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Case Report

Ilizarov frame delayed internal fixation of Lisfranc fracture dislocation with severe soft tissue injury: New technique☆

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ABSTRACT

We describe a new technique of temporary stabilisation of a divergent Lisfranc fracture dislocation of foot with severe crush injury using an Ilizarov frame. A 69-year-old man presented with severe crush injury and complete disruption of the midfoot. Examination revealed full thickness skin necrosis, haemorrhagic blisters and extensive swelling. A staged technique was used with temporary application of an Ilizarov frame followed by delayed limited internal fixation. Excellent result was achieved with restoration of medial arch, complete pain relief and good functional outcome. A staged treatment initially using an Ilizarov frame prior to limited internal fixation allows soft tissue to settle in severe crush injury.

Introduction

Injuries through tarsometatarsal are described as Lisfranc injuries after Jacques Lisfranc, a French Napoleonic field surgeon who described forefoot amputation. Lisfranc injuries account for 0.2% of all fractures with an incidence of 1/55,000 cases per year [1]. Lisfranc injury results in disruption of the transverse arch of the midfoot as a result of either a pure bony/ligamentous injury or a combination of both. Associated injuries include fracture of metatarsals, cuneiform, navicular and cuboid.

Open fractures are associated with high energy trauma [2] while low energy injuries can be missed with long term consequence of pain and disability [3]. MRI and CT scans can diagnose occult Lisfranc injuries in cases of negative plain radiographs [4]. A most commonly used classification system is a modification of Myerson et al. [5,6]. The injuries are grouped into Type A (total congruity), Type B (partial incongruity) and

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Type C (divergent). Percutaneous and open reduction methods have been used. K wires, screws, plates, tight-rope and external fixator have been described in the literature to stabilise the fracture dislocation [1,2,7–17].

We present a case report on a staged treatment of a crush injury with Lisfranc fracture dislocation. A 69 year old gentleman presented with crushed foot with extensive soft tissue injury. A staged approach, with initial application of ring fixator was implemented to allow soft tissue to settle. This was followed by limited internal fixation with excellent results.

Case report

A 69 year old gentleman presented with severe crush injury to the left foot when a heritage tractor accidentally ran over his foot. On admission he had extensive soft tissue swelling, haemorrhagic blisters and full thickness skin necrosis (Photograph 1). The dorsal soft tissue was at risk of breakdown and necrosis due to pressure from underlying dislocated tarso-metatarsal joints. Clinically the medial arch was lost and forefoot was abducted. The foot was perfused with no sensory deficit. There was no evidence of compartment syndrome. Radiographs revealed a fracture through base of second metatarsal and fifth metatarsal and a divergent Myerson type C Lisfranc fracture dislocation(Figs. 1 and 2). Tarso-metatarsal joints were dislocated dorsally. Initial reduction and below knee cast under sedation failed.

We used a staged treatment in managing this difficult case. We initially applied an Ilizarov frame across the foot for the soft tissue to settle down. The frame held the TMT joint reduced allowing the soft tissue to settle. Limited open reduction and internal fixation was carried out as a delayed procedure. A simple frame assembly was used with one 155 mm 5/8 stainless steel ring around the calcaneum. Fixation was achieved using 2 half pins and 2 olive wires while the hind foot is held in plantigrade position. Two half carbon fibre 155 mm rings were assembled on short hexagonal posts to form an arch over the forefoot. 3 Forefoot olive wires were applied, 2 from the medial and 1 from the lateral side. The wire placement was in the distal aspect of metatarsal taking into account to avoid close proximity to future internal fixation. The metatarsals were held reduced while passing the olive wires and wires tensioned. The olive wires achieved fixation across all metatarsals and provided stability(Fig. 3). The forefoot and calcaneal rings were connected using threaded rods and hindges(Photograph 2). TMT joints were reduced and hindges were locked to maintain reduction.

Once soft tissue swelling has improved, a limited open reduction was performed. The frame was removed. Due to full thickness skin necrosis only a dorso-medial incision was used. Using the dorso-medial incision first and second TMT joints were exposed. Second metatarsal was reduced using reduction clamp applied across the medial cuneiform and second metatarsal. A 4 mm cannulated screw was applied across medial cuneiform/second metatarsal. The first TMT joint was temporarily held reduced using a K wire. The first TMT was stabilised using a locking plate. Through a percutaneous approach, a 4 mm cannulated screw was applied

Photograph 1. Illustrates the extent of soft tissue injury.

Fig. 1. Lateral radiograph at presentation.

across the reduced third TMT joint. The 4th and 5th TMT joints were stabilised using K wires (Fig. 4 and 5). Reduction and fixation were confirmed both clinically and radiologically.

