Technical Note

Arthroscopic Treatment of Medial Femoral Knee Osteochondral Defect Using Subchondroplasty and Chitosan-Based Scaffold

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Abstract: Osteochondral defects of the knee are highly common, cause significant pain, and reduce function. Standard articular cartilage repair treatments include microfracture alone or in conjunction with subchondroplasty or CarGel (chitosan-based scaffold) application (Piramal Life Sciences). Combining such cartilage regenerative techniques with microfracture yields better long-term outcomes than microfracture alone. The purpose of this Technical Note was to describe the surgical technique of applying CarGel after subchondroplasty and microfracture to repair a medial femoral knee osteochondral defect.

Osteochondral defects are highly common; a review of 1,000 arthroscopies showed that 61% of adult knees had osteochondral defects.[1] This can have profound implications for quality of life considering that these defects can result in significant pain, functional disability, swelling, and osteoarthritis.[2]

Common standard articular cartilage repair treatment is arthroscopic microfracture.[3] This can be used in conjunction with subchondroplasty, a technique whereby flowable calcium phosphate, a synthetic bone-void filler, is injected into subchondral bone to fill a defect.[4] Although there are still no single treatments recommended for knee cartilage defects, repairs performed with cartilage regenerative techniques as an adjunct to microfracture alone have better long-term outcomes.[5] Newer arthroscopic techniques can also involve the addition of CarGel (Piramal Life Sciences) after microfracture and subchondroplasty. CarGel is a soluble polymer scaffold made from chitosan (derived from crustacean exoskeleton) that can stabilize the blood clot formed in a cartilaginous lesion.[6] Compared with microfracture alone, application of CarGel solution after microfracture has shown greater lesion filling and superior repair tissue quality.[7,8] The purpose of this Technical Note was to describe our arthroscopic treatment of a medial femoral knee osteochondral defect using subchondroplasty and CarGel.

Surgical Technique

Preoperative Assessment

The patient is assessed in the clinic with a focused history and physical examination. This includes the mechanism of any injury, provoking factors, and previous management with physiotherapy or surgery. Previously undiagnosed collagen disorders must also be excluded. The most common complaint in a patient with a knee osteochondral defect is a progressive onset of pain and occasional mechanical symptoms such as locking and/or catching.[9] A thorough physical examination should then be performed on the affected joint with comparison to the contralateral knee. This is performed to rule out malalignment, meniscal tears, ligamentous instability, or extensor mechanism problems.[10] Imaging should start with weight-bearing anteroposterior and lateral radiographic views. In addition, magnetic resonance imaging should be completed to evaluate for capsular pathology. A 3-dimensional knee model is then printed from the

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computed tomography scan to aid in preoperative and intraoperative planning. Patients should also be enrolled in a preoperative physiotherapy program focused on strengthening the dynamic stabilizers of the knee joint.

Anesthesia and Patient Position

A general anesthetic and antibiotic prophylaxis are administered. The patient is positioned supine with the assistance of a beanbag positioner. The operative knee is then prepared with a chlorhexidine solution and draped in sterile fashion with the foot on the operative side placed into a Spider knee holder (Smith & Nephew, London, England) (Fig 1). Two arthroscopic portals are then marked: medial and lateral.

Diagnostic Arthroscopy

The complete surgical technique is shown in Video 1. A diagnostic arthroscopy is completed in standard fashion from the lateral portal (Fig 2). This includes assessment of the patellofemoral joint, cartilage of the trochlea and patella, medial gutter, and femoral condyle. From the medial compartment, the lateral aspect of the medial femoral condyle and meniscus is assessed. In the central compartment, the anterior cruciate ligament, posterior cruciate ligament, and lateral gutter are also assessed.

Osteochondral Defect Removal and Debridement

The osteochondral lesion is examined with the knee flexed upward to show an unstable loose fragment. A shaver is used to remove all synovitis from the medial, central, and lateral compartments. The medial portal is increased in size with a scalpel to remove the osteochondral defect with a grasper (Fig 3A). A curette is used to remove remaining edges down to healthy, stable margins, and a passport cannula is inserted to keep the soft tissue away from the area. The curette is also used to remove the calcific layer of subchondral bone (Fig 3B).

Fig 1. The patient is positioned in the supine position with the right foot placed into a Spider knee holder.

