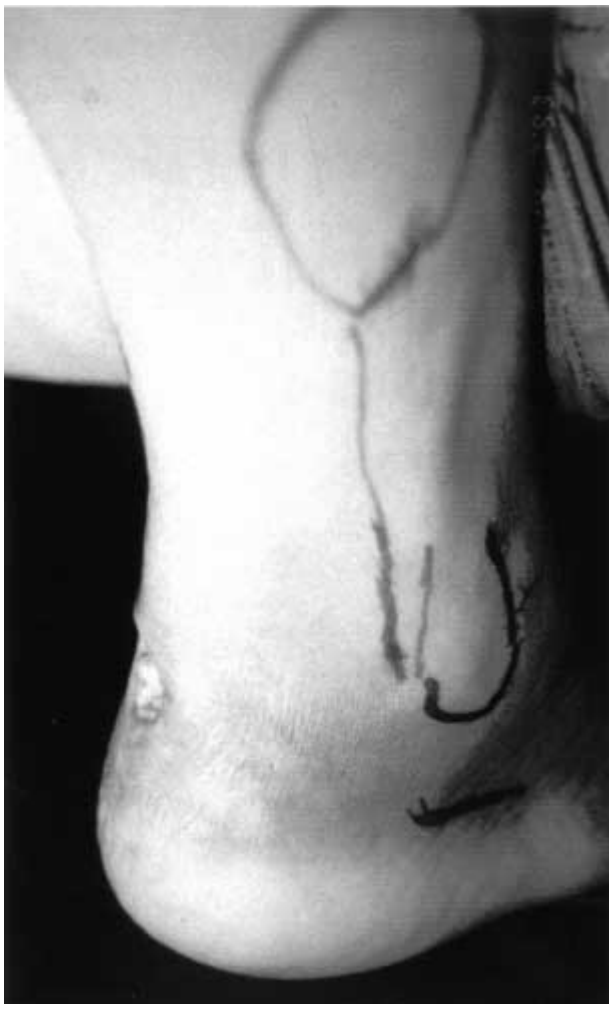

Fig. 1a. — Patient 3. At presentation 11 days after open repair. An outline of the proposed reverse peroneal flap is shown.

Fig. 1b. — Intra-operative detail of reverse peroneal flow flap. The vascular pedicle has been raised. Note the excellent vascularity of the skin of the flap.

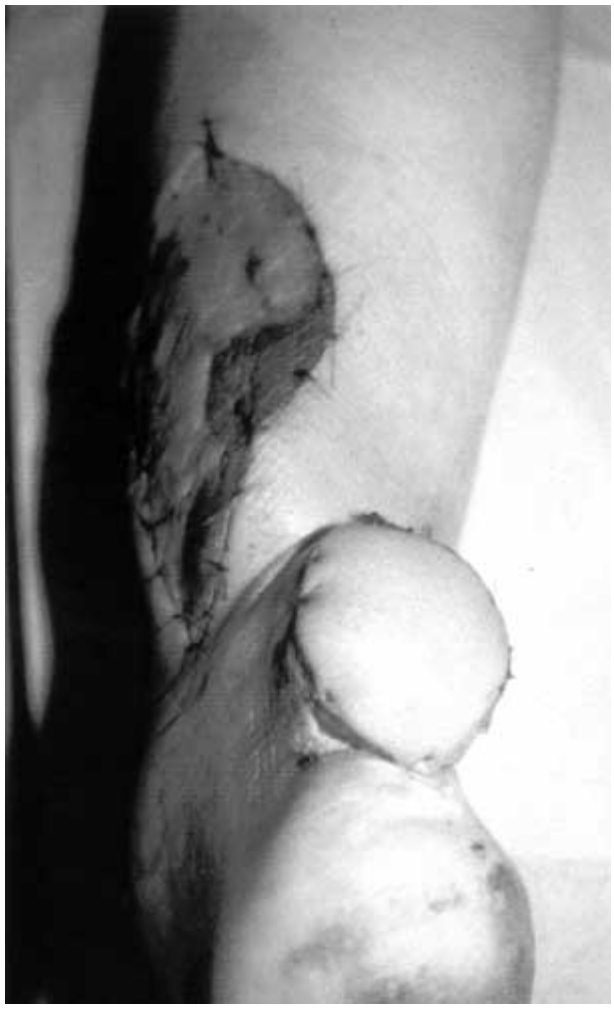

Fig. 1c. — The reverse flow peroneal flap *in situ*

an average of 47.2 months (range 24 to 92 months) from the operation.

