Technical Note

Retrograde Drilling With Tibial Autograft in Osteochondral Lesions of the Talar Dome

Eugenio Jimeno Torres, M.D., Maximiliano Ibañez, M.D., David Campillo Recio, M.D., Ph.D., Gloria Alberti Fito, M.D., Ph.D., Ana Mendez Gil, M.D., and Jose Maria Jimeno Torres, M.D.

Abstract: Osteochondral lesions that compromise the ankle are rare, with an incidence between 0.02% and 1.5% according to different series. This location is the third in frequency, after knee and elbow. The location of the osteochondral lesion allows one to infer the producing mechanism. Lateral defects are produced by inversion and dorsiflexion of the ankle (usually anterior, affecting 3 and 6 talar zones), whereas medial defects are produced by plantar flexion, inversion, and internal rotation (most commonly posterior, affecting 4 and 7 talar zones). The injury causes pain associated with weight load, impaired function, limited range of motion, stiffness, blockage, and edema. Early diagnosis of an osteochondral lesion is particularly important because the lack of diagnosis can lead to the evolution of a small and stable lesion in a larger lesion or an unstable fragment, which can result in chronic pain, instability of the joint, and premature osteoarthritis. Multiple therapeutic strategies have been described, including conservative and surgical treatment. The purpose of this Technical Note is to describe arthroscopic-assisted retrograde drilling with tibial autograft procedure for osteochondral lesions of the talar dome.

Osteochondral lesions (OCLs) that compromise the ankle are rare. The incidence rate ranges from 0.02% up to 1.5%, depending on the series cited.[1] This location is third place in terms of frequency after knee and elbow injuries. Various etiologies have been described that include both traumatic and atraumatic mechanisms. Among the latter, certain genetic factors, including hypercoagulability, hypoparathyroidism, and altered lipid metabolism, have been proposed.

Flick and Gould concluded that 90% of lateral injuries and 70% of the medial ones of 500 patients with OCL could be attributed to a traumatic event.[2] The location of the OCL makes it possible to deduce the producing mechanism. Lateral defects are produced by inversion and dorsiflexion of the ankle (usually anterior, affecting talar zones 3 and 6), whereas the medial defects are produced through plantar flexion, inversion, and internal rotation (most commonly posterior, affecting talar zones 4 and 7) (Fig 1).

The pain caused by the injury with weight-bearing can give rise to impaired function, limited range of motion, stiffness, blockage, and edema. Chronic lesions manifest with persistent or intermittent pain during or after activities, and patients report blockage and the sensation of "clicking in the presence of a displaced fragment."[3]

Early diagnosis of an OCL is particularly important, because the lack of a diagnosis of a small, stable lesion can lead to the development of a larger lesion or an unstable fragment. That progression can result in chronic pain, instability of the joint, and premature osteoarthritis.

Since Monro described OCL in 1856, multiples therapeutic strategies have been put forth. They include conservative as well as surgical treatments.[4-8] For surgical treatments, the alternatives can be divided into 3 groups: palliative (washing, radiofrequency, and debridement), stimulation (abrasion, perforations,

From Department of Orthopedic Surgery and Traumatology, ICATME, Hospital Universitari Dexeus, UAB, Barcelona, Spain.

The authors report that they have 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.

Received February 22, 2020; accepted April 25, 2020.

Address correspondence to Maximiliano Ibañez, M.D., Department of Orthopedic Surgery and Traumatology, ICATME, Hospital Universitari Dexeus, Carrer de Sabino Arana, 5-19, 08028, Barcelona, Spain. E-mail: drmaximilianoibanez@gmail.com

