CASE REPORT

Three floating metatarsals and a half-floating cuneiform

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SUMMARY

Floating metatarsals are rare and complex injury patterns in the world of foot trauma. The injury is typically characterised by concomitant dislocations of the metatarsals from both articular ends ('bipolar dislocations'). Fascination arises from the fact that there have been only 15 cases reported in the English literature from 1964 to date. The first metatarsal has been more frequently reported than the lesser metatarsals. More than one floating metatarsal is also extremely uncommon. Inter-cuneiform diastasis is another rare entity seen in low velocity injuries and sports injuries; this condition is very difficult to diagnose clinically and radiologically. The occurrence of these two injury patterns in isolation is itself rare, making their combination even more unique.

BACKGROUND

English¹ first described a case of floating metatarsal in 1964 while defining the phenomenon of linked toe in dislocations of the tarsometatarsal joint; however, it was Leibner *et al.*,² in 1997, who coined the term 'floating' metatarsals. To date, there have been only 15 cases reported of this rare injury pattern in the English literature (table 1). The majority of these injury patterns are invariably associated with fractures of adjoining foot bones or the metatarsals themselves. The index case presented with closed multiple pure dislocations of the lesser metatarsals in combination with intercuneiform diastasis; making it the rarest among rare injury patterns. The mechanism of injury clinical features, surgical management and outcome have been briefly discussed here.

CASE PRESENTATION

A 42-year-old banker presented to the emergency room 4 h after a road traffic accident (RTA). He was driving a two wheeler and hit a stationary car, lost his balance and fell into a nearby ditch, twisting his right foot. On examination, his right foot was grossly swollen; however, there were no external injuries (figure 1). Distal sensation and vascularity were intact. Preliminary radiographs and CT scans revealed second, third and fourth floating metatarsals in association with intercuneiform (medial and intermediate cuneiforms) diastasis along with avulsion of naviculocuneiform ligament (figure 2A,B).

TREATMENT

The patient was posted for emergency reduction within 2 h of presentation. He was operated under

spinal anaesthesia and tourniquet control. Attempted closed reduction was successful and brought the third and fourth metatarsophalangeal (MTP) joint back into position. However, the second floating metatarsal required open reduction. A formal dorsal approach to the first metatarsal was made. It was observed that the long flexor tendon was trapped at the second MTP joint, preventing its reduction. This reduction was first stabilised with 1.4 mm K-wire. The capsule of the first tarso-metatarsal joint (TMT) joint was torn and frayed, resulting in instability. This was fixed with a 3.5 mm cortical screw passed from base of first metatarsal, directed proximally into the medial cuneiform. Another 3.5 mm cortical screw was passed from the medial cuneiform directed towards the second metatarsal after reducing it into the 'keystone'. Two more 3.5 mm cortical screws were passed; one from medial cuneiform into the intermediate cuneiform and another from medial cuneiform to the naviculum. The three lateral TMT joints fell back into position, which was stabilised with a single 1.8 mm K-wire passed percutaneously from fifth metatarsal to the cuboid (figure 3).

OUTCOME AND FOLLOW-UP

Postoperatively, the patient was given a short below-knee slab support and advised strict non-weight bearing for 6 weeks. The K-wires were removed at the end of 6 weeks and partial weight bearing was initiated with walking cast for six more weeks; full weight bearing was only allowed at the end of 3 months. At 6 months follow-up, the positional screw between medial cuneiform and navicula was found to be broken despite having used solid screws for stabilisation and maintaining strict adherence to the regulated weight bearing regime with cast support. The patient remained asymptomatic and no implant removal procedure was undertaken. At last follow up, 1-year post injury, the patient is comfortably walking and has returned to work, but complains of mild pain on exertion and swelling of the foot on prolonged standing or walking for long distances (figure 4A–C). His American Orthopaedic Foot and Ankle Society Mid-foot score is 81/100.

DISCUSSION

For floating metatarsals, as in most other orthopaedic injuries, road traffic accidents and falls from a height are the common culprits; the former being the commonest aetiology. An axial loading force with toes in dorsiflexion and ankle in equinus is the typically attributed mechanism of injury. Unlike in

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Table 1 Floating metatarsals described in the English literature (1964 to date)

