Combining a comprehensive review of the literature with their own experience, these authors take a closer look at diagnostic tips, pertinent surgical considerations and treatment pearls for performing the first MPJ arthrodesis in active patients.

Surgical recommendations are sparse when evaluating treatment options for the athletic population diagnosed with hallux limitus, hallux rigidus or first metatarsophalangeal (MPJ) osteoarthritis. However, we have found success in treating athletes with first MPJ arthrodesis, and helping them to achieve pain relief and a return to activities.

Several surgeons have found similar success as evidenced by a review of the literature on this subject. In 1996, Bouche, et. al., advocated first MPJ arthrodesis in active patients, reporting that it could “relieve pain and allow patients to perform some athletic function (including running).”¹ They performed first MPJ arthrodesis for five individuals who ranged from 42 to 57 years old and each patient returned to his or her respective preoperative weightbearing activity. The daily activities of these patients included walking, exercise, race walking, power walking and running.

While there is still controversy on whether one should perform first MPJ arthrodesis in the active population, Bouche says the first MPJ arthrodesis is the preferred joint destructive procedure in active patients and is a “definitive, predictable and viable option.”¹

In 2005, Brodsky, et. al., presented results of a retrospective study and indicated that “patients with a first MPJ fusion function extremely well and most athletic patients continue participating in sports with the advantage of greatly diminished discomfort.”² Surgeons performed a first MPJ arthrodesis on 53 patients (60 feet), who ranged between 21 to 79 years old. These patients engaged in weightbearing activities ranging from activities of daily living to recreational sports and exercise.² The researchers performed postoperative functional testing on 45 patients. Of those 45 patients, 64 percent could stand on their tiptoes, 94 percent could kneel, 87 percent could squat and 98 percent could pick up a small object from the floor.²
The following are the results of patient answers to a functional questionnaire:\(^2\)
- 100 percent could ascend stairs
- 96 percent could descend stairs
- 100 percent could walk less than one block
- 96 percent could walk one to six blocks
- 90 percent could walk over six blocks
- 75 percent returned to jogging
- 80 percent returned to golfing
- 92 percent returned to hiking
- 75 percent returned to tennis
- 98 percent returned to work
- 45 percent had no shoe limitations
- 47 percent required comfort shoes
- 8 percent required prescription insoles

Brodsky, et. al., described arthrodesis of the first MPJ as “a successful surgical procedure that provides relief of pain, correction of deformity and allows a high level of function in everyday life and in recreational activities.”\(^2\)

**Hallux Rigidus: Essential Staging Insights**

When staging hallux rigidus, we prefer to use the Modified Regnauld Classification as presented by Vanore, et al., and adapted by the American College of Foot and Ankle Surgeons.\(^3-6\) Here are the stages of this classification.

**Stage I: functional hallux limitus.** This includes hallux equinus/flexus, plantar subluxation of the proximal phalanx and metatarsus primus elevatus. There is also joint dorsiflexion that may be normal with non-weightbearing but is limited by first metatarsal elevation secondary to ground reactive forces. The category includes no radiographic degenerative joint changes, hallucal interphalangeal joint hyperextension and pronatory architecture of the foot.\(^3\)

**Stage II: joint adaptation.** This includes flattening of the first metatarsal head; osteochondral defect/lesion; cartilage fibrillation and erosion. There is also pain on end range of motion (ROM) with possible limitation of passive ROM; small dorsal exostosis; subchondral eburnation; periarticular lipping of the proximal phalanx, first metatarsal head and sesamoids.\(^3\)

**Stage III: established arthrosis.** This includes severe flattening of the first metatarsal head; osteophytosis; asymmetric joint space narrowing; articular cartilage degeneration; erosions, excoriations and subchondral cysts; crepitus and pain on full ROM; associated inflammatory joint flares.\(^3\)

**Stage IV: ankylosis.** This includes obliteration of the joint space, exuberant osteophytosis with loose bodies, less than 10 degrees of ROM, deformity and/or malalignment. It also includes possible total ankylosis, possible inflammatory joint flares; local pain often resulting from skin irritation or bursitis secondary to underlying osteophytosis.\(^3\)

While staging is not an exact science, the clinical and radiographic findings can aid in formulating a treatment plan and educating the patient. (For an overview of conservative management, see “A Guide To Conservative Treatment Options” below.) One should not rigidly tie various stages to specific procedures. When reviewing
surgical treatment options, it is prudent to inform the patient that the appropriate surgical intervention may change intraoperatively after one has a direct view of the cartilage. The appropriate surgical intervention may also change after the surgeon completes certain steps of the procedure such as joint decompression, angular correction or joint stabilization.

