

Lisfranc fracture-dislocation: screw vs. K-wire fixation

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Introduction. Fracture-dislocations of the tarso-metatarsal joint are a relatively rare injury, but their long-term consequences can be devastating for the patient. The aim of this study is to analyze the results obtained by surgical treatment.

Materials and methods. The authors reviewed 26 patients between 1995 and 2006. Fractures were classified according to the Myerson & Hardcastle classification. All patients were treated by emergency surgery by means of either screws or K-wires. The AOFAS functional scale was used to assess results in the midfoot; patient satisfaction was also evaluated.

Results. After a mean 5-year follow-up, the mean score on the AOFAS scale was 85.38 points, with a high level of satisfaction in nearly all patients. Results obtained with screw fixation were slightly better than those with K-wires.

Conclusions. Like most authors, we believe that the best results are to be obtained by the immediate reduction and fixation of the injury. We rule out nonoperative treatment and favor an ORIF procedure with screws provided that the condition of the soft tissues allows it.

Fractura-luxación de Lisfranc. Osteosíntesis con tornillos frente a agujas de Kirschner

Introducción. La fractura-luxación de la articulación tarso-metatarsiana es una lesión relativamente infrecuente, pero cuyas consecuencias a largo plazo pueden ser devastadoras para el paciente. El objetivo de este estudio fue analizar los resultados del tratamiento quirúrgico.

Material y método. Los autores presentan una revisión de 26 pacientes tratados entre los años 1995 y 2006. Las fracturas fueron clasificadas según Myerson y Hardcastle. Todos los pacientes fueron tratados quirúrgicamente de urgencia usando tornillos o agujas de Kirschner. Para la valoración de resultados se utilizó la escala de valoración funcional de la AOFAS para el mediopié, analizando también el grado de satisfacción subjetiva de los pacientes.

Resultados. Tras un seguimiento medio de 5 años, la puntuación media en la escala AOFAS fue de 85,38 puntos, siendo el grado de satisfacción alto en casi todos los pacientes. Los resultados conseguidos en la osteosíntesis con tornillos fueron ligeramente superiores a los obtenidos con agujas de Kirschner.

Conclusiones. Como la mayoría de autores, recomendamos la urgente reducción y síntesis de la lesión para conseguir los mejores resultados, descartando como opción el tratamiento ortopédico e inclinándonos por una reducción abierta y fijación interna con tornillos, siempre que el estado de las partes blandas lo permita.

Key words: foot, Lisfranc joint, fracture-dislocation.

Palabras clave: pie, articulación de Lisfranc, fractura-luxación.

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The fracture-dislocation of the tarso-metatarsal joint is a relatively infrequent injury, 1/55,000 people per year¹⁻⁶, however, it can have devastating long-term effects for the patient. At present the most common mechanisms of injury are high energy mechanisms, vehicle accidents and occupational accidents^{3,4,7-9}. It is an injury that often appears in

multiple trauma patients or associated to other injuries of the lower limbs, due to which it may be overlooked or its diagnosis deferred (20% of the cases)^{2-4,7}.

The most widely accepted treatment is anatomic reduction of the dislocation, be it by open or closed methods, and fixation of the dislocation^{2,4,10} by means of the Kirschner wire, 3.5mm screws¹³⁻¹⁵ or dorsal plates. Primary arthrodesis, according to several authors, must be used in cases of great comminution and displacement, or it could also be the chosen treatment in this kind of injury^{7,14,16-19}.

The aim of this study is to evaluate the results of the treatment of Lisfranc fracture-dislocations in our hospital between the years 1995 and 2006 in relation to the type of fixation used and trying to identify whether a preferable method exists as well as which are the negative prognosis factors.

MATERIALS AND METHODS

We carried out a retrospective study on 26 patients with a diagnosis of tarso-metatarsal fracture-dislocation who were treated in our department in the last 10 years. All the patients were included in the study once we had reviewed their x-rays and confirmed their correspondence with the diagnosis. We classified the injuries we observed following Myerson^{9,18} (Table 1), and Hardcastle et al²⁰ (Table 2).

