Disarticulation at the ankle using an anterior flap

A PRELIMINARY REPORT

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Disarticulation has been carried out in ten ankles in nine patients in whom it was not possible to use a heel flap. Four patients were able to walk with a prosthesis which gave satisfactory function. In five who were bedridden, healing was achieved and was of sufficient quality to allow transfers. There was no operative morbidity or mortality.

This technique can be used instead of a transtibial amputation if necrosis or ischaemia of the heel is a contraindication to conventional Syme's amputation.

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An anterior skin flap taken from the instep can be used to cover the bone ends in disarticulation of the ankle when ulceration or necrosis of the heel prevents the use of the heel flap for a conventional Syme's amputation. This technique was originally described by Baudens¹ and quoted by Murdoch.² It can be carried out under regional anaesthesia. It is well tolerated in the unfit patient and avoids many of the problems of the Syme's procedure. Ground contact is acceptable and there are some advantages for the fitting of a prosthesis.

Patients and Methods

Experience in the rehabilitation of a 24-year-old patient in whom disarticulation of the ankle had been carried out using skin from the instep rather than a heel flap after a compound fracture of the calcaneum, led us to the use of this method in patients with necrosis of the heel.

Patients selected for this procedure had intact skin on the proximal part of the instep but ulceration, fissuring necrosis or infection involving the heel. There was absence of pain at rest, adequate perfusion, colour and temperature with evidence of flow in one of the three arteries to the ankle on testing with a hand-held Doppler apparatus. In one patient a

transcutaneous oxygen measurement of 40 mmHg was found in the skin at the instep. A systolic pressure of 30 mmHg in one or more vessels of the ankle is ideal and a transcutaneous PO₂ of 40 mmHg is necessary.

Before operation, sepsis was controlled by local cleansing and antibiotics. Diabetic control was optimised. The patients' nutrition was assessed and protein deficiency corrected when possible. Renal insufficiency and cardiac and pulmonary disease were treated. Subcutaneous heparin or fragmin were used to prevent venous thrombosis and embolism. Prophylactic antibiotics including metronidazole and often cefotaxime were used over the perioperative period. Anaesthetic assessment was carried out by ECG and pulmonary function tests, usually leading to the selection of epidural or spinal anaesthesia.

Operative technique. The design of the long anterior flap, as an alternative to the Syme's heel flap, was tested initially on cadavers. A rectangular anterior flap based on the tip of the malleoli provided the best cover.

The operation is carried out with the patient supine. A tourniquet is applied above the knee, but not inflated. The skin is prepared with povidone iodine. The skin flaps, based on the prominence of the medial and lateral malleoli, are marked out with an indelible marker, describing a short posterior skin flap and a long rectangular anterior flap extending on to the mid-forefoot, to allow for subsequent trimming if required (Fig. 1). The anterior flap is raised, initially superficial to the extensor tendons, which are divided under tension at the anterior capsule of the ankle. The anterior tibial artery and veins are carefully ligated, avoiding the terminal branches of the nerve. Dissection is carried to the anterior capsule of the ankle and then under the malleoli to clear these completely and to allow the incision to be continued into the posterior flap, where tendo Achillis is cut close to its insertion into the calcaneum. Care is taken to secure the posterior tibial and peroneal arteries and their veins without entrapment of the nerves. Once the medial and lateral ligaments of the ankle have been divided, the foot can be plantar flexed allowing the posterior incision to be carried around the remainder of the joint capsule. At this stage, the soft tissues can be retracted gently to allow the periosteum to be cleared from the lower part of the malleoli to define the anterior and posterior surfaces of the distal tibia and fibula. This allows an

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Fig. 1

Drawing showing the surgical procedure: a) flaps marked out, before incision; b) line of bone resection; c) rounding of sharp bone edges; and d) the completed stump.

accurate saw-cut to be made transversely through the distal tibia and fibula at the minimum distance to eliminate the articular cartilage of the ankle mortise, which involves a resection of 0.75 cm of distal tibia. A flat surface of cancellous bone is then produced with a maximum area for ground contact when standing, and adequate width to retain a prosthesis on the malleolar flare. The margins of the transected bone are carefully rounded with a fine bone file or a cylindrical burr (Elan-E. Drill; Aesculap, AG & Co, Tuttlingen, Germany), and the medial and lateral aspects of the malleolar remnants are rounded to a minimum degree. Once the bone filings have been washed away with saline the tourniquet can be released if it has been inflated to control any bleeding. In most cases inflation of the tourniquet is not required and is best avoided. Tendo Achillis can then be sutured to the posterior remnants of the joint capsule and tibial periosteum to provide an attachment. The anterior skin flap can be reflected posteriorly and trimmed to provide cover for the exposed bone end without tension. A 5 mm suction drain is left to avoid a haematoma and the stump incision is sutured with vertical mattress sutures of 3/0 nylon alternated with 5 mm steristrips. To avoid any local pressure producing impairment of skin blood flow, a dressing of fluffed cotton gauze is applied beneath the tension-free elasticated bandage.

