



Review Articles

Another Classification of First Metatarsophalangeal Joint Dislocation—Type 3: Review and Case Description of the Plantar Dislocation

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ABSTRACT

Plantar dislocation of the first metatarsophalangeal joint is a possible, albeit rare, injury to the foot. The mechanism has been attributed to a hyperflexion motion, with the hallux situated plantar to the first metatarsal head. In this article, we provide a case example of an open, plantar dislocation of the first metatarsophalangeal and perform a literature review of this rare injury. Based on x-ray analysis of the published cases, the sesamoids may or may not dislocate with the phalanx based off of the local capsuloligamentous anatomy. As a result, a modified Jahss classification (type 3A and type 3B) has been proposed to amend the existing system, adding plantar dislocations of the first metatarsophalangeal without (type 3A) and with (type 3B) sesamoid dislocation.

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Dislocations of the first metatarsophalangeal joint (MTPJ) were initially described by Chrisholm (1) in 1914, with Jahss further classifying these injuries in his 1980 article (2,3). His system, based on a hyperextension mechanism, exclusively defines a variety of dorsal hallux dislocation patterns with and without sesamoid pathology (e.g., osseous and ligamentous). Since then, additions to the Jahss classification have been suggested, with descriptions of the medial, lateral, and plantar dislocation patterns in the literature (3–7).

The original Jahss classification does not define plantar dislocations of the first MTPJ, which, although rare, have been cited in the literature (8–15). A review of the available case report studies produced < 10 examples of the first MTPJ dislocations that have been described in various presenting circumstances as case reports.

In this article, we review the classification system and discuss a case of an open traumatic plantar dislocation of the first MTPJ. The patient presented to the emergency department (ED) and was treated with irrigation and closed reduction of the joint. In addition, a literature review was performed to identify any patterns in plantar dislocations, in order to add to the already-existent Jahss classification, as others have done before us (3,6,7).

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Materials and Methods

A PubMed advanced key word search was performed on April 15, 2017. Search criteria keywords used included “dislocation,” “hyperflexion,” “Jahss,” “metatarsophalangeal,” “plantar,” and “reverse.” The titles, abstracts, or database tags of the resulted articles were reviewed to determine whether they were relevant to the primary search goal of obtaining articles that demonstrated a plantar dislocation of the first MTPJ. From these articles, a secondary identification process was performed using relevant cited references within the initially discovered articles to provide a complete search discovery of articles on plantar dislocation of the first MTPJ. Each case was described based on the factors listed as follows. The only exclusion criterion was any injury to the first MTPJ that was pure dorsal, medial, or lateral in direction.

Case parameters evaluated included the following:

- Age
- Sex
- Dislocation direction (dislocation): plantar versus dorsal and acute versus chronic
- Skin pattern (skin): open versus closed
- Mechanism of injury
- Motion of hallux: at the time of injury
- Location of sesamoids on x-ray (XR): plantar to metatarsal head or cristae (“anatomic”) versus plantar to dislocated hallux
- Associated injuries: secondary injuries to the primary reviewed plantar first MTPJ.
- Treatment: open versus closed
- Morbidity: results at the last follow-up.

Case Report

A 46-year-old male presented to the ED of a level 2 trauma center with pain and a laceration to the right great toe region. He stated that the night before, he was drinking on his birthday and remembered running up the steps in the dark, when he hit his foot on the facing surface of a stair. He woke up in the middle of the night in pain, noting a bloody



Fig. 1. Presentation of a 46-year-old male to the emergency department. Prereduction films. Note plantar dislocation of the hallux at the first metatarsophalangeal joint, with concurrent dislocation of the sesamoids with the hallux.

sock. On removing his sock, the patient noted a laceration localized to the dorsal aspect of the first MTPJ. He had no medical history, no current medications, and no allergies.

On physical examination, he was noted to have a 5-cm laceration that started at the dorsal aspect of the first MTPJ and extended in a lateral direction into the plantar aspect of the first interspace. The wound appeared to be clean, with no visible deep capsule or tendon injury. Active range of motion (ROM) to the joint in the sagittal plane was nonexistent. Forced passive ROM in the sagittal plane produced a high degree of pain. Neurovascular status to the extremity was intact. On evaluating the performed XRs, there was a plantar dislocation of the hallux, with concomitant dislocation of the sesamoids with the hallux (Fig. 1). No fractures across the foot were noted. No advanced imaging was performed.

