INTERNATIONAL JOURNAL OF ORTHOPLASTIC SURGERY

Cigna, E, et al. Metatarsal Bone Transposition as an Innovative and Alternative Salvage Procedure for Complex Foot Injuries: A Case Report. *International Journal of Orthoplastic Surgery.* 2018; 1(2), pp. 67–71. DOI: https://doi.org/10.29337/ijops.14

CASE REPORT

Metatarsal Bone Transposition as an Innovative and Alternative Salvage Procedure for Complex Foot Injuries: A Case Report

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Acute lower limb trauma can cause complex functional damage and lead to amputation as treatment of choice. Nevertheless, salvage surgery is recommended in order to restore the limb function. The preservation of a stable, sensitive and plantigrade foot provides better function than prosthesis. In this report we treated a complex foot injury after motorbike accident using a conservative reconstructive management, never described before. The patient reported several skin, muscle and bone defects, especially involving phalanges, second and third metatarsal bones. During the procedure the damaged III metatarsal bone was transferred to the fourth bone in the position of the lateral cuneiform and, at the end of the surgery, we maximized the plantar skin coverage to preserve the three points of weight bearing. An appropriate intravenous drug therapy and Negative pressure wound therapy promoted wound healing. A split thickness skin graft was necessary to cover the dorsal defect. An acceptable physiological gait was restored at 9 months follow up. This case may be useful for surgeons who are approaching combined procedures (plastic and orthopaedic) in these types of complex foot injuries.

Keywords: Case Report; Orthoplastic; Humans; Foot Injuries; Limb Savage; Metatarsal Bones

Introduction

Complex foot injuries, usually include open fractures or metatarsal bones loss, large soft tissue defects, with the risk of infection and osteomyelitis. That kind of injuries represent a clinical challenge and a difficult management for orthopaedics and plastic surgeons [1]. In fact, acute lower limbs trauma can cause complex functional damage associated with skin loss and soft tissue damage exposing tendons, joints, bones, nerves or vessels. This situation requires a multidisciplinary approach for an early coverage of these structures [2]. Amputation can represent in this case a treatment of choice but a salvage attempt to restore the limb function is likely recommended. A prompt thought can lead to an arthrodesis or amputation to solve the case [3]. However, the preservation of a stable, sensate, and plantigrade foot provides better function than prosthesis [4]. Therefore, the prosthesis needs a long learning curve to accurately walk and requires cognitive ability, training, balance and sense of equilibrium and affects the overall quality of life [5]. One of the major challenges in this scenario is take the right indication. The decision to perform a limb salvage procedure or an immediate amputation, is mainly based on the severity of the injury. Amputate a limb segment is a difficult decision, because is an irreversible procedure that can cause different problems such as functional loss, self-image issues and behavioural disorders decreasing the quality of life [6]. In recent years, thanks to the advancement in complex foot injuries management and surgical procedures, limb salvage has replaced amputation as the treatment of choice for severe limb trauma in many centres [7]. In an effort to diminish arthrodesis and amputation rates, foot reconstruction options have been developed. Most of them include multiple staged procedures that cause prolonged hospitalization with high risk of infection and functional impairment resulting often in poor outcomes [8]. Based on these aspects, we developed in our centre a strategy of foot trauma management that consider the foot salvage the primary treatment in this scenario [9]. The propose of this paper is to describe a reliable and innovative reconstructive procedure, for the management of large complex foot injuries. This article is based on SCARE guidelines [10].

Case

A 59–years-old Caucasian male was transferred by ambulance to the emergency department of our institution after a motorbike accident. He had a left forefoot high energy-crush injury. On admission, the overall condition of the patient was stable, and he was fully conscious. He

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had not relevant medical or surgical history and he was taking no medications and reported no medical allergies. At the first clinical inspection the foot had several skin lesions with large muscle and bone defects (**Figure 1**). In particular, the patient suffered fractures of all distal and proximal phalanges, then fractures of second and third metatarsal bones (**Figure 2**). The third metatarsal bone had multiple fractures. The skin of the forefoot was missing and a large plantar skin defect was present.

