ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 04 | April - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A COMPARATIVE STUDY: LISFRANC JOINT INJURIES TREATED WITH PRIMARY ARTHRODESIS VERSUS OPEN REDUCTION INTERNAL FIXATION

Orthopaedics

Dr Abraham M Antony	Department of Orthopaedics , Aarupadai Veedu Medical College and Hospital.
Dr Jayakumar Bommusamy	Department of Orthopaedics , Aarupadai Veedu Medical College and Hospital.
Dr Boblee James	Department of Orthopaedics , Aarupadai Veedu Medical College and Hospital.
Dr Kamalesh T	Department of Orthopaedics , Aarupadai Veedu Medical College and Hospital.
Dr Gokul Anand M*	Department of Orthopaedics, Aarupadai Veedu Medical College and Hospital. *Corresponding Author

ABSTRACT

Background: Tarsometatarsal joint is a structural complex which allows for effective force transfer and propulsion during gait. Lisfranc joint injuries sometimes can be missed, or delayed treatment may lead to disability with chronic pain and deformity of tarsometatarsal joint. There is a controversy between primary arthrodesis versus open reduction with internal fixation as to which is superior treatment with better outcome for these injuries. **Aim** To compare primary arthrodesis versus open reduction with internal fixation for Lisfranc joint injuries. **Materials and Method** A comparative observational study was conducted from August 2020- October 2022 at AVMC & H, Pondicherry. 21 patients were included in the study. All were followed up for a minimum of 6months. **Results** In our study, According AOFAS score we had excellent to good outcome in 90% patients treated with Primary arthrodesis than open reduction internal fixation **Conclusion** In our study, we conclude that in south Indian population, shows that primary arthrodesis has better functional outcome than Open reduction and internal fixation for Lisfranc joint injury. Since the sample size is limited and the duration of study is short, further study is need with larger population.

KEYWORDS

Lisfranc joint injuries, AOFAS score, Primary arthrodesis, open reduction internal fixation and cannulated cancellous screws.

INTRODUCTION

The term "Lisfranc injury" was named for a French gynaecologist and field surgeon named Jaques Lisfranc de Saint-Martin in 1815(1). He was the one who illustrated traumatic amputation in mid-foot (2). Lisfranc injuries are defined as any bony or ligamentous injury that involves the tarsometatarsal joints of the foot (3). Lisfranc fracture-dislocations can be missed clinically as well as radiologically (4). It is a complex joint injury, in which 20% of cases are unnoticed or some are diagnosed late (5). Lisfranc injuries are more commonly seen in the third decade of life and men are commonly around 2-4 times more affected than females (7). Approximately 0.2% of the population are affected by the fracture – dislocation of Lisfranc joints and associated with fractures of the tarsal and metatarsal bones (5). Even though fractures of cuneiform bones are common but the most common fractures of mid-foot occur in the tarsometatarsal complex which is mostly seen in the base of 2nd metatarsal bones (8). The variety of foot injuries affecting the tarsometatarsal joint first, second, and third metatarsal bones to the corresponding cuneiform (6). It is critical to diagnose these injuries early and provide treatment because failing to do so will result in mid-foot arthritis, persistent discomfort, and functional instability (7). Even when diagnosed and treated early, the risk of chronic impairment and consequences remains substantial (6). This study is conducted in South Indian population we have conducted our study regarding mode of injury, either bony or pure ligamentous injury, and the management of injury in unstable and stable Lisfranc injuries either by conservative by below knee slab and surgical by open reduction internal fixation (ORIF) or primary arthrodesis (PA). We have compared ORIF and PA which are surgically managed and evaluated the near return to daily activities and patients were followed up to minimum of 6 months. The maximal walking distance/blocks, walking surfaces, alignment, sagittal motion (flexion and extension), hindfoot motion (inversion and eversion), ankle-hindfoot stability, and pain were all evaluated using the American Orthopaedic Foot and Ankle Society (AOFAS) score (8).

