

Modern principles of treatment in Lisfranc midfoot dislocations

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Abstract. The Lisfranc midfoot dislocations are uncommon, and the results of the treatment are often unsatisfactory. The open reduction and internal fixation of the tarso-metatarsal injuries by various technics like: Kirschner wiring transfixation, screwing or combinations of these methods, are the recommended choice of treatment. The aim of the present study is to review the functional outcomes of 31 patients with dislocations and fracture - dislocations of the Lisfranc joint over a 10-year period, treated by different surgical methods. The average follow-up period was 44 (range 12 – 108) months. *Results.* The average American Orthopaedic Foot and Ankle Society (AOFAS) for midfoot score, used for results interpretation, was 72 (range 52 – 92); the highest scores were obtained by patients with screwing technics of internal fixation. Fourteen patients (45%) developed posttraumatic arthritis of the tarso-metatarsal joints. The major causes were an imperfect and nonanatomic reduction, and an instable internal fixation, especially in patients with only Kirschner wiring fixation as single technique used. *Conclusions.* On the basis of our study, the principles of treatment of the Lisfranc tarso-metatarsal fracture- dislocations are: anatomical open reduction and stable internal fixation, using transfix screw fixation or a combination of wiring and screwing techniques.

Key words: *midfoot dislocations, Lisfranc joint, open reduction, internal fixation.*

Introduction

The tarso-metatarsal anatomic region has become known as the Lisfranc joint after the name of a well-known French surgeon. This term is used in present to describe a large spectrum of posttraumatic injuries of the midtarsal region of the foot (1).

Lisfranc injuries are, generally, uncommon, with a rate of occurrence of only 1/55,000 persons per year. Frequently, these injuries are misdiagnosed (2), so their real incidence is much higher (approximately 20%).

The specialist preoccupation for the midtarsal injuries is quite limited, leading often, inevitably, to a wrong treatment of these injuries (3,4). The most important contribution is realised using the anatomo-clinical classification of each variety of injury (5). The principal outcome is to obtain a good surgical result, a correct joint alignment, due to the standardization of the surgical approach and the methods of internal fixation, in direct relationship with each type of Lisfranc injury (6). The actual progress in the treatment of the midfoot injuries, using the open reduction and stable internal fixation (ORIF), has demonstrate that the foot function can be effectively improved

when the anatomical structure is restored (6,7), avoiding the prolonged immobilization of the foot. In time, a number of authors were interested by the anatomy and biomechanics of the midfoot, the treatment of the midtarsal injuries, such as Sangeorzan (9), Myerson (8), Hardcastle (10), and many others; they studies underlined the complex biomechanics of the foot, resulting in the normal mobility, joint alignment and stability of the tarso-metatarsal joint (5,8).

The internal fixation methods of Lisfranc midtarsal injuries were exposed in The Manual of internal Fixation (7), accomplished by AO-ASIF. Although the pin fixation has their own supporters (3), the postoperative and functional results have a relatively high rate of failures (7).

The advantages of the open reduction and internal fixation are obvious: protect the soft tissues, relieve pain, minimize the occurrence of secondary displacements and deformities (9), decompress a potential compartment syndrome of the forefoot (11).

The aim of the study was to review:

- the functional results after these injuries
- the factors that influenced the results

- which surgical treatment ensures the best functional results
- the incidence of posttraumatic midtarsal arthritis.

This study reviews the outcome of these fractures treated by different methods. In addition, it attempts to determine whether there is a correlation between traditional physician-based outcome and patient based outcomes in order to establish a benchmark for future assessments (3, 11).

Material and methods

We have performed a retrospective study on a group of 31 patients with Lisfranc tarso-metatarsal dislocations and fracture-dislocations, investigated and operated between January 1st 2001 and 31 of December 2010, in the Orthopaedic Clinic in the Emergency County Hospital in Suceava, Romania.

The annual incidence of Lisfranc injuries is continuously increasing, especially in the last four years of the study 5 cases per year in 2010, from 2100 admissions to our services.

Age distribution of the 31 patients available for follow-up was from 18 to 67 years with a mean of 39 years. There were 19 male (61,3%) and 12 female patients (38,7%).

The left foot was involved in 18 patients and the right in thirteen. One patient with multiple injures had a diagnosis that was missed initially but was treated within 2 weeks of the original injury.

10 patients (24%) with multiple injures associated, but only two of them, in traumatic or haemorrhagic shock, were admitted in the AIC ward for monitoring of the general condition and haemodynamic rebalancing (6,11). Isolated foot injuries occurred in 21 patients.

