

Closed Irreducible Traumatic Dislocation of Third, Fourth and Fifth Metatarsophalangeal Joint: A Case Report and Review of Literature

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Abstract

Traumatic closed dislocation of multiple metatarsophalangeal (MTP) joints of lesser toes are uncommon injuries. These dislocations cause severe pain, deformity and difficulty to wear footwear if left untreated. Early diagnosis and proper treatment help the patient for better functional out-come. The complex anatomy of the MTP joint hinders for closed reduction in most of the cases. We are reporting a case of closed irreducible traumatic dislocation of third, fourth and fifth MTP joint following a road traffic accident. Closed attempt was done under local anesthesia in the casualty but failed to reduce. Open reduction was done through dorsal longitudinal incision and reduction was secured with k-wires. There was a button holing of the metatarsal head in the medial part of the plantar plate and were able to reduce all three dislocations through a single incision, without damaging the extensor tendons and the neurovascular bundle. Surgical outcomes after open reduction, followed by effective immobilization and early rehabilitation results in good functional outcome in all cases with nil or minimal complications.

Keywords: Lesser MTP joint dislocation; Plantar plate; Irreducible MTP joint; Open reduction; Surgical approach

Abbreviations: MTP- Metatarsophalangeal Joint; OR- Open reduction; MVA- Motor vehicle accident; NA- Not available; MT- Metatarsal; K- wire- Kirschner wire

Introduction

Closed traumatic dislocation of multiple MTP joints of lesser toes is a rare injury [1]. The MTP joint is a complex synovial joint with strong plantar plate, capsule, deep transverse metatarsal ligament, long and short flexor tendons and lumbrical muscles [2,3]. They play an important role in flexion and extension of the toes especially during the terminal stance and pre-swing phase of the gait cycle [4]. The dislocation of these joint becomes irreducible due to the button holing of the metatarsal (MT) head in the complex plantar structures [5]. These are the unique injuries sometimes we cannot reduce the dislocation by closed manner. Dislocation in this area will have a chronic pain and deformity for the patient to bear weight or walking, if left untreated [6]. There are only few cases in the literature of irreducible dislocation of multiple MTP joints of lesser toes.

We are reporting a case of closed traumatic dislocation of third, fourth and fifth MTP joint following a road traffic ac-

cident. Subsequently discussed relevant anatomical structures to understand the injury's intricacies, the various approaches to make a good clinical decision.

Case Presentation

A 26-year gentleman male patient presented to the casualty with a history of fall from two-wheeler with pain, swelling, and deformity in the left foot. Clinical examination revealed shortening of lateral three toes and fullness on the dorsum of distal foot. An initial radiograph where taken which showed dorsal dislocation of third, fourth and fifth MTP joint as shown in **Figure 1**. Closed reduction was tried under regional block, but the reduction was unsuccessful. Patient was taken to the operating theatre under regional anaesthesia for open reduction.

Surgical steps

A 5-cm long dorsal longitudinal incision was taken over medial aspect of 4th MT, skin and subcutaneous dissection was done. The extensor tendons of the third toe were identified and a cap-

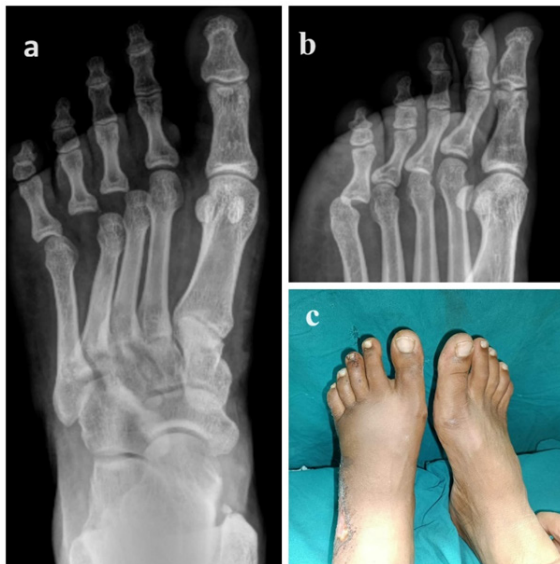


Figure 1: Radiographs of foot. (a) Anterior-posterior view, (b) Oblique view, (c) Clinical picture of patient.

