Technical Note

Arthroscopic Treatment of Osteochondral Lesions of the Talus With Microfracture and Platelet-Rich Plasma-Infused Micronized Cartilage Allograft

Daniel J. Cunningham, M.D., M.H.Sc., and Samuel B. Adams, M.D.

Abstract: Osteochondral lesions of the talus (OLTs) are difficult to treat. Arthroscopic microfracture augmented with micronized cartilage (BioCartilage; Arthrex, Naples, FL) and platelet-rich plasma is emerging as a treatment for moderate-sized, well-contained full-thickness OLTs. This treatment may provide superior histologic results and is less technically demanding and yields less morbidity than an open osteochondral allograft or autograft transfer. This technique guide presents the senior author's preferred strategy for treatment of a moderate-sized OLT with arthroscopic microfracture and placement of micronized cartilage and platelet-rich plasma.

Osteochondral lesions of the talus (OLTs) are a diverse group of pathologies that encompass osteochondritis dissecans, osteochondral defects, and osteochondral fractures. These lesions often arise idiopathically or are related to acute trauma or repetitive microtrauma. OLTs are challenging to treat because of their complex geometry and poor innate biology. Nonoperative treatment consisting of physical therapy, nonsteroidal anti-inflammatory medications, and protected weight bearing may be successful in treating approximately 50% of cases.[1,2]

Several treatment strategies exist to address OLTs, falling into the general categories of cartilage repair, cartilage regeneration, or cartilage replacement.[3] Cartilage repair strategies include bone marrow stimulation with microfracture and retrograde drilling. Cartilage regeneration strategies include autologous chondrocyte implantation and its derivatives, along with autologous matrix-induced chondrogenesis from bone marrow–derived cells or platelet-rich plasma (PRP). Cartilage replacement strategies include osteochondral autografting or allografting and particulated juvenile cartilage allograft transplantation. There are limited comparative data regarding strategy selection.

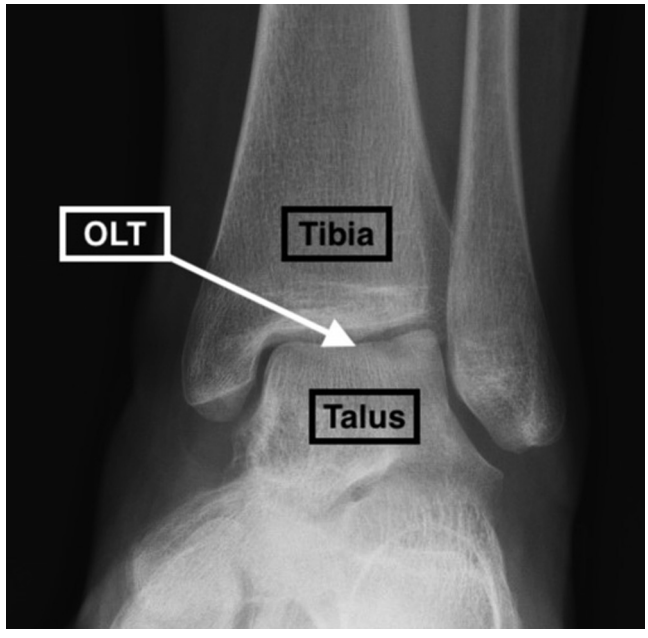

Fig 1. Anteroposterior radiographic view of left ankle showing osteochondral lesion of lateral talus (OLT).

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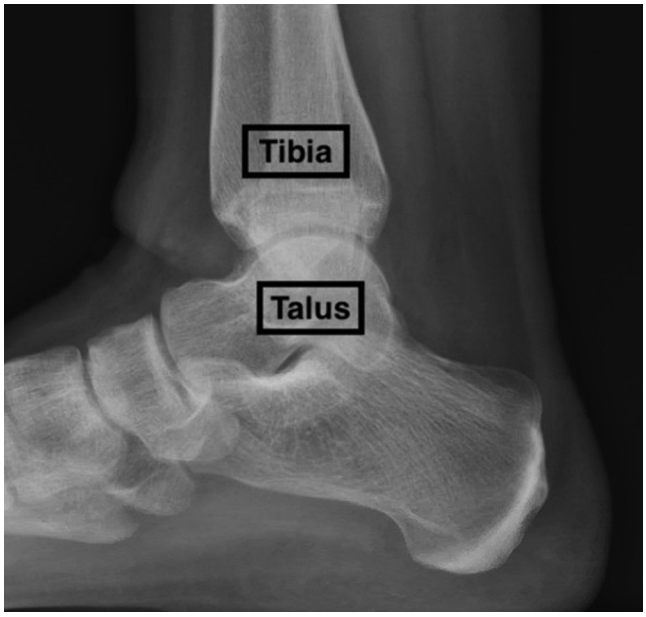

Fig 2. Lateral radiographic view of left ankle.

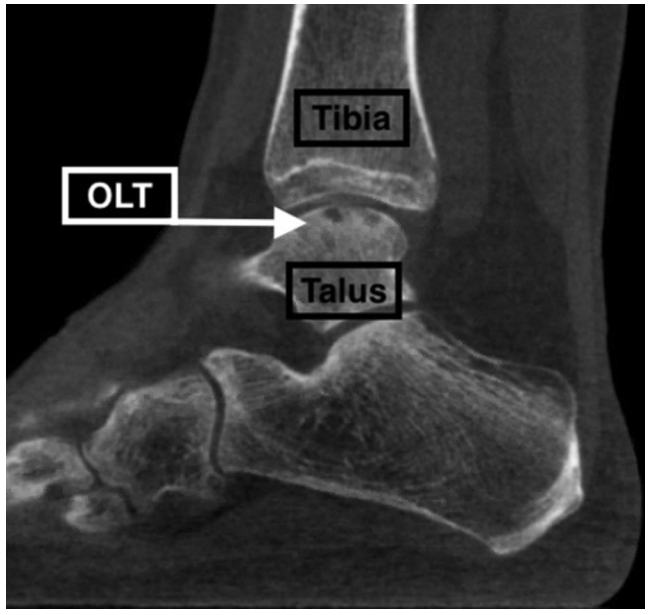

Fig 4. Sagittal computed tomography scan view of left ankle showing osteochondral lesion of lateral talus (OLT).

However, cartilage repair strategies such as microfracture are commonly used for small lesions of less than 1.5 cm^2, whereas larger lesions may require cartilage regeneration or replacement.[4] Uncontained defects may require osteochondral autografting or allografting.

