Tarsometatarsal/ Lisfranc Joint

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KEYWORDS

• Lisfranc injury • Foot • Tarsus • Metatarsus

It has been projected that injuries to this region of the foot occur in approximately 1 in 55,000 people per year, encompassing 0.2% of all fractures; however, these numbers may be an underestimation.[1] It is the opinion and the experience of the authors that this injury occurs more commonly and the diagnosis is often unseen. It is common for foot and ankle specialist to evaluate patients with a Lisfranc injury days or weeks after a visit to the emergency room with an unrecognized injury. Subtle injuries can occur in the midfoot and are frequently missed by the initial evaluator as well the follow-up evaluations. A Lisfranc injury can be difficult to diagnose and may be unnoticed in patients who have experienced polytrauma (multiple injuries) or in patients who experience simple injuries such as a slip and or misstep. There are varying degrees of these injuries from a simple sprain to an unstable fracture/dislocation. Misdiagnosis and inappropriate treatment can lead to a painful long-term condition.

HISTORICAL REVIEW

During the Napoleonic era, the field surgeon Jacques Lisfranc encountered a patient who suffered from vascular compromise and secondary gangrene of the foot after a fall from a horse. Subsequently, Lisfranc performed an amputation at the level of the tarsometatarsal joints, and thereafter the eponym of Lisfranc joint has been applied to that area of the foot. Although Lisfranc did not describe a specific mechanism of injury or classification scheme for the injury within this region, a Lisfranc injury traditionally reflects a dislocation or fracture-type injury at the tarsometatarsal joints.

ANATOMY

Thorough comprehension of the osseous, capsular, and ligamentous structures encompassed within the tarsometatarsal joint complex is essential for appropriate diagnosis and treatment of disorders in that region.

The Lisfranc joint complex consists of the articulations of the intertarsal, intermetatarsal, and tarsometatarsal surfaces. This complex forms medial, central, and lateral

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columns, which together form an arch configuration through the midfoot (**Figs. 1** and **2**). Each of the columns is independent of the others, with unique synovial membranes.[2] The medial column is formed by the first metatarsal and medial cuneiform, the second column is formed by the second and third metatarsals and the intermediate and lateral cuneiforms, and the third column consists of the cuboid and its relationship with the fourth and fifth metatarsals.[2,3] Each of these columns possesses the following amount of sagittal plane motion: 3.5 mm, 0.6 mm, and 13 mm, respectively.[4] The base of the second metatarsal is recessed between the medial and lateral cuneiforms, and this placement is thought to provide much of the stability to the joint, by providing limitation in the amount of plantarflexion and dorsiflexion (**Fig. 3**).[5,6] In addition, the wedge-type shape of the base of the second metatarsal in conjunction with the shape of the other metatarsals is another component adding stability to the joint, because it gives stability in the frontal plane, which allows for enhanced function of the surrounding soft tissue structures.[7] In general, the osseous components of the joint are larger dorsally than plantarly.[2]

Fibrous membranes that are lined with synovium divide the complex into the 3 divisions, and are referred to as articular capsules.[2,8] These capsules insert at various bony articular surfaces within the complex.

The ligamentous structures throughout the Lisfranc joint have been found to have moderate variability in cadaver studies, and may or may not present as thickenings of the surrounding capsular linings.[2] Each structure is composed of longitudinal and oblique strands and, together, the ligaments are grouped into dorsal, interosseous, and plantar sections.[2] There are 6 to 8 ligaments in the dorsal group, and these flat structures conjoin the tarsal and metatarsal bones.[2] The interosseous ligament group contains 3 members, including the interosseous intercuneiform ligament, which has been found to provide significant stability to the joint. Another key stabilizing structure within this group and the overall joint complex is thought to be the Y-shaped ligament that connects the medial base of the second metatarsal to the lateral aspect of the medial cuneiform, and this is referred to as the Lisfranc ligament.[6] There is no intermetatarsal ligament between the base of the first and second metatarsals, and this may contribute to the propensity for dislocation-type injuries in this region.[9] There are traditionally at least 5 ligaments in the plantar ligament group, including the intertarsal and intermetatarsal components. These ligaments are stronger than their dorsal counterparts.[2]

