



## Outcome of surgically treated Lisfranc injury: A review of 34 cases

### Cerrahi olarak tedavi edilen Lisfranc yaralanmasının sonucu? 34 olgunun değerlendirilmesi

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#### BACKGROUND

We reviewed cases with Lisfranc injuries who presented to our center in order to study the adequacy of the treatment method and their final functional outcome.

#### METHODS

This is a retrospective review of 34 cases diagnosed with Lisfranc injuries treated at our center from 2000 to 2006. This review is aimed to determine the demography and functional outcome of all patients with Lisfranc injury treated during this period.

#### RESULTS

The injury was classified based on the "Hardcastle and Associates Classification". In our review, we found that the commonest Lisfranc injury was type B2 (41%). These injuries are mostly fixed with K-wires (76.5%). All patients assessed with Bristol Foot Score (BFS) had a good score in all categories, with a total score ranging from 16 to 25.

#### CONCLUSION

We concluded that all Lisfranc injuries, whether treated with closed or open fixation methods, demonstrated a good long-term functional outcome.

**Key Words:** Lisfranc injuries; functional outcome.

#### AMAÇ

Merkezimize başvuran Lisfranc yaralanması olan olgular, tedavi yöntemi ve nihai fonksiyonel sonuçları incelenerek değerlendirildi.

#### GEREÇ VE YÖNTEM

Bu retrospektif çalışmada, merkezimizde 2000 ile 2006 yılları arasında Lisfranc yaralanması tanısıyla tedavi edilen 34 olgunun sonuçları değerlendirildi. Bu yazıyla, bu dönemde tedavi edilen Lisfranc yaralanması olan tüm hastaların demografik ve fonksiyonel sonucun belirlenmesi amaçlandı.

#### BULGULAR

Yaralanmalar "Hardcastle ve Arkadaşlarının Sınıflaması"na göre sınıflandırıldı. En yaygın Lisfranc yaralanması tipi, tip B2 (%41) oldu. Bu yaralanmalar, çoğunlukla K-telleri ile sabitlendi (%76,5). Bristol Foot Skoru (BFS) ile değerlendirilen hastalar, 16 ile 25 arasında değişen toplam skor ile bütün kategorilerde iyi bir skora sahipti.

#### SONUÇ

İster kapalı ister açık fiksasyon yöntemleri ile tedavi edilsin, bütün Lisfranc yaralanmalarının iyi bir uzun süreli fonksiyonel sonuç gösterdiğini düşünüyoruz.

**Anahtar Sözcükler:** Lisfranc yaralanmaları; fonksiyonel sonuç.

Fracture dislocation of the tarsometatarsal joint of the foot (Lisfranc injury) is a serious injury. It is rare, with less than 1% ever reported in the literature.<sup>[1-4]</sup> However, the true incidence is probably higher and is increasing daily due to the increased number of motor vehicle accidents, industrial accidents and sports

injuries. Traumatic tarsometatarsal injuries are usually accompanied by multiple other injuries and may be caused by a high-energy motor vehicle or industrial accident. These injuries can be caused by a direct or indirect mechanism. They normally present as open fractures and are associated with soft tissue injuries,

such as degloving injuries and bone and cartilage loss.

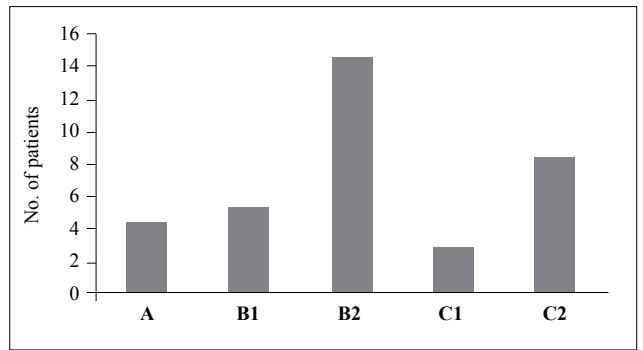
Isolated Lisfranc injuries are more common in sports injuries and occur as a result of a sudden torque applied to the foot when a portion of it is fixed or by axial loading of the foot in a vertical position. The Lisfranc joint consist of articulation of first and second metatarsal bases with the first and second cuneiform bones. It is held together by the Lisfranc ligament, which is a band of ligamentous tissue that connects the medial cuneiform and the base of the second metatarsal. Thus, the Lisfranc joint is considered the “key-stone” of the midfoot due to the wedging of the second metatarsal into the second cuneiform space. The joint is also the focal point of all tarsometatarsal articulation.<sup>[3-6]</sup>

