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Boguslaw Sadlik, MD, PhD¹, Adrian Blasiak, MD¹, Alexej Barg, MD², Victor Valderrabano, MD, PhD², and Martin Wiewiorski, MD²

Level of Evidence: Level V, expert opinion

Keywords: ankle arthroscopy, osteochondral lesions of the talus, cartilage repair, autologous matrix-induced chondrogenesis, dry ankle arthroscopy

Access to osteochondral lesions of the talus (OCLT) for osteochondral repair may be challenging, often requiring an osteotomy of the medial malleolus for exposure.^{1,10,15} Due to the confined ankle joint space and the location of the more frequently found medial OCLT,⁶ conventional arthroscopic treatment faces several technical difficulties and thus is usually limited to debridement and bone marrow stimulation procedures. Such procedures usually yield good short-term clinical results.^{3–5,13} Within the past decade, a number of novel techniques have been developed that aim to restore biomechanically superior hyaline-like cartilage. Examples of such procedures are matrix-associated autologous chondrocyte implantation (MACI),^{9,14} autologous matrix-induced chondrogenesis (AMIC),^{18,19} and hyaluron-based scaffold implantation.⁸ These techniques use a matrix to cover the defect after debridement, bone marrow stimulation, and optional cancellous bone grafting. Fibrin glue is typically used for matrix fixation on the defect. However, insertion and fixation of the matrix in a regular arthroscopic setup with a fluid-filled joint can be technically demanding or impossible. Dislocation, rolling, and loss of matrix are commonly encountered problems. This can be time-consuming and frustrating. A dry, fluid-free joint cavity for matrix insertion and fixation would be favorable. However, usually fluid is needed to inflate the confined space of the ankle joint and to retract the capsule from the anterior joint line to create adequate workspace.

To overcome this problem, the authors have developed a technique allowing for minimally invasive retraction of the joint capsule that creates a dry setup for matrix implantation.

Description of Technique

Under epidural or spinal anesthesia, the patient is placed in a supine position with a thigh tourniquet. The surgery starts with a conventional anterior arthroscopy via an anteromedial portal (Video 1, available online), and the precise location of

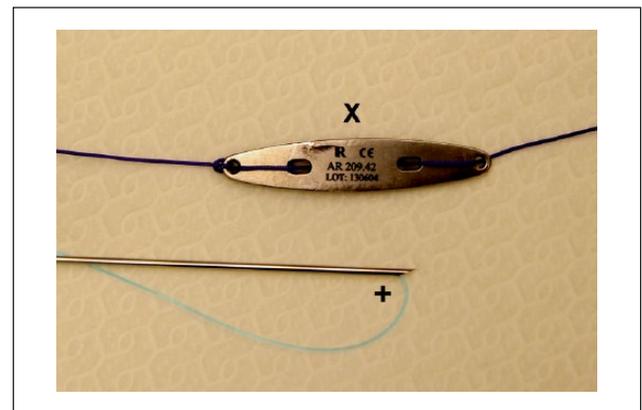


Figure 1. Plate preparation. A monofilament suture is placed through a cannulated spinal needle (+), and a braided suture is placed through the holes of the retracting plate (x).

the OCLT is determined. Next, the retraction system is installed, which consists of threads, a retraction plate (ATMED, Katowice, Poland), and a holder rod (Artromast; ATMED, Katowice, Poland) attached to the surgery table.

¹Orthopaedic Department, St Luke's Clinic, Bielsko-Biala, Poland

²Orthopaedic Department, University Hospital of Basel, Basel, Switzerland

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Corresponding Author:

Boguslaw Sadlik, MD, PhD, Orthopaedic Department, St Luke's Clinic, Bystrzanska 94B, 43-309 Bielsko-Biala, Poland.

Email: bs@lukasza.pl

Alexej Barg, MD, Orthopaedic Department, University Hospital of Basel, Spitalstrasse 21, CH-4031 Basel, Switzerland

