Technical Note

Arthroscopy of the Fourth and Fifth Tarsometatarsal Joints: Anatomic Guide, Operative Technique, and Four-Point Inspection

George T. Liu, D.P.M., F.A.C.F.A.S., and Tun Hing Lui, M.B.B.S. (H.K.), F.R.C.S. (Edin.), F.H.K.A.M., F.H.K.C.O.S.

Abstract: Soft tissue impingement and arthrofibrosis of the fourth and fifth tarsometatarsal joints can be a source of intractable pain and functional impairment. Arthroscopic debridement of the fourth and fifth tarsometatarsal joints is a minimally invasive method that can provide clinical relief from soft tissue impingement pathologies associated with trauma and degenerative joint disease. Arthroscopic landmarks, four-point arthroscopic inspection, and operative technique will be reviewed.

Introduction

The Lisfranc joint complex, also known as the tarsometatarsal (TMT) joints, comprises the medial (first TMT joint), central (second and third TMT joints), and lateral (fourth and fifth TMT joints) columns. The medial and central columns are the least mobile, functioning as a rigid lever for the push-off phase of gait, whereas the fourth and fifth TMT joints are the most mobile of the Lisfranc’s joint complex. The fourth and fifth TMT joints average 9.6° and 10.2° range of motion in the sagittal plane, respectively.1,2

Symptomatic arthrofibrosis that limits joint range of motion or soft tissue impingement syndromes that are symptomatic with range of motion are sequelae encountered after injury of the fourth and fifth TMT joints.3

Arthrotomies to the fourth and fifth TMT joints may increase the risk of nerve injury, as well as operative scar and fibrosis to the area. Arthroscopy is a minimally invasive approach to diagnose and treat symptomatic soft tissue pathologies of the fourth and fifth TMT joints. We describe an arthroscopic approach to the fourth and fifth TMT joints.

History and Physical Examination

Often, patients will report a history of inversion sprain of the foot or ankle area. Pain can be elicited at the fourth and fifth TMT joints, with direct palpation and also with piano key maneuver.4 Diagnostic block is useful for verifying intra-articular pain to the respective joints.

Surgical Technique

The patient is positioned supine on the operating room table with translucent table extension. The operative limb is elevated on a foam block (The Ramp, Bonefoam). Ipsilateral hip bump is placed to rotate the leg into slight internal rotation. Calf tourniquet (Color Cuff Tourniquet System Cuff 18 Inch Length Dual Port, Single Bladder, Stryker) is placed for hemostasis. No distraction of the joint is needed. A fluid ingress pump (CrossFlow, Stryker) is set at 20-30 mmHg or may use gravity flow.

The location of the P3-4 (portal third-fourth TMT joints) is between the third and fourth TMT joints, and the lateral portal is lateral to the fifth TMT joint, as
shown in Fig 1. A medial oblique foot view with intraoperative fluoroscopy is used to locate the P3-4 and the lateral portal, shown in Fig 2. Portal incision is made, and a mosquito hemostat is used to bluntly dissect into the joint. A 2.7-mm cannula with obturator is inserted in the P3-4 portal followed by a 2.7-mm arthroscope with 30° lens (2.7 mm 30° Autoclavable Arthroscope, Eyepiece, J-Lock, 75 mm, Stryker), and 2.5-mm aggressive soft tissue shaver (2.5-mm TPS Small Joint Aggressive Cutter, Stryker) is inserted in the lateral portal shown in Fig 3. The P3-4 portal is often adjacent to the intermediate dorsal cutaneous branch of the superficial peroneal nerve as shown in Fig 3. The trajectory of arthroscope and

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**Fig 1.** Portal placement is shown in a right foot with the incision for the P3-4 portal placed between the third and fourth tarsometatarsal (TMT) joints and the incision for the lateral portal placed at the lateral aspect of the fifth TMT joint. CN, cuneiform; MT, metatarsal.

