Technical Note

Arthroscopic Tibiotalar Arthrodesis Using an Arthroscopic Autologous Tissue Collector: A Technique Guide

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Abstract: Tibiotalar arthrodesis is a common procedure performed in patients with ankle arthritis to relieve pain, restore function, and improve the quality of life. Obtaining proper bone-to-bone apposition is crucial to obtaining a solid fusion. Therefore, adequate joint preparation is critical. Open-joint preparation is the standard of care, but arthroscopic arthrodesis is becoming increasingly popular, as it can decrease tissue trauma, postoperative pain, hospital stay, and complications. The addition of bone matrix allograft and autograft also improves healing rates. Use of an arthroscopic autologous tissue collector through standard arthroscopic portals allows harvesting of bone matrix autograft without having to perform additional invasive bone harvesting outside of the affected joint. We present our technique for tibiotalar arthrodesis using an arthroscopic approach with an arthroscopic autologous tissue collector.

Tibiotalar arthrodesis is a common procedure performed in the United States to relieve pain, restore function, and improve the quality of life of patients with severe end-stage tibiotalar osteoarthritis, Charcot joint, posttraumatic tibiotalar arthritis, avascular necrosis, rheumatoid arthritis, among others.[1-6] With the aid of arthroscopy, joint preparation for tibiotalar arthrodesis can be done in a minimally invasive manner and has been gaining popularity, as it decreases soft-tissue damage and risk of infection, which can reduce postoperative pain, hospital length of stay, and complications.[1-3,5]

Structural bone matrix allograft or autograft is used to increase fusion rates in tibiotalar arthrodesis.[1,4,5] The advent of autologous tissue collectors has eliminated the need for a second surgical site, as the collector can be used at the original operative site. Therefore, it reduces harvest-site morbidity and number of incisions while also facilitating the collection of autogenous bone graft material. This Technical Note describes an arthroscopic approach with an arthroscopic autologous tissue collector system (GraftNet Autologous Tissue Collector; Arthrex, Naples, FL) in tibiotalar arthrodesis.

Operative Technique

Indications

Arthroscopically assisted tibiotalar arthrodesis using the arthroscopic autologous tissue collector system is indicated for severe tibiotalar arthritis in the setting of posttraumatic or longstanding tibiotalar arthritis refractory to conservative management. The approach and use of the autologous tissue collector is useful, as it eliminates the need for a second surgical site for autogenous graft. This eliminates autogenous donor-site morbidity as well as the need to obtain allogeneic material, which contributes to an overall improved postoperative healing course. Arthroscopic assistance allows for direct visualization of the tibiotalar joint space and decreased soft-tissue damage compared with open approaches, which also augments patient recovery.

Contraindications

General contraindications to arthroscopically assisted tibiotalar arthrodesis using the autologous tissue collector system include, but are not limited to, active infection, poor vasculature status, avascular necrosis, patients with ankle malformation or poor alignment,

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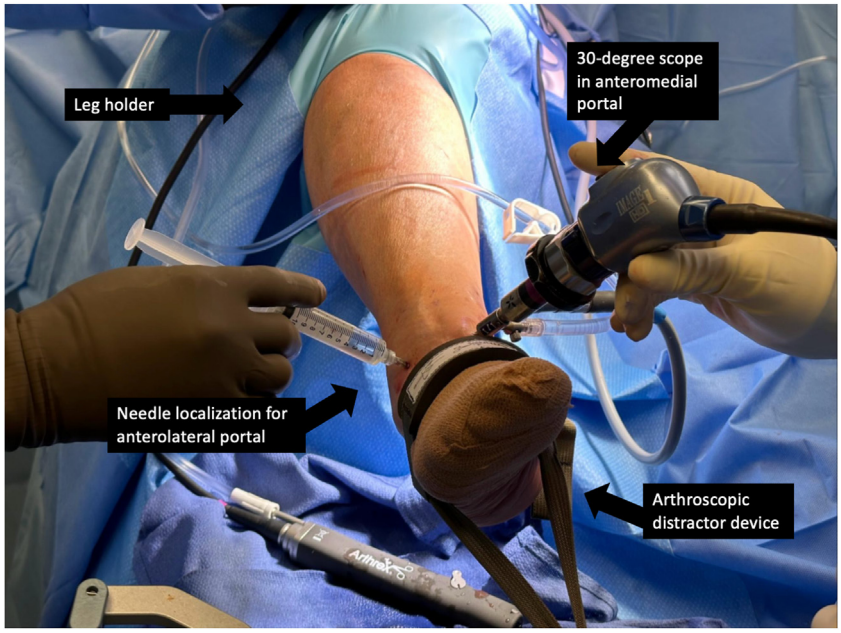