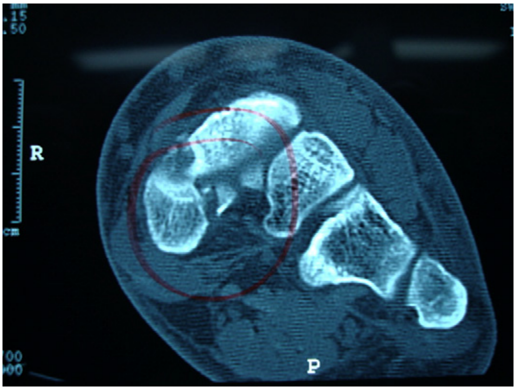

Fig. 1. A frontal plane view of a computed tomography (CT) scan showing an injury at the bases of the metatarsals.

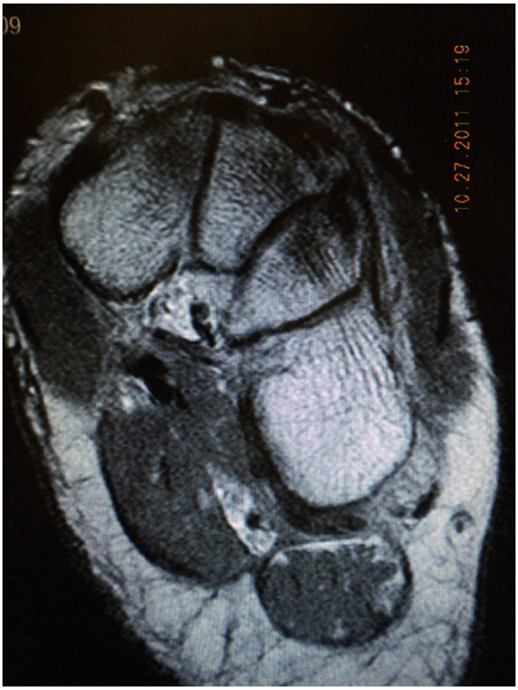

Fig. 2. A frontal plane view of a magnetic resonance imaging (MRI) scan of the medial, intermediate, and lateral cuneiforms and cuboid. Note the naturally occurring arch.

In an anatomic study of injured Lisfranc joints, it was determined that the mortise between the medial and lateral cuneiform bones was significantly shallower in people who had sustained injuries to the area, therefore suggesting that this anatomic difference may predispose certain individuals to damage to the joint.[6]

MECHANISM OF INJURY

In general, Lisfranc joint injury can be secondary to either direct or indirect trauma, and this mechanism determines the type of clinical presentation and the type of injury. Direct trauma involves a crushing-type injury, most likely to create a plantar dislocation of the metatarsals. Indirect trauma results from a rotational-type force across the joint with the eversion/pronation type being the most common.[7] Strong forces directed from lateral to medial often cause ligamentous rupture or fracture sites located at the second metatarsal base.[7] Eversion/pronation-type injuries can lead to medial dislocation of the first metatarsal, followed by dorsal and lateral dislocation of the lateral metatarsals.[7]

Most injuries at this joint result in displacement in a dorsal and lateral direction, because of the paucity and weakness of the surrounding dorsal and plantar ligamentous structures.[9] It has been found that, in injuries in which dislocation occurs, the dorsal tarsometatarsal ligaments are ruptured first, followed by the stronger plantar ligaments.[10] Stavlas and colleagues,[11] in their review of 11 articles examining outcomes in 257 patients with Lisfranc injuries, found that 57.5% of the patients had combined osseoligamentous injuries and 42.5% experienced purely ligamentous injury.

Fig. 3. The base of the second metatarsal is situated between the medial and lateral cuneiforms as well as the base of the first and third metatarsals.

Traditionally, the injury is more common in male patients who have suffered a high-energy indirect traumatic event, in which a rotational force has been applied to a plantarflexed foot.[3,4,9] Because of the mechanism of action related to this type of injury, they can be seen in athletic scenarios, but they are commonly seen in high-impact incidents such as motor vehicle and industrial accidents.[12,13]

INJURY CLASSIFICATIONS

A variety of classification schemes have been developed to describe injury to the Lisfranc joint complex. These systems typically describe anatomical radiographic variations of the anatomic injury pattern.

