

Open Reduction and Temporary Rigid Internal Fixation of Lisfranc Fracture-Dislocations

J S P Yuen, S W Yung, M K Wong

ABSTRACT

Aim: To review the results of open reduction and temporary rigid screw fixation of Lisfranc fracture-dislocations performed in Singapore General Hospital (SGH) from 1996 to 1998.

Methods: A retrospective review of 11 cases of Lisfranc injuries treated with temporary rigid internal screw fixation with a minimum follow up of six months was carried out. Radiological assessment was made at follow up to ascertain the anatomical reduction achieved and complications such as post-traumatic arthritis. In addition, the patients were evaluated with a functional assessment with relation to pain, interference to usual activities and the time to resumption of work.

Results: Anatomical reduction was achieved in all cases. None of the cases showed loss of reduction at follow up after the temporary implants were removed. No longitudinal arch collapse or other deformities were seen. All the patients had good or excellent functional outcomes.

Conclusions: Results of treatment of Lisfranc injuries are related to anatomical correction. Temporary screw fixation allows rigid internal fixation with stability to allow anatomical correction. Screws also maintain their stability longer, allowing ligamentous injuries the longer period necessary for healing. In conclusion, temporary rigid screw fixation of Lisfranc fracture maintains anatomical reduction and gives excellent functional outcomes for the patients.

Keywords: Lisfranc injuries, AO Screw fixations

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INTRODUCTION

Fracture dislocations of the Lisfranc (Tarsometatarsal) joint of the foot are uncommon but serious injuries with a high potential for chronic disability. These injuries can be easily missed in the Accident and Emergency Department as standard

radiographs may show only a subtle incongruity of the joint⁽¹⁾. The outcome of these injuries depends on the accuracy of anatomical reduction⁽²⁻⁸⁾. These difficult fracture-dislocations are commonly fixed with non-rigid means such as smooth k-wires^(2,5,9). However, this method of fixation is often found to be unable to hold the reduction accurately and adequately for the required time for healing⁽¹⁰⁾. This leads to late loss of reduction or in some cases, these wires are unable to even maintain reduction intra-operatively.

Arntz et al⁽¹⁰⁾ reported their experience with rigid screw fixation following open reduction in 40 patients with 41 Lisfranc injuries. The screws were removed at an average of 16 weeks post operatively. In 28 of 30 patients, anatomical reduction was achieved and these patients had good to excellent results. Results were related to the accuracy of reduction and also to the severity of associated articular damage and soft tissue injury.

We report our experience of 11 cases of Lisfranc fracture dislocation treated with open reduction and temporary rigid internal fixation from 1996 to 1998. Lagged 3.5 mm AO cortical screws were used for internal fixation and in some cases this was supplemented with plates and screws, or external fixators.

MATERIAL AND METHODS

11 patients, 8 male and 3 female, aged between 15 and 56 with Lisfranc fracture-dislocations treated in the Singapore General Hospital from 1996 to 1998 were included in this review. Six of the cases involved the left foot while the remaining five involved the right foot. Two cases had other associated injuries; one had a fibular fracture while the other had a medial femoral condyle fracture on the ipsilateral side.

All patients had closed injuries. Using the Quenu and Kuss classification⁽⁵⁾ (Fig. 1), there were 9 partial and two divergent injuries. There were no type A injuries with total incongruity. Comminution of the metatarsal bases of the medial three metatarsal bones was present in one patient.

All the operations were performed by the two senior authors. Six of the patients were operated acutely