Microfracture has long been the gold standard for small-scale cartilage repair in the ankle because of its ease of performance and low cost.[5,6] However, microfracture generates biomechanically and biologically inferior fibrocartilage.[7-9] Despite this, microfracture for OLTs has shown acceptable symptomatic and functional improvement, at least in the short term.[10-12]

Microfracture augmented with PRP-infused micronized cartilage allograft (BioCartilage; Arthrex, Naples, FL) is a cartilage repair and regeneration strategy that

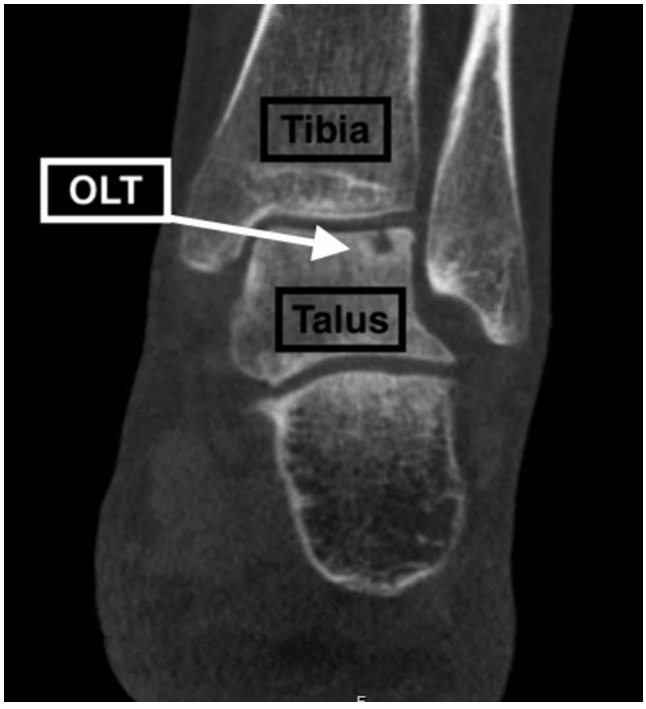

Fig 3. Coronal computed tomography scan view of left ankle showing osteochondral lesion of lateral talus (OLT).

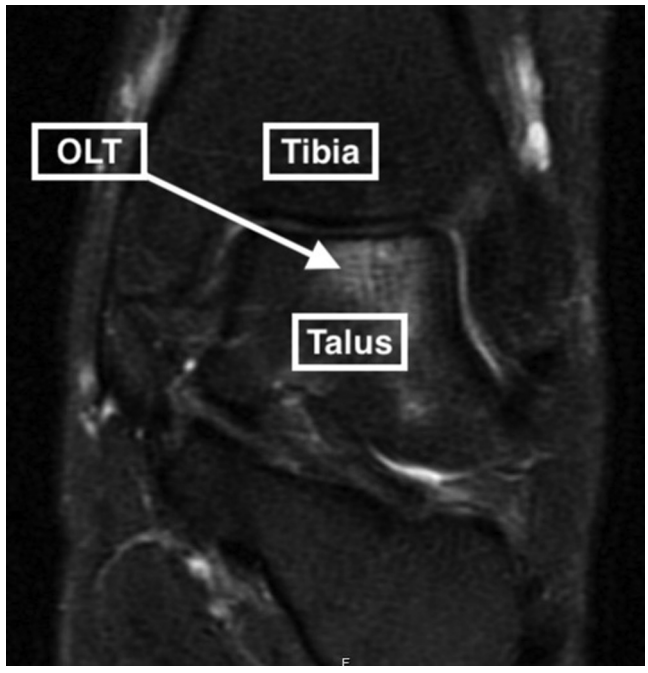

Fig 5. Coronal magnetic resonance imaging scan view of left ankle showing osteochondral lesion of lateral talus (OLT).

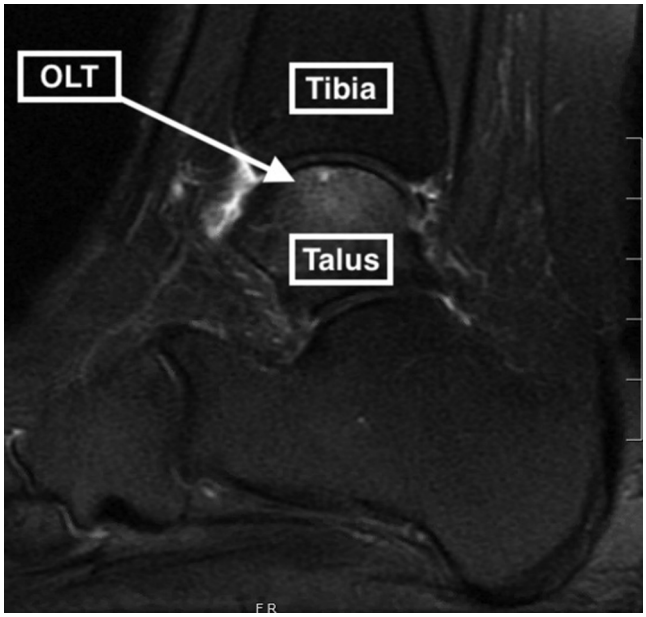

Fig 6. Sagittal magnetic resonance imaging scan view of left ankle showing osteochondral lesion of lateral talus (OLT).

has gained popularity for treating full-thickness hip chondral defects.[13] BioCartilage acts as a scaffold for local microfracture-derived mesenchymal stem cell growth and chondrogenic differentiation in contrast to the hematoma formed in microfracture, which is not contained by a cap. Known complications of microfracture and BioCartilage application are similar to those of microfracture alone and include soft-tissue overgrowth, delamination, and sclerosis. This article details the preferred strategy of the senior author (S.A.B.) for BioCartilage application for small to moderate sized OLTs.

Surgical Technique

Plain radiographs, computed tomography scans, and magnetic resonance imaging scans can be used to assess the extent of the lesion (Figs 1-6). The patient is placed supine on a standard operating room table. The thigh is placed in a well-padded holder to elevate the leg off the bed. A thigh tourniquet is placed. After induction of anesthesia, standard sterile preparation and draping are performed. Anesthesia staff obtain an appropriate volume of blood for processing into PRP. The ankle is placed in a sterile traction device (Noninvasive Ankle Distractor Set with Ankle Arthroscopy Distractor Strap; Arthrex) to provide steady distraction through the ankle joint. A spinal needle is placed through the skin at the soft spot between the tibialis anterior tendon and the medial malleolus to localize the ankle joint space. A longitudinal 2-mm incision is made at this location. A trocar is placed into the joint to establish the medial ankle portal. The camera is inserted into the medial portal. Under direct visualization, a spinal needle is inserted at the soft spot between the peroneus tertius and the lateral malleolus to determine the location for the lateral ankle portal. A second longitudinal 2-mm incision is made through the skin at this location (Figs 7 and 8). A small-joint (2.5- or 3.5-mm) shaver is placed through the lateral portal, and initial debridement of hypertrophic, inflamed synovium is performed (Fig 9).