Treatment consisted of irrigation and evaluation of the laceration to determine surgical needs. No deep capsular or tendon laceration was appreciated. Under a local anesthesia digital block, closed reduction was performed with the motion of the distal traction, with (a) slight flexion to increase the deformity, followed by (b) hyperextension to reverse the suspected mechanism. The hallux was able to be reduced and remained stable on passive ROM, and the patient was able to perform active ROM. Closed reduction XRs were taken, which confirmed proper reduction alignment (Fig. 2). The wound was then irrigated again, and the laceration was closed with nonabsorbable suture to the skin. Digits 1 to 2 were splinted together, and the patient was given a surgical shoe for weight-bearing (WB), as tolerated. A dose of intravenous antibiotics was given to the patient in the ED, and he was discharged afterward, with a 7-day course of oral antibiotics.

At outpatient follow-up 5 days later, the wound was evaluated, and there were continued no signs of infection with the hallux still in its reduced anatomic location. The patient was left splinted for another 2 weeks and was allowed to bear weight as tolerated in a surgical shoe. Sutures were subsequently removed, and the laceration healed uneventfully. Transition to a regular sneaker was achieved by week 4. He started to develop postreduction stiffness in the joint, with subjective complaints of decreased ROM and soreness in the joint (Fig. 3). He underwent formal physical therapy in an attempt to increase ROM and break up any scar tissue. At last follow-up approximately 4 months later, there had been no redislocation of the joint, and the patient had returned to normal activities of daily living. He had not returned for further treatment and was ultimately lost to follow-up.

Results

The literature review provided 8 examples of plantar dislocations. The features of these cases are listed in Table 1. Of these, 6 (75%) were acute, 1 (12.5%) was subacute, and 1 (12.5%) was chronic. Only 1 open injury was noted. Half of the cases were isolated plantar dislocations of the first MTPJ, whereas the other half contained a variety of concomitant fracture-dislocation injuries to the foot. During the treatment, in 3 cases, closed reduction was attempted, which required conversion to open reduction, whereas 3 cases were amenable to closed reduction alone. Two cases went straight to open surgical treatment. Sesamoid position was determined to be either anatomic, plantar to the first metatarsal head in the crista (type 3A), or dislocated with the plantar hallux (type 3B). This was evaluated either by notations made in the case report or, if not

mentioned, by the senior author (C.R.H.) based on the XRs provided in the report. From this, 1 case had the sesamoids dislocation with the hallux, 5 cases had anatomic sesamoids, and 2 cases were unable to be determined owing to low-quality XR. The case presented here adds a second plantar sesamoid dislocation situation (type 3B).

Discussion

In 1980, Jahss (2) described a classification system for dorsal dislocations of the first MTPJ¹ (Table 2). There has been literature to expand the original Jahss classification system, incorporating various other dorsal dislocation patterns not described previously (e.g., type 1B, type 2C, and type 3) (6,7,17,18). Furthermore, others have suggested to expand the system to include coronal deformities owing to reported medial and lateral dislocations (3,4,11).

We promote expansion to include full sagittal plane deformities by adding plantar dislocations, coined the “Dancer’s Dislocation” (5). Zrig et al (3) reviewed the published data on variations of dislocations and suggested a new “unifying classification” of all directions of dislocations with subtypes (Table 3). We agree with this concept and system; however, we take it 1 step further by creating a subset of their type 3 (plantar) dislocation, that is, type 3A and type 3B that are based on sesamoid position with the plantarly dislocated hallux (Table 4). In a type 3A injury, the sesamoids remain anatomic, articulating submetatarsal head 1 with the crista and there is a presumed rupture of the sesamoid-phalangeal ligament (distal sesamoid complex ligament rupture), whereas in a type 3B injury, the sesamoids dislocate plantarly with the hallux and there is a presumed rupture of the metatarsal-sesamoid ligament complex (proximal sesamoid complex ligament rupture).

Owing to the finding of the sesamoid position post dislocation in our review, we created this system, attempting to mirror the systems described previously such as Jahss, where sesamoid position was a key component in distinguishing the type of the injury. Although the system put forth by Zrig et al (3) redefines the entire first MTPJ dislocation system, adding a variety of patterns, we wish to specifically discuss and divide the plantar dislocation pattern.