	Author (year)	Age/ sex	Mechanism of injury	Floating metatarsals	Associated fractures (#)	Treatment	Follow-up
1	English (1964) ¹	22/M	RTA	1st, 4th and 5th rays (open wound)	2nd, 3rd TMT dislocation, cuboid #	Open reduction and K-wire fixation	► 8 weeks ► Delayed return to work
2	Leibner <i>et al</i> (1997) ²	30/M	RTA	1st ray (open wound)	2nd, 4th, 5th metatarsals, distal phalanx 1st toe #	Failed closed reduction Open reduction and 2 cancellous screw fixations	► 1 year ► Minimal discomfort on activity
3	Rajan <i>et al</i> (2002) ⁶	30/F	RTA	3rd, 4th and 5th rays	#-dislocation 2nd metatarsal, dislocation 1st TMT joint	Open reduction and multiple K-wires fixation	► 6 months ► Mild discomfort without interfering in daily activities
4	Kasmaoui <i>et al</i> (2003) ¹⁰	28/M	RTA	1st ray	2nd, 3rd metatarsal #	Open reduction and multiple K-wire+ bone staple fixation	► 2 years ► Good anatomical and clinical results
5	Christodoulou <i>et al</i> (2003) ¹¹	29/M	RTA	2nd and 3rd rays	1st, 4th, 5th tarsometatarsal dislocation, nutcracker # cuboid, Galaezzi #	Two closed reduction attempts failed Open reduction and multiple K-wire fixations	► 18 months ► No limp or pain
6	Cuenca Espierrez <i>et al</i> (2003) ³	20/ M	RTA	1st ray	2nd, 3rd, 4th metatarsals #	Open reduction (medial approach) and K-wire fixation	► 1 year ► Full return to activity
7	Milankov <i>et al</i> (2003) ¹²	36/M	RTA	1st and 2nd rays	Neck of 3rd metatarsal, avulsion # Navicula, # lateral condyle tibia	Open reduction and multiple K-wires fixation	► 5 years ► Asymptomatic, contracture of 1st MTP joint
8	Jain and Jain (2006) ¹³	48/M	RTA	1st ray	Posterior ankle dislocation with medial malleolar #	Open reduction and K-wires and multiple screws fixation	Lost to follow-up
9	Setty <i>et al</i> (2007) ¹⁴	25/M	Fall from 5 m height	1st ray	NONE	Open reduction and K-wire fixation	► 2 years ► Totally symptom-free
10	Mobarake <i>et al</i> (2009) ¹⁵	22/M	RTA	2nd ray	Tibia #, cuboid #, dislocation of 3rd, 4th, 5th TMT joint	Closed reduction and percutaneous pinning	► 1 ½ years ► Essentially asymptomatic
11	Singh <i>et al</i> (2004) ¹⁶	25/M	RTA	1st ray (reverse floating) and 3rd ray	2nd, 4th, 5th metatarsals #, cuneiforms #	Open reduction and K-wires fixation	► 10 weeks ► Patient returned to his activities with only minimal discomfort
12	Lasanianos <i>et al</i> (2010) ⁵	27/M	Fall from 15-foot height	2nd ray	Lateral and posterior malleolar fracture-dislocation, # 2nd, 4th and cuneiforms	Developed compartment syndrome-fasciotomy and ex fixator f/b screw fixation	► 18 months ► Patient returned to his pre-injury level of activity
13	Jeong <i>et al</i> (2012) ⁴	21/F	RTA	1st ray (locked)	NONE	Open reduction without fixation	► 2 years ► Patient can ambulate without pain, instability or limitation of motion
14	Trikha <i>et al</i> (2013) ¹⁷	30/F	RTA	2nd, 3rd and 4th rays	Dislocations of 1st TMT joint and 5th MTP joint, B/L femur #, acetabulum #	Open reduction and multiple K-wires Fixation	► 2 ½ years ► Pain free with full range of motion
15	Kumar (2014) ¹⁸	40/M	RTA	1st ray	Base of 1st proximal phalanx #	Open reduction and K-wire fixation	► 1-year ► Mild MTP joint pain

MTA, metatarsophalangeal.

floating 1st metatarsal, where there is a characteristic cavoid deformity of the foot³ or a cock-up deformity of the great toe,⁴ lesser floating metatarsals have relatively benign presentation apart from gross swelling of the foot. Despite gross displacement of metatarsals and soft tissue injury, there has been, in the literature, only one case developing compartment syndrome that required formal fasciotomy and external fixation.⁵

From the treatment perspective, there are guidelines to facilitate easier joint reduction and stabilisation. The order of reduction depends on the type of floating metatarsals. For first floating metatarsal, it is vital to reduce the distal joint first in order to release tension over the plantar fascia thereby facilitating easier reduction of the proximal joint.² For lesser metatarsals, it is in opposite order (proximal to distal) to release the tension of dorsal interossei.⁶ Regardless of the type of metatarsal involved, there appears to be a common consensus that open approach is almost always required to achieve some or all

reductions. In our case, we attempted to reduce the distal joints first and succeeded in third and fourth MTP joint reduction, but the second MTP joint could not be reduced by closed means. We eventually had to employ the technique of reducing the second floating metatarsal from distal to proximal by an open approach. The three lateral TMT joints fell back into place spontaneously.

Intercuneiform diastasis is a subtle injury commonly associated with Lisfranc fracture-dislocation.⁷ In the index case, the medial cuneiform subluxated from the normal anatomy due to disruption of the Lisfranc ligaments and naviculocuneiform ligaments, thereby drifting away from two (out of three) of its articulations, resulting in a 'half-floating' phenomenon. Radiographically, the intercuneiform diastasis can be identified by a slight widening between the cuneiforms in weight bearing films, characteristically defined as the 'gap' sign. Reduction of the gap and fixing with screws is recommended, with or

Figure 1 Clinical picture of the right foot.

without arthrodesis.⁸ We employed 3.5 mm screws and trans-fixed medial cuneiform to navicula and intermediate cuneiform.

Although the present case essentially represents a pure ligamentous Lisfranc injury, the preoperative planning was drafted to proceed with closed/open reduction and internal stabilisation

Figure 2 (A) X-ray of the right foot; (B) three-dimensional reconstruction CT scan.

Figure 3 Postoperative X-ray (below-knee slab given).

Figure 4 At 1 year follow-up (A). Anteroposterior view; (B). Oblique view (positional screw is broken between medial cuneiform and navicula); (C). Lateral view.

of the dislocations, as against primary arthrodesis of mid-foot, as both procedures yield satisfactory and equivalent results.⁹ Some authors have achieved satisfactory stabilisation with the use of K-wires alone (table 1). However, stabilisation to the medial three TMT joints with screws and lateral two TMT joints with K-wires is recommended, as maintaining some mobility of lateral TMT joints is desirable.

Learning points

- ▶ Closed pure ligamentous patterns of multiple lesser floating metatarsals are extremely rare.
- ▶ For floating metatarsals, order of reduction is probably more important than the type of fixation.
- ▶ It is important to have a close follow-up to look out for loss of reduction, implant failure or development of arthritic changes in the mid-foot.

Competing interests None declared.

Patient consent Obtained.

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