Next, a probe is introduced, and diagnostic arthroscopy is carried out to inspect all cartilage surfaces and the synovium. The margins of the spongy and delaminated cartilage are palpated with a probe or cup curette, as shown in Figure 10.

Cup and/or ring curettes and elevators are used to debride the diseased cartilage to subchondral bone

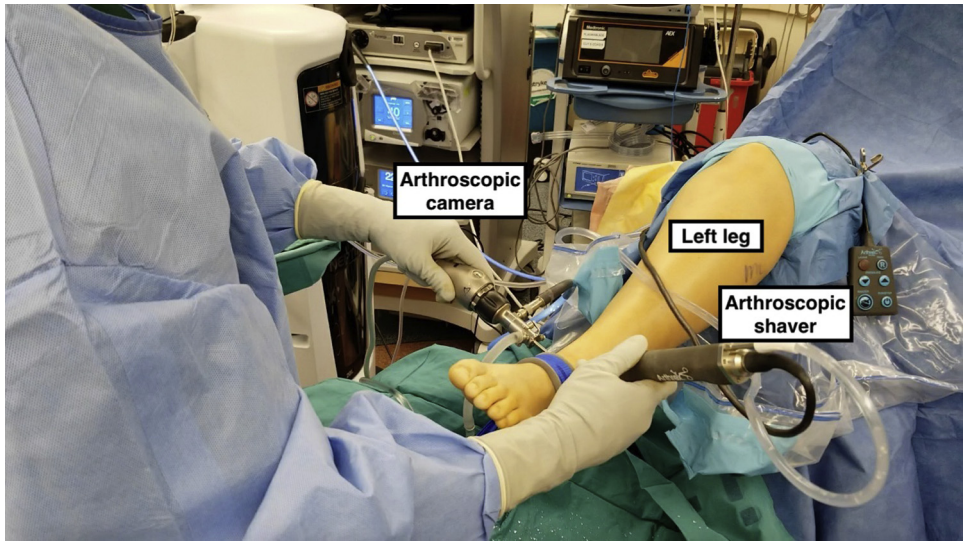

Fig 7. Operating room setup for left ankle arthroscopy with patient in supine position, ankle in sterile traction device, arthroscopic camera viewing lateral talus from anteromedial portal, and arthroscopic shaver or other instrument addressing lateral talus from anterolateral portal.

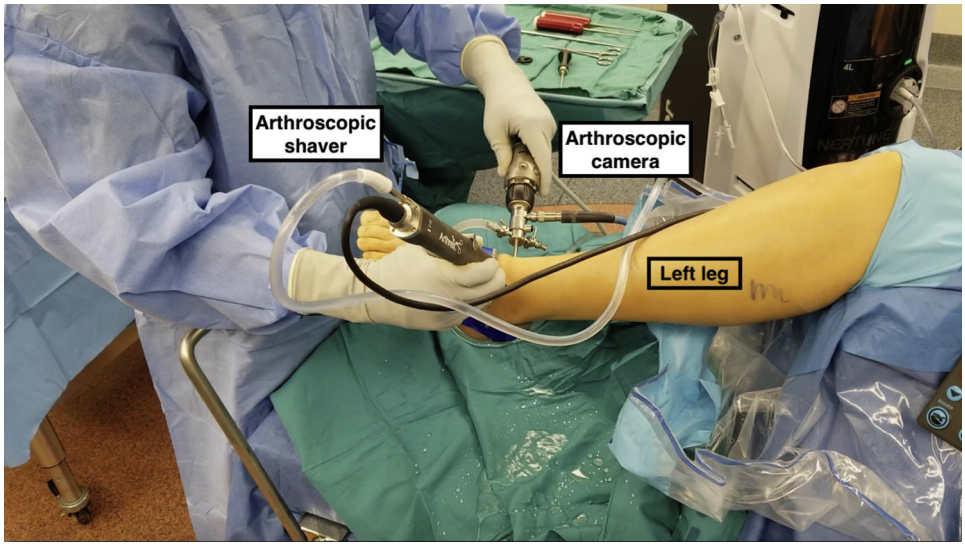

Fig 8. Additional view of operating room setup for left ankle arthroscopy with patient in supine position, ankle in sterile traction device, arthroscopic camera viewing lateral talus from anteromedial portal, and arthroscopic shaver or other instrument addressing lateral talus from anterolateral portal.

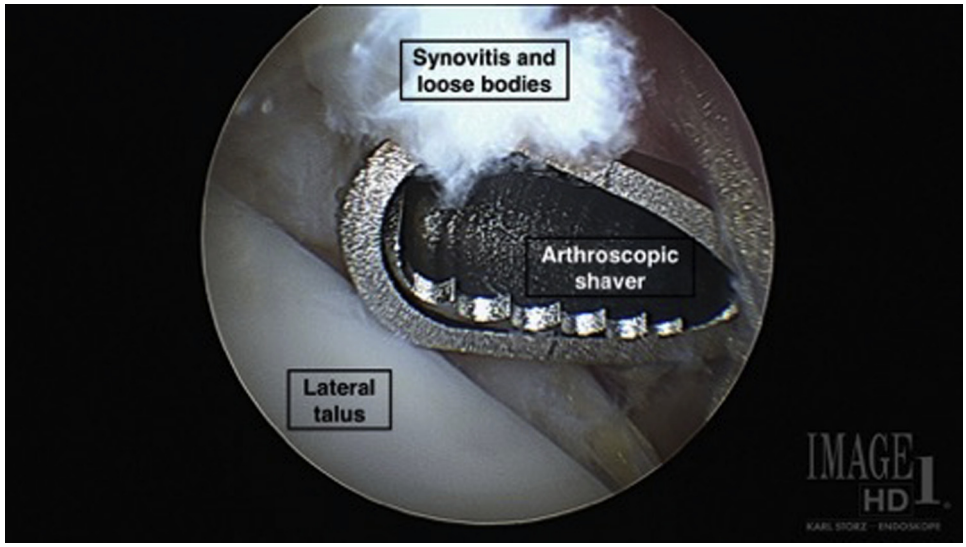

Fig 9. Arthroscopic shaver removing synovitis in left anterior tibiotalar joint at anterolateral portal site viewed from anteromedial portal.

