Technical Note

Dorsal Cheilectomy Using Great Toe Metatarsophalangeal Joint Arthroscopy for the Treatment of Hallux Rigidus

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Abstract: Great toe metatarsophalangeal joint (MTPJ) arthroscopy has been described in the literature for more than 50 years for treatment of a multitude of first MTPJ pathologies, including hallux rigidus, hallux valgus, and osteochondritis dissecans, among others. Despite this, the use of great toe MTPJ arthroscopy has not become widely used for treatment of these conditions as the result of reported difficulties with adequate visualization of the joint surface and manipulation of surrounding soft-tissue structures with the instruments available. We propose a simple technique with illustrations of the operating room setup and procedural steps to perform a dorsal cheilectomy in those with early-stage hallux rigidus using great toe MTPJ arthroscopy and a minimally invasive surgical burr in a way that is reproducible by foot and ankle surgeons.

Hallux rigidus is a condition that causes pain and restricted range of motion of the great toe metatarsophalangeal joint (MTPJ) secondary to degenerative joint disease. Although the primary etiology of this condition is unknown, the pathologic process typically includes osteophyte formation and degeneration of cartilage dorsally in the early stages followed by involvement of the entire great toe MTPJ during its later stages.[1] For patients with early-stage disease, noted by pain at the extremes of range of motion and the presence of a dorsal osteophyte, dorsal cheilectomy has been shown to be a satisfactory treatment option. Completion of a dorsal cheilectomy using an open technique is reported to provide greater than 90% patient satisfaction rates after completion of the procedure.[2,3] Unfortunately, despite their initial improvement with open dorsal cheilectomy, approximately 10% of patients requiring a further surgical procedure resulting from progression of disease at 2 years from their index procedure.[4]

A minimally invasive technique including the use of great toe MTPJ arthroscopy with high-torque, low-speed burrs has been described with the potential for quicker recovery, faster rehabilitation, and decreased length of hospital stay in the early postoperative period, with low rates of complications at intermediate follow-up.[5,6] Recent technological advances have made the great toe MTPJ more accessible using arthroscopic techniques, including the creation of 1.9-mm high-definition cameras and 1.4-mm bipolar radiofrequency ablation devices.[7] Even with the aforementioned technological advances in performing great toe MTPJ arthroscopy, contraindications still exist, including severe soft-tissue swelling, arterial insufficiency, infection, and presence of a large osteophyte.[8]

Minimal literature is available on the use of great toe MTPJ arthroscopy for the treatment of hallux rigidus,

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with 1 previous study noting high patient satisfaction with minimal complications postoperatively.[6] Our aim is to illustrate a simple technique to perform an arthroscopic dorsal cheilectomy for treatment of hallux rigidus in a way that is reproducible by arthroscopically trained foot and ankle surgeons.

Surgical Technique (With Video Illustration)

The patient is positioned supine on the operating table under general anesthesia. The patient is positioned so that the operative lower extremity has the ankle hanging off the end of the bed. A small bump is made using rolled bedsheets or towels under the operative hip to allow the ankle to lay in a neutral position. 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 during the procedure, as well as to prevent the contralateral leg from falling off the operative table. The patient is then prepped and draped in typical sterile fashion. Toes 2 through 5 are wrapped together with a strip of Ioban (3M, St. Paul, MN). The hallux is left uncovered and the procedure is performed without distraction to allow for manipulation of the first MTPJ when required. Pertinent anatomic structures are marked with a surgical skin marker, including the extensor hallucis longus (EHL) tendon and the MTPJ, and the dorsal medial and dorsal lateral portals are marked approximately 5 mm from the EHL tendon (Fig 1).