Quenu and Kuss[14] first described a straightforward classification detailing variations in tarsometatarsal injuries, which were classified as isolated, homolateral, and divergent, in 1909. Subsequent classifications described the injury primarily based on the mechanism of action, and some divided the injury based on the presence or absence of soft tissue spraining.[15] However, these did not address the method of treatment based on the appearance of the injury.

In 1982, Hardcastle and colleagues[13] modified the previously described Quenu and Kuss[14] model to provide a system that could dictate what treatment modality may be used based on the appearance of the injury. The classification was broken down into 3 groups, beginning with type A, which describes total uniplanar incongruity of the tarsometatarsal joint. Type B in this scheme entails partial displacement of either the first metatarsal or the remaining metatarsals, individually or together. Type C presents as any combination of displacement that always includes the first metatarsal in combination with any or all of the lesser metatarsals. This type typically also shows sagittal and frontal displacement.[13]

Myerson and colleagues[16] (1986) further developed the Hardcastle classification to describe the congruity of the joint as it related to the injury. This classification system is presently commonly used for this injury.

Postoperative functional outcomes after Lisfranc injury have been evaluated by several investigators.[5,7,17] Gaweda and colleagues[5] (2008), in their analysis of 19 patients, found that Hardcastle type B injuries showed the worst functional results, and they believed that this type of injury is most likely to be either misdiagnosed or undertreated.

DIAGNOSIS

A detailed history and physical examination is a key component to accurate and timely diagnosis of a Lisfranc injury. Injuries to the joint complex that result in subtle joint displacement are often difficult to diagnose clinically and radiographically. Many previously missed injuries have occurred in patients who dismissed their symptoms as resulting from a routine foot sprain, and later presented with lingering pain, swelling, or instability.[10]

Clinical examination should include evaluation of edema and ecchymosis, because typically there may be diffuse edema and plantar medial arch ecchymosis present in this type of injury (**Fig. 4**).[11,18] In addition, passive manipulation of the forefoot into pronation and supination allows for evaluation of stability of the joint complex.[18] Long-standing injuries that were previously misdiagnosed or undiagnosed show a variety of symptoms depending on the time span since, and severity of, the initial injury. These changes may include a flatfoot deformity stemming from the midfoot; pain with palpation over any of the metatarsocuneiform joints, specifically the second; or decreased arch height during heel rise.[10,15]

Diagnostic radiographic imaging should always be conducted for completeness of the examination. Weight-bearing radiographs taken in anteroposterior, lateral, and 30° oblique views can help to show frank diastasis as well as gross bony abnormalities (**Figs. 5–7**). If suspicion is high for soft tissue injury, radiographic stress views can be performed, either with or without anesthetic block (**Figs. 8** and **9**).[10] However,

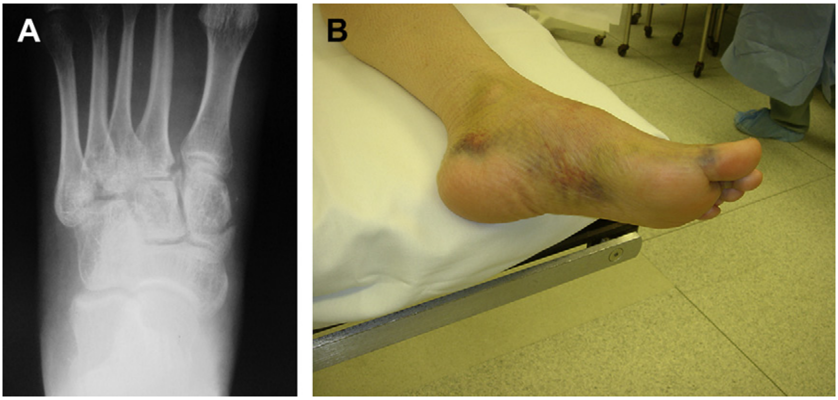

Fig. 4. (*A*) A fleck sign with gapping is noted at the intercuneiform and Lisfranc joint. (*B*) Clinically, there is residual edema and echymosis in the plantar medial arch, which is typically seen with Lisfranc injuries.