2212-6287/20275
https://doi.org/10.1016/j.eats.2020.04.015

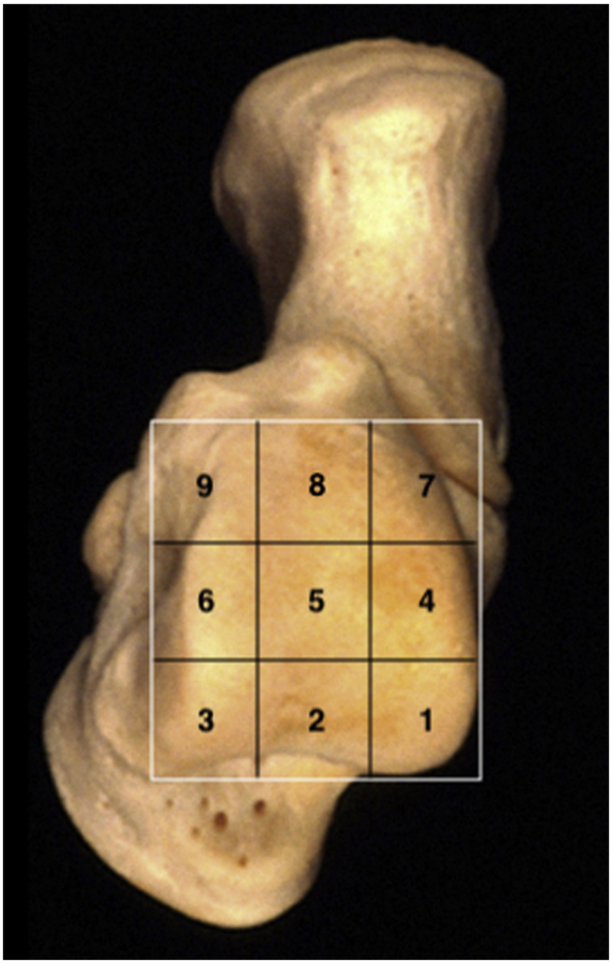

Fig 1. Nine-zone anatomic schematic of the talar dome.

and microfractures), and restoration (osteochondral allograft, autologous chondrocyte graft, autologous membrane chondrocyte graft, autologous osteochondral graft/mosaicplasty). The purpose of this Technical Note is to describe arthroscopic-assisted retrograde drilling with a tibial autograft procedure for OCLs of the talar dome.

Surgical Technique (With Video Illustration)

Hindfoot Endoscopic Technique

The procedure[9] is performed with the patient under spinal anesthesia with a thigh tourniquet applied. The patient is positioned prone with the ankle draped and hanging freely over the edge of the table (Fig 2). What is routinely used are the conventional posterior endoscopic portals as originally described by van Dijk et al.[10] along with a supplementary posterolateral portal 1 cm proximal to the conventional posterolateral portal. We prefer a 4-mm 30° arthroscope for posterior ankle arthroscopy.

With the ankle in a neutral position, the landmarks are drawn (the lateral malleolus, medial and lateral borders of the Achilles tendon, and the sole of the foot). A straight line is drawn from the tip of the lateral malleolus to the Achilles tendon, parallel to the sole of the foot. The posterolateral and posteromedial portals are made above this line, near the Achilles tendon. First, the skin incision is made for the posterolateral portal. Then, the subcutaneous layer is split using a mosquito clamp pointing toward the first interdigital space. The clamp is then exchanged for the arthroscope shaft.

The posteromedial portal is made at the same level as the posterolateral portal but on the medial side of the Achilles tendon. A mosquito clamp is introduced and directed toward the shaft of the arthroscope at a 90° angle. The shaft of the arthroscope is touched with the clamp and used as a guide to go anteriorly toward the ankle joint until the clamp can be seen with the arthroscope. The tip of the shaver (3.5-mm shaver; Stryker, Greenwood Village, CO) is directed in the same manner. The subtalar joint capsule and surrounding fatty tissue is then removed (Fig 3). The flexor hallucis

