

Lisfranc Injuries of the Foot, Outcomes of Surgical Treatment in Sudanese Patients, 2017

Sami Nogdallah¹, Ismail M. Saleem², * Mona Ali³,

1. Orthopedic Consultant surgeon. MD, Orthopedic Surgery Department, Ibrahim Malik Teaching Hospital. E-mail: sami_nogod@yahoo.com

2,3. Orthopedic resident. Orthopedic Surgery Department, Ibrahim Malik Teaching Hospital

* Address for correspondence: Ismail Mahgoub Saleem, Khartoum 11111, P.O.Box 10139, Sudan. E-mail: isma3ilsaleem@hotmail.com. Mobile: +249912221564

ABASTRCT

Background: Fracture dislocations involving the Lisfranc joint are rare; they represent only 0.2% of all the fractures. Open reduction and internal fixation of displaced or unstable Lisfranc injuries represents the gold standard for the treatment of this complex injuries. The recent establishment of specialized foot and ankle units in Sudan provided the chances to assess the outcome of surgical intervention for the Sudanese patients suffering these injuries as there are no previous work on this important condition.

Objective: To evaluate the clinical and functional outcomes of open reduction and internal fixation of Lisfranc injuries of the foot.

Material and Methods: In an, observational hospital-based case series study; a total of twenty-seven consecutive adults \pm 40-years-old; with displaced ligamentous or osseous Lisfranc injuries, due to high and low energy foot trauma; January 2015 to January 2017 were recruited from the Foot and ankle clinics at Sharg-Elneel and Ibrahim Malik specialized hospitals in Khartoum, Sudan. Open reduction and internal fixation by screws \pm Kirschner wire (K-wires) has been done to all patients after careful pre-operative assessment. At 6 months following surgery, patients were examined clinically and assessed using the American Orthopaedic Foot and Ankle Society (AOFAS) and foot function index.

Results: The AOFAS rating scale of the 27 patients ranges between 73 and 97 with a mean of 85. Which indicates very good outcome, However, the foot function index (FFI) score ranges from 11 to 41 with a mean FFI of 18.85, which was consistent with the Good AOFAS Foot Functional Outcome score, reflecting 'Good Foot Functional Outcome'. The timing of surgery was variable, from 1-3 weeks due post-trauma edema and swelling of the soft tissue.

Conclusion: Surgical correction of Lisfranc injuries by open reduction and internal fixation is found to be a valid treatment, which is directly linked to a good clinical and functional outcome. Particularly in reducing post-operative pain.

Keywords: Lisfranc injuries, Tarsal joints injury, AOFAS, Metatarsal bones, Kirschner wire, open reduction and internal fixation.

INTRODUCTION

The Lisfranc joint is the point at which metatarsal and tarsal bones connect. Injuries to the Lisfranc joint is a type of foot injury in which one or more of the metatarsal bones are displaced from the tarsus. ^[1] It is more common in males ^[2] and it presents itself as a dislocation or subluxation of the tarsometatarsal joint. ^[1]

It is most commonly occurred in low and high energy crush injuries ^[3,4] like road traffic accident, military personnel runners, football players, and other rough contact sports. ^[1] Less commonly, a direct blow to the midfoot can cause disruption of the joint complex. ^[5]

The severity of injury depends on the degree of violence, which can be purely ligamentous injury or associated with fractures of the metatarsals, cuneiforms, navicular and cuboid. ^[4,6] Early and accurate diagnosis of Lisfranc injury is of utmost importance to the patients' outcome; however, Lisfranc injuries are commonly misdiagnosed (about 20% of the cases) ^[2,7] Quenu E, Kuss G (1909) categorized Lisfranc injures into: homo-lateral, isolated and divergent. ^[8] However, according to Myerson they are divided into total incongruity, partial incongruity and divergent. ^[7] Conservative management which consists of closed reduction and plaster immobilization was found to be ineffective in LisFranc injuries. ^[9] Recent recommendations showed that the best surgical intervention can be achieved by using cannulated screws. Multiple K-wires have also been advocated, although they have poor stability and difficult installation. ^[10,11,12,13,14,15]

As far as we know there is no available published data concerning Lisfranc injures in Sudan, particularly the outcome of surgical fixation. Therefore, the aim of this study is to estimate the clinical and functional outcomes of ORIF of Lisfranc injuries in Sudan using AOFAS and FFI.