Outcome measures : At the follow-up clinic, patients underwent clinical examination and anthropometric measurements of the affected and the contralateral limb. Residual sequelae, pain, weakness and complications, and the patients' ability to return to their sporting and living activities were documented. Passive and active motion of the ankle were measured using goniometry (32). The repair site and the scar were inspected.

Clinical outcome was assessed using Percy and Conochie's (25) criteria. An excellent result was attributed to patients who had regained full function, reported no symptoms, had a stable flap, and returned to the same level of activity as before the injury. A good result was

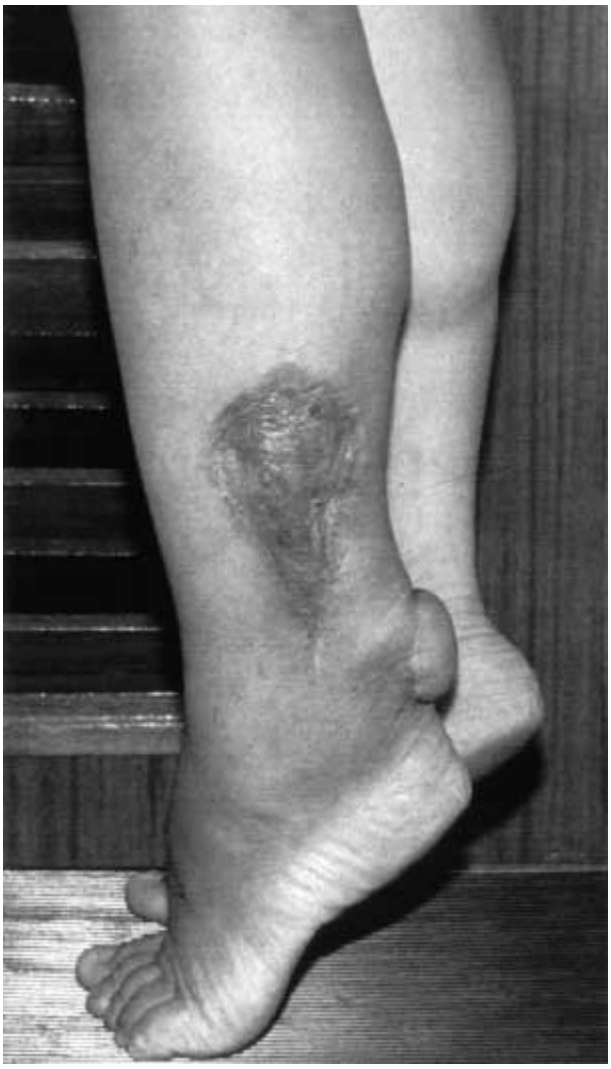

Fig. 1d. — Functional result three years after reconstruction

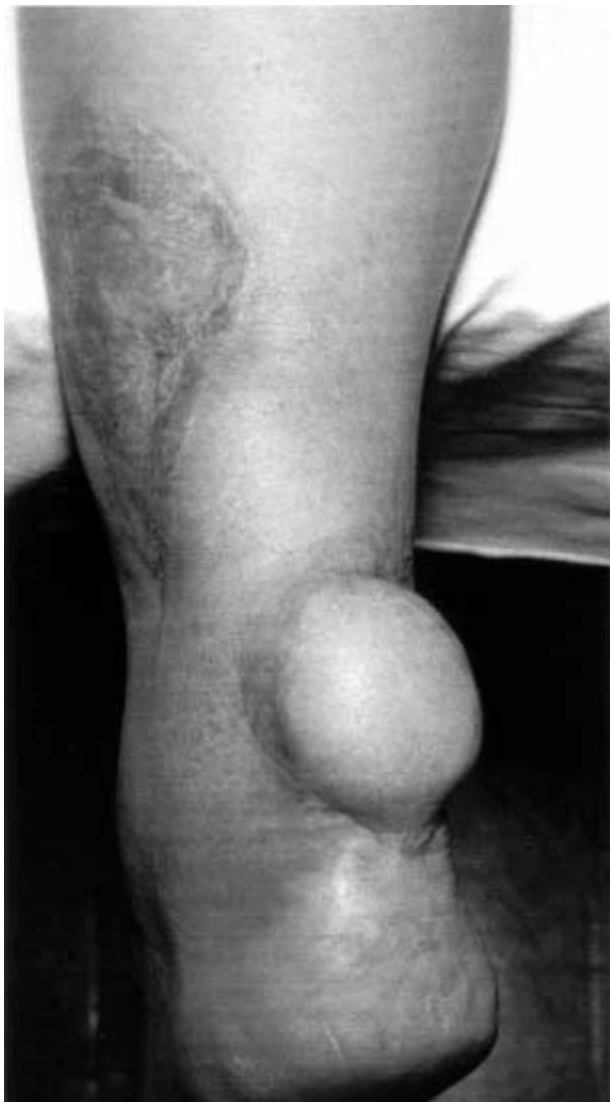

Fig. 1e. — Stable flap four years after reconstruction

attributed to patients with slight stiffness and an adherent scar, but who returned to the same level of activity as before the injury. A fair result was given if there