The reason for such few documented cases of plantar dislocations has been attributed to the anatomy of the first MTPJ (5,9). The more prevalent dorsal dislocation is owing to hyperextension (i.e., dorsiflexion), which is a more common direction of motion (5). Anatomically, the hallux proximal phalanx lies in a more dorsal position than the first



Fig. 2. Postreduction films. Note relocation of the right hallux at the first metatarsophalangeal joint, with the sesamoids now adjacent, plantarily repositioned underneath the first metatarsal head.

metatarsal, and with any extension, a dorsal dislocation is possible, depending on the forces involved (9). The plantar dislocation mechanism is often described with a hyperflexion (i.e., plantarflexion) motion, a less common movement of the hallux (9,10,12). A lesser injury includes a reverse turf toe pathology coined “sand toe” from a hyperplantarflexion with dorsal capsular injury (19). To further the injury with frank plantar dislocation, the moniker “Dancer’s Dislocation” is credited to the motion of hyperflexion being more common during the act of dancing and the main mechanism of these kinds of injuries (3,5).

The first MTPJ has a complicated anatomy consisting of the ligament and capsular structures. The plantar plate of the first MTPJ is a capsuloligamentous complex that provides stability to the great toe, sesamoids, and distal metatarsal. Anatomically, the plantar plate is a thickened fibrocartilagenous capsule running from the distal first metatarsal neck to the base of the proximal phalanx (19–21). Within its course, it contains the tibial and fibular sesamoids, which are embedded in the flexor hallucis brevis tendon (medial and lateral heads), and it also serves as an attachment for the medial and lateral collateral, suspensory, and

deep transverse metatarsal ligaments. The sesamoids pair also contains its own sesamoids-phalangeal distal ligament, as well as an intersesamoid ligament joining the 2 bones.

Prasad et al (5) explain the pathodynamics of a plantar dislocation as a stretch or tear of the dorsal and medial capsule and collateral ligaments as the toe is flexed. In addition, owing to the first MTPJ plantar plate having a stronger attachment distally at the base of the proximal phalanx and weaker attachment to the first metatarsal, the sesamoids are thought to follow the proximal phalanx in traumatic plantar displacements, a finding appreciated in our example (3,21).

However, the available case reports in the literature do not reflect this point. Our review found more incidents of tears in the phalangeal-sesamoid ligament (i.e., rupture at the proximal phalangeal base), with the sesamoids remaining anatomic (type 3A). Although this is contrary to the presumed location of rupture at the weaker plantar plate proximal first metatarsal insertion, based on anatomic studies of the ligament, in turf toe injuries, the rupture is also more commonly seen on the distal, phalangeal side (21). This may be owing to the other capsuloligamentous



Fig. 3. Follow-up films at 2 months. Patient returned to full weightbearing in a sneaker, with no redislocation of the great toe.

Table 1
Documented cases of plantar dislocations of the first metatarsophalangeal joint

