Dry Arthroscopy With a Retraction System for Matrix-Aided Cartilage Repair of Patellar Lesions

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Abstract: Several commercially available cartilage repair techniques use a natural or synthetic matrix to aid cartilage regeneration (e.g., autologous matrix–induced chondrogenesis or matrix-induced cartilage implantation). However, the use of matrix-aided techniques during conventional knee joint arthroscopy under continuous irrigation is challenging. Insertion and fixation of the matrix can be complicated by the presence of fluid and the confined patellofemoral joint space with limited access to the lesion. To overcome these issues, we developed a novel arthroscopic approach for matrix-aided cartilage repair of patellar lesions. This technical note describes the use of dry arthroscopy assisted by a minimally invasive retraction system. An autologous matrix–induced chondrogenesis procedure is used to illustrate this novel approach.

Access to the patellar joint surface for cartilage repair procedures is challenging. Because of the confined patellofemoral joint space, conventional arthroscopic treatment faces several technical difficulties and is limited to debridement and bone marrow stimulation procedures. Although such procedures yield acceptable clinical results, more advanced surgical techniques are available that aim to restore hyaline/hyaline-like cartilage with improved biomechanical properties. Some of these techniques use matrices composed of either natural or synthetic material. Examples of such techniques are autologous cartilage implantation (ACI) (first-generation ACI or matrix-aided [second-generation] ACI),[1] autologous matrix–induced chondrogenesis (AMIC),[2] and hyaluronan-based scaffold implantation (Hyalofast; Anika Therapeutics, Bedford, MA).[3]

An important prerequisite of all cartilage restoration techniques is adequate debridement of the defective patellar cartilage. Debridement is typically followed by bone marrow stimulation, and a cut-to-size matrix is glued into the defect. Insertion and fixation of the matrix in a regular arthroscopic setup under continuous irrigation are complicated. A dry, fluid-free joint cavity would be favorable. However, fluid is needed to inflate the joint and retract the patella from its femoral surface. To overcome this problem, we developed a novel retraction system using plates and sutures allowing for minimally invasive retraction of the patella.

Surgical Technique

The cartilage repair steps described in this report follow the principles of the AMIC procedure for a lateral patellar cartilage lesion. In the AMIC procedure, the cartilage defect is debrided, followed by bone marrow stimulation and subsequent insertion of a bilayer matrix composed of porcine type I/III collagen (Chondrogide; Geistlich Biomaterials, Wolhusen, Switzerland).[2]

Surgery begins with conventional arthroscopy (Video 1). Standard anterolateral, lateral, and suprapatellar lateral portals are installed. The patellar lesion is located. Next, the retraction system is installed. The retraction system consists of threads, a retraction plate (ATMED, Katowice, Poland), and a holder rod (Artromast; ATMED) attached to the surgery table. First, a nonabsorbable monofilament No. 2-0 thread is put through a cannulated spinal needle (Fig 1A). The joint cavity is punctured with the spinal needle at the lateral-superior patellar pole where the retraction thread will come out (Fig 1B). The monofilament thread loop is pulled out through the anterolateral portal. Then, a braided No. 2 thread is led through the holes of the retracting plate (Fig 1A). The

