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Case report

Reconstruction of an extensive soft tissue and bone defect of the first metatarsal with the use of Masquelet technique: A case report

Konstantinos G. Makridis MD, MSc, PhD*, Stelios Theocharakis MD, Evangelos Minas Fragkakis MD, Peter V. Giannoudis

Academic Department of Trauma and Orthopaedics, School of Medicine, University of Leeds, Leeds General Infirmary, Clarendon Wing Level A, Great George Street, LS1 3EX, Leeds, UK

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ABSTRACT

The literature regarding reconstruction of foot bone defects is limited. The purpose of this study is to present a case report with an extensive bone defect of the first metatarsal bone which was treated with the use of the induced membrane technique.

A 53-year-old man, with comminuted foot grade IIIb open fracture was treated with the Masquelet procedure. At 14 months follow-up, clinical and radiological assessment of the foot revealed osseous healing and no signs of infection, osteolysis or hardware failure. At 18 months follow-up, the patient had no pain and returned to his usual daily activities. The Masquelet procedure provides an effective method of treatment of extensive bone defects of the foot. It can restore the normal length and metatarsal arch minimizing the risk of complications that occurs with other surgical procedures.

Level of evidence: Level V, case report.

1. Introduction

Reconstruction of lower extremity diaphyseal bone defects is demanding and requires a combination of orthopedic and plastic surgery techniques. Defects less than 2 cm and up to 4 cm can be treated with autogenous bone grafting [1]. The vascularized fibula autograft and the Ilizarov bone transfer techniques are commonly used to restore defects greater than 5 cm, but they are associated with several disadvantages. When the distraction osteogenesis method is used, complications such as pin-tract infection, mal-union, non-union and problems with the docking-site have been reported, while the need for long-term application of the external fixator creates difficulties in patients' compliance to the treatment [2]. With the free fibula transfer, there is a significant risk of donor site pain and morbidity, whilst prolonged operative time and microsurgery expertise are required [3]. Masquelet first described the induced membrane technique for the reconstruction of extensive diaphyseal bone loss up to 25 cm in length [4]. This is a two-staged approach and the first procedure involves radical soft tissue and bone debridement. A cement spacer is implanted at the site of the bone defect preventing fibrous tissue invasion and inducing the formation of a biological pseudo-membrane that will revascularize the bone graft. At the second stage, 6–8 weeks later, the cement spacer is carefully removed and the defect is filled with morcelized cancellous autologous bone graft, while the bone fragments are usually stabilized with plating or nailing. Numerous human [5–9,2,10–15] and animal [16–18] studies have been reported regarding the use of Masquelet technique. However, the literature regarding reconstruction of foot bone defects is limited. The purpose of this study is to present a case report with an extensive bone defect of the first metatarsal bone which was treated with the use of the induced membrane technique. The staged method is described succinctly and useful tips are being discussed for the reconstruction of the medial arch of the foot.

2. Case report

A 53-year-old man, with comminuted left distal tibia and ipsilateral foot grade IIIb open fractures, was referred to our institution. The patient was a motor-bike driver and he injured his left ankle 3 weeks before admission to our clinic after a road traffic accident. The initial injuries were multiple involving brain and right brachial plexus contusion, and right pleural effusion. Following careful evaluation with ATLS protocol, wound debridement was made and an external fixator was applied bridging the ankle joint. The fractures of second and third metatarsals were

* Corresponding author. Tel.: +44 7933875043/+44 306974907852.
E-mail addresses: kmakrid@yahoo.gr (K.G. Makridis), stheocharakis@yahooo.gr (S. Theocharakis), angelo.fragakis@gmail.com (E.M. Fragkakis), pgiannoudi@aol.com (P.V. Giannoudis).

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Fig. 1. (a) Application of external fixator to stabilize the fracture of the 1st metatarsal and (b) implantation of cement spacer at the site of the defect.

temporarily stabilized with K-wires, while there was a large (5 cm) bone defect of the first metatarsal. A vacuum assisted closure of wound was initially performed. He was referred to our tertiary hospital for the definitive treatment of his ankle and foot. Radical soft-tissue and bone debridement and wound irrigation were performed for the first metatarsal bone defect. Tissue specimens were sent for culture examination to exclude any possible low-grade infection. A mini-external fixator was applied to stabilize the fracture of the first metatarsal and a cement spacer (impregnated with gentamycin, Palacos®, Heraeus, Hanau, Germany) was implanted at the site of the defect (Fig. 1a, b). The soft tissue envelope over the dorsum of foot was reconstructed with the use of radial forearm flap anastomozed to tibialis posterior artery. After six weeks, a well-formed pseudo-synovial membrane was found at the second stage of the procedure (Fig. 2). The cement spacer was carefully removed with minimal disturbance of the membrane and the fracture was stabilized with 2 locking plates (Synthes Inc., USA, West Chester, PA) creating a stable construct (Fig. 3). The whole defect was filled with autologous bone graft from the intramedullary canal of the left femur using a composite graft containing RIA graft, scaffolds (Orthos, Orthobiologics, UK), BMP-7 (Osigraft, Stryker, UK) and concentrate bone marrow aspirate (Fig. 4). Five months later clinical and radiological examination revealed osseous healing of the 1st metatarsal defect. Ten months after the surgery, arthrodesis of tibiotalar joint and the first metatarsophalangeal joint was performed using a retrograde calcaneal intramedullary nail and screws as well as K-wire fixation