Email: alexejbarg@mail.ru

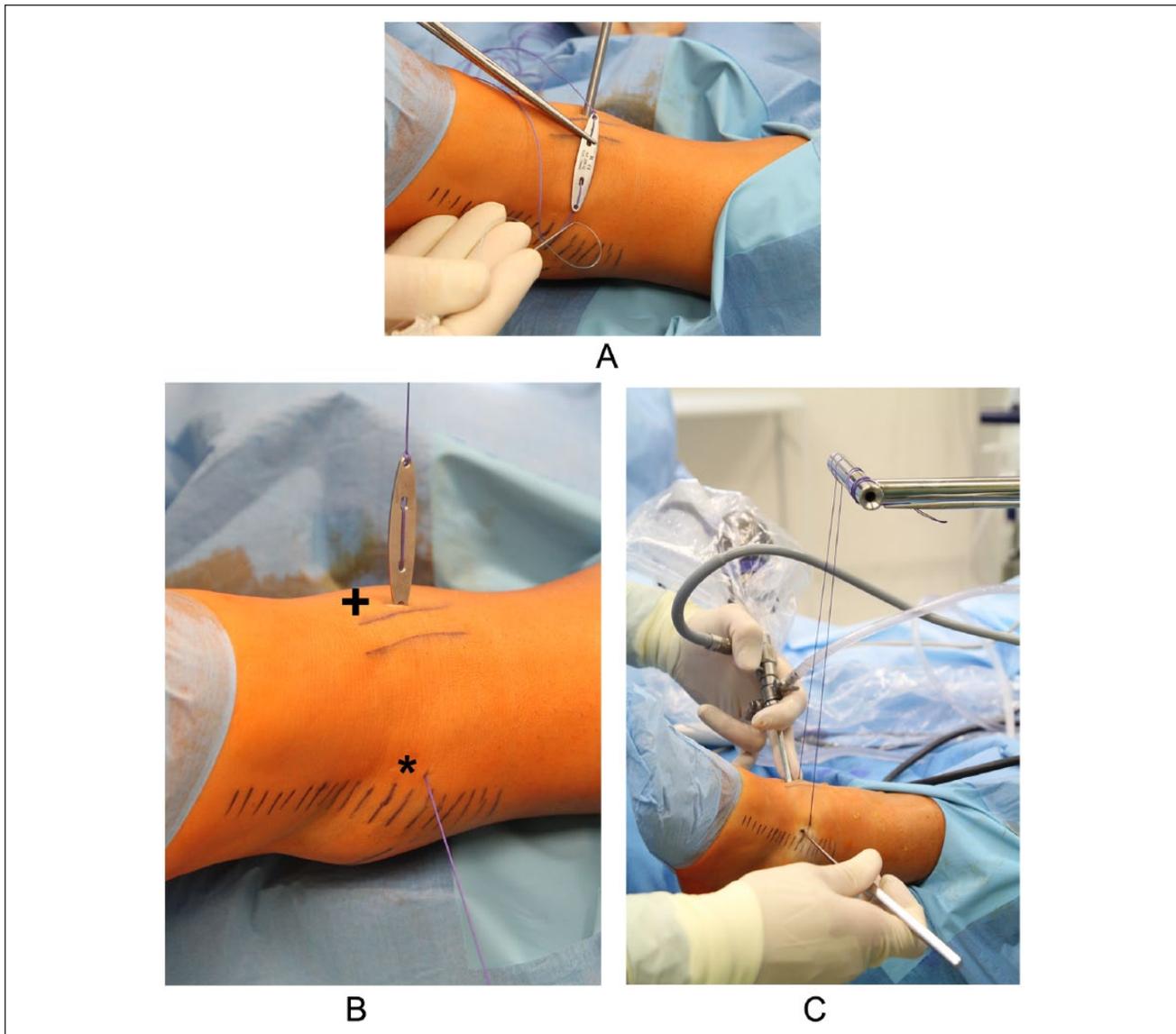


Figure 2. Plate insertion and placement. The anteromedial portal is created (A). The proximal end of the braided suture is inserted into the joint cavity through the anteromedial portal (+) and pulled out through the high anterolateral puncture site (*) (B). Next, by dragging the proximal end of the braided suture, the plate is pulled into the joint and placed at the anterior ankle joint capsule. Both ends of the retracting suture run from the inside of the joint to the outside and can be attached to a holding rod (C).

First, a nonabsorbable monofilament No. 2-0 suture is put through a cannulated spinal needle (Figure 1). The joint cavity is punctured with the spinal needle at the lateral superior pole where the retraction thread will come out (Figure 2A). The monofilament thread loop is pulled out through the anteromedial portal. A braided No. 2 suture is placed through the holes of the retracting plate (Figure 2B). The proximal end of the suture in the retracting plate is inserted into the loop and pulled out through the lateral puncture site. Next the plate is pulled into the joint cavity and placed at the anterior capsule (Figure 2C). The distal end of the suture remains in the anteromedial portal. Tension

applied to the sutures lifts the capsule and distracts the joint cavity (Figure 3A,B). The sutures are then attached to a holder rod or held manually to maintain tension. The plates are available in different sizes according to joint size.