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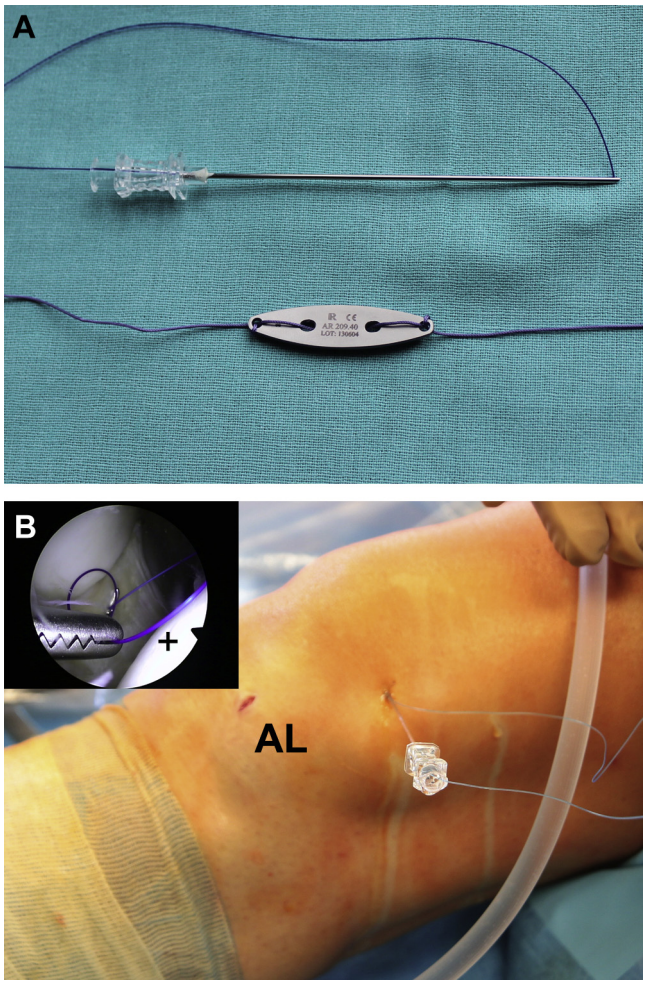

Fig 1. Plate preparation and needle placement. (A) A monofilament thread is led through a cannulated spinal needle, and a braided thread is led through the holes of the retracting plate. (B) The spinal needle is inserted into the joint cavity lateral to the superior patellar pole. The monofilament loop (plus sign) is then pulled out through the anterolateral portal (AL), and the proximal end of the thread of the retracting plate is placed in the loop.