All toes were present with sub amputation at different levels, not perfused and with multiple comminute fractures. The patient received tetanus antitoxine and 2 g of intravenous cefazolin and was taken to the operating room for surgical management. The procedure was performed by a senior consultant. Under general anaesthesia and tourniquet, an accurate debridement of the damaged and unreliable tissues was performed. The whole necrotic tissues and foreign bodies were removed until healthy and viable tissue was visible. All toes were amputated. After the debridement, a dorsal skin defect was visible measuring 12 × 6 cm, as well as a plantar one of 3 × 6 cm. At this point, in order to preserve the plantar support of the limb, and guaranteed an adequate plantar skin coverage for weight bearing area, the third metatarsal bone, which was suffered multiple fractures was sacrificed. That kind of approach, allowed to immediately reconstruct the plantar portion of the foot, maintaining a sufficient broad and resistant surface for the support. The forth metatarsal bone was found intact and well vascularised by the dorsal metatarsal artery through the arcuate artery that appeared not injured. So, the bone including the vascular bundle was mobilized from the medial, intermediate and lateral cuneiform articulations and stabilized with a double K-Wire through the lateral cuneiform replacing the defect of the third metatarsal bone head. The remaining metatarsal bones, muscles and soft tissues were stabilized together. Following this method, it was possible to spare the residual plantar skin and fat pads and reposition the soft tissue maintaining a functional and vital surface for the support. Negative Pressure Wound Therapy (NPWT) was placed on the dorsal wound, (at 125 mmHg in a dynamic pressure cycle with 5 ml of 0,05 chlorine solution every 4 hours). A plaster was applied in resting position.

Antibiotics were administered after surgery according to our trauma protocol: amoxicillin-clavulanic acid 2,2 g two times. NPWT was changed every 3 days in surgical theatre under local anaesthesia with peripheral block to avoid contamination simultaneously to further wound

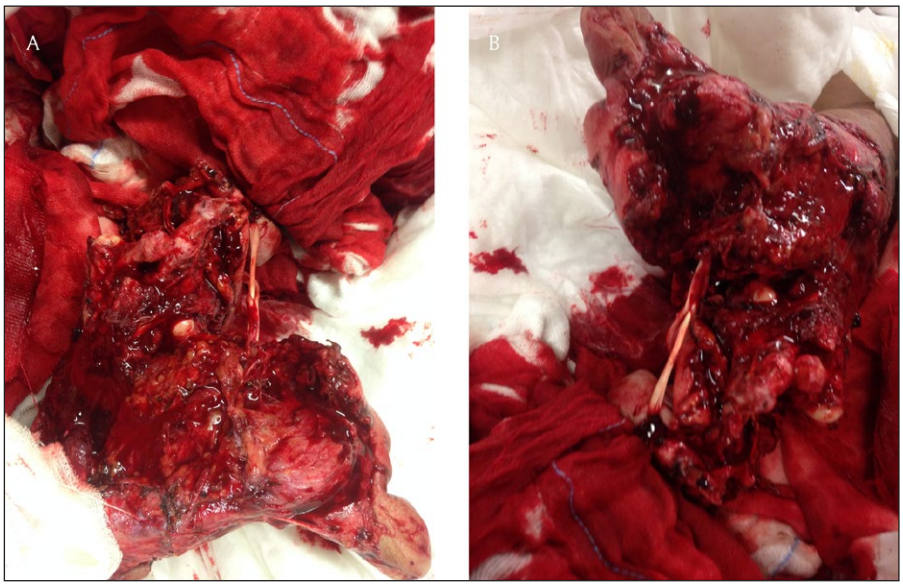

Figure 1: Patient on admission at emergency department.

