

## Technical Note

# Hip Chondral Defects: Arthroscopic Treatment With the Needle and Curette Technique and ChondroFiller

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**Abstract:** Management of symptomatic focal cartilage defects of the hip can be challenging. Cells, scaffold therapies, and injectable agents have emerged as an adjunctive modality to improve clinical outcomes. Long and malleable needles that can be bent are used to release these kinds of biological products. Distance between the tip of the needle and the area to be filled should be minimal to ensure full contact with the chondral lesion to avoid losing material inside the hip cavity and to increase the efficiency of the release of the product. Nevertheless in many cases the accessibility is not easy, and the distance between the tip of the needle and the area to be treated is such that the efficiency of the release is difficult, if not impossible. We aim to describe a simple, inexpensive, and reproducible technique to facilitate the implantation of biologic and injectable materials in hip chondral defects during arthroscopy: the use of a combination of a curette and a needle inside the tip of the curette. Additionally we describe the use of ChondroFiller liquid, a liquid cell-free collagen matrix, for the treatment of symptomatic full-thickness chondral defects of the hip in a 1-step arthroscopic procedure.

Chondral lesions are commonly found during hip arthroscopy in patients with femoroacetabular impingement, can progress to osteoarthritis if left untreated,<sup>1</sup> and can cause significant pain and functional impairment. Microfracture is the current standard of treatment for small chondral lesions encountered during hip arthroscopy with good outcomes and minimal complications but results in a fibrocartilaginous tissue lacking hyaline articular structure and clinical benefit that is variable beyond 2 to 3 years.<sup>2</sup> Cam-type femoroacetabular Impingement (FAI) typically produces acetabular cartilage lesions that can be quite extensive in

young and active patients.<sup>3</sup> These cartilage lesions start at the periphery and are typically located anterosuperiorly in the area of impingement. Scaffolding materials and cell-based therapies that can be injected into the cartilage lesion have been described with the aim of improving or augmenting traditional microfracture, to achieve more consistent success and to facilitate cartilage repair. ChondroFiller liquid (Amedrix GmbH, Esslingen, Germany) is a cell-free 2-component collagen type-1 gel that is isolated out of rat tail tendons, and it is a promising technique in the treatment of cartilage lesions. Injectable agents like ChondroFiller liquid have been developed with the potential of an easier and less-invasive implantation process because they are applied as a highly adhesive gel. This provides the framework for the formation of new cartilage. Implantation techniques of these products and other therapies using a conventional needle are technically challenging in the hip because of its constrained nature and because the typical acetabular cartilage defect is located in the anterolateral marginal area that is located in a steeply sloping surface or even in an overhang situation that makes the application process difficult. The purpose of this Technical Note is to describe the arthroscopic treatment of chondral lesions greater than 2 cm in the hip with ChondroFiller in a 1-step procedure and to describe a reproducible, efficient, and quicker

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method to facilitate the implantation of similar materials: the needle and curette technique.

### Preoperative Planning

The presence of cartilage lesion is important when considering a hip arthroscopy procedure to facilitate preoperative planning and to set patient expectations. Diagnosis is based on patient's history and clinical presentation, magnetic resonance (MR) imaging (Fig 1), MR arthrography, or delayed gadolinium-enhanced MR imaging of cartilage. As with every patient presenting with hip pain or symptoms, other sources of injury must be ruled out.

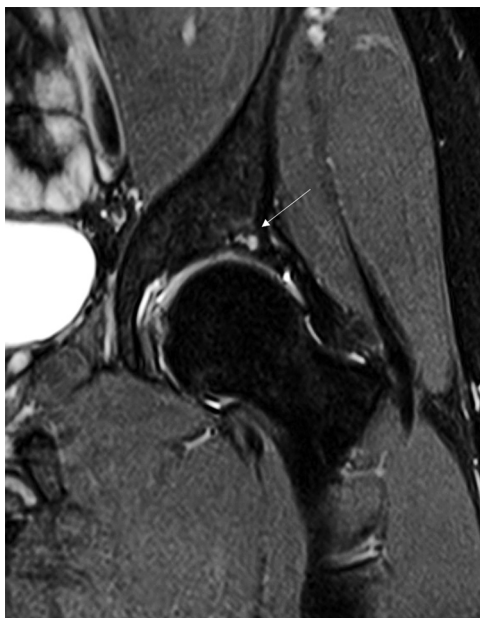
### Surgical Technique

#### Patient Positioning and Portal Placement

The patient lies supine on a traction table with the feet well padded and placed into traction boots. After placement of an extra-wide post (perineal post) to protect the perineum, the hip is placed in a position of 10° of flexion, 15° of internal rotation, and neutral abduction. Traction force is applied gradually in the operative limb, with gentle countertraction applied to the contralateral limb. After traction, the leg is placed in slight adduction over the post, which forces the femoral head laterally. Traction is controlled with fluoroscopy. After routine preparation and draping of the hip, the procedure is begun by establishing standard anterolateral, mid-anterior, and distal anterolateral portals.

