Technical Note

# Great Toe Metatarsophalangeal Joint Arthroscopy: Simple Technique for Painful Nonunion

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**Abstract:** Great toe metatarsophalangeal joint (MTPJ) arthroscopy was first described as a viable technique for a multitude of first MTPJ pathologies in the early 1970s; however, with improving arthroscopic technique and technology, these indications will continue to expand. Arthroscopy of the first MTPJ has increasingly become a new pursuit for foot and ankle specialists. Therefore, we have proposed a simple technique and illustration from our operating room setup to traction and to our procedural technique to make great toe arthroscopy simple and reproducible for arthroscopic foot and ankle surgeons.

Toe arthroscopy has been deemed difficult and limited in the type of pathologies most surgeons can treat owing to limited workspace. Great toe metatarsophalangeal joint (MTPJ) arthroscopy was first described by Watanabe[1] in 1972 in Japan. Since that time, various other authors have described their own techniques when performing arthroscopy on the great toe MTPJ from the early 1990s to today.[2,3] The indications for arthroscopy regarding great toe MTPJ continue to increase, including early osteophytosis, chondromalacia, osteochondral defects, loose bodies, arthrofibrosis, hallux rigidus, gouty arthritis, medial sesamoidectomy, microfracture, and nonreducible plantar plate tears.[4,5]

Arthroscopy of the great toe MTPJ is a new frontier for foot and ankle specialists. Recent technology has made MTPJ arthroscopy easier to perform. Such innovations include 1.9- to 2.7-mm high-definition cameras, the Trimano positioning arm (Arthrex, Naples, FL), and 1.4- to 1.9-mm bipolar radiofrequency ablation devices, all of which allow for an increased workspace in such a small joint.[5] Even with these improved technologies, there are some contraindications to first MTPJ arthroscopy including the presence of a large osteophyte, severe soft-tissue swelling, arterial insufficiency, and infection.[6] Despite these minor contraindications to first MTPJ arthroscopy, the benefits of an arthroscopic procedure are well known, including a reduction in wound complications, a faster rehabilitation, and a shorter hospital stay.[7]

To date, there has been limited literature on arthroscopy-assisted cheilectomy. One report has described patients undergoing minimally invasive cheilectomy of the first MTPJ with a high-torque, low-speed burr with arthroscopic debridement, resulting in high satisfaction with a low complication profile.[8] Our aim is to illustrate a minimally invasive technique to perform nonunion debridement for the great toe MTPJ.

## Surgical Technique

The patient is placed in the supine position on the operating table. In a stepwise fashion, our surgical team performs the following steps for our great toe MTPJ arthroscopy. A small bump is placed under the operative side's hip to allow the ankle to roll into a neutral position, thus aligning the ankle perpendicular to the table. In our facility, we typically create this bump using rolled bedsheets or towels based on the size of the patient. A safety strap is placed around the patient's waist, and a 4-inch strip of silk tape is applied around the contralateral leg to reduce overall movement of the body, as well as to prevent the contralateral leg from

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**Fig 1.** The patient is supine on the operating table; the operative heel is placed slightly off the edge of the operating table. An ipsilateral hip bump is placed to allow the ankle to roll to a neutral position. The Trimano positioning arm is placed on the most distal aspect of the bed and on the side of the operative extremity.

falling off the table during the procedure. Next, the Trimano external positioning arm is used on the ipsilateral surgical side with the mounting bracket for the Trimano at the most distal aspect of the bed rail, which will be important later for joint distraction purposes (Fig 1). The patient is then prepared and draped in typical sterile fashion. Toes 2 through 5 are wrapped together with Ioban (3M, St. Paul, MN). Now, the hallux is wrapped separately with Ioban. Mastisol adhesive (Eloquest Healthcare, Ferndale, MI) is applied to the first layer of Ioban; then, a second layer of Ioban is applied around the hallux, making sure the size is twice as long as the two times the length of the big toe to later be used in the distraction device. This will give the Ioban a long "tail" for future use. Once completed and once the patient is fully draped, the external positioning arm is draped with a disposable clear camera sheath (3M Steridrape, 13 cm and 244 cm), which is standard in most operating rooms. Before we place the great toe in the distraction apparatus, the patient's pertinent structures are marked with a surgical skin marker (Fig 2). First, the extensor hallucis longus (EHL) tendon is marked; then, the MTPJ is marked. Finally, the dorsal medial and dorsal lateral portals are marked approximately 5 mm from the EHL tendon. Typically, an extra-large finger trap is slid over the great toe and attached to the Trimano for joint distraction. In this case, we used a small Kocher clamp, which was placed on the distal tip of the Ioban tail and attached to the external positioning arm. By use of this distraction mechanism, an extra 4 to 6 mm of distraction can be obtained, which allows for increased exposure and workspace within the joint.