Fig. 5. An anterior-posterior and medial oblique radiograph with no abnormalities at the Lisfranc joint.

radiographic evaluation can be difficult, secondary to shadowing or overlapping that occurs between the metatarsal and tarsal bones.[19] Radiographic findings may include widening between the metatarsal bases, a fragmentary fracture at the medial base of the second metatarsal or lateral medial cuneiform, or displacement of the lesser metatarsals. Myerson[4] identified a fleck sign that can be seen at the medial base of the second metatarsal or lateral base of the first metatarsal as an avulsion fracture.

In injuries in which there is less than 2 mm of diastasis between the bases of metatarsals 1 and 2, magnetic resonance imaging (MRI) or computed tomography (CT) is the preferred imaging modality (**Figs. 10** and **11**).[20] Soft tissue structures can be thoroughly evaluated by using MRI performed in various planes. In the oblique axial plane, the integrity of the Lisfranc ligament is visible, in addition to the overall alignment of the tarsal and metatarsal bones. The transverse arch of the foot can be evaluated in the frontal plane, and, in the sagittal plane, plantar and dorsal joint alignment as well as the tarsometatarsal ligaments can be viewed.[19] CT imaging has been described as the diagnostic tool of choice by some investigators, because it has been found to be more reliable than plain radiographs.[17]

Overall, timely diagnosis is thought to be the key for successful outcomes for patients with this injury. This factor has been examined in several studies, specifically on athletes, who typically desire to return to full activity. In his review of 15 patients treated for this injury, Saxena[21] found that a delay of diagnosis greater than 6 weeks decreased the chance of the patient having an excellent outcome. Posttraumatic

Fig. 6. An anterior-posterior and medial oblique radiograph with no abnormalities at the Lisfranc joint.

arthritis is common and is typically caused by articular surfaces damaged in the initial incident, poor anatomic reduction, or failure to recognize the injury.[4] The additional concern of neurovascular compromise associated with injuries to this area is paramount, and thus reinforces the principle of early diagnosis.[11,22] Hardcastle and colleagues[13] (1982) asserted that it was essential to perform open reduction of the injury if there seems to be vascular insufficiency to the foot after closed reduction has been performed.

TREATMENT

The aim of the treatment is to promptly create a stable, painless, plantigrade foot. This objective is achieved by anatomic reduction, alignment, and, if required, stable fixation. Delayed diagnosis of the injury, even when followed by appropriate correction of the deformity, typically results in poorer functional outcomes.[10,21] Proper anatomic reduction of the deformity has been shown to be a key component in the prevention of posttraumatic arthritis.[20,22]

Some investigators have proposed determining the treatment of choice based on whether there has been partial or complete ligamentous disruption.[23] In the group showing incomplete/partial ligamentous disruption, there are 3 stages of injury, each consisting of increasing amounts of diastasis within the joint. Also noted in this group is whether or not there is collapse of the medial arch. The treatment protocol for each of these types ranges from just symptomatic treatment to open reduction and internal fixation (ORIF). The other group, which entails complete disruption of the ligament, consists of 2 main subgroups: those without significant intra-articular

Fig. 7. An anterior-posterior view showing diastasis between the first and second metatarsal, a fleck sign, as well as the medial and intermediate cuneiform. Note the bone avulsion off the navicular.

Fig. 8. Stress radiographs showing the instability at the tarsal metatarsal joints.

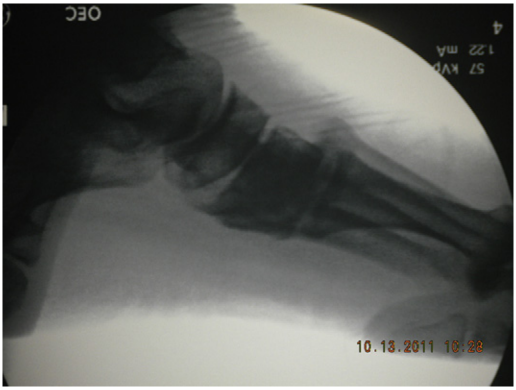

Fig. 9. A lateral radiograph showing instability in the sagittal plane.