was definite weakness, moderate pain, or some decrease in activity level. Finally, a poor result was defined when there was severe weakness, a limp, an unstable flap, and no return to the level of activity before the injury.

RESULTS

In three patients, a pathogen organism was identified (coliforms), and appropriate antibiotic therapy was instituted for 7 to 14 days. All flaps and donor sites healed well, and the flaps were stable. There were no partial flap losses, flap failures, infections or wound dehiscences, and all skin graft donor sites were well healed, although three patients remarked about the discoloration of the skin graft donor site. Although salvage of the Achilles tendon repair was achieved in all 11 patients, none reached an excellent outcome according to our criteria, although seven had a good outcome. In the patients with a good outcome, the passive and active range of motion of the

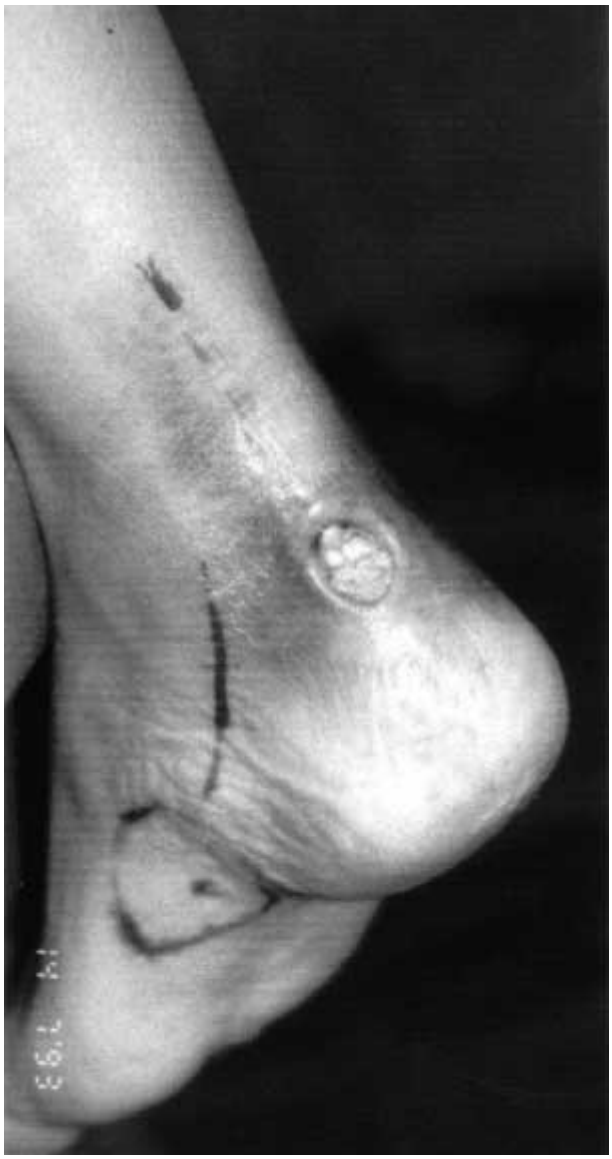

Fig. 2a. — Patient 6. At presentation 14 days after open repair. The defect was 2 cm by 3 cm with poor surrounding skin.