Radiographs taken of the injured foot would reveal an abnormal space between the bases of the first and second metatarsal. This can be easily missed in the Accident and Emergency setting. Failure to recognize this can lead to chronic pain and impairment.<sup>[1]</sup> A good outcome to this injury depends on accurate anatomical reduction.<sup>[1,2,4]</sup> Lisfranc injuries are mostly treated with percutaneous K-wire fixation or temporary screw fixation whether using closed or open reduction technique. The reported results are related to the accuracy of reduction and also to the severity of associated articular and soft tissue damage. Conservative casting of the injuries without fixation has not proven to be effective.

We reviewed cases of Lisfranc injuries presenting to our center in order to study the adequacy of the treatment method and their final functional outcome.

**MATERIALS AND METHODS**

This was a retrospective study carried out from 1 January 2000 to 31 December 2006. Patients were identified by reviewing the operating theater records. Patients’ records were then traced from the records department and the X-rays were traced from the Radiology Department. The radiographs were evaluated by an independent reviewer from the Radiology Department. The radiographs taken at diagnosis and initial follow-up are usually in three views, as anterior-posterior, lateral and oblique. Once the injury had



**Fig. 1.** Distribution of patients according to Hardcastle classification.

healed, weight-bearing stress radiographs were taken to determine any subtle instability. All cases had a radiograph of the affected foot taken at their last follow-up.

These injuries were classically evaluated with the Hardcastle Classification.<sup>[1]</sup> We used the Modified Hardcastle Classification<sup>[7]</sup> for this study (Table 1). Patients were then contacted for further evaluation, and all data were entered in the data collection form. This qualitative assessment was developed based on an evaluation performed using the Bristol Foot Score (BFS).<sup>[8]</sup> As it is a self-administered assessment, there are no inter-observer variations. The entire questionnaire can be completed within 3 to 5 minutes, encouraging better response levels. It consists of questions regarding the function, i.e. mobility, pain, footwear, foot health, and disability, and self-perception as a result of the foot problems. We also repeated radiographs of the affected foot during the evaluation to study the current status of the injury.

**RESULTS**

Over this study, we identified 34 patients with Lisfranc injuries. The majority of the patients were males, with only one female. The average age of our patients was 30 years, with the majority (85%) between 18 to 45 years old. Two cases were younger than 18 years of age and three were older than 45 years of age. The mean follow-up was 48 months (range: 8-72 months).

These injuries were sustained via motor vehicle ac-

**Table 1.** Hardcastle classification

<b>Type A</b> (total incongruity)	All five metatarsals are displaced as a unit.
<b>Type B1</b> (partial incongruity)	The first metatarsal is displaced medially with or without displacement of one or more of the other metatarsals.
<b>Type B2</b> (partial incongruity)	The first metatarsal remains intact whereas there is lateral displacement of one or more other metatarsals.
<b>Type C1</b> (divergent/partial displacement)	The first metatarsal is displaced medially with less than four of the other metatarsals displaced laterally.
<b>Type C2</b> (divergent/total displacement)	The first metatarsal is displaced medially and all the others are displaced laterally.

cident in 21 cases, industrial accident in 8 and sports injury in 1; in 4 cases, they were due to other causes. There was almost equal involvement of both feet (right foot: 18 cases, left foot: 16 cases). There were 20 cases of isolated injury and 14 cases related with polytrauma. Twenty-five patients (74%) had closed injuries and 9 (26%) open injuries.

In our series, 4 patients sustained type A injury, 5 type B1, 14 type B2, 3 type C1, and 8 type C2 injury, based on Hardcastle Classification (Fig. 1).

