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Case Report

# Temporary Bridging of Severe Medial Column Injury of the Foot using Internal Fixation
# 使用內固定支架原理來為嚴重足部內側柱損傷作臨時橋接：病例報告

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ABSTRACT

Inadequate treatment of midfoot crush injury often leads to permanent disability. The principle of treatment is to restore foot column length and joint congruity while it is stable enough to allow an early rehabilitation. Choices of treatment include external fixation plus pinning, circular frame fixation, and open reduction plus internal fixation. External fixation is minimally invasive but it poses the threat of inaccurate reduction, loss of reduction secondary to pin loosening, and pin tract infections. Open reduction and internal fixation *per se* allows good reduction of fragments and restoration of joint congruities but it lacks the protection of the whole construct. We report a case of severe midfoot crush injury that was treated with temporary bridging fixation using a low-profile locking plate. It is an evolving technique that solves the problems of external fixation, and a stable construct can be achieved for early weight bearing.

中 文 摘 要

足部內側柱損傷如果治療不徹底，往往導致終身殘疾。治療的原則是恢復腳柱的長度和關節一致性，並且有足夠的穩定性讓病人早日進行康復治療。治療的選擇包括外固定支架和鋼針，圓框形支架固定，以及開放性復位和內固定。外固定支架雖然是微創，但它有復位不準確，因鋼針鬆動和感染造成的復位喪失等問題。開放性復位和內固定容許准確的復位和恢復關節一致性，但它缺少整個構建體的保護。我們報導一個嚴重足部內側柱損傷的病例，使用了低厚度的鎖定鋼板，作為臨時橋接固定。它是一個新發展的技術，解決了外固定支架的問題，同時提供穩定的結構讓讓病人可以提早作負重步行。

## Introduction

Midfoot crush injuries are uncommon foot and ankle trauma. However, inadequate treatment could lead to significant disability.[1,2] The midfoot can be conceptualised as the medial and lateral foot columns and the two pillars that connect the forefoot to the hindfoot. The medial column consists of the talus, tarsal navicular, the three cuneiforms, and the first, second, and third metatarsals. The lateral column comprises the cuboid and the fourth and fifth metatarsals. The tarsal navicular and the cuboid are the cornerstones of the medial and lateral columns, respectively.[3,4] We report a case of severe medial column injury of the midfoot that was successfully managed by the bridging plate technique.

## Case report

A 47-year-old man sustained a crush injury of his left foot when his motorbike was hit by a lorry from behind. On physical examination, his left foot was swollen and there was a bony prominence of the dorsum. No signs or symptoms of compartment syndrome were noted. There was no open wound and the circulation and sensation of the foot and toes were intact. There were no other associated injuries.

Plain radiographs of the foot showed a Myerson type C2 fracture/dislocation of the tarsometatarsal joints (Figure 1). The C2 type describes a “total displacement” in which not only the tarsometatarsal joints but also the intercuneiform and naviculocuneiform joints are involved.[5] There was also a Sangeorzan type 3 injury to the tarsal navicular fracture.[6] It was characterised by a comminuted fracture in the sagittal plane of the navicular body with lateral forefoot displacement.

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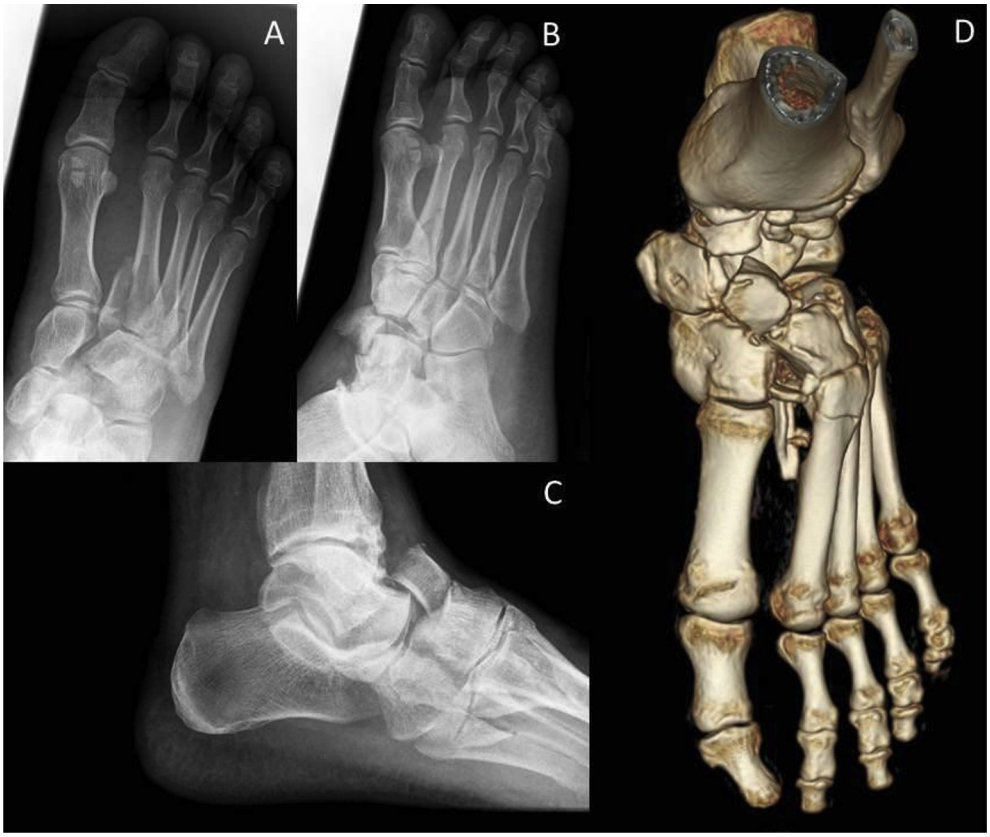