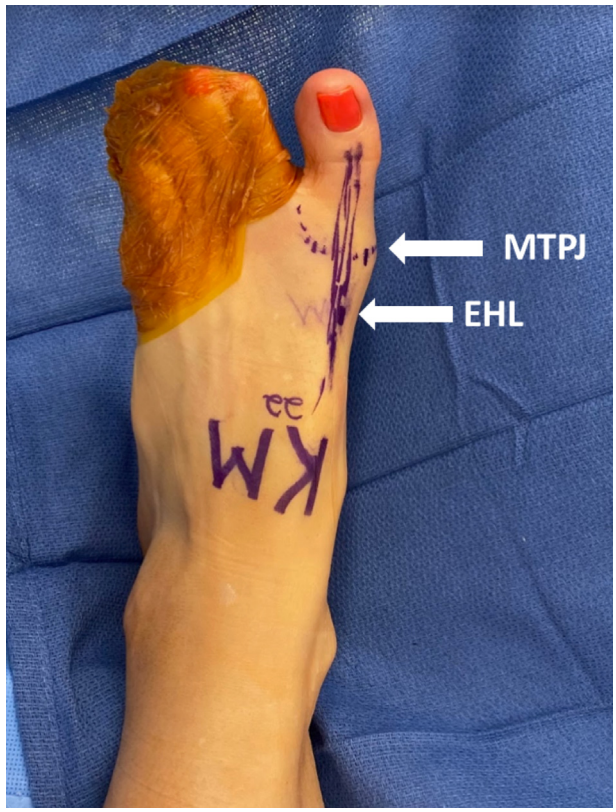

Fig 1. Before the completion of a dorsal cheilectomy using an arthroscopic approach, pertinent anatomical structures are marked, including the extensor hallucis longus (EHL) tendon and great toe metatarsophalangeal joint (MTPJ). The dorsal medial and dorsal lateral portals are marked approximately 5 mm from the EHL tendon after the patient is prepped and draped in the supine position.

The arthroscope and arthroscopic tools are then inserted via a standard nick-and-spread technique. The senior author (K.M.) uses a NanoScope (Arthrex, Naples, FL), which is a 1.9-mm high-definition flexible camera with a rubber blunt tip and a 2.5-mm shaver for initial debridement of the great toe MTPJ. Thickened synovium and hemorrhagic soft tissue should be debrided with use of the 2.5-mm shaver (Fig 2). The great toe MTPJ is evaluated to assess the amount of remaining cartilage, amount of exposed subchondral bone, and size of the dorsal osteophyte. The loose chondral flaps on both the surface of the metatarsal head and proximal phalanx are debrided with the shaver and all bone debris are removed from the joint (Fig 3). When the thickened synovium, bone debris and loose chondral tissue are adequately debrided and removed, and a 3- to 4-mm accessory portal is made approximately 2 cm proximal and slightly medial to the MTPJ. This portal is made parallel with the dorsal cortex of the first metatarsal and proximal to allow for the burr to be inserted within the soft tissues when removing the dorsal osteophyte. A periosteal elevator is inserted through the accessory portal and visualized within the joint inferior to the EHL tendon. The 4.3-mm × 13-mm conical wedge minimally invasive surgical (MIS) low-speed, high-torque burr (Arthrex) is then inserted within the path created by the periosteal elevator underneath the EHL tendon and into the great toe MTPJ (Fig 4).

Intraoperative fluoroscopy in combination with arthroscopic visualization is then used to determine how much of the dorsal osteophyte of the first metatarsal should be removed (Fig 5). The dorsal osteophyte is excised under direct visualization using the MIS low-speed, high-torque burr by slowly manipulating the burr with medial-to-lateral sweeps. Successful removal of the osteophyte (up to 30% of the metatarsal head) is then confirmed using intraoperative fluoroscopy (Fig 6). The joint is taken through complete range of motion under direct

