Simplified Setup to Achieve Distraction for Toe Arthroscopy

Cody R. Englert, M.S. III, Alicia M. Unangst, M.S. IV, M.C., and Kevin D. Martin, D.O., M.C.

Abstract: Toe arthroscopy has historically had limited applications but is beginning to emerge as a viable treatment option for select toe pathologies, and continues to have expanding indications as technology and techniques improve. Toe arthroscopy has used a multitude of distraction techniques to perform the procedures but all have had limited success. Thus, we propose a simple toe arthroscopy distraction technique that uses an external positioning arm to allow the surgeon to apply manual traction in multiple positions without the use of an assistant, external weights, or any reprocessed sterile equipment.

Toe arthroscopy and arthroscopic interventions within the metatarsophalangeal joint (MTPJ) have been very limited and out of reach for most surgeons. The difficulty has centered on procedural space within the joint and the ability to keep the joint distracted while having working tools in the joint space. The lack of uniformity and consistency in distraction techniques has led to surgeon frustration and abandonment of the procedure. With the development of high definition small joint arthroscopes and small joint instruments, the spectrum of surgical indications has expanded. Current indications include hallux rigidus, synovitis, loose bodies, arthrofibrosis, gouty arthritis, osteochondral lesion chondroplasty, microfracture, and nonreducible plantar plate tears.[1] Because of the increasing number of toe arthroscopy indications, the number of cases is continuing to grow and there is a new need for re-evaluation of equipment setup and surgical techniques (Table 1).

From the Rocky Vista University College of Osteopathic Medicine (C.R.E.), Pueblo; Rocky Vista University College of Osteopathic Medicine (A.M.U.), Colorado Springs; and Department of Orthopaedic Surgery and Rehabilitation, Evans Army Community Hospital (K.D.M.), Fort Carson, Colorado, U.S.A.

The authors report that they have no conflicts of interest in the authorship and publication of this article.

Received December 24, 2015; accepted March 30, 2016.

Address correspondence to Cody R. Englert, M.S. III, Rocky Vista University College of Osteopathic Medicine, Pueblo, CO 81004, U.S.A. E-mail: Cody.Englert@rvu.edu

2212-6287/151221/$36.00

http://dx.doi.org/10.1016/j.eats.2016.03.010

Arthroscopy of the first MTPJ is an area of interest that is continuing to grow amongst "foot and ankle specialists." Currently, several things must be considered for a successful surgical outcome of the first MTPJ. Because of the size of this joint, appropriate equipment is mandatory for both visualization and treatment of the joint arthroscopy. Typically, either a 1.9-mm or a 2.7-mm 30° high definition arthroscope is needed to provide adequate visualization while mitigating iatrogenic injury. A 2.9-mm shaver or 3-mm burr is adequate for most procedures, and a 1.4-mm electric cautery is also useful at times if used cautiously in safe anatomic regions.

To assist in visualization and to decrease iatrogenic complications, adequate distraction is paramount. Early arthroscopists used several different skeletal and soft tissue traction techniques. Some of the techniques used include a mini external fixator[2] and a large Chinese finger trap attached to the hallux with ropes and pulleys strung off the end of the bed or over a rail with free weights (2.7 kg) attached.[3] There has also been the use of manual distraction of the joint by an assistant when necessary throughout the surgery.[4] This can be dangerous and increase iatrogenic damage because of the inherent inability to maintain constant joint distraction. Newer techniques have also been documented that have the hallux suspended using a Kirschner wire[5] or a 4 × 8 gauze used in a finger trap fashion around the distal phalanx.[6] Although effective, we feel that these distraction techniques have deficiencies that can be eliminated and simplified saving time and money. Thus, we propose a simple toe arthroscopy distraction technique that uses an external positioning arm and finger trap to allow the surgeon to

Table 1. Indications and Contraindications

Indications	Contraindications
First metatarsophalangeal joint arthroscopy	Presence of large osteophytes that prevent adequate visualization of the anatomy
Hallux rigidus	Severe swelling
Hallux valgus	Arterial insufficiency
Gouty arthritis	Soft-tissue infection/compromise
Osteochondral lesion chondroplasty	
Microfracture	
Nonreduceable plantar plate tear	
Synovitis	
Loose bodies; arthrofibrosis	

apply constant manual traction in multiple positions without the use of any rope/pulleys/weights, reprocessed sterile equipment, or the reliance on an assistant in the operating room, which further decreases cost and increases operating room efficiency.

