CHAPTER **8**

ADVANCED FOREFOOT DERANGEMENT: Multiple Weil's Versus Pan Metatarsal Head Resection and Rethinking Digital Surgery

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As foot and ankle surgeons, when addressing advanced forefoot deformities why don't we seek to preserve digital length first and decompress metatarsal length primarily? The initial answer is we have been indoctrinated with the unreliability of lesser metatarsal osteotomies and that the most effective means of gaining control over an unstable metatarsophalangeal joint (MTPJ) is by fusing a PIPJ and thereby converting the FDL tendon to a planterflexor of the MTPJ and not a dorsiflexor of the PIPB and reverse buckler of the MTPJ. And yet we have all seen for years the vagaries of multiply operated hammertoes drifting unstably in all planes, stiff, rigid, nonpurchasing and deviated (Figure 1). Are we fusing too many toes and is there a better answer?

For the last 15 years the lead author has considered carefully alternative approaches to advanced forefoot derangement in an effort to reduce the use of the panmetatarsal head resection as the definitive be-all cure-all salvage procedure and determine if indeed there is a reliable joint preservation option of both the MTP joints and PIP joints for these deformities. The works of Bernard Regnauld and Louis Barouk internationally as well as as my residency training and participation as faculty member in all Podiatry Institute activities since 1990 have led to a revamped constellation of thought on these conditions. Well done pan metatarsal head resections with digital stabilizations in combination with either first MTPJ arthrodesis or arthroplasty are time honored procedures that reliably correct the most severe forefoot deformities (Figure 2). However, we routinely encounter patients with severe deformities that have well preserved cartilage of the metatarsal heads as well as the heads of the proximal phalanges. Over the last several years I have had reasonable success and certainly equivalent if not better functional results with the use of the principles of longitudinal and mediolateral decompression of the forefoot most closely attributed to Barouk's approach (Figure 3). It is desirable to offer a 45-year-old man with aspirations to stay physically fit, perhaps run a marathon and continue in high physical demand gainful employment a joint preservation type approach in spite of subluxed MTPJ and deviated toes (Figure 4).

So what is the change in the philosophical approach? By the time the toes are drifting in 5 different directions the soft tissues are trying to tell us something. They have become through soft tissue adaptation essentially too short for the foot, or phrased differently the bones have become in a sense too long for the soft tissues that surround them (Figure 5).

Figure 1. Note elevation of the second and third toes with residual angular deformities after previous digital surgery. These cases are common.

Figure 2. Preoperative and postoperative panmetatarsal head resection with digital PIPJ fusions and first MTPJ fusion. Excellent alignment is obtained but with the sequela of stiff non functional digits.

Figure 3. Global harmonization of the metatarsal parabola for advanced forefoot deformity. The first ray has been addressed via a shortening scarf osteotomy of the first metatarsal and then generous shortenings of the central metatarsals to achieve a longitudinal decompression of the entire forefoot and relaxation of the deviated and subluxed MTP joints.

Figure 4A. Multiple Weil osteotomies with harmonization of the parabola in a 45-year-old member of the local police force who desired to run a marathon. He has already completed one prior. Note the central metatarsals are decompressed back to a length that essentially leaves a parabola of 1 = 2 >3 >4> 5. This allows relaxation of the intrinsic muscles and stabilizers at the MTP level and thereby relaxes the extrinsic tendons as well.

Figure 4B.

Figure 5. With such advanced forefoot deformity, the periarticular soft tissues have simply become too short for the osseous length of the foot and therefore they have no choice but to deviate considerably.

The Podiatry Institute stepwise approach to hammertoe/clawtoe correction is reliable and proven effective in stabilizing digital deformity and reducing plantar pressures beneath the metatarsal heads. However, I am not convinced that the results are lasting except for in mild deformities. I continually see residual or late drift of the toes in spite of perfect execution of the stepwise approach including pinning across the MTPJs. In fact, I abandoned placing pins across the MTPJ years ago due to dissatisfaction with the late results and postoperative course for the patients. I am proposing a reassessment of the PI stepwise approach and a philosophical reassessment of the order in which we address advanced derangement of the MTPJs.