MATERIALS & METHODOLOGY

This is a comparative observational study done on 21 patients, seventeen male patients and four female patients. who were admitted and given care for Lisfranc injuries under the supervision of the orthopaedics department at the Aarupadai veedu medical college and hospital in Puducherry between August 2020 and October 2022. Prior to the start of the research, permission from the institutional ethics committee was obtained. Inclusion criteria were Patient aged above 18 years, Planter ecchymosis, Insufficient closed anatomic reduction and Insufficient stability after closed reduction

The patients who satisfy the inclusion criterion for Lisfranc joint injury were selected in this study. The data of each patient was collected using a clinical proforma which assesses the patient clinically as well as radiologically confirms the case of Lisfranc joint injury. The type of fracture is classified using Myerson classification. The research was based on two groups of patients who underwent two different surgical procedures to manage their Lisfranc injuries.

Group A underwent Primary Arthrodesis (PA) and Group B managed by open reduction and internal fixation (ORIF).

But since Lisfranc injury is a rare case, in this study we have concluded with 10 patients who were managed with ORIF and 11 patients with PA in Aarupadai Veedu medical college and hospital and all these 21 patients were followed for minimum of 6 months. Post-operatively the patient was analysed using AOFAS score and VAS score for both the surgical groups. The data was uploaded in Microsoft Excel for assessing the standard random variable.

Surgical Procedures

Approach For Primary Arthrodesis (9)

Patients were placed in the supine posture after spinal anaesthesia. Preoperative antibiotic was administered. A thigh tourniquet was applied and inflated, and a sandbag was put under the ipsilateral hip. After standard preparation and draping of the extremity. A 5–6 cm in length incision was made over the interval between the first and the second metatarsal bases, TMT joint was derided and articular cartilage was removed. Reduction clamp was used to achieve reduction between the second metatarsal base to medial cuneiform. A temporary k- wire was passed from the base of second metatarsal base to intermediate cuneiform and fused with 4.0 mm cannulated cancellous screw. First metatarsal base and medial cuneiform was fixed with a temporary k-wire and fused with 4.0mm cannulated cancellous screw. A second incision was made lateral to the base of the third metatarsal and lateral cuneiform and third metatarsal- lateral cuneiform joint was reduced and fixed with a k- wire. Fourth and fifty TMT joint are fixed with k- wires if it is unstable. Wound wash was given. Wound was closed in layers. Below knee slab was applied. We do not remove hardware on a regular basis.

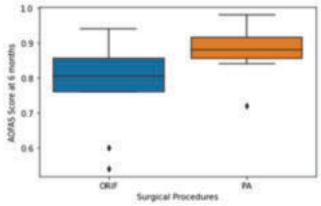
Approach To Open Reduction Internal Fixation (9)
Open surgery is what we do most frequently. To facilitate reduction and bone fixation, the patient is in supine position and sandbag placed under the ipsilateral thigh and also used a thigh support to keep the knee in 90-degree flexion.

We use a double approach, creating a longitudinal incision in the first inter-metatarsal space and another longitudinal incision parallel to the fourth metatarsal, if third and fourth and fifty TMT is involved A reduction is carried out from the medial to lateral. we reduce the first cuneiform-metatarsal joint with K-wires and secure the bone from the first metatarsal to the first cuneiform with two k-wires. For this purpose, we secure the bones with a k-wire from the first cuneiform to the base of the second metatarsal using a reduction clamp between the medial region of the first cuneiform bone and the lateral to the second metatarsal. Once the joint has been minimized, the following k-wire is placed from the second metatarsal to the second cuneiform. The third metatarsal joint is assessed and, if necessary, reduced through an incision on the fourth metatarsal fourth and fifth TMT joints are fixed if required. Two k- wires are used for bone reduction. A K-wire are required to support each joint.

Post Operative Protocols (10)
After surgery patients were immobilised for 6 weeks. Affected limb was elevated. All the patients were on non-weight bearing for minimum for 6 weeks. Regular wound was inspection was done and on 14th day sutures were removed. After 10-12 weeks, patients were encouraged for non-weight bearing and gentle range of motion exercise were initiate for to prevent stiffness over the mid-foot. Weight bearing is encouraged at the end of 4th month depending on the clinical and radiographic evaluation.

RESULTS
The mean age for ORIF is 41.2 years old, whereas the mean age for PA is 38.1 years old. Patients who gone through PA surgical procedure stayed more days in Hospital than the Patients who gone through ORIF surgical procedure. It's because those patients were tested positive for covid- 19. The average duration of a stay in PA is approximately 8 days whereas, in ORIF is about 5 days. In this study, both ORIF and PA, there is more male domination than the female population.