We measured the distance between the bases of the 1st and 2nd metatarsals and the alignment between the base of the 1st metatarsal and the medial cuneiform on the sagittal plane in the radiographic post-surgical control and after a year's evolution, taking them as indicators of the final degree of anatomic reduction. At the end of follow-up, we searched for signs of osteoarthritis and the results obtained were analyzed according to the functional value scale, 0 to 100 points using the AOFAS midfoot score²¹, taking 90-100 points as *excellent*, 80-89 as *good*, 65-79 as *fair* and less than 65 as *poor*. The subjective evaluation of the patients was obtained by an analogical visual scale of pain going from 0 to 10 points (no pain—maximum possible pain) and a questionnaire about satisfaction and quality of life for pa-

tients with pain that is called Espiditest that establishes three groups ranging from a superior to an inferior quality of life: group A (mild pain, 0-48 points), group B (moderate pain, 49-62 points) and group C (intense pain, more than 65 points).

We finally classified patients into two groups, according to the treatment they had received (screw or wire) and in relation to factors that could possibly lead to a negative prognosis, analyzing the results with the statistical program SPSS, taking amounts equal or less than 0.05 as significance level p.

RESULTS

The mean follow-up period of the 26 patients was 53 months (range 6-134 months). The average age of the series was 36 (range 14-66 years), 80.8% of which were males (21 males and 5 females). The left foot was affected on 17 occasions (65.4%), whereas the right foot was affected 9 times (34.6%). 73.1% of the injuries were caused by high energy traumas, vehicle accidents being the most common etiology (13 cases), followed by falls from heights (6 cases). Simple falls produced injuries on 5 occasions (19.2%).

According to the classifications of Hardcastle et al²⁰ and of Myerson^{9,18} there were 14 cases of type A injuries (53.8%), 9 type B injuries (34.6%; 11.5% B1 and 23.1% B2) and 3 type C injuries (11.5%; 7.7% C1 and 3.8% C2).

In all the cases except one, the injury was closed, and there were no bilateral injuries or cases of pure dislocation. The most common concomitant injuries at the level of the tarso-metatarsal joint were the ones of the base of the 2nd metatarsal on 92% of the occasions, followed by one case of scaphoid fracture and another injury at the level of the cuboid bone. As a consequence of the great intensity of the trauma, 50% of the patients presented with fractures associated to other levels, 71% in the lower limbs, 13% in the upper limbs, 8% in the thorax and 8% in other locations.

As regards the treatment, there were 21 emergency cases, in 5 of which the injury was at first overlooked and they

Table 1. Myerson's classification

Type A (total incongruity)
Lateral or dorsoplantar dislocation of the 1st-5th metatarsals
Type B (partial incongruity)
B1: Medial dislocation of 1st metatarsal
B2: Lateral dislocation of 2nd-5th metatarsals
Type C (divergent)
C1: partial displacement of any of the 2nd-5th metatarsal laterally and 1st metatarsal medially
C2: total displacement of the 2nd-5th metatarsals laterally and 1st metatarsal medially

Source: Myerson et al¹⁸.

Table 2. Hardcastle's classification

Type A (total incongruity)
All the metatarsals are dislocated and together move as a unit in one direction
Type B (partial incongruity)
B1: medial displacement of the first metatarsal
B2: lateral displacement of the 2nd to 5th metatarsals
Type C (divergent)
Medial displacement of the 1st metatarsal and lateral displacement of the 2nd-5th metatarsals

Source: Hardcastle²⁰.

were treated with a 10-day delay at most. The reduction was closed on 7 occasions and open on 19. In 15 patients the reduction was stabilized with Kirschner wire and in 11 cases with normally cannulated 3.5mm screws. A post-surgical cast splint for immobilization was placed in all the patients during an average period of 4.9 weeks, initiating progressive partial loading at 7.7 weeks on average.

On two occasions reduction was not considered to be anatomical, since the distance between the base of the first and the second metatarsals was greater than 5mm. On one occasion there was a secondary loss of reduction which was observed in later radiographic controls in a patient treated with Kirschner wire; the other was a case of an insufficient surgical reduction in a patient treated with closed reduction and Kirschner wire. On another occasion a 3mm distance between the 1st and 2nd metatarsals was observed in an open reduction and fixation with screws, and in the remaining cases the distance was inferior to 3mm.

Osteosynthesis material was removed in 22 patients (84.6%) between post-surgical weeks 6.a and 28.a (7.5 weeks, on average).

With respect to the complications that were found, 46% of the patients showed the degenerative changes of secondary osteoarthritis one year after radiographic studies. There was one case of paresthesia at the level of the first

finger that was resolved spontaneously, one case of complex regional pain syndrome that was resolved with medical treatment and physiotherapy, one rupture of osteosynthesis material after healing in a patient treated with screws and for whom surgical extraction was ruled out, and one case of cutaneous necrosis that needed a graft.