The stepwise approach of extensor lengthening, PIP joint fusion or arthroplasty, extensor hood release followed by MTPJ capsulotomy, McGlamry elevator to release the plantar plate fails to include an assessment of the functionality of any anatomy on the plantar side of the joint. Routinely, the push up test is performed on the metatarsal head between each step and if the toe is still elevated, a pin is advanced across the MTPJ. Here is the first point of divergence in the thought process. If the toe is still elevated in the sagittal plane after the sequential release and fusion of the toe then there must be an anatomical explanation. It is without question 1 of 3 possibilities, a compromised plantar plate, a dysfunctional flexor tendon, or an abnormal metatarsal length or parabola. Simply pinning the MTPJ for 3 to 6 weeks is not a lasting solution and the toes

Figure 6A. A classic example of pinning of MTPJs with Kirschner wires in the hopes that they will stay aligned only to have the toes drift back into abduction promptly due to uncorrected osseous length versus soft tissue contracture.

Figure 6B.

consistently deviate again over the long term (Figure 6.) I now reserve the traditional stepwise approach for only the earliest and most reducible deformities.

My preferred approach in advanced deformity of the forefoot is to address each individual ray as a "junior" first MTPJ and a potentially "junior" bunion. The forefoot is looked at globally and consideration given to the MTPJ surgical work first rather than the digital work. This is similar to how we routinely correction HAV deformity and decide if an Akin is required or not. So rather than starting surgically with the digital dissection and proceeding to the MTPJ level, I will start with the MTPJ level and proceed to the digital level depending on necessity or not. The deformity at the MTPJ level is addressed through a longitudinal or transverse incision depending on how many rays are to be addressed. If it as an isolated ray deformity then a longitudinal incision will suffice. If adjacent ray deformities exist, then an interspace longitudinal incision may be used or a dorsal transverse incision to access all MTPJs at the same time (Figure 7).

Step 1 therefore is attention and surgical procedure at the MTPJ level where the deformity is corrected with MTPJ release, medial and lateral capsulotomy or capsulorraphy, medial or lateral intrinsic release if warranted, and a metatarsal osteotomy with decompression and or medial and lateral translation. Step 2 then proceeds with careful evaluation of whether any residual hammertoe is passively reducible or not. This is really an extension of the preoperative examination and a reassessment of the need for a stepwise approach to correct the hammertoe. Many times

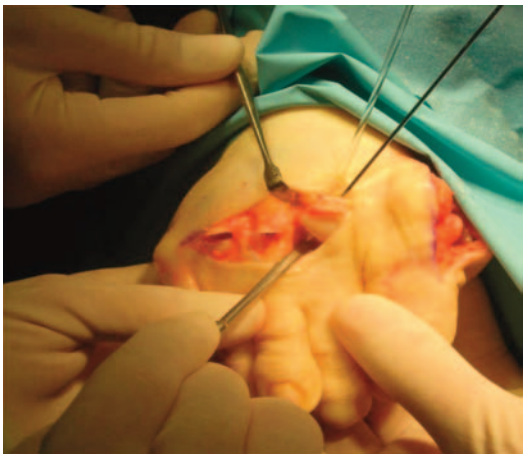

Figure 7. Example of transverse incision across dorsal distal forefoot that allows intraoperative inspection and performance of all central Weil osteotomies at the same time.

after the surgical work is performed at the MTP level, enough slack has been created in the long flexor tendons that a PIP fusion or arthroplasty may not be warranted and we may have the option of preserving not only digital length but also a contractable functional toe that frequently has no abnormality of the cartilage of the proximal phalangeal head nor metatarsal head thereby obviating the need for a resection of that cartilage. Either flexor digitorum brevis or longus tenotomies may be selectively performed with or without temporary pinning. The sequence for the selective release of the FDB or FDL tendon will be illustrated shortly.