The patients were evaluated in term of postoperative evolution, the incidence of early and late complications, the functional outcome of surgery, depending on the severity of injuries and the treatment methods applied.

It was intended, in the complex treatment program, to apply the latest innovative techniques of fixation and reconstruction surgery, in accordance to the orthopaedic modern principles, so that therapeutic outcome to be as satisfactory.

We have performed a descriptive statistical analysis together with a correlation study in order

to evaluate the ratio between different methods of internal fixation and the AOFAS scores at 3 and 6 months following surgery.

The final evaluation was conducted surrounding the clinical and functional results in a standard assessment scale, made especially for the mediotarsal region of the foot by AOFAS (American Orthopaedic Society for Ankle and Foot) (3, 6). Continuous variables (interval) were characterized by calculating the main statistical indicators (mean and confidence interval 95%, median, standard deviation, dispersion).

B. Between 2008 and 2010, we have tried to standardize the internal fixation methods according to the principles stated by AO-ASIF. Therefore, we introduced the internal fixation by screws, respecting the internal fixation principles and algorithm in order to minimize the error rate and to ensure a generally rigid stabilization of the mediotarsal and especially of the internal spine. This algorithm was achieved by strictly following the steps cited by the AO school (6,7), the screws being introduced after the tarso-metatarsal anatomic reduction. The temporary initial fixation was done by pins, after the entire exposure of the lesions and their reduction through the two parallel longitudinal incisions. The fixation of the medial column was done after having tested the intercuneiform instability neutralized by fixation with screw. The reduction of the metatarsal 2 base and the fixation with screw of intercuneiform 1 and base of metatarsal 2, reduction of the metatarsal 1 luxation and fixation by screwing of the transmetatarsal 1 – cuneiform 1 by the „pocket hole” method; reduction of the base of metatarsal 3 and fixation by screwing of intermetatarsal 3 – cuneiform 3 (4,6). 11 patients have been operated by this fixation method of the medial column since 2008. (figure 1).

The fixation of the lateral column was not always necessary after the fixation of the medial column due to the post-reduction secondary stability (6,7) (only to 5 of 11 patients treated by screwing the medial column); other 4 patients presented only isolated lesions of the medial column, without surgically approaching the lateral column.

The associated metatarsal fractures were fixed by pins to 3 patients or by fixation with miniplates to the comminute fractures, in 2 cases.



Figure 1. Internal fixation of the medial column with screws for a Lisfranc fracture luxation type B2 Myerson. Pre and post-surgery aspect

The treatment done to all the patients included the profound venous thrombosis prophylaxis, antibiotics prophylaxis (cephalosporin) for 7 days for the closed lesions (4), long term double or triple associated antibiotic treatment for the open lesions. The anti-coagulating therapy was usually performed from their admission up to 6 weeks since the trauma (4,8). The peri-surgery prophylaxis with cephalosporin was done for all the closed lesions for 5-10 days from the trauma, according to the evolution of the wounds. For the 2 cases of crushing syndromes with lesions of the smooth parts, there was practiced a curative treatment of triple association with cephalosporin, aminoglycoside and Metronidazole for a period of 14-21 days. In 2 cases of open fractures-dislocations with important contamination, the cephalosporin was associated with Clindamycin with very good results. Post-surgery care included the immobilization with gypsum after surgery with well cushioned cast-leg splints for a period of 6 weeks. The sutures were extracted after 14 up to 21 days after surgery and the anticoagulation LMWH treatment was extended up to 6 weeks after surgery (12). For the patients who were practiced the pin method, especially between 2001 and 2008, we usually chose to extend the immobilization period up to 8-10 weeks for the prevention of the secondary displacements.

The extraction of the osteosynthesis materials (pins) was usually done after 6-8 weeks (6,14) after the end of the immobilization period for 29 patients (who only had pins or pins associated to screws). The rest of the patients had only screws or osteosynthesis miniplates, being recently operated (during the last 2 years). The support of the foot was usually done late for the patients with pins, respectively at 10-12 weeks after surgery, in order to avoid secondary displacements (15). During the last 3 years, we have chosen to preserve the immobilization with gypsum after

surgery up to 6 weeks, once with the extraction of the osteosynthesis material (in the case of the pin associated to screws). We have also chosen the early introduction of the recovery treatment at 6 weeks, with the progressive relapse of the partial support of the operated leg, followed by the total support after 8-10 weeks (16).