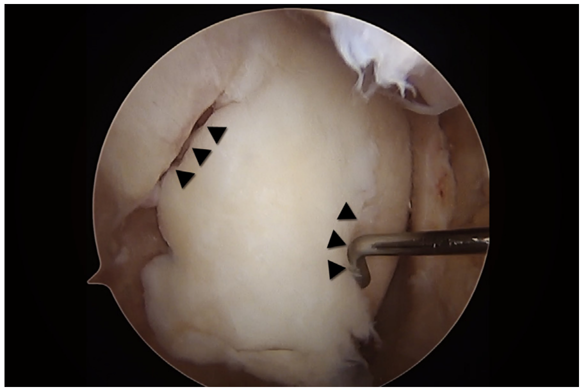

Fig 2. View from lateral portal of osteochondral lesion in distal medial femoral condyle. The arrowheads outline the flap edges of the osteochondral lesion.

Subchondroplasty

On the basis of preoperative computed tomography images and the 3-dimensionally printed model, a cannulated drill is used to drill to the subchondral cyst and marrow changes (Fig 4A). This is achieved using fluoroscopic guidance to enter the anterior aspect of the medial condyle by aiming 45° posteriorly. The knee is left in full extension with the scope in the lateral portal (Fig 4B). Five milliliters of subchondroplasty material is injected into the defect area under fluoroscopic guidance and using the scope to ensure there is no leakage into the joint (Fig 4C).

Microfracture and Drainage

Starting in the lateral portal, a Phoenix microfracture drill (Stryker) is used to drill multiple holes 2 to 3 mm apart into the bone (Fig 5A). The drill is then switched to the medial portal to finish drilling holes into the remaining defect area (Fig 5B). After the microfracture drilling is completed, the knee is flexed upward and balanced to aid in draining fluid from the posterior aspect. After drainage of remaining fluid using a shaver (Fig 5C), thin strips of gauze are used to completely dry the lesion. A separate percutaneous needle is then placed through the patellar tendon in the lateral notch and suction is applied to keep fluid out of the joint, in addition to a separate cannula to allow for air to enter the area to aid in drying.

CarGel Application

CarGel is mixed with 5 mL of blood on the back table and set for 20 minutes using a warmer. In preparation for CarGel application, the knee is flexed 45° and the

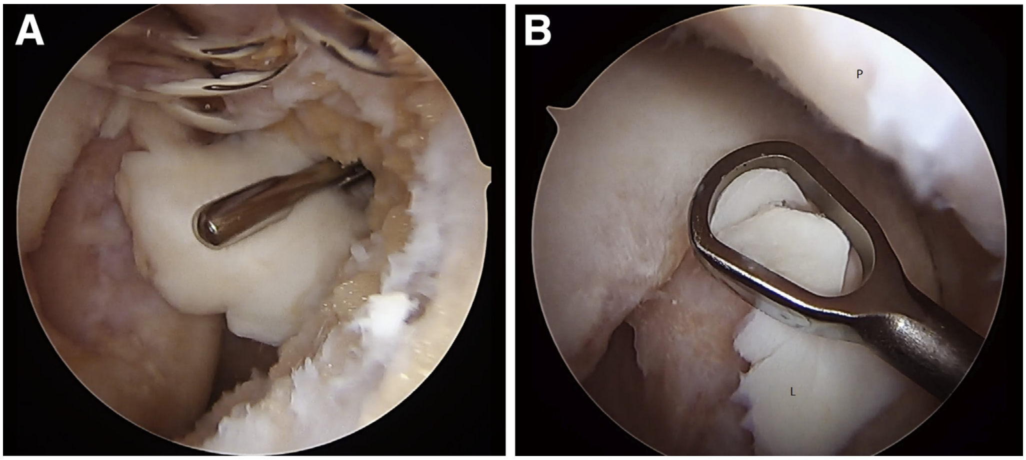

Fig 3. (A) View from lateral portal of grasper holding osteochondral lesion from medial portal. (B) View from lateral portal of curette used to remove attached cartilage of osteochondral lesion in distal medial femoral condyle. (L, osteochondral lesion; P, patella.)

hip is flexed 45° and abducted 20° with 30° of external rotation to ensure the defect is as horizontal as possible. A 16-gauge needle containing the CarGel mixture is inserted into the medial passport cannula (Fig 6A). It is applied by a stepwise approach, drop by drop, to re-create the 3-dimensional structure of the defect. All 5 mL of CarGel is used to re-create the defect in its entirety (Fig 6B). After waiting 10 minutes for the CarGel to dry, the surgeon assesses range of motion in the knee by cycling, bending, and flexing the knee. The CarGel stays in position in the defect area during all of these movements (Fig 6C).