The intra-operative goal in the correction of these deformities is distinct. First, all toes must be straight in all planes with no external pins out the tips of the toes. This is easily accomplished with the use of absorbable pins and

Gently flexed PIPJ fusions that leave all toes purchasing the ground functionally and aesthetically. No external Kirschner-wires are required nor desired (Figure 8). Second, no pins should be crossing the MTPJs. Third, previously undamaged articular surfaces should be left intact at the PIP or MTP level and the toes should not require the surgical soft tissue dressing to maintain the alignment.

Figure 8A. The 6 month follow up of well consolidated PIPJ flexed fusions of toes 2,3,4.

Figure 8B. Note the excellent purchase of all toe pulps on the ground.

ILLUSTRATED CASE

Figure 9A. Preoperative deformity of overlapping second toe, medial drift of the third toe, and clear clinical compromise of the plantar anatomy.

Figure 9B.

Figure 10A. Intraoperative correction of the deformity. Note no Kirschner wires crossing the MTPJ. PIPJ fusions were performed with absorbable pins and a V to Y skin plasty was performed to relax dorsal soft tissues. Short digital transverse incisions were made to discourage any soft tissue recurrent contracture dorsally.

Figure 10B.

REDEFINING DIGITAL SURGERY

Concepts regarding hammertoe surgery have been discussed in numerous literary sources for many years. New fixation devices have gained much momentum in the last decade from the standard Kirschner wires, allograft pins, screws, to absorbable to the smart toe devices, but not much has been discussed regarding technique since the 5-step hammertoe approach. Traditional hammertoe correction has typically consisted of resection arthroplasty or arthrodesis with fixation devices for 6 weeks rendering the joint immobile. The purpose of this article is to familiarize the reader with some modifications and thought processes to allow the surgeon an alternative approach, possibly avoiding the joint destructive procedures such as an arthroplasty or arthrodesis, allowing the proximal or distal toe interphalageal joint to function both normally and anatomically as it was designed to, instead of producing rigid, inflexible digits that can cause further postoperative symptoms in the future. This section is dedicated to the hammertoe, mallet toe and clawtoe deformity and creating more predictable results for a challenging problem.

EVALUATION

Proper evaluation and assessment of the deformity are necessary to determine the surgical approach. The evaluation for each specific type of toe deformity is dependent on soft tissue contractures or bone deformities. These can be either congenital or biomechanical in nature, but the clinical diagnosis for the causative factor must be addressed in order to achieve the best long term result. In most cases, the bones of the foot adapt to the soft tissue imbalances and contractures, either in the transverse (hallux valgus) or sagittal plane (contracted PIPJ hammertoe). The soft tissue must first be addressed for rigidity, or more likely, reduction of rigidity when the foot is held in a neutral position. Can the toe be reduced at the PIPJ or DIPJ to neutral or is it locked due to joint adaptation over time? The soft tissue deforming forces including tendon, capsules, and ligaments have profound effect to persuade the joints to move into the contracted position they will end up in.

The foot must be evaluated in the seated position and with the foot in a plantarflexed position to the leg as well as dorsiflexed position. The potential reduceability of a digital deformity and thereby avoidance of an arthrodesis can only

be determined by putting the long flexors and short flexors under either stretch or relaxation. If hammertoes are reducible with the foot plantarflexed to the leg but not when the foot is neutral or dorsiflexed then an FDL tendon release may suffice. Conversely, if the patient has the classic flexor substitution type appearance to the toes in weight bearing (Figure 11) the primary deforming force is the FDB tendon and a release of both slips at their insertion point into the base of the middle phalanx with temporary pining for 3 weeks is a very attractive way to preserve a mobile toe and long flexor function (Figure 12).

Figure 11. Clear clincal example of hammertoe deformities that are caused by FDB contracture rather than FDL. The toes are clearly gripping the ground.