The treatment of the complications was emergency instituted within the first 4 hours since the admission (4,11), complying with the previously mentioned therapeutic standard protocol. The solution of the osteo-articular lesions was done in the same manner as for uncomplicated fractures-lesions, respecting the same reductions steps and the internal fixation. In addition, the peri-surgery treatment included the permanent monitoring of the neurovascular condition of the foot, the institution of the curative long term antibiotic treatment of triple association, plastic surgery supplementary interventions for covering the skin defect. Two patients with crushing syndrome needed subsequent plastic surgery to cover with musculocutaneous flaps and skin grafts.

Discussions

The Lisfranc injuries are rare, but they carry considerable potential for long-term disability (3, 4, 12, 14). Leriche syndrome had a higher incidence (2,4), especially at the patients with medio-tarsal dislocation when the exclusive pin-fixation technique was applied.

A total of 14 patients from a total of 20, operated in the 2001-2008 period (70%) had pain, paraesthesia, swelling, cyanosis of the foot and loco regional osteoporosis on radiographic images, in the late postoperative period after plaster immobilization suppression (8 to 12 weeks). This was mainly due to extension in excess of plaster immobilization (15), and absence of establishing of an early recovery treatment

(16). The patients operated since last three years by stable internal fixation (screwing techniques) had a much lower Leriche syndrome as a result of lower assets (6 weeks) and the immediate resumption of the support leg, associated with active rehabilitation treatment (2 of 11 patients developed this complication, 18.2% respectively). From all 31 patients who performed early or late recovery treatment, 6 patients remained with pain, trouble light and medium gait, foot deformities and keloid scars (2 patients with crush syndrome).

The midtarsal osteoarthritis had a fairly high incidence (17,18), especially in patients operated in the first years by pin fixation (Figure 2).

From these 20 patients, 6 patients developed mediotarsal osteoarthritis (30%).

From the group operated with screw techniques of the medial column, only 2 of 11 patients developed midtarsal arthritis, respectively 18,2%. Overall, the incidence of posttraumatic midtarsal arthritis was 45% (14 patients).



Figure 2. Severe midfoot arthritis after a Lisfranc dislocation, operated with pin fixation technique, secondary displaced (postoperative radiographic control and at 6 months after surgery).

Functional outcome was assessed in all patients included in the study, using the AOFAS scale for midtarsal region of the foot, developed by the American Orthopaedic Foot and Ankle Society (3). This takes into account individually, for each patient, the presence and type of pain, the functional and morphological appearance of the foot, estimating the form of points awarded for each change in part (downwards, depending on the severity of organ or functional damage). Therefore, for a healthy foot, the maximum amount of the scoring is 100; the score decreases gradually to zero, according to functional impairment of the midtarsal region.

We intentionally tie the group of 20 patients operated in 2001-2008 period, who underwent exclusively internal pin fixation, and the group of 11 patients operated in 2008-2010, that we applied stable internal fixation, according to the AO screw fixation techniques of the medial column. We apply individually, to all patients, the functional assessment scale. The incidence of late postoperative complications is high, especially in patients who had established internal pin-fixation, with a high rate of midtarsal osteoarthritis developing, foot deformities and painful neuro-dystrophic syndrome, more than those resulting

from group patients operated by means of modern internal fixation. The functional prognosis of patients with midtarsal dislocations, measured by the AOFAS scale scores, are quite reserved in the group of patients treated by pin-fixation methods. The final results showed the presence of an average AOFAS score of only 62 patients operated exclusively with pin – fixation techniques and an average AOFAS score of 90 for group of patients operated by standard AO methods of fixing. Overall, patients took the study group had an average AOFAS score of 72 points.

Conclusions

Comparing the data obtained through the personal study with those in the speciality literature, several conclusions can be reached, that may ultimately lead to a better quality of the medical procedures, to properly caring the patients with such lesions, and to avoiding therapy errors that might have major consequences over function (2, 5, 6).

Lisfranc midtarsal dislocations are very serious traumatic lesions, rather easy to diagnose when solitary (15, 16), but significantly more difficult if associated with polytrauma (3, 7). It is absolutely imperative that these lesions are given more heed,

not only because of their high risk of aggravation, but also because of the negative psychoemotional impact in case of their misdiagnosis or mistherapy (1, 3).

The treatment of these lesions should be standardized for all tarso-metatarsal lesions, but with the therapeutic characteristics of open traumas, crush syndrome, or associated vasculo-neural lesions (11). As a rule, first-intention surgical treatment should be applied in the first 24 hours, regardless of the anatomoclinical variety, comprising open anatomic reduction and screw fracture fixation, using the screw insertion algorithm for fixing the medial column (7, 9, 11). Pin fixation of the lateral column, of the metatarsus, or fixation with screwed-in miniplates can also be included (13). Internal fixation of the medial column using open or percutaneous pin fixation has a poor prognosis because of the high incidence of secondary displacements and posttraumatic arthrosis (18), and should be abandoned.