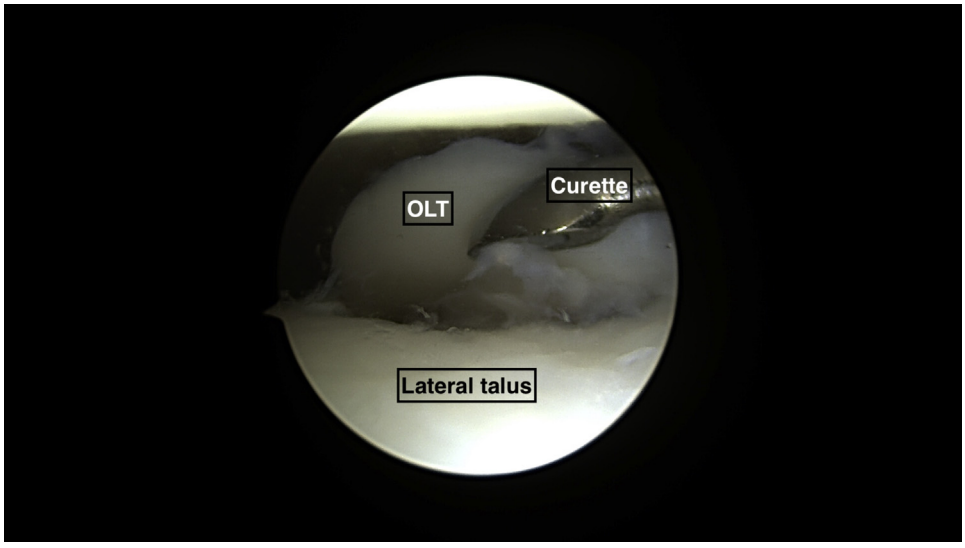

Fig 10. Cup curette used to delineate margins of spongy cartilage at left lateral talus viewed from anteromedial portal. (OLT, osteochondral lesion of talus.)

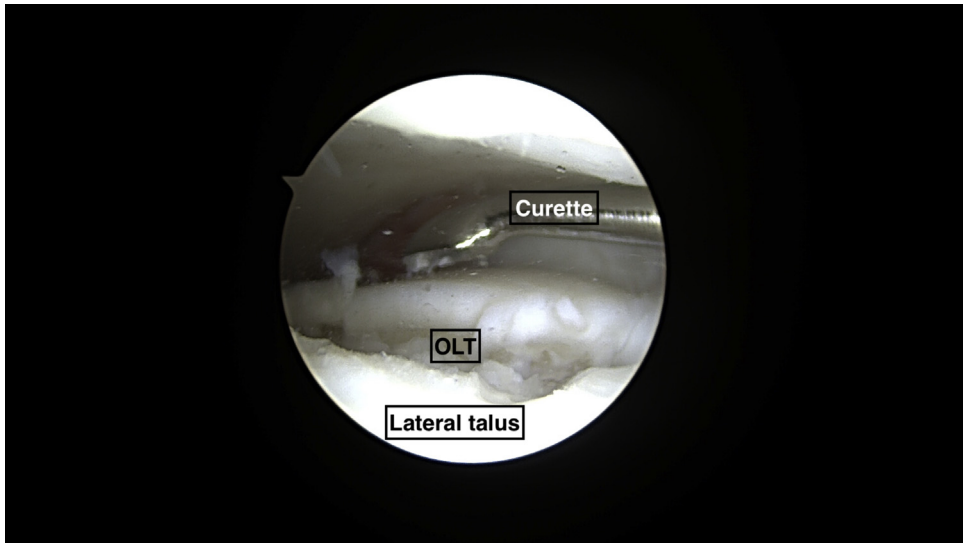

Fig 11. Cup curette used to remove diseased cartilage at left lateral talus viewed from anteromedial portal. (OLT, osteochondral lesion of talus.)

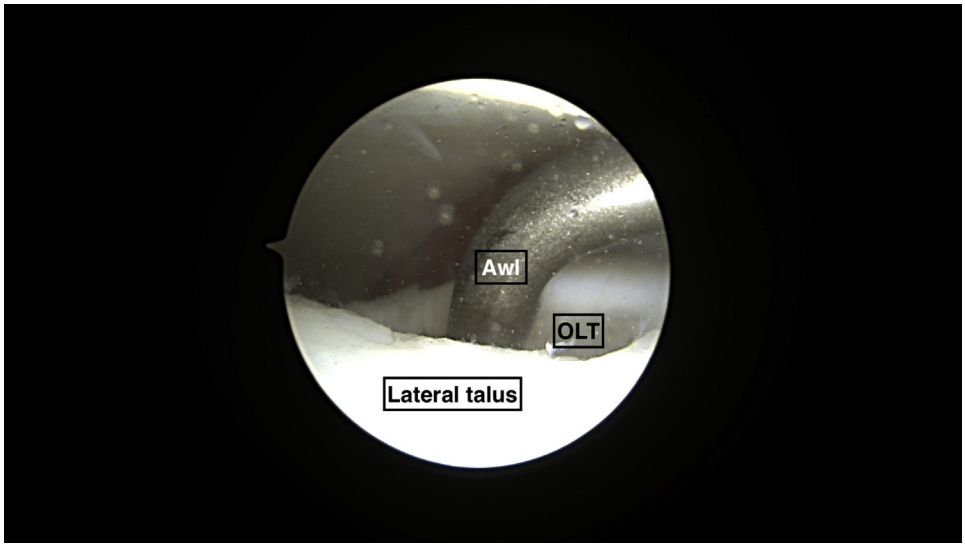

Fig 12. Vertical shoulder at margin of left lateral talus viewed from anterolateral portal. (OLT, osteochondral lesion of talus.)

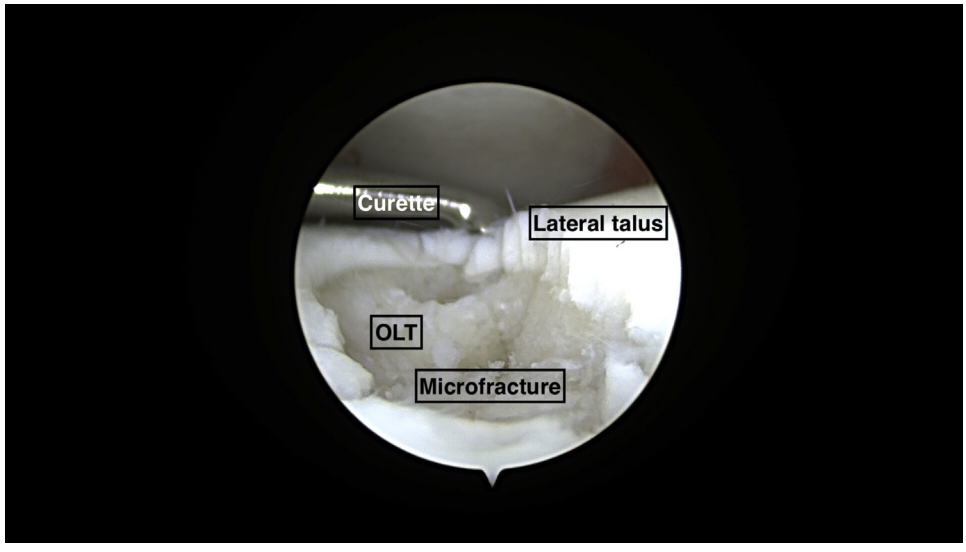

Fig 13. Removal of loose debris at left lateral talus with shaver viewed from anterolateral portal. (OLT, osteochondral lesion of talus.)

