Injuries of the Lisfranc joint

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Injuries of the Lisfranc’s joint are not so common, but in most of cases they are misdiagnosed. This have been changed by better diagnostic procedures, CT scan and MRI in some of the cases. The number of patients increases and this is of importance, due to the mentioned overlooked cases. The surgical treatment is preferable, either within few days or postponed for 7-10 days in aim to oedema subside. Intraoperative fluoroscopy is mandatory and stable fixation is better for the first three metatarsal bones, while the lateral two MT bones could be stabilized by Kirschner wires. Prolonged nonweight bearing is prescribed as well as physical therapy if one should obtain favorable outcome.

Key words: Lisfranc joint injury, treatment, surgery

INTRODUCTION

Lisfranc gave his name to fractures and dislocations of the tarsometatarsal joints (TMTJ), as well as to the Lisfranc ligament, and Lisfranc amputations at the TMTJ level. Lisfranc injuries were reputedly first described in 1840 by Jacques Lisfranc de St. Martin (1790-1847), a French gynecologist and surgeon to Napoleon³⁴, who also performed these amputations. Classically, the cause of these injuries were falls of horsemen from their horses while their feet were still fixed to the stirrups; oedema and ischemia ensued, and amputation followed.

Nowadays, Lisfranc injuries more commonly occur as a result of traffic accidents, falls from a height, and sports activities¹. These injuries occur equally from both direct and indirect trauma²⁴. Direct high-energy injuries often result in open fractures and are more frequently associated with compartment syndrome and ischemia³ from secondary damage to the communicating vessels between the plantar arch and the dorsal arcuate arteries. 69% of high energy injuries have other associated injuries and 32% have concomitant foot and ankle fractures. Vascular injuries occur in up to 13%, while compartment syndrome occurs in 4-7% of crush injuries.

Lisfranc injuries account for 0.2% of all fractures, however they have seen recent increases in their incidence by around 70% (in the study of Vuori 1993), thought to be because of modern life-styles and probably also because of improved diagnostic modalities. Nevertheless the number of undiagnosed cases remains high, and are estimated to be as high as 20-39%.²

Biomechanically, the main function of the midfoot (and the Lisfranc joints) is during the "stance" phase of gait, at the end of which it becomes rigid and locks the foot to aid push-off/toe-off. While most forefoot fractures generally have favorable outcomes, Lisfranc fractures result in dysfunction of the TMTJs, which often result in a stiff and painful foot. If these injuries are overlooked, the outcomes are usually poor, and timely fracture reduction is vital in order to obtain acceptable clinical results.

The TMT joints are created where the metatarsals bones (MT) join their corresponding cuneiforms¹²³ and cuboid⁴ bone. They are fixed together by ligaments, and have a joint capsule. Together they form an osseous geometry resembling a Roman arch. The bones are wider dorsally than in the planar plane which makes them stable and supportive of the medial arch of the midfoot. In the frontal plane, this arch is higher medially and lower laterally; with its apex at the second metatarsal.¹ The second MT is longest and sits between the medial and the lateral cuneiform bones. The 2rd and 3rd TMTJs are effectively immobile, while the 4th and the 5th are quite mobile. Longitudinal ligaments connect the TMTJs, while transverse interosseous ligaments connect the intermetatarsal and the intercuneiform bones. The plantar tarsometatarsal interosseous ligaments are stronger that the dorsal ligaments¹³; and are in turn also reinforced by the plantar fascia, the peroneus longus tendon, and the tendons and insertions of the tibialis anterior and tibialis posterior, and the intrinsic muscles.
One should note that there is no intermetatarsal ligament between the first and second MTs, leaving them vulnerable and prone to divergence. The only ligament between the medial cuneiform and the second MT is the Lisfranc ligament, which connects the medial and the middle columns of the foot.

**CLASSIFICATION**

Quenu and Kuss first classified these fractures based on radiographic findings and on the direction of the metatarsal displacement; homolateral, isolated and divergent. Hardcastle modified the classification into 3 groups, total, partial, and divergent patterns (A,B,C), and Myerson relabeled these further to include subgroups of B and C; these are helpful for both the planning of treatment and prognosis

- Type A - Total incongruity - entire dislocation of the TMTs as a single unit, displacing in the sagittal or coronal planes or both.
- Type B - Partial incongruity - either isolated 1st MT medial displacement, or lateral displacement affecting combinations of the 2nd-5th MTs, (but not the first metatarsal).
- Type C - Divergent: whereby the first MT is displaced medially with combinations of the other four metatarsals displaced laterally.

Nunley added TMTJ sprains: where Stage 1 TMTJ sprains are non-displaced, while Stage 2 and 3 (ligament ruptures) are visibly displaced on x-ray.

**DIAGNOSIS**

Given the high levels of missed diagnoses, one should be all the more vigilant. Clinically soft-tissue oedema/tissue swelling, pain, and bruising are usually present. The great toe can be angled dorsally – the “toe-up” sign. AP, lateral and oblique view x-rays should be taken. X-rays can frequently appear normal, and when one is suspicious of the injury then stress x-rays should be performed under anaesthesia; manipulating/distracting the 1st and 2nd metatarsals dorsally and plantarly.

Many surgeons now use CT as a standard basic diagnostic tool. CT has the advantage of being rapid and can identify minor fractures, associated cuneiform and cuboid injuries and the presence of Fleck signs (indicating Lisfranc ligament and other ligament injuries). MRI too can be useful in identifying subtle and ligamentous injuries, though is not currently a routine diagnostic modality.