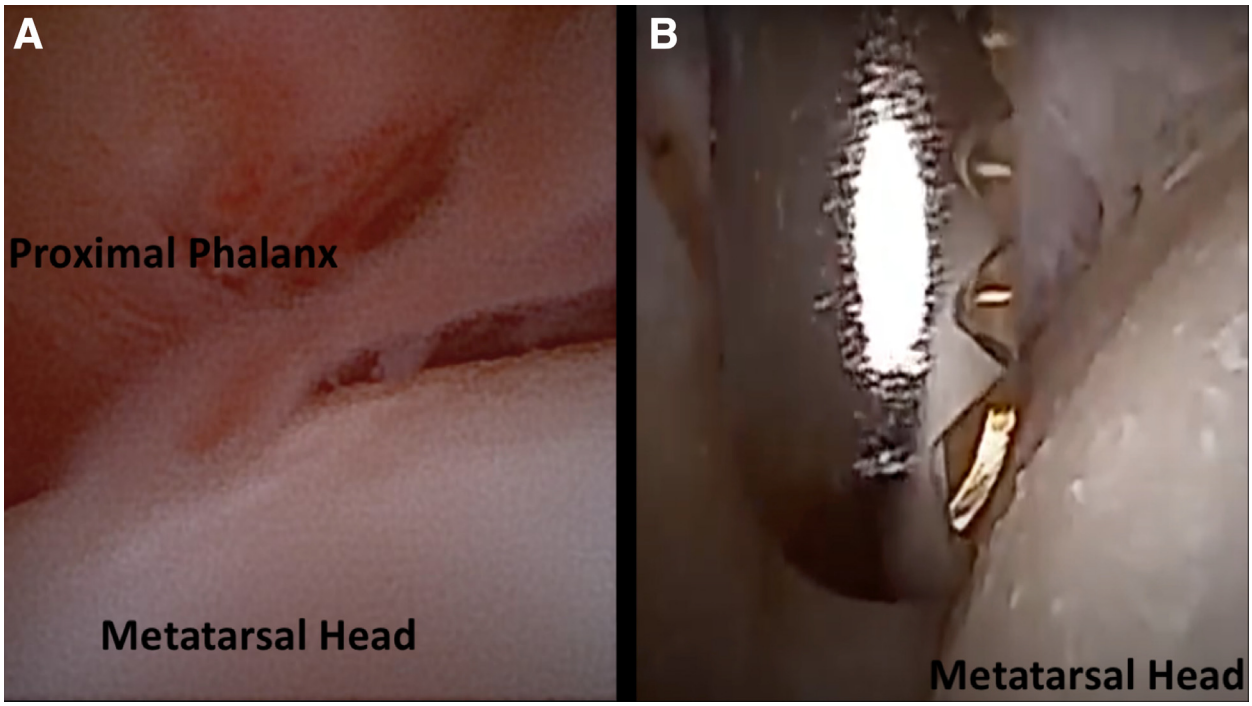

Fig 2. (A) Demonstrates an arthroscopic view of the great toe metatarsophalangeal joint when visualized from the dorsal medial portal, demonstrating evidence of thickened hemorrhagic synovium adjacent to the great toe metatarsal head. (B) Demonstration of thickened synovium and bone debris being removed from the great toe metatarsophalangeal joint with a 2.5-mm arthroscopic shaver that is inserted through the dorsal lateral portal.