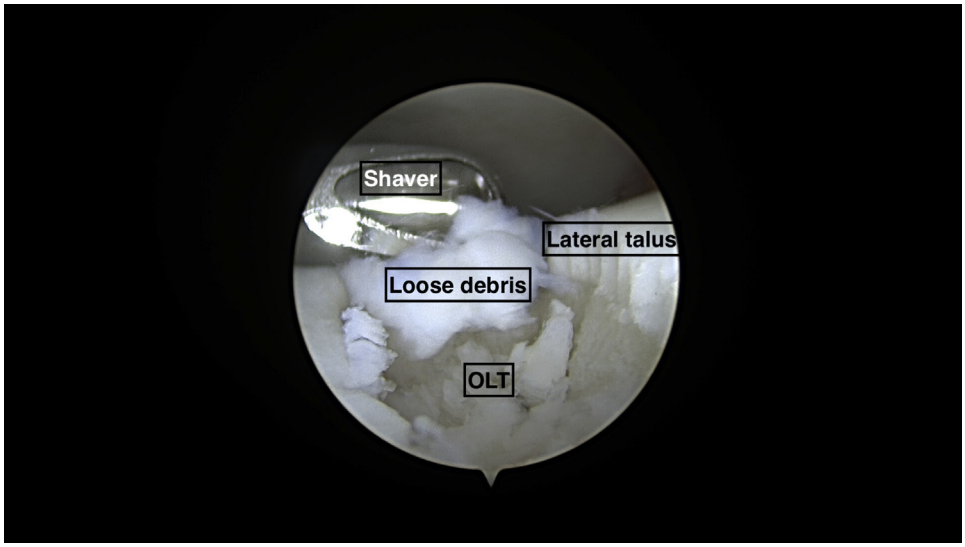

Fig 14. Awl penetrating subchondral bone within defect at left lateral talus with release of fatty marrow viewed from anteromedial portal. (OLT, osteochondral lesion of talus.)

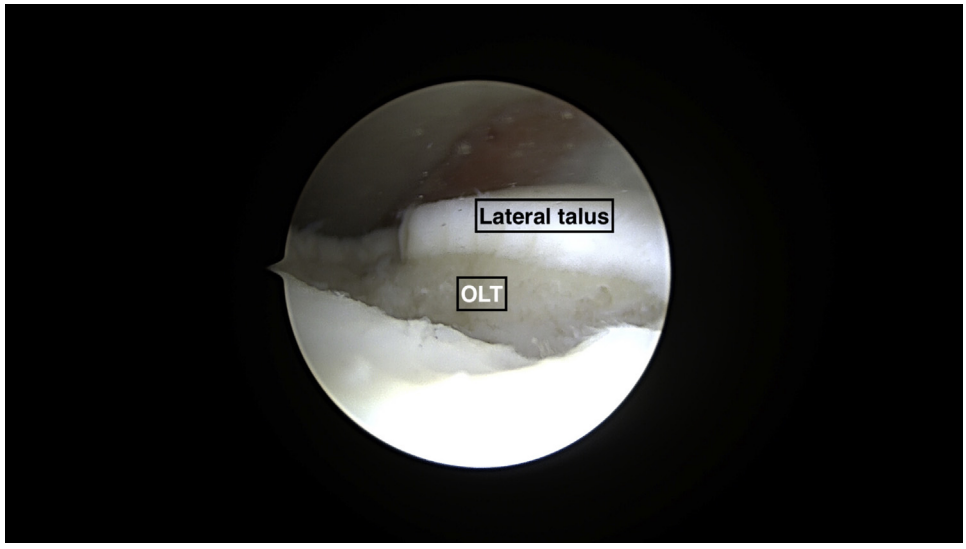

Fig 15. Left lateral talus prepared with stable vertical shoulder viewed from anteromedial portal. (OLT, osteochondral lesion of talus.)

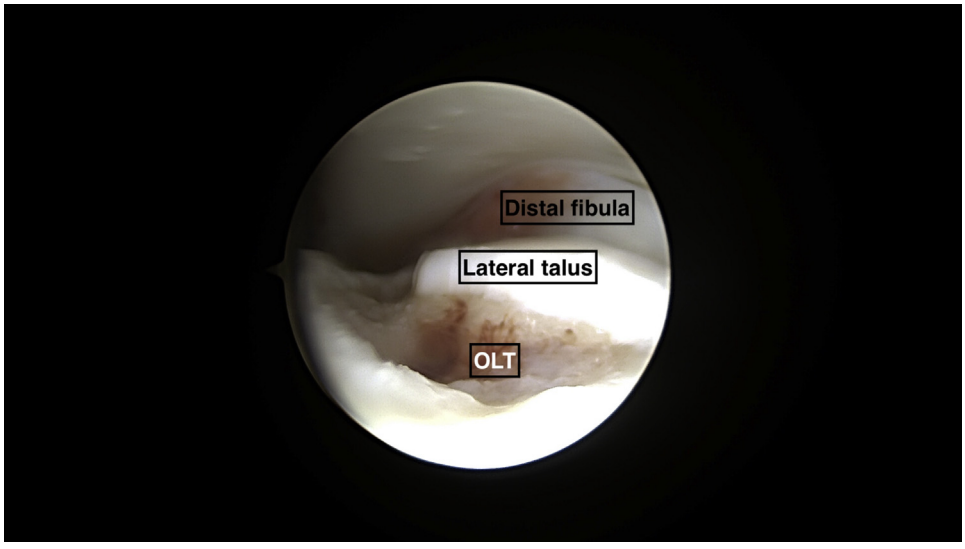

Fig 16. Left tibiotalar joint desiccated through use of swabs viewed from anteromedial portal. (OLT, osteochondral lesion of talus.)

