Etiology and Management of Lesser Toe Metatarsophalangeal Joint Instability

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KEYWORDS

• Plantar plate • Lesser MTP joint instability • Crossover toe • Drawer test

KEY POINTS

- A plantar plate tear is associated with instability of the lesser MTP joints and may be associated with collateral ligament tears leading to sagittal and coronal plane malalignment.
- The drawer test is a reliable examination to assess pain and instability of the lesser MTP joint in the presence of plantar plate insufficiency.
- MRI may help to define the presence and magnitude of a plantar plate tear.
- Staging of the clinical examination and grading of the surgical findings are useful in defining the plantar plate tear and formulating the appropriate operative intervention.
- Exposure of the plantar plate is possible through a dorsal approach using a Weil osteotomy.
- Direct repair of the tear is possible allowing anatomic reapproximation and advancement of the plantar plate.

INTRODUCTION

Crossover toe, a term introduced in 1986 as a description of the end result of instability of the metatarsophalangeal (MTP) joint, culminates in sagittal and coronal plane deformity.[1] Deterioration of the collateral ligaments and/or plantar plate is associated with

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instability of the lesser MTP joint and leads to the involved toe crossing over or under the adjacent toes or hallux.[2,3] Multiple reports have described both the progression of the deformity and method of treatment.[4–8] Pain in and around the lesser MTP joints is a common complaint that is difficult to diagnose especially when there is no obvious deformity.[5,9,10] Acute trauma, high-fashion shoe wear, rheumatoid arthritis, and other various inflammatory conditions have all been linked with metatarsalgia and lesser MTP joint deformity.[2,4,7,11,12] The crossover toe deformity has been associated with hallux rigidus, hallux valgus, hammertoes, and interdigital neuromas.[4,6,7] For 25 years, the treatment of lesser MTP joint instability has been characterized by indirect repairs of the deformity using soft tissue releases, balancing procedures, extensor and flexor tendon transfers, and periarticular osteotomies.[1,4–6,8,11,13–24]

A degenerative tear of the plantar plate as a definitive cause of this deformity has now been well documented as the primary pathology.[13–15,21–23,25–27] Classifying the plantar plate tear, based on the location and magnitude of the lesion, helps make it possible to directly repair the plantar plate tear as a means to stabilize the MTP joint.[13–15,21–23,25]

ANATOMY

The lesser MTP joints are stabilized by the dynamic intrinsic and extrinsic muscles of the lesser toes, but also by static stabilizing structures including the plantar plate and collateral ligaments.[20] The plantar plate is the major stabilizing structural force of the lesser MTP joint.[24,28] The plantar plate originates on the proximal neck of the metatarsal metaphysis by a thin synovial attachment. It inserts distally as a firm fibrocartilagenous attachment into the plantar base of the proximal phalanx adjacent to the phalangeal articular cartilage (**Fig. 1**).[26,29] The plantar plate averages 2 cm in length, 1 cm in width, and varies from 2 to 5 mm in thickness. The plate is thicker along the medial and lateral borders but also thickens directly beneath the metatarsal head.[29] The major composition of the plantar plate contains type 1 (75%) and type 2 collagen (21%), which are woven together to create a dense fibrocartilagenous network that lends itself to weight-bearing function.[26,29] The plantar plate serves as a cushion to support compressive forces transferred to the forefoot during weight bearing by functioning similar to the meniscus in the knee, also a structure characterized by type 1 collagen.[26,27,29] Several structures interdigitate with the plantar plate including the plantar fascia, the tendon sheath of the flexor tendons, the transverse intermetatarsal ligament, the collateral ligaments, and the interossei tendons.[26,27,30]

Two distinct collateral ligaments of the MTP joint can be identified, and both ligaments arise from the metatarsal head. The proper collateral ligament attaches to the lateral base of the proximal phalanx, and the accessory collateral ligament attaches directly to the plantar plate (**Fig. 2**).[26] Barg and colleagues found that both collateral ligaments contribute to the stability of the MTP joint, but that the accessory collateral ligament, with its attachment directly to the plantar plate, affords key stability to the joint.[31] With chronic hyperextension forces at the lesser MTP joint, the plantar plate and capsular attachments may become attenuated and insufficient leading to a loss of stability of the MTP joint.[1,4,9,25]

DEMOGRAPHICS OF LESSER MTP JOINT INSTABILITY

Lesser MTP joint instability occurs much more commonly than has been recognized previously.[5] The most frequent presentation of this deformity occurs in older sedentary women.[1,17] However, Coughlin reported this to occur in the younger male athletic population.[5,17] Kaz and Coughlin[17] examined the demographics of a large series of