CASE PRESENTATION

This stepwise approach popularized by Louis Samuel Barouk has been employed quite effectively the past three years by the authors with predictable long term results. The advantages of this technique are avoidance of prolonged pain and swelling, arrow straight rigid toes that sometimes lack stability to purchase the ground, and maintain joint integrity and normal function, neutralization of soft tissue contracting forces. This digital approach has been combined with an attempt to embrace and duplicate the joint preservation concept of the advanced forefoot deformity to improve or maintain as much function as possible for those patients with advanced forefoot deformities. The panmetatarsal head resection and PIPJ fusions or manipulations with pinning is still used by the authors in the presence of inflammatory arthritis and or joint destructive processes that have clearly damaged the articular surfaces of the metatarsal heads or proximal phalanges. When this is not the case, we continue to attempt joint preservation procedures at all times.

Figure 12A. Shows clear radiographic evidence of contracture at the PIPJ joint due to excessive pull of the FDB tendon. After isolated FDB release the toes are temporarily pinned for 3 weeks percutaneously and complete correction of the deformity is observed.

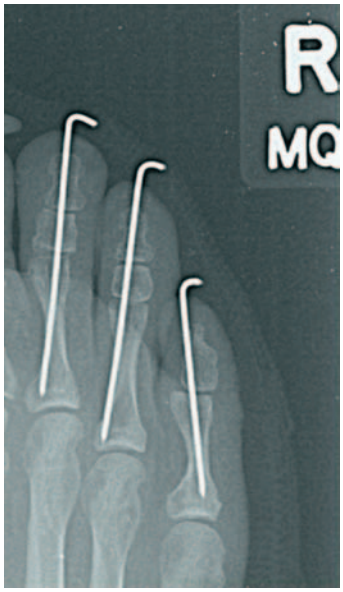

Figure 12B.

Figure 12C.

Figure 13. The skin incision for medial approach to isolated FDB tenotomy for a reducible hammertoe deformity as determined by the preoperative clinical examination. The incision is made medially on the second toe and laterally on toes 3,4,5.

Figure 14. The skin incision is deepened.

Figure 15. Retractors are placed and the deep fascia that encompasses the flexor tendons is identified.

Figure 16. A metzenbaum is used to penetrate the deep fascia and identify the actual tendons.

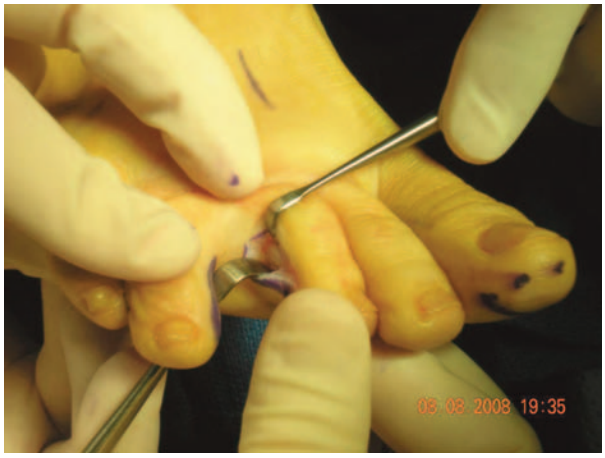

Figure 17. Visualization of the flexor apparatus.

Figure 18. A hemostat is used to identify and separate the long flexor tendon from the short flexor tendon.

Figure 19. The long flexor tendon is identified.

Figure 20. The long flexor tendon and short flexor tendons are identified. The short flexor tendons will be isolated and selectively cut leaving the long flexor tendons intact and still functional to assist in digital function.

Figure 21. Note the toe is completely passively reducible. If the toe does not reduce after release of the FDB tendon then a plantar capsulotomy maybe performed at the PIPJ level. This is then followed by percutaneous pining with a small caliber Kirschner wire such as a 0.045.

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