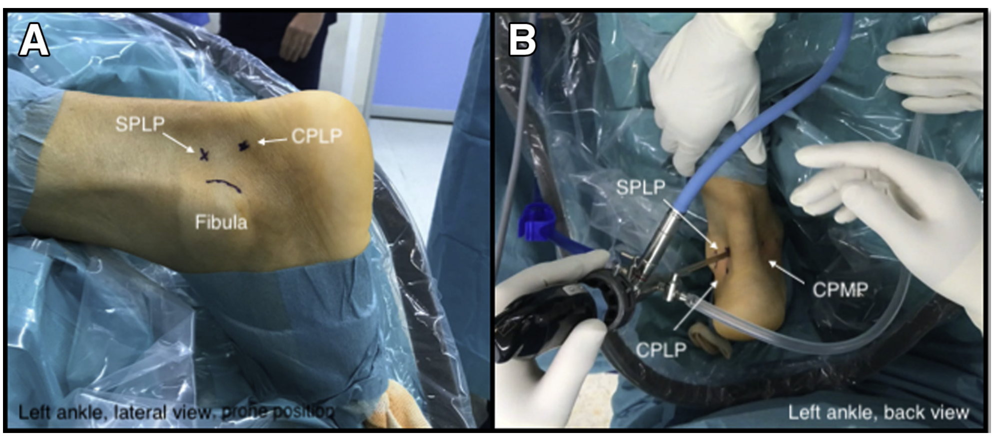

Fig 2. (A) Left ankle, lateral view. The patient is positioned prone with the ankle draped and hanging freely over the edge of the table. SPLP 1 cm proximal to the CPLP. (B) Left ankle, back view. With the ankle in a neutral position, posterolateral and CPMPs are made. The arthroscope shaft is placed in the SPLP. (CPLP, conventional posterolateral portal; CPMP, conventional posteromedial portals; SPLP, supplementary posterolateral portal.)

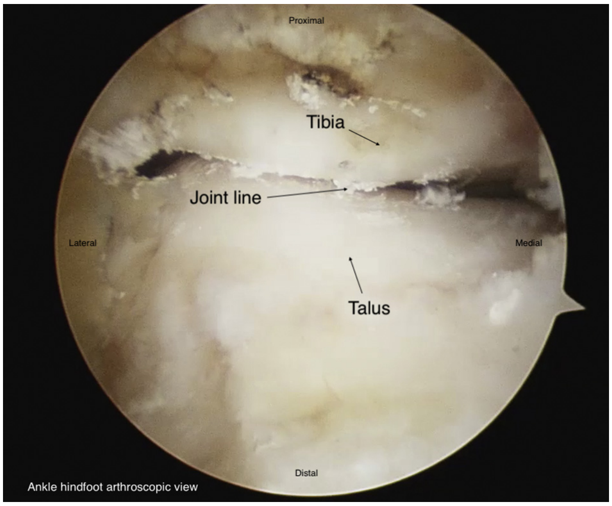

Fig 3. Left ankle hindfoot arthroscopic view. Tibio-talar joint line after removing soft tissue.

longus tendon is an important landmark, with the safe area lying lateral to this tendon.

Retrograde Drilling

Retrograde drilling is performed using the conventional posterolateral portal and with the arthroscope placed in the accessory posterolateral portal (Fig 4). Under the fluoroscopic view, anteroposterior and lateral images of the ankle are obtained to decide on the direction of the guidewire. A 1.2-mm diameter Kirschner wire is inserted and the tip of the wire is advanced from the posterolateral talus toward the lesion so as not to penetrate the chondral layer. The precise placement and depth of the K-wire is confirmed fluoroscopically on 2 planes. The K-wire is then over-reamed with an 8.0-mm cannulated reamer (CONMED, Largo, FL) while avoiding damage to the cartilage covering (Fig 5). The drill bit diameter ranges from 7 to 9 mm. The arthroscope is then placed in the bone tunnel created in the talus. The OCL with its necrotic bone, at the top of the drill tunnel, is distinguishable from the adjacent healthy cancellous bone. The necrotic tissue is removed using either a curette, spoon, or mini-shaver while preserving the cartilage layer covering the defect.

Placing the scope in the conventional posterolateral portal, the cancellous bone graft cylinder from the distal tibia is harvested through the posteromedial portal using a trephine of the same diameter as the drilled tunnel (Fig 6).