MATERIAL AND METHODS

In an, observational hospital-based retrospective case series study; a total of twenty-seven consecutive cases of male and female patients (n=27; 22 males and 5 females) who were diagnosed with displaced Lisfranc injuries in 2 years period, from January 2015 to January 2017 were included. All cases were collected from our '2 days-per-week' only specialized orthopedic 'Foot and ankle units' for such cases in the country, at Sharg-Elneel and Ibrahim Malik specialized hospitals in Khartoum, Sudan. The patients were adults with either ligamentous or osseous injury, free from any other closed or open foot injuries. Those with peripheral neuropathy or pathological fractures were excluded from the study.

All patients were fully assessed (by the same surgical team), before and after surgery. Clinical examinations and radiographic studies were taken in at least two planes, to confirm the Stability status. Preoperatively, a minimum of one-millimeter misalignment in the medial column line or loss of the linear relationship of either the second metatarsal to the middle cuneiform or the fourth metatarsal to the cuboid on the antero-posterior (AP) and oblique radiograph views were

documented respectively. Patients with a fleck sign (an avulsion fracture of the Lisfranc ligament) were considered to have purely ligamentous injury.

Surgical Technique:

The timing of surgery was influenced by the soft tissue condition and the degree of swelling. Surgery has been delayed in some patients for more than one week waiting for the massive foot swelling to subside. After routine preparations, the patient was positioned supine and tourniquet was used. Two dorsal incisions were used to approach the tarsometatarsal joints. The medial incision was just dorsal to the first intermetatarsal space, in which better exposure to the first and second metatarso-cuneiform joints was achieved. Through this incision, the two joints were irrigated, debrided from bone debris and then reduced anatomically. The first tarsometatarsal joint was aligned by reducing the medial border of the medial cuneiform to the medial border of the first metatarsal. Reduction was held with provisional Kirschner wire, and then 3.5-millimeter screws were used to fix the middle cuneiform to the first metatarsal. The second metatarsal was then reduced to the medial border of the middle cuneiform and was held provisionally with a Kirschner wire. A 3.5-millimeter cortical screw was inserted from distal to proximal across the joint. An additional 3.5-millimeter cortical screw was inserted under from the medial cuneiform into the second metatarsal to add stability to the fixation. When the third metatarsal base was dislocated, a second dorsal incision (lateral incision) was made between the third and fourth metatarsals to expose the third metatarso-cuneiform joint. This joint was then reduced and stabilized with a 3.5-millimeter screw from distal to a proximal direction. The fourth and fifth tarsometatarsal joints usually reduced once the above three reductions were achieved, and they were held with one or two trans-articular percutaneous smooth Kirschner wires (K-wires) from the base of the fifth metatarsal into the cuboid. In few patients the K-wires were left as definitive fixation because of either severe bone comminution or in availability of the appropriate screw sizes. The final alignment of the fractures and the position of the implants were checked with intraoperative radiographs.

Post-Operative Protocol:

Below knees posterior slap was applied immediately after surgery and was kept for two weeks before switching to walker boot after the removal of stitches. Non-weight bearing plan was followed for six weeks then partial weight bearing for additional six weeks. In the cases K-wires were used, removal was considered at 6 weeks. Patients were sent to the physiotherapy department after three months postoperatively.

Patients were followed subsequently on monthly basis for 11 months. The clinical and functional outcomes were assessed using the AOFAS score and the FFI respectively in the 6th month visit. The AOFAS score is a clinical score based on a scale of 0 to 100 points, with 100 points indicating an excellent or maximum outcome.