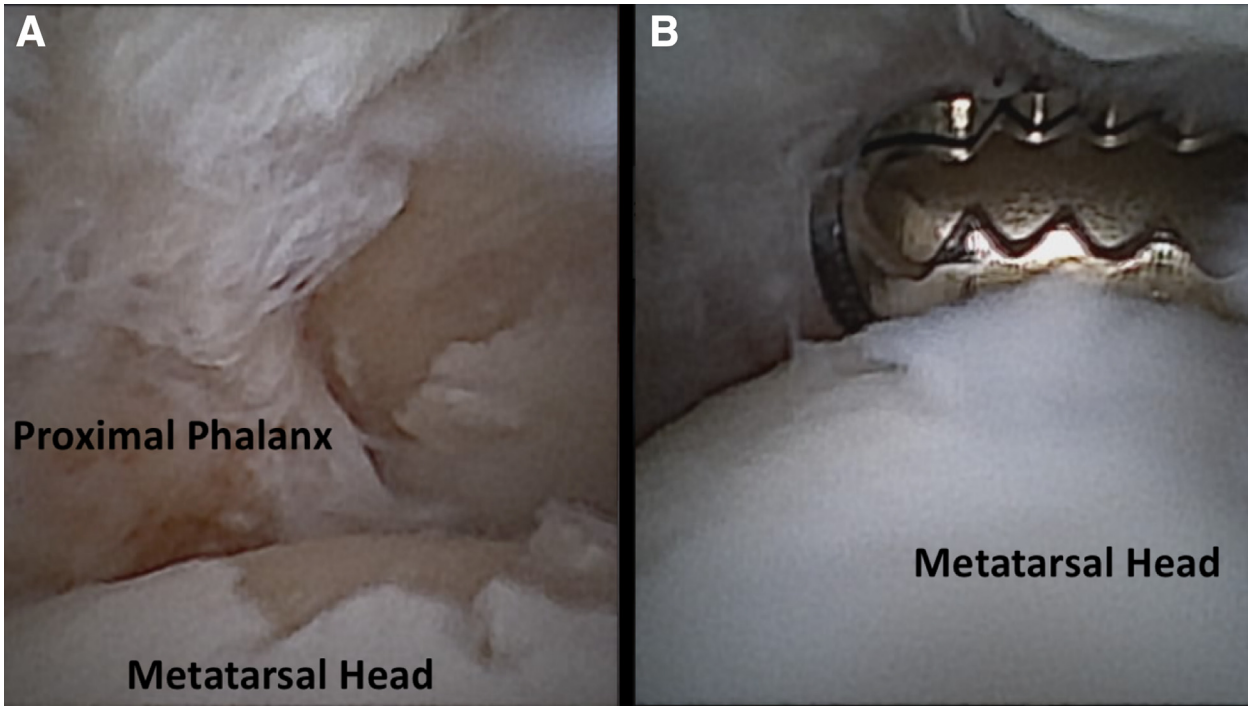

Fig 3. (A) The articular surface of the great toe metatarsophalangeal joint is evaluated using the NanoScope (Arthrex) from the dorsal medial portal demonstrating evidence of cartilage loss and debris within the great toe metatarsophalangeal joint. (B) Demonstration of all loose chondral flaps and bone debris being removed from the great toe metatarsophalangeal joint using a 2.5-mm shaver inserted through the dorsal lateral portal.