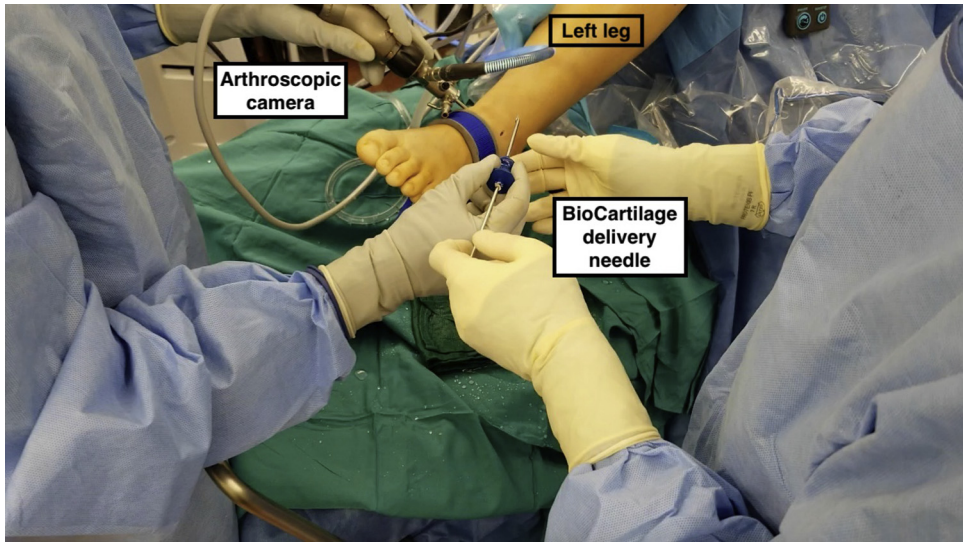

Fig 17. BioCartilage delivery needle being prepared to be placed through anterolateral portal of left ankle with arthroscopic camera viewing from anteromedial portal.

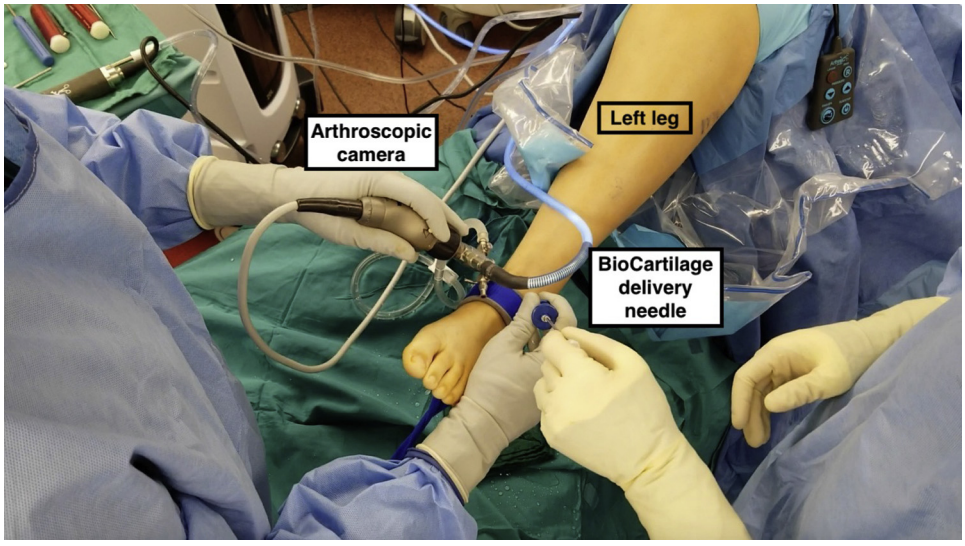

Fig 18. BioCartilage delivery needle passed into left tibiotalar joint through anterolateral portal with arthroscopic camera viewing from anteromedial portal.

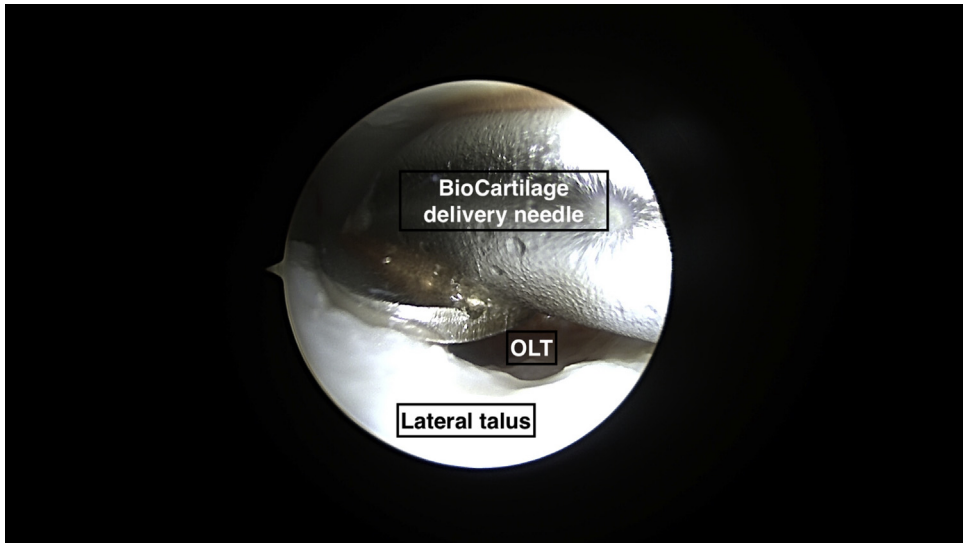

Fig 19. BioCartilage delivery needle over left lateral talus defect viewed from anteromedial portal. (OLT, osteochondral lesion of talus.)

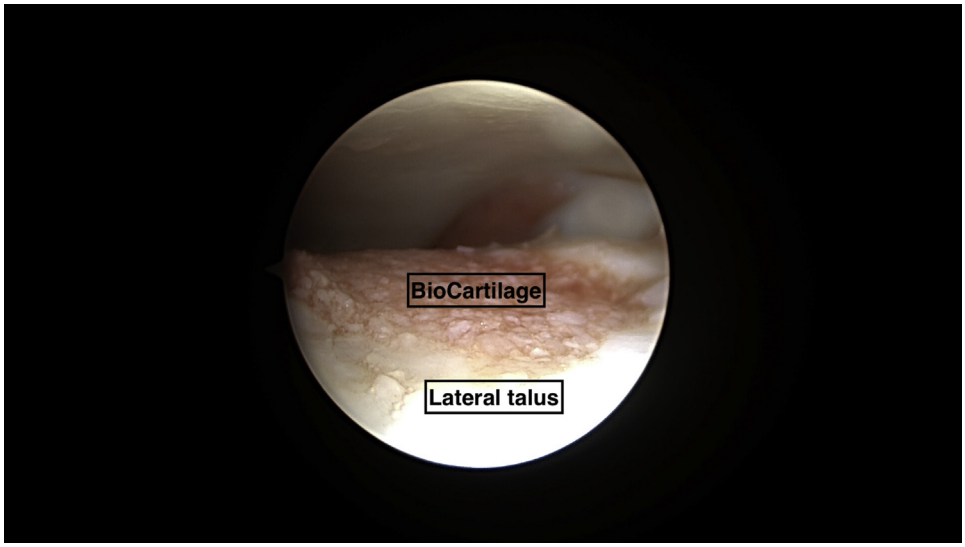

Fig 20. BioCartilage and platelet-rich plasma mixture placed into left lateral talus defect viewed from anteromedial portal.