Rehabilitation

The postoperative rehabilitation protocol is described in Table 1.

Discussion

In this technique article, we describe a method for arthroscopic treatment of medial femoral knee

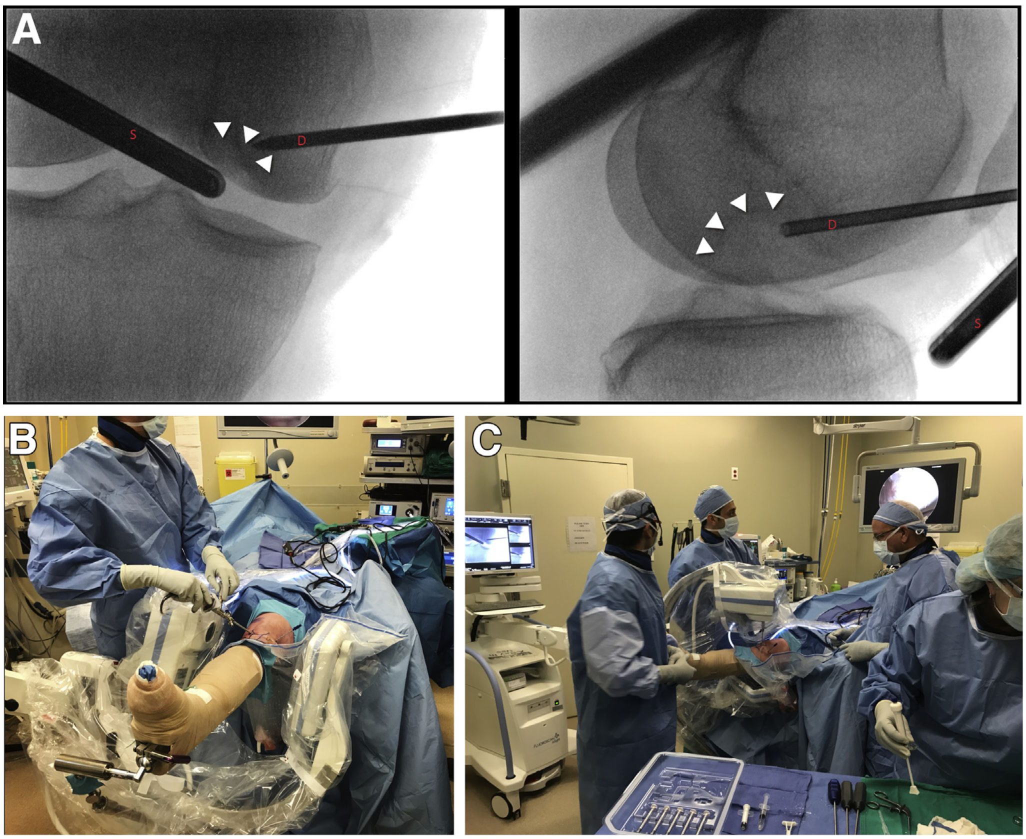

Fig 4. (A) Mini C-arm anteroposterior and lateral views of right knee showing cannulated drill (D) from medial femoral condyle. The arrowheads outline the osteochondral lesion. (S, scope.) (B) Outside view of mini C-arm lateral view confirming position of cannulated drill in medial femoral condyle in right knee. (C) Outside view of mini C-arm anteroposterior view confirming position of cannulated drill in medial femoral condyle in right knee.

