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To fuse or not to fuse the Lis Franc Joint? The rationale

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Abstract

Introduction: The term “Lisfranc injury” commonly describes injuries which occur at the bases of the five metatarsals, their articulations with the distal four tarsal bones, and the Lisfranc ligament. The injury is rare and accounts for 0.2% of all fractures with up to 20% of injuries being missed in the acute setting. The treatment of these injuries has been the subject of much debate over the years. Primary arthrodesis has increased as a treatment option for acute injuries in the recent literature.

Case Report: A 25-year-old female with Type 1 diabetes mellitus presented with a two-week history of a swollen right foot after falling while descending a flight of stairs. Radiographic imaging revealed a partial incongruity of her right Lis franc joint with a comminuted fracture of the second tarsometatarsal joint. She underwent a primary arthrodesis of the Lis Franc joint with no functional impairment or midfoot deformity progression at one year follow up.

Conclusion: This construct has shown to better withstand the abnormal biomechanical forces which are placed on the midfoot during ambulation in patients with peripheral neuropathy such as diabetics. The case presented highlights the benefits of this treatment modality in the young, diabetic patient.

Keywords: Lis Franc injury, midfoot arthrodesis

Introduction

The term “Lisfranc injury” was coined after a French surgeon, Jacques Lisfranc who served in Napoleon’s army and described an amputation involving the tarsometatarsal joint ^[1]. The term commonly describes injuries which occur at the bases of the five metatarsals, their articulations with the distal four tarsal bones, and the Lisfranc ligament. The Lisfranc ligament refers to the strong interosseous attachment located between the medial cuneiform and the second metatarsal. The injury is rare and involves ligamentous or bony or a combination of both. It accounts for 0.2% of all fractures with an incidence on 1 in 55,000 per year with up to 20% of these injuries being missed on early presentation ^[2]. The case described is that of an obese, diabetic patient who was treated with a primary arthrodesis after sustaining a Lis Franc injury. The benefits of a primary arthrodesis versus open reduction internal fixation are highlighted in this report.

Case

Ms. K.L., a 25-year-old female with Type 1 diabetes mellitus presented with a two week history of a swollen right foot after falling while descending a flight of stairs. On presentation, she was partially weight bearing and had a weight of 75 kgs with a height of 1.55m giving a body mass index (BMI) of 31.2 kg/m². Examination of her both lower limbs demonstrated findings consistent with diabetic peripheral neuropathy. There was no evidence of features of peripheral vascular disease and her pulses were palpable bilaterally. Radiograph findings revealed a partial incongruity of her right lis franc joint with a comminuted fracture of the second tarsometatarsal joint. (Figure 1)

She was initially found to have a glycosylated haemoglobin of 9.5%. Glycemic control was ensured preoperatively and prior to discharge post operation. The presence of lower limb peripheral neuropathy, an increased BMI and poor glycemic control resulted in a decision to perform a primary arthrodesis in preference to the conventional open reduction and internal fixation (ORIF). A longitudinal incision was made dorsally in the first intermetatarsal space. The first and second tarsometatarsal joints were exposed and the articular surface of the base of first and second metatarsal together with the medial and intermediate cuneiforms were denuded. The joints were subsequently reduced and temporarily held with kirschner wires while fixation with a quad plate was performed.(Figure 2) She was then treated in a below knee cast for two months. After removal she started weight bearing in a fracture walker for a further two months. At six months she was fully weight bearing in standard shoes. At one year post surgery she reported no impairment of her daily activities and clinically had no evidence of subsequent pes planus or midfoot deformity.



Fig 1: Radiograph showing partially incongruent lis franc injury



Fig 2: Post Operative radiograph of primary arthrodesis with a quad plate

Discussion

Approximately one third of Lisfranc injuries are attributed to low energy trauma with the rest being linked to incidents involving high energy trauma. The mechanism of injury can be either direct or indirect. Direct injuries occur secondary to crush injuries to the dorsum of the foot. Indirect injuries are related to a plantarflexed, stationary foot undergoing an axial and/or rotational force. The unique relationship of the osseous and ligamentous structure of the tarsometatarsal complex is essential for the maintenance of the transverse and longitudinal arch of the foot. Lisfranc injuries result in a disruption of this complex with compromise to the arches. The first three metatarsals articulate with the medial,

intermediate and lateral cuneiforms respectively with the second metatarsal and middle cuneiform articulation being recessed in the coronal plane. This creates a 'Roman arch' configuration of the transverse arch with the second tarsometatarsal joint acting as the keystone. The ligamentous structure of the tarsometatarsal joint complex comprises; the transverse intermetatarsal ligaments which stabilises the bases of the second through the fifth metatarsals and a series of dorsal, interosseous, and plantar oblique ligaments. These structures help to maintain the mortise relationship formed by the interaction of the medial cuneiform and the recessed second metatarsal. The interosseous ligament of the second metatarsal-medial cuneiform articulation is the strongest restraint of this complex and is referred to as the Lisfranc ligament. The rigid construct created by the osseous and ligamentous structures of the first three tarsometatarsal joints results in limited joint mobility. The cuboid articulates with the lateral fourth and fifth metatarsals creating a more flexible construct which helps the foot to adapt when it encounters uneven surfaces.