An additional standard anterolateral portal is made. The defective cartilage and the subchondral bone are debrided. Lesion size is determined and dimensions marked on the matrix, which is then cut to match the defect size. In this case, a single-step AMIC procedure using a natural collagen type I/III matrix (Chondro-Gide; Geistlich Pharma AG, Wolhusen, Switzerland) is performed.^{16,17} Microfracture is performed antegrade through the joint cavity. Before the

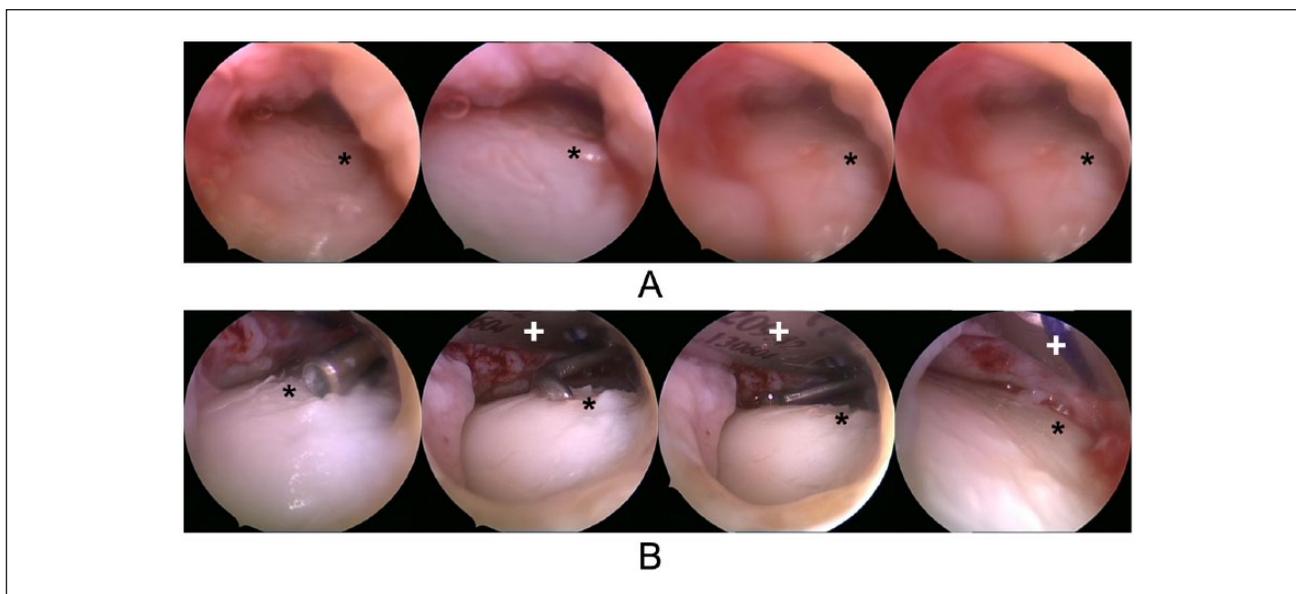


Figure 3. Intra-articular arthroscopic view. Before putting the retractor in, the cartilage lesion (*) on the medial talus shoulder can be visualized. However, the visualization of the lesion is poor due to a collapsed anterior capsule and unavoidable contact between the camera and the capsule (A). Upon installation of the retracting plate (+), pulling the retracting sutures lifts the capsule of the talus, allowing adequate access to the cartilage lesion (*) and safe intra-articular arthroscopic visualization (B).

matrix is inserted, intra-articular fluid is completely evacuated. To continuously drain the joint cavity of blood and remaining saline solution, we recommend installation of a drainage cannula. To equilibrate the pressure in the joint with atmospheric pressure, the trocar sleeve is used. The retraction plate prevents collapse of the joint cavity after fluid removal. The matrix is immersed in saline solution or bone marrow concentrate and placed on the talar defect. Optionally, cancellous bone is impacted before matrix implantation to reconstruct the bony defect. Before insertion of the matrix into the joint, one has to make sure that all fluid has been evacuated. The bottom of the lesion needs to be meticulously dried. The matrix is fixated with fibrin glue along the edges of the defect. Fibrin should be applied step-by-step by small amounts. Typically, the fibrin glue needs 5 minutes to dry. During this time, the matrix has to be pressed against the bottom of the defect. This can be done with an arthroscopy hook in small lesions or with an inflated Foley catheter balloon for lesions larger than 150 mm². With the matrix in place, the ankle joint is moved several times through its range of motion. The matrix should remain in place. It is important that the matrix remains stable at the cartilage interface. Additional fibrin glue is added.