**Fig 2.** Intraoperative fluoroscopy is used for precise placement of the portals. A medial oblique view of right foot is used to locate the junction between third and fourth tarsometatarsal (TMT) joints for the P3-4 portal (left image) and the lateral gutter of the fifth TMT joint for the lateral portal (right image).
shaver should be deep into the tendon and neurovascular structures, as shown in Figure 4. Arthrofibrosis and capsular fibrosis of the dorsal capsule are commonly encountered and require extensive debridement before the TMT joints can be visualized as shown in Fig 5; therefore, fluoroscopic imaging is useful to verify location of the fourth and fifth TMT joints, as shown in Fig 6. As shown in the video, the dense scar tissue to the dorsal capsule is debrided with the 2.5-mm aggressive soft tissue shaver. Once the dorsal TMT joint capsule is debrided, the joint space is examined. Acute and chronic synovial soft tissue impingement and articular cartilage degeneration can be seen in Figs 7 and 8. Soft tissue impingement and

**Fig 3.** Instrumentation placement is shown with the arthroscope placed in the medial P3-4 and soft tissue shaver placed in the lateral portal of a right foot. The P3-4 portal is often .5 cm medial to the intermediate dorsal cutaneous branch of the superficial peroneal nerve (longitudinal dotted line).

**Fig 4.** An illustration of a coronal cross section of the right foot at the level of the tarsometatarsal (TMT) joints is shown with orientation of instrument placement. The junction between the third and fourth TMT joints and the position of the lateral gutter are indicated by the vertical dashed lines. The arthroscope is placed in the medial P3-4 and soft tissue shaver is placed in the lateral portal of a right foot. The position of arthroscope and shaver are deep to the extensor tendons and nerve structures.

**Fig 5.** Right foot tarsometatarsal (TMT) joint is shown with shaver in the lateral portal. For orientation, the MTs are to the left and cuboid to the right of the image. Dense scar tissue from arthrofibrosis is commonly encountered and requires aggressive debridement to expose the TMT joints.
Joint debris are debrided with soft tissue shaver. Gentle suction outflow is used to draw soft tissues into the shaver to facilitate debridement. Lateral fifth TMT joint gutter is also examined for soft tissue impingement lesions as shown in Fig 9. The fourth and fifth metatarsal (MT) heads may be plantarflexed to facilitate access to the fourth and fifth TMT joints for inspection and further debridement, as shown in Figs 10, A and B. Distraction of the TMT joints are not necessary for joint access. The plantar TMT joint ligaments are preserved. Debridement of the dorsal capsule does not lead to instability to the fourth and fifth TMT joints. Portals are closed with vertical mattress stitch with 3-0 Nylon. Pearls and pitfalls are summarized in Table 1.
Four-Point Arthroscopic Inspection

Soft tissue impingement can occur in four areas of the fourth and fifth TMT joints, which warrants inspection noted in Fig 11. The four-point exam is shown in the video. The fourth and fifth TMT joint articulation is also inspected for arthritis. The first point of inspection is the fourth TMT joint articulation shown in Fig 12. The second point is the junction between the fourth and fifth MTs and the cuboid shown in Fig 13. The third point is the fifth TMT joint articulation, and the fourth point of inspection is the lateral gutter of the fifth TMT joint shown in Fig 14. The video demonstrates arthroscopic portals, debridement of soft tissue impingement lesions within the fourth and fifth TMT joints, and the four-point exam in a left foot.

Postoperative Management

Postoperatively, patients are placed in a surgical shoe and allowed to bear weight as tolerated. Sutures are removed at 2 weeks. Once skin is healed, patients are instructed with range of motion exercises to the TMT joints to prevent post-debridement fibrosis. At 4 to 5 weeks, patients may bear weight, as tolerated, in shoes.
Discussion
The fourth and fifth TMT joints of the lateral column are the most mobile joints of the Lisfranc complex functioning as a flexible adaptor to accommodate uneven terrain. From heel strike to toe off phase of gait, the center of pressure travels from the lateral heel to the lateral midfoot to the second MT finally through the hallux.\(^7\) The first through third TMT joints are considered nonessential joints, as there is little excursion with range of motion; therefore, loss of motion with arthrodesis is well tolerated.\(^9\) Rigidity to the lateral column seems to be poorly tolerated and may result in lateral column overload and intractable metatarsalgia to the fourth and fifth MT heads.\(^9,10\)

