CHAPTER 9

LISFRANC INJURIES: Current Treatment Options and Outcomes

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INTRODUCTION

Representing the articulation between the midfoot and forefoot, it is a well known fact that injuries at the Lisfranc (LF) joint are rare but complex and serious if inadequately treated. The joint is composed of all five tarsometatarsal (TMT) articulations forming an asymmetric arc from medial to lateral supported by an extensive ligamentous network. When it comes to injuries, the most commonly disrupted ligament is the LF ligament. Accounting for the only support between the first and second ray at the midfoot level, the LF ligament is attached to the lateral margin of the medial cuneiform as well as to the medial surface of the second metatarsal base. Although there is support between the first and second rays, the lack of ligamentous attachment between the first and second metatarsals is responsible for the injury pattern typically seen that causes lateral displacement of the lesser metatarsals. When it comes to the preferential dorsal dislocations, this can be explained by the fact that the dorsal TMT ligamentous structures are weaker than the plantar ligaments. The dorsal ligaments account for only one-third of the strength to the TMT ligamentous structure (1).

Although the documented incidence of LF dislocation/fracture is low at close to 0.2% per year, it is estimated that approximately one-third of injuries are missed on initial presentation. That being said, these injuries ultimately have a high impact on functional outcome if not managed properly; thus making early diagnosis a key factor in achieving an optimal result (1,2).

DIAGNOSIS

With early diagnosis being an essential prerequisite for favorable long-term outcomes, it is important to understand what studies to order when a LF injury is suspected and how to properly utilize them in treatment planning.

Initial imaging with plain radiographs is the obvious first step in diagnosis a LF injury, however due to the obliquity and close geometry of the joints, interpretation and diagnosis of dislocations can be difficult and they are often missed. A recent study looked at the diagnostic accuracy of radiographs in LF injuries and found that imaging angles play an important role in optimizing visualization of the joints in the majority of patients with a craniocaudal angle of 28.9° on the anteroposterior view being most beneficial (3). Furthermore, it has been found that plain radiographs are not reliable in detecting diastases of less than 2 mm, which is problematic considering cadaveric studies show that a diastasis of as little as 1.3 mm may be significant in differentiating between an intact and torn Lisfranc ligament (4). Stress radiographs are always an option and allow for better visualization, although the patient will need some form of anesthesia and the results may be variable due to the inability to reproduce the forces that caused the injury (1).

If clinical suspicion of a LF injury is still present after what appear to be negative plain radiographs, computed tomography (CT) or magnetic resonance imaging (MRI) can be performed. CT scanning will identify minor subluxations and subtle fractures not found on plain radiography and can serve as a valuable preoperative planning tool, especially if 3D imaging is available. MRI is particularly helpful in non-displaced or minimally displaced injuries as it is able to identify bone edema and/or individual ligament damage (1). MRI has a sensitivity and predictive value of 94% when identifying disruption of the LF ligament complex (5).

TREATMENT OPTIONS AND TRENDS

When it comes to the management of LF injuries, it is important to remember the goal of treatment: restoration of the midfoot anatomy, which in turn restores function and prevents arthritis/disability. Post-traumatic arthritis is the most common complication associated with these injuries and occurs to some degree in up to half of all cases (6). The risk is greatest in cases where the injury is unrecognized, only partially treated, not adequately reduced, or is a purely ligamentous injury (1). Although there are many treatment options, not all are appropriate for each individual injury; thus, the first step is to understand what the possibilities are and when they are appropriate.

Conservative Management

It is well known that the conservative options for a LF injury include nonsurgical treatment or closed reduction with or without pinning.

Closed reduction and percutaneous repair is often a treatment option that surgeons will utilize at first in an attempt to avoid open reduction when possible. If unable to achieve adequate correction, then the surgeon will resort to open reduction with internal fixation. Percutaneous repair seems to be a simple and logical approach to fixing what appear to be minor LF injuries; however, the inability to closely analyze the reduction achieved may prove to be a major problem.

In a study by Schepers et al, a significant difference was found in the rate of anatomical reduction between a closed reduction with percutaneous fixation group and an open-reduction internal fixation (ORIF) group. The findings showed in the closed group that only 33.3% of the postoperative results were considered anatomical, whereas 86.4% of the results in the open group were anatomical (7). Thus, although one may think they are doing their patient a great service by trying to prevent an open reduction, they may ultimately be causing worse long-term results.

Studies also show that screw fixation provides better stability of the medial and middle columns and also eliminate the risk of pin-site infection and Kirschner wire (K-wire) migration. Screws can be placed percutaneously or in open reduction (1).

Ultimately, there is always concern of inaccurate reduction and interposed tissues with percutaneous fixation, with many potential postoperative complication possibilities, thus open reduction is the primary recommendation over percutaneous repair for LF injuries throughout literature, especially with screw fixation (1).

Open Reduction Internal Fixation

Throughout the literature, ORIF is the preferred method of repairing LF injuries. Screws are typically utilized except for in the lateral column, which is found to be satisfactorily stabilized with K-wires (6,8).