Fig 1. The patient is placed supine on table with the right leg in the leg holder and arthroscopic ankle traction set up with small joint scope in place in the anteromedial portal. It is important to use needle localization of anterolateral portal under direct visualization to have the optimal portal placement for joint preparation.

ankle varus and valgus alignment greater than 15°, and severe ankle varus and valgus malformations.

Setup

The patient is placed supine on the operating room table with a bump under the ipsilateral hip to ensure the ipsilateral foot has neutral alignment with toes pointing to the ceiling. A tourniquet is applied on the upper thigh of the operative extremity. A well-padded leg holder is attached to the bed railing and placed underneath the right thigh to provide countertraction during ankle distraction needed for arthroscopy.

Technique

The ankle is placed in the arthroscopic distractor device. The anteromedial ankle portal is marked at the level of the joint line medial to the tibialis anterior tendon and lateral to the medial malleolus. Using a nick-and-spread technique after needle localization, the anteromedial portal is made and then a 4.0-mm, 30° arthroscope is inserted into the joint. Create an anterolateral portal under visualization to verify the position using a needle (Fig 1). After the optimal position is confirmed, insert a 4.0-mm arthroscopic shaver. After inserting the shaver, perform diagnostic arthroscopy (Fig 2). Denude all the remaining articular cartilage with a combination of shaver, curette, and osteotomes. This cartilage tissue is then debrided and lavaged in the joint and pathway (Fig 3). The GraftNet system is placed in line on the suction apparatus with arthroscopic burr to capture the bone shavings to be used as bone graft (Fig 4). Perform subchondral bone decortication using a 4.0-mm arthroscopic burr (Fig 5). Transfer bone graft from autologous graft collector to a specimen cup. This may need to be performed depending on the amount of graft collected. After subchondral bone is denuded, transfer bone graft to 1-cc syringes (Fig 6). After denuding all of the articular subchondral bone on the

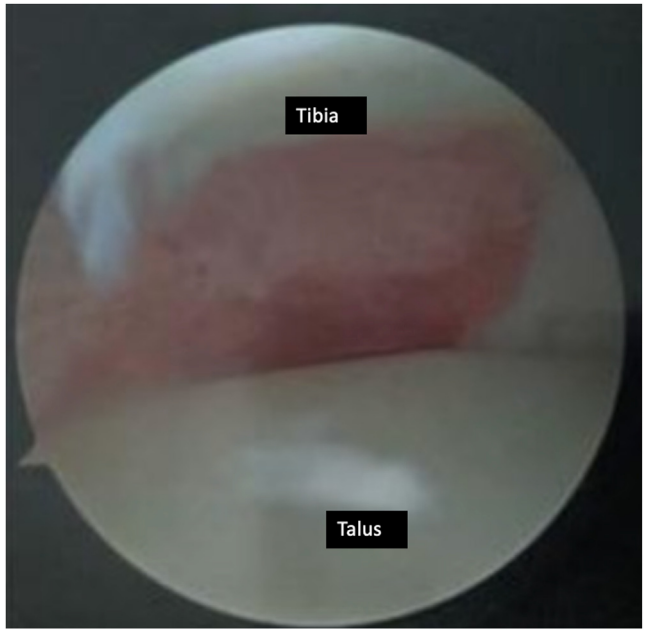

Fig 2. Arthroscopic view of right ankle through anteromedial portal revealing tibiotalar joint before preparation with cartilage intact. At the bottom of the screen, we have the talar dome. At the top of the screen, we have the tibial surface. It is important to ensure good visualization of joint before beginning joint preparation.