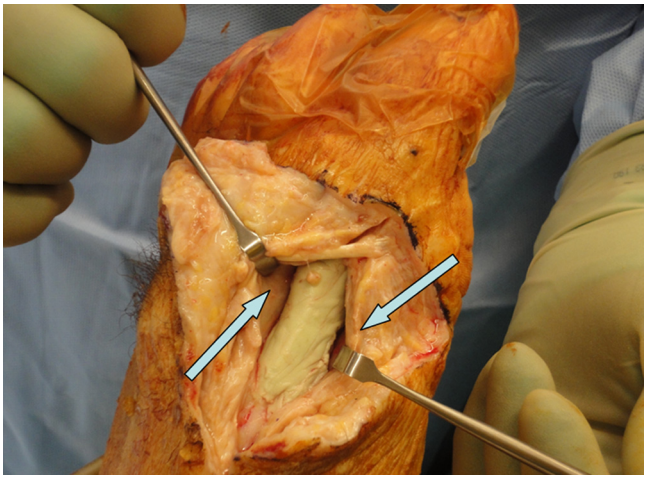

Fig. 2. Pseudo-synovial membrane (blue arrows) pulled apart by retractors revealing the cement spacer.

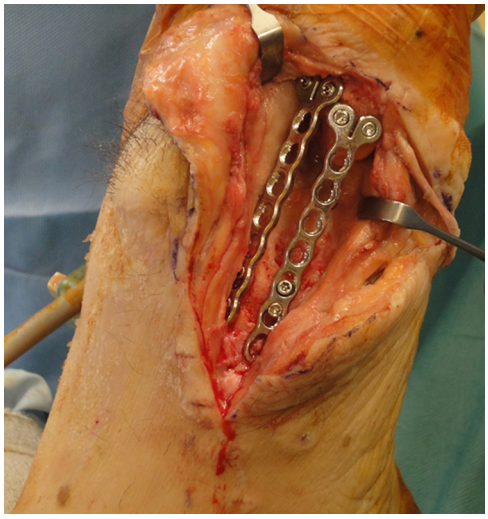

Fig. 3. Metal plates bridging the bone defect.

respectively; instability of the first MTP joint had caused residual pain to the patient and difficulties to wear shoes. At 14 months follow-up, clinical and radiological assessment of the foot revealed osseous healing and no signs of infection, osteolysis or hardware failure (Fig. 5). Four months later, the patient had no pain and returned to his usual daily activities. Soft-tissues wound had satisfactorily healed with no signs of infection (Fig. 6).

3. Discussion

Techniques for reconstructing extensive bone defects have evolved in an attempt to restore the length of diaphyseal bones and function of adjacent joints [19–21]. The free vascularized fibular autograft and distraction osteogenesis still remain the most common bone defect reconstruction methods. Despite their reported advantages (biological reconstruction and ability to restore the required bone length), they have been associated with several drawbacks. Donor site morbidity, technical difficulties, stiffness of adjacent joints, prolonged distraction time and pin-site

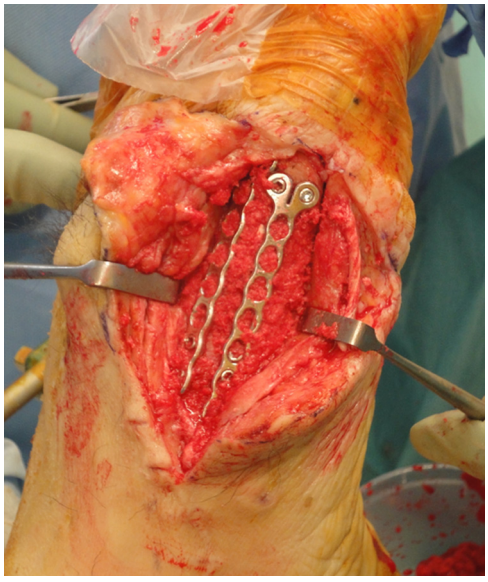

Fig. 4. The whole bone defect was filled with graft.