sule was incised longitudinally medial to the extensor tendons. The tendons were retracted medially. Now we can see distally the base of the proximal phalanx, plantar plate at the base and the head of MT is dislocated in the medial part of the plantar plate. A small longitudinal incision was given to the plantar plate to enlarge the buttonhole. The head was delivered with the small bone lever and the joint was reduced later secured with k-wire under fluoroscopic guidance as shown in **Figure 2a & 2b**. Similarly, the other two dislocation of fourth and fifth MTP joint were reduced through the same incision as shown in **Figure 2c & 2d**.

Postoperative X- rays were taken, showed good reduction. Sutures were removed at 14th day of surgery. Patient was made to walk with help of walker support with non- weight bearing along with below knee plaster support was given for one month. K-wire were removed after one-month, patient was made to walk with full weight bearing as tolerable to pain and active/passive ankle movements were started. At two-month patient was able to walk full weight bearing without any pain

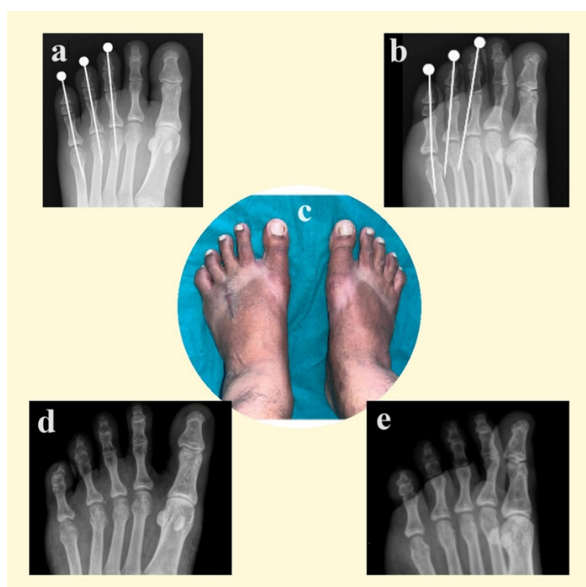


Figure 3: Post-operative radiographs (a) Anterior-posterior, (b) Oblique view, (c) Clinical picture after 1 year follow-up, (d) and (e) Radiographs after 1 year follow-up anterior-posterior and oblique views respectively.



Figure 2: Intra-operative picture showing (a) White structure shown by black arrow is plantar plate, (b) Yellow arrow shows the 3rd metatarsal head after reduction, (c) Blue arrow shows 2nd metatarsal head after reduction, (d) After reduction all the MTP joints.

with good ankle movements. Postoperative radiographs and clinical picture are shown in **Figure 3**. At three-month follow-up patient was able to resume his daily activity wearing a regular footwear without any pain. At one year follow-up patient was able to do all his activities like jogging, running, squatting and sitting cross legged without any difficulties.

Discussion

Dorsal dislocation of the MTP joint of lesser toes is a rare but potentially debilitating injury that requires timely and appropriate management. Traumatic dislocations of the first MTP joint are more common compared the lesser toe. Jahss et al in 1980 has classified first MTP joint dislocation on the basis of their anatomy into two types [7]. The lesser MTP joint dislocation can occur isolated singly remove or two-three MTP joints, or all four of them have been reported. We searched the PubMed, Embase, and Web-of-Science databases and found 22 case reports of lesser toes MTP joint dislocation which were not reducible by closed reduction. The characteristics of all reported cases are listed in the **Table 1**.