#### Capsulotomy and Addressing Intra-articular Pathology

After access is obtained, an interportal capsulotomy is done, and a standard diagnostic arthroscopy is



**Fig 1.** Left hip. Coronal magnetic resonance image showing a superolateral cartilage defect (arrow) in the acetabulum.

performed using a 70° arthroscope to evaluate any other concomitant pathology. Any treatment of cartilage injury from underlying FAI should be addressed during surgery, through a removal of the pincer lesion (acetabular rim trimming) and Cam-type femoroacetabular Impingement lesion (femoral osteochondroplasty) as evident by preoperative imaging.

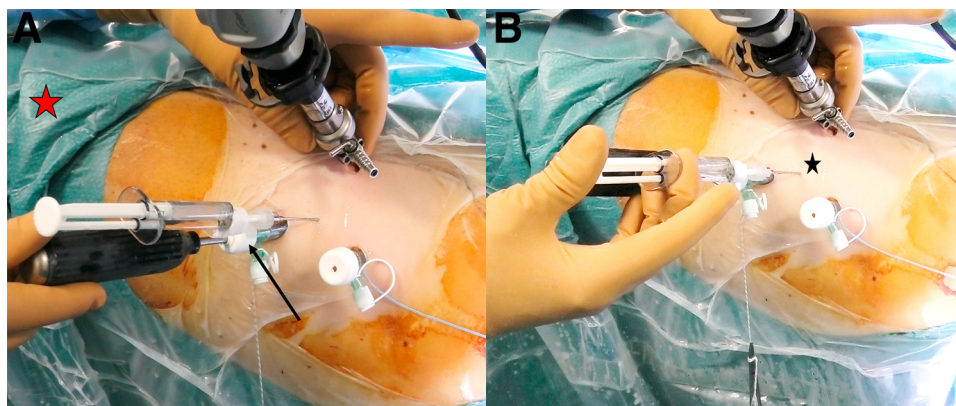
#### Preparation of the Chondral Defect

Evaluation and specific quantification of the size, location, depth, and severity of the chondral lesion is performed. An arthroscopic probe is used to measure the short and long axes of cartilage defects to calculate defect area. Location of acetabular and femoral head cartilage damage is identified by the geographic zone method<sup>4</sup> and the Grupo Iberico Preservacion Cadera.<sup>5</sup> The Beck classification<sup>6</sup> is used to characterize the severity of femoral and acetabular chondral defects. At this point chondral flaps are debrided to a stable edge using motorized shavers and a 45° curved open arthroscopic rectangular curette (Smith & Nephew, Memphis, TN) to generate a stable, well-defined, and well-contained lesion bordered by healthy cartilage and labrum circumferentially and to completely remove the calcified cartilage layer over the subchondral bone in preparation for the injection. Labral pathology is then addressed in a standard fashion, and suture anchors were used to refix the labrum if the labrum was repairable with careful insertion of these at the edge of the acetabular rim to ensure containment of the chondral lesion. It is important to prepare the cartilage bed before fixing labral tissue. If femoroplasty needs to be performed, traction is relaxed to facilitate the procedure, and removal of the bony prominence before applying ChondroFiller is recommended to keep traction for no more than 2 hours.

