CHAPTER **21**

TRANSVERSE PLANE METATARSOPHALANGEAL JOINT DEFORMITY: Another Etiology and Solution

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The second metatarsophalangeal joint (MPJ) is a location of frequent pathology in the foot, often resulting in metatarsalgia-type pain. It may be associated with such deformities as plantar plate subluxation, a second metatarsal that is relatively too high or too low, too short or too long, or flexor tendon malalignment. The joint itself may present with nontraumatic synovitis, predislocation syndrome, degenerative joint disease, rheumatoid arthritis, or avascular collapse due to Freiberg's infraction.

There may also be associated sagittal, frontal, or transverse plane deformities of the second toe which may present singularly or in any combination. Probably the most difficult component to treat successfully is the transverse plane deformity occurring at the MPJ (Fig. 1). Although this may or may not be symptomatic, it is usually pain that brings the patient into the clinical setting.

Both the pain and the degree of transverse plane deformity are usually insidious in onset, and the toe most often adducts towards the hallux, although it may present abducted. The second MPJ is the most commonly affected joint. Without correction, the transmetatarsophalangeal joint tendons tend to displace, and the capsule contracts ipsilateral to the direction of the deformity. Over time, the head of the metatarsal will adapt to the same direction, resulting in "tracking" of the toe in its altered position. In addition, the plantar plate will tend to shift in the same direction, carrying with it the flexor tendons. Once this shift takes place, the transverse plane deformity increases as the change in vector force gives the contracting tendons more mechanical advantage. Thus, a vicious cycle ensues.

In its early stages, the deformity is simply a subluxation at the MPJ (Fig. 2). However, over time

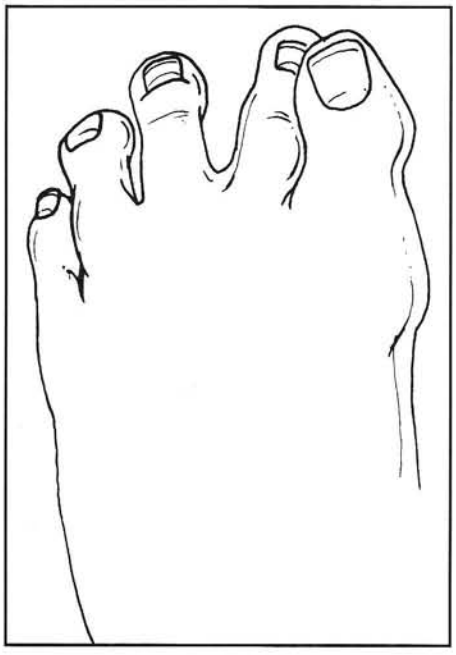

Figure 1. Clinical appearance of a second toe transverse plane deformity.

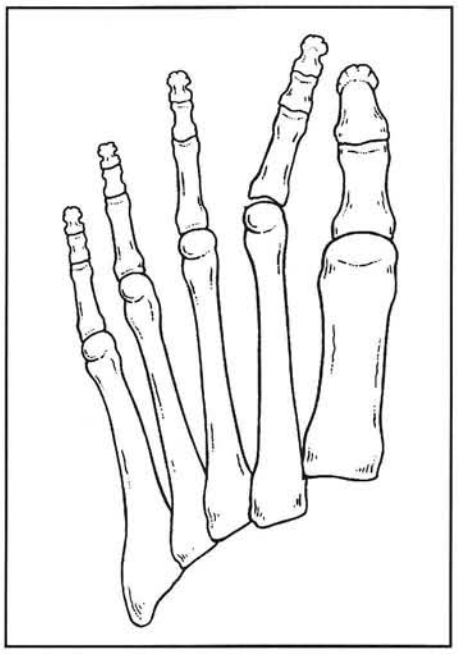

Figure 2. Transverse plane deformity at the second MPJ.

there often develops flexion contractures at the interphalangeal joints of the toe. Occasionally, the toe may even rotate in the frontal plane at the same time. In its most extreme degree, the second toe will overlap the hallux.

ETIOLOGY

Determining what initiates this transverse plane deformity remains an enigma. There is very little information in the medical literature to date that addresses this entity alone. Various descriptive terms really address a continuum of instability leading to subluxation of the (usually second) metatarsophalangeal joint that occasionally eventuates in complete dislocation (Table 1). The transverse plane deformity is a frequent component of this syndrome.