Rating of the 'Functional Outcome' was taken according 'The American Orthopaedic Foot and Ankle Society (AOFAS) Rating Scale Range' The parameters of the AOFAS are the pain, function

and alignment. AOFAS indicates the 'Functional Outcome' as:(a) Excellent in which the AOFAS-Rating Scale range from 91 to 100 (b) Good in which the AOFAS-Rating Scale range from 81 to 90 (c) Fair in which the AOFAS-Rating Scale range from 71 to 80 (d) Poor in which the AOFAS-Rating Scale range is below 70 Rating Scale'. Rating of the 'Good Foot Functional Outcome' also was taken according AOFAS foot function index (FFI) score or Rating Scale (AOFAS-FFO) ranges from 11 to 41 in normal functional ranges, although, the scale reaches 230, but the big values reflecting poor function. The FFI is a functional score with a scale of 230, with the big values reflecting poor function. Additionally, standard structured questionnaire was filled through a direct interview with the patients.

Data Statistical Analysis: Data were statistically analyzed using the Statistical Package for the Social Sciences; (SPSS) for windows, version 20 (Manufactured by IBM SPSS Inc. PASW Statistics for Windows, Version 20; 2011. Chicago: SPSS Inc; IL, USA). Results obtained were presented in tables and figures.

Ethical clearance was sent through the hospital administration to MOH.

Disclaimer

The authors hold in financial or Conflict of interest.

RESULTS

Twenty-seven (n=27) Sudanese males and females were enrolled in the current study. Twenty-two (n=22; 82%) were males, while only 5 (18%) were females. [Figure 1] 19 (70.3%) candidates were less than 40-years-old while 8 candidates (29.7%) were more than 40-years-old; younger's being dominating. [Figure 2] Out of the whole participants, 4 (14.8%) of them being an 'in-doors' occupation candidates; as house-wives, while the majority (85.2%) being an 'out-doors' occupation candidates; as employees, students or free workers. [Figure 3] Almost all of our patients were non-smokers (96.3%), except one patient being smoker (3.7%). Concerning their general medical status, most of them (88.9%) had no known medical illness apart from 3(11.1%) One (3.7 %) was hypertensive and 2 (7.4%) were diabetic.

Twenty-two patients (81.5%) had high energy foot trauma and 5 patients (18.5 %) had low energy foot trauma. [Figure 4] In 16 patients (59.2%) the right foot was affected, and in 11 patients (40.8%) the left foot was affected. [Figure 5]

Twelve patients (44.4%) has been treated with Open Reduction and Internal Fixation (ORIF) using K-WIRES, 11 patients (40.7%) treated with both K-WIRES and Screws, and only 4 patients treated with Screws only. [Figure 6]

The timing of surgery was variable, which was influenced by certain clinical and logistic post-trauma findings and situations; like the degree of edema and swelling of the soft tissue at the joint or the urgency of the patient's presentation to the hospital. So, Surgery has been delayed in some patients for more than one week waiting for the massive foot swelling to subside.

The majority of patients in the current study were operated within less than one week, constituting 14 patients (51.9%), followed by 10 patients (37%) operated in 1-2 weeks, 2 patients (7.4%) operated in 2-3 weeks, and only one patient (3.7%) operated within more than 3 weeks. [Figure 7] [Table 1]

The AOFAS Rating Scale range from 73 to 97 with a mean of 85, which indicate 'Good to satisfactory Functional Outcome'. These results were distributed as: 7 (26%) patients scored an Excellent AOFAS Rating Scale, 15 (55.6%) patients scored a Good AOFAS Rating Scale, 3 (11%) patients scored a Fair AOFAS Rating Scale, while only 2 patients scored a Poor AOFAS Rating Scale. [Figure 8] [Table 2]

The foot function index (FFI) score ranges from 11 to 41 with a mean FFI of 18.85, which was consistent with the Good AOFAS Foot Functional Outcome score, reflecting 'Good Foot Functional Outcome'; SD being 8.070.