After dissection of the sclerotic area at the top of the tunnel, the arthroscope is moved to the accessory posterolateral portal. Through the conventional posterolateral portal, the trephine loaded with the viable autologous cancellous bone cylinder is placed and plugged underneath the chondral roof through the drill-hole by mild tapping in a press-fit manner (Fig 7). No additional bone harvesting is performed (Fig 8). After surgery, a soft bandage is placed in all patients.

Postoperative rehabilitation consists of 6 weeks of non—weight-bearing activity. After this, partial weight-bearing is allowed. No cast or ankle bracing is provided. Full range of motion is immediately allowed. Nonimpact sports activity is allowed at 8 weeks post-operatively. Impact sports activities are restricted for 3 months.

A step-by-step description of the surgical technique is summarized in Table 1.

Table 2 provides pearls and pitfalls in performing this procedure. Table 3 shows advantages and limitations. Video 1 shows the whole technique in detail.

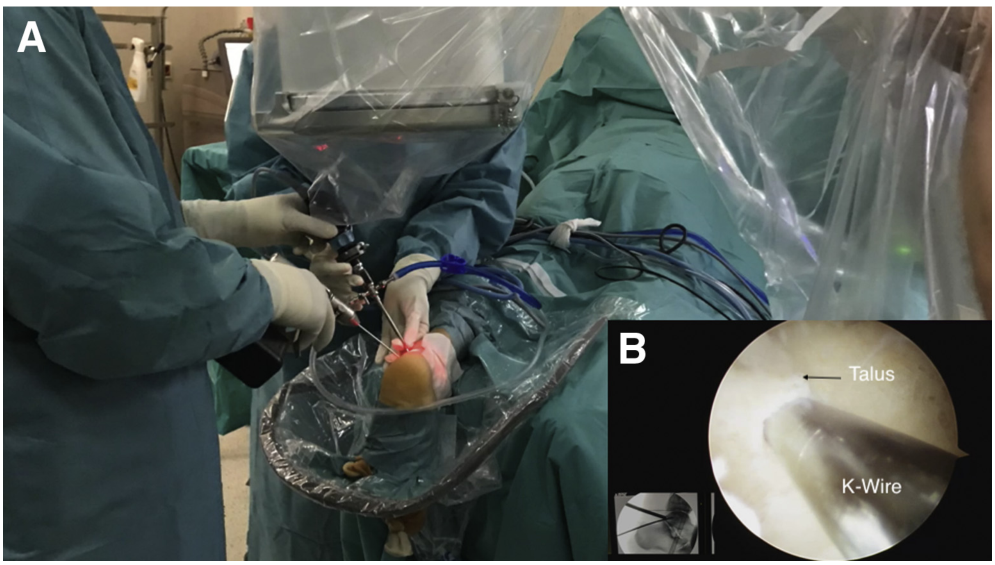

Fig 4. Left ankle, hindfoot view. Prone position. (A) Retrograde drilling is performed using the conventional posterolateral portal and with the arthroscope placed in the accessory posterolateral portal. (B) Under the fluoroscopic view, a 1.2-mm diameter Kirschner wire is inserted and the tip of the wire is advanced from the posterolateral talus toward the lesion.

