Injury, Int. J. Care Injured 49 (2018) 420–424

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Full length article

Acute management of high-energy lisfranc injuries: A simple approach

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ARTICLE INFO

Keywords:
Lisfranc
High energy injury
K-wires
Pinning
Reduction
Staged approach

ABSTRACT

Introduction: The aims of this study were to (1) describe the use of the K-wire for the initial management of high-energy Lisfranc dislocations or fracture dislocations, (2) to evaluate whether this standalone technique allowed for adequate reduction of these injuries, (3) to evaluate whether reductions were maintained until definitive fixation was performed, (4) and to determine if it contributed to any increase in complications prior to or after definitive fixation.

Patients and methods: A retrospective review was performed on all patients who presented with tarsometatarsal injuries from January 2005 through June 2015. Dislocations of the tarso-metatarsal joints were classified as either *Type A* (total incongruity, homolateral complex), *Type B* (partial incongruity, homolateral incomplete) or *Type C* (divergent, total or partial displacement) patterns, with or without associated fractures. For the purposes of this paper, high-energy injuries were defined as patients presenting with either a Type A or Type C (total displacement) dislocations or fracture-dislocation patterns. A total of 176 patients presented with a tarsometatarsal injury. Eighteen patients with divergent or homolateral patterns underwent a staged approach. Fifteen patients were managed exclusively with K-wire fixation. Wound complications, infections or the unexpected need to return to surgery were recorded.

Results: All patients demonstrated an improved alignment using K-wires. There were no compartment syndromes, vascular insufficiency, complications to the skin associated with traction or manipulation, or pin site infections. At definitive fixation, no patient demonstrated a loss in the alignment that had been obtained at the index procedure or had an unexpected return to surgery.

Discussion and conclusions: This study demonstrates that high-energy Lisfranc injuries are uncommon and that K-wires are a simple and adequate technique that can be used for initial staged approach of these injuries. The use of 2.0 mm K-wires were sufficient to obtain and maintain the reduction until definitive fixation has been obtained, without producing any increase risk for complications.

Introduction

Injuries involving the tarsometatarsal (Lisfranc) joint are uncommon, accounting for only 0.2% of bony injuries and are seen in about one in 55,000 people per year. [1] In the absence of severe trauma, subtle injuries are often missed. [2] In contrast, radiographs of high-energy tarsometatarsal injuries are easily identified because they often present with multiple joint dislocations or fracture-dislocations. On physical exam these high-energy injuries produce significant swelling of the foot, may present with clear or blood filled blisters, and often require a delay in definitive fixation until the soft tissue envelope has improved.

Although, it is well documented that a precise anatomic reduction is important for optimum results, [3–5] the goal on initial presentation of these injuries is directed towards improving the overall alignment of the foot. This avoids prolonged pressure to the skin and the associated soft tissues and will help correct the distortion of the blood vessels, which ultimately leads to an overall improvement in the circulation of the extremity. [6–8] However, taking a simplistic approach of applying a splint or boot without a reduction, and waiting for the soft tissue envelope to improve, does nothing to address the malalignment of the fractures and dislocations and can make the definitive surgery more difficult. Conversely, attempting to manually reduce and maintain a reduction in the emergency department, even with the use of conscious sedation, may be difficult to obtain and maintain given the amount of swelling and instability at the time of presentation. Given the success that has been obtained for the management of

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https://doi.org/10.1016/j.injury.2017.11.012
0020-1383/

other bony injuries, [9–12] the use of a staged surgical approach is an effective tactic to use for these high-energy injuries.

The goals of these staged procedures are to improve the axial alignment of the extremity, rather than obtaining an anatomic reduction. This then permits one to wait until the soft tissue envelope has improved and also allows adjunctive tests to be performed to better delineate bone and joint injuries. Most staged procedures, addressing high-energy Lisfranc injuries, have been addressed using some type of external fixation, placed either medially or laterally (unicolumnar) or on both sides (bicolumnar) of the foot. [13–15] These are effective but not all institutions have smaller types of external fixator sets and pins readily available. Using large pins may ultimately produce iatrogenic bony injuries and may not adequately reduce the central part of the foot, especially if the soft tissue constraints have been compromised. [15] A simpler approach, and one that is readily available in almost all hospitals and comes in different sizes, is the use of a Kirschner (K-wire) pin as an implant to obtain and hold a reduction in the foot until definitive fixation is performed.

Our hypotheses were that standalone K-wire fixation, used for the initial staged management of high-energy Lisfranc fracture and fracture-dislocations, worked equally as well as external fixation. In order to gauge the success of K-wire fixation, the aims of this study were to (1) describe the use of the K-wire for the initial management of high-energy Lisfranc dislocations or fracture dislocations, (2) to evaluate whether this standalone technique allowed for adequate reduction of these injuries, (3) to evaluate whether reductions were maintained until definitive fixation was performed, (4) and to determine if the k-wires contributed to any increase in complications prior to or after definitive fixation.