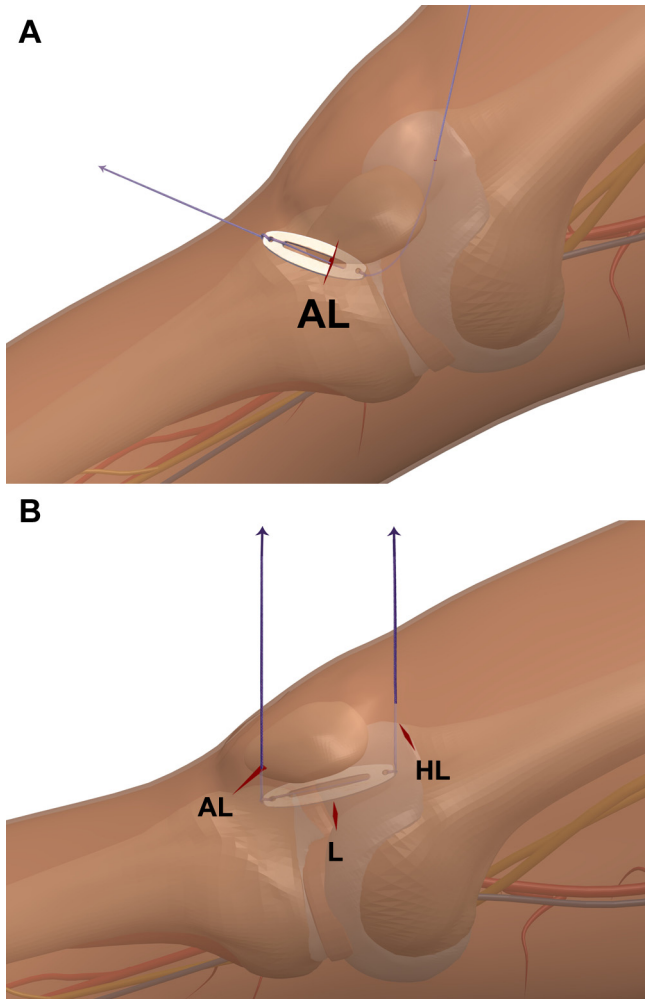

Fig 2. Plate insertion. The proximal end of the braided thread is pulled into the joint through the anterolateral portal (AL) and then pulled out of the joint at the needle insertion site by dragging the monofilament thread. Next, by dragging the proximal end of the braided thread, the plate is (A) pulled into the joint and (B) placed at the lateral edge of the patella. Both ends of the retracting thread run from the inside of the joint to the outside and can be attached to a holding rod. We recommend 3 portals for the cartilage repair procedure: anterolateral (AL), lateral (L), and high lateral (HL) (supra-patellar lateral).

proximal end of the thread of the retracting plate is placed in the loop and pulled into the joint and out through the skin at the needle insertion site (Fig 2A). The plate is pulled into the joint and placed at the lateral border of the patella (Fig 2B). The distal end of the thread remains in the anterolateral portal. Tension applied to the sutures lifts the capsule, distracts the joint cavity, and tilts the patella medially (Fig 3). The sutures are then attached to a holder rod or can be held manually to retain tension. The plate comes in different sizes according to joint size.

After the installation of the retracting system, the defective cartilage is debrided. Next, lesion size is determined. For this, the minimum and maximum diagonal of the defect is measured. The results are transferred to the matrix, which is cut to size. Microdrilling can be performed antegrade through the joint cavity or retrograde by transpatellar drilling. Before the matrix can be inserted, intra-articular fluid needs to be evacuated. To continuously drain the joint cavity of blood and remaining saline solution, we recommend installation of a drain hose. To equilibrate the pressure in the joint with atmospheric pressure, the trocar sleeve can be used. The retraction plate prevents collapsing of the joint cavity after fluid removal. The cut-to-shape matrix is immersed in saline solution or bone marrow concentrate and placed on the patellar defect. Before insertion into the joint, one has to make sure that all fluid has been evacuated. The bottom of

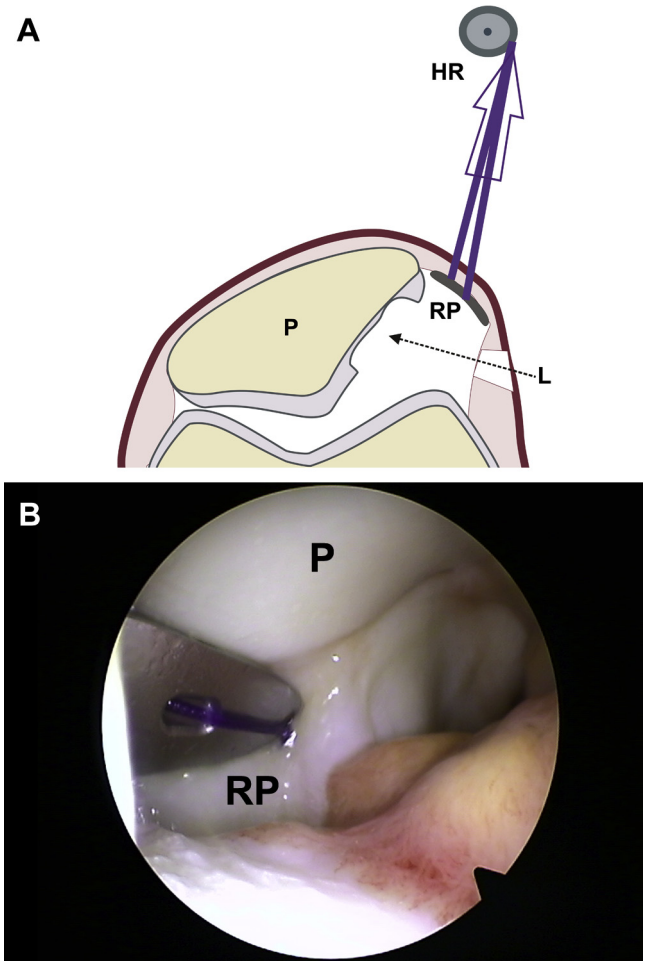

Fig 3. (A) Intra-articular view. On installation of the retracting plate (RP), pulling the retracting threads lifts and tilts the patella (P), allowing adequate access to the cartilage lesion through the lateral portal (L). The sutures can be attached to a holding rod (HR). (B) Intraoperative arthroscopic view, showing the location of the plate.