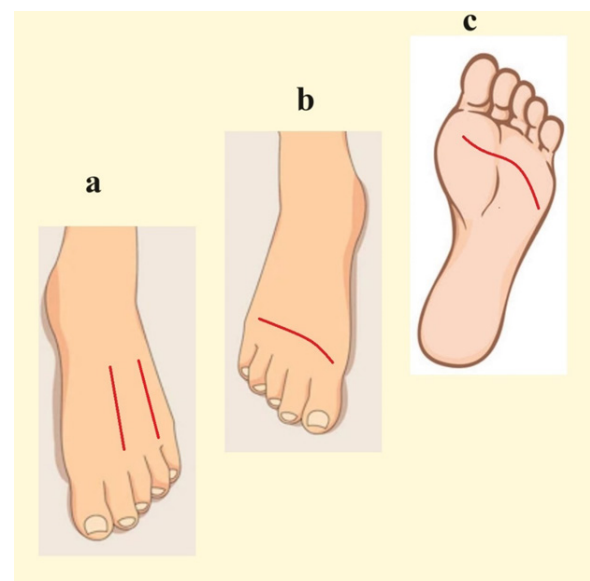


Figure 5: Picture showing various incisions described by different Author's. (a) Dorsal longitudinal incision, (b) Dorsal transverse incision, (c) Plantar transverse incision.

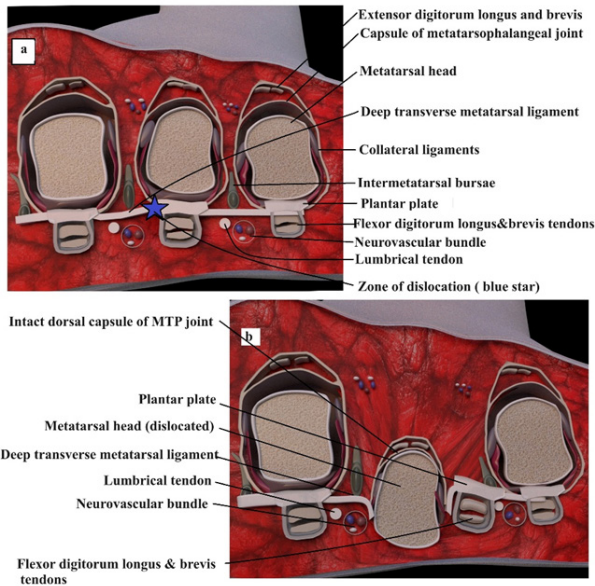


Figure 4: (a) Coronal anatomical section of normal MTP joint showing different structures and Zone of dislocation (blue star), (b) Coronal section after dislocation of MTP joint showing the structures hindering for reduction.

Mechanism of injury

MTP joint dislocation of lesser toe occurs due to fall from height that lands the foot on ground with forceful hyperextension of the MTP joints with foot in equinus position [2,5]. Most common cause for the dislocation is by motor vehicle accident, followed by fall from height. Males are more prone for such injuries than females, and can occur in all age groups.

The MTP joint dislocates dorso-laterally with respect to the MT head. The MT head dislocates towards the plantar surface through the weak medial part of plantar plate and deep transverse metatarsal ligament as shown in Figure 4a. The strong plantar joint capsule consisting of the deep transverse metatarsal ligament, plantar plate, long and short flexor tendons, and lumbrical muscles have been reported to become an obstruction that interferes with the reduction of the dorsal dislocation, independently or in combination with each other [2,12]. The deep transverse metatarsal ligament and plantar plate are strong and caught by the dorsal side of the MT neck, or because the flexor tendons and lumbrical tendons strangulate the MT neck during the closed reduction as shown in Figure 4b.

Johnston et al in 1994, performed an anatomical study using cadavers and reported on the anatomical structure of the MTP joint in lesser toes. The proximal region of the joint capsule ruptures, resulting in dorsal dislocation of the deep transverse metatarsal ligament and the plantar plate. Simultaneously, the flexor tendon strangulates the MT neck laterally and lumbrical tendons medially [25]. In our patient the MT was dislocated medially through the medial part of the plantar plate and the deep transverse metatarsal ligament. The neck of MT head was button holed between deep transverse metatarsal ligament and strong plantar plate Figure 4b. Irreducible dorsal dislocations of MTP joint of lesser toes requires open reduction and with or without fixation. There are various approaches have been described by different authors for open reduction of lesser MTP joints as shown in Figure 5.

