LISFRANC MIDFOOT DISLOCATIONS: CORRELATIONS BETWEEN SURGICAL TREATMENT AND FUNCTIONAL OUTCOMES

R. C. Bandac1,2, P. Botez3
1. Ph. D. student at University of Medicine and Pharmacy „Grigore T. Popa”- Iaşi „Sf. Ioan cel Nou” Emergency County Hospital - Suceava
2. Orthopedics-Traumatology Unit
University of Medicine and Pharmacy „Grigore T. Popa”- Iaşi School of Medicine
3. Discipline of Orthopedics-Traumatology

LISFRANC MIDFOOT DISLOCATIONS: CORRELATIONS BETWEEN SURGICAL TREATMENT AND FUNCTIONAL OUTCOMES (Abstract): Lisfranc dislocations and fracture dislocations are the most common severe injuries of the foot. Aim: To assess the functional outcome of patients with Lisfranc dislocations of the midfoot by applying the latest methods of diagnosis and treatment. Material and methods: The study reviewed 31 patients with dislocations and fracture-dislocations of the Lisfranc joint over a 10 years period. The average follow-up period was 44 months (range 12-108). Injuries were classified according to Myerson scale. Results: The outcomes were evaluated using the Baltimore Painful Foot score (PFS) and American Orthopaedic Foot and Ankle Society (AOFAS) mid-foot scoring scale. 10 patients had an excellent outcome on the PFS scale, 8 were classified as good, 13 fair and poor. The average AOFAS score for the midfoot, used for results interpretation was 72 (range 52-92). Conclusions: Of all methods of surgical treatment used, the highest scores were obtained by internal fixation with screws. Eight patients (25.8%) developed posttraumatic arthritis of the tarsometatarsal joints. Key words: TARSOMETATARSAL DISLOCATION, LISFRANC JOINT, INTERNAL FIXATION, FUNCTIONAL OUTCOME

Lisfranc injury is relatively rare, with an incidence variously reported between one per 5,500 fractures per year (1), one per 60,000 populations per year (2) or accounting for 0.2% of all fractures (3). This term is used in present to describe a large spectrum of posttraumatic injuries of the midtarsal region of the foot (1). Diagnosis is aided by high-quality radiographs (AP, 30° oblique and lateral views). Diagnosis is often overlooked, especially in the multiply injured patient with other distracting injuries (3, 4), which can significantly reduce outcome (2) with resultant long-term disability (5, 6). A spontaneous partial or complete relocation is not unusual (4, 7) and may complicate accurate assessment. A high index of suspicion must be maintained for these injuries, and additional imaging, stress radiographs (2), weight-bearing radiographs (6), CT (8, 11) or MRI (4) performed as indicated.

Although some controversy exists about the optimal method of treatment (6, 8, 10, 12) most authors now advocate anatomic reduction with internal fixation as the
Lisfranc midfoot dislocations: correlations between surgical treatment and functional outcomes

treatment method of choice (2, 13, 14). The internal fixation methods of Lisfranc midfoot injuries were exposed in The Manual of Internal Fixation (7), recommended by Association of Osteosynthesis (AO). Although pin fixation has their own supporters (3), the postoperative and functional outcomes have a relatively high failures rate (7). This study reviews the outcome of Lisfranc midfoot injuries 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 conducted a preliminary study on a series of 31 patients with Lisfranc tarsometatarsal fracture-dislocations, investigated and operated between January 1, 2001 and 31 December 2010 in the Orthopedic Unit of the Suceava Emergency County Hospital, Romania. A historical retrospective study was performed and all case notes and radiographs were examined. Data was collected from patient charts under the following headings: age, gender, date of injury, side of injury, delay in diagnosis, mechanism of injury, classification of injury, associated injuries, treatment method, method of wound closure and any resultant complications. Injuries were classified on reviewing the initial radiographs according to the scale proposed by Myerson (14). The patients were evaluated in terms of postoperative course, incidence of early and late complications, functional outcome of surgery, depending on the severity of injuries and treatment methods applied. A descriptive statistical analysis and a correlation study were conducted in order to evaluate the relation between different internal fixation methods and functional outcome scores at 3 and 6 months following surgery. Outcome instruments used were the Baltimore Painful Foot score (PFS) (14) and the American Orthopaedic Foot and Ankle Society (AOFAS) mid-foot scoring scale (9).