fractures and those with comminuted intra-articular fractures. For these injuries, primary arthrodesis of the joint has been found to have more successful outcomes than those treated with ORIF.[23]

Conservative treatment of Lisfranc injuries is typically reserved for nondisplaced, stable injuries or fractures commonly seen with low-energy injuries. Some investigators have suggested that, for injuries more than 6 weeks old, without fracture, and without significant joint subluxation, conservative treatment is acceptable.[10] For this

Fig. 10. CT scan showing disruption at the Lisfranc joint as well as a cuneiform fracture.

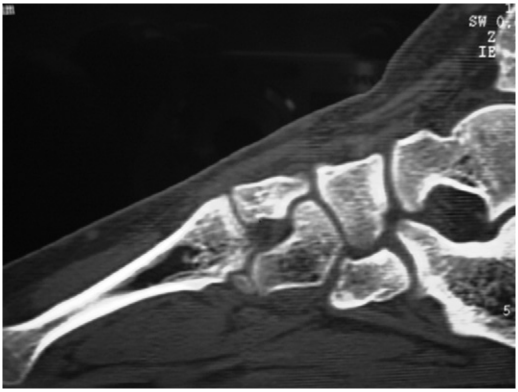

Fig. 11. CT scan showing disruption at the Lisfranc joint as well as a cuneiform fracture.

type of injury, a variety of modalities have been described, including below-knee immobilization and closed reduction with plaster casting; however, there is a risk of loss of reduction with these methods.[5,9,11,20] If closed reduction is to be attempted, some investigators have proposed using longitudinal traction followed by plantarflexion and supination of the forefoot, followed by dorsiflexion and pronation.[24] The authors suggest that patients who present with negative weight-bearing radiographs and a negative stress test can be managed well with a weight-bearing fracture boot.

If the Lisfranc complex shows a displacement of 2 mm or greater, anatomic reduction is necessary. If the fracture/dislocation is mobile and reducible, closed reduction should be attempted. However, postreduction radiographs are required to ensure adequate reduction and to ensure that no residual subluxation is noted. If closed reduction can be sustained, then a below-the-knee cast can be used as treatment alone.[25–28] Many investigators have suggested that closed reduction without fixation, either open or closed, does not maintain adequate reduction and often requires surgical stabilization.[29–32] Closed reduction should be attempted. If it does not maintain because of instability, reduction and fixation will be necessary.[13,33] In cases in which closed reduction cannot be maintained, open reduction and stable fixation is then mandatory and can be done via percutaneous pin and/or screw fixation (**Fig. 12**) (the authors routinely use screw fixation and do not believe k-wire fixation can provide an equally stable construct; **Fig. 13**). Placement of the percutaneous pin/screws depends on the type of injury. Fixation of the medial cuneiform to the second metatarsal base reconstitutes the Lisfranc ligament. If using k-wires, threaded k-wires provide better purchase than smooth k-wires, but are more difficult and more painful to remove.

Correction of deformity, maintaining anatomic alignment, in addition to the creation of a functional, stable plantigrade foot, are key components to surgical repair of this type of injury. Realignment typically is initiated at the medial column and then progressed laterally.[4] A plethora of internal and external fixation techniques for dislocation-type injuries has been described (**Figs. 14–25**). We prefer the use of a 4.0-mm solid cortical screw because the head is the same size as a 3.5-mm screw, the core diameter is 2.9 mm, and it is fully threaded and solid.

ORIF is the traditionally accepted treatment of displaced Lisfranc joint injuries. However, even with anatomic reduction and stable internal fixation, treatment of these injuries has not consistently provided excellent outcomes. Primary arthrodesis has

Fig. 12. An intraoperative view using a Weber clamp and k-wire fixation. The authors do not recommend k-wire fixation as a first-line option.

Fig. 13. Postoperative weight-bearing anterior-posterior radiograph showing a significant diastasis at the Lisfranc joint following k-wire fixation. This is the same patient as in **Fig. 12**, who had a poor result.