Dorsal approach

Two types of dorsal approaches have been described in the literature dorsal longitudinal and transverse incisions. In our case

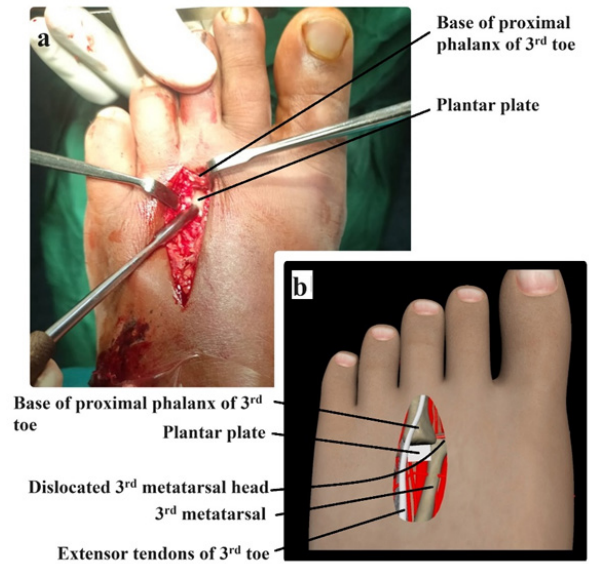


Figure 6: (a) Intraoperative picture showing plantar plate and base of the proximal phalanx of third toe before reduction, (b) Animated picture of the above clinical picture showing different structures and dislocated metatarsal head.

dorsal longitudinal incision is taken, the skin and subcutaneous tissue is cut and the extensor tendon is retracted medially. The capsule of the MTP joint is incised dorso-medially. After retracting the extensor tendons medially, we can see distally the base of the proximal phalanx, plantar plate at the base and the head of MT is dislocated medial to the plantar plate as shown in Figure 6. A small longitudinal incision was given medial to the plantar plate to enlarge the buttonhole. The head is delivered with the small bone lever and the joint is reduced. Hynes et al. reported that the obstacle to reduction was the flexor digitorum longus tendon [1]. Nakano et al. reported that the deep transverse metatarsal ligament interfered with the manipulative reduction [2]. Hibino et al found the fibrocartilaginous plate and lumbrical tendon were the main obstacles to successful closed reduction [17]. Dorsal longitudinal incision is preferred by most of the authors as it requires less retraction and decreases edge necrosis of the wound. However, we require multiple incisions if there are more than two MTP joint dislocations.

Dorsal transverse incision was described by Neogi et al and Leung et al can be used when all the MTP joint are dislocated [3,16]. It includes transverse incision over the MTP joint, the extensor tendons were retracted and joint is open after cutting the capsule. The fibrocartilaginous plantar plate was incised longitudinally to increase the opening and other hindering structures for the reduction of the MT head in position. Advantages of transverse dorsal incision are (a) no need for multiple incisions and (b) decreases problem of wound closure when we need multiple longitudinal incisions. Disadvantages requires too much retraction and increases the risk of edge necrosis of the skin and wound gapping.

Plantar approach

Nakano et al in 2001 described the plantar approach with transverse incision over the MT head [2]. In plantar approach, (a) directly approach to the obstruction, (b) the incised deep transverse metatarsal ligament and plantar plate can be sutured, (c) reduction will be stable may not require the k-wire fixation. Disadvantages of plantar approach, (a) wound related complications, (b) requires the identification and protection of the neurovascular bundle.

Table 1. Shows the characteristics of various case reports of lesser MTP joint dislocations.