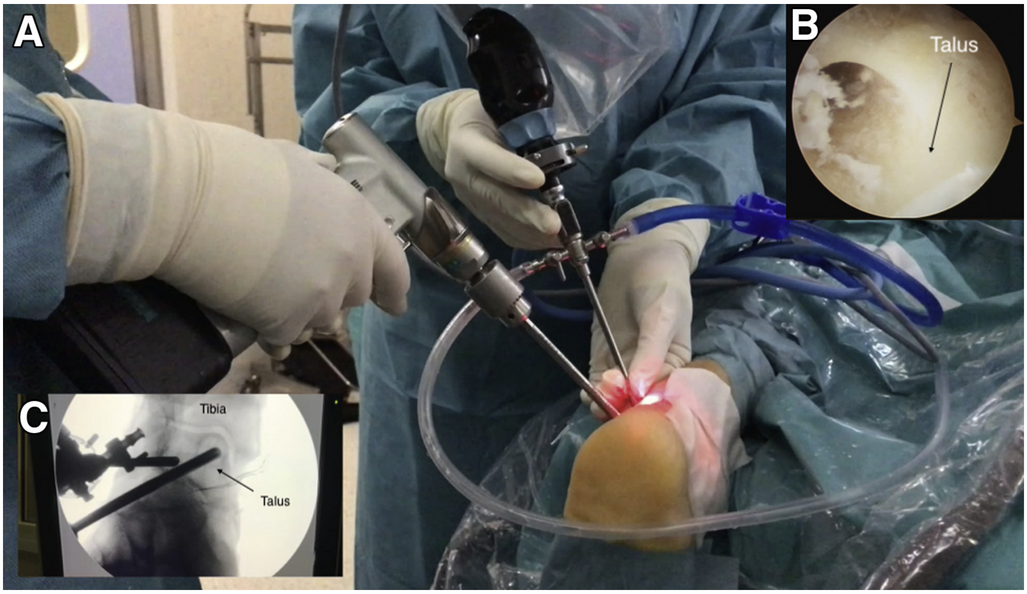

Fig 5. Left ankle, hindfoot view. Prone position. (A) The arthroscope placed in the accessory posterolateral portal, reamer in the conventional posterolateral portal. The K-wire is over-reamed with an 8.0-mm cannulated reamer while avoiding damage to the cartilage covering. (B) Bone tunnel created in the talus. (C) The precise placement and depth of the K-wire and reamer is confirmed fluoroscopically.

Discussion

Retrograde drilling is a well-accepted procedure for OCL of the talus with a subchondral cyst and an intact cartilage covering.[11,12] In 1959, Berndt and Harty[1] reported on the results of nonsurgical treatment of OCL of the talar dome and stated that the results were good in 16.9%, fair in 8.5%, and poor in 74.6% of their patients. Small, low-grade, acute, and stable lesions in younger patients are reported to have a moderate success rate of 25% to 50% with conservative treatment.[13,14] For any other condition, operative revision should be provided.[15,16]

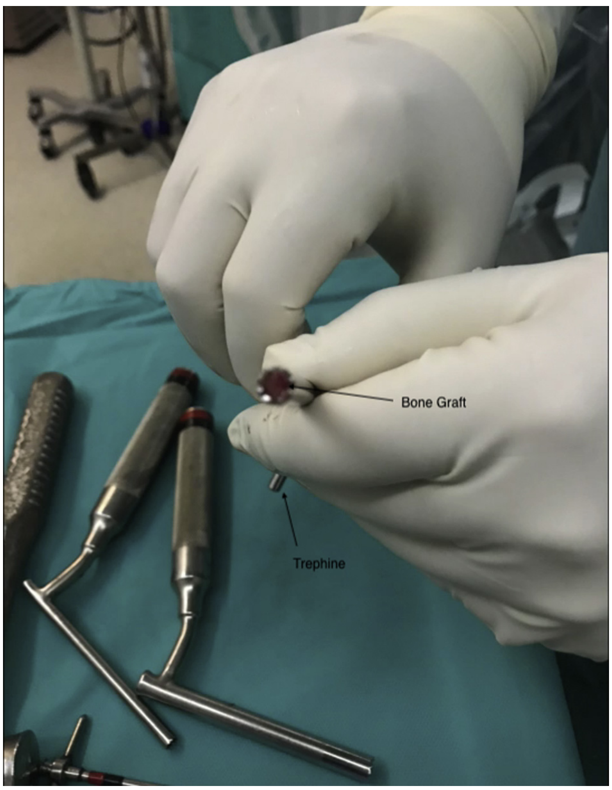

Fig 6. The cancellous bone graft cylinder from the distal tibia is harvested through the posteromedial portal using a trephine of the same diameter as the drilled tunnel.

Preserving an intact cartilage is the key factor in stable lesions. Therefore, retrograde drilling is the recommended technique.