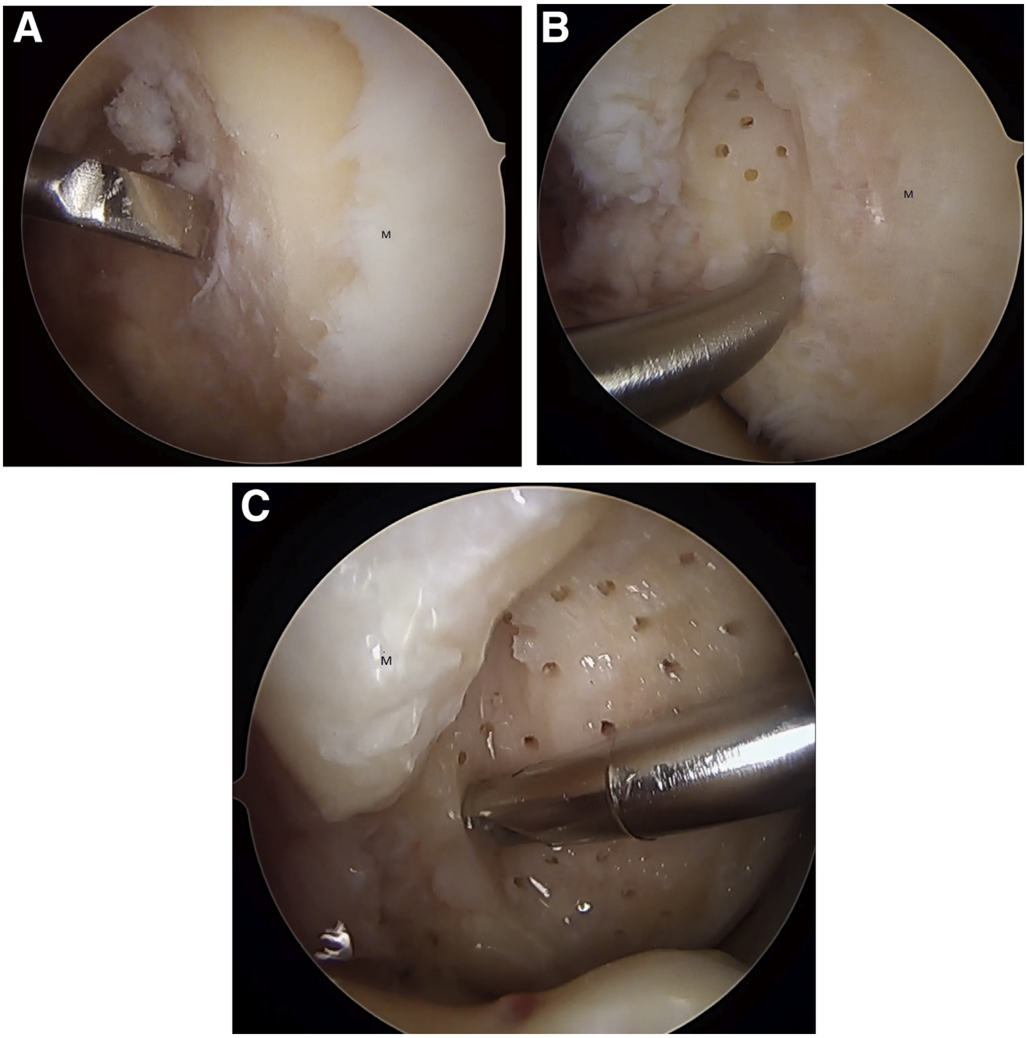

Fig 5. (A) View from medial portal with curette from lateral portal to remove calcific layer off defect in distal medial femoral condyle (M). (B) View from medial portal of medial femoral condyle (M) with Phoenix microfracture drill from lateral portal. (C) View from lateral portal with shaver in medial portal used to drain fluid from inside knee. The needle is inserted percutaneously and attached to suction. (M, medial femoral condyle.)

osteochondral defects using subchondroplasty and CarGel. The described technique offers patients the advantages of an arthroscopic procedure, including decreased postoperative pain, lower morbidity, and general acceptance by patients. In addition, using CarGel paired with microfracture (compared with microfracture alone) yields significant cost savings by reducing the risk of adverse clinical events, especially in patients with larger lesions.[11] It also does not cause hypertrophic repair tissue formation.[12] Limitations of this procedure include the demanding surgical technique involved, as well as the fact that some localized cartilage defects (patella, posterior condyles) may not be addressed and that the long-term outcomes are unknown.[10] The advantages and limitations of this technique are described in Table 2.

A study examining the use of polyglycolic acid–hyaluronan immersed in platelet-rich plasma after drilling found continuation of the good outcomes found in the short term up to 5 years after the surgical procedure, suggesting the potential for good long-term outcomes of this technique.[13] Although the implant used was not the same as CarGel, both are platelet rich, plasma immersed, and polymer based, and perhaps similar good outcomes in the 5-year range can be expected for CarGel.

