Turn-up bone flap for lengthening the below-knee amputation stump

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When amputation just below the knee becomes necessary after extensive loss of bone from the tibia and of anterior soft tissue in the treatment of tumours, fractures or infection, the remaining proximal tibia may be too short for a below-knee prosthesis, although the knee may be normal. We have included the distal tibia or foot in a long posterior flap by turning it up thus increasing the length of a very short proximal tibial stump. The knee is thereby saved, allowing satisfactory use of a below-knee prosthesis.

This technique is particularly applicable when the distal leg is normal and well vascularised. Five procedures have been undertaken. We present two illustrative cases.

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There may be extensive loss of bone from the tibia after trauma, tumours or infection, and, when reconstructive techniques fail, amputation may be required. A below-knee amputation is usually not considered if less than about 3 cm of the tibia remains, although the knee may be normal. We report further experience with a procedure which was previously described by Younge and Dafniotis¹ in which a below-knee amputation became possible in this situation by lengthening of the stump. We have undertaken four additional procedures since reporting our first case.¹

With healthy posterior and distal tissues, the distal tibia and part of the foot may be included in a long posterior flap.

This can be turned up to increase the length of the remaining tibia to create a good below-knee stump. In five patients, after extensive loss of bone from the shaft of the tibia, the distal part was turned up in a flap to lengthen the short remaining proximal element. In one patient the talus was included for added length (Fig. 1). The subsequent fitting of a prosthesis was straightforward, as for a standard below-knee amputation.

The five patients included one with post-traumatic osteomyelitis of the tibia, two who had had resection of a tumour of the upper tibia, and two with trauma in whom, after failure of reconstruction, amputation had been recommended. In all patients primary healing was good with a satisfactory stump and normal function. There was rapid union of the distal to the proximal tibia with simple fixation. Cerclage wires were used in two patients (Fig. 2), staples in two and a plate in one.

Illustrative case reports

Case 1. A 20-year-old man had an extensive degloving injury of the lower limb which was complicated by a deep compartment syndrome. One year later the anterior tibia remained exposed. There was extensive loss of the distal quadriceps, and a fixed equinus deformity of the ankle with poor distal sensation. The knee was satisfactory. He was referred for a free flap to cover the tibia and for correction of the equinus deformity. The 'turn-up' procedure was advised in order to obtain a below-knee amputation. Fixation was minimal with two cerclage wires. Union was achieved two months after operation and, despite the lack of quadriceps function, he has a good below-knee amputation (Fig. 2).

Case 2. A 16-year-old girl with an osteosarcoma of the proximal tibia underwent resection and reconstruction with a bone graft. The wound did not heal and the graft failed. The anterior soft tissue was deficient, with exposed necrotic bone (Fig. 3a). The planned resection of the anterior tissue with the exposed segment shows the long posterior flap (Fig. 3a). Figure 3b shows the turning-up of the posterior flap after amputation of the foot just above the ankle. The distal tibia was stapled to the proximal tibial stump, and tendo Achillis sutured to the patellar tendon. There was rapid bony union and the resulting stump is normal in appearance and function (Fig. 3c).

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Fig. 1a

Fig. 1b

Radiographs showing the appearance after resection of a tumour and 'turn-up' of the distal fibia. The talus was included to give greater length.

Fig. 2

Radiograph at two months after operation showing union of the distal tibial metaphysis to the proximal tibia, with two cerclage wires.

Fig. 3a

Fig. 3b

Fig. 3c

Case 2. Photographs showing a) a failed limb salvage with exposed necrotic tibia, the posterior flap, planned resection of anterior tissue, and incision for amputation of the foot, b) the removal of the foot just above the ankle with suturing of tendo Achillis to the patellar tendon, and c) good healing of the stump.

Discussion

Younge and Dafniotis¹ described this technique in a case report in 1992. Song et al² described two further patients in 1994. We have now undertaken five operations which illustrate the application of this technique especially as a salvage procedure in cases of severe trauma to the lower limb. When it is used with the appropriate indications the function of the knee in young patients may be saved.

McDonald, Scott and Echardt³ reported a similar technique using the proximal tibia to lengthen a short proximal femoral stump. Peterson, Koch and Wood⁴ turned up all of the tibia as a flap to replace the femur, placing the calcaneum in the acetabulum. Other authors have used a neurovascular island flap from the foot to lengthen the short tibial stump after trauma or a free flap from the amputated foot to cover the site of a below-knee amputation.⁵⁻⁸

Our technique is simpler since it does not require dissection of neurovascular structures or microvascular techniques. In all our patients, an extensive amount of tibia had been lost after trauma or resection of a tumour, leaving only 2 to 5 cm of proximal bone. A prerequisite for the technique is that the posterior tibial vessels and nerves be intact and available to be included in a long posterior flap, reaching as far distally as needed.

The preparation of the long posterior flap is an extension of the Burgess technique⁹ for below-knee amputation, with no dissection of neurovascular structures being necessary. The only precaution is that more than half of the distal circumference of the soft tissue of the leg is retained since the tibia is larger proximally than distally. The broad surface of

the distal tibia is placed against the cut surface of the proximal tibia and unites satisfactorily. We used a plate in one patient, but simpler fixation such as with staples or cerclage wires was sufficient in the other four, and all had rapid healing (Figs 1 to 3).

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