Transmalleolar drilling is one of the most frequently used methods to treat OCL of the talar dome.[17] However, it has some limitations because the intact tibial cartilage can be injured when the K-wire is inserted into the lesion.[18]

Retrograde drilling of the talus was first proposed by Taranow et al.[18] in 1999. The advantage of this procedure is that it is possible to drill close to the subchondral bone without injuring the articular cartilage. Notwithstanding, performing this technique requires skilled surgeons because the lesion is located far from the insertion point and the surgeons must be able to 3-dimensionally visualize the lesion as accurately as possible. Thus, computer-assisted navigation might be useful.[19]

Adding a subchondral cancellous bone graft without penetrating the cartilage surface is preferred in an attempt to promote the bony revitalizing process, thereby obtaining better results than with the isolated drill technique.

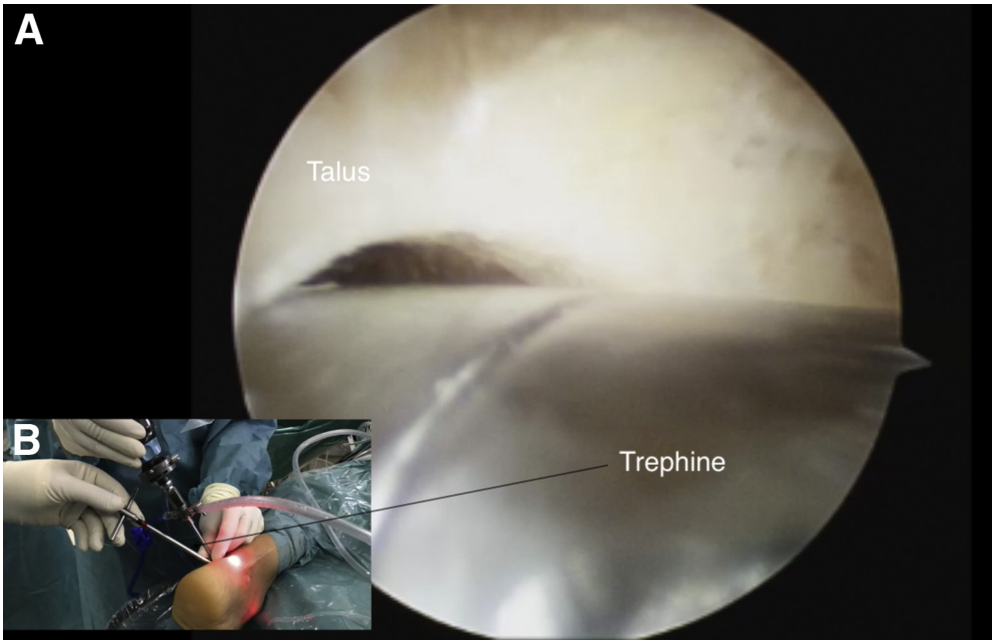

Fig 7. (A) Arthroscopic view and (B) clinical view. Left ankle, hindfoot view. Prone position. Through the conventional posterolateral portal, the trephine loaded with the autologous cancellous bone cylinder is placed and plugged by mild tapping.

The main advantage is that it is a minimally invasive technique without the need for malleolar osteotomy, additional bone grafting, aiming devices, or navigation. Among its disadvantages are a long learning curve, its technically demanding nature, and the need for experience in posterior ankle arthroscopy.

With an intact cartilage surface, the retrograde drilling technique could be a treatment option in mid-size OCL of the talus after failed conservative therapy.

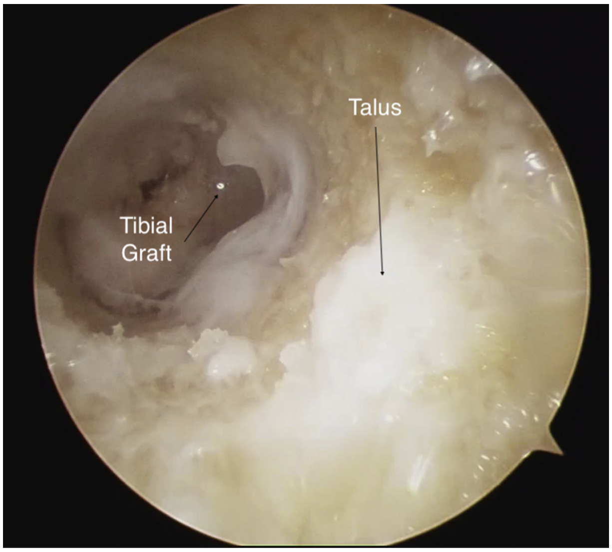

Fig 8. Final arthroscopic view of the tibial graft inside the drilled tunnel on the talar dome.