The mean total was 85.38, which was obtained using the AOFAS midfoot score, in which 15 registered *excellent* or *good* (more than 80 points) and two scored *poor* (under 65 points) (Table 3). As regards the subjective evaluation of the patients, one case presented with continuous intense pain, another with moderate pain and in 7 patients the pain was mild—the remaining patients manifesting no pain and 89.6% being satisfied with the results they obtained. The patient that presented with continuous intense pain was treated with arthrodesis.

Patients under 45 years of age obtained a mean score of 81.55 whereas those of over 45 years of age obtained 94, thus an age component of under 45 was considered a negative prognosis factor.

No statistically significant differences were found regarding the mechanism of injury, the scoring being similar in all the groups. This leads us to conclude that the mechanism of injury is not in itself a factor of negative prognosis as has been commonly thought.

Table 3. Main data in our study

Case	Gender	Age (years)	Follow-up (months)	Etiology	Type	Treatment	Delay (days)	AOFAS (points)	Complications
1	M	25	18	Fall from height	A	Screws	0	79	
2	M	64	26	Fall from height	A	Pins	1	95	
3	M	17	22	Sports accident	B	Screws	0	79	
4	M	18	10	Vehicle acc.	C	Pins	0	79	
5	M	63	43	Fall from height	A	Screws	0	100	
6	M	66	38	Vehicle acc.	A	Screws	0	100	Foot paresthesia
7	M	37	55	Direct blow	C	Pins	0	78	
8	M	61	35	Simple fall	A	Screws	3	93	
9	M	18	19	Vehicle acc.	B	Screws	0	100	
10	M	14	38	Vehicle acc.	B	Pins	0	100	
11	M	27	27	Vehicle acc.	B	Screws	0	88	
12	F	66	54	Simple fall	A	Pins	4	93	
13	F	36	71	Simple fall	B	Pins	7	58	
14	M	25	112	Vehicle acc.	B	Pins	0	88	Südeck
15	F	47	112	Vehicle acc.	A	Pins	0	93	
16	M	30	50	Simple fall	A	Screws	0	93	
17	M	33	52	Fall from height	A	Pins	0	79	
18	M	17	61	Vehicle acc.	A	Screws	0	95	Material broken
19	F	29	8	Vehicle acc.	B	Pins	0	82	
20	M	45	129	Vehicle acc.	B	Pins	0	78	
21	M	26	118	Fall from height	A	Screws	0	79	
22	F	33	6	Fall from height	C	Pins	0	78	
23	M	24	134	Vehicle acc.	A	Pins	10	13	Reoperation
24	M	26	92	Vehicle acc.	A	Pins	0	100	Skin necrosis
25	M	18	6	Vehicle acc.	B	Screws	0	100	
26	M	63	46	Simple fall	A	Pins	0	100	

M: male; F: female.

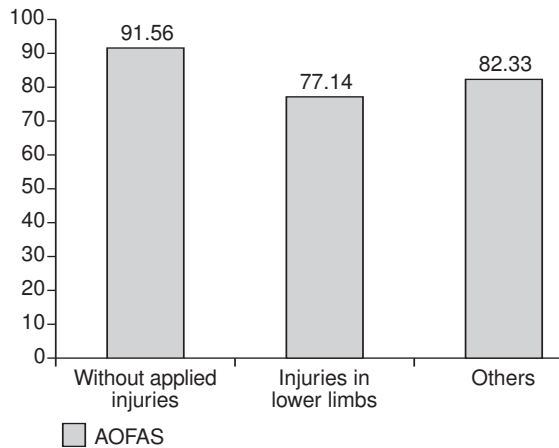


Figure 1. Mean AOFAS score comparing patients with and without associated injuries. Injuries in lower limbs.

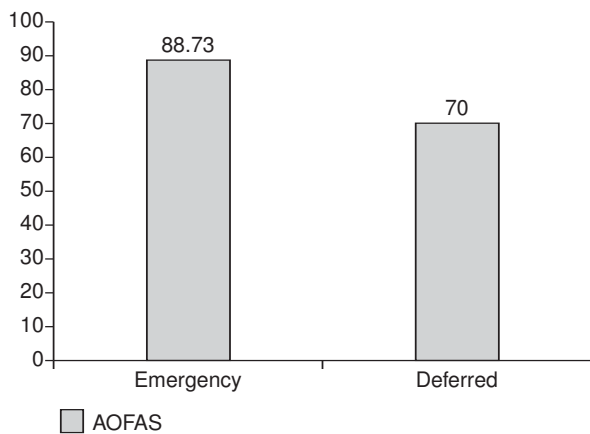


Figure 2. Mean AOFAS score comparing patients with emergency vs. deferred diagnosis and treatment.