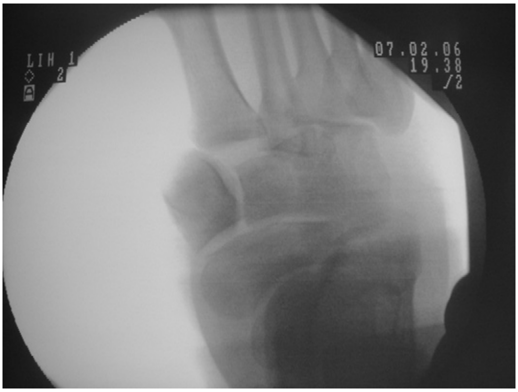

Fig. 14. A significant injury and displacement at the Lisfranc joint along with other involved midfoot joints.

also been shown to be a viable alternative for correction in scenarios in which there is severe dislocation or in those with minimal deformity isolated to the medial or middle columns.[4,15] Lateral column arthrodesis is typically unnecessary because those areas show few symptoms.[4] In the neuropathic patient, the authors suggest an arthrodesis of the lateral column when significant disorder is involved. In addition, diabetes mellitus with secondary Charcot neuropathic changes is responsible for most neuropathic fracture-dislocations. Joints that are unstable secondary to the neuropathic changes have a high rate of pseudoarthrosis resulting in the need to attempt a fusion.

It is common to need to remove hardware in patients who have received internal fixation, and this has been an issue in those receiving metallic as well as bioabsorbable hardware.[15]

Fractures with bony displacement are treated with external fixation or, more commonly, with traditional ORIF techniques. Open reduction provides a good means of achieving an anatomic reduction. Significant edema in the soft tissue envelop may impose a delay with open reduction of up to 14 to 21 days. The basic construct of open reduction consists of an interfragmentary compression screw (3.5-mm or

Fig. 15. A significant injury and displacement at the Lisfranc joint along with other involved midfoot joints.

Fig. 16. Note the significant soft tissue injury secondary to the gross displacement of the bony structures; this can create a significant soft tissue injury.

4.0-mm fully threaded cortical screws) inserted into the second metatarsal base from the proximal superior-medial corner of the medial cuneiform. The initial compression screw is the key to the reduction and fixation of the injured complex, followed by multiple interfragmentary screws placed from the bases of the involved metatarsals to their respective cuneiform bones. If cuneiform instability is present, reduction and screw fixation between the cuneiforms can be inserted. In cases in which comminution of the cuneiform and metatarsal bases may be involved, this can be treated with bridge plating, allowing the surgeon to span the fracture and maintain anatomical alignment and length.

The standard incisional approach consist of 1 or 2 incisions. The most medial is slightly lateral and parallel to the first metatarsal shaft starting at the distal one-third

Fig. 17. Note the significant soft tissue injury secondary to the gross displacement of the bony structures; this can create a significant soft tissue injury.

Fig. 18. Treatment consisted of protecting the soft tissue envelop and maintaining anatomic alignment with the use of an external fixator.

metatarsal and extending to the navicular. The authors recommend making the incision curvilinear over the first tarsal metatarsal. This technique can provide good exposure to the first, second, and third tarsal metatarsal joints while allowing the surgeon to retract the deep peroneal nerve and dorsalis pedis artery. When needed, the second incision should be over the fourth metatarsal shaft. The soft tissue island between the incisions needs to be adequate in size to prevent tissue necrosis. If only the medial tarsal metatarsal joints are involved, the authors make 1 large dorsal curvilinear incision starting at the dorsal lateral first metatarsal and extending to the

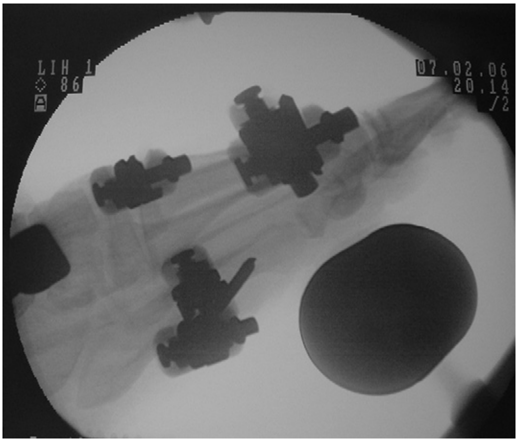

Fig. 19. Treatment consisted of protecting the soft tissue envelop and maintaining anatomic alignment with the use of an external fixator.