The treatment of these injuries has been the subject of much debate over the years. Myerson *et al.* 1986^[3] stated that there is no role for non-surgical management of fractures or fracture-dislocations of the Lisfranc joint. Most authors although in agreement with the necessity for surgical intervention cannot agree on a recommended fixation technique. A variety of fixation techniques have been described ranging from closed reduction with percutaneous pinning to ORIF to arthrodesis. Despite the choice of fixation, it is agreed that the achievement of a good anatomic reduction is paramount to achieving a good functional outcome. The current literature has been leaning towards open reduction and internal fixation as the primary treatment^[4]. However, strong considerations have been given to primary arthrodesis in acute injuries in the more recent literature^[4]. Previously arthrodesis was considered a salvage procedure for patients who had failed ORIF or for late treatment^[5].

Primary arthrodesis should be considered for the treatment of multidirectional instability and major ligamentous disruptions, comminuted intra-articular fractures involving the bases of the first or second metatarsal, as well as crush injuries of the midfoot with an intra-articular fracture dislocation. Adib *et al.* found that the anatomic reduction had a strong relationship to the development of osteoarthritis^[6]. They reported that 35% of their anatomically reduced patients developed osteoarthritis compared to 80% in the non-anatomically reduced subset^[6]. Researchers have suggested that there would be a higher incidence of arthritis in patients with unstable injuries despite the best anatomic reduction^[7]. It is believed that the inherent stability of the Lisfranc joints depends on the scar tissue which forms following open reduction and internal fixation. This scar tissue however, is not strong enough to support the injured joint and it has been found that the associated ligaments do not heal after fixation. This results in instability of the joint on weight bearing leading to the development of arthritis with chronic pain and foot deformity.

Cadaveric studies have demonstrated that limited motion is present at the first, second, and third tarsometatarsal joints in comparison to the naviculocuneiform joint which is more mobile^[8]. Therefore, a primary arthrodesis of these

tarsometatarsal joints will be able to achieve the same function of an ORIF without the risk of post-operative arthritic changes. The lateral column is not incorporated in the arthrodesis to maintain its high mobility which contributes to the flexibility of the foot.

Lis Franc injuries in the diabetic patient requires special consideration when deciding on its treatment. Importance must be given to differentiating whether the injury is an acute neuropathic fracture or an acute fracture in patients with diabetic peripheral neuropathy. Ms. K. L. had a reported a mechanism of injury in keeping with the occurrence of these injuries and was deemed to have an acute fracture. Acute injuries in the diabetic patient can be treated with the same indications and techniques for ORIF as in the non-diabetic patient. The treatment of choice is stable rigid internal fixation. The treatment of choice in was a primary arthrodesis which allowed the achievement and maintenance of a stable rigid fixation. This construct can better withstand the abnormal biomechanical forces which are placed on the midfoot during ambulation in patients with peripheral neuropathy^[9]. However, individuals with acute neuropathic fractures which are associated with early demineralization and soft tissue inflammation are considered poor candidates for surgical treatment. These patients should be treated conservatively.

A good functional outcome has been found in patients treated with primary arthrodesis with some reporting as high as 90% of patients returning to their pre-operative level of function^[4]. The return to sporting activity after primary arthrodesis is still a highly debated topic. Myerson *et al.* 1986^[3] believe that the return to sporting activities requires the maintenance of the limited motion of the second and third tarsometatarsal joints with the retention of mobility at the first tarsometatarsal joint to ensure full function of the foot. However, it has been shown that patients were able to return to their previous physical activities despite undergoing a primary arthrodesis^[10]. The level of sporting participation when compared to their pre-injury level was found to be the same or improved in 75%^[10].

Conclusion

The use of primary arthrodesis for the treatment of acute Lisfranc injuries is relatively new to this institution. However, the experience with this case was in keeping with the success rate demonstrated in the published literature. Although the dissection is indeed more extensive for an arthrodesis we did not experience any soft tissue complications in our patient who had significant preoperative risk factors for post-operative wound complications. Her clinical outcome at one year despite her diabetes mellitus associated neuropathy and previous experience with ORIF in the diabetic population has led us to explore this treatment option as our treatment of choice in this subset of patients.

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