Table 1. Step-by Step Retrograde Drilling With Tibial Autograft in Osteochondral Lesions of the Talar Dome

Step	Description
1	The patient is positioned prone with the ankle draped and hanging freely over the edge of the table.
2.	With the ankle in a neutral position, the landmarks are drawn. A straight line is drawn from the tip of the lateral malleolus to the Achilles tendon, parallel to the sole of the foot. The posterolateral and posteromedial portals are made above this line and near the Achilles tendon.
3.	We routinely use an accessory posterolateral portal, 1 cm proximal to the conventional posterolateral portal.
4.	We perform retrograde drilling using the posterolateral portal and the arthroscope placed in the accessory posterolateral portal. Under the fluoroscopic control, anteroposterior and lateral images of the ankle are obtained to decide the direction of the guidewire.
5.	A Kirschner wire 1.2 mm in diameter is inserted and the tip of the wire is advanced from the posterolateral talus toward the lesion so as not to penetrate the chondral layer.
6.	The K-wire is over-reamed with an 8.0-mm cannulated reamer, avoiding damage to the cartilage covering. The necrotic tissue is removed sing a curette, spoon, or mini-shaver, preserving the cartilage layer covering the defect.
7.	Placing the scope in the conventional posterolateral portal, we proceed to harvest the cancellous bone graft cylinder from the distal tibia through the posteromedial portal using a trephine of the same diameter as the drilled tunnel.
8.	After dissection of the sclerotic area at the top of the tunnel, the arthroscope is changed to the accessory posterolateral portal.
9.	Through the conventional posterolateral portal, the trephine loaded with the viable autologous cancellous bone cylinder is placed and plugged it underneath the chondral roof through the drill-hole in a press-fit manner.
10.	After surgery, a soft bandage is placed in all patients.

Table 2. Pearls, Pitfalls, and Risks

Pearls

- The correct preoperative planning and identification of the osteochondral lesion are essential to formalize the indication of this surgical technique
- Patient position and instrument organization of the operating room must allow the use of both the arthroscopy tower and the image intensifier
- Take special care when drilling the tunnel not to damage the articular cartilage of the talar dome
- We recommend having previous experience in posterior ankle arthroscopy, as it is a particularly demanding technique
- Use a trephine of the same diameter as the tunnel to facilitate the introduction and impact of the graft

Pitfalls and risks

- This technique should not be used extensively, as it is indicated only in stable cystic lesions type V of the Hepple classification (Table 4)
- Excessive deep drilling can injure overlying cartilage
- Failure to use arthroscopic assistance may lead to errors in the indication and ignore associated injuries
- Risk of injury to the posterior neurovascular structures: the sural nerve in the lateral region and the tibial neurovascular bundle medially
- Damage to the Achilles tendon
- Damage of the flexor hallucis longus tendon
- Iatrogenic injury to the medial calcaneal branch of the tibial nerve

Table 3. Advantages and Limitations

Advantages

Minimally invasive technique without need for malleolar osteotomy
Avoid damaging the articular cartilage
No additional bone grafting, aiming devices, or navigation are needed
Treatment option in mid-size osteochondral lesion of the talus after failed conservative therapy with an intact cartilage surface

Limitations

Risk of chondral lesion if the drilling goes to deep
Long learning curve
Technically demanding procedure
Experience in posterior ankle arthroscopy to avoid complications such as neurovascular injuries

Table 4. Hepple Classification System

Stage	Findings
I	Articular cartilage injury only
IIA	Cartilage injury with bony fracture and edema (flap, acute)
IIB	Cartilage injury with bony fracture and without bony edema (chronic)
III	Detached, nondisplaced bony fragment (fluid rim beneath fragment)
IV	Displaced fragment, uncovered subchondral bone
V	Subchondral cyst present