One major area of debate against screw fixation is in the amount of cartilage damage caused at the joint level. A cadaveric study has shown that the use of one 3.5 mm screw can damage a significant percentage of the TMT joint's articular cartilage, with just one screw hole accounting for approximately 6% cartilage damage, this number is thought to be greatly underestimated and does not include any provisional K-wire fixation, additional screws, or maldirected screw holes (8). One fixation option that preserves the joint from further damage is dorsal plating. Studies show that plates produce similar to potentially better stability than trans-articular screws and are capable of spanning complex comminuted fractures (8,9).

Bioabsorable screws have also been advocated to avoid the need for a second procedure for screw removal and for avoidance of possible screw breakage; however there are some concerns with regard to their strength, possibility for loss of fixation with degradation, and excessive articular damage that accommodates insertion and breakdown of these screws (8).

Tightrope fixation is another option for ORIF of LF injuries. This suture-endobutton is placed where the LF ligament would typically lie, from the medial cuneiform to the second metatarsal base. Ahmed et al showed in a cadaveric study comparing standard screw fixation with the tightrope that there is increased diastasis with the tightrope in comparison to a 4.0 mm cannulated screw during fixed loading. Furthermore, the tightrope is far more costly than screw fixation and may have a component of creep or late diastasis due to the suture construct. Some advantages to using the tightrope include no need for re-operation to remove fixation and a potential for more physiologic and less rigid fixation (10).

As previously mentioned, another factor that may come into play during surgical planning is the need for a further procedure to remove hardware. Internal fixation for LF injuries, especially screws, is frequently symptomatic and requires removal in up to 16% of cases (1). A recent study by Rammelt et al showed no loss of alignment with removal of fixation at eight weeks, however the standard throughout the literature to avoid subsequent loss of reduction is 12-14 weeks for internal fixation and approximately 6 weeks for K-wires (11). The need for a second procedure is definitely something to take into account, especially with elderly patients that may not fair well with another procedure.

Primary Arthrodesis

A final option for repair of LF is primary arthrodesis. A small number of studies are available that show in cases with significant articular injury or comminution, primary arthrodesis has better outcomes than ORIF due to the high likelihood of severe post-traumatic arthritis (12). Primary arthrodesis is also recommended for purely ligamentous injuries as they show poor overall long-term outcomes with ORIF (13).

A study by Mulier et al comparing ORIF, complete fusion, and partial fusion (excluding the lateral column) showed very similar outcomes between the fixation and partial arthrodesis groups at 30 months postoperative. The complete arthrodesis group showed more pain, stiffness, and loss of metatarsal arch, which is all thought to be due to the stiffening of the relatively mobile lateral column. It should be noted too that although the ORIF and partial arthrodesis groups have very similar functional outcomes, 94% of the ORIF group had degenerative changes on plain radiographs and it was felt that a large portion would need an arthrodesis later in life; thus early partial arthrodesis was thought to be a better option (14).

Henning et al found in their prospective randomized study that there was no significant difference in long-term outcome scores between the ORIF group and partial primary arthrodesis group (again, excluding lateral column). The successful fusion rate in the study was 94%, which is comparable to the standard fusion rates of TMT joints in both traumatic and non-traumatic settings throughout the literature (15).

OPEN LISFRANC INJURIES

When it comes to open LF injuries that need to be fixated, the consensus is for K-wire fixation as it allows for insertion away from compromised soft tissues, avoiding further devitalization. K-wires also produce minimal further articular cartilage damage to what are likely to be comminuted fractures. Sometimes external fixation is needed due to the extent of the soft tissue damage. It has been found that open injuries have a high incidence of spontaneous fusion; thus primary arthrodesis is typically not necessary. Ultimately, the soft tissues are a major factor in the outcome of these injuries and appropriate management is essential (16).

OUTCOMES

Throughout the literature it is found that favorable long-term outcomes are most dependent on reduction and the degree of soft tissue damage sustained. In the classic Myerson et al article, patients with a good or excellent result had an average width between the first and second metatarsal bases of 2.9 mm. Those with a poor or fair result had an average width of 5.8 mm; thus greatly emphasizing the importance of quality initial reduction on long-term results. They further found that the direct crush type injuries had the poorest long-term results, which is attributed to the extensive soft tissue damage experienced (17).

Although post-traumatic arthritis is thought to be a negative outcome of LF injuries, it may be of lesser concern than once believed. In a recent article by Marin-Pena with a mean follow up of 14 years, poor clinical results did not match poor radiological findings as several patients had poor radiological results but excellent clinical results (18).

GENERAL GUIDELINES

Based on the literature reviewed of clinical and biomechanical studies, the following guidelines for management can be recommended:

When to operate?

1. >1 mm displacement in any plane affecting the medial 3 TMT joints, intercuneiform or naviculocuneiform joints (on radiographs, CT or MRI)
2. Evidence of complete LF ligament injury, including:
   - A "fleck sign" on radiographs/CT
   - Ligament disruption on MRI
   - Displacement on stress or weight-bearing views

Which procedure to perform?

1. Osseous injury with minimal comminution: Fixation
   - TMT Joints 1-3: Screw fixation
   - TMT Joints 4-5: K-wire fixation
2. Purely ligamentous injury: Limited fusion (TMT 1-3)
3. Significant comminution/displacement, extensive soft tissue damage: Limited Fusion
4. Open injury: surgical debridement with K-Wire fixation, Ex-Fix as needed (consider delayed fixation of fusion when necessary)

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