The modes of injury in our study were 50% RTA, 30% self-fall, 15% fall from heavy object, and 6% sports injury. Calculating for laterality in both surgical groups reveals that there are more patients with the right than the left. The most common Myerson classification in our study is type B.



Graph1: AOFAS score at 6 months showing primary arthrodesis is superior than ORIF

The Variance of both the surgical procedures with respect to the patient satisfactory levels is unequal.

```
In [33]: import numpy as np

         #define F-test function
         def f_test(x, y):
             x = np.array(x)
             y = np.array(y)
             f = np.var(x, ddof=1)/np.var(y, ddof=1) #calculate F test statistic
             dfn = x.size-1 #define degrees of freedom numerator
             dfd = y.size-1 #define degrees of freedom denominator
             p = 1-scipy.stats.f.cdf(f, dfn, dfd) #find p-value of F test statistic
             return f, p

In [34]: f_test(one_side_mean_test_orif['Weighted_average'],
                one_side_mean_test_pf['Weighted_average'])

Out[34]: (3.5447015324176383, 0.030687715101367696)
```

Figure 1: F test statistic

- H0 - Variance of ORIF = Variance of PA; H1 - Variance of ORIF <= Variance of PA
- Alpha value = 0.05
- P value is lesser than Alpha value (figure 1). Hence, we are rejecting the Null Hypothesis. Therefore, the Variance of ORIF is not equal to the Variance of PA. Here,

```
In [30]: scipy.stats.ttest_ind(one_side_mean_test_orif['Weighted_average'],
                               one_side_mean_test_pf['Weighted_average'], equal_var=False)

Out[30]: Ttest_indResult(statistic=-2.059021655057542, pvalue=0.05945657799270427)
```

Figure 2: To determine the p-value between the variables

H0 - Mean of PA > Mean of ORIF; H1 - Mean of PA <= Mean of ORIF. The P-value is greater than 0.05. Hence, we are accepting the Null Hypothesis (figure 2). Therefore, the mean of ORIF is less than or equal to PA. The Patient satisfactory level for PA surgical procedure is greater than patient satisfactory level of ORIF surgical procedure.

Case illustration
[a] Treated With Primary Arthrodesis:

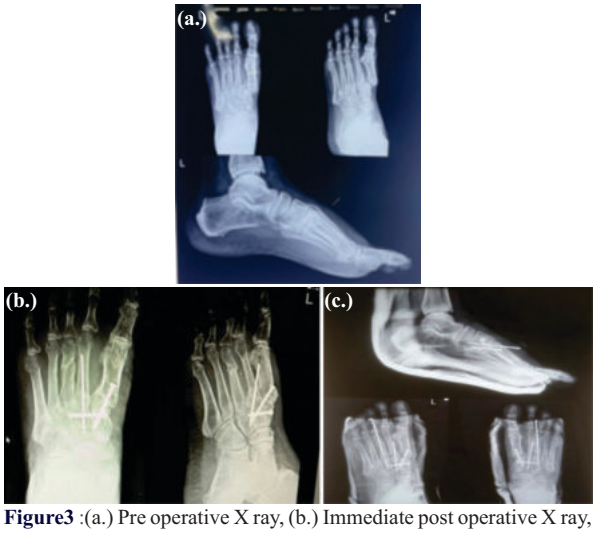


Figure3 :(a.) Pre operative X ray, (b.) Immediate post operative X ray, (c.) Follow up X ray after 3 months

[b] Treated With Open Reduction And Internal Fixation

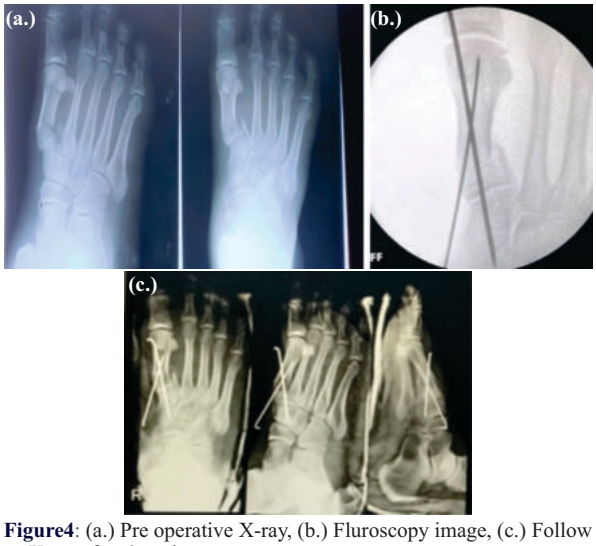


Figure4: (a.) Pre operative X-ray, (b.) Fluroscopy image, (c.) Follow up X-ray after 6 weeks