**A Guide To Conservative Treatment Options**

Conservative treatment of hallux limitus or rigidus is not the focus of this article. However, it is important to be aware of the various conservative treatment modalities. For example, one may delay or avoid surgical intervention by utilizing a stiff soled shoe, which reportedly reduces "first MPJ dorsiflexion to 25 to 30 degrees without significantly altering gait."^7,8

Non-surgical treatment options include but are not limited to the following: custom orthotics with or without a Morton’s extension to limit first MPJ dorsiflexion, rigid graphite shanks, stiff soled shoes, extra-depth shoes or rocker bottom shoes. Injection options and medications include corticosteroid injections, NSAIDs, glucosamine and chondroitin sulfate and Synvisc injections (Hylan G-F 20 has FDA approval for knee osteoarthritis). Other treatments include joint manipulation post-local anesthesia, physical therapy, ROM exercises, splinting and activity modifications or limitations.^1,9

**A Primer On Joint Preservation Procedures**

Surgical treatment options of hallux limitus or rigidus traditionally focused on two procedures described as joint preservation and joint destructive. More recently, surgeons have utilized specialized techniques such as arthroscopy, arthrodiastasis and the Osteochondral Autograft Transplant System (OATS) independently or in combination with traditional surgical techniques to address hallux limitus or rigidus.

Joint preservation procedures include cheilectomy with joint debridement and chondroplasty.^10-14 One may also perform joint realignment or decompression via various first metatarsal osteotomies such as the Watermann, Green-Watermann, Youngswick, Modified Reverdin Green, Shortening Scarf, Modified Weil or Modified Hohmann procedures.^15-19 Other options for joint preservation are joint realignment or decompression via various proximal phalanx osteotomies (Bonney-Kessell, Off Set L, Akin-Scarf).^20-23 Surgeons may choose angular corrections via first metatarsal osteotomies, including Lambrinudi (plantarflexing wedge) and Juvara C (sagittal oblique) and Modified Crescentic). Other options are sagittal translational corrections such as the Off Set V osteotomy, sagittal Z osteotomy and first metatarsocuneiform arthrodesis (Lapidus).^12,24

Mulier, et. al., reported 90 percent "good to excellent results when performing cheilectomy in athletes for stage I and II hallux rigidus with a mean five-year follow-up."^14 The athletes, who were between 19 and 45, participated in soccer, judo, volleyball, basketball, skating, dancing and tennis. Mulier noted the cheilectomy provides good results in athletes and in cases with cartilage damage to the dorsal aspect of the first metatarsal head.^13,25-26 Feltham, et. al., concluded the cheilectomy should be the surgical treatment of choice for patients over 60 years old regardless of the stage of hallux rigidus.^27
What You Should Know About Joint Destructive Procedures

Joint destructive procedures include resection arthroplasty with or without soft tissue interposition (Valenti, Keller, Modified Keller, Stone, Mayo), total or hemi-implants and arthrodesis.\textsuperscript{1-3,25,28-38} Reported objectives of a joint destructive procedure include “to eliminate or minimize pain, stabilize the first MPJ and allow the hallux to bear weight.”\textsuperscript{1} Bouche noted “the only procedure that achieves such long-term objectives is the first MPJ arthrodesis.”\textsuperscript{1}

DeFrino, et. al., demonstrated through gait analysis and pedobarographic studies that “the stable weightbearing position and function of the first ray is restored via arthrodesis of the first MPJ.”\textsuperscript{39} Lambardi, et. al., reported “the first MPJ arthrodesis reconstitutes the medial column longitudinal arch by plantarflexing and stabilizing the first ray.”\textsuperscript{39}

First MPJ arthroscopy, arthrodiastasis and osteochondral autogenous transplantation are specialized procedures. Surgeons may utilize these procedures independently or combine them with other joint preservation procedures. We limit independent use of these specialized procedures to posttraumatic hallux limitus, hallux rigidus and first metatarsal head osteochondral defects when void of contributing global structural or functional/positional pathology.