The majority of the injury's types were non-ligamentous, which were found in 24 patients (88.8%): Homolateral (n=11; 40.7%); Divergent (n=7; 26%) and Isolated injuries in 6 (22.2%). While purely ligamentous injuries were few; only in 3 patients (11.0%). [Table 3]

[Figure 9] Showing 11 Coulered and Radiographic Photographs of the affected feet of patient One and patient two (as samples) of preoperative, intraoperative and postoperative Lisfranc joints managements of the 27 cases [9A, 9B. 9C. 9D. 9E. 9F.9G,9H. 9Ii, 9Iii, 9Iiii].

TABLES AND FIGURES**A. TABLES:***[Table 1] Distribution & Timing of surgery post-trauma in weeks*

Timing of surgery post-trauma in weeks	Frequency of patients	Percentages
< one week	14	51.9%
1-2 weeks	10	37%
2-3 weeks	2	7.4%
> 3 weeks	1	3.7%
Total	27	100%

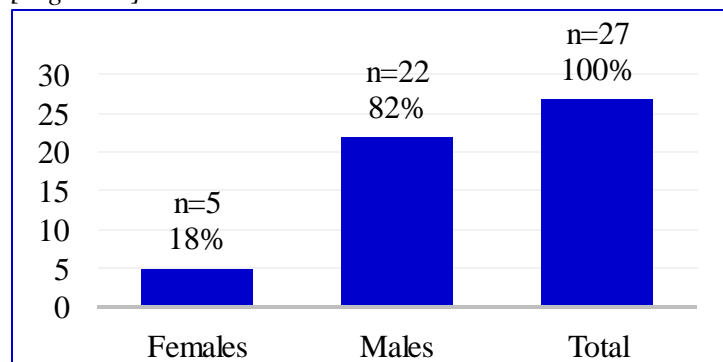
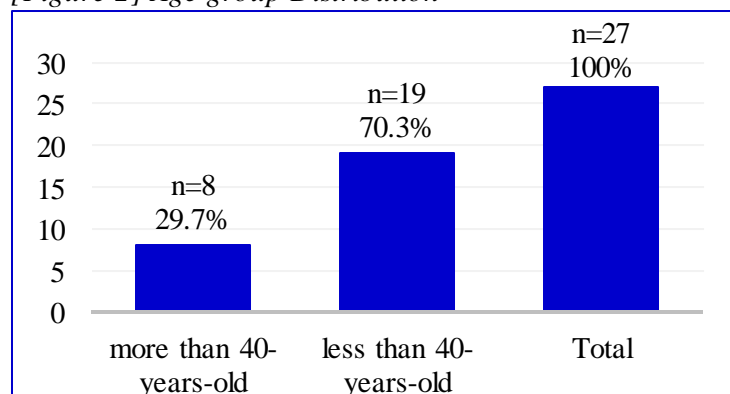
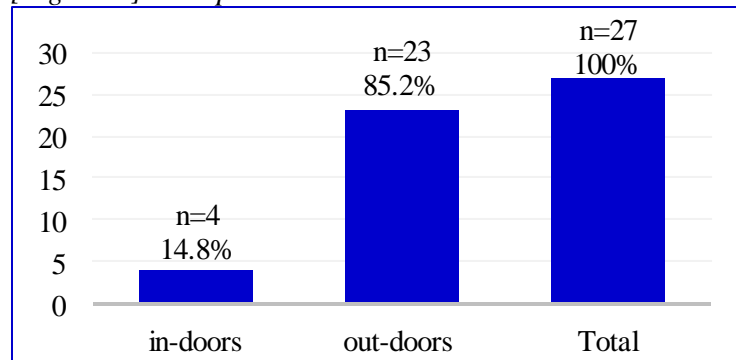
[Table 2] Distribution of AOFAS-Rating Scale

AOFAS Rating Scale	Frequency of patients	Percentages	Mean AOFAS
Excellent (91-100)	7	26%	85
Good (81-90)	15	55.6%	
Fair (71-80)	3	11 %	
Poor (< 70)	2	7.4%	

