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Injuries of the Tarsometatarsal Joints: Treatment and Outcome

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A B S T R A C T

Between January 2005 and May 2009, a total of 26 patients, 21 males and 5 females, were admitted for treatment of Lisfranc lesion. All patients were radiologically evaluated and classified according to the criteria proposed by Myerson: 5 (19.2%) patients had a type A injury, 2 patients (7.7%) presented with a type B1 injury, 17 (65.4%) sustained the most common type B2 injury and 1 (3.8%) patient suffered from a type C1 and C2 injury. Taking radiological and clinical findings in account, fifteen patients were elected for operative treatment and eleven patients were treated conservatively. According to type of fracture we established three groups; in group I metatarsal fracture was found in fourteen (53.9%) patients, group II with phalangeal fracture in three (11.5%) cases, whereas in group III nine (34.6%) patients sustained combined metatarsal, navicular and, most commonly, a cuneiform fracture.Using the American Orthopedic Foot and Ankle Society (AOFAS) midfoot scoring scale and SF-36 questionnaire, the functional outcome was assessed. The mean value for age distribution was 42.7±13.2 years and the mean follow up was 27.9±12.4 months. A p value <0.005 was regarded as statistically significant for the analysis of the results. We found by means of SF 36 questionnaire a statistically significant difference in the role limitation due to existence of pain (p=0.04) and poor general health (p= 0.013) in the group of patients that sustained combined foot fracture. The purpose of this study is to assess the treatment of Lisfranc injuries in our patients, according to SF 36 and AOFAS criteria, clinical outcome was evaluated. In the group I the mean AOFAS score was 74.0±9.1 and in the group II it reached 72.0±5.2 signifyng fair outcome! Poor outcome was present in the group III with mean AOFAS score 67.1±9.0. All unstable injuries require surgery. Clinical outcome is highly dependent on the restoration of normal anatomic alignment.

***Key words**: tarsometatarsal injury, dislocation, clinical outcome*

Introduction

The eponym »Lisfranc injury« represents a wide spectrum of injuries in the tarsometatarsal area. The incidence is statistically low, accounting for 0.2% of all fractures according to some authors[1]. Quenu and Kuss described the first classification system for Lisfranc injuries[2]. This classification system was modified by Hardcastle in 1982, while in 1986, Myerson et al., further modified the Hardcastle classification[3] (Figure 1).

Type A is a total incongruent tarsometatarsal joint complex. Types B1 is a partial incongruity with medial displacement affecting the first ray or first metatarsal, and B2 is partial incongruity resulting in lateral displacement of one or more lesser metatarsals. Types C1 and C2 injuries result in partial or total displacement of the joint.

This injury results from high-energy trauma, like car accidents, motorcycle accidents, and labor-related accidents; on the other hand, low-energy injuries can cause ligament rupture particularly in athletes and aged patients[4,5]. The major problem is detection of this rare condition and also a commonly underestimated extent of this complex lesion[6–8].

Most tarsometatarsal ligament injuries are grade I or grade II representing with mild laxity but no instability.

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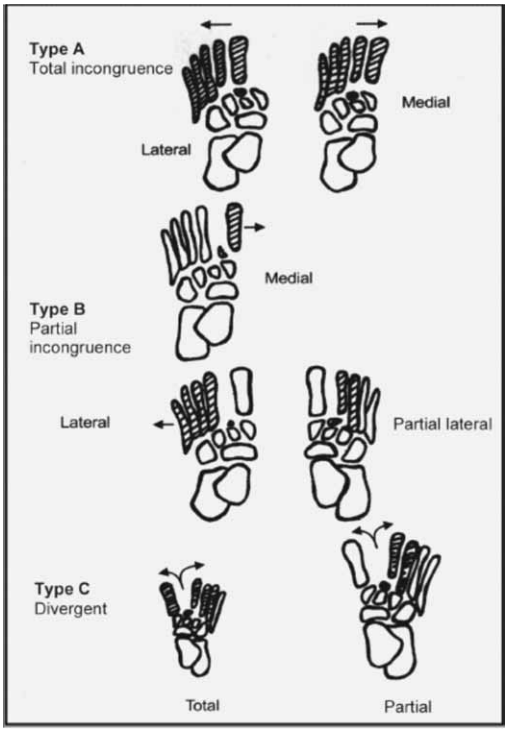

Fig. 1. Schematic ilustration of Hardcastle classification modified by Myerson.

