

## Concomitant Dislocation of Both Ends of Second and Third Metatarsals (Floating Metatarsals): A Unique Injury

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### Abstract

The term "Floating metatarsal" is defined as a complex injury which includes simultaneous dislocation of both metatarsal joints. This injury is very rare and if is remained undiagnosed then the final result is disorganization of the foot and leads to chronic pain and incapacity. We present a 52 years old female who admitted to emergency department after a fall from a height and appeared with Lisfranc injury Myerson type A of right foot, simultaneous distal dislocation of 2<sup>nd</sup> - 3<sup>rd</sup> metatarsophalangeal joints, subcapital fracture of 4<sup>th</sup> metatarsal and a fracture of the base of proximal phalange of little toe. We performed open reduction and internal fixation of both injuries (primary partial arthrodesis for Lisfranc injuries and Kirschner wire for dislocation of 2<sup>nd</sup> - 3<sup>rd</sup> metatarsophalangeal joint). At six months final follow-up the patient was very satisfied and the AOFAS score was 93. The aim of this study has two objectives: first, to describe this rare injury with scope to get the physician at the emergency department suspect that the tarsometatarsal joint could be accompanied with other injuries of the metatarsophalangeal joints and second, to analyze the mechanism of injury and the modalities of treatment.

**Keywords:** Floating Metatarsal; Tarsometatarsal Dislocation; Metatarsophalangeal Fracture-Dislocation; Lisfranc Injuries

### Introduction

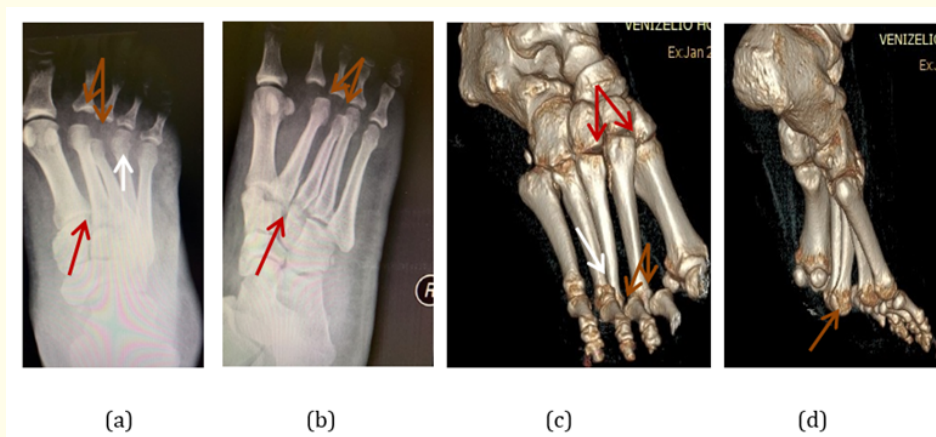
Jacques Lisfranc de Saint - Martin in 1815 first described the tarsometatarsal (TMT) injuries referred to lesion in which one or more metatarsals are displaced regarding to the tarsus [1]. Injuries to tarsometatarsal joint are unusual and have an incidence of 0,2% of all human body fractures, affecting males during the third decade of life [2]. In rare cases the Lisfranc injuries can be accompanied with metatarsal fractures or with dislocation of metatarsophalangeal joint [3,4]. Isolated metatarsophalangeal (MTP) dislocations are rare injuries with a few cases reported in literature [6]. Leibner, *et al.* first introduce the term "Floating metatarsal" which referred to a lesion in which there is dislocation of both metatarsal joints(tarsometatarsal and metatarsophalangeal).These traumatic derangements of the foot lead to high percentage for secondary chronic infirmity specifically in cases in which initial diagnosis in emergency department is missed out.

### Aim of the Study

The aim of this study has the objectives: first, to describe this rare injury with scope to trouble the physician at the emergency that injuries of the tarsometatarsal joint should be accompanied with other injuries from the metatarsophalangeal joints and to analyze the mechanism of injury and the modality of treatment.