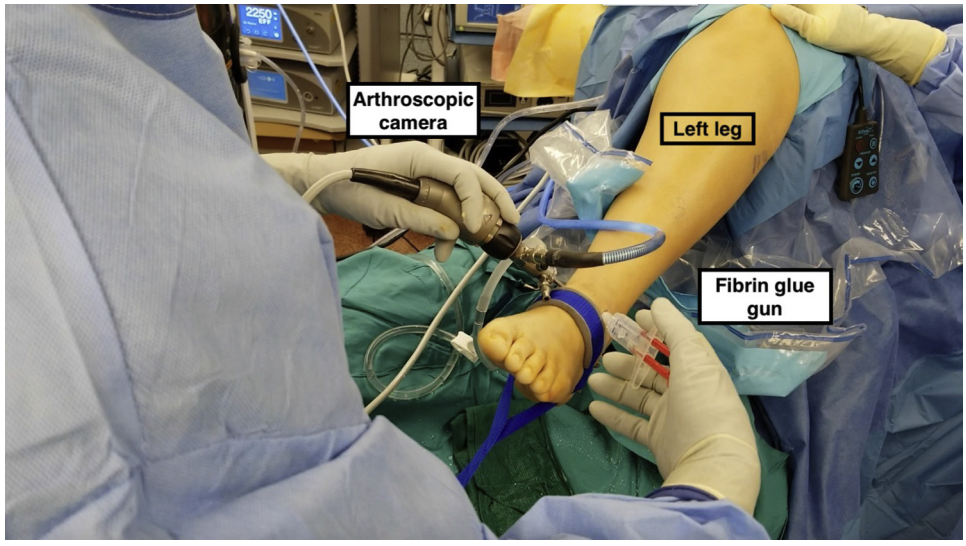

Fig 21. Fibrin glue gun passed into left tibiotalar joint through anterolateral portal with arthroscopic camera viewing from anteromedial portal.

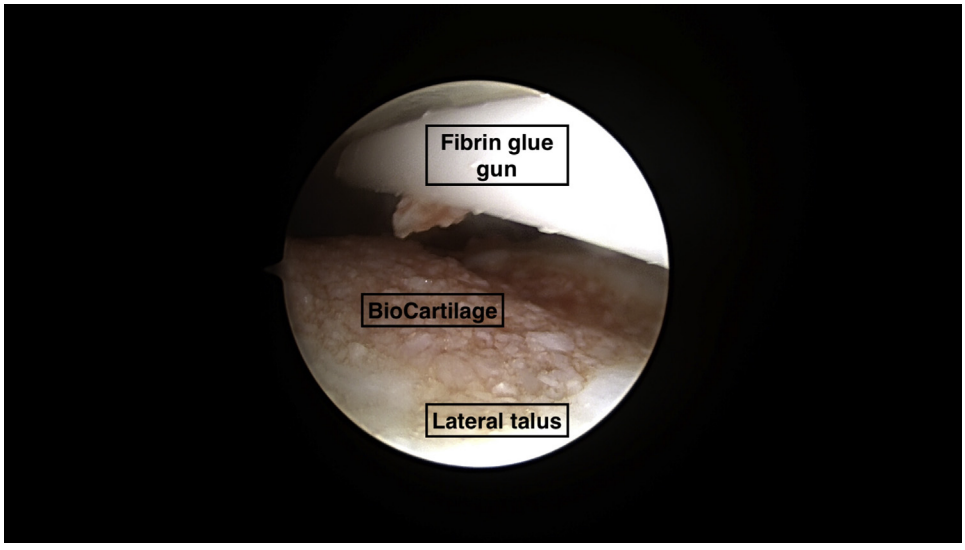

Fig 22. Fibrin cap applied to BioCartilage within left lateral talus defect viewed from anteromedial portal.

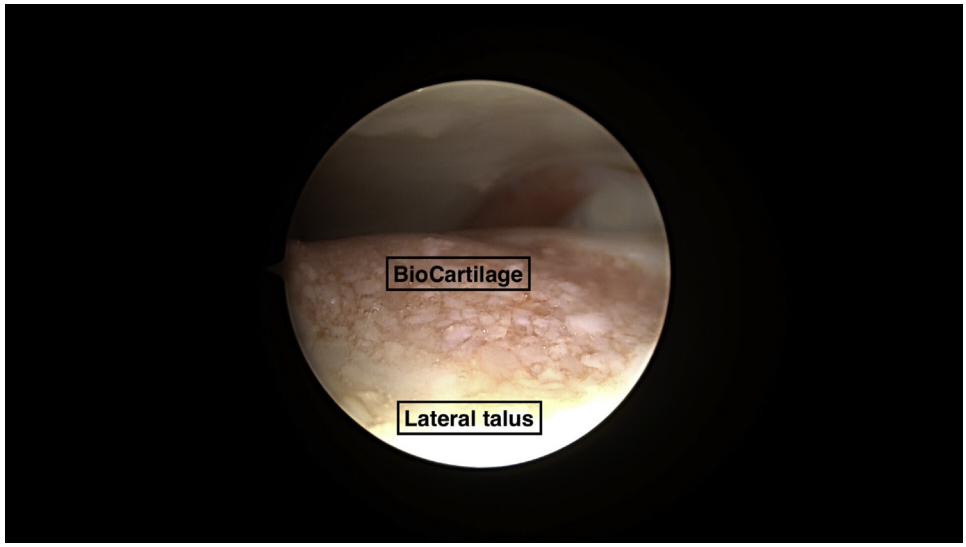

Fig 23. Final view of BioCartilage with fibrin cap at left lateral talus viewed from anteromedial portal.

(Figs 11 and 12), with care taken to leave a vertical shoulder, whenever possible, on the edges of the lesion to assist with containing the future graft material. Loose debris is removed from the joint with the shaver (Fig 13). The lesion size can then be measured.