the lesion needs to be meticulously dried. The matrix is fixated with fibrin glue along the edges of the defect. 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 achieved with an arthroscopy hook in small lesions or with a Foley catheter balloon in cases of lesions larger than 150 mm^2. With the matrix in place, the knee 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 can be added.

Discussion

Implantation of matrices onto the patellar joint surface is challenging because of limited access to the cartilage lesion. In the presented novel surgical technique, an intra-articularly placed retraction plate is used to retract and tilt the patella. This increases the work space in the joint and allows adequate access to the patellar lesion for debridement and bone marrow stimulation. In addition, the retraction plate prevents the joint cavity from collapsing after evacuation of the saline solution. This allows for insertion of a matrix in a dry arthroscopy setup. In our opinion, a fluid- or gas-free joint cavity is mandatory for matrix implantation. To gain adequate access, an arthrotomy is commonly performed and the patella is dislocated. The presented technique offers a minimally invasive approach, avoiding disruption of the joint capsule and the patellar stabilizing ligaments. In our opinion, this could reduce the risk of arthrofibrosis and postoperative hematoma. An all-arthroscopic approach would also reduce the risk of infection and facilitate speedy postoperative mobilization. Technical pearls and pitfalls are given in Table 1.

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

Pearls	Pitfalls
Appropriate planning of the portal location is essential; an incorrect portal site complicates surgery and extends the operative time.	The exact implant size is difficult to judge arthroscopically.
One can always switch to a mini-open approach if arthroscopy fails.	Implant folding/rolling is time-consuming.
In the case of a ruptured retraction suture, the plate can be easily recovered from the joint.	Fogging of the arthroscope in a dry arthroscopy setup is annoying and prolongs surgery.

Other arthroscopic techniques have been described that also aim to create a suitable work space and allow matrix insertion during knee arthroscopy. Some compartments of the knee joint are still accessible by simply evacuating the fluid and opening the inflow and outflow ports of the trocar sleeve.[4] This method is limited to lesions located in the central part of the femoral condyles or the trochlea. A mandatory prerequisite for such a procedure is equilibration of the joint pressure with atmospheric pressure.[5] Substituting gas for saline solution is an alternative to create a fluid-free environment but has been criticized because of the increased risk of gas-induced vascular embolization. Another issue is the constant outflow of gas, which complicates the insertion of the matrix.

Maeno et al.[6] adapted a method originally described for laparoscopic procedures. An extracapsular space is created above the patella.[7] A loop-shaped hanger[6] or a metal coil[8] is inserted in that space and is attached to a clamp bar running across the operative field. Although this technique increases the intra-articular work space, the instruments needed are bulky. Siebold et al.[9] developed a technique in which the patient is placed in a prone position. A suture is placed through the lateral patellar retinaculum, to which a weight is attached. The patella is

tilted by the gravitational pull of the weight. The reversal of the anatomic situation can be challenging, even for the experienced arthroscopist. In addition, the ability to perform a diagnostic arthroscopy of the whole knee is limited.

Dry arthroscopy using the presented retraction system is a feasible and safe procedure for matrix-aided arthroscopic treatment of patellar cartilage lesions. The retraction system lifts and tilts the patella to allow adequate access to patellar cartilage lesions. The joint cavity is prevented from collapsing after fluid evacuation, which allows insertion of a matrix onto the defect site.

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