Sl. No.	Author's	Age (yrs)	Sex	Mechanism of injury	Type of injury	Dislocated MTP Joint	Associated injuries	Reduction	Approach	Fixation
1	Turkmensoy et al ⁶ 2014	66	M	MVA	Closed	5 th MTP joint	Fractures on the 2 nd , 3 rd , and 4 th MT heads and the proximal fibula	OR	Dorsal	K-wire
2	Kamath et al ⁸ 2004	22	M	Fall from height	Closed	4 th MTP joint	NA	OR	Dorsal	NA
3	Stephenson et al ⁹ 1994	24	M	MVA	Closed	2 nd and 3 rd MTP joints	Avulsion fracture of the tibial collateral ligament of the 2 nd MT head, and a fracture of the planar condyle of 3 rd MT head	OR	Dorsal	K-Wire
4	Silver et al ¹⁰ 2000	NA	M	NA	Closed	2 nd MTP joint	Fracture 2 nd of the MT neck and dislocation of the 1 st MTP joint	OR	Dorsal	K-wire
5	Sharma et al ¹¹ 2017	19	M	MVA	Open	2 nd MTP joint	1 st MTP dislocation	OR	Plantar open wound	K-Wire
6	Santosh Raj et al ¹ 2020	34	M	MVA	Closed	2 nd , 3 rd , 4 th and 5 th MTP joints	NA	OR	Dorsal	NA
7	Roche et al ¹² 2005	33	M	MVA	Closed	2 nd and 3 rd MTP joints	NA	OR	Dorsal	NA
8	Rao et al ⁵ 1979	23	M	MVA	Closed	3 rd , 4 th and 5 th MTP joints.	Fracture of neck of 2 nd MT	OR	Dorsal	NA
9	Pai et al ¹³ 2008	21	M	MVA	Closed	2 nd and 3 rd MTP joints	Left foot injury with talar dislocation and talar head fracture	OR	Dorsal	K-Wire
10	Neogi et al ³ 2012	29	M	Fall from height	Closed	2 nd , 3 rd , 4 th and 5 th MTP joints	NA	OR	Dorsal transverse	K-Wire
11	Nakano et al ² 2001	56	F	MVA	Closed	2 nd and 3 rd MTP joints	NA	OR	Plantar	K-Wire
12	Murphy et al ¹⁴ 1980	27	F	Fall from height	Closed	2 nd MTP Joint	Right medial malleolus fracture	OR	Dorsal	NA
13	Lo et al ¹⁵ 2013	37	M	MVA	Closed	2 nd and 3 rd MTP joints	1 st MTP joints dislocation and fractured the 4 th MT head	OR	Dorsal	K-Wire
14	Letung et al ¹⁶ 2001	25	M	MVA	Closed	2 nd , 3 rd and 4 th MTP joints	5 th MT neck fracture	OR	Dorsal transverse	K-Wire
15	Hynes et al ¹ 1994	10	M	While kicking foot ball	Closed	5 th MTP joint	NA	OR	Dorsal	NA
16	Hibino et al ¹⁷ 2010	21	M	MVA	Closed	4 th and 5 th MTP joint	Fracture of the 3 rd MT base	OR	Dorsal	NA
17	Hey et al ¹⁸ 2013	61	M	Fall from height	Closed	4 th MTP joint	NA	OR	Dorsal	K-Wire
18	Bassil et al ¹⁹ 2023	53	M	MVA	Closed	2 nd MTP joint	1 st MTP joint	OR	NA	NA
19	Boussouga et al ²⁰ 2010	35	M	Fall from height	Closed	5 th MTP joint	NA	OR	Dorsal	K-Wire
20	Biyani et al ²¹ 1988	30	M	Fall from height	Open	2 nd , 3 rd , 4 th and 5 th MTP joints	1 st MTP joint	OR	Dorsal open injury	NA
21	Basciani et al ²² 2022	30	M	MVA	Closed	5 th MTP joint (4 weeks old)	NA	OR and osteotomy	Dorsal	K-Wire
22	Mundakattu et al ²³ 2024	54	M	Fall from height	closed	2 nd , 3 rd and 5 th MTP joints	4 th MT neck fracture	OR	Dorsal	K-wire
23	Ito et al ²⁴ 2007	23	M	Injured by horse	Closed	2 nd , 3 rd and 4 th MTP joints	4 th MT head fracture	OR	Plantar and Dorsal	K-wire
24	Our case	26	M	MVA	Closed	3 rd , 4 th and 5 th MTP joints	NA	OR	Dorsal	K-Wire

Conclusion

Dorsal dislocation of lesser MTP joint is a rare injury may be associated with fracture of the adjacent metatarsals. Irreducible MTP joint requires open reduction preferably dorsal approach with or without fixation with the k-wire. The surgical repair of the plantar plate is not necessary. Surgical outcomes after open reduction, followed by effective immobilization and early rehabilitation results in good functional outcome in all cases with nil or minimal complications.

Conflict of interest: The authors declare that there is no conflict of interest with respect to authorship and /or publication of this article.

Ethics: Informed written consent was taken from patient to be research participant.

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