Fig. 20. Treatment consisted of protecting the soft tissue envelop and maintaining anatomic alignment with the use of an external fixator.

navicular-cuneiform joint. Care should be taken not to undermine/separate the tissues to prevent soft tissue damage. The incision is deepened to the extensor hallucis brevis tendon, which runs over the neurovascular bundle. The neurovascular bundle should be retracted to whichever side is easiest and allows the best exposure to provide excellent visualization to the base of the second metatarsal to the medial cuneiform as well as the second tarsal metatarsal joint. Identifiable bony fragments that are too small to be fixed are removed. Next, k-wires are used for temporary fixation until anatomic alignment is confirmed under fluoroscopy. A 3.5-mm or 4.0-mm fully threaded cortical screw with a lag technique should enter from the medial cuneiform

Fig. 21. A staged percutaneous screw fixation procedure was provided for additional stability, following a favorable response by the soft tissues.

Fig. 22. After 10 weeks of fixation, the hardware was removed. Clinical and radiographic views show a well-aligned foot.

and be directed in an oblique fashion into the base of the second metatarsal. If instability is noted at the intercuneiforms (the more stabile proximal base), then an intercuneiform lag screw should be used from medial to lateral. If the lateral segments are disrupted, the second incision is used. The incision is deepened and attention should be directed to the third metatarsal tarsal base. Soft tissue or bony fragments that may be blocking the reduction are resected. A smooth k-wire is used for temporary fixation beginning at the third metatarsal base into the lateral cuneiform. Similar to ankle fractures, the Vassal principle applies to the Lisfranc complex. Once reduction of the

Fig. 23. After 10 weeks of fixation, the hardware was removed. Clinical and radiographic views show a well-aligned foot.

Fig. 24. After 10 weeks of fixation, the hardware was removed. Clinical and radiographic views show a well-aligned foot.

medial (dominant segment) tarsal metatarsal is successfully reduced, the remaining lesser tarsal metatarsal joints will find their natural anatomic location.

The postoperative course varies with the surgical protocol; the patient is placed in a dorsally slotted non–weight-bearing plaster cast for 2 weeks and instructed to keep

Fig. 25. After 10 weeks of fixation, the hardware was removed. Clinical and radiograph views show a well-aligned foot.

the extremity elevated. Provided there are no wound problems and the reduction and construct are stable, a below-the-knee fiberglass cast is applied for an additional 4 to 6 weeks. Full weight bearing in a fracture boot with physical therapy is then prescribed for 4 weeks. If percutaneous smooth or threaded k-wires have been used, they can be removed at approximately 8 weeks. If screws have been used, they can be removed at approximately 12 weeks. Full unprotected weight bearing is typically not permitted until hardware has been removed.[34]

ARTHRODESIS TECHNIQUE

In the patient who is non-neuropathic, typically the first, second, and/or third tarsal metatarsal joints are fused. A single curvilinear incision as described earlier is used. The neurovascular bundle is identified and retracted. The first, second, and/or third metatarsal cuneiform joints are exposed. The articular surfaces are debrided to bleeding bone while attempting to preserve as much of the natural integrity as possible, which minimizes the shortening bone voids. Osteotomes, mallets, picks, rongeurs, drills, and curettes are the instruments used for the debridement. A significant amount of time is spent on joint preparation because we believe that the success of an arthrodesis is in the joint preparation, alignment, and fixation construct. After adequate articular debridement, the reduction is performed using temporary k-wire fixation. The alignment is confirmed both clinically and with fluoroscopy. The stabilization is begun from proximal to distal with the cuneiforms. Once the cuneiforms are stabilized, the first tarsal metatarsal is temporarily fixated. It is important that the first metatarsal is in a neutral position and any varus/valgus position is corrected. In some scenarios, a temporary external fixator may need to be used for distraction. Next, the base of the second metatarsal is positioned appropriately into the native keystone position, followed by the third tarsal metatarsal. If the fourth and fifth metatarsal tarsal joints are involved, it has been the authors' experience that, once the first 3 tarsal metatarsal joints are positioned, the fourth and fifth metatarsal tarsal joints reduce anatomically. Fixation is achieved using a lag technique involving solid 3.5 or 4.0 cortical screws and/or plating techniques. A screw hole technique as described by Manoli and Hansen[35] allows for a difficult angulation and the first screw is inserted from the first metatarsal to the medial cuneiform, creating interfragmentary compression. The next screw is inserted from the stable superior proximal medial cuneiform, obliquely oriented into the second metatarsal base. Interfragmentary compression is also used at this stage. Additional screws can be inserted from the proximal metatarsal base into the cuneiform and from the base of the first metatarsal into the base of the second metatarsal (**Figs. 26** and **27**). All bone voids are then packed with autogenous or allogenic cancellous bone graft for a shear strain relief graft, as described by Perren.[36]