DISCUSSION
The choice between performing an open reduction and internal fixation (ORIF) or a primary arthrodesis of the involved joints is still up for discussion (1). Due to the conflicting evidence in the literature, it is currently up to the surgeon's choice whether to perform a primary fusion or an ORIF. Arthrodesis emphasise the need for subsequent surgery, while ORIF proponents prefer to avoid fusing a joint if it is not clearly necessary. In 2006, Ly and Coetzee (11) compared ORIF VS PA which is a prospective randomized controlled trial shows that primary arthrodesis overperformed it and states that patients had better postoperative American Orthopaedic Foot and Ankle Society (AOFAS) Midfoot Score. In our study comparison between both the groups primary arthrodesis estimated that their level of activity postoperatively was 90% of their preinjury level, whereas those who received open reduction estimated that their level of activity was 65%

of preoperative level. (12) Foot & Ankle Consultant mentioned that many surgeons prefer to use dorsal bridge plating techniques to preserve the articular cartilage, but in his study ORIF was performed using a transarticular screw. Additionally, 16 of the 20 patients who underwent ORIF had their hardware taken out, which may have been a confounding factor in instances of poor ligament healing because it would have allowed for more joint motion. There were no statistically significant variations in the rates of satisfaction, activity levels, and return to work, according to Alcelik et al., (13).

In our study we achieved reduction by using a pointed reduction clamp. Which helped us to reduced the diastasis between the medial and middle columns, position of the clamp from the medial side of the medial cuneiform to the lateral side of the second metatarsal. However, excessive tension should be avoided to prevent metatarsal subluxation.

Panchbhavi (14) shows us a method in which the medial cuneiform is screwed into position in place of the second metatarsal base. This method has several benefits. The medial cuneiform bone, which is the larger target, is where the threaded portion of a partially threaded screw is located. Last, if any damaged hardware needs to be removed, it is simpler to do so by removing the screw's head from the base of the second metatarsal (14). Avoiding a screw's plantar course is important because doing so could cause the joint to move in the plantar-flexion. (15). In this study, we contrast between PA with ORIF in the population of South India. We now state that PA is preferable than ORIF based on our research which based on the AOFAS score which shows significant improvement at the minimum of 6 months. Based on our study we recommend using partially threaded cannulated 4.0 mm screws rather than completely threaded ones for Lisfranc joint injuries. Since patient blinding is difficult during surgical intervention, this study's limitations include its lack of it. Is it possible to fix a severe midtarsal collapse by being treated with an external fixator. Which requires additional research to elaborate on the various methods of correcting the collapse, especially in Myerson type C fracture.

CONCLUSION

It is obvious that the diagnosis and treatment of these potentially life-altering injuries can only be improved by raising awareness of normal foot anatomy and the severity of Lisfranc joint injuries in apparently insignificant accidents. Our goal is to achieve normal anatomy and joint congruence. However, the traditional way of fixation is by osteosynthesis (ORIF) but the literature highly recommends primary arthrodesis because firstly, Primary arthrodesis is becoming more popular and the patient's satisfactory level for PA surgical procedure is greater than the patient's satisfactory level for ORIF surgical procedure. Secondly, Lisfranc joint injury is purely ligamentous. And thirdly, even though ORIF was performed, few patients had intended for re-surgery because of post-traumatic osteoarthritis.

For ligamentous Lisfranc joint injuries, an initial stable arthrodesis of the medial two or three rays appears to be preferable to open reduction and internal fixation. In our study, we have found that younger adults 38- 42 years old who underwent PA have fared than patients managed with ORIF patients with a Lisfranc injury can typically expect a positive outcome with a return to near pre-injury levels at the end of minimum six-month follow-up.