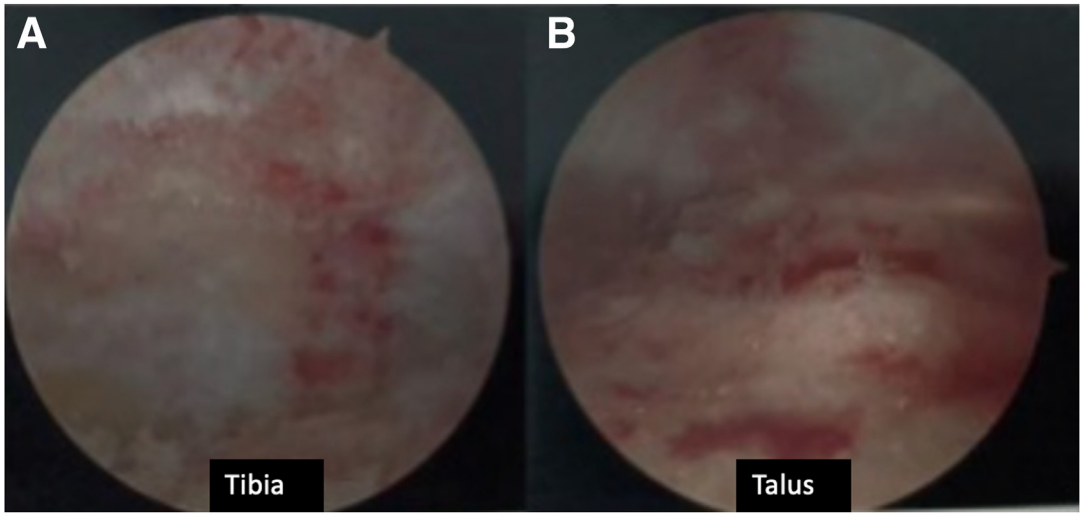

Fig 3. Arthroscopic view of right ankle through anteromedial portal showing Tibial surface (A) and talar dome (B) after articular cartilage is removed. Here we are able to see subchondral bone and bleeding. Ensure bleeding bone is seen throughout the tibial and talar surfaces to optimize fusion potential.

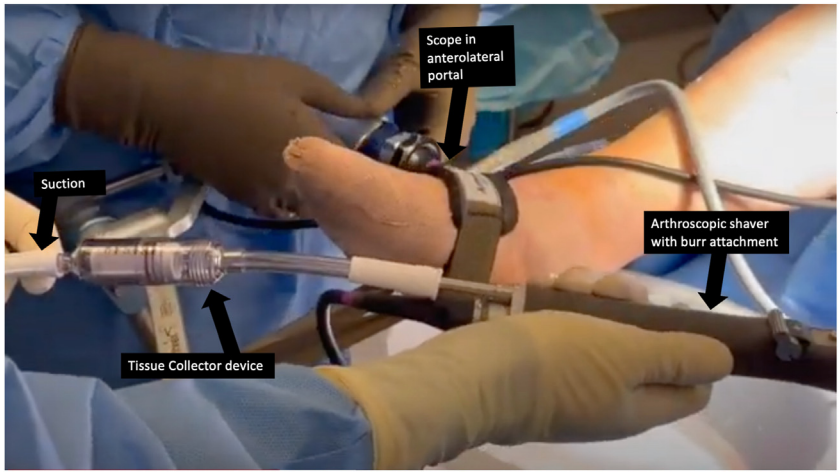

Fig 4. The patient is supine with arthroscopic ankle traction set up in place. An arthroscopic camera is in anterolateral portal or right ankle. Here, we see the arthroscopic autologous bone graft collector connected in-line with suction and 4.0-mm burr. Connection of bone autograft collector must be done after thorough joint preparation has been completed but before the decortication step.

distal tibia and dorsal talar fibular surfaces, place multiple fenestrations to the subchondral bone using a microfracture awl (Fig 7). The tourniquet is deflated and verification of bleeding through the bone surfaces on the tibia and the talus is completed (Fig 8). Cut the tips of the 1-cc syringes containing bone graft then proceed to inject the bone graft into the joint using previous arthroscopic portals for filling of the tibio-talar joint surface. Then, smooth out with a Freer elevator (Fig 9). Proceed with tibiotalar fusion. Three cannulated screws are used for the ankle arthrodesis in this study. The ankle distractor device is removed and the ankle is held in neutral dorsiflexion, slight eversion, and slight external rotation followed by 2.0-mm Steinmann pins to hold the reduction. Then, 3 guidewires for the 6.7-mm cannulated screws, 2 medially and 1 laterally across the tibiotalar joint, are placed (Figs 10 and 11). Make a skin incision, dissect down to the bone, measure and drill, then proceed with screw placement,