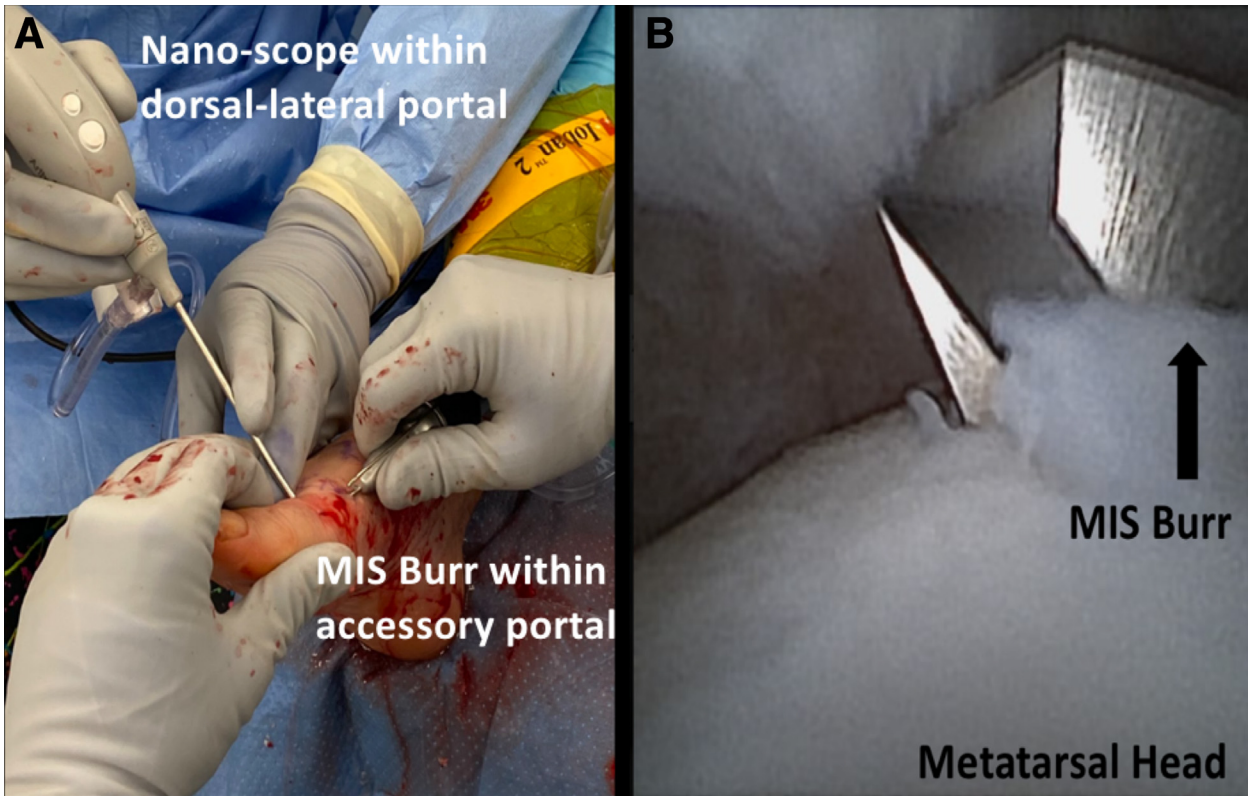

Fig 4. (A) Clinical photo demonstrating the NanoScope (Arthrex) within the dorsal lateral portal and the MIS burr placed within accessory portal into the great toe metatarsophalangeal joint. An assistant is performing gentle traction with flexion and extension of the great toe metatarsophalangeal joint as needed to allow for completion of the procedure. (B) Arthroscopic view of the MIS burr being used to excise the dorsal osteophyte of the great toe metatarsal head under direct visualization. (MIS, minimally invasive surgical.)

visualization to ensure no mechanical impingement remains. Before removing the arthroscope, we ensure all bone debris is removed with the shaver. The 3 small portal incisions are closed with simple nylon stitches, and the foot is placed in a soft postoperative dressing. The patient is allowed to bear weight as tolerated within a hard-soled shoe. A demonstration of using great toe metatarsal phalangeal joint arthroscopy for completion of dorsal cheilectomy for treatment of hallux rigidus can be found in Video 1.

Discussion

Our described surgical technique for treatment of early-stage (1, 2, and select grade 3) hallux rigidus with great toe MTPJ arthroscopy and completion of a dorsal cheilectomy using a low-speed, high-torque MIS burr may decrease postoperative pain, stiffness, and scar formation. Similar to open techniques, the use of the 1.9-mm NanoScope (Arthrex) allows for the procedure to be completed under direct visualization to ensure adequate resection of the dorsal osteophyte. There are many advantages of an arthroscopic approach when completing a dorsal cheilectomy compared to open techniques (Table 1). A large benefit of the arthroscopic technique when compared with open techniques is that it allows for more targeted debridement of the chondral surfaces, removal of loose bone debris, and thickened synovium, which may play a role as pain generators in the postoperative period.[5] Patients who undergo dorsal cheilectomy using our arthroscopic technique are allowed to weight-bear as tolerated in a hard-soled shoe and with no limitations on flexion and extension of the great toe MTPJ.

One previous study has demonstrated that completion of a dorsal cheilectomy can be performed using an arthroscopic technique with high patient satisfaction and minimal complications at an average follow-up of more than 4 years.[6] Using only 3 small incisions, therefore decreasing soft-tissue morbidity, can decrease the risk of wound complications in those