Author Contributions

The authors contributed equally for its content, writing, and reviewing and/or editing of the manuscript before submission.

Conflicts Of Interest

The authors declare no conflict of interest.

Acknowledgement

The authors are grateful to the authorities of Aarupadai Veedu Medical College and Hospital, Vinayaka Missions Research Foundation (Deemed to be University) and to all the patients who participated in the study.

REFERENCES

1. Chen J, Sagoo N, Panchbhavi VK. The Lisfranc Injury: A Literature Review of Anatomy, Etiology, Evaluation, and Management. Foot Ankle Spec [Internet]. 2021 Oct 20;14(5):458–67. Available from: http://journals.sagepub.com/doi/10.1177/1938640020950133
2. Clare MP. Lisfranc injuries. Curr Rev Musculoskelet Med. 2017 Mar;10(1):81–5.
3. Suzuki Y, Edama M, Kaneko F, Ikezu M, Matsuzawa K, Hirabayashi R, et al. Morphological characteristics of the Lisfranc ligament. J Foot Ankle Res [Internet]. 2020 Jul 16;13(1):46. Available from: https://pubmed.ncbi.nlm.nih.gov/32677989
4. Gupta RT, Wadhwa RP, Learch TJ, Herwick SM. Lisfranc Injury: Imaging Findings for this Important but Often-Missed Diagnosis. Curr Probl Diagn Radiol [Internet]. 2008;37(3):115–26. Available from: https://www.sciencedirect.com/science/article/pii/S036301880700062X
5. Moracia-Ochagavía I, Rodríguez-Merchán EC. Lisfranc fracture-dislocations: current management. EFORT open Rev [Internet]. 2019 Jul 2;4(7):430–44. Available from: https://pubmed.ncbi.nlm.nih.gov/31423327
6. Buchanan BK, Donnally III CJ. Lisfranc dislocation. In: StatPearls [Internet]. StatPearls Publishing; 2021.
7. Kurup H, Vasukutty N. Midfoot arthritis- current concepts review. J Clin Orthop trauma [Internet]. 2020/03/08. 2020;11(3):399–405. Available from: https://pubmed.ncbi.nlm.nih.gov/32405198
8. Van Lieshout EMM, De Boer AS, Meuffels DE, Den Hoed PT, Van der Vlies CH, Tuinebreijer WE, et al. American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot Score: a study protocol for the translation and validation of the Dutch language version. BMJ Open. 2017 Feb;7(2):e012884.
9. Coetzee JC, Ly T V. Treatment of primarily ligamentous Lisfranc joint injuries: primary arthrodesis compared with open reduction and internal fixation. Surgical technique. J Bone Joint Surg Am. 2007 Mar;89 Suppl 2:122–7.
10. Deol RS, Roche A, Calder JDF. Return to Training and Playing After Acute Lisfranc Injuries in Elite Professional Soccer and Rugby Players. Am J Sports Med. 2016 Jan;44(1):166–70.
11. Ly T V, Coetzee JC. Treatment of primarily ligamentous Lisfranc joint injuries: primary arthrodesis compared with open reduction and internal fixation. A prospective, randomized study. J Bone Joint Surg Am. 2006 Mar;88(3):514–20.
12. Calder JDF, Whitehouse SL, Saxby TS. Results of isolated Lisfranc injuries and the effect of compensation claims. J Bone Joint Surg Br. 2004 May;86(4):527–30.
13. Alcelik I, Fenton C, Hannant G, Abdelrahim M, Jowett C, Budgen A, et al. A systematic review and meta-analysis of the treatment of acute lisfranc injuries: Open reduction and internal fixation versus primary arthrodesis. Foot ankle Surg Off J Eur Soc Foot Ankle Surg. 2020 Apr;26(3):299–307.
14. Panchbhavi VK. Orientation of the "Lisfranc Screw." J Orthop Trauma [Internet]. 2012;26(11). Available from: https://journals.lww.com/jorthotrauma/Fulltext/2012/11000/Orientation_of_the__Lisfranc_Screw_.15.aspx
15. Lewis JSJ, Anderson RB. Lisfranc Injuries in the Athlete. Foot ankle Int. 2016 Dec;37(12):1374–80.