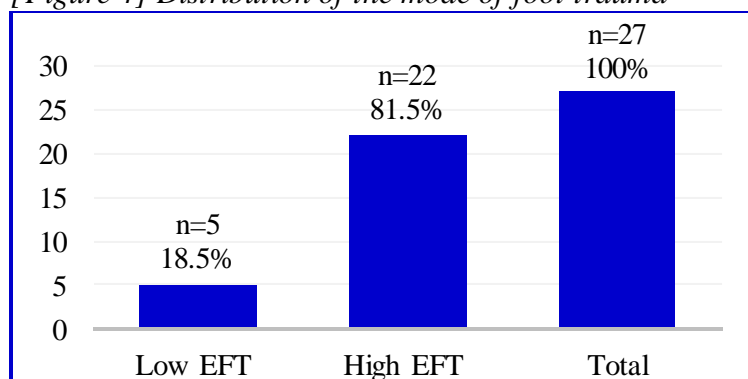
SD: 7.014. Note: AOFAS: The American Orthopaedic Foot and Ankle Society (AOFAS) Rating Scale Range.

[Table 3] Distribution of the injury Type (Classification)

Type of injury (Classification)	Frequency of patients	Percentages
Homolateral	11	40.7%
Divergent	7	26.0%
Isolated	6	22.2%
Purely ligamentous	3	11.0%
Total	27	100%

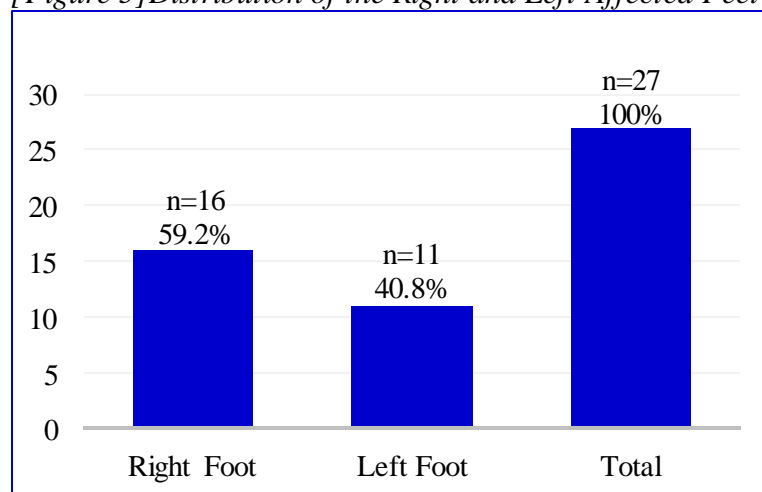
B. FIGURES:*[Figure 1] Sex Distribution**[Figure 2] Age group Distribution**[Figure 3] Occupation Distribution*