**Fig 2.** The patient's left foot is placed supine on the operating table; the operative heel is placed slightly off the edge of the operating table. The Trimano positioning arm is attached to the end of the operating table. Ioban is wrapped around the hallux with an Ioban tail, allowing this tail to be clamped by a Kocher clamp. A distraction force is placed through the Trimano, allowing for ample distraction of the great toe metatarsophalangeal joint.

The arthroscope and arthroscopic tools are then inserted via a standard nick and spread technique. The senior author (KM) uses a Nanoscope (Arthrex), which is a 1.9-mm high-definition flexible camera with a rubber blunt tip, a 2.5-mm shaver, and a 1.9-mm electrocautery device (Fig 3). Once great visualization of the proximal phalanx nonunion site is obtained, it is mobilized with the 2.5-mm shaver (Fig 4). This allows us to free up the fibrous nonunion site. We then proceed with mobilizing the fragment with a small osteotome (Fig 5). Once the fragment is fully mobile, we use an arthroscopic grasper to remove the fragment piecemeal (Fig 6). Moreover, using the 1.9-mm electrocautery device, we obtain hemostasis around the capsule and nonunion site. Finally, by use of the mini C-arm,

**Fig 3.** Proper preparation for great toe metatarsophalangeal joint arthroscopy. The second to fifth toes are wrapped together and out of the way while in the supine position. The extensor hallucis longus tendon is marked to avoid injury to the hallux extensor mechanism. A simple nick and spread technique is performed over the dorsomedial portal, allowing access of the 1.9-mm high-definition flexible camera with a rubber blunt tip into the first metatarsophalangeal joint.

we are able to obtain radiographs illustrating the removal of the nonunion site (Fig 7). The 2 small portal incisions are closed with a simple nylon stitch, and the

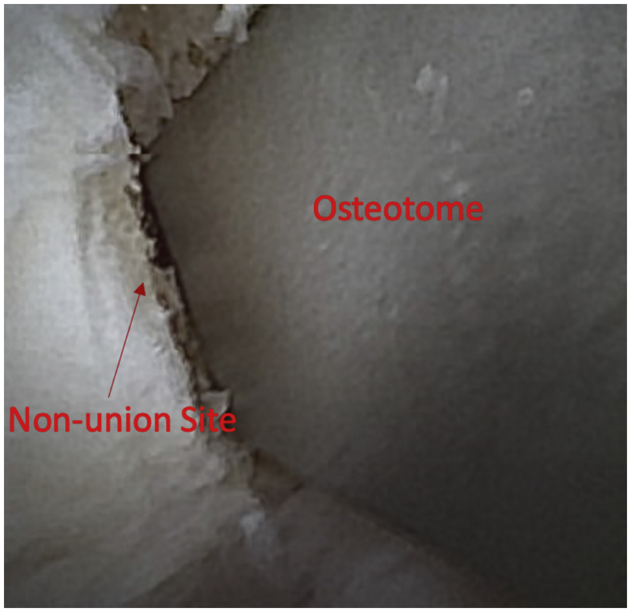


**Fig 5.** A small osteotome is introduced through the dorsomedial portal. The small osteotome has now mobilized the fibrous nonunion and separated the nonunion site from the rest of the articular surface. This nonunion site will later be removed from the joint piecemeal.

foot is placed in a soft dressing postoperatively; the patient is allowed to bear weight as tolerated with no restrictions on hallux range of motion. A complete narration of the described technique can be found in Video 1.