The more severe grade III sprain represents the most challenging cases, including fracture dislocation.

The tarsometatarsal articulation consists of four separate parts; the medial one is formed between the base of the first metatarsal and the medial cuneiform, the second unit includes articulation between the second metatarsal and middle cuneiform, while the base of the third metatarsal and lateral cuneiform form the third articulation. Finally, the lateral articulation is formed by the base of the fourth and fifth metatarsals with the cuboid. The movements at the tarsometatarsal articulation have been clarified by Ouzounian and Shereff in 1989[9]. Each metatarsal base is connected by interosseuus ligaments with the exception of the base of the first and second metatarsals. A strong ligament connects the base of the second metatarsal and the medial cuneiform and represent a key stone for the stability. Furthermore, soft tissue structures like plantar fascia, tendons and intrinsic muscles form the secondary stabilizers of the tarsometatarsal joint.

Patients and Methods

Between January 2005 and May 2009, a total of 26 patients, 21 males and 5 females, were admitted for treatment of Lisfranc lesion. This was a retrospective study and the patients were identified by search of the hospital database.

Data were collected from patient charts with regard to age, gender, mechanism of injury, delay in diagnosis, classification of injury, treatment method and complications.

All patients were radiologically evaluated, anteroposterior and lateral weight-bearing views were obtained and classified according to the criteria proposed by Myerson; the space between the first and second metatarsals with the medial and intermedial cuneiform should be more than 2 mm and the talometatarsal angle over 15 with the presence of deviations between metatarsals in the dorso-plantar plane[10].

Diagnosis was confirmed by observing the malalignment between the metatarsal bases and the midfoot and lateral talometatarsal angle (the intersection of a line along the long axis of the talus and long axis of the first metatarsal normally forms a straight line).

On admission, all patients developped a significant swelling of the injuried foot, pains along the mentioned area and usually a visible deformity of the same foot. A mechanism of injury previously described, as well as a soft tissue edema or pain that persists for more than five days after initial lesion should raise suspicion to Lisfranc injury[11].

Using the American Orthopedic Foot and Ankle Society (AOFAS) midfoot scoring scale and SF-36 questionnaire, the functional outcome was assessed.

Following the abovementioned criteria, there were fifteen patients who needed operative procedure, while eleven patients were treated conservatively.

The mean value for age distribution was 42.7±13.2 (range 20–71) years, the mean follow up was 27.9±12.4 (range 10–52) months. The patients were recalled to the clinic or contacted by telephone.

Injury mechanism involved a traffic accident in three patients, a fall in fourteen cases, heavy weight injury in five cases, furthermore, two patients where injured during sport activity and one patient was injured during dancing.

According to the Mayfield classification, 5 (19.2%) patients had a type A injury, 2 patients (7.7%) presented with a type B1 injury, 17 (65.4%) sustained the most common type B2 injury and 1 (3.8%) patient suffered from a type C1 and C2 injury.

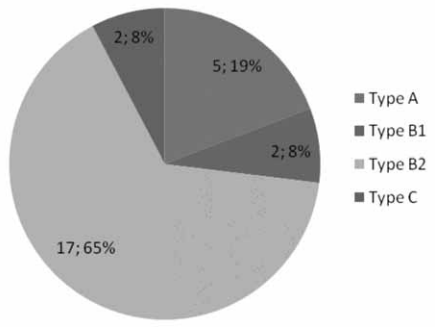

Fig. 2. Distribution of Lisfranc injury types in 26 patients.

All patients were divided in three groups, metatarsal fracture was found in fourteen (53.9%) patients, phalangeal fracture in 3 (11.5%) cases, while 9 (34.6%) patients suffered from combined metatarsal, navicular and, most commonly, a cuneiform fracture. There were no patients with a vascular compromise.

The average time to surgery was 12 days. Six out of fifteen patients were operated immediately after admission, the rest were operated after swelling had subsided, in a period range from 4 to 22 days. Such a delayed treatment is usually due to a diagnostic failure in country hospitals, before admition to our institution.