### Case Report

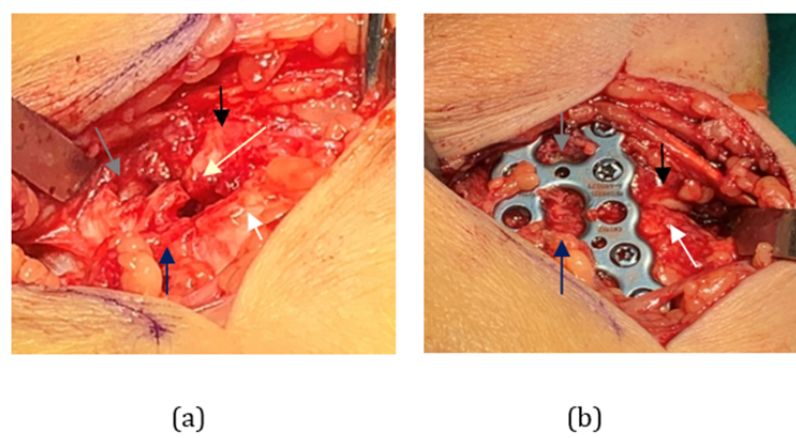
A 52 year-old female proceeded in the emergency after a fall from height with a closed injury on right foot. Patient complained of mid-foot pain and discomfort. On clinical examination the dorsal surface of midfoot was swollen with tenderness and an obvious deformity of second and third metatarsophalangeal joints. At plantar arch there was ecchymosis. Besides the midfoot pain and discomfort, patient appeared also weakness on passive motion of the midfoot. Neurovascular examination was intact and no clinical evidence from compartment syndrome was appearing. Her medical history included diabetes mellitus type II. Initial x-ray and CT scanning showed a tarsometatarsal dislocation Myerson type A, dislocation of second and third metatarsophalangeal joints, a subcapital fracture of 4<sup>th</sup> metatarsal and



**Figure 1:** Preoperative x-rays AP (a) and Oblique (b) and ct/scan shown a Lisfranc injury (red arrows) with a plantar dislocation of 2<sup>nd</sup> - 3<sup>rd</sup> Metatarsophalangeal joints (brown arrows) and a subcapital fracture of 4<sup>th</sup> metatarsal (white arrow).

a fracture of a base of proximal phalange (Figure 1a-1d). Trial of closed reduction of metatarsophalangeal joints under topical anesthesia proved unsuccessful because the dislocation of 2<sup>nd</sup> MTP joint was unstable and the 3<sup>rd</sup> unreduced. To avoid future complication from the soft tissue the surgical intervention was postponed.

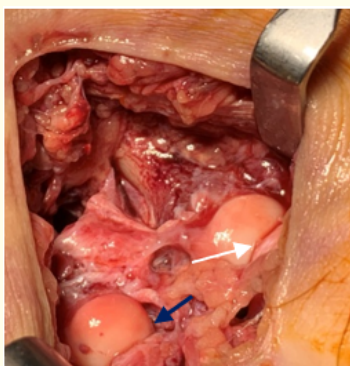
Six days after, patient admitted to the operative theatre in which under general anesthesia and tourniquet two dorsal incisions applied one dorsomedial over 2<sup>nd</sup> metatarsal and the other between 3<sup>th</sup> and 4<sup>th</sup> metatarsal. After meticulous irrigation, removing small cartilage bony pieces and decortications of joints, provisional fixation at 1<sup>st</sup> TMT and 2<sup>nd</sup> TMT joints was performed with Kirschner wires. Finally, primary partial arthrodesis was performed with H-shaped locking plate (Trilock Grid/Wing plate 2,8-Medartis Aptus-Foot) (Figure 2a and 2b). From the second approach after irrigation was performed the osteosynthesis between lateral cuneiform and base of 3<sup>rd</sup> metatarsal with straight locking plate (Trilock plate 2,8 Medartis Aptus-Foot) and finally the 4<sup>th</sup> and 5<sup>th</sup> metatarsal were stabilized with Kirschner wires (Figure 3). A central small approach was performed between 2<sup>nd</sup> and 3<sup>rd</sup> tarsometatarsal joint. The 2<sup>nd</sup> metatarsophalangeal joint was reduced by traction in dorsomedial direction applied to the base of 2<sup>nd</sup> proximal phalange. The joint was unstable and a Kirschner wire stabilized the joint. The 3<sup>rd</sup> metatarsal head was entrapped: plantar plate and capsule dorsal and the fibrocartilaginous plate on the plantar surface of the foot. The dislocation was reduced spontaneously after sectioning the dorsal capsule (Figure 4). Subcapital fracture of 4<sup>th</sup> metatarsal was reduced under manipulation. Radiography after operation confirmed acceptable reduction (Figure 5a and 5b). Postoperatively a short leg splint applied for 3 weeks and for the next 6 weeks a controlled, functional ankle motion boot was worn with non-weight bearing.