[Figure 4] Distribution of the mode of foot trauma

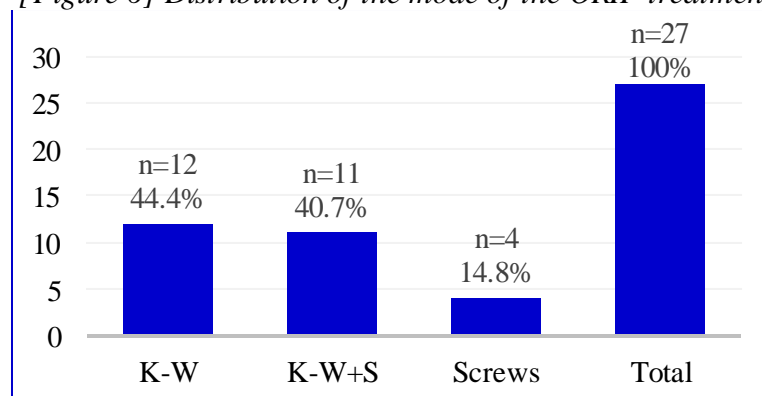


Note: Low EFT: low energy foot trauma; High EFT: high energy foot trauma

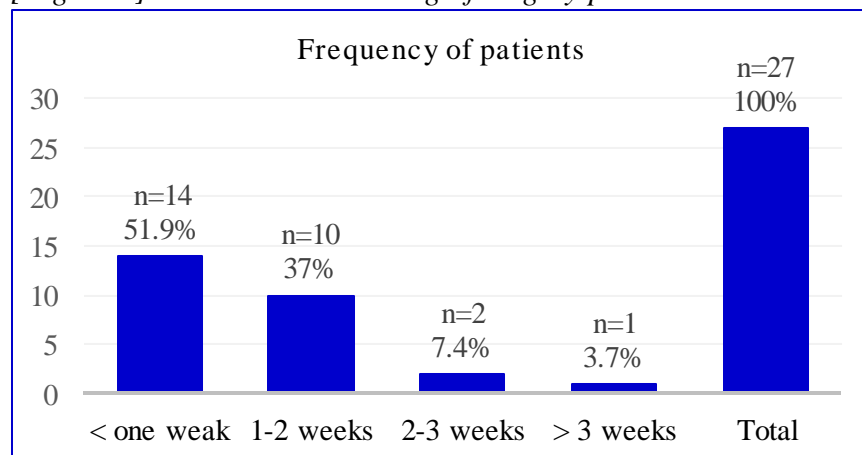
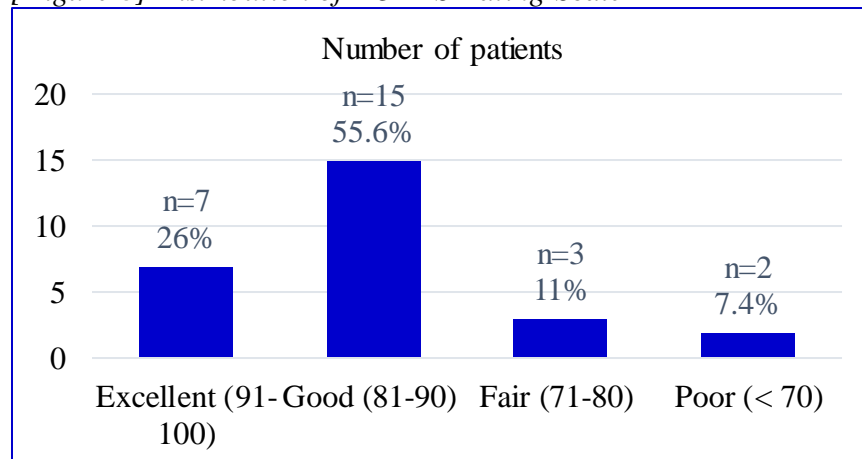
[Figure 5] Distribution of the Right and Left Affected Feet



[Figure 6] Distribution of the mode of the ORIF treatments



Note: ORIF: Open Reduction and Internal Fixation; K-W: Kirschner wire (K-WIRES); K-W+S: K-WIRES and Screws; Screws: treated with Screws only.

[Figure 7] Distribution & Timing of surgery post-trauma in weeks*[Figure 8] Distribution of AOFAS-Rating Scale*

Note: AOFAS: The American Orthopaedic Foot and Ankle Society (AOFAS) Rating Scale Range

[Figure 9] 11 Photographs of the affected feet of patient One and patient two (as samples) of preoperative, intraoperative and postoperative Lisfranc joints [9A, 9B. 9C. 9D. 9E. 9F.9G,9H. 9Ii, 9Iii, 9Iiii].