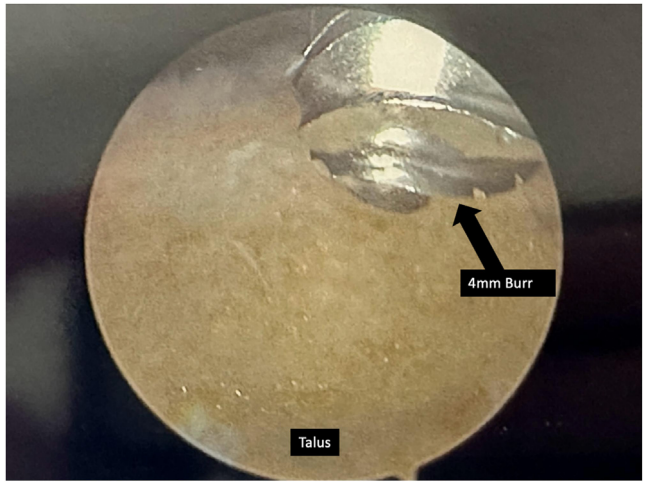

Fig 5. Arthroscopic view of right ankle, showing talar dome through anterolateral portal with 4.0-mm burr in anteromedial portal performing subchondral decortication after cartilage has been removed. It is important to create an even layer throughout.

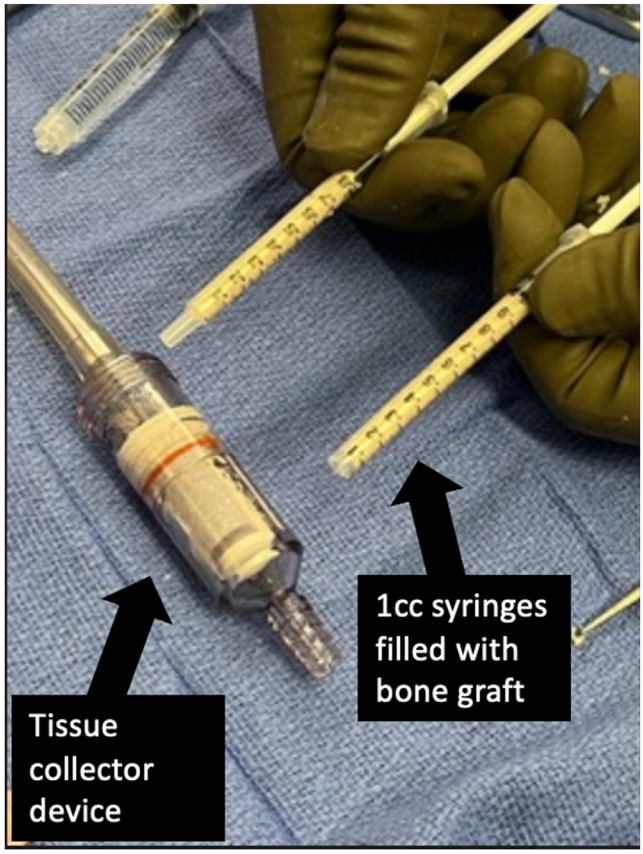

Fig 6. GraftNet device, autologous tissue collector, is shown on bottom left, with collected bone shavings from the mesh already transferred to 1-cc syringes with tips cut off for ease of application into portal sites. Loading bone graft into syringes streamlines the grafting process and allows for an even application throughout the joint surface, as it makes it easier to direct intra-articularly.