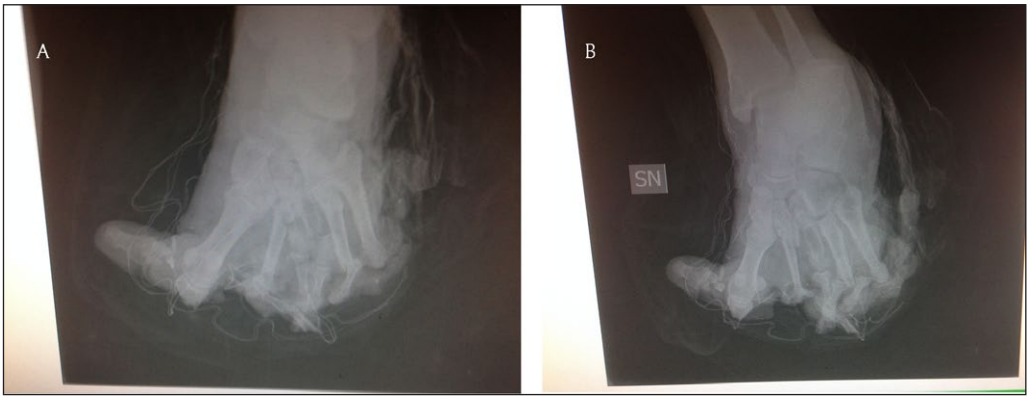

Figure 2: Patient's foot X-RAY on admission at emergency department.

debridement. After 14 days, when the plantar foot was completely healed and adequate granulation tissue was present, a split thickness skin graft with NPWT over it was applied [7]. The postoperative course was uneventful and the patient was discharged after 19 days of operation with completely healed dorsal skin graft. The splint was removed 11 days later and a physiotherapy program was started instructing patient to avoid full weight bearing and using crutches. The dorsal graft healed completely after 6 weeks. The foot brace was kept for 8 weeks and a full weight bearing started after 10 weeks. At 9 months follow-up, it was restored an almost physiological gait. Then, the patient attended the clinic at 12 and 18 months after surgery and overall foot function was evaluated. At the last follow up the full range of motion of the ankle, hindfoot, and forefoot was restored. Full weight bearing was achieved, and walking capacity was normal with no limp. No sign of infection, including osteitis and infection in or around the metalwork, was observed during the time following the surgery (**Figures 3** and **4**).

Discussion

Complex foot injuries, usually include open fractures and loss of metatarsal bones, associated with severe soft tissue defects with the risk of early infection and osteomyelitis, represent a clinical challenge [1]. Amputation can be considered a treatment of choice in numerous cases but represent an irreversible procedure with several sequelae impairing the mobility and quality of life of the patient. So, in our view, reconstructive options are always preferable. The surgical goal after medical optimization include establishing mobility and function to achieve an adequate medium- to long-term quality of life. Nowadays, several techniques are available for orthopaedic and plastic surgeon to avoid foot amputation. Furthermore, with development of surgical technologies and microsurgical procedures, it is more common to perform local, pedicled and free flaps even in difficult or emergency contexts [11–16]. Furthermore, the increasing collaboration between orthopaedic and plastic surgeons, developing a new discipline known as orthoplastic surgery, has contributed to offer a more integrated approach to solve difficult cases [17]. In our situation we have reported the possibility to perform a foot salvage after large complex foot defects with an innovative reconstructive method, in order to preserve the function of the foot.

Approaching this specific case, we followed the reconstructive ladder theory and considered mandatory to maximize the plantar skin salvage and preserve the three points of weigh bearing (I-V rays and the heel). With those assumptions in mind, we decided to spare most of the plantar skin. About that, the plantar skin structurally differs from other type of skin in the whole body. Then, it was sacrificed the III metatarsal bone that was already compromised and transferred the forth metatarsal bone into the lateral cuneiform. Appropriate medical therapy and the