Surgical Technique

The patient is positioned supine. The following ordered steps are then conducted. (1) A small bump is placed under the patient's ipsilateral hip to align the ankle perpendicular to the table. We use a bump consisting of folded bed sheets or towels. (2) A standard safety strap is applied around the waist, and an additional 4-inch strip of tape is applied around the contralateral padded ankle and bed to decrease movement of the body and contralateral leg during the procedure. The tape is placed over the padding to ensure patient safety and comfort. (3) An external positioning arm Trimano (Arthrex, Naples, FL) is attached to the ipsilateral surgical side of the bed (Fig 1). The mounting bracket of the external positioning arm is placed at the most distal point of the main bedrail. (4) The patient undergoes sterile preparation and draping in the standard fashion. (5) Toes 2 to 5 are wrapped in Ioban together. (6) The hallux is separately wrapped ensuring that the Ioban is approximately twice as long as the toe for incorporation into the distraction apparatus (Fig 2). Mastisol adhesive is

Fig 1. The image showing our patient's left foot in the supine position with a small soft bump under the left hip. The operative heel is placed within one hand breath of the end of the table. Next, the Arthrex Trimano positioning arm is attached to the end of the operative table at approximately the same level as the operative heel; this position allows for ample distraction with gravity or manual traction. This position is adequate for most finger trap attachments while providing unimpeded access for a c-arm fluoroscopy.

Fig 2. The image showing proper preparation of the toes for great toe metatarsalphalangeal joint arthroscopy. Toes 2 to 5 are wrapped together in a single Ioban wrap. The great toe is then separately wrapped after the surgical prep has completely dried; the Ioban should be nearly twice as long as the toe due to the fact that it will be incorporated in the distraction. Mastisol adhesive is then applied to the Ioban on the great toe followed by immediate application of an extra-large finger trap. The toe is marked to indicate the correct portal placement approximately 5 mm on either side of the extensor hallucis longus tendon.

Fig 3. The image showing a patient in the supine position properly prepped and draped in a sterile fashion. The great toe metatarsalphalangeal joint dorsal lateral and dorsal medial portals along with the extensor hallucis longus are palpated and draw out. The external positioning arm is sterilely prepped with a specific Arthrex Trimano sheath and the great toe is prepped with Ioban followed by a large Chinese finger trap. The distal loop of the finger trap is then simply looped around the central post of the positioning arm eliminating rope/pulleys and external weights. The toe is now ready to be placed in the correct position with simple gravity or traction applied as needed.

then applied to the Ioban on the great toe. (7) Once the patient and table are fully draped, the external positioning arm is prepared with a disposable clear camera sheath (3M Steri-Drape, 13 cm and 244 cm; 3M, St. Paul, MN) standard to most operating room supplies. The external fixation device is now ready to be positioned properly relative to physician preference for the procedure being performed. (8) The patient's critical landmarks are marked and identified; we start with identifying the great toe MTPJ and the extensor hallucis longus tendon. We then mark the dorsal medial and dorsal lateral portals sites both approximately 5 mm from the extensor hallucis longus directly over the MTPJ. (9) The extra-large finger trap is slid over the great toe just proximal to the interphalangeal joint ensuring that the extra Ioban goes deep inside the finger trap (Fig 2). (10) The finger trap is simply squeezed to help the adhesive adhere the Ioban, and then a small kocher clamp is placed just distal to the tip of the toe squeezing the extra Ioban in the finger trap. The finger trap is attached to the external positioning arm (Fig 3) directly; no ropes or pulleys are used. In most cases, simple gravity of the lower extremity provides 4 to 6 mm of distraction, which provides enough

Fig 4. The images showing great toe metatarsalphalangeal joint arthroscopy with the patient in the supine position with soft tissue distraction to gravity. A 2.7-mm arthroscope in the dorsal medial portal looking lateral, an osteochondral lesion can be identified on the infralateral aspect of the proximal phalanx. The second image shows the microfracture of the lesion using a standard Smith and Nephew small joint 45° angle microfracture awl.