Table 1

TERMS TO DESCRIBE SECOND MPJ PROBLEMS

Predislocation Syndrome of the Lessor MPJ
Sub-2nd Metatarsal/Neuroma Syndrome
Chronic Lesser Metatarsalphalangeal Dislocation
Floating Toe Syndrome
Lesser MPJ Instability Syndrome
Second MPJ Dislocation/Subluxation
Nontraumatic Synovitis of the Second MPJ
Crossover Second Toe Deformity Second Metatarsophalangeal Joint Instability

Based on clinical observations, including response to treatment, one probable etiology relates to the deep transverse intermetatarsal ligament (DTIL) between the first and second metatarsophalangeal joints (Fig. 3). According to Sarrafian[1] and Deland et al.,[2] the plantar plate of the second MPJ is attached transversely to the sesamoid apparatus of the first MPJ via the DTIL. The plantar plate is firmly connected to the proximal phalanx of the toe. Therefore, if there is any increase in tension on the DTIL, as for example when the first metatarsal is shortened iatrogenically in hallux valgus surgery, the DTIL will pull the plantar plate and proximal phalanx toward the hallux, instigating a transverse plane digital deformity.

Over time, the medial second MPJ structures contract and the thicker lateral joint structures stretch, making the digital deformity less reducible. As the plantar plate shifts medially, it carries with it the flexor tendons which are firmly held within the sheathed plantar groove of the plate.[2] Once the flexor tendons have moved medial to the vertical axis of the second MPJ, their force vector pulls the second toe into further adduction, thereby increasing the deformity. With such imbalance, the medial interosseous tendon attached to the base of the proximal phalanx will add its force to the adduction as it gains mechanical advantage.

A congenital short first metatarsal may also lead to transverse plane deformity of the second toe, but it will generally take a much longer time for the functional pull of the DTIL to overwhelm the stabilizing structures about the second MPJ plantar plate.

SURGICAL CORRECTION

Conservative measures to straighten the toe rarely give permanent correction. Pain about the joint can be relieved with steroid injection,[3] toe taping or splinting,[4] and shoe or orthotic modifications. The pain relief is usually only temporary as the actual deformity will progressively worsen.

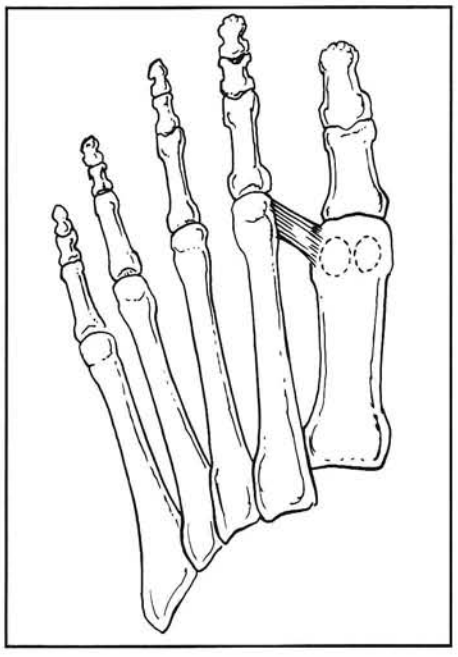

Figure 3. Deep transverse intermetatarsal ligament connecting the plantar plate of the second metatarsophalangeal joint to the sesamoid apparatus underneath the first metatarsophalangeal joint.

Surgical procedures for correcting transverse plane second toe deformities at the MPJ have included arthroplasties,[4,5] various tendon transfers,[6-9] collateral ligament reconstruction,[10-11] and a metatarsal head osteotomy.[5] The osteotomy can be either transpositional to realign the metatarsal head back over the plantar plate (Fig. 4) or angulational to reduce the medially directed articular adaptation.

NEW APPROACH

Since a short first metatarsal leaves a relatively long second metatarsal, then one method of reducing the deforming tension on the DTIL is to shorten the second metatarsal. This can be done via a diaphyseal osteotomy using a technique of choice. For example, a shortening Z-osteotomy can be fixated with screws (Fig. 5), whereas a cylindrical shortening osteotomy can be fixated with a plate (Fig. 6), or a screw if it is angulated. Once the second metatarsal is shortened, the second toe will spontaneously fall back into correct alignment (Figs. 7A, 7B, 8A, 8B).