Marrow stimulation is performed with an awl to release underlying marrow contents, as shown in Figure 14. With the lesion thoroughly debrided of delaminated cartilage, a stable shoulder created, and the subchondral bone marrow stimulated (Fig 15), the arthroscopic fluid is turned off and the remaining intra-articular fluid is evacuated. Ankle swabs from the Mixing and Delivery Kit, Small Joint (Arthrex) are passed through the portals to any areas of residual fluid to further desiccate the joint, as shown in Figure 16.

On the back table, the dehydrated BioCartilage scaffold is mixed with the PRP to achieve a thick but smooth consistency. The suggested mixture is 1 part BioCartilage to 0.8 parts blood product (typically PRP,

Table 1. Technical Pearls and Pitfalls During Treatment of OLTs With BioCartilage

Topic	Pitfalls	Pearls
Exposure	Difficult joint visualization	The appropriate trajectory of the planned portal sites should be ensured using a needle. This can be achieved under fluoroscopy if needed. If an arthroscopic approach appears infeasible, an open approach should be considered. Distraction, dorsiflexion, plantar flexion, varus, and valgus forces can be applied across the tibiotalar joint to improve visualization. The gastrocnemius-soleus complex can be relaxed using a thigh holder to promote knee flexion.
Debridement	Difficult lesion debridement	A small curved cup or ring curettes should be used to create a clean vertical cartilage edge.
Lesion containment	Lesion becomes uncontained during debridement	Only delaminated, loose cartilage should be removed to reach healthy bleeding bone. Preoperative imaging should be closely scrutinized to ensure that the lesion is likely amenable to the planned surgical technique, and alternative options should be ready.
Joint desiccation	Defect submerged in fluid	A suction shaver should be used to remove bulk liquid from the joint; then, joint sponges should be used to remove residual liquid.
Graft preparation	PRP unavailable	Use of bone marrow aspirate concentrate should be considered.
Graft placement	Graft escapes defect during BioCartilage delivery	The BioCartilage should be delivered in small increments. If needed, a freer elevator can be used to smooth the defect. In case of a large BioCartilage spill that cannot be swept into the defect, a Frasier suction tip can be used to remove BioCartilage from the joint in a controlled manner.
Fibrin cap placement	Fibrin cap sits proud	The surgeon should ensure that the BioCartilage sits slightly recessed to the surrounding vertical cartilage wall to accommodate a small layer of fibrin glue.

OLT, osteochondral lesion of talus; PRP, platelet-rich plasma.

Table 2. Advantages and Disadvantages Regarding Treatment of OLTs With BioCartilage

Topic	Advantages	Disadvantages
Wound healing	The arthroscopic approach and instrumentation allow for minimally invasive treatment of OLTs.	Exposure can be challenging, and an arthroscopic technique may need to be aborted.
BioCartilage graft	Graft conforms to the shape of the defect and avoids donor-site morbidity and the need to use a bulk allograft.	A stable vertical shoulder is required for graft containment.
Outcomes	Micronized allograft cartilage with PRP may allow improved healing of these challenging lesions.	No long-term comparative human studies exist yet.

OLT, osteochondral lesion of talus; PRP, platelet-rich plasma.

but bone marrow aspirate concentrate can be used). After thorough mixing and placement of the BioCartilage into the delivery needle, the delivery needle is advanced through the appropriate portal and the mixture is pushed through the delivery needle with the obturator opening facing the OLT, as shown in Figures 17-19. Care must be taken not to deliver too much BioCartilage into the defect.

The mixture should sit slightly recessed from the cartilage edge to allow for the placement of a fibrin cap (Fig 20). The delivery needle or a freer elevator is used to smooth the BioCartilage product. If needed, excess mixture can be removed from the defect with the freer elevator, curette, or similar instrument. Finally, a fibrin cap is applied over the defect (Figs 21 and 22), with care taken to ensure that the fibrin cap does not sit proud on the BioCartilage base, as shown in Figure 23. The fibrin sealant is allowed to set for about 1 minute; then, traction is removed and dorsiflexion of the ankle is performed to keep the BioCartilage contained and molded to the tibia. This position is held for 5 minutes. Video 1 shows the key steps of lesion definition, OLT debridement, microfracture, joint desiccation, placement of BioCartilage into the defect, smoothing of the surface with a freer elevator, and application of a fibrin cap to the BioCartilage.

The tourniquet is deflated, and the portals are closed with nonabsorbable suture. A well-padded short-leg splint is then applied with the ankle in a neutral position, and the patient is kept immobilized and made non–weight bearing until 2 weeks after surgery, at which time sutures are removed. The patient is then placed in a removable boot, and the non–weight-bearing status is continued, with the exception of removal of the boot for intermittent range-of-motion exercises. At 6 weeks postoperatively, the patient progresses to full weight bearing in the boot, with gradual weaning from its use. The patient may progress through using a lace-up ankle brace. We routinely begin physical therapy and other exercises at 6 weeks postoperatively but ask that the patient refrain from impact activities until 6 months postoperatively.

Discussion

This Technical Note details the senior author's preferred method using BioCartilage in conjunction with microfracture to address small to moderate sized cartilage defects with stable cartilage margins. Pearls and pitfalls of this technique are shown in Table 1. BioCartilage is composed of micronized allograft cartilage combined with PRP to form a paste that can be applied to OLTs in conjunction with microfracture. The micronized cartilage acts as a scaffold for stem cell recruitment and differentiation,[14] whereas PRP may improve migration and chondrogenic differentiation of subchondral stem cells liberated by microfracture.[15] In an equine model of full-thickness chondral defects, BioCartilage was shown to improve cartilage repair compared with microfracture alone.[16] Use of BioCartilage is less technically demanding and invasive than osteochondral grafting and appears to improve outcomes compared with microfracture alone. However, despite the early encouraging results, there are no long-term comparative studies of BioCartilage, and further work is needed to prove the clinical efficacy for OLTs. Advantages and disadvantages of the treatment of OLTs with BioCartilage are shown in Table 2.

Specific risks of arthroscopic treatment of OLTs with the described technique include graft hypertrophy and/or overgrowth, delamination, progression of disease, and no relief of pain or improvement in function, as well as the risks of ankle arthroscopy including damage to surrounding structures, infection, bleeding, and need for future surgery. This technique should not be used to address uncontained lesions without a vertical shoulder because the graft material has little intrinsic structural stability. Furthermore, this technique is intended for small to moderate sized individual defects and should not be used diffusely throughout an arthritic joint given the importance of lesion size in clinical outcomes.[4] We prefer to use BioCartilage to supplement the biological capacity of microfracture rather than to extend the indications for microfracture.

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