One may use first MPJ arthroscopy to perform the following procedures: synovectomy; ablation of adhesions, fibrous bands and scar tissue; removal of loose bodies; debridement and drilling of osteochondral defects; cheilectomy and debridement of osteophytes.\textsuperscript{41-43} Van Dijk reported no improvement in two patients and a slight improvement in three patients following arthroscopy for hallux rigidus. He also reported “good or excellent results in seven of 12 patients post-arthroscopy for first MPJ impingement syndrome with limited ROM and dorsiflexion; and good to excellent results in three of four patients post-arthroscopy for osteochondritis dissecans.”\textsuperscript{42}

Van Dijk also noted “promising results” for professional athletes with first MPJ dorsal impingement syndrome.\textsuperscript{42} Ferkel reported post-arthroscopy results on 21 patients with various first MPJ pathologies and noted 73 percent had good results, 13.5 percent had fair results and 13.5 percent had poor results.\textsuperscript{42} Ferkel also noted that the most common indication for first MPJ arthroscopy was “degenerative joint disease including chondromalacia, mild to moderate dorsal osteophytes and mild limitation of motion.”\textsuperscript{44}

One may utilize first MPJ arthrodiastasis to break up scar tissue, reduce contractures, reduce tension of deforming soft tissue structures and promote healing. Talarico, et. al., presented this option as a joint restorative procedure and noted the “purpose of distraction is to stretch the periarticular soft tissue structures in a staged process, causing lengthening and increasing the joints’ functional range of motion.”\textsuperscript{9}
Talarico, et. al., noted excellent long term results in 133 patients who had a mix of stage I, II and III hallux rigidus. At one year post-op, the study noted an average score of 8 on the American Orthopedic Foot and Ankle Society Hallux Metatarsophalangeal-Interphalangeal score. The score indicates patients had no limitations of daily activities, including employment responsibilities, or limitation of recreational activities. Intraoperative distraction of 5 mm is desirable and one should maintain this for one week followed by a gradual increase in diastasis up to 8 to 12 mm over a two-week period, according to Talarico. Removing the external fixator is recommended after five to six weeks of joint distraction and one should provide immediate physical therapy for a minimum of two weeks.

One may use osteochondral autogenous grafting and the Osteochondral Autograft Transplantation System (OATS) to replace regions of isolated first metatarsal head cartilage defects in an attempt to reduce pain and improve function.

**Essential Surgical Considerations**

Now let us turn our attention to our treatment plan for hallux limitus, hallux rigidus and first MPJ osteoarthritis. We will provide specific surgical treatment recommendations for stage I, II and III hallux rigidus in the presence of first metatarsocuneiform joint hypermobility. We also provide our approach to arthrodesis of the first MPJ in the presence of stage IV hallux rigidus.

These recommendations are based upon our experience as well as the literature. However, it is important to remember that each case is unique and it is not uncommon for patients’ pathology as well as their desires and expectations to fall outside of the structured environment of a first MPJ classification system. Accordingly, one must identify the etiology as structural or functional/positional with or without concomitant midfoot, rearfoot, ankle or leg pathology. Give equal attention to the patient’s daily activities, specific athletic event, expectations, goals, past medical history, health and physiological age. Establish realistic expectations and goals, and ensure the patient understands the proposed result of surgical intervention.

We believe the etiology of hallux rigidus is usually functional/positional and secondary to pathology at or proximal to the Lisfranc’s joint. Therefore, unless one can accommodate both structural and functional/positional etiologies, surgical intervention is recommended.

We favor addressing the global pathology via surgical intervention specific to the first MPJ as well as correcting associated findings such as a hypermobile first ray, structural first metatarsal elevatus, midfoot fault, rearfoot valgus or equinus. Kilmartin presented “a prospective study of age-matched and condition-matched surgically treated patients.” He reported that “neither phalangeal osteotomies or metatarsal decompression osteotomies could be considered a definitive treatment for hallux rigidus.”