All the patients were treated surgically. For closed isolated injuries, the surgery was carried out on an elective basis within two days of injury and for cases of polytrauma, the reduction was done as soon as possible on an emergency basis. There was only one case that was initially treated conservatively by closed manual reduction (conservative), but the post-reduction radiograph showed that there was still displacement and the patient was subsequently stabilized operatively. In

**Table 2.** Distribution of patients according to type of fixation

Type of fixation	No. of patients
Closed reduction & percutaneous K-wire	11
Open reduction & K-wire fixation	15
Open reduction & screw fixation	5
Open reduction with K-wire & screw fixation	3

all patients, the operated foot was immobilized in a below-knee back slab for eight weeks postoperatively. After eight weeks, the K-wires were removed and these patients were allowed partial weight-bearing for the subsequent three weeks, followed by full weight-bearing.

The methods of fixation used are shown in Table 2, and consisted of close manual reduction with percutaneous K-wire, open reduction with K-wire or screw fixation (as shown in Fig. 2) or both K-wire and screw

**Table 3.** Patient demographics

No	Age	Sex	Etiology	Site	Nature of injury	Hardcastle classification	Operation done	BFS	Isolated of polytrauma
1	57	Male	Fall	Right	Closed	B1	ORIF, screw & K-wire	23	Isolated
2	43	Male	MVA	Right	Open	B1	CMR, p/c K-wire	24	Polytrauma
3	17	Male	Sports	Right	Closed	B2	CMR, p/c K-wire	20	Isolated
4	24	Male	Industrial	Left	Closed	B2	OR & K-wire	24	Isolated
5	25	Male	MVA	Left	Closed	C2	OR & K-wire	25	Isolated
6	55	Male	MVA	Right	Closed	B2	ORIF & screw fix	24	Isolated
7	18	Male	MVA	Left	Closed	B2	CMR, p/c K-wire	15	Polytrauma
8	27	Male	MVA	Right	Open	B2	OR & K-wire	24	Polytrauma
9	44	Male	MVA	Right	Open	C2	OR & K-wire	16	Isolated
10	21	Male	MVA	Right	Open	B2	OR & K-wire	15	Polytrauma
11	28	Male	MVA	Left	Closed	B1	ORIF, screw & K-wire	23	Polytrauma
12	21	Male	MVA	Left	Closed	C2	ORIF, screw & K-wire	25	Isolated
13	25	Male	MVA	Left	Closed	B2	ORIF & screw fix	16	Isolated
14	33	Male	Industrial	Right	Closed	B2	ORIF & screw fix	20	Isolated
15	23	Male	MVA	Left	Closed	B2	OR & K-wire	18	Isolated
16	22	Male	Industrial	Right	Closed	A	CMR, p/c K-wire	20	Polytrauma
17	23	Male	Industrial	Right	Open	C2	OR & K-wire	23	Isolated
18	29	Male	Industrial	Right	Closed	C2	CMR, p/c K-wire	18	Isolated
19	35	Female	Fall	Left	Closed	B2	CMR, p/c K-wire	16	Isolated
20	48	Male	MVA	Left	Open	C1	OR & K-wire	25	Polytrauma
21	37	Male	MVA	Left	Closed	C1	OR & K-wire	20	Isolated
22	21	Male	Industrial	Right	Closed	A	CMR, p/c K-wire	15	Isolated
23	19	Male	Fall	Right	Closed	B1	OR & K-wire	16	Polytrauma
24	23	Male	MVA	Right	Open	C2	OR & K-wire	24	Polytrauma
25	28	Male	MVA	Right	Open	C2	OR & K-wire	23	Isolated
26	28	Male	MVA	Right	Closed	C2	CMR, p/c K-wire	16	Polytrauma
27	20	Male	Industrial	Left	Closed	B2	ORIF & screw fix	18	Polytrauma
28	34	Male	MVA	Right	Closed	B2	CMR, p/c K-wire	20	Polytrauma
29	34	Male	Fall	Left	Closed	B2	CMR, p/c K-wire	25	Isolated
30	22	Male	MVA	Left	Closed	A	ORIF & screw fix	23	Polytrauma
31	29	Male	Industrial	Left	Closed	A	CMR, p/c K-wire	15	Isolated
32	32	Male	MVA	Left	Open	B1	OR & K-wire	16	Isolated
33	36	Male	MVA	Right	Closed	B2	OR & K-wire	25	Isolated
34	30	Male	MVA	Right	Closed	C1	OR & K-wire	24	Polytrauma

MVA: Motor vehicle accident; ORIF: Open reduction internal fixation; CMR: Closed manipulative reduction; p/c: Percutaneous; OR: Open reduction.