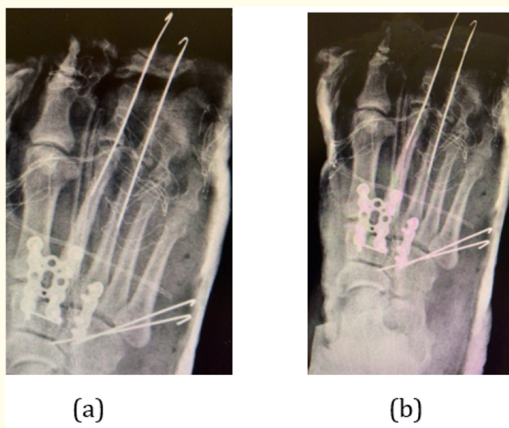
**Figure 2:** Intraoperative picture (a) of TMT injury (Medial cuneiform black arrow, Median cuneiform grey arrow, 1<sup>st</sup> Metatarsal white arrow, 2<sup>nd</sup> Metatarsal blue arrow) and Lisfranc ligament tear (yellow arrow). Primary partial arthrodesis (b) of medial and medial column with low profile locking plates (Medial cuneiform black arrow, Median cuneiform grey arrow, 1<sup>st</sup> Metatarsal white arrow, 2<sup>nd</sup> Metatarsal blue arrow).



**Figure 3:** Arthrodesis between lateral cuneiform (grey arrow) and base of 3rd metatarsal (white arrow).



**Figure 4:** Intraoperative view of reduced 2nd - 3rd Metatarsophalangeal joints (2nd MTT joint white arrow, 3rd MTT joint blue arrow).



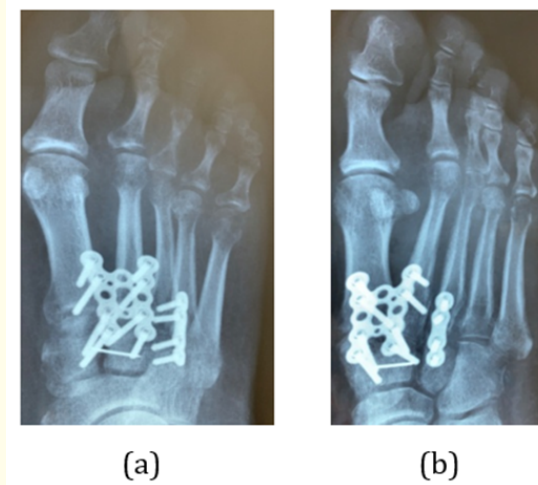
**Figure 5:** Postoperative x-rays AP (a) and Oblique (b).

Rehabilitation program started after Kirschner wires removal at six weeks. Swelling was controlled mostly with lymph drainage and ice application. An exercise program was initiated in three weeks including passive and early active exercises to decrease stiffness and increase range of motion of ankle and foot. Gradually active exercises with resistance were performed to enhance muscle strength whereas light weight bearing initiated in 8 weeks approximately. Patient was trained to perform a home exercise program and full weight bearing succeeded in 12 weeks.