Applying CarGel in addition to subchondroplasty and microfracture is an acceptable arthroscopic technique for patients with medial femoral knee osteochondral defects. Short-term improvements in pain reduction and increased function are clear; however, the quality of this repair over the long term is still unknown.

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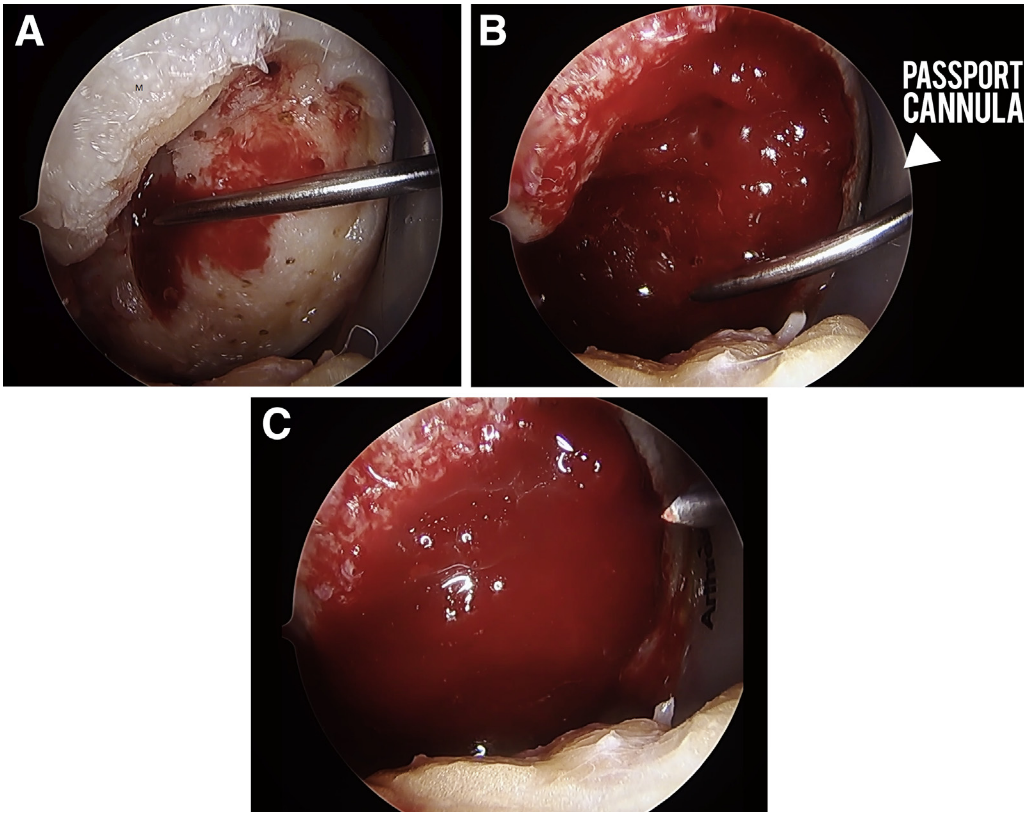

Fig 6. Sequential views from lateral portal showing CarGel used to re-create 3-dimensional scaffold of defect in distal medial femoral condyle (M). (A) Needle with CarGel mixture inserted from medial portal through passport cannula. (B) Sequential filling of defect allowing CarGel to solidify and form 3-dimensional scaffold. (C) Final view of CarGel.

Table 1. Postoperative Rehabilitation Protocol

20% WB for 7 wk—continue to optimize gait pattern with crutches
50% WB at 8 wk
75% WB at 9 wk
Full WB at 10 wk

WB, weight bearing.

Table 2. Advantages and Limitations of Described Technique

Advantages
Superior tissue repair compared with microfracture alone
No hypertrophic repair tissue formation
Decreased postoperative pain
Decreased morbidity
Highly acceptable to patients
Cost savings associated with decreased risk of adverse clinical events
Customizable size and shape to accommodate any lesion
Limitations
Inability to address some localizations of cartilage defects (patella, posterior condyles)
High level of surgical technique involved
Time constraint intraoperatively between CarGel preparation and application
Unknown long-term outcomes at this time

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