As far as open reduction and internal fixation was concerned, we used the dorsal approach with two or three longitudinal incisions. After reaching the tarsometatarsal area, the first TMT was fixed temporarily with a pin. Then, reduction of the base of the second metatarsal and stabilization of the Lisfranc ligament was performed using a reduction clamp between the medial cuneiform and the base of the second metatarsal. After reduction, Kirchner wires were used for fixation of the first three tarsometatarsal joints and, if necessary, the intercuneiform or naviculocuneiform joints were also stabilized with a screw (Figure 3).

A postoperative immobilization was maintained for a period of 4 to 6 weeks in a below knee non-weight bearing cast and after that time 4 weeks of partial weight bearing was allowed.The K-wires were removed after 3–4 weeks, cancellous screws were removed one year after the initial treatment. In eleven patients there was no significant radiological findings of tarsometatarsal disloca-

Fig. 3. C type Lisfranc injury, a,b) anteroposterior and profile images before operation, c, d) same foot after reduction and fixation with Kirschner wires.

TABLE 1
SF 36 QUESTIONNARE SHOWING STATISTICALLY SIGNIFICANT DIFFERENCE IN THE ROLE LIMITATION DUE TO EXISTENCE OF PAIN IN THE INJURY GROUP 3

CROSSTAB

			Pain		Total
			Poor	Good	
Injury group	1	Count	7	7	14
		% within Injury	50.0%	50.0%	100.0%
	2	Count	2	1	3
		% within Injury	66.7%	33.3%	100.0%
	3	Count	9	0	9
		% within Injury	100.0%	.0%	100.0%
Total		Count	18	8	26
		% within Injury	69.2%	30.8%	100.0%

χ^2-tests

	Value	Df	p
Pearson χ^2	6.440[a]	2	.040
Likelihood ratio	8.869	2	.012
Linear-by-linear association	6.109	1	.013
N of valid cases	26		

[a] 4 cells (66.7%) have expected count less than 5. The minimum expected count is 92

tion. We decided to perform conservative treatment with a below knee non-weight bearing cast for 4–6 weeks, and after that time a four week partial weight bearing was allowed.

Statistics

Descriptive statistics and the Smirnov-Kolmogorov test were performed to analyze data distribution. A paired-samples t-test was conducted to evaluate the difference between pre-op and post-op data. Using the SF-36 questionnaire and χ^2-test for the evaluation of physical functioning, role limitation due to physical problems, role limitation due to emotional problems, social functioning, mental health, energy vitality, pain, general health and change in health in all groups. Descriptive statistics and the χ^2 distribution test – the scores of certain aspects, were divided into good (>60%) and poor (<60%) quality of life. All statistical procedures were performed with SPSS for Windows statistical package, version 15.0. All P values under 0.05 were considered significant.

Results

Using the American Orthopedic Foot and Ankle Society (AOFAS) midfoot scoring scale and SF-36 questionnaire, the functional outcome was assessed.

In the AOFAS score, a maximum of 40 points are allocated for pain, 15 points for hindfoot alignment and a maximum of 45 points are allocated to a variety of functions as determined by history and physical examination. Specifically, 10 points are allocated for activity level and aids used, five for walking distance, five for footwear requirements, and ten for ability to walk on uneven surfaces. 10 points are allocated for gait.

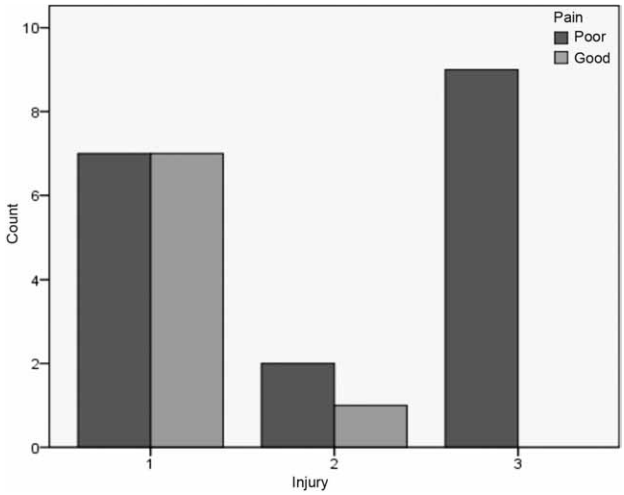

Fig. 4. Bar chart of SF 36 score for existence of pain in the injury group 3 representing good (>60%) and poor (<60%) quality of life.