Differential diagnoses include tendon ruptures (particularly tibialis anterior and posterior), ankle sprains, compartment syndrome of the foot.

**TREATMENT**

Most authors would agree that operative treatment is preferable, and conservative management typically has worse outcomes. Treatment through closed reduction and plaster cast immobilization is frequently associated with fracture re-displacement once the soft-tissue swelling subsides, and only one article describes good long-term function at 15 years in severe Lisfranc injuries managed in this way.

Only undisplaced Lisfranc injuries should be treated non-operatively, whereby if there is no sign of a fracture/fracture displacement or clinical instability, then immobilization in a non-weight bearing cast is recom-
mended for 2-3 weeks, followed by a weight bearing cast for 2 further weeks if there is no pain at the injury site. With any ongoing pain patients should be immobilized for a minimum 6 weeks. If there is any clinical instability however, then surgery is recommended.

Most authors prefer operative treatment, stating better results after surgery. The literature reports that good results can be obtained in 17% of those managed nonoperatively compared with 85% in those operated. One should bear in mind however that post-traumatic arthritis is common, affecting 15% of all cases, and there are reports that no patients achieve a normal gait.

Clear indications for surgery include open injuries, large/very displaced fracture dislocations and compartment syndrome. Surgery is contraindicated in patients with neuropathies and severe peripheral vascular disease.

Surgery is best carried out within 24 hours, or after 7-10 days to allow the soft-tissue oedema to subside. After 6 weeks, there are irreversible changes in the joint. Only one author reported surgical treatment after one year. Salvage TMTJ arthrodesis is recommended after one year.

Surgical options include open/closed reduction and percutaneous stabilization with Kirschner wires, cannulated screws/screws, plate fixation devices (Figure 1 and Figure 2).

or through primary joint arthrodesis. In cases with lateral column collapse, comminution of the cuboid or gross soft tissue damage, external fixators are used; one can also manage these through distraction and bone grafting using H-plates.

Kirschner wires (non-rigid fixation) have high rates of loosening and breakage and (pin tract) infection, particularly after 4 months. Screws can be difficult to position, though 4.0 and 4.5mm cannulated screws under X-ray control are a little easier. Open reductions are performed through single curved or double incisions (between the 1st-2nd MTs and over the 4th MT bone).

When stabilising Lisfranc injuries the treatment stages tend to follow a typical order: fracture reduction, temporary K-wire stabilization, then definitive fixation (Scheme and case 1, and 2):

1. Firstly one stabilizes the medial column with K-wires. Next one internally fixes it with screws, bioabsorbable screws or plates. Screws can be cannulated using the same K-wires.

2. The 1st MT can be fixed to the medial cuneiform, the 2nd MT to the middle cuneiform, and medial and the middle cuneiforms to one another.

3. The 3rd MT can be fixed to the lateral cuneiform. Short-term lateral stabilization of the 4th and 5th MTs to the cuboid is achieved with K-wires SCHEME 2.

4. Where there is comminution of the lateral column or cuboid bone, adjunctive bone grafting and external fixation is performed (SCHEME 3).

Postoperatively a plaster cast is worn for 6-12 weeks. The patient is non-weight bearing for 6 weeks. Where there is stable and rigid internal fixation a plaster cast is worn for 2 weeks (to allow wound healing) and then physical therapy and early mobilization of the foot and ankle follows, with protected weight-bearing for 4-6 weeks. K-wires are removed after 6-8 weeks.
Internal fixation hardware is generally retained (though some authors recommend removal of metalwork)\textsuperscript{20,21}.

Acute complications include vascular injury, compartment syndrome, skin/tissue necrosis; while late complications include osteoarthrosis, chronic pain and foot deformities (pes cavus, pes planovalgus). Even after satisfactory fracture reductions post-traumatic arthritis occurs in 15\% of cases after a mean of 1.3 years following the injury\textsuperscript{22}. When painful these are usually treated through arthrodesis/fusion, though the 4\textsuperscript{th} and 5\textsuperscript{th} MTs either undergo resection or interposition arthroplasty rather than fusion to the cuboid\textsuperscript{23}. Where deformity is present this too is usually corrected through bone grafting and fusion surgery. These typically take 9-12 months to fully heal.

\textbf{SUMMARY}

\textit{POVREDE LISFRANKOVOG ZGLOBA}

Povrede Lisfrankovog zgloba nisu česte, ali se u mnogo slučajeva previde. Ovo se menja sa boljom dijagnostikom, primenom novih tehnika kao što su kompjuterizovana tomografija i nuklearnja magnetna rezonanca, koja se primenjuje u odredjenim slučajevima. Tako se broj pacijenata povećava, i zbog stila `ivota i zbog manjeg broja nedijagnostikovanih slučajeva. Prepočuje se hirurško lečenje, ili unutar par dana, ili odloženo za 7-10 dana, u cilju smanjenja otoka. Poželjna je intraoperativna radio-loška procena, kao i čvrsta fiksacija za prve tri metatarzalne kosti, dok se lateralne dve metatarzalne kosti mogu fiksirati Kirschner iglama. Postoperativno se prepo-ručuje zabrana oslonca, kao i fizikalna terapija radi pos-tizanja povoljnog ishoda lečenja.

Ključne reči: Povrede Lisfrankovog zgloba, lečenje, hirurško lečenje

\textbf{LITERATURE:}


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