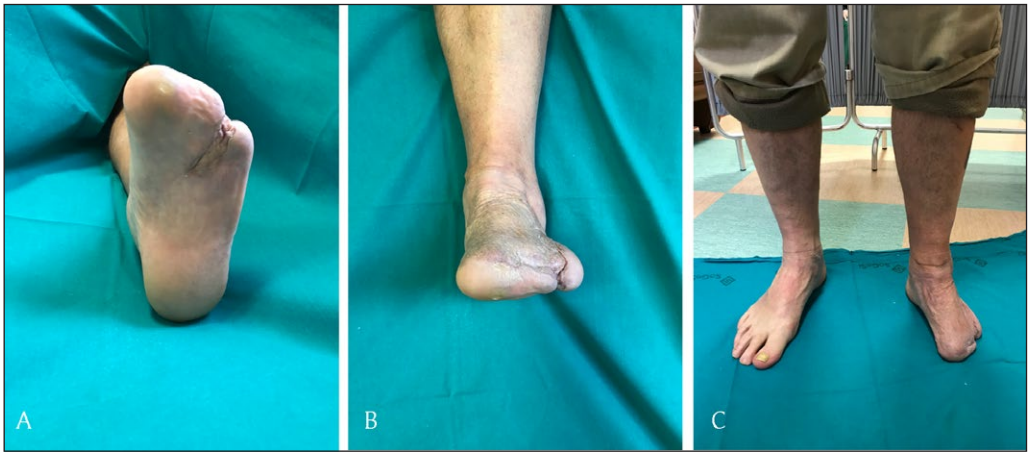

Figure 3: Patient at follow up 18 months postoperatively.

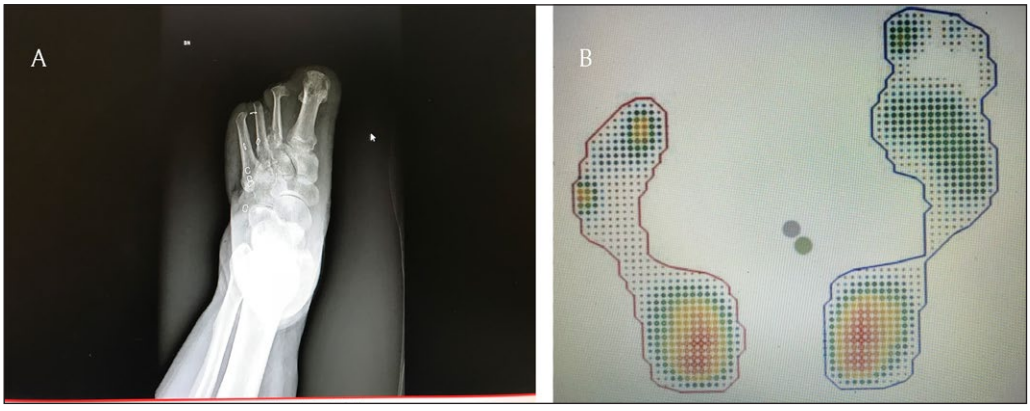

Figure 4: X-ray at 18 months post op.

use of NPWT allowed the surgeons to optimize surgical results. In our case, the reconstruction started at the same time of the surgical planning. An aggressive debridement was also performed during the same surgery to minimize the risk of infection. This has allowed to recover immediately the plantar function obtaining a thinner and strong and functional foot, keeping the plantar skin below the heads of the metatarsal bones. This approach can be considered for complex foot trauma when the involvement of the plantar region is not excessive and a functional support is guaranteed with the bone transposition. At 18 postoperative month the patient was able to walk and had no local complications.

Conclusion

In our experience, the decision to proceed with an aggressive debridement and immediate reconstruction, to spare and transfer the remaining vital tissues, was fundamental to achieve a successful foot salvage procedure. This case could be useful for surgeons who are approaching orthoplastic procedures, representing a possible scenario of complex foot reconstruction and a positive example of multidisciplinary healthcare team work.

Ethics and Consent

The patient give informed consent for publication of this case report.

Funding Statement

There was no funding received for this paper.

Competing Interest

The authors have no competing interests to declare.

Author Contibution

- Diego Ribuffo (Unit Chief)
- Emanuele Cigna and Enrico Cavalieri (Surgeons)
- Vittorio Quercia, Marco Marcasciano and Luca Codolini (paper writers)

Guarantor

Enrico Cavalieri is the guarantor.

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How to cite this article: Cigna, E, Cavalieri, E, Quercia, V, Marcasciano, M, Codolini, L and Ribuffo, D. Metatarsal Bone Transposition as an Innovative and Alternative Salvage Procedure for Complex Foot Injuries: A Case Report. *International Journal of Orthoplastic Surgery*. 2018; 1(2), pp. 67–71. DOI: https://doi.org/10.29337/ijops.14

Submitted: 13 April 2018 **Accepted:** 05 September 2018 **Published:** 10 October 2018

International Journal of Orthoplastic Surgery is a peer-reviewed open access journal published by IJS Publishing Group.

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