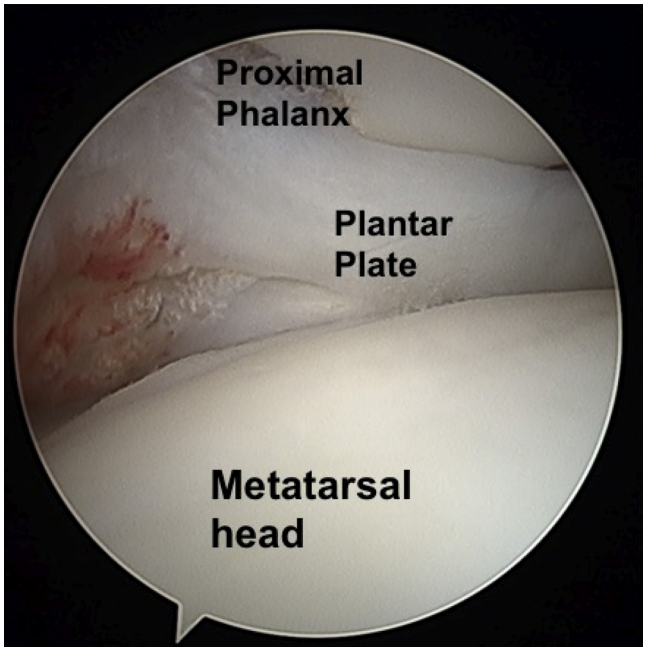

Fig 5. The image showing a patient in the supine position with the left great toe in soft tissue distraction to gravity. A 30° 2.7-mm arthroscope is in the metatarsalphalangeal joint dorsal lateral portal looking lateral and proximal. The soft tissue band seen is the plantar plate, which has partially ruptured and flipped into the joint.

room for complete joint exposure (Fig 4). The arthroscope and arthroscopic tools are then inserted in the standard nick-and-spread technique. The senior author (K.D.M.) prefers to use a short 30° 2.7-mm high definition camera, a 2.9-mm shaver, and a 1.4-mm cautery. Initially, a dorsal synovectomy is performed to create visualization; next a complete articular examination is completed (Fig 5). The working and viewing portals are exchanged as needed for adequate visualization and instrumentation. Small to moderate dorsal cheilectomys (Fig 6) can be performed as well as debridement and microfracture of osteochondral defects (Fig 4) using standard small joint instruments. If, during the procedure, visualization is not adequate because of tight spacing, the external positioning arm is gently pulled in line with the lower extremity for additional distraction. This can provide a larger space for placement of the arthroscope and tools. If an angle needs to be obtained for visualization, the external positioning arm allows for varus or valgus stress to be applied or flexion/extension depending on the angle needed. The trimano external positioning arm is a single cylinder that allows for easy access to all quadrants of the MTPJ; it also makes incorporation of fluoroscopy positioning much easier, thus limiting radiation exposure to not only the patient but also the medical personnel in the operating room. (Video 1 details our technique.)

Discussion

Using our simple toe distraction setup may decrease surgical setup times, reduce overall costs, and minimize the burden on central sterilization and operative equipment as well as decreasing essential personnel. The surgical setup time is decreased when the ancillary