| | Age (y) | Sex | Dislocation | Skin | MOI | MOH | LOS | Associated Injuries | Tx | Morbidity |
|---------------------|---------|-----|-------------------------------------|--------|---|----------------|-----------------|---|--|--|
| Biyani et al (13) | 30 | M | Plantar, acute (s/p 1 h) | Open | FFH, 20 ft | Flexion | n/a | Plantar d/l of 1st to 5th MTPJ; fx of 2nd to 3rd MT bases | Surgical irrigation and debridement, soft tissue repair | At 2-y f/u, patient with normal gait, no functional incapacity, no pain |
| Mata et al (9) | 33 | F | Plantar, acute | Closed | Axial load (gently kicked leg of table); physiological ligamentous laxity | Flexion | Anatomic | None | CR, buddy splintage 1 to 2 and protected weightbearing for 6 wks | At 4-y f/u, no further problems |
| Clark et al (15) | 84 | F | Plantar, acute | Closed | Axial load/stubbed toe in a slightly PFX hallux secondary to foot | Flexion | Anatomic | Dorsolateral displaced 1st MT neck fx | CR failed; OR with KW stabilization of fx; no stabilization across 1st MTPJ | At 4-mo f/u, clinical and radiographic union of fx, with no residual pain |
| Kasmaoui et al (16) | 28 | M | Plantar-lateral, acute (s/p 19 d) | Closed | MVA | Unknown | Anatomic | Fx of 2nd to 3rd MT necks; plantar-lateral d/l 1st to 2nd MT bases | CR failed; OR with KW stabilization of 1st MTPJ and 1st tarso-metatarsal joint | At 2-y f/u, clinical and anatomic results were good |
| Sarban et al (11) | 17 | M | Plantar-lateral, chronic (s/p 3 mo) | Closed | Dorsal direct trauma onto hyper-PFX foot | Flexion | n/a | None; patient with bilateral postaxial polydactyly | Planned OR; soft tissue reconstruction; KW stabilization of 1st MTPJ | At 20-mo f/u, mild osteoarthritic changes to 1st MTPJ, with decreased ROM; patient satisfied with result |
| Prasad et al (5) | 27 | M | Plantar-lateral, acute | Closed | FFH, 4 ft | Flexion | D/l with hallux | Comminuted fx of 2nd to 3rd MT midshaft, segmental fx 4th MT, nondisplaced fx 5th MT neck | CR successful | At 8-mo f/u, patient free of pain and pleased with result; developed asymptomatic hallux valgus |
| Lomax et al (8) | 29 | M | Plantar, acute | Closed | Jujitsu | Forced flexion | Anatomic | None | CR failed; OR with soft tissue reconstruction. | At 12-wk f/u, patient regained pain-free full ROM and ability to perform an unassisted tiptoe stand |
| Zizah et al (12) | 32 | M | Plantar | Closed | MVA | Unknown | Anatomic | None | CR successful | At 1-y f/u, patient asymptomatic, with full ROM and no clinical deformity; patient back to full sport activity |
| Hood et al (2019)* | 46 | M | Plantar-medial | Open | Hyper-PFX of forefoot into stair | Flexion | D/l with hallux | Open laceration from dorsal 1st MTPJ into 1st interspace | CR successful; irrigation and closure of laceration | At 4-mo f/u, patient with mild pain and decreased ROM; laceration healed |

Abbreviations: CR, closed reduction; d/l, dislocated; F, female; FFH, fall from height; f/u, follow-up; fx, fracture; KW, Kirschner wires; LOS, location of sesamoids; M, male; MOH, motion of hallux; MOI, mechanism of injury; MT, metatarsal; MTPJ, metatarsophalangeal joint; MVA, motor vehicle accident; OR, open reduction; PFX, plantarflexion; ROM, range of motion; s/p, status, post.

* Present study.

Table 2
Jahss classification system for dorsal dislocations of the first metatarsophalangeal joint, with addendums

| Type | Description | Reduction Method |
|---|---|--|
| Type 1 | Dorsal dislocation of hallux with sesamoids, hallux lateral or abducted position, intact intersesamoid ligament | Open reduction necessary |
| *Type 1B (Lantor and Borovoy (7)) | Dorsal dislocation of hallux with sesamoids, hallux adducted position, intact intersesamoid ligament | Open reduction necessary |
| Type 2A | Dorsal dislocation of hallux without sesamoids, no sesamoid fracture, completely ruptured intersesamoid ligament | Closed reduction possible |
| Type 2B | Dorsal dislocation of hallux without sesamoids, transverse sesamoid fracture (1 or both), partially ruptured intersesamoid ligament | Closed reduction possible |
| *Type 2C (Copeland and Kanat (6)): combination of 2A and 2B | Dorsal dislocation of hallux without sesamoids, sesamoid fracture (1 or both), completely ruptured intersesamoid ligament | Closed reduction possible |
| *Type 3 (Edwards and Malay (17) Killian et al (18)) | Dorsal dislocation of hallux without sesamoids, no sesamoid fracture, intact sesamoid complex, rupture of plantar sesamophalangeal ligament distal to sesamoids | Closed reduction can be attempted; open reduction as necessary |

*Not included in the original Jahss publication.

structures proximal to the joint line such as the suspensory and intersesamoid ligaments and flexor hallucis brevis musculature. To the best of our knowledge, this case is the ninth description of any sort of plantar dislocation and the fifth isolated acute first MTPJ case reported in the literature (8–15).

The examples in the literature are of varied etiology. In looking at the patterns of plantar dislocations and how to relate to the Jahss classification (though in the opposite direction), pathology to the sesamoids was further analyzed. In each example, no fracture to the sesamoids was noted. There were 2 example of bipartite sesamoids, 1 of each tibial and fibular; but we felt that this did not contribute to the injury in any capacity (8,10). One finding that did vary was the position of the sesamoids in relation to their normal anatomic location. The presented cases show that the sesamoids remain either in their anatomic position, plantar to the first metatarsal head in the cristae (type 3A) or dislocated plantarward with the dislocated hallux (type 3B) (Fig. 1). This finding led to the formulation of our proposed addendum.