After the operation, the patient is nursed with a cradle over the stump and a soft pad under tendo Achillis to avoid

pressure on the new stump. After 24 to 48 hours the suction drain is removed and active exercise and wheelchair transfers commenced. The stump is shown in Figure 2. While standing is avoided at this stage, inadvertent ground contact

Fig. 2

Photograph showing the completed amputation; arrow indicates the anterior aspect.

Table I. Details of the nine patients who had ten ankle disarticulation amputations

Case	Gender	Age at time of surgery (yr)	Indications for surgery	Comment	Follow-up
1	M	24	Trauma	Prosthetic walking	8 years
2	F	87	PVD*	Indoor walking	11 months
3	M	75	Diabetes, PVD	Bed and chair	4 months
4	F	63	Diabetes, PVD	Prosthetic walking	6 months
5	F	84	Diabetes	Bed and chair	3 months†
6	F	62	Bilateral amputations, PVD Past cold injury	Prosthetic walking	2 years
7	M	81	Diabetes, PVD	Indoor walking	3 months
8	F	84	PVD, talipes	Prosthetic walking	10 months
9	M	84	PVD	Prosthetic walking	10 months

* peripheral vascular disease

† follow-up records incomplete

can be accepted. It is advisable to keep sufficient padding in the wound dressing to avoid damage to the healing stump.

A sheepskin cylindrical bootie is provided for at least 14 days as a protector and, after a further week, for indoor standing and walking. For walking a Syme's type of prosthesis is recommended. In the absence of the bulky Syme's heel flap the amputated limb has a real shortening of between 5 and 7 cm. While this does not affect limited walking, for energetic activity a prosthesis is required for stability and to relieve some of the end-bearing stress. A patellar-tendon-bearing type of socket is provided, but in the absence of a soft-tissue heel flap there is room to provide a multiaxial ankle joint below the stump. A much more sophisticated prosthesis can be provided than can be achieved with the usual Syme's amputation. If the malleolar flare is preserved by this technique the prosthesis can be entirely self-suspending without a suprapatellar strap. The prosthesis may consist of an inner plunge liner or a side window to accommodate the malleolar flare. It has been our practice to provide a temporary check socket for initial assessment.

Results

Nine amputations in this series were carried out by the author. The first patient (case 1) had disarticulation elsewhere using the anterior flap method. Details of the patients are shown in Table I.

No patient died and none required a secondary operation. Although primary healing was achieved, delay occurred in one patient (case 8) after accidental trauma. One patient (case 1) had normal circulation, three (cases 2, 3 and 4) had only a femoral pulse, one (case 5) had a right dorsalis pedis pulse only and three (cases 7, 8 and 9) had popliteal pulses but none palpable in the foot. The patient with bilateral amputations (case 6) had only a dorsalis pedis pulse on the right. All patients were considered for possible angioplasty and vascular surgery. One (case 2) had a preamputation angioplasty. Patients who have subsequently died (cases 2

to 5 and 7) have all done so from progression of their disease, and not as a result of the ankle disarticulation. These patients were in geriatric care, were largely bedridden with intercurrent disease and had developed severe ulceration of the heel. All survived the operation and postoperative period. They were able to use the amputated leg for transfer and occasional standing; a prosthesis was provided only for one (case 4).

The remaining patients are in good general health. The three (cases 6, 8 and 9) with peripheral vascular disease have achieved good walking with a prosthesis, including one (case 6) with bilateral amputations.

Discussion

Disarticulation of the ankle, described by Syme in 1843,³ superseded the anterior skin flap procedure introduced by Baudens¹ in the preceding year. A review of the recent results of Syme's amputation by Choudhury and Kitaoka⁴ and Gaine and McCreath⁵ has shown a widely varying rate of failure requiring reamputation, mainly in patients with peripheral vascular disease. In our experience many patients with diabetic gangrene of the forefoot also have fissuring, ulceration or necrosis of the heel. If a Syme's procedure is then contraindicated transtibial amputation is required. Healing of a Syme's procedure and the presence or absence of peripheral pulses indicate a considerable tolerance to impaired perfusion. Francis et al⁶ believed that the posterior tibial pulse had to be palpable for Syme's amputation to heal. If, however, any one of the three arteries at the ankle is patent, and the anterior tibial artery was patent in 86% of the patients treated successfully by Syme's amputation, healing is satisfactory.⁷ It is therefore probable that this alternative method of ankle disarticulation could be successful in many patients selected for transtibial amputation when Syme's procedure is contraindicated due to heel pathology.

Analysis of the gait of patients with partial foot amputations and ankle disarticulation by the conventional methods, has shown it to be superior to that after a partial foot

amputation.^{8,9} The disarticulation in our nine patients showed no problems with wound healing. It was amenable to ground contact and standing without a prosthesis, although a soft cylindrical bootie was advised for indoor use. For outdoor walking, a prosthesis which would combine partial end-bearing and partial weight-bearing on the patellar tendon and tibial flare was used. Whether the conventional Syme's prosthesis shank, with a lateral window, was provided or the residual limb was enclosed in a contoured liner which could be introduced into a parallel-sided socket as a plunge fit, was determined by a trial polypropylene socket of the patellar-tendon bearing type. Another advantage of this operation was that the slender stump was easier to fit into the prosthesis.

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