## Discussion

Using the described surgical technique may decrease postoperative pain and stiffness and may decrease postoperative scar tissue formation, allowing for a faster return to work and activity. Our patient was allowed to bear weight as tolerated postoperatively without the need for a hard-soled shoe and with no

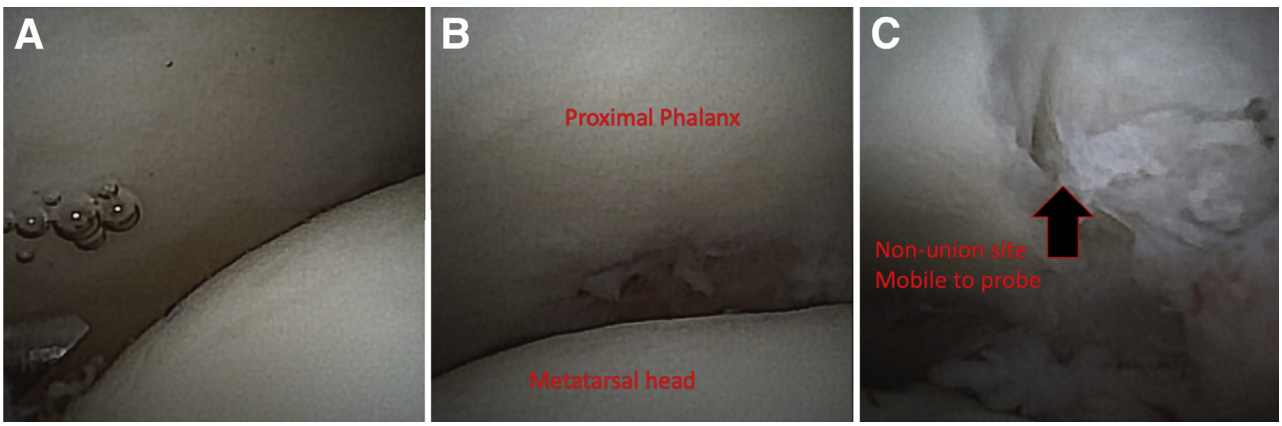


**Fig 4.** First metatarsophalangeal joint while under distraction via Trimano positioning arm. (A) Lateral aspect of first metatarsophalangeal joint during diagnostic arthroscopy. (B) Metatarsal head and proximal phalanx within middle of joint. (C) Medial aspect of articular surface as well as nonunion site. When probed, the nonunion site is found to be freely mobile.

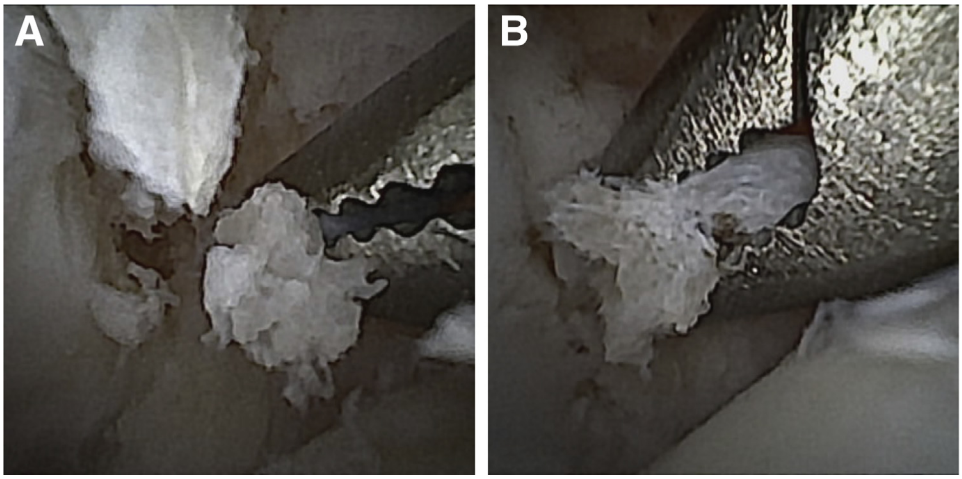


**Fig 6.** Nonunion site after mobilization by small osteotome. (A) We are able to remove the nonunion site with a small arthroscopic grasper. (B) Piecemeal removal of nonunion site. After these steps are performed, a 2.5-mm shaver is used to perform debridement of the nonunion site edges to make a smooth surface for articulation.

limitations on flexion and extension of the great toe MTPJ. By making 2 small poke hole incisions, soft-tissue morbidity is decreased, which is extremely important, especially in patients with diabetic neuropathy.[9] This arthroscopic technique can be used in a whole host of patients; however, it is important to understand some of the technical pitfalls before enacting it in one's practice (Table 1). Unlike previously described minimally invasive techniques that require a high-speed burr and the use of a mini C-arm to completely achieve cheilectomy,[9] this method allows the surgeon to directly visualize the dorsal osteophyte—or, in this case, the nonunion site—allowing for limited fluoroscopic exposure. Finally, this method decreases the risk of EHL rupture or dysfunction owing to a completely intracapsular approach with arthroscopy instead of a high-speed burr technique.