Postoperatively the patient was treated using a below knee cast for 8 weeks and K wires were removed on the 8th week. There was no wound complications and full thickness skin necrosis has healed well. Limited weight bearing was allowed in a Walker Boot until the removal of the metal work at 5–6 months. Medial arch orthotic support was provided after the removal of the metal work to maintain the arch. At 1 year follow up the patient was fully weight bearing, pain-free and back to his normal activities. The medial arch was well maintained and AOFAS score was 92.

Fig. 2. Anteroposter radiograph at presentation.

Fig. 3. Illustrates well reduced TMT joints and forefoot.

Discussion

Lisfranc fracture dislocation describes a range of injuries from occult fractures/ligament injuries to open crush injuries with extensive bone/soft tissue damage. Anatomic realignment, stabilisation and soft tissue coverage are the key principles in managing Lisfranc injuries [2]. There is no general consensus with regard to the best method of fixation. But current trend is towards treating this injury with open anatomical reduction and internal fixation [11,15]. This improves function while restoring normal anatomy and also reduces the risk of developing traumatic arthritis. A strong correlation has been described by Adib et al. between anatomic reduction and the onset of osteoarthritis. 35% developed osteoarthritis in the anatomical reduction

Photograph 2. Ilizarov foot frame with forefoot and calcaneal rings.

Fig. 4. AP radiograph of foot with ORIF.

group compared to 80% in the non-anatomical reduction group. This is not supported by other studies [5,18,19]. One needs to be aware of the impact of joint/cartilage damage at the time of initial trauma.

Due to high incidence of arthritis some advocate primary fusion as the treatment of choice. Sheibani et al. [1] has systematically reviewed the literature comparing fusion versus ORIF. Fusion group had better AOFAS scores and lower reoperation rate compared to ORIF group. Systematic review by Stavlas et al. [11] reviewed fixation methods, complications and functional outcomes in 257 cases. The preferred method of treatment was open reduction and fixation using screws for the medial and middle column and K wires for the lateral

Fig. 5. Oblique radiograph of ORIF.

column. A disadvantage of screw fixation is the additional damage to articular cartilage. Plate fixation is a viable option but does involve furthur soft tissue dissection and difficulties with wound closure.

In the presence of severe crush injury, immediate open reduction and internal fixation can furthur compromise the soft tissue with high risk of wound breakdown and infection. Alternative fixation methods using a K wire across the tarsometatarsal joints does not provide adequate stability. Deformity, nonanatomical reduction and osteomyelitis have been described by Manasseh et al. [20]. Conversion to delayed screws or plate fixation after K wires does carry a risk of deep infection.

Chandran et al. [2] applied uniplanar external fixator and K wires on complex midfoot injuries including Lisfranc injuries. 10 patients were studied and the frame was removed at an average time of 9 weeks. 7 patients had foot deformity and 4 fractures malunited. Zgonis et al. [18] described the technique of Ilizarov frame in stabilising or fusing the Lisfranc injuries. Additional screw was applied across the Lisfranc joint. Ilizarov frame assembly involved 2 tibial rings and a foot ring. Oliver wires were applied across cuneiforms and metatarsal to aid reduction. In the case of primary fusion compression was achieved with bending wires.

We describe a unique technique of staged treatment of severe crush injury with Lisfranc fracture dislocation. Considering the extent of soft tissue injury immediate open reduction and internal fixation was deemed to carry a high risk of skin/wound breakdown and necrosis. As the initial treatment, a simple Ilizarov frame was applied across the midfoot with fixation in the calcaneum and metatarsals for soft tissue to settle. Pin site placement was well away from incision site for late open reduction and internal fixation.

Soft tissues settled with elevation and rest. Due to full thickness skin necrosis over the dorsum of foot limited open reduction was performed. Through a dorsomedial incision second metatarsal was reduced and held with a cannulated screw. First TMT joint was reduced and stabilised with a plate. Third TMT joint was reduced closed and stabilised with a percutaneously applied cannulated screw. Lateral column was stabilised with K wires. We were able to achieve anatomical reduction and stabilisation safely without compromising soft tissues. There was no deep infection and soft tissue healed well. This staged technique provided a solution to a difficult problem resulting in good function, pain relief and restoration of normal anatomy.

There is a cost implication with frame surgery. Implant cost for the frame in this case was £571.00. However this is only a fraction of the cost if one were to compare to debridement procedure and free flap surgery. The treatment cost of free flap surgery in lower limb has been estimated to be between £10953–£12792. The other drawback is the skill required to apply the frame. Only selected centres have access to frames and orthopaedic surgeons trained in frame surgery.

Conflict of interest

There is no conflict of interest with this article publication.

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