9A, Photo of the foot of patient One

9B. preop x-ray of patient One

9C. preop x-ray of patient One

9D: Intra-op x-ray of patient One

9E,F. post-op x-ray of patient One

9G, Photo of The Foot of Patient Two

9H. preop x-ray of patient two

9Ii, post-operative x-rays of patient two

9Iii post-operative x-rays of patient two

9Iiii post-operative x-rays of patient two

DISCUSSION

Twenty-seven patients were included in this study; twenty-two males and five females with a mean age of 36.6 (20 to 65 years old), with a prevalence of 59.3% on the right side. Prevailing of males over females in this study is similar to José Antonio Enríquez Castro and colleagues (2005) ^[16] study of seventeen patients with a 4.6:1 male to female ratio. Lisfranc injuries can result from high energy trauma. ^[17] In this study twenty-two patients (81.75%) had high energy trauma to the foot, a finding consistent with the literature. ^[17] Numerous outcome measurements can be used to evaluate the treatment. ^[18] AOFAS scoring system is a well-accepted and a standard method for reporting result, The FFI scoring system is used to measure functional outcome (Scale of 0 to 230 points, with 0 point indicating an excellent outcome). The average overall score for the 27 patients who underwent open reduction and internal fixation in this study was 85 for AOFAS score, which was exactly in line with Zhang LJ and colleagues (2010) ^[19] The average AOFAS (85) was insinuating in that the anatomical reduction of tarsometatarsal joint and metatarsal is important to rebuild the function of foot. Additionally, a retrospective study performed by Kuo RS et al (2000). ^[20] evaluated 92 patients who underwent open reduction and screw fixation of a Lisfranc injury. The results support the concept that stable anatomical reduction of fracture-dislocations of the Lisfranc joint leads to the best long-term outcomes as patients treated in that way have less arthritis as well as better AOFAS midfoot scores; average AOFAS midfoot score was 77 points. Open reduction and internal fixation have become a standard principle governing treatment of tarsometatarsal fracture-dislocations. Fixation can entail K- wires or screws, although the former has slightly higher failure rates. In this study twelve patients were treated with ORIF using K-wires (44.4%) and eleven patients were treated with both K-wires and Screws (40.7%), while only four patients were treated with Screws alone. There was no statistically significant correlation between method of fixation and both AOFAS score ($p=0.240$) and FFI score ($p=0.232$). Lee CA et al ^[21] tested the biomechanical stability of three fixation methods: K-wires, screws plus K-wires, and screws; screw fixation provides a more rigid and stable method of fixation for Lisfranc injuries as compared to K-wire fixation. This fixation method allows maintenance of anatomic reduction and possibly earlier mobilization with a decreased risk of posttraumatic arthrosis.

Good results are reported with open reduction up to 6 weeks after injury. ^[15] In the current study majority of patients were operated within less than 2 weeks (51.9% of them within less than one week, 37% within 1-2 weeks). A significant correlation was found between the time of surgery and the AOFAS score ($p=0.032$). Apparently, there is no correlation between the time of surgery and the FFI score ($p=0.104$).

Similarly, Cléber de J. P. et al and fellows (2008) ^[22] enrolled 19 patients in a retrospective study (17 males - 89.47%, and 2 females - 10.53%), with a mean age of 31.53 years (ranging from 17 to 50 years old). Surgical treatment was provided to these patients within one week, and those patients showed a mean AOFAS score of 87.6, reflecting a good outcome. This Cléber de J. P. et al and fellows (2008) results support the current study findings. ^[22]

In the current study there were two diabetic patients and one hypertensive patient. The presence of wound infection as a complication was found in four cases (14.8 %). There was no correlation between the co-morbidities and wound infection ($p=0.746$). In Sushant D Ghate et al (2012) [23] study, two patients from the total of 19 with Lisfranc fractures who underwent open reduction and internal fixation developed superficial infection. As well illustrated in the current study that one patient developed malunion post-operatively; but still no there is no correlation between method of fixation and malunion ($p=0.523$). An early surgery is important in improving the post-operative results indicated by significantly better AOFAS score in patients operated within less than 2 weeks.

Pertaining to the main limitations of this study, which were the limited number of patients, the short duration of follow-up and the use of two different fixation devices (screws and wires) despite of the minimal difference between the two in the literature.

Conclusion:

This study supports the role of open reduction and internal fixation in lisfranc injuries with good clinical and functional outcomes reflected by AOFAS score and FFI score respectively.

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