**Figure 1.** A Myerson type C2 injury of the tarsometatarsal joint. (A) Anteroposterior view. (B) Oblique view. (C) Lateral view. (D) Computed tomography with three-dimensional reconstruction.

Computed tomography of the injured foot together with image reconstruction showed similar findings. In view of severe midfoot injuries, operative reconstruction was performed.

The patient was placed in a supine position after general anaesthesia. A dorsal midline incision was made along the second ray, which was extended up to the talar neck. Dissection was performed with the neurovascular structures including the dorsalis paedis artery and the deep peroneal nerve safeguarded. The fixation started from proximal to distal. First, open reduction of the comminuted fracture of tarsal navicular was performed and it was fixed with two percutaneous 3.0-mm cannulated screws (Synthes Inc., USA). In this way, the talonavicular joint was reduced. Second, the intermediate cuneiform was reduced with the dorsal fragment of the proximal part of the second metatarsal bone *en bloc* and the three cuneiforms were transfix with one 3.5-mm cortex screw (Synthes Inc., USA). Third, the Lisfranc joint was reduced. The whole medial column was bridged by a 2.7-mm locking plate (Synthes Inc., USA) from the shaft of the second metatarsal bone to the talar neck. The fourth/fifth cuboidal joint was reduced and transfixed with two Kirschner wires via a separate incision (Figure 2).

The foot was protected with a plaster slab temporarily to improve wound swelling. The patient was advised to start touch-down walking once the swelling was subsided. Touch-down weight bearing was continued for 6 weeks followed by 6 weeks of partial weight bearing walking exercise. The patient was then allowed as much weight bearing as was tolerated with the pain. The bridging plate and K-wires were removed altogether at 12 weeks postoperatively, because it was more comfortable for the patient to have all implants removed in one surgery. Broken screws were found over the fixation points at the talar neck. The screw tips were not removed because they did not cause any impingement. The transfixing screws across the cuneiforms and the cannulated screws within the tarsal navicular were retained (Figure 3).

On his latest follow-up at 20 months after the operation, the patient had already returned to work as an indoor decorative worker although he reported weakness on single leg stance (Figure 4).

The latest radiographs revealed maintenance of the length and the arch of the medial column. There was evidence of midfoot arthritis over the talonavicular joint and the tarsometatarsal joints. Sclerosis of the tarsal navicular also suggested the process of osteonecrosis although the patient enjoyed a painless, stable, and plantigrade foot.

## Discussion

Medial column injury refers to a severe disruption of the pillar over the medial part of the midfoot that comprises Lisfranc fracture/dislocation, intercuneiform disruption, and fracture/dislocation of the talonavicular joint. The treatment algorithm includes: (1) reduction of the fracture and preservation of joint congruity, (2) maintenance of column length, (3) stable fixation that allows early mobilisation plus weight bearing, and (4) preservation of the talonavicular and calcaneocuboidal joints that allows a supple foot for supination and pronation.[3]

There are a number of treatment choices. If the injury was associated with significant soft tissue damage, external fixation plus percutaneous Kirschner wire fixation provides a minimal invasive method to stabilise the medial column while the length is maintained.[7] However, problems like pin tract infections, loosening