Results

From January 2013 to January 2014, there were 8 patients treated for osteochondral lesions of the talus using AMIC with dry ankle arthroscopy. There were 3 male and 5 female patients with a mean age of 28.2 ± 8.9 years (range, 17-42

years). The OCLT was localized on the medial and lateral side in 4 and 4 ankles, respectively. The mean surface and volume of the OCLT were 101 ± 14.1 mm² (range, 84-120 mm²) and 503 ± 70.7 mm³ (range, 420-600 mm³), respectively.

The average surgical time was 65 ± 13.9 minutes (range, 53-80 minutes). There were no intraoperative or perioperative complications. Wound healing occurred within 2 weeks after the surgery, without adverse events, in all 8 ankles. All patients were followed clinically 1 year postoperatively. The mean preoperative American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot score was 63.1 ± 19.6 points (range, 17-79 points), and the postoperative AOFAS hindfoot score was 86.0 ± 12.0 points (range, 61-100 points) ($P < .01$). The mean postoperative Lysholm score was 82.8 ± 14.2 (range, 62-100 points). All patients were able to return to sport activities by 6 months postoperatively.

Discussion

Conventional arthroscopic matrix insertion into the ankle joint has been reported.^{2,7} Typically, a dry environment for matrix insertion was created by evacuating the arthroscopic fluid by simply opening the in- and outflow ports of the trocar sleeve. The lesion was also dried with gauze or a cotton wool stick. However, evacuating the fluid collapses the ankle joint capsule and makes this procedure more difficult due to limited working space and reduced visibility. To improve the time-consuming and challenging matrix insertion, we modified the commonly used arthroscopy setup by adding an

Table 1. Pearls and Pitfalls of Matrix-Aided Cartilage Repair in a Dry Arthroscopy Setup.

Pearls	Pitfalls
<ul style="list-style-type: none"> • Appropriate planning of portal location is essential: wrong portal site complicates surgery and extends surgery time. • One can always switch to the mini-open approach if arthroscopy fails. • In cases of a ruptured retraction suture, the plate can be easily recovered from the joint. 	<ul style="list-style-type: none"> • Exact implants size is hard to judge arthroscopically. • Implant folding/rolling is time-consuming. • Fogging of the arthroscope in a dry arthroscopy setup is annoying and may prolong surgery.

intra-articular retraction plate. The plate retracts the anterior capsule of the ankle joint, thus increasing the workspace and preventing collapse of the capsule after evacuation of the saline solution. This allows for straightforward insertion of a matrix in a dry arthroscopy setup.

A similar approach has been described for arthroscopic matrix-aided cartilage repair of patellar cartilage lesions in the knee joint.^{11,12} Here a retraction plate was used to lift the patella off the femur and to distract the knee joint, resulting in a suitable environment for collagen matrix insertion.

We see several advantages of this new surgical technique. The use of the retraction system might reduce the number of cases in which an arthrotomy is needed due to an inability to access the lesion or place the matrix. Avoiding arthrotomy of the ankle joint might reduce the risk for post-operative wound complications and facilitate speedy post-operative mobilization. The technical pearls and pitfalls are given in Table 1. Dry ankle arthroscopy remains a technically demanding procedure, requiring significant experience of the surgeon in performing arthroscopic procedures.

Conclusion

Dry arthroscopy using the presented retraction system is a feasible procedure for matrix-aided arthroscopic treatment of osteochondral lesions of the talus. The retraction system lifts the capsule to allow adequate access to talar osteochondral lesions. The joint cavity is prevented from collapsing after fluid evacuation, which facilitates insertion of a matrix onto the defect site. Further clinical studies are needed to assess the learning curve and possible advantages of this new surgical technique.

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Authors' Note

B. Sadlik designed the study, developed the surgical technique, performed surgical treatment, and wrote the initial manuscript draft. A. Basiak performed surgical treatment and reviewed the

manuscript drafts. A. Barg performed statistical analysis, ensured the accuracy of the data analyses, and reviewed the manuscript drafts. V. Valderrabano ensured the accuracy of the data analyses and reviewed the manuscript drafts. M. Wiewiorski examined patients and wrote the initial manuscript draft.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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