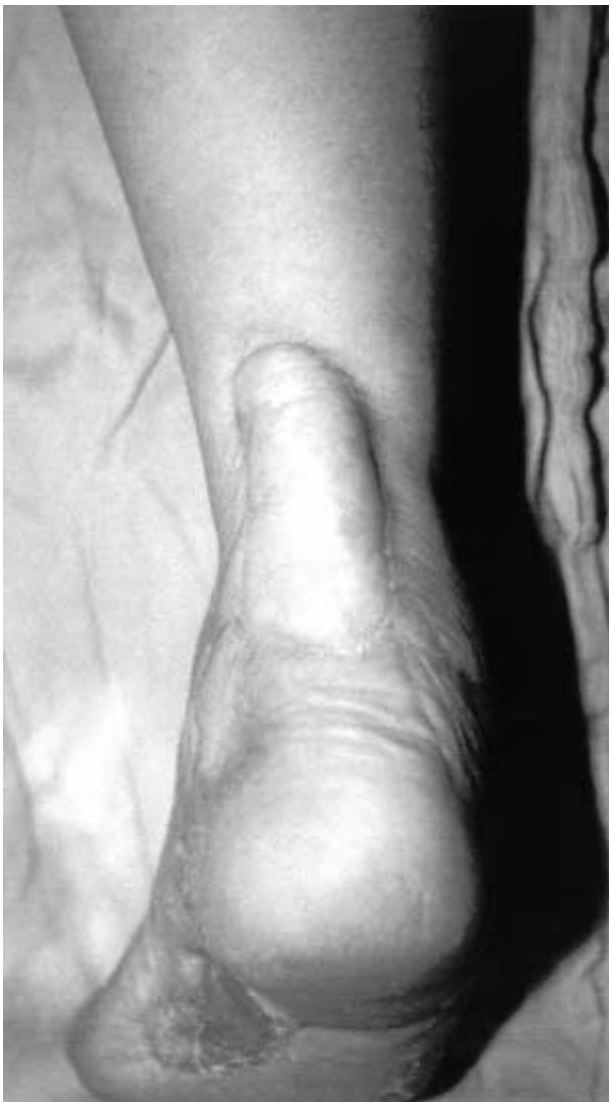

Fig. 2b. — Final result four years after the posterior tibial reverse flow flap had been used for reconstruction.

affected ankle was within 5° of the contralateral. In three of the four patients with a fair result, there were local peritendinous adhesions, with ankle motion limited to 5° to 15° in dorsiflexion. In one patient who received a medial plantar reverse flap, we observed an area of hypercallosity of the skin graft adjacent to the glabrous tissue on the plantar surface of the foot. Although we were concerned about cosmesis, the patient was not, and was very satisfied with the functional result of the procedure.

All patients returned to their previous occupations, and, of the three patients who sustained their original injury through sports participation, two were able to resume their sport activity at the same level as before the injury, and one at a more recreational level.

In all patients, the maximum calf circumference was decreased, ranging from 2.5 to 1.3 cm less than the non-affected contralateral leg. However, none reported a subjective sensation of weakness in their

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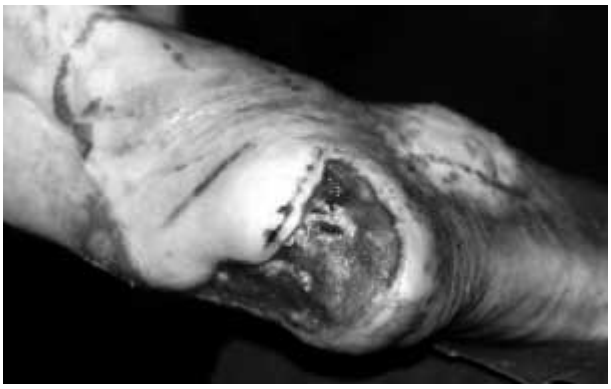

Fig. 3a. — Patient 10. This patient presented 7 days after open Achilles tendon repair. After debridement, the defect involved the whole of the heel.