Patients and materials

After obtaining approval through the Institutional Review Board (#103998), a retrospective review was performed on all patients who presented with tarsometatarsal injuries from January 2005 through June 2015. Dislocations of the tarso-metatarsal joints were classified according to Myerson et al. [4] as either *Type A* (total incongruity, homolateral complex), *Type B* (partial incongruity, homolateral incomplete) or *Type C* (divergent, total or partial displacement) patterns, with or without associated fractures. For the purposes of this paper, high-energy injuries were defined as patients presenting with either a Type A or Type C (total displacement) dislocation or fracture-dislocation pattern. Patients were included for evaluation if they had been managed solely with K-wire fixation as their initial staged approach. Exclusion criteria consisted of patients with minimally displaced injuries or those managed non-operatively, tumors producing subluxations or dislocations of the foot, patients with Charcot arthropathy of the midfoot, patients who presented with a partial amputation or injuries that were initially managed with the use of external fixation to the foot.

A total of 176 patients were identified with a tarsometatarsal injury. Eighteen patients (10%) with high-energy injuries underwent a staged approach. Three patients managed using external fixation were excluded leaving fifteen patients with fifteen Lisfranc injuries that were managed exclusively with K-wire fixation on initial presentation. (Table 1) There were thirteen males and two females with a mean age of thirty-seven years (range nineteen to sixty-three). The mechanism of injuries consisted of: eight due to motor vehicle/motorcycle accidents, three due to falls from heights, two due to crush injuries, one resulting from a sports event, and one from an assault. One injury was open (Grade 3B)[17] and seven patients (47%) presented as an isolated injury. Ten (67%) patients presented with Type C patterns and five (33%) had Type A patterns. (Fig. 1A-B) After initial pinning and discharge from the hospital, patients were followed on a weekly basis until the soft tissue envelope had improved enough to be scheduled for definitive fixation.

Table 1
Demographics of Staged Lisfranc Patients.

Total Number of Patients	15
Type A	5
Type C	10
Average Age (range)	37 (19–63)
Males (Females)	12 (3)
Mechanisms of Injury	
Motor vehicle/Motorcycle	8
Falls	3
Crush	2
Sports	1
Assualt	1
Polytrauma (open)	8 (1)
Time to index Procedure in Hours (range)	33.9 (4–120)[a]
Time to Definitive Fixation in Days (range)	18.6 (2–37)
Length of Follow-up in Days (range)	192.6 (63–362)
Complications	2[b]

[a] Two patients were transferred at 120 h.
[b] Occurred after definitive surgery.

Operative technique

At the time of initial presentation, all patients underwent a closed reduction of their fractures and fracture-dislocations in the operating room. Tourniquets were applied as a precaution but were not inflated. Anticipating future surgical incisions, care was taken to place pins away from these sites. Utilizing finger traps or RAY-TEC sponges (Johnson and Johnson, Dublin, Ohio, U.S.A), longitudinal traction to the toes and manual pressure to the midfoot (to correct dorsal or plantar dislocations) was applied. Intraoperative fluoroscopy was used to demonstrate that an improvement to the alignment of the foot had been obtained, defined as some minimal subluxation but no dislocations. If the reduction was difficult to obtain with traction or manipulation alone, a K-wire was used as a "joystick" to push the metatarsal or cuneiform into an adequate position and was then advanced into a stable area of the mid- or hindfoot. Once improvement was noted on fluoroscopy, stabilization of the midfoot was achieved using three or four 2.0 mm K-wires. (Fig. 2A, B) Post-operatively, a bulky Jones dressing and splints were applied and were changed weekly during scheduled follow-up visits. All pins were left in position until the time of definitive fixation. (Fig. 3A, B)

Results

Fourteen of the fifteen patients (93%) completed the staged protocol and ultimately underwent definitive fixation. Transportation issues occurred in two patients resulting in a delay in transfer (120 h each) to our institution. Surgery was also delayed in three other patients who presented as a polytrauma (seventy-two, forty-eight and twenty-seven hours, respectively), until medical stability had been obtained. Therefore, the index procedure for all patients was performed at an average of 33.9 h (range 4–120) from the patient's time of injury. Excluding these afore mentioned five patients, the time to surgery averaged 9.7 h (range four to eighteen). Fluoroscopic evaluation, at the time of the index reduction, demonstrated an improved alignment in all patients. Definitive fixation was performed at an average of 18.6 days (range two to thirty-seven) and patients were followed for an average of 192.6 days (range 63 to 362). (Table 1) No compartment syndromes of the foot or vascular insufficiency were identified as a result of the index surgery.