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CLINICAL REPORT

Tibial segmental bone defect reconstruction by Ilizarov type bone transport in an induced membrane

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Open fracture;
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Summary The management of combined loss of skin coverage and bone substance in the lower third of the leg is problematic. A recommended sequential strategy associates removal of infected tissue and coverage followed by treatment of the bone defect. We report a technique without microsurgery, using Masquelet's induced membrane technique to manage the bone loss, associated to bone transport and coverage by a fasciocutaneous flap with distal pedicle. In a patient presenting with a 10 cm defect with bone exposure, this 2-step procedure allowed consolidation at 7 months without functional sequelae; the fixator was kept in place for 9 months. Neither microsurgery nor cancellous bone graft was required. Using a spacer to induce a membrane facilitated bone transport and distal consolidation.

Introduction

Loss of cutaneous and boney substance in the lower third of the leg secondary to infected open fracture raises complex treatment issues as the bone is poorly vascularized, surrounded only by tendons and fasciocutaneous tissue. Free muscle flap coverage is required in extensive or circumferential lower limb bone loss [1]. Free fasciocutaneous flaps (FCF) have proved as effective as free muscle flaps in lower limb reconstruction [2,3], even in case of sepsis [4]. Free flaps are becoming less frequently indicated [5,6], in favour of pediculated flaps, which are easier to obtain and induce fewer and less severe complications. Sural neurocutaneous flaps show great flexibility of use [7]. Perforator flaps are a novel approach [6,8]. Bone defects may be managed by fibula [9—11] or free vascularized iliac crest [12], using Masquelet's induced membrane technique [13—15] or bone transport [16—28].

The present case report is of bone defect managed by part of Masquelet's procedure, associating pediculated FCF cover to bone transport. This 2-stage technique may offer a new perspective in the management of such lesions. It has the interest firstly of involving no microsurgery for bone loss and soft-tissue reconstruction. Secondly, it conserves bone

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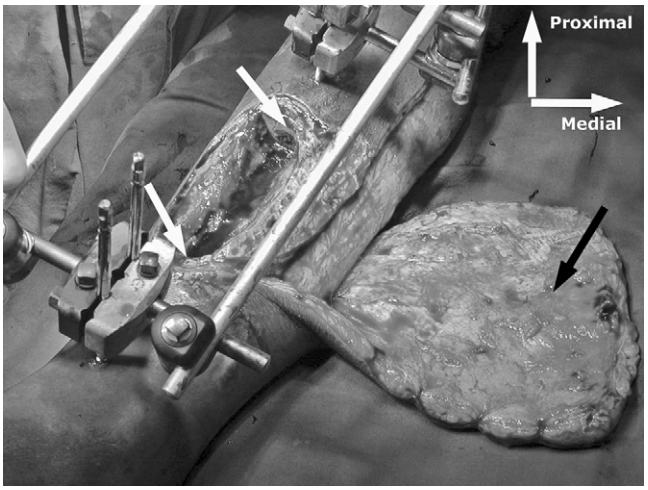

Figure 1 Distal fasciocutaneous flap (black arrow) and monoblock resection of infected bone (white arrow).

capital, requiring no cancellous bone graft, by preparing the transport site by means of a temporary spacer to facilitate transport and distal consolidation.

Observation

Mr D., 27 years old, was referred to the Pointe-à-Pitre hospital in Guadeloupe on February 29, 2004, from a neighbouring English-speaking Caribbean island, following an open fracture of the right lower limb sustained 1 month before, when his motorcycle was overturned by a car. The fracture was grade III A on Gustilo's classification [29]. Clinical check-up found a bifocal fracture stabilized by Hoffmann I external fixator transfixation pins, with anteromedial soft tissue loss exposing the lower third of the tibia for more than 6 cm around the distal fracture line. There was no sensorimotor or vascular impairment. X-ray check-up showed bifocal tibial fracture with an oblique proximal line at the union of the proximal and mid thirds, and a transverse distal line at the union of the mid and distal thirds. There was an associated fibular fracture at the union of the mid and distal thirds. Biological analysis found CRP at 151 mg/L, leucocytes at 11,400/L (normal: 4000—10,000) and 8.3 g/dl anemia (normal: 13—17). The patient was operated on 7 days after admission, for debridement, removal of the original fixator and fixation of a monoplanar Hoffmann II fixator on the medial side of the limb. One week later, debridement was repeated, the patient having initially refused radical exeresis of the infected bone. Two months after admission, a 10 cm bone fragment was dissected by oscillating saw at the distal tibial site, up to the presumed healthy area. A gentamycin-impregnated cement spacer was introduced, with coverage by distally pediculated FCF (Figs. 1 and 2). Bacteriological analysis of soft tissue and bone samples found *Aeromonas hydrophyla* and *Pseudomonas aeruginosa* infection. Antibiotherapy was initiated: amikacin 15 mg/kg/dqy perfusion for 10 days and pefloxacin 400 mg per os for 45 days. Cutaneous status was satisfactory, and the infection appeared to be controlled. Four months after admission, the spacer was removed, an Orthofix™ lengthening fixator (three pins in the proximal, two in the distal and two in the mid epiphysis) replaced the Hoffmann II, and proximal metaphyseal corticotomy was performed for the bone transport. The flap harvesting site was covered by a dermo-epidermal graft. Intermediate fragment transport was initiated on Day 10, at a rate of 1 mm per day (divided in four increments of 0.25 mm). Two weeks later, the patient was discharged home to achieve bone transport. Partial weight-bearing with two crutches was allowed. The patient was followed up monthly by control X-ray. Consolidation was achieved 7 months after initiation of the transport procedure, and the fixator was removed at 9 months, with crutches prescribed for a further month.

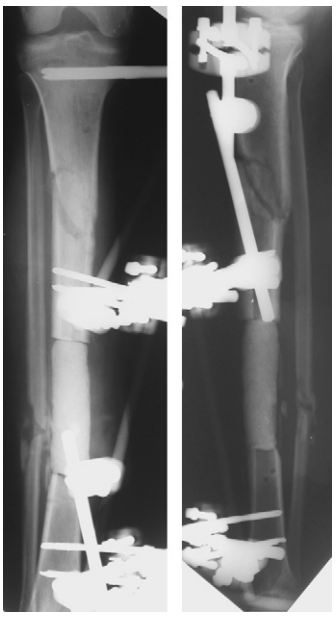

Figure 2 Cement spacer in place on antero-posterior and lateral X-ray.

At 3½ years' FU (late January, 2008), the patient was walking normally, without limp, and without orthopedic heel; monopodal stance was stable (Fig. 3), running was possible, ROM was 0/130° in the knee and 20/30° in the ankle. Consolidation showed 4° valgus and 15 mm shortening of the tibia (Fig. 4).

Discussion

In this patient treated in second intention, the cleansing of the initial open fracture site was uncertain, and we chose to dissect the infected bone, which had lost its periosteal connections, as recommended by most authors [13,19,23]. *Pseudomonas aerugionosa* and *Aeromonas hydrophyla*, found in biological analysis, are especially virulent, the latter sometimes causing necrotizing fasciitis requiring amputation [30].

We did not use the whole of Masquelet's et al. procedure [13], as the 10 cm defect seemed too great, although certain authors set no limit [13,14,15], and preferred a bone transport technique [14]. With such extensive loss of substance, the patient's bone capital available for autograft seems to us to be severely depleted, raising the threat of amputation if consolidation required further grafting or in case of