#### Injection of the ChondroFiller

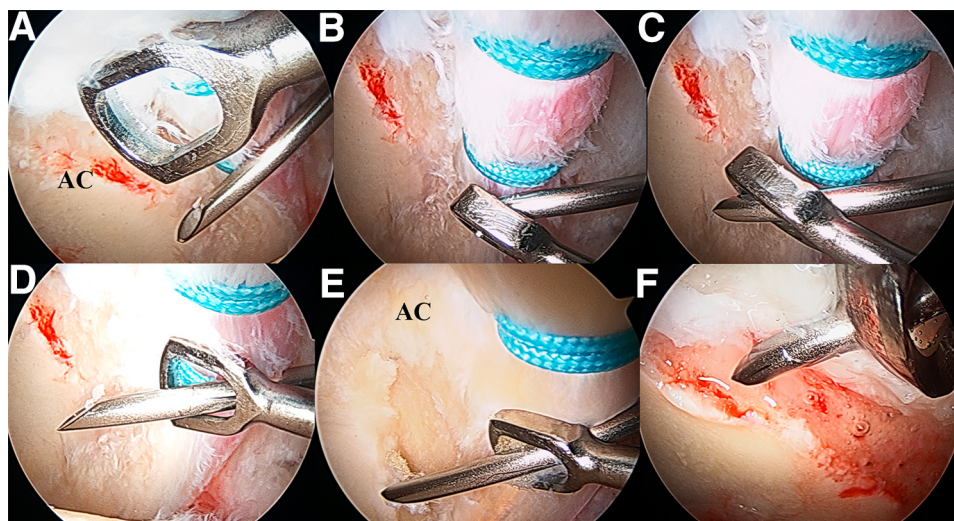
The ChondroFiller mixture is prepared according to the manufacturer's instructions and has to be defrosted up to 37°C before implantation. After osteoplasty traction is reapplied to access the central compartment again, the inflow of irrigation is stopped, and the fluid is extravasated from the hip joint. At this point the patient is placed in Trendelenburg positioning of 10° to ensure gravity-dependent flow away from the implantation site of any excess fluid within the hip, and a spinal needle, shaver, or suction catheter is inserted into and attached to a suction to drain the joint completely, which assists in consistent maintenance of a dry joint for optimal implantation and preventing washout. Neurosurgery swabs can be used during the drying process. At this point ChondroFiller Liquid is inserted into the defect zone with a needle and the aid of a curette to guide it to ensure full contact with the

**Fig 2.** Intraoperative photograph of a left hip with 2 arthroscopic cannulas placed in the antero-lateral portal and the distal anterolateral portal. Scope in the midanterior portal. The curette portal is chosen on the basis of the lesion site. Acetabular chondral lesions are usually located anterosuperior so most of the times the curette portal is the distal anterolateral portal (black arrow) (A). The needle or “delivery portal” (black star) is located just 2 to 3 cm superior and anterior from the “curette portal” (B). Red star = distal.

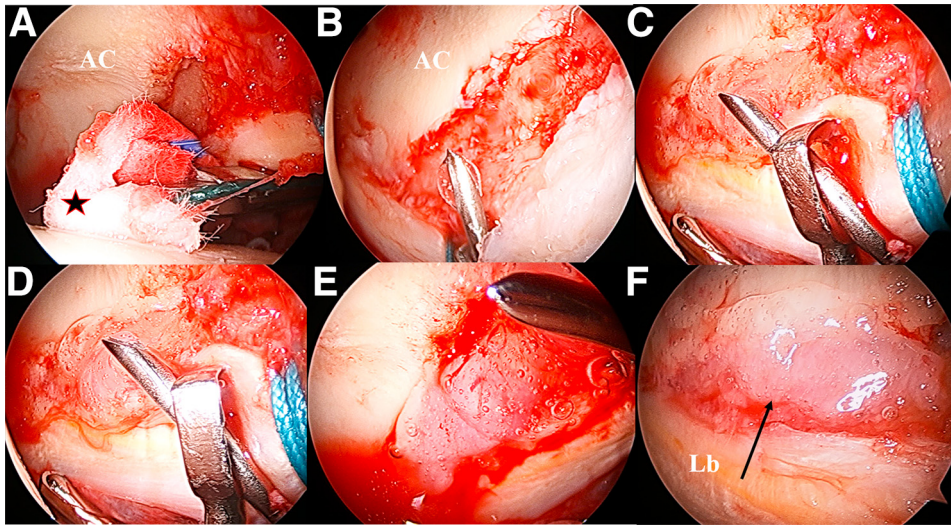


chondral lesion, because the needle alone does not allow easy direct application or implantation process. The needle or “delivery portal” is percutaneously created and checked until good position is achieved. This portal must be located just 2 to 3 cm superior and anterior from the “curette portal.” The curette portal is chosen on the basis of the lesion site (Fig 2). Acetabular chondral lesions are usually located anterosuperior, so most of the times the curette portal is the distal anterolateral portal. In cases of posterior acetabular wall lesions, an accessory posterolateral portal must be used for the curette portal. For femoral head lesions the curette portal is again chosen on the basis of the site of the lesion and rotation of the extremity so it can help

achieve better access. Once inside the joint, thread the needle through the hole/eye of the curette with the bevel facing the femoral head, pass through the curette, and then rotate the needle and face the labrum (Fig 3). The curette is used as a guide for the needle to travel around the defect. Pressure, rotation, and small up and medial lateral movements of the curette assist in optimal, consistent, and controlled delivery of the mixture. Manipulation must be done softly to avoid breakage of the needle. Once the chondral bed is dry, the collagen gel is filled and distributed with a homogenous layer into the defect in a drop-wise manner until the defect is filled completely up to the native cartilage level using a dual chamber preloaded syringe