The perioperative auxiliary drug therapy comprises LMWH-type anticoagulant therapy for 6 weeks, antibiotic prophylaxis for 7-10 days for closed dislocations, triple antibiotic remedial therapy for at least 14-21 days for open lesions. Postoperative immobilization is compulsory for 6-8 weeks, with well-padded plaster splints, according to the instability degree of the lesion, followed by the partial extraction of the osteosynthesis material (the Kirschner pins from the external column).

Starting the recovery physical therapy immediately after the 6-8 weeks period is compulsory, progressively resuming the support function of the foot until full support at 10-12 weeks, and wearing foot ware arch cushions up to 12 months after surgery to support the arch of the foot. The goal is to lower the incidence of the complex regional pain syndrome, the foot stiffness, and walking disorders (15,16).

References

1. Browner B, Levine A, Jupiter J, Trafton P (2003). *Skeletal Trauma: Basic Science, Management and Reconstruction*, 3rd edition, Saunders Ed, pp.1534 – 1566.
2. Kuo R S, Tejwani N C, Di Giovanni C W, et al (2003). *Outcome after ORIF or Lisfranc joint Science, Management and Reconstruction*, 3rd edition, Saunders Ed; pp.1534 – 1566.
3. Chapman M D, Levine J M, Mann R A, Morder R A (2000). *Chapman's Orthopaedic Surgery*, 3rd edition, Lippincott Williams & Wilkins., pp.2956 – 2981.
4. Bucholz R W, Heckman J D, Court-Brown C M (2006). *Rockwood & Green's Fractures in Adults*, 6th edition, 2006, Lippincot Williams & Wilkins; pp.2339 – 2400.
5. Botez P, Munteanu F (2006). *Biomecanica aparatului locomotor*, Vol. I, Venus Ed, pp. 55-61.
6. Canale Terry S, Beaty M D (2007). *Campbell's Operative Orthopaedics*, 11th edition, Mosby Edt; pp.4461 – 4884.
7. Muller M E, Allgower M, Schneider R, et al (1991): *Manual of Internal Fixation*, 3rd edition, Springer Verlag Ed: pp. 348-385.
8. Myerson MS (1999). The diagnosis and treatment of injury to the tarsometatarsal joint complex. *J Bone Joint Surg*; 81B: 756.
9. Sangeorzan BJ, Benirschke SK, Gould MT(2006):Tarsometatarsal Lisfranc injuries: evaluation and management. In: *Wiss D,ed. Master Techniques of Orthopaedic Surgery: Fractures*; Ed.2 Philadelphia, PA: Lippincot-Williams&Wilkins; pp: 605-607.
10. Hardcastle PH, Reschauer R, Kutscha-Lissberg E Surg, Schoffmann W (1982). Injuries to the Tarsometatarsal Joint: Incidence, Classification and Treatment. *J Bone Joint Surg* ; 64B: 349.
11. Weber TG, Manoli A II (1999). Compartment Syndromes of the Foot. In: *Sanders R, ed. Foot and Ankle Clinics: Concepts of Foot and Ankle Trauma*, Vols. 3 and 4. Philadelphia: W. B. Saunders Company, pp.473.
12. Myerson MS (1989). The Diagnosis and Treatment of Injuries to the Lisfranc Joint Complex. *Orthop Clin North Am* ; 20:4:655-664.
13. Sirbu P, Botez P, Frieal W, Stratan L, Hopulele S, Asaftei R (2008). *Osteosinteza minim invaziva cu placi. Fixatoare interne*, Venus Ed, Iasi, pp. 10-12.
14. Hardcastle P, Reschauer R, Kutscha-Lissberg E (1982). Injuries to the tarsometatarsal joint: incidence, classification, and treatment. *J Bone Joint Surg Br*; 64: 349-356.
15. Curtis M, Myerson M, Szura B (1993). Tarsometatarsal joint injuries in the athlete. *Am J Sports Med*; 21, 497-502.
16. Meyer S, Callaghan J, Albright J, Crowley ET, Powell JW (1994). Midfoot sprains in collegiate football players. *Am J Sports Med*; 22: 392-401.
17. Mann R, Prieskorn D, Sobel M (1996). Mid-tarsal and tarsometatarsal arthrodesis for primary degenerative osteoarthritis or osteoarthritis after trauma. *J Bone Joint Surg Am*; 78: 1376-1385.

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19. Sangeorzan B, Veth R, Hansen S (1990). Salvage of Lisfranc's tarsometatarsal joints by arthrodesis. *Foot Ankle Int* ; 4: 193-200.

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