**Fig. 2.** Type B Lisfranc injury fixed with screw fixation.  
*Type B: Pre and post reduction.*

fixation. The majority of the patients (44%) were treated with open reduction and K-wire fixation. In our series, an average of 2 K-wires or 2 screws were used for the fixation. In unstable cases, a combination of 2 screws and 2 K-wires was used. There were no cases of displacement of the Lisfranc injury as of the latest follow-up.

Functional outcome was assessed using the BFS. All patients assessed with BFS had a good score in all categories, with a total score ranging from 16 to 25 (scores ranging from 15 to 42 were considered as a good functional outcome). Details are shown in Table 3. There was only one patient in our series with symptoms of osteoarthritis.

## DISCUSSION

The etiology of Lisfranc injuries has changed over time. The commonest cause of Lisfranc injuries in our series was motor vehicle accident, followed by industrial accidents. These injuries are a result of direct crushing force or an indirect pronation force acting on a fixed forefoot in equines. The commonest type encountered in our center was type B2 (41%), followed by type C2 (23%), type B1 (15%), type A (12%), and the least common, type C1 (9%). This is in contrast to a series reported by Aitken and Poulson,<sup>[5]</sup> in which there was dorsolateral displacement of all five metatarsals, or the series reported by Wilppula,<sup>[9]</sup> in which dorsolateral displacement of four lateral metatarsals was the commonest injury.

We treated the majority (76.5%) of these injuries with reduction and K-wiring either percutaneously or via the open method. None of our patients experienced any displacement of the reduction, and the method of fixation was adequate until healing occurred. We removed all the K-wires at the postoperative eighth week. This is similar to the protocol used by Rajapakse.<sup>[10]</sup> However, in his series, he also removed the screws after six months, which we did not do. This is in contrast to what has been reported by Aitken.<sup>[5]</sup> In his series, he felt that temporary fixation with K-wires was inadequate as it led to eventual displacement. Gaweda<sup>[11]</sup> reported, in his series of 41 patients with

acute and chronic Lisfranc injuries followed for 16 years, that the best results were achieved after closed reduction and percutaneous K-wire fixation in acute cases. Teng et al.<sup>[12]</sup> analyzed the gait of the injured foot and the control foot in cases of Lisfranc injury with anatomic reduction, and showed no significant difference in the parameters. Therefore, anatomic reduction of the Lisfranc injury is essential to restore normal function of the foot.

In our series, we did not encounter any major complication, such as vascular impairment, compartment syndrome, redisplacement of the Lisfranc injury post-fixation, or skin complications. We had only one case that had immediate displacement after closed manual reduction and casting, which had to be fixed electively with closed K-wiring. Jeifreys<sup>[13]</sup> reported in his series that osteoarthritis is almost an inevitable sequela of Lisfranc injury, and Hardcastle<sup>[1]</sup> reported in his series an osteoarthritis rate of 30%. We encountered only one patient with signs and symptoms of osteoarthritis in our series - a 44-year-old male who presented with an isolated open Lisfranc injury (type C2). His injury was fixed with open reduction and K-wiring. He developed symptoms of osteoarthritis 13 months after the surgery.

In our study, we used the Modified Hardcastle Classification to classify the Lisfranc injuries. Talari-co<sup>[14]</sup> studied the interrater reliability of this classification and concluded that there is moderate interrater agreement among clinicians when using this scale for interpreting Lisfranc injuries. For the functional score, we used the BFS, which is a useful tool for evaluating the efficacy of interventions and for describing foot health within populations. The BFS was designed to produce a measure that quantifies, from the patient's rather than the clinician's perspective, the impact that foot problems has on their everyday life. This will enable the health services to provide more responsive and equitable care. It also displays good internal reliability, loading predominantly on a single factor that addresses the feet and perceived disability. The BFS provide a valuable additional contribution to professional foot-health status scores and potentially uncovers subtle psychological factors that influence behavior and outcomes.<sup>[7]</sup> All the patients in our series scored within the range of good functional outcome (15-42) regardless of the fixation methods used or type of Lisfranc injury sustained.

In conclusion, all Lisfranc injuries treated in our center, regardless of the severity of the injury or method of treatment, demonstrated a good long-term functional outcome based on the BFS. We found that both K-wire and screw fixation were adequate in achieving an acceptable anatomical reduction until the injury healing occurred.

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