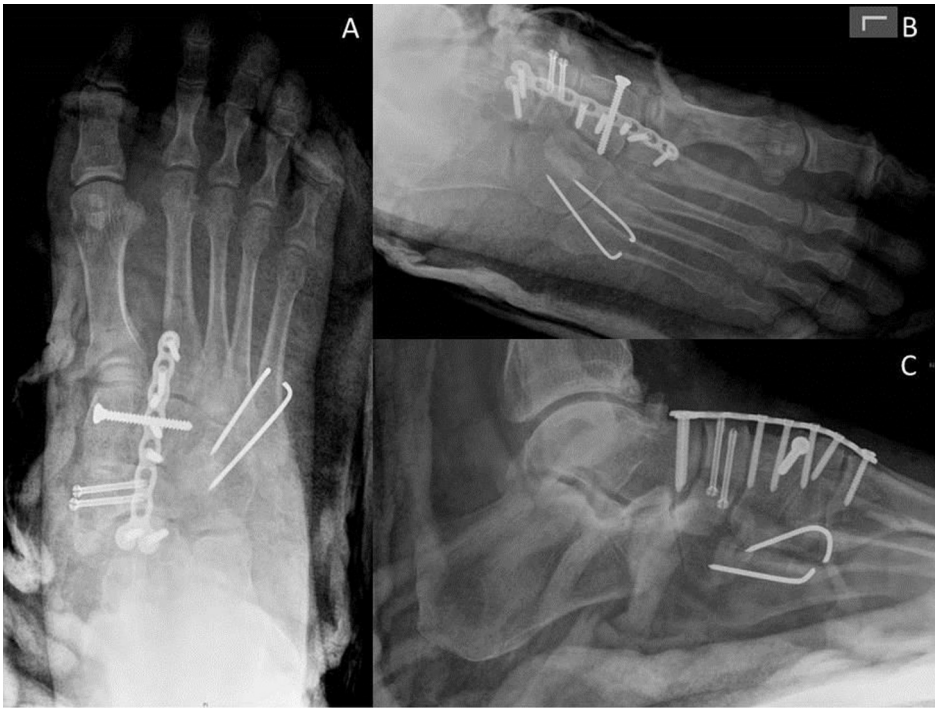


**Figure 2.** Immediate postoperative radiographs. (A) Anteroposterior view. (B) Oblique view. (C) Lateral view.

and migration of pins, and interference of activity of daily living by the cumbersome external construct can arise. Another similar method that is available is the circular frame construct, for example, an Ilizarov external fixator or a Taylor Spatial Frame (Smith & Nephew), which are commonly used for reconstruction of foot and ankle pathologies in Charcot's neuropathy.[8]

However, if closed reduction is not successful, the mainstay of treatment of severe midfoot injury is still open reduction and internal fixation. Frink et al[9] concluded that poor results are related to initial unsatisfactory restoration of anatomic conditions and they suggested a more aggressive approach, that is, open reduction and internal fixation during the early clinical stage in all complex midfoot fractures. Primary arthrodesis is another treatment option, although it is more preferable in cases where reconstruction of the joint surface is not possible. It was also suggested that primary arthrodesis of ligamentous Lisfranc injury would yield a better


**Figure 3.** Radiographs of the patient at the latest follow-up at 20 months with the bridged plate removed. (A) Anteroposterior view. (B) Oblique view. (C) Lateral view.

**Figure 4.** Clinical photos showed a plantigrade foot with restoration of dorsi- and plantar-flexion.

short-term outcome.[10] If we did opt for primary arthrodesis in this patient, another question raised was whether we should also fuse the talonavicular and Chopart joints. There is no definite answer at the moment.

Internal fixation using the bridging plate technique is an emergent treatment option. Internalisation of the implant minimises the risk of infection. A newer implant such as the locking plate that was used in our case is an excellent example of an "internal ex-fix".[11] In cases where the first tarsometatarsal joint is disrupted, the bridging plate could be placed over the medial side of the medial column, where we can put in a 3.5-mm locking plate. In our case, because the first tarsometatarsal joint was intact, we preferred to place the plate directly over the second ray as illustrated.[3] We have chosen a 2.7-mm low-profile locking plate because a 3.5-mm locking plate would be too proud. The drawback of using an internalised bridging plate is the need for implant removal at the second stage and screw breakage is fairly common. We intended to remove the locking plate before allowing the patient to start partial weight-bearing walking. However, we expected there might be delayed healing of the comminuted fractured navicular so we delayed the time for plate removal and we allowed the patient to start partial weight bearing before the plate was removed. Placing the plate over the second ray also posed the problem of interference of implant removal by the neurovascular structures. Thus, extra caution is needed during the dissection process.

In conclusion, the temporary column bridging technique using locking technology provides satisfactory stabilisation after reconstruction of an acute medial column disruption.

## Conflicts of interest

The authors declare that they have no financial or non-financial conflicts of interest related to the subject matter or materials discussed in the manuscript.

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