Recommendations for treatment are not standardized but come from the case examples in the literature (9,12). We agree on the need to attempt closed reduction. Reversing the mechanism requires a hyperextension motion to the hallux after maximum distraction. Once successful, protection is recommended by means of “buddy” splinting of the first and second digits and protected WB to cast immobilization and non-WB for a length of time (4 to 6 weeks) (11,12). Of note, once reduction is confirmed, placing the joint through an ROM is important to determine the stability of the reduction. If redislocation occurs, or if there is an inability to close or reduce the deformity, surgical intervention may be necessary (8,11,12). This was required in 50% of the cases reported in the literature.

Surgery can include percutaneous pinning with Kirschner wires to enhance the stability around the joint while the soft tissue structures heal to full open reduction and direct ligament repair. Ligament repair often includes the dorsal capsule and medial collateral ligaments, among any additional tendon ruptures found (5). Depending on the grade of injury sustained (i.e., type 3A versus type 3B), a targeted approach can be performed to repair the ruptured ligament structures proximal or distal to the sesamoids with end-end repairs, tendon transfers, and/or tendon tenotomy to balance and restore joint alignment and anatomy. This especially may be the case in either a failed closed reduction or an unstable joint after successful reduction. Lomax et al and Sarban et al provide detailed open technique for difficult-to-reduce plantar dislocation deformities (8,11). It is important to consider all associated injuries when deciding the best course of treatment. In the case presented in this article, reduction was performed before laceration closure to prevent iatrogenic dehiscence to the repair site during the reduction maneuver. Similarly, other fractures may require altered treatments, such as laceration repair, soft tissue repair, and concurrent fracture repair, instead of the basic closed reduction. The overall outcome for these injuries has been good, with limited morbidity to the patient regardless of the treatment (closed or open) performed.

Our review of the literature is limited, like all reviews, by publication biases that restrict the available information to reports of small series of patients, retrospective investigations, and relatively low-quality clinical information, which is understandable in association with the first MTPJ dislocation injuries. Moreover, our inclusion of the case report in this review was limited by the short duration of follow-up; however, our intent was to describe the injury and not necessarily the long-term result of our treatment of the individual patient.

Table 3
Unifying classification of first metatarsophalangeal joint dislocations

| Type | Description | Reduction Method |
|---------|---|---------------------------|
| Type 1 | Dorsal dislocation of the 1st MTPJ | |
| Type 1A | The intersesamoid ligament is intact, and the sesamoidal complex is not dislocated | Closed reduction possible |
| Type 1B | The intersesamoid ligament is intact, and the sesamoidal complex is dislocated over the metatarsal neck | Open reduction necessary |
| Type 1C | Real discontinuity of the intersesamoid ligament (tearing or avulsion) is present | Closed reduction possible |
| Type 2 | Lateral and medial dislocations of the 1st MTPJ | |
| Type 2A | Pure lateral dislocation | Closed reduction possible |
| Type 2B | Dorsolateral and dorsomedial dislocations | Closed reduction possible |
| Type 3 | Plantar dislocation of the 1st MTPJ | Closed reduction possible |

Abbreviation: MTPJ, metatarsophalangeal joint.

*Adapted from Zrig et al. (3) Permission via Elsevier/Rightslink Copyright Clearance Center.

Table 4

Unifying classification of first metatarsophalangeal joint dislocation: type 3 plantar modification^{2,4}

| Type | Description |
|---|---|
| Type 3A (Mata et al (9), Clark et al (15), Kasmaoui et al (16), Lomax et al (8), Zizah et al (12)) | Plantar dislocation of hallux without sesamoids (sesamoids remain anatomic, articular to cristae) |
| Type 3B (Hood et al, Prasad et al (5)) “Dancer’s Dislocation” | Plantar dislocation of hallux with sesamoids (sesamoids dislocate with hallux dislocation) |

In conclusion, the Jahss classification appears to be incomplete, as additional isolated examples of variable direction dislocations (medial, lateral, and, as described here, plantar) can be found throughout the literature. The purpose of this case report was 2-fold: to offer another case example of the rare plantar first MTPJ dislocation and to propose the addition of type 3A and type B plantar “Dancer’s Dislocation” injuries to the unifying classification of first MTPJ dislocations, expanding on the work of Jahss and Zrig et al (2,3).

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