The patients that did not present with associated injuries showed mean scores of 91.5 points, whereas those that had injuries in the lower limbs obtained a score of 77.14 (fig. 1), the difference being statistically significant ($p < 0,05$).

In the group that received emergency diagnosis and treatment the mean score was 88.73 points, whereas in the group of patients with deferred diagnosis and treatment it was 70 (fig. 2), the difference being statistically relevant ($p < 0,01$).

Analyzing results in relation to type of injury, we found that type C obtained the lowest scores (78.33 on average), the difference not being statistically significant due to the small size of the sample.

Anatomic reduction is also a fundamental factor for prognosis: a mean total of 35.5 was obtained when anatomic reduction was not achieved. As regards the type of reduction, higher scores were obtained with open reduction (89.6)

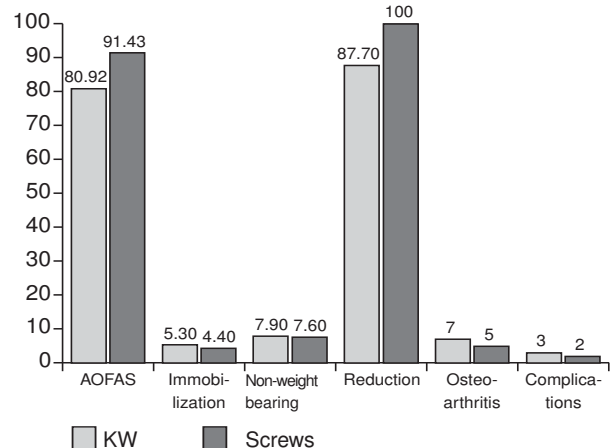


Figure 3. Comparison between cases treated with screws and with wire: Mean AOFAS scores, immobilization, non-weight bearing, anatomic reduction, osteoarthritis and complications. Kirschner wire.

than with the closed type (74.3), this being a statistically significant difference ($p < 0,05$).

Also, the patients were divided into two groups according to the kind of treatment they received (fig. 3), obtaining scores of 91.4 for those with screws and 80.9 for those with Kirschner wire, using the AOFAS midfoot score. All the patients with screws and 87.7% of those with Kirschner wire underwent anatomic reduction. The results for immobilization, non-weight bearing, secondary osteoarthritis and other complications were similar in the two groups. By excluding the Hardcastle type C injuries, treated only with wire, so as to avoid a bias in the statistical analysis, we confirmed that the results were the same, the mean score for the Kirschner wire increasing only by 0.6 points.

DISCUSSION

The injuries of the tarso-metatarsal joint are rather infrequent, but they may cause pain and permanent disability due to their location and the high demand when standing and walking^{13,17,22,23}, especially in those cases in which the injury is overlooked.

This fact is especially significant if we take into account that young males are the ones most affected by this kind of injury^{3,4,11,13,22-24} and that the percentage of delays in the diagnosis and treatment is high^{4,8,13,25}—19.2% in our series. This kind of injury occasionally presents little radiographic significance, but the injury of the Lisfranc ligament produces different degrees of dislocation and radiographic diastasis, both of which can bring about severe disability^{16,22,26-28}. Thus, those cases that are diagnosed as midtarsal sprain, with pain and persistent swelling in fact require exhaustive study²² with dorsoplantar, lateral and oblique 30° x-rays, axial CT-scan, MRI, or stress maneuvers^{13,26}.



Figure 4. Sixty-six year old patient with Lisfranc fracture-dislocation type A, following a vehicle accident. Initial x-ray (A), post-surgical (B) and at end of follow-up and after extraction of osteosynthesis material (C).

The mechanisms of injury can be direct or indirect²⁸, high-energy trauma being the most common cause in our series. There were 19 cases (73.1%), a rate that is similar to others found in the literature^{9,20}. We observed a significant percentage of simple low-energy falls (19.2%), basically in people over the age of 60.

In the cases with a deferred diagnosis we observed more unfavorable functional results²⁷ which were directly proportional to the length of time that elapsed between diagnosis and treatment: the longer the period of delay the lower the score.