**Fig 3.** Needle and curette technique. Arthroscopic image of a left hip as viewed through the midanterior portal. Curette into the joint through the distal anterolateral portal and needle through the percutaneously created needle portal (A). Once inside the joint, thread the needle through the hole/eye of the curette with the bevel facing the femoral head (B), pass the curette through (C, D), and then rotate the needle and face the labrum (E). The curetted is used as a guide for the needle to travel around the defect. Pressure, rotation, and small up and medial lateral movements of the curette assist in optimal, consistent, and controlled delivery of the mixture (F). (AC, acetabulum.)

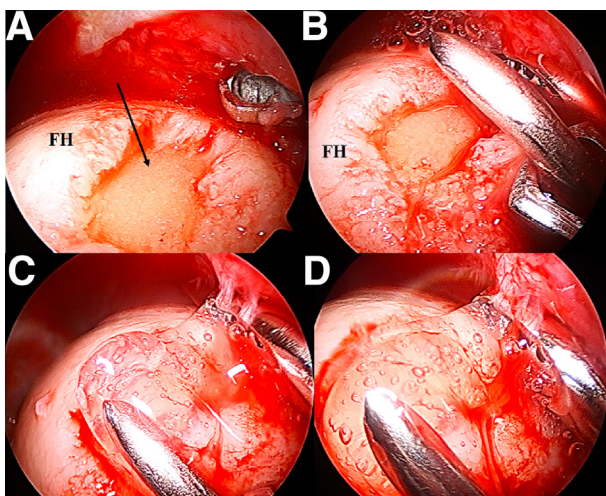


**Fig 4.** Left hip. Arthroscopy view through the midanterior portal of a full-thickness acetabular cartilage lesion treatment with ChondroFiller. Neurosurgery swab (black star) can be used during the drying process (A). Once the chondral bed is dry, the collagen gel is distributed with a homogeneous layer into the defect in a drop-wise manner (B) until the defect is filled completely up to the native cartilage level (C, D, E) and forms a solid scaffold by autoadhesion. Five to 10 minutes after complete filling of the defect, the initially clear matrix hardened into a whitish, cloudy matrix (arrow) (F). (AC, acetabulum; Lb, labrum.)

and forms a solid scaffold by autoadhesion (Figs 4, 5). Some fluid gel can run down through the acetabular rim during the process. At this point, the needle is removed from the curette, and the joint is kept dry and under traction to ensure a proper adhesion and full stabilization of the mixture. Five to 10 minutes after the complete filling of the defect, the initially clear matrix hardens into a whitish, cloudy matrix. Hardening of the matrix is tested using a probe. Once this is achieved, traction is released, the interportal capsulotomy and T-capsulotomy are repaired, followed by closure of the portal sites. Key steps of the procedure are shown in [Video 1](#).

### Postoperative Recovery and Rehabilitation

The patient was discharged the following day and followed the usual postoperative rehabilitation of



**Fig 5.** Left hip. Arthroscopy view through the midanterior portal of femoral head cartilage lesion after debridement (arrow) (A). Needle through the curette (B). Delivery of the ChondroFiller into the defect (C,D). (FH, femoral head.)

labral repair and osteochondroplasty with assisted loading with crutches, circumduction movements, and stationary bicycle. Partial weightbearing assisted by crutches are recommended for 6 weeks. Heterotopic ossification prophylaxis was routinely administered, with the use of naproxen for a minimum of 4 weeks and up to 6 weeks after surgery. Hip range of motion is limited to neutral extension and 90° of hip flexion. At 6 weeks, motion is advanced, ambulation is allowed as tolerated, and lower extremity closed-chain strengthening is initiated. Jogging and running are allowed at 4 months after surgery, with a transition to return to full activity at 5 to 7 months after surgery.

### Discussion

Cartilage defects resemble severe pathology because of their limited healing potential and have been shown to be the major prognostic factor in FAI surgery.<sup>7</sup> Bone marrow stimulation is the most frequently used technique for treating small symptomatic lesions of the articular cartilage. The most common bone marrow stimulation technique is microfracture. Hip microfracture is the most popular cartilage repair technique used in the hip and has shown good short-term outcomes,