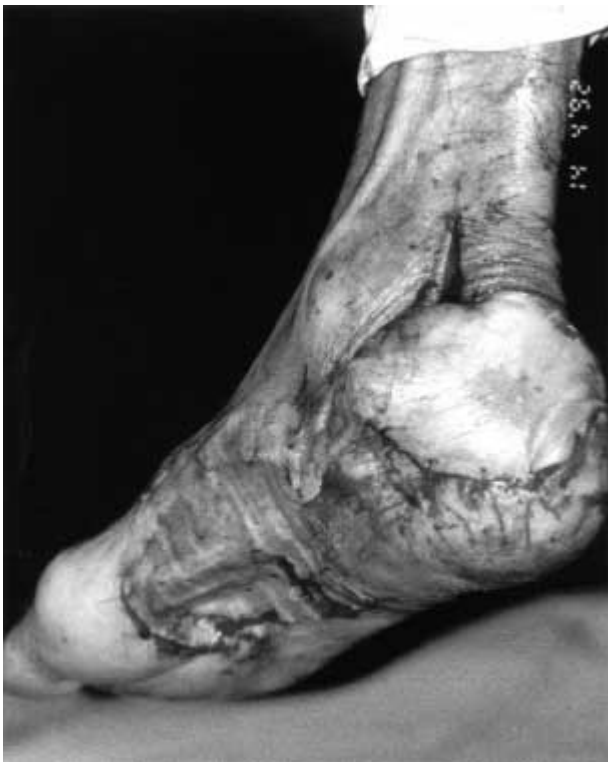

Fig. 3b. — After medial plantar flap

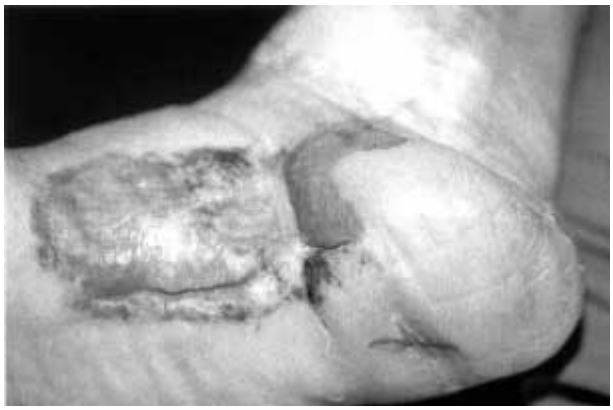

Fig. 3c. — Final result three years after the procedure

calf muscles. All were able to stand on tiptoes unaided and were able to walk without aid by the time of the latest clinical examination.

DISCUSSION

This study presents a strong selection bias, as the patients were secondary or tertiary referrals to a specialised unit after failure of a routine procedure. The referral pattern was such that we saw these patients very early after the skin problem developed, and we were able to plan and perform the reconstructive surgery within a very short period. Also, the number of patients with infected wounds was relatively low, and the prompt soft tissue reconstruction helped in keeping morbidity to a minimum. Most of our Achilles tendon rupture patients were not sports injuries, reflecting the different patterns of physical activity in non-Western countries (5).

All the open Achilles tendon repairs had been originally performed using a tourniquet and by suturing the skin. We routinely perform open repair of subcutaneous ruptures of the Achilles tendon without a tourniquet, through a medial approach and without using skin sutures (19, 30), and flap coverage has been required in only two patients, both smokers, in more than 200 consecutive open repairs of the Achilles tendon (16).

The occurrence of potential wound complications following surgery of Achilles tendon rupture must be recognized and anticipated (14). We have shown that it is possible to salvage and retain Achilles tendon function following wound breakdown with the use of local flaps and, if needed,

appropriate augmentation of the tendon repair. Such flaps should provide a suitable gliding surface for the tendon repair to move without adhesions, and the repair itself must be secure enough to permit early mobilisation (15). Early recognition of potential wound problems and prompt referral to a reconstructive unit with expertise in such surgery ensures a high chance of success and of good functional outcome. A combination of healthy pliable skin cover and well supervised rehabilitation allows retention of a functional Achilles tendon, prevention of secondary contractures in the ankle, and minimises the chances of secondary infection. A potential complication could be the bulk of the flap overlying the Achilles tendon (fig 1d, 1e). However, should this be perceived as a problem, secondary debulking with liposuction can be performed once the flap has stabilised. None of our patients required this.

By the latest follow-up appointment, all patients were able to stand on tiptoes unaided and were able to walk without aid. We would have liked to perform quantitative strength testing : we acknowledge that this is a weakness in our study, but we were not granted ethics permission for this additional outcome measure to be taken.

The relatively small number of patients in this series precluded statistical analysis. Nevertheless, in our hands, local flaps are the procedure of choice for the primary management of skin defects up to 2.5 by 2.5 cm at presentation following open repair of the Achilles tendon. Large skin defects overlying the Achilles tendon offer a therapeutic challenge. In general, skin grafting alone is not suitable. Recent work has outlined the good outcome following free flaps (8). Local flaps offer the advantage of restricting the morbidity to the leg originally operated on, especially if the skin graft required to cover the defect in the donor area is harvested from the same leg. However, we do perform free flaps in patients with larger defects, and in patients who present late.

Prior to reconstructive surgery, one must assess the extremity circulation, pedal pulses, possible venous stasis, and previous surgical procedures to decide on the appropriate type of flap for a given patient. The local flaps described in this article are reliable. We do acknowledge, however, that they require the sacrifice of one major artery of the leg, which may pose problems later on, and pedicled flaps and free flaps have therefore been developed to address this issue (3, 11, 14, 31).

In our unit, defects in the lower leg of the size reported in the present study are primarily treated using local flaps (15). These are convenient and, in the context of the previous failed surgery, our patients were reluctant to accept distant free tissue flaps. A further advantage is that, should the local flap fail, a free flap can still be performed. Fortunately, this did not happen in any of our patients, who were all able to wear normal shoes and to walk freely at the latest follow-up.

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