The clinical outcome was evaluated according to following scale: less than 70 points signifining poor outcome, for the fair outcome 70–80 AOFAS points were allocated, the interval between 80 and 90 points represented good outcome, and more than 90 points was dedicated for an excellent outcome.

According to type of fracture we established three groups; in group I metatarsal fracture was found in fourteen (53.9%) patients, group II with phalangeal fracture in three (11.5%) cases, whereas in group III nine (34.6%)

TABLE 2
SF 36 QUESTIONNARE SHOWING STATISTICALLY SIGNIFICANT DIFFERENCE CONCERNING GENERAL HEALTH IN THE INJURY GROUP 3

Crosstab			General Health		Total
			Poor	Good	
Injury group	1	Count	6	8	14
		% within Injury	42.9%	57.1%	100.0%
	2	Count	1	2	3
		% within Injury	33.3%	66.7%	100.0%
	3	Count	9	0	9
		% within Injury	100.0%	.0%	100.0%
Total		Count	16	10	26
		% within Injury	61.5%	38.5%	100.0%

^{2}-tests			
	Value	Df	p
Pearson Chi-Square	8.698[a]	2	0.013
Likelihood Ratio	11.706	2	0.003
Linear-by-Linear Association	6.807	1	0.009
N of Valid Cases	26		

[a] 3 cells (50.0%) have expected count less than 5. The minimum expected count is 1.15.

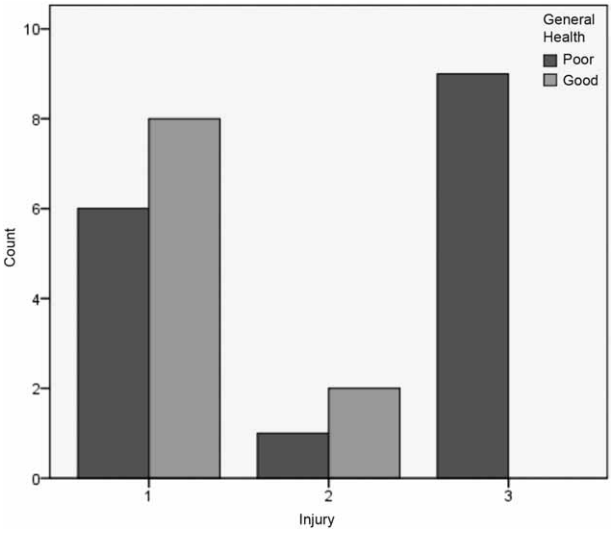

Fig. 5. Bar chart of SF 36 score concerning general health in the injury group 3 representing good (>60%) and poor (<60%) quality of life.

patients sustained combined metatarsal, navicular and, most commonly, a cuneiform fracture.

Furthermore, the average AOFAS score in group I was 74.0±9.1 and in the group II it reached 72.0±5.2 signifying fair outcome. Poor outcome was present in the group III with mean AOFAS score 67.1±9.0.

Using the SF-36 questionnaire and χ^2-test for the evaluation of physical functioning, role limitation due to physical problems, role limitation due to emotional problems, social functioning, mental health, energy vitality, pain, general health and change in health. We found a statistically significant difference in the role limitation due to existence of pain (p=0.04) (Table 1, ±ure 4), and poor general health (p= 0.013) in the group of patients that sustained combined foot fracture (Table 2, Figure 5).

Arthritic changes were present in 14 patients (53.8%) staging from grade I in 31%, grade II in 19% and grade III in less than 4% of cases. Problems with foot alignment were present in almost 100% of cases. There was no need to perform an ankle arthrodesis.

Discussion

Recognizing Lisfranc injury still represent a significant mistery and it's treatment needs to be conducted by experience surgeon.

In our study, 15 patients were submitted to a surgical procedure – thirteen were treated by open reduction and internal fixation using Kirschner wires, while percutaneous fixation using Kirchner wires was done in only 2 patients.

All 26 patients were evaluated and classified according to the criteria proposed by Myerson; the space between the first and second metatarsals and the medial and intermedial cuneiform – up to 2 mm, the talometatarsal angle and the presence of deviations between metatarsals in the dorso-plantar plane.

Based on our statistical data, we found by means of SF 36 questionnaire a statistically significant difference in the role limitation due to existence of pain (p=0.04) and poor general health (p=0.013) in the group of patients that sustained combined foot fracture.(Table 2). When it comes to operative solutions for Lisfranc injury, a great variability is present depending on surgeon preferences and findings[12–14].