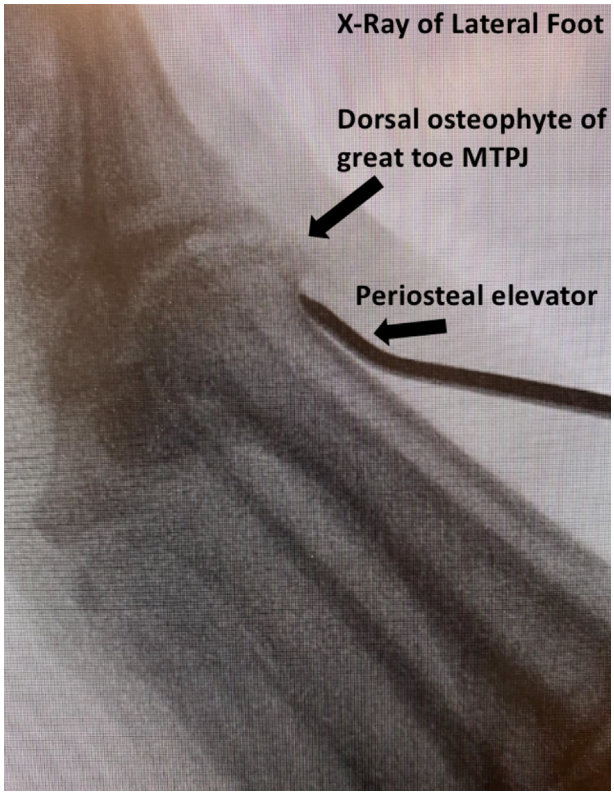

Fig 5. Mini C-arm image of the lateral foot demonstrating the presence of a dorsal osteophyte on the great toe metatarsal head being measured using a periosteal elevator within the proximal accessory portal. This is completed before placement of the minimally invasive surgical burr and debridement of the osteophyte in an effort to perform a more precise excision. (MTPJ, metatarsophalangeal joint.)

Fig 6. Final mini C-arm image of the lateral foot demonstrating adequate excision of the dorsal osteophyte from the great toe metatarsal head. The great toe metatarsophalangeal joint is then taken through gentle flexion and extension to ensure adequate osteophyte excision has taken place.

patients with diabetic neuropathy or vascular insufficiency.[9] Our technique also allows for direct visualization of the articular surface before and after removal of the dorsal osteophyte, which allows for more limited fluoroscopic exposure when compared with more traditional techniques. In addition, this method decreases the risk of EHL rupture during the operative procedure by allowing for the creation of the accessory portal and insertion of the MIS burr under direct visualization.

While management of early-stage (1, 2, and select grade 3) hallux rigidus is attempted to first be treated using great toe metatarsal phalangeal joint arthroscopy within our practice, the surgeon has the opportunity to convert the case to an open procedure if needed based on their intraoperative findings. In particular, if inadequate visualization is obtained using the arthroscope, conversion to an open procedure may be necessary. Before implementation of an arthroscopic technique for the treatment of hallux rigidus within one's practice, it is important to understand some of the technical pitfalls, which include use of appropriate arthroscopic technique, portal placement, and instrumentation (Table 2).

The decreased risk profile, described high patient satisfaction at intermediate follow-up, faster patient recovery, and decreased use of intraoperative fluoroscopy are all benefits of our described technique. In conclusion, improved arthroscopic techniques can allow arthroscopically trained orthopaedic foot and ankle surgeons to perform a dorsal cheilectomy in those with early-stage hallux rigidus in a reproducible way.

Table 1. Advantages and Disadvantages of an Arthroscopic Approach for Completion of Dorsal Cheilectomy of the Great Toe MTPJ for Treatment of Hallux Rigidus When Compared With a Traditional Open Approach

Advantages	Disadvantages
Minimal soft-tissue disruption, allowing early accelerated rehabilitation	Operating room set up, requiring appropriate arthroscopic equipment
No violation of the metatarsal head blood supply	Residual bone slurry from use of the MIS burr must be evacuated fully
Allows tapered resection of the metatarsal head under direct visualization	Need for surgeon familiarity with arthroscopy
Allows dynamic joint examination under direct visualization	

MTPJ, metatarsophalangeal joint.

Table 2. Technical Pearls and Pitfalls of an Arthroscopic Approach for Completion of Dorsal Cheilectomy of the Great Toe MTPJ for Treatment of Hallux Rigidus

Pearls	Pitfalls
Use the nick-and-spread technique to establish the dorsal portal 1 cm proximal to the joint line to all for a good working angle of the burr	Using a standard 4.0-mm arthroscope makes visualization and maneuvering difficult
Maintain clear visualization of the burr to titrate the amount of bone resected	Poor portal placement near neurovascular structures and EHL
Uses small joint arthroscopy equipment with minimal damage to surrounding soft tissues	Arthroscopically visualize the joint and ensure no articular cartilage flap or unstable rim is left free—all edges should be smooth to prevent late propagation
Use the arthroscope and shaver to evacuate all bone debris from within the joint	Stiffness—encourage early frequent range of motion exercises starting as soon as patient tolerates them postoperatively

EHL, extensor hallucis longus; MTPJ, metatarsophalangeal joint.

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