References

1. Berndt AL, Harty M. Transchondral fractures (osteochondritis dissecans) of the talus. *J Bone Joint Surg Am* 1959;41:988-1020.
2. Flick AB, Gould N. Osteochondritis dissecans of the talus (transchondral fractures of the talus): review of the literature and new surgical approach for medial dome lesions. *Foot Ankle Int* 1985;5:165-185.
3. Deol PPS, Cuttica DJ, Smith WB, Berlet GC. Osteochondral lesions of the talus: Size, age, and predictors of outcomes. *Foot Ankle Clin N Am* 2013;18:13-34.
4. Al-Shaikh RA, Chou LB, Mann JA, Dreeben SM, Prieskom D. Autologous osteochondral grafting for talar cartilage defects. *Foot Ankle Int* 2002;23:381-389.
5. Kumai T, Takakura Y, Kitada C, Tanaka Y, Hayashi K. Fixation of osteochondral lesions of the talus using cortical bone pegs. *J Bone Joint Surg Br* 2002;84:369-374.
6. Robinson DE, Winson IG, Harries WJ, Kelly AJ. Arthroscopic treatment of osteochondral lesions of the talus. *J Bone Joint Surg Br* 2003;85:989-993.
7. Sasaki K, Ishibashi Y, Sato H, Toh S. Arthroscopically assisted osteochondral autogenous transplantation for osteochondral lesion of the talus using a transmalleolar approach. *Arthroscopy* 2003;19:922-927.
8. van Dijk CN, Scholte D. Arthroscopy of the ankle joint. *Arthroscopy* 1997;13:90-96.
9. y Rico JV, Thies CO, Sanchez GP. Arthroscopic posterior subtalar arthrodesis: Surgical technique. *Arthrosc Tech* 2016;5:e85-e88.
10. Van Dijk CN, Scholten PE, Krips R. A 2-portal endoscopic approach for diagnosis and treatment of posterior ankle pathology. *Arthroscopy* 2000;16:871-876.
11. Hyer CF, Berlet GC, Philbin TM, et al. Retrograde drilling of osteochondral lesions of the talus. *Foot Ankle Spec* 2008;1:207-209.
12. Corominas L, IJr Sanpera, Masrouha K, et al. Retrograde percutaneous drilling for osteochondritis dissecans of the head of the talus: Case report and review of the literature. *J Foot Ankle Surg* 2014;55:328-332.
13. Canale ST, Belding RH. Osteochondral lesions of the talus. *J Bone Joint Surg Am* 1980;62:97-102.
14. Bruns J, Rosenbach B. Osteochondrosis dissecans of the talus. Comparison of results of surgical treatment in adolescents and adults. *Arch Orthop Trauma Surg* 1992;112:23-27.

15. Zengerink M, Szerb I, Hangody L, Dopirak RM, Ferkel RD, van Dijk CN. Current concepts: treatment of osteochondral ankle defects. *Foot Ankle Clin* 2006;11:331-359.
16. Takao M, Ochi M, Naito K, Uchio Y, Kono T, Oae K. Arthroscopic drilling for chondral, subchondral, and combined chondral-subchondral lesions of the talar dome. *Arthroscopy* 2003;19:524-530.
17. Kumai T, Takakura Y, Higashiyama I, Tamai S. Arthroscopic drilling for the treatment of osteochondral lesions of the talus. *J Bone Joint Surg Am* 1999;81:1229-1235.
18. Taranow WS, Bisignani GA, Towers JD, Conti SF. Retrograde drilling of osteochondral lesions of the medial talar dome. *Foot Ankle Int* 1999;20:474-480.
19. Bale RJ, Hoser C, Rosenberger R, Rieger M, Benedetto KP, Fink C. Osteochondral lesions of the talus: Computer-assisted retrograde drilling—feasibility and accuracy in initial experiences. *Radiology* 2001;218:278-282.