**RESULTS**

The annual incidence of Lisfranc injuries kept increasing especially in the last 4 study years, culminating in 2010 with 5 cases out of 2100 admissions to our unit. Age distribution of the 31 patients available for follow-up was 18 to 67 years (mean age 39 years). There were 19 male (61.3%) and 12 female patients (38.7%). Left foot was involved in 18 patients and the right in 13. In one patient with multiple injuries a diagnosis of Lisfranc injury was initially missed but treated within 2 weeks of the original injury. Ten patients (24%) with multiple associated injuries, but only two of them in traumatic or hemorrhagic shock, were admitted to ICU for monitoring of the general condition and hemodynamic re-balancing (6, 11). Isolated foot injuries occurred in 21 patients.

The mechanism of injury was: crush injury at workplace in 4 patients; motor vehicle accident in 12 cases, motorbike accident in 7 cases („high velocity trauma”: 74.2%), and in 8 cases the injury occurred during sports activities or falling from height („low velocity trauma”: 25.8%). Associated injuries in polytrauma patients were: neurological trauma in 2 patients, rib fractures in 3, long bone fractures in 5, intraabdominal injuries in 1 patient. Twenty patients had associated tarsal fractures (4 cases, 12.9%), metatarsal fractures (5 cases, 16.1%), metatarso-phalangeal dislocation (1 case), with only 11 patients having
neither (35.4%). The loco-regional complications were quite common, involving the dorsalis pedis artery (n=4), the peroneal nerve (n=2), open fracture-dislocations (n=4), crushing syndrome (n=2), compartment syndrome (n=5). Twenty-nine patients had primary wound closure, and 2 secondary closures, split skin grafting being performed in 2 cases. Average follow-up was 44 months (range 12–108).

Injuries were classified according to Myerson scale. A type A1 injury was found in 9.7% (n=3) of the cases, type A2 in 19.3% (n=6), B1 in 6.4% (n=2), B2 in 12.9% (n=4), C1 in 32.2% (n=10), and C2 in 19.3% (n=6) (fig.1).

Fig. 1. Lisfranc divergent fracture dislocation type C2 Myerson

TREATMENT PRINCIPLES

The patients with closed Lisfranc mediotarsal traumas were subjected to surgery in a variable period of time that did not exceed 24 hours since their admission (12). Generally, the surgical approach was by the two longitudinal, standard incisions, recommended by the specialty literature (6). This approach was practiced in 28 patients with dislocations or midtarsal fracture-dislocations, including those who developed a compartment syndrome (5 patients), this way both syndrome diffusion (11) and open reduction and internal fixation being obtained. In 3 patients we practiced a single medial incision due to the presence of the isolated tarsal-metatarsal lesions, strictly located at the level of the internal spine (4). By this approach we have performed the open reduction and the fixation of the first three tarsal-metatarsal joints.

The surgical technique used in all the patients was that of anatomical open reduction followed by the internal fixation under direct visual control (12) by different fixation techniques. We have chosen this technique, being the most modern and accepted technique by most of the nowadays specialists (7, 13, 15).

In twenty patients (64.4%) surgery was performed between 2001 and 2008. The technique and algorithm for introducing the pins were not generally standardized. 1, 8 and 2 mm Kirschner wires were used. Usually the lesions were approached by the two previously mentioned longitudinal incisions.

Between 2008 and 2010, we have tried to standardize the internal fixation according to AO-ASIF principles in 11 patients (35.6%). Therefore, we introduced internal fixation by screws, observing 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 strictly follows the steps recommended by the AO school (6,7), the screws being introduced after the anatomic tarsometatarsal reduction. The initial temporary fixation was done by K-wires, after the entire exposure of the lesions and their reduction through the two parallel longitudinal incisions. Fixation of the medial column was done after having tested the intercuneiform instability neutralized by screw fixation. Fixation of the lateral column
Lisfranc midfoot dislocations: correlations between surgical treatment and functional outcomes

was not always necessary after the fixation of the medial column due to post-reduction secondary stability (6, 7) (in only 5 of 11 patients treated by screwing the medial column); other 4 patients (12.9%) presented only isolated lesions to the medial column, without surgically approaching the lateral column (fig.2). The associated metatarsal fractures were fixed by K-wiring in 3 patients (9.6%) or by fixation with miniplates to the comminute fractures in 2 cases (6.4%).