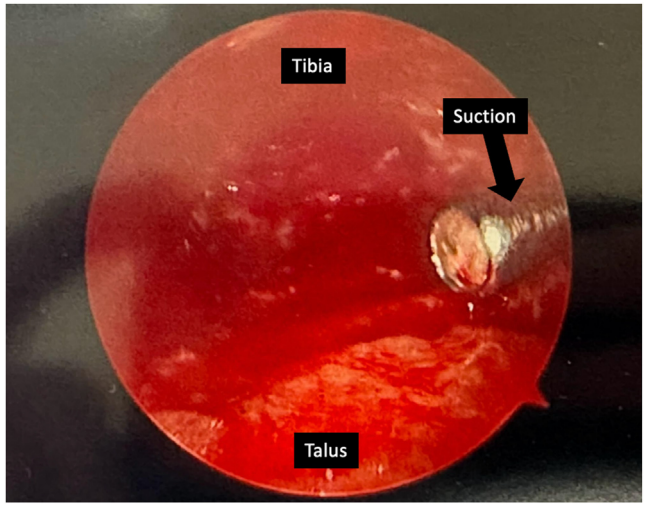

Fig 8. Arthroscopic view of right ankle tibiotalar joint, with dry scope verification through anterolateral portal of tibiotalar joint bleeding bone surfaces after tourniquet has been released. Suction tip in place to make certain that joint is fully prepped and there is good bleeding bone throughout.

making sure to verify good purchase and compression of the tibiotalar joint surface with no screw extrusion into subtalar joint surface (Fig 12). After satisfactory screw placement, remove guidewires and obtain final radiographs. Skin closure is achieved with 3-0 VICRYL for the subcutaneous layer and 3-0 nylon for skin. Incisions are dressed with JumpStart Antimicrobial Wound Dressing (Arthrex), fluffs, ABD pads, and sterile Webril (Cardinal Health, Dublin, OH), and a well-padded bulky Jones splint is applied to the leg. The entire technique can be viewed in Video 1.

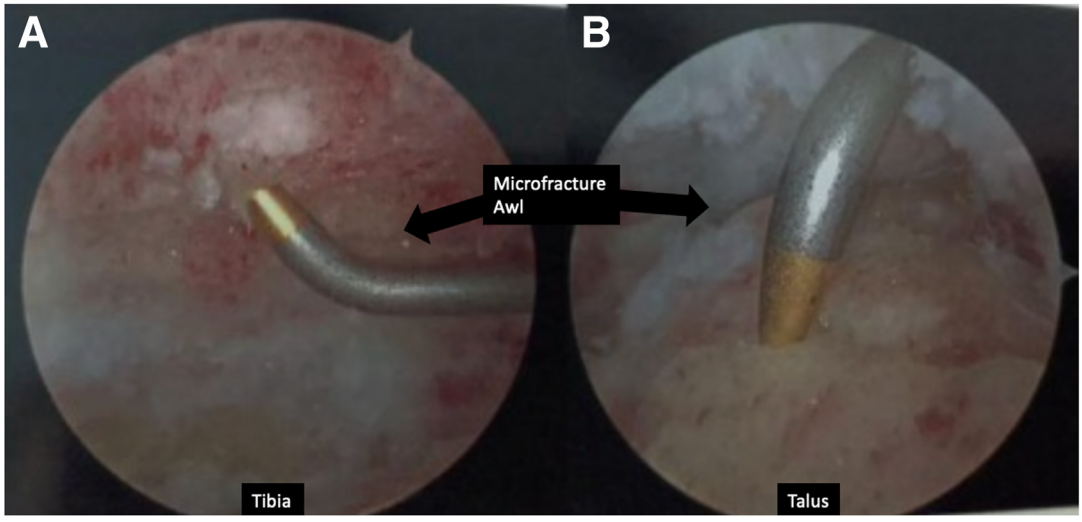

Fig 7. Arthroscopic views of right ankle revealing tibia (A) and talar dome (B) surfaces through the anterolateral portal after subchondral bone has been removed. The microfracture awl through anteromedial portal is shown in place making fenestrations in bone. It is important to make sure bone fenestrations are dispersed evenly throughout joint surface to allow bone graft penetration and optimize fusion.