Patient was re-examined in two weeks, one, three, six months. At six months postoperatively the patient refers AOFAS (American Orthopaedic Foot and Ankle Society) score 92% and reported to be very satisfied from the final result. Radiographic evaluation at six months shows maintenance of reduction and no evidence of post traumatic arthritis (Figure 6a and 6b).

**Discussion**

Tarsometatarsal joint injuries presented as an incidence of missing diagnosis at the emergency in about 20% of cases [7]. This is due two reasons: first, a large percentage of these lesions occur in polytrauma with a great significance given to other injuries, and second



**Figure 6:** X-rays AP (a) and Oblique (b) at six months postoperatively.

could be present in strict ligamentous injuries especially in athletes reduced spontaneously. Trikha., *et al.* reported a case of floating metatarsal in which the diagnosis was done at operative theatre table [7]. We postulate that in any patient with foot edema and pain who presented in the emergency independently of the cause of injury, the physician should suspect the possibility of co-existed complexity of lesions. Untreating this lesion leads to chronic foot pain and disability.

Simultaneous dislocation of both ends of metatarsal is very rare injury. Since 1997 in when Leibner., *et al.* reported the first case and introduced the term “floating metatarsal” only a few cases with various spectrum of lesions had been reported in literature. Cases reported varied from one or two floating metatarsals on to four last metatarsals [4,6-8]. Myerson., *et al.* suggested that “when viewing Lisfranc dislocation, it is mistake to regard it as isolated, because the forces are propagated across the entire midfoot and forefoot they can generate osteo-articular and soft tissue damage” [9]. In our case there was 2<sup>nd</sup> -3<sup>rd</sup> floating metatarsal, neck fracture of 4<sup>th</sup> metatarsal and fracture of the base of 5<sup>th</sup> proximal phalange.

The mechanism of injury until today is unclear. English., *et al.* introduced the term “linked toe metatars” developing his hypothesis in which the traction on the soft tissue especially the first dorsal interosseous muscle after TMT joint dislocation cause and simultaneous MTP joint dislocation [10]. In literature there is another hypothesis in which the metatarsophalangeal dislocation is caused by axial loading during dorsiflexion of the toes and if axial loading continues with plantar flexion of the foot, the TMT joint will dislocate [9]. In our case we believe that English hypothesis was exuded. During open reduction of MTP joints, the 3<sup>rd</sup> metatarsal head was entrapped under plantar plate and capsule dorsal and relocate spontaneously after sectioning dorsal capsule and deep transverse metatarsal ligament.

Each injury of the midfoot and forefoot has a specific mechanism and requires similarly specific treatment. The main goal of treatment is the restoration of a pain-free, functional foot. To achieve this good reduction of tarsometatarsal and tarsometatarsal joints is essential [13]. Trinquier., *et al.* suggest the sequence of repair these injuries should be started from MTP joint. After reduction of MTP joint the plantar fascia relaxes and allows the Lisfranc joint to be reduced [11]. Initially an attempt should be made to close reduction and if it fails, open reduction is mandatory. However there are proponents of the immediate open reduction in order to allow anatomical reduction of MTP joints and to treat the intra-articular lesions (osteochondral fractures, loose body and interposed soft tissue) [12]. After MTP reduction follows tarsometatarsal joint open reduction and rigid fixation (Kirschner wires, Transarticular screws, locking plates, primary partial fusion). In our case after closed reduction of 2<sup>nd</sup> - 3<sup>rd</sup> MTP joints failed and avoiding prolonged surgical time we started with open reduction of Lisfranc injuries (primary partial fusion of medial, median column and Kirschner fixation of lateral) and then we opened the 2<sup>nd</sup> - 3<sup>rd</sup> metatarsophalangeal joint and stabilize with Kirschner wires.

## Conclusion

“Floating metatarsals” are rare and unique injuries and represent a various spectrum of lesions. A high suspicion must be arised to physicians in the emergencies for any swollen foot appeared independently of the broad of polytrauma patient or isolated injury. Precise anatomical reduction of both joints is the crucial factor to achieve good function, because posttraumatic arthritis is directly proportional to the degree of damage of articular surface.

### Conflict of Interest

The authors declare that have no conflict of interest.

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