There are recommendations suggesting that a displacement of more than 2 mm requires open reduction and internal fixation[15,16]. Some orthopedists advocate closed fixation with percutaneous Kirschner wires[17]. According to some authors, closed fixation with percutaneous Kirschner wires does not hold anatomic reduction and fixation[18].

Tan et al. reported that open reduction with Kirschner wire internal fixation offered satisfactory anatomical and functional results[19].

Gaweda et al achieved satisfactory results after closed reduction and percutaneous Kirschner wire fixation in acute cases. Some authors advocate a stable, primary arthrodesis which seemed to have better short- and medium-term outcomes compared to ORIF[20,21]. Mulier et al. concluded in their study that primary arthrodesis demonstrated no advantage compared to ORIF[22]. The existence of posttraumatic arthrosis is very important for the final outcome with incidence reported to be up to 58%[23].

The role of adecvate reduction cannot be overstated. Kuo et al. hypotethised that for poor reductions, the incidence of arthrosis is 60% compared to 16% when anatomic reduction is obtained[24]. Posttraumatic arthrosis, due to additional injury of forefoot and also hindfoot, can lead to significant clinical impact and demands managing according to standardized protocol of treatment[25,26]. Biomechanical functionality of the foot structures is important for many reasons[27].

Althought we evaluated a relatively small number of patients, to the best of our knowledge, this is the first study describing Lisfranc injury in the Croatian scientific literature. All unstable injuries in the tarsometatarsal region require surgery. Clinical outcome is highly dependent on the restoration of normal anatomic alignment.

As a conclusion, the extent of local trauma, a delay in injury recognition and the degree of displacement are strong predictors of the outcome in the treatment of Lisfranc injury.

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LISFRANCOVA OZLJEDA

SAŽETAK

U periodu između siječnja 2005. g. i svibnja 2009. g. 26 pacijenata, od toga 21 muški i 5 žena, liječeni su zbog Lisfrancove ozljede. Izvršena je klasifikacija ozljede na temelju Myersonove klasifikacije: 5 bolesnika zadobilo je ozljedu tipa A, 2 bolesnika tipa B1 a 17 njih je pretrpilo najčešći tip ozljede B2. Ozljeda tipa C bila je prisutna u samo jednom slučaju. Na temelju RTG I kliničke slike, 15 bolesnika bilo je podvrgnuto operativnom liječenju dok je ostalih jedanaest liječeno konzervativno. Uzimajući u obzir prijelome kostiju stopala, dobili smo podjelu na tri grupacije: grupa I obuhvaćala je prijelome metatarzalnih kostiju – 14 bolesnika (53,9%), grupa II prijelome falangi prstiju – 3 bolesnika (11,5%) te grupa III gdje su bile prisutne kombinirane frakture metatarzalnih kostiju, navikularnih i, najčešće, kuneiformnih kostiju. Koristeći klasifikaciju Američkog ortopedskog udruženja za kirurgiju stopala i gležnja (AOFAS) te SF-36 upitnik, procijenili smo rezultate liječenja. Prosječna dob bolesnika bila je 42,7±13,2 godina dok je prosječno praćenje iznosilo 27,9±12,4 mjeseci. U analizi rezultata korištena je p vrijednost, koja je bila statistički značajna u slučaju <0.005. Na temelju SF 36 upitnika uvidjeli smo statistički značajnu razliku u smanjenju aktivnosti bolesnika zbog postojanja boli ($p=0,04$) i lošeg općeg zdravlja ($p=0,013$) u grupi III. Svrha ovog rada bila je uvidjeti uspješnost liječenja Lisfrancove ozljede na temelju već spomenutih SF 36 i AOFAS kriterija. U grupi I prosječni AOFAS skor iznosio je 74,0±9,1 bod, u grupi II 72,0±5,2 bod što govori u prilog dobrog rezultata. Loši rezultati bili su prisutni u grupi III sa prosječnim AOFAS skorom 67,1±9,0 bod. Sve nestabilne ozljede tarzometatarzalne regije zahtijevaju operacijsko liječenje. Klinički ishod uvelike ovisi o uspostavljanju normalnih anatomskih odnosa.