When this technique is compared with the open technique, which was first described and subsequently popularized in 1959 by Duvries, the complication profile is minimal.[10] Through an open approach, there is an increased risk of postoperative swelling, pain, and scar formation.[7] However, with our arthroscopic technique, this risk decreases, thus decreasing the amount of narcotic pain medication required to control a patient's pain postoperatively. This has become increasingly more important in the United States because of the opioid epidemic, given that 32% of opioid overdoses and deaths involved prescription opioids.[11] Finally, the use of a flexible 1.9-mm arthroscope has a major advantage in increasing the visual field (Table 2). Reports have illustrated that the use of a flexible arthroscope can increase the range of visualization in major joints such as the hip, knee, and ankle. One article illustrated that the flexible arthroscope increases visualization by 82% in hips, 77% in knees, and 62% in ankles.[12]

Given how small the first MTPJ is, we believe the joint distraction to be paramount. When we compare our technique for joint distraction, it decreases the need for a K-wire through the proximal phalanx.[13] By taking advantage of indirect traction versus direct traction, we minimize soft-tissue disruption, which is a major


**Fig 7.** (A) Preoperative anteroposterior radiograph of patient's left foot with nonunion site marked on radiograph. (B) Intraoperative arthroscopic picture of nonunion site after debridement and resection. (C) Final radiograph of patient's left foot after successful arthroscopic debridement and resection of nonunion site. (S/P, status post.)

**Table 1.** Technical Pearls and Pitfalls

| Technical Pearls | Technical Pitfalls |
| --- | --- |
| The bed should be configured to allow the surgeon to stand at the side of the bed, on the operative side, facing the foot of the bed. | This configuration will require the arthroscopist to move the monitor from the normal head-of-the-bed position. |
| The external positioning arm should be placed on the nonoperative-side bed rail near the foot of the bed, allowing distraction but not preventing surgeon movement. | Standard finger traps often slip even if adhesive is used; we recommend Ioban circumferentially wrapped around the toe. |
| A small 1.9-mm arthroscope and similar sized equipment should be used to prevent iatrogenic injury. | Equipment > 2.5 mm in diameter should not be used. |
| One should ensure that standard equipment is available if arthroscopy cannot address the pathology identified. | Regarding portal placement, the congruent shape of the joint makes visualization difficult if the portals are placed too proximal or distal. |
| Low-flow pump pressure is used to prevent further soft-tissue disruption. | Mini-fluoroscopy should be available to ensure that adequate debridement has been achieved; the small joint and limited landmarks make estimations difficult. |
| Accessory portals can be established based on specific indications. | |

advantage of first MTPJ arthroscopy, in addition to decreasing the risk of another site of a possible wound complication and fracture. To our knowledge, there has been no study to identify what the amount of improvement in the range of visualization would be with a flexible arthroscope in the great toe MTPJ; however, we believe that the range of visualization is significantly increased.

**Table 2.** Advantages and Disadvantages

| | |
| --- | --- |
| Advantages | |
| | Minimal soft-tissue disruption occurs. |
| | No collateral ligament disruption occurs. |
| | There is minimal risk to the collateral vascular supply. |
| | An early and aggressive range-of-motion protocol is allowed postoperatively. |
| Disadvantages | |
| | The great toe MTPJ is one of the smallest joints in which to perform arthroscopy. |
| | The MTPJ is a highly congruent joint, minimizing the ability to "drive through" the joint. |
| | Meticulous micromotion is needed to prevent arthroscopic pistoning and iatrogenic injury. |

MTPJ, metatarsophalangeal joint.

The potentially decreased risk profile, faster patient recovery, and decreased fluoroscopy time are all benefits of the described technique. In conclusion, using improved arthroscopic techniques can allow arthroscopic foot and ankle surgeons to perform a multitude of surgical procedures arthroscopically within a joint as tiny as the great toe MTPJ with great success.

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