Age is another significant prognostic factor, results being more positive in older people due to a lower functional demand and because they often present type A and B fractures following low-energy mechanisms.

People with associated injuries, chiefly in the lower limbs, also present a more unfavorable prognosis due to a longer period of immobilization, non-weight bearing and longer rehabilitation delay.

Type C fractures are the ones that present the lowest scores, thus conditioning a less favorable prognosis. The mechanism of injury does not imply in itself an unfavorable prognosis as was traditionally thought. The least favorable functional result for high-energy trauma was found in the high frequency type C fractures, in associated injuries, in the under-45 age group or in cases of deferred diagnosis.

The most important prognostic factor is directly related with obtaining correct reduction^{3,6,9-11,13,16,25}. It has been shown that those patients with an adequate anatomic reduc-

tion obtain a higher score in the AOFAS functional scale and present a lower prevalence of post-traumatic arthrosis¹⁰. To achieve this aim we find it necessary to perform emergency surgical treatment^{13,19} with open reduction and internal fixation with 3.5mm screws^{13,22}—at least for a medial stabilization—producing a more stable fixation (earlier stabilization), a lower rate of secondary displacement and a lower risk of secondary osteoarthritis (figs. 4 and 5). Stabilization with Kirschner wire should be used in the lateral region, for concomitant injuries or when soft tissue is in poor conditions (fig. 6). Taking a conservative attitude by choosing the use of closed reduction and cast boot, should not be considered a therapeutic option in this type of injury, since it implies a high rate of reduction loss^{2,3,6-8,11,12,18}. Arthrodesis should be retained for cases of salvage surgery, although some authors advocate its initial use in fractures with intense comminution or displacement (type C), deferred injuries or ligament type Lisfranc fracture, due to its high post-traumatic osteoarthritis incidence¹⁹.

Concerning the number and placement of screws, we recommend first treating the instabilities of cuneiforms or cuboids and tarso-metatarsal surface joints (minifragment screws or screws detached from the fragment). Subsequently, one screw should be placed to fix the median cuneiform to the base of the 2nd metatarsal and another one to fix the base of the 3rd metatarsal to the lateral cuneiform. The 4th and 5th metatarsals can be fixed to the cuboid by means of screws or wire. Lastly, the 1st metatarsal is fixed to the median cuneiform.



Figure 5. Twenty-seven year old patient with Lisfranc fracture-dislocation type B2, after vehicle accident. Initial x-ray (A), post-surgical (B) and at end of follow-up (C), where a reduction deficiency inferior to 5mm can be observed between 1st and 2nd metatarsals.



Figure 6. Sixty-four year old patient with Lisfranc fracture-dislocation type A, after a fall from height. Initial x-ray (A), post-surgical (B) and at end of follow-up (C), where a reduction deficiency greater than 5mm can be observed between 1st and 2nd metatarsals.

75% of our patients obtained a score equal to or above 80 points on the AOFAS scale, and 88% were satisfied with the result. These data, which are similar to those found in other series, entitle us to state that the Lisfranc fracture-dis-

location does not have such a negative prognosis as has traditionally been thought. Osteoarthritis is the most frequently found deferral complication (46%), which nevertheless does not correspond directly with less favorable functional re-

sults^{3,6}. Osteoarthritis appears even in patients with anatomic reduction, although it is more common in those cases in which reduction is not achieved.

The meaning of the term «anatomic reduction» with respect to the Lisfranc fracture-dislocation varies according to the different authors, being under 2mm for Myerson^{9,18} and under 1.5mm for Hardcastle, though it has been widely agreed that a diastasis of over 5mm between the bases of the 1st and 2nd metatarsals and associated to a sinking plantar arch brings about an unfavorable evolution in most cases. However, according to Giannini⁷ the functional result can be favorable if this last factor is absent.

When there is a reduction deficiency, the most frequently found residual deformity is a flat adult foot, which often demands treatment with arthrodesis⁷.

In our series we found one case of arthrodesis due to flat foot and another case of a diastasis of over 5mm without sinking of the plantar arch that has not required arthrodesis up to the present moment (fig. 6).

In conclusion, we obtained the most favorable functional results in the cases in which there was emergency surgical treatment, anatomic reduction was obtained through open methods and screw synthesis, the type of fracture was A or B according to Hardcastle, age was over 45 and there were no associated injuries.

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Conflict of interests

The authors have declared that they have no conflict of interests.