There is little consensus regarding treatment of choice of symptomatic fourth and fifth TMT joints, as outcomes of operative intervention are variable.\(^9-14\) Arthrodesis of the fourth and fifth TMT joints was considered a standard treatment of choice; however, variable outcomes and concerns for lateral column rigidity led to other treatment considerations.\(^9,13,15\) Treatments such as interpositional arthroplasty with tendon graft or ceramic sphere implants to preserve motion have been reported to provide limited improvement but long-term outcomes are unknown.\(^11,12,14,16\) Resectional arthroplasty of the fourth and fifth TMT joints has also been shown to provide limited improvement in a small heterogeneous case series.\(^17\)

There are risks and benefits with fourth and fifth TMT joint arthroscopy, as summarized in Table 2. The principal advantage of fourth and fifth TMT joint arthroscopy is the minimally invasive approach to joint evaluation, identification of intraarticular pathology,

### Table 1. Pearls and Pitfalls of Fourth and Fifth TMT joint Arthroscopy

| Pearls | Pitfalls |
|--------|----------|
| Use intraoperative fluoroscopy for portal placement and to guide joint location. | Inaccurate portal placement may impede joint visualization and access. |
| Incision slightly lateral to the lateral portal and incision slight medial to the P3-4 portal reduces skin tension with arthroscopic and shaver placement. | Aggressive maneuvering with arthroscopy and/or shaver causes skin tearing of the portal leading to infiltration of air into the visual field. |
| Piano key maneuver facilitates access, and inspection of the articular surfaces | Disorientation and loss of joint location are common without intraoperative fluoroscopy. |
| Gentle suction outflow to draws soft tissues into the shaver to facilitate debridement | Superficial approaches increase risk of injury to the extensor tendons and nerves during debridement. |

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**Fig 12.** The first point of inspection is the fourth tarsometatarsal (TMT) joint articulation. Right foot is shown with the fourth metatarsal (MT) on the left and cuboid on the right of the image. Arthroscopic view is from the P3-4 portal.

**Fig 13.** The second point of inspection is the articular junction between the fourth and fifth metatarsals (MTs) and the cuboid. Large arrow indicates the articulation between the fourth MT and cuboid. The smaller double arrows indicate chronic synovial fibrosis interposed between the fifth MT cuboid joint. Right foot is shown with the fourth and fifth MTs on the left and cuboid on the right of the image. Arthroscopic view is from the medial P3-4 portal.
and debridement of soft tissue impingement lesions. Patients are allowed to bear weight immediately after the procedure. Compared to open procedures, arthroscopy is often associated with decreased postoperative pain, wound complications, and surgical site infections. The intermediate branch of the superficial peroneal nerve is often located just lateral to the P3-4 portal; therefore, there is a remote risk for nerve injury. Precise portal placement is necessary for successful small joint arthroscopy. Because of the smaller field of navigation, inaccurate portal placement can lead to poor joint visualization, inadequate joint debridement, and tendency to tear the skin portals. Arthroscopy of the fourth and fifth TMT joints requires surgeons to have extensive experience in joint arthroscopy.

We are not aware of any specific reports on arthroscopic debridement of the lateral TMT joints for soft tissue impingement conditions. Lui previously described a technique of arthroscopic lysis for symptomatic arthrofibrosis of the fifth TMT joint. Only one case report discussed use of arthroscopy for osteochondral lesions of the lateral TMT joints, but it provided no description of the arthroscopic technique.\(^\text{18}\)

Soft tissue impingement conditions have been a recognized indication arthroscopic debridement.\(^\text{19-22}\) Immunofluorescent studies have demonstrated the presence of neuropeptides substance P and calcitonin gene-related peptide, demonstrating the presence of sensory nerves in the synovial tissues.\(^\text{23-26}\) Hypertrophic acute and chronic synovial fibrosis with villus projections are a source of symptomatic intra-articular impingement.

Management of chronic pain in the fourth and fifth TMT joints is a clinical challenge, as there is no consensus for the best method of care. Arthroscopic debridement of the fourth and fifth TMT joints is a minimally invasive method that can provide clinical relief from soft tissue impingement pathologies associated with degenerative joint disease.

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