We concur with joint realignment theories proposing that realigned joints, although arthritic, may function free of pain. We associate the majority of hallux rigidus to hypermobility of the first metatarsocuneiform joint, and have spared stage III joints by stabilizing the first ray. Therefore, when we have identified first metatarsocuneiform hypermobility in stage I, II or III hallux rigidus, we will often combine the appropriate first MPJ joint preserving procedure with a sagittal Lapidus procedure in order to stabilize the first metatarsocuneiform joint and translate the first
metatarsal plantarly.

Critics of the Lapidus procedure often cite extended periods of non-weightbearing, malunion and nonunion as reasons to avoid the procedure. The authors recommend this procedure without hesitation.\textsuperscript{45-48} This recommendation is via Drs. Haro and DiDomenico based on their experience as well as the techniques and fixation utilized by the cited authors. Bednarz and Manoli point out that concerns regarding “prolonged convalescence, dorsal drift of the first metatarsal and the significant incidence of nonunion all stem from the initial use of cat gut suture as fixation.”\textsuperscript{49,50} Patel, et. al., obtained a 94.7 percent fusion rate in 215 of 227 modified Lapidus arthrodesis procedures with a minimum of six months’ follow-up.\textsuperscript{51}

We recommend the first MPJ arthrodesis for stage IV hallux rigidus and for post-traumatic structural deformities resulting in severe osteoarthritis. Vanore, et. al., noted “the first MPJ arthrodesis provides stability to the medial column and allows efficient weight transfer through the medial portion of the foot.”\textsuperscript{53}

Resection arthroplasties and hemi- or total joint implants are strongly discouraged in the active athletic population. When it comes to this patient population, various authors have noted that the resection arthroplasty is fraught with complications and destabilizes the first ray.\textsuperscript{52-55} Brodsky, et. al., referred to resection arthroplasty as being less favored and believed it deprived the first ray of its weightbearing function.\textsuperscript{2} Rogers, et. al., noted the procedure “impaired weightbearing function of the hallux with weakening of the foot or toe.”\textsuperscript{53} Baumhauer, et. al., reported post-resection arthroplasty complications that included lateral metatarsalgia in 75 percent of patients, intractable plantar keratosis in 88 percent of patients, cock-up hallux deformity in 94 percent of patients and marked shortening of the proximal phalanx in 25 percent of patients.\textsuperscript{52} Yu, et. al., noted that “complications of resection or implant arthroplasty, such as hallux malleolus, hallux extensus, flail toe, hallux abducto valgus and hallux varus, are unlikely with a successful first MPJ arthrodesis.”\textsuperscript{56}

First MPJ implants are also not recommended in the athletic population as the implants do not provide definitive stabilization of the joint. Bouche, et. al., noted that surgeons should not perform joint implantation in active patients “as it is not predictable and the potential for complications is great.”\textsuperscript{1} Bouche, et. al., also stated that “if a joint implantation is performed, it is better to think in terms of when the implant fails as opposed to if it fails.”\textsuperscript{1}

**Pertinent Treatment Insights For The First MPJ Arthrodesis**

One should place the patient into a supine position and utilize a tourniquet. Evaluate post-anesthesia assessment of the first MPJ range of motion. Manually distract the first MPJ and plantarflex the first metatarsal. Dorsiflex the hallux to determine the obtainable first MPJ range of motion and evaluate for crepitus. If there is first ray hypermobility and no crepitus, one may be able to salvage the first MPJ by translating the first ray plantarly and stabilizing the medial column.

Initially, surgeons should address contributing global pathology. Then proceed to the first ray and make a dorsomedial skin incision spanning the first MPJ. Retract the neurovascular structures. Make a longitudinal incision to bone, spanning the distal one-third of the first metatarsal and proximal one-half of the proximal phalanx.

Evaluate the adjacent cartilage and make a critical decision to preserve or
destroy the joint. It is important to realize that evaluation of cartilage quantity and quality via direct intraoperative visualization weighs heavily upon the final decision to perform a joint preservation or destructive procedure. One should strongly consider joint destructive procedures if greater than 30 percent of the dorsal portion of the first metatarsal head presents as grade III to grade IV chrondromalacia. One must independently evaluate grade III and IV chrondromalacia and osteochondral defects in the remaining 70 percent of the metatarsal head. Small cartilage lesions may yield themselves to debridement, drilling or OATS procedures whereas large cartilage defects will likely result in arthrodesis.