Post-surgical care included the immobilization with well cushioned below-knee cast for a period of 6 weeks. Sutures were removed 14 to 21 days after surgery, and anticoagulation Low Molecular Weight Heparin (LMWH) treatment was extended up to 6 weeks after surgery (12).

In the patients in whom the pinning method was used, we usually chose to extend the immobilization period up to 8-10 weeks for the prevention of secondary displacements. A foot support was usually done late in the patients with pin fixation, 10-12 weeks after surgery, respectively. The osteosynthesis materials (K-wires) were usually removed 6-8 weeks (6, 14) after the immobilization period ended in 29 patients (with only pins or pins associated to screws). We have also chosen to initiate an early recovery treatment plan (at 6 weeks), with a progressive relapse of the partial foot support, followed by total foot support after 8-10 weeks (16). Algoneuroidystrophic Leriche syndrome had a higher incidence (2, 4), especially in the patients with mediotarsal dislocation when the exclusive pin-fixation technique was applied. Fourteen of a total of 20 patients operated by this technique (70%) had pain, paresthesia, 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) (14, 15).

The patients operated during the last three study years by stable internal fixation (screwing techniques) had a much lower incidence of Leriche syndrome as a result of lower assets (6 weeks) associated with active rehabilitation treatment (15) (2 of 11 patients developed this complication, 18.2%, respectively).

Midtarsal osteoarthritis had a fairly high incidence (16, 17), especially in patients operated during the first study years by K-
wire fixation (fig. 3). Of these 20 patients, 6 patients developed mediotarsal osteoarthritis (30%). In 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 25.8% (8 patients).

**DISCUSSION**

The aim of the study was to review: the functional results after these injuries; which factors influence the outcomes; which surgical treatment yielded the best functional outcomes; the incidence of posttraumatic midtarsal arthritis following these injuries. 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 Orthopedic Foot and Ankle Society (3). This scale has three major items, pain, function and alignment, the total score being set at 100 points. Each item is scored depending on the severity of organ or functional damage. Thus, for a healthy foot, the highest score 100; the score gradually decreasing according to the functional impairment of the midtarsal region found.

We intentionally united the group of 20 patients operated in the interval 2001-2008, who exclusively underwent internal pin fixation, with the group of 11 patients operated in 2008-2010, in which we applied stable internal fixation, according to the AO screw fixation techniques of the medial column. The functional assessment scale was administered individually to all patients. The incidence of late postoperative complications was high, especially in patients with internal pin fixation: midtarsal osteoarthritis, foot deformities, and painful neurodystrophic syndrome, as compared to the group of patients operated by means of modern internal fixation. The functional prognosis of patients with midtarsal dislocations, measured by AOFAS scale (3) is quite poor in the group of patients treated by pin fixation methods.

The end results showed an average AOFAS score of only 62 in the patients operated exclusively by pin fixation techniques, and an average AOFAS score of 90 in the group of patients operated by AO standard fixation methods. Overall, the study patients had an average AOFAS score of 72 points.

In our study, the Baltimore Painful Foot Score (12, 14), that quantifies the outcomes of the treatment measuring pain, function, gait, cosmesis and motion, the outcome was excellent (90 to 100) in 10 patients, good (75 to 90) in 8, fair (60 to 75) in 8, and poor (less than 60) in 5. The average PF score was 75. There were 18 patients (58%) with good and excellent results, and 13 with fair or poor results (42%). Twenty patients with open reduction and pinning fixation performed between 2001 and 2008 had an average PF score of only 68. The reminder of 11 patients with open reduction and internal screw fixation performed between 2008 and 2010 had an average PF score of 92.

**CONCLUSIONS**

The treatment of these lesions should be standardized for all tarsometatarsal lesions, but with the therapeutic characteristics of open traumas, crush syndrome, or associated vasculoneural lesions (11). As a rule we applied first-intention surgical treatment with the first 24 hours, regardless of the anatomoclinical variety, comprising open anatomic reduction and screw 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 arthritis (17), so we abandoned this technique. Starting 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, foot stiffness, and walking disorders (14, 15).

REFERENCES