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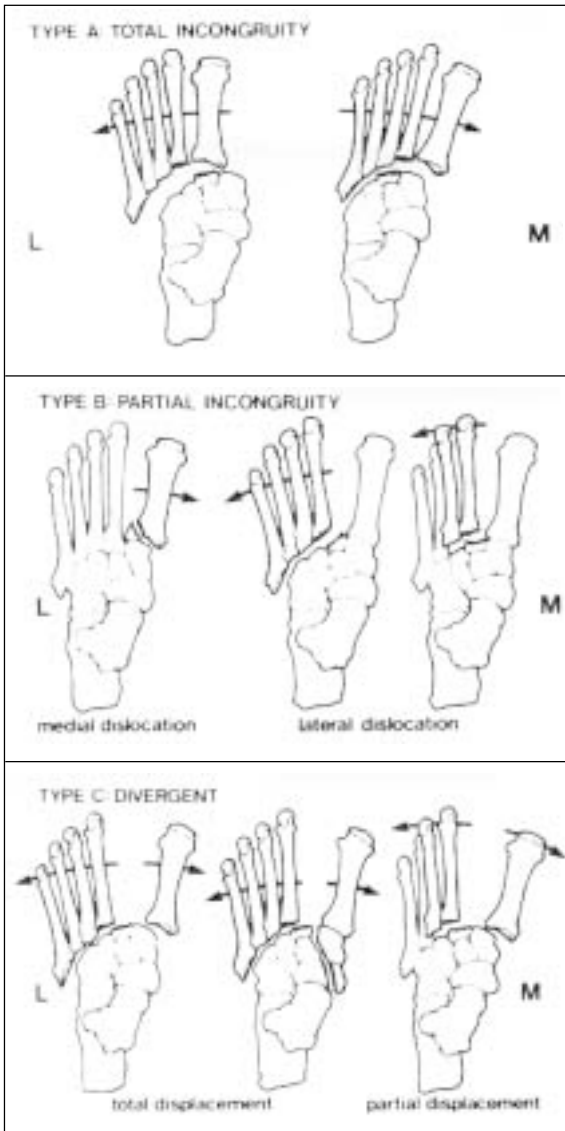


Fig. 1 Classification of Lisfranc injuries (modified from Quenu and Kuss, 1909).

on the day of admission while a further five had their operations delayed about two weeks due to gross swelling at presentation. If the swelling was severe, surgery was deferred until the soft tissue swelling was better.

The patients were assessed at an average of six months post-operatively. All cases were assessed radiologically (Weight Bearing AP, Lateral and Oblique) at follow up to assess the accuracy of reduction. In addition, the patients were evaluated with a functional assessment with relation to pain, interference to usual activities and the time to resumption of work.

SURGICAL TECHNIQUE

In most cases, the tarso-metatarsal joint dislocations were fixed through multiple dorsal longitudinal incisions as described by Arntz et al⁽¹⁰⁾. The basic fixation technique consisted of open reduction and lagged 3.5 mm screw fixation of the 2nd Tarso-Metatarsal



Fig. 2a A 26-year-old male who sustained a Type C Divergent Lisfranc injury of the left foot.



Fig. 2b Post-operative X-ray illustrates the use of lagged 3.5 mm screw fixations of the 1st, 2nd and 3rd Tarso-metatarsal joints and K-wires fixations of the 4th and 5th Tarso-metatarsal joints.

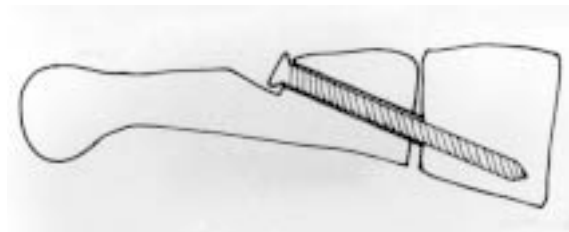


Fig. 3 Illustration showing the 'countersink' hole used to prevent crack fracture of the metatarsal shaft on tightening of the screws.



Fig. 4a A 28-year-old male who sustained a Type C Divergent Lisfranc injury of the right foot with comminution of the metatarsal bases.



Fig. 4b Post-operative X-ray showed fixation with a 2 mm plate spanning the fracture sites from the metatarsal shaft to the cuneiform instead of the Screw.

joint from the Postero-Medial corner of the Medial Cuneiform to the bases of the 2nd Metatarsal and occasionally, the 3rd as well (Fig. 2). This first lagged screw is the key to the reduction and fixation of the whole injury complex. This was followed by multiple lagged screws placed from the bases of the involved Metatarsals (I to III) to their respective Cuneiform bones. The metatarsal insertion point was first



Fig. 5a A 15-year-old female with Type B Partial Incongruity Lisfranc injury of the left foot with associated crush fracture of the cuboid.

Fig. 5b In addition to the standard screw fixation technique, an external fixator using 4 mm and 2.5 mm shantz pins in the Calcaneus and 4th Metatarsal shaft was used. The cuboid was also bone grafted and fixed with a small AO cervical 'H' plate.

prepared by creating a "countersink" hole as described by Manoli et al⁽¹¹⁾ in order to prevent a crack fracture of the Metatarsal shaft on tightening of the screw (Fig. 3). In all the cases, reduction of the Medial 2 Metatarsals resulted in reduction of the 4th and 5th Metatarsal bases with relative stability. These were then fixed with simple K-wires (Fig. 2).

If there was comminution of the metatarsal bases, this was treated with a 2 mm Plate spanning the fracture from the Metatarsal shaft to the Cuneiform instead of the Screw (Fig. 4). For the 1st Metatarsal bone, a 2.7 mm Plate was used.