Postoperatively, the patient is placed in a dorsally slotted, non–weight-bearing plaster cast for 2 weeks and is instructed to keep the extremity elevated. Provided there are no wound problems and the reduction and construct are stable, a fiberglass below-the-knee cast is applied for an additional 4 to 6 weeks. Full weight bearing in a fracture boot with physical therapy is then prescribed for 4 weeks, followed by full weight bearing and regular activity. During the postoperative course, serial radiographs are taken until bony consolidation is noted.

COMPLICATIONS

Compartment syndrome is a serious condition that involves increased pressure in a muscle compartment. It can lead to muscle and nerve damage and problems with

Fig. 26. An anterior-posterior radiograph showing a well-aligned midfoot following a primary arthrodesis after a Lisfranc injury.

blood flow. Heightened awareness assists the foot and ankle surgeon in avoiding the sequela of a missed compartment syndrome. Significant injuries to the midfoot can lead to prolonged ischemia, which may lead to irreversible destruction of myoneural tissue and subsequent fibrosis. Untreated compartment syndrome may lead to

Fig. 27. After primary arthrodesis of the Lisfranc joint, the foot is stable, painless, and plantigrade, and the patient has minimal limitations.

a disabling outcome. The patient may experience chronic debilitating pain, and forefoot deformity such as residual claw toes. An intrinsic-minus deformity commonly arises from interosseous and lumbrical muscle atrophy and subsequent fibrosis. In addition, fibrosis of the short flexors secondary to the neural insult develops. Paresis and anesthesia to the plantar foot may be permanent. Compartment syndrome of the foot is a potentially disabling condition but is treatable if promptly recognized. Therefore, the foot and ankle surgeon must be highly suspicious, along with seeking objective evidence through pressure monitoring, to lessen the likelihood of this condition.

Additional injuries may consist of redislocation and circulatory compromise.[37,38] An inevitable (and the most common) long-term complication is arthrosis.[31,38,39] However, not all patients who develop radiographic degenerative changes are symptomatic.[16] Arntz and colleagues[31] concluded that injuries to the articular surface and anatomic reduction were the most important determinants in the development of posttraumatic arthritis. Injuries to the deep peroneal nerve or dorsal pedis artery may occur. In cases in which k-wires have been used, loss of fixation and/or reduction is possible. Other complications consist of cellulitis/wound infection, contractures, complex regional pain syndrome, posttraumatic arthritis, hardware failure, broken screws, deep venous thrombosis, pulmonary embolism, incomplete reduction, redislocation, chronic pain, posttraumatic arthritis/deformity (planovalgus), difficulty wearing shoes, chronic pain, and malalignment.

DISCUSSION

Accurate early diagnosis with adequate reduction and maintenance of anatomic alignment of the dislocation or fracture within the Lisfranc joint complex have been found to be the key to successful outcomes regarding this injury. Because of the anatomic variations, the thin soft tissue envelop, and the abundance of ligamentous and capsular structures in the region, repair of these injuries can be a challenge. The classification systems used to describe these injuries aid in describing the mechanism of injury or displacement type present, which may aid in determining what treatment modality can provide the best outcome.

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