The greatest advantage here is that the metatarsophalangeal joint does not have to be violated and no digital pinning is required. A disadvantage is the postoperative care necessary to heal the osteotomy. Unfortunately, this procedure is not helpful in the long term deformities where there are advanced contractures of the soft tissues and adaptations of articular structures. It is offered as an additional technique to address the difficult transverse plane digital deformity. It also offers some insight into the etiology of the problem.

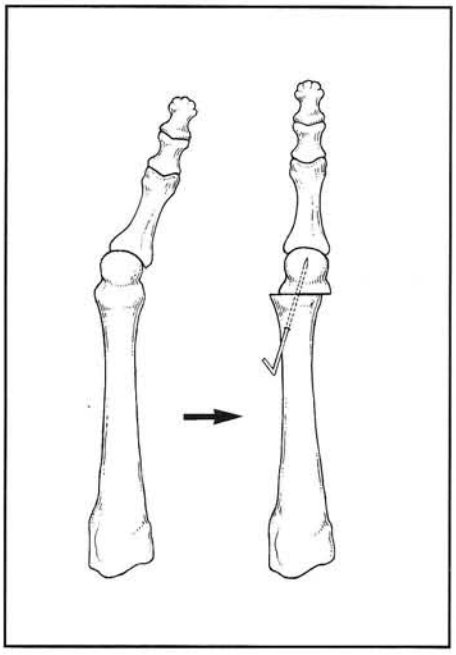

Figure 4. Transpositional osteotomy of a metatarsal head to relocate a dislocated second MP joint by repositioning the head over the plantar plate.

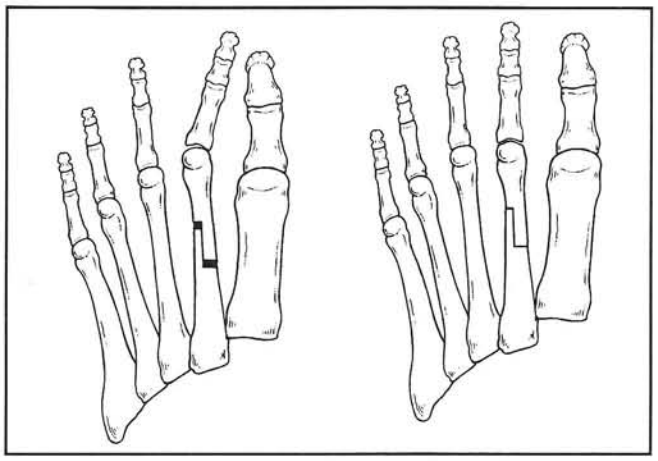

Figure 5. Shortening Z-osteotomy of the second metatarsal resulting in realignment of the second MPJ.

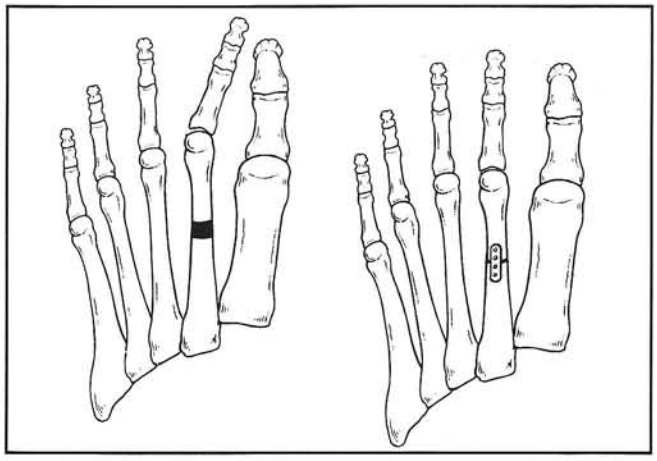

Figure 6. Cylindrical shortening osteotomy of the 2nd metatarsal resulting in relocation of the 2nd MPJ.

Figure 7A. Case #1. Preoperative x-ray of subluxing second MPJ.

Figure 7B. Case #1. Relocation of the 2nd MPJ after shortening osteotomy of the 2nd metatarsal.

Figure 8A. Case #2. Preoperative x-ray of subluxation transverse plane deformity of the second toe.

Figure 8B. Case #2. Relocation of the second MPJ by shortening of the second metatarsal.

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