In addition to the screw fixation, a crush fracture of the Cuboid with shortening of the lateral column was fixed with an external fixator using 4 mm and 2.5 mm Shantz pins in the Calcaneus and 4th Metatarsal Shaft. The cuboid was then bone grafted and fixed with a small AO cervical "H" plate (Fig. 5).

The patients were kept non-weight bearing for about 6 to 8 weeks followed by partial weight bearing for another 6 to 8 weeks. Prior to full weight bearing, the lagged screws or plates crossing the Tarso-Metatarsal joints were removed at about 12 to 16 weeks post-operatively. In one patient the implants were broken after weight bearing and were left in-situ. External fixator if used, was removed at about 6 to 8 weeks post-operatively.

RESULTS

Anatomical reduction was achieved in all cases except for one case where a missed cuboid fracture resulted in some mild lateral deviation of the forefoot from shortening of the lateral column. None of the cases showed loss of reduction at follow up. No longitudinal

arch collapse or other deformities was seen other than the one case mentioned above. There were no cases of chronic osteomyelitis or deep infection.

There was one patient who had compartment syndrome as a result of delayed presentation resulting in some clawing of the toes from intrinsic muscle contracture at one year. Other complications noted include one superficial wound infection after removal of implants and broken implants (2 mm plate) in one patient which were left in-situ.

Functionally, two complained of chronic pain and two complained of numbness over the dorsum of the foot. 10 out of 11 of the patients resumed work six months post-operatively. One rejoined the Army six months post-operatively. None of the patients had significant foot deformity as a result necessitating the use of special footwear and none had gait abnormality post-operatively.

DISCUSSION

Many methods of fixation of Lisfranc injuries have been described. Most of them use non-rigid methods of fixation with Kirshner wires. Unfortunately, this leads to loss of correction or in many cases, they are unable to hold the reduction at all. Arntz et al⁽¹⁰⁾ first described a more rigid method of fixation as well as emphasised the need for accurate open reduction of these injuries. The results of treatment of these often severe injuries are directly related to the accuracy of reduction and rigid fixation with screws appears to be an excellent method to achieve this.

In our small series, we have found this method of open reduction and rigid fixation very effective especially in the severely unstable injuries. The complication rate was low. There were no cases with deep infection. Accurate reduction and the maintenance of this reduction was achieved in almost all the cases.

In addition to the standard techniques described by Arntz et al, we have further added supplementary fixation techniques with plate and screws, or external fixators as needed.

The disadvantages of this method of fixation include the need for removal of implants 3 to 4 months post-operatively and the initial steep learning curve in accurately placing the lag screws. For this, the proper understanding of the anatomy and pathoanatomy of the region is essential. The use of fluoroscopy is useful for checking the reduction and positioning of the screws.

A further point of contention is the concern for the screws crossing the synovial tarso-metatarsal joints causing damage to the joint. Arntz noted that this did not seem to cause any problems⁽¹⁰⁾. In our series, we did not notice any problem as well. In any case, we removed the screws early. Moreover, the medial three tarso-

metatarsal joints particularly, the 2nd and the 3rd are normally relatively immobile and the late treatment for instability is that of fusion.

We found that lagged 3.5 mm cortical screws were superior to 4.0 mm partially threaded cancellous screws. In fact, when the bone is soft, the 4.0 cancellous screws were totally ineffective. In some cases, extra long 3.5 mm cortical screws (more than 40 mm) may be needed.

This study however, as a retrospective study, has a number of limitations in evaluating the patients' functional outcome post-operatively. This problem was further compounded by the fact that some of the patients studied were foreign workers who were no longer contactable for assessment. To address this, a prospective study using an internationally accepted functional assessment method like the American Orthopaedic Foot and Ankle Society Midfoot Scale (100 points)⁽¹²⁾ would be more useful in evaluating the functional outcome of the above treatment method. Nevertheless, based on the assessment of the time to assume work and normal activities as well as change in footwear and gait, this study does provide useful preliminary information on the effectiveness of this fixation technique on this difficult and complex injury of the foot.

CONCLUSIONS

Results of treatment of Lisfranc injuries are related to anatomical correction. Temporary screw fixation allows rigid internal fixation with stability to allow

anatomical correction. Screws also maintain their stability longer, allowing ligamentous injuries the longer period necessary for healing. In conclusion, open reduction and temporary rigid internal fixation of Lisfranc injuries achieved accurate anatomical reduction and maintenance of reduction for healing. There is good long term functional outcome while the complication rate is low.

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