If the joint is salvageable and one identifies first metatarsocuneiform hypermobility, perform a cheilectomy and a subsequent, sagittal Lapidus procedure. If one identifies hypermobility or posttraumatic first metatarsal angular pathology, correct it after completing the first MPJ soft tissue and osteophyte debridement. If one decides to perform arthrodesis on the joint, debride identified osteophytes, loose bodies, synovitis and scar tissue.

Denude the adjacent cartilaginous surfaces to the healthy level of bleeding bone via curettage or via convex distal and concave proximal reamers. Fenestrate the adjacent bone surfaces with a 1.0- or 1.5-mm drill bit. Temporarily fixate the hallux by utilizing two K-wires in the desired position. The position should be approximately 20 to 30 degrees dorsiflexed in relation to the first metatarsal declination; abducted and parallel to the second digit; and with the nail void of frontal plane varus or valgus rotation.

Obtain an AP radiograph to evaluate the bony apposition and alignment of the proposed first MPJ arthrodesis. Also obtain a lateral radiograph with the foot loaded in order to evaluate the hallux and its relationship to the first ray. After obtaining the desired position, utilize two fully threaded (3.5 or 4.0) crossing cortical screws for permanent fixation. Place the first screw from proximal medial to distal lateral and place the second screw from distal medial to proximal lateral across the first MPJ. Ensure the screws do not cross at the level of the joint.

Use a 3.5-mm burr to create a dell in the cortical bone where the head of the screws engage the bone as Manloli and Hansen have described. After obtaining rigid internal fixation across the first MPJ, utilize a shear strain autograft (harvested via a percutaneous calcaneal grafting technique) at the arthrodesis site. Place the autograft in two troughs created by the 3.5-mm burr at the arthrodesis site. Use a bone mallet and tamp to provide a press fit.

Key Postoperative Pearls

Postoperatively, surgeons may allow protected, partial weightbearing in a post-op shoe or removable walking cast for one week. Transition the patients to protected full weightbearing for an additional two or three weeks. At three to four weeks post-op, allow the patient full weightbearing in a walking shoe as tolerated.

Numerous authors support early weightbearing and they report good results in the presence of early weightbearing after a first MPJ arthrodesis. Dayton, et. al., reported 100 percent union of 47 first MPJ arthrodesis procedures in 42 patients (ranging from 36 to 83 years of age), who began ambulating within one week of surgery. Dayton, et. al., also reported the mean time required to return to athletic shoes was 6.23 weeks.
In Summary
First MPJ arthrodesis with surgical correction of associated pathology via a global approach is our procedure of choice for individuals who engage in an active lifestyle. While presenting each adjunctive surgical procedure is beyond the scope of this article, the authors cannot overemphasize the importance of utilizing a global approach when addressing first MPJ pathology in the presence of contributing midfoot, rearfoot, ankle or leg pathology.

Accordingly, when one identifies contributing global pathology, we encourage the use of additional surgical interventions. These include a displacement calcaneal osteotomy, lateral column lengthening calcaneal osteotomy, double calcaneal osteotomy, isolated first ray arthrodesis, medial column arthrodesis, dorsal opening medial cuneiform osteotomy, percutaneous Achilles tendon lengthening, endoscopic gastrocnemius recession and a modified Kidner with or without FDL or FHL tendon augmentation.

The first MPJ arthrodesis is an effective surgical procedure and boasts high fusion rates. A cheilectomy and sagittal Lapidus procedure are recommended for athletes diagnosed with stage I, II and III hallux rigidus in the presence of a hypermobile first metatarsocuneiform joint. Judicious use of specialized arthroscopy, arthrodiastrasia and osteochondral autograft transplantation procedures is recommended for athletes diagnosed with stage I, II and III hallux rigidus without proximal pathology. Arthrodesis is recommended for athletes diagnosed with stage IV hallux rigidus and severe osteoarthritis.

The definitive nature, medial column stabilizing effect, long-term predictability, reliability and durability of the first MPJ arthrodesis are the basis for recommending the procedure for athletic patients and individuals who expect to maintain an active weightbearing lifestyle.

Although the literature specifically related to the first MPJ arthrodesis in athletes is limited, academic circles are actively discussing the topic and this should spur additional research and outcome-based studies.

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