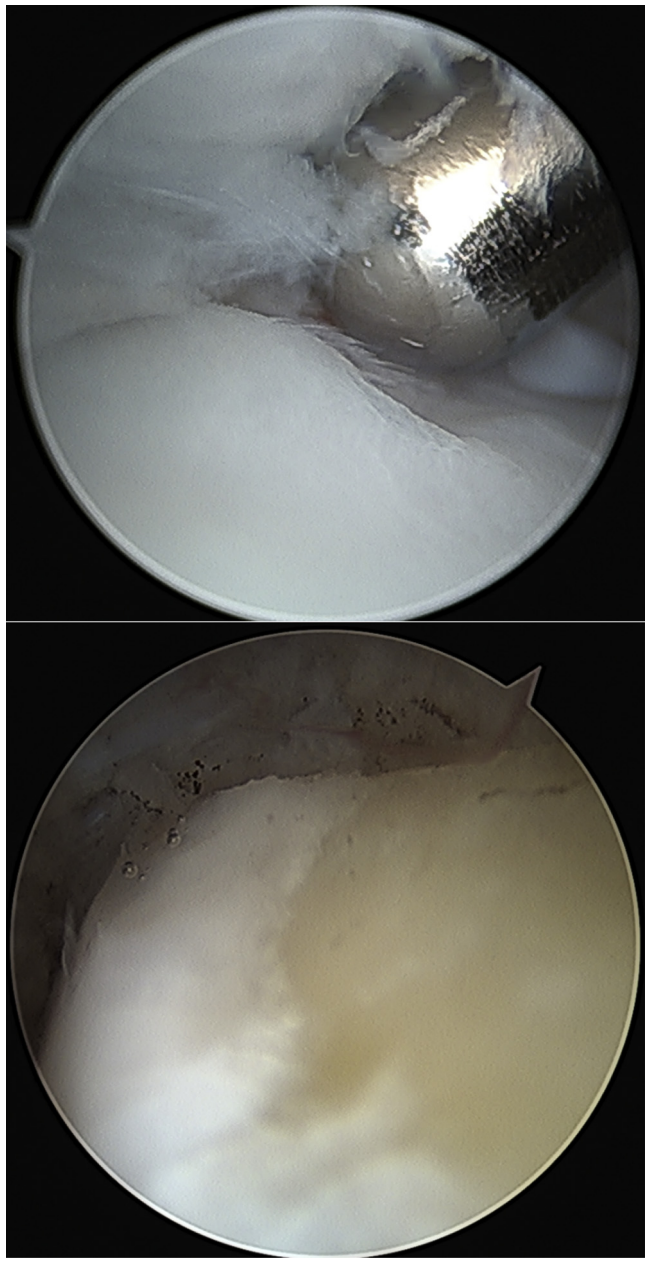

Fig 6. The images showing a dorsal cheilectomy of the great toe metatarsalphalangeal joint. After completion of the diagnostic examination traction is released to allow dorsal capsular expansion. A 2.7-mm arthroscope is in the dorsal lateral portal and the shaver is working through the dorsal medial portal. The ridge seen at the tip of the shaver is the metatarsal dorsal osteophyte typically described with hallux rigidus. The second image shows postsynovectomy and dorsal osteophyte resection, while preserving the articular cartilage.

Table 2. Pitfalls and Risks

Pitfalls	Risks
Purchasing enough external fixation arms for both shoulder and ankle procedures	Too much traction placed by the surgeon can lead to neurovascular damage (very uncommon) Slippage due to traction during the procedure can lead to iatrogenic damage

staff prepositions the external positioning arm on the operative bedrail as described earlier. This method removes all reprocessed sterile equipment, ropes/pulleys/external weights, and additional operative assistants, thus, cutting costs and the burden regarding the sterilization process and operating room staff. The external positioning arm is a common piece of equipment in operating rooms in which shoulder arthroscopy is performed; in most cases, the burden of the upfront equipment purchase has already been accounted.

We acknowledge that there are some limitations. Two of our main concerns are: (1) slippage secondary to water saturation of the Ioban, and (2) the finger traps may cause the toe to slip out secondarily to the circumference of the hallux, which may exceed that of the extra-large finger trap thus prohibiting its use.[7] We have addressed the first problem with the use of an Ioban being placed on a dry prepped toe. Mastisol is applied over the Ioban and allowed to become tacky, and then the extra-large finger trap is applied. If slippage remains problematic, a 2-0 nylon suture can be used through the skin and finger trap keeping in mind the location of the neurovascular structures. A third option, which is our current preferred method, is a pointed reduction clamp through the finger trap into the proximal phalanx that tightens the trap and decreases slippage. A combination of all the above may also be used to decrease known limitations/complications (Table 2).

Potential safety improvements associated with our technique include elimination of ropes/pulleys/external weights and inconsistent distraction provided by a fatigued assistant. Our technique may also help prevent traction injuries because the surgeon can easily gauge tension applied to the toe. In addition, the ease of positioning may potentially decrease the amount of fluoroscopy time and radiation exposure to the patient and the surgical team if indicated. In conclusion, using an external positioning arm to provide toe distraction can be completed in simple setup while reducing operative costs and improving patient positioning and surgeon comfort (Table 3).

Table 3. Tips and Pearls

Tips	Pearls
The external positioning arm should be applied before sterile draping on the ipsilateral side of the patient	The need for reprocessing equipment is eliminated. The use of a single sterile dressing that is discarded after the procedure is all that is required
The foot pedal for the arm should be positioned before draping	The setup time and amount of equipment for toe arthroscopy are reduced
The external positioning arm should be removed from under the sterile drapes; then, its sterile dressing should be placed just before the procedure	The technique allows for easy maneuverability of the leg or joint of interest at any time during the procedure. It enables easy removal of the Chinese finger trap and external positioning arm for films to be taken without interfering with the picture
	The need for a Kirschner wire through the distal phalanx is eliminated

References

1. Ishikawa S. Arthroscopy of the foot and ankle. Chapter 50. In: Canale ST, Beaty JH, eds. *Campbell's operative orthopaedics*. Ed 12. Philadelphia: Mosby, 2013.
2. Derner R, Naldo J. Small joint arthroscopy of the foot. *Clin Podiatr Med Surg* 2011;28:551-560.
3. Ferkel R, Dierckman B, Phisitkul P. Arthroscopy of the foot and ankle. In: *Mann's surgery of the foot and ankle*. Ed 9. Philadelphia: Saunders, 2014.
4. Davies M, Saxby T. Arthroscopy of the first metatarsophalangeal joint. *J Bone Joint Surg* 1999;81:203-206.
5. Siclari A, Decantis V. Arthroscopic lateral release and percutaneous distal osteotomy for hallux valgus: A preliminary report. *Foot Ankle Int* 2009;30:675-679.
6. Hunt KJ. Hallux metatarsophalangeal (MTP) joint arthroscopy for hallux rigidus. *Foot Ankle Int* 2015;36:113-119.
7. Siclari A, Piras M. Hallux metatarsophalangeal arthroscopy. *Foot Ankle Clin* 2015;20:109-122.