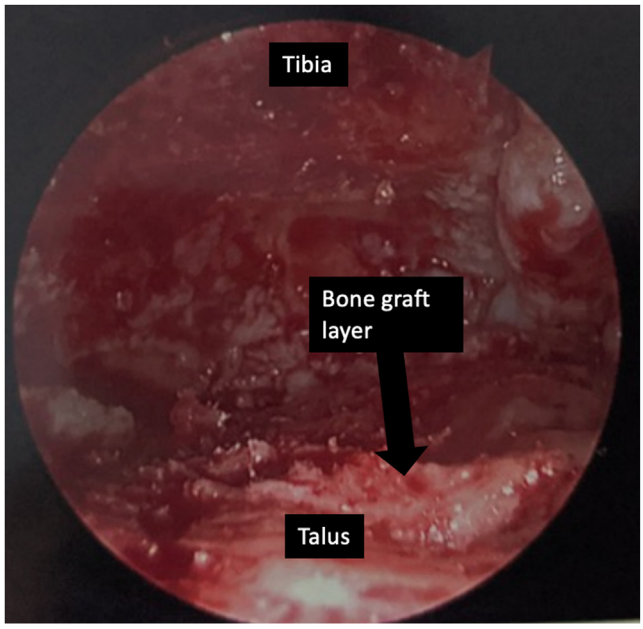

Fig 9. Arthroscopic view of right ankle through the antero-lateral portal after inserting the bone graft, you may disperse it and ensure an even coating of joint surface using a Freer (not shown) under direct visualization. After evenly coating with bone graft, dry scope of tibiotalar joint with bleeding bone surfaces and bone graft in place should look like this figure.

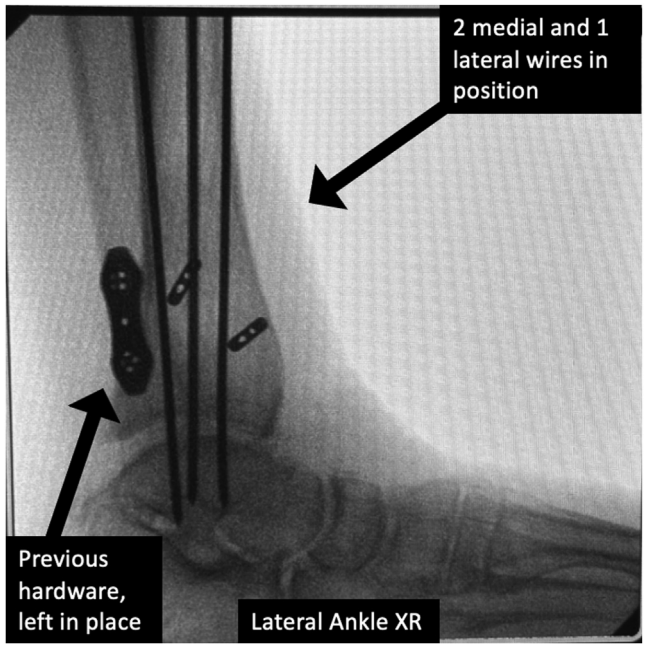

Fig 11. Lateral ankle radiograph view of the tibiotalar guidewires in place. This patient had previous hardware; Syndesmosis TightRope (Arthrex) with two-hole lateral fibular plate, visualized here, was left in place. We ensure that wire is not crossing the subtalar joint.

Postoperative Protocol

The postoperative protocol is summarized as follows: at 0 to 2 weeks, the patient's operative extremity is placed in a well-padded posterior short leg splint. The patient is non—weight-bearing. There is emphasis on ice and elevation to help mitigate pain and swelling.

The patient is instructed to take aspirin, 81 mg once daily, for 6 weeks starting on postoperative day 1 if there are no contraindications. At 2 to 6 weeks, the splint is removed in the outpatient office to perform a wound check. The patient is transitioned into a controlled ankle movement boot and continues to remain non—weight-bearing. At 6 to 8 weeks,

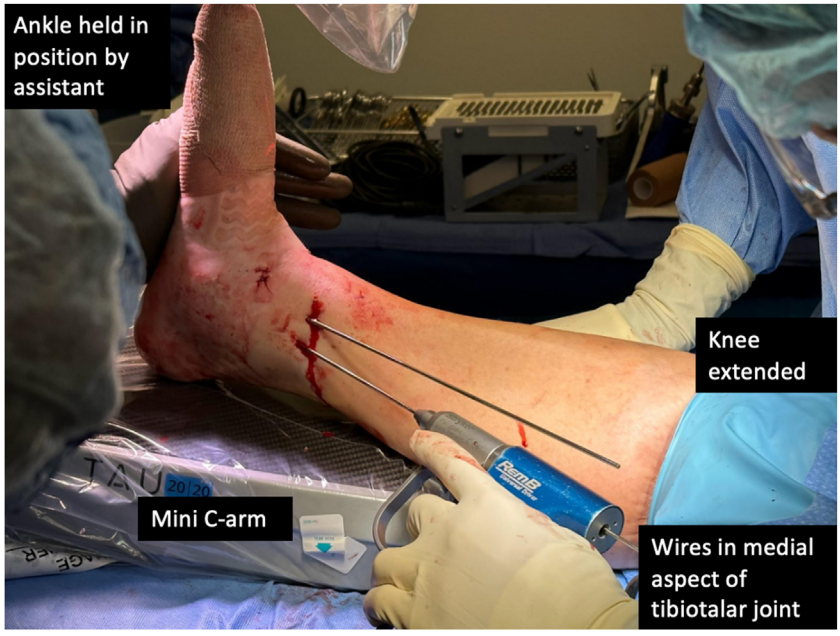

Fig 10. While the patient remains supine, the ankle distractor and leg positioner are removed. After bone grafting, we proceed with placement of hardware for arthrodesis. Position ankle with neutral dorsiflexion, slight valgus, and external rotation over mini C-arm for direct visualization. In the figure, we see the posteromedial wire being placed to ensure adequate screw trajectory for tibiotalar arthrodesis.

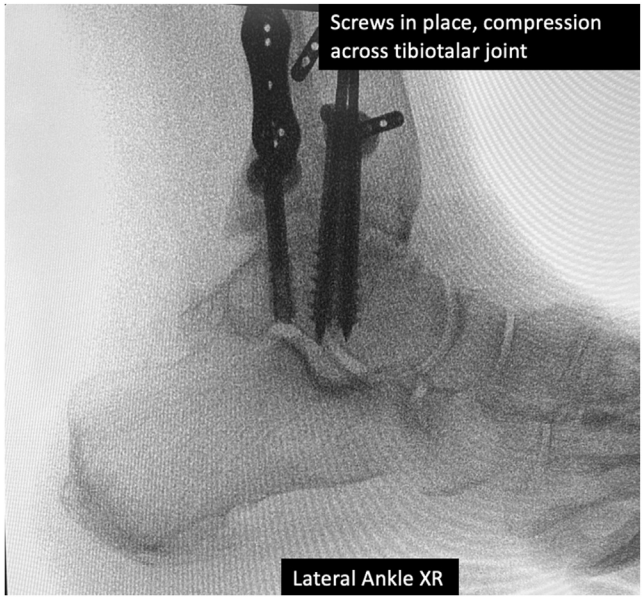

Fig 12. Lateral radiograph of the ankle with screws in place to verify appropriate screw length and ensure that there is no screw extrusion into subtalar joint. We again visualized the patient's previous hardware in place.

progressive weight-bearing is initiated in the postoperative boot. Physical therapy is initiated with gentle range-of-motion exercises. At 8 to 12 weeks, the patient is encouraged to wean themself from the controlled ankle movement boot as tolerated. As gait normalizes, use of the boot is discontinued. Physical therapy can be advanced to more weight-bearing activities, such as the treadmill, weight-bearing exercises, or proprioceptive movements. At 12 weeks, a walk-to-run program and greater-impact activities are initiated based on the patient's functional level.

Radiographic Assessment

Three views, namely anteroposterior, lateral, and mortise views, are obtained at the designated time points of 2 weeks, 6 weeks, and 3 months. The images are evaluated for callus formation, joint congruency, and signs of complications such as avascular necrosis or malunion.

Discussion

Tibiotalar arthrodesis continues to be the treatment of choice for patients with severe tibiotalar arthritis refractory to conservative measures. Advantages of arthroscopic approach include decreased soft-tissue injury, decreased postoperative deep and superficial infections, decreased time to fusion, length of hospital stay, and tourniquet time.[5,7,8] Autogenous sources are preferred for cortical bone graft in tibiotalar arthrodesis as the result of no immunogenic reaction and decreased likelihood of infection.[9] By using an autologous tissue collector at the same operative site in conjunction with arthroscopy, the preferred bone graft can be used and the need for a second surgical site is eliminated. This mitigates patient complaints of donor-site pain and comorbidities.

Complications of arthroscopic joint preparation can be secondary to portal placement or approach techniques including neurovascular injury to saphenous nerve when creating anteromedial portal and superficial peroneal nerve with anterolateral portal. Palpation or transillumination to identify superficial peroneal nerve before portal creation can diminish risk of injury. Proper training in ankle arthroscopy can facilitate joint preparation and reduce complications from portal placement as well as reduce surgical time. Other complications may include those related to any general anesthetic event. Common postoperative complications may include infection, numbness, hematoma, and delayed union, malunion, and nonunion. Although the gold standard for bone grafting traditionally has been iliac crest autograft, the donor-site morbidity and complications with a second incision and harvest site outweigh the theoretical benefit of having more nucleated cells.[10] More studies are needed to compare the fusion rates with iliac crest autograft compared with distal harvest sites. The pearls and pitfalls of our technique are discussed in Table 1 and advantages and disadvantages in Table 2.

Table 1. Pearls and Pitfalls of Our Technique

Pearls	Pitfalls
Aggressive cartilage debridement is necessary for adequate joint preparation	Failure to obtain enough subchondral bleeding bone could inhibit fusion. It is important to verify with the dry scope before grafting
Creating portals over needle localization can ensure adequate placement and ease of instrumentation	Poor portal placement can lead to limited access for joint preparation
Transferring bone shavings to 1-cc syringes creates ease of bone grafting	Failure to make fenestrations in the bone could decrease bone graft penetration

Table 2. Highlighted Advantages and Disadvantages of Our Technique

Advantages	Disadvantages
Eliminates secondary grafting site, pain, and complications associated with second incision	Distal harvest sites are thought to contain fewer osteoprogenitor cells compared with iliac crest bone graft
Ease of grafting by loading bone graft into 1-cc syringes before insertion	Need to time placement of collection device after cartilage has been removed
Arthroscopic joint preparation diminishes wound complications by requiring smaller incisions when portal sites are placed in optimal locations	Difficult to visualize joint with suboptimal portal placement

Disclosures

The authors report no conflicts of interest in the authorship and publication of this article. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

References

1. Leucht AK, Veljkovic A. Arthroscopic ankle arthrodesis. *Foot Ankle Clin* 2022;27:175-197.
2. Woo BJ, Lai MC, Ng S, Rikhraj IS, Koo K. Clinical outcomes comparing arthroscopic vs open ankle arthrodesis. *Foot Ankle Surg* 2020;26:530-534.
3. Abuhantash M, Veljkovic A, Wing K, et al. Arthroscopic versus open ankle arthrodesis: A 5-year follow up. *J Bone Joint Surg Am* 2022;104:1197-1203.
4. Tricot M, Deleu PA, Detrembleur C, Leemrijse T. Clinical assessment of 115 cases of hindfoot fusion with two different types of graft: Allograft+DBM+bone marrow aspirate versus autograft+DBM. *Orthop Traumatol Surg Res* 2017;103:697-702.
5. Shah AB, Davis W, Littlefield ZL, et al. Patient and surgical factors affecting fusion rates after arthroscopic and open ankle fusion: A review of a high-risk cohort. *Indian J Orthop* 2022;56:1217-1226.
6. Bai Z, Yang Y, Chen S, et al. Clinical effectiveness of arthroscopic vs open ankle arthrodesis for advanced ankle arthritis: A systematic review and meta-analysis. *Medicine* 2021;100:e24998.
7. Berk TA, van Baal MCPM, Sturkenboom JM, van der Krans AC, Houwert RM, Leenen LPH. Functional outcomes and quality of life in patients with post-traumatic arthrosis undergoing open or arthroscopic talocrural arthrodesis—a retrospective cohort with prospective follow-up. *J Foot Ankle Surg* 2022;61:609-614.
8. Quayle J, Shafafy R, Khan MA, Ghosh K, Sakellariou A, Gougoulias N. Arthroscopic versus open ankle arthrodesis. *J Foot Ankle Surg* 2018;24:137-142.
9. Archunan MW, Petronis S. Bone grafts in trauma and orthopaedics. *Cureus* 2021;13:e17705.
10. Iturregui JM, Moses AM, Shi GG, Haupt ET. Contemporary review: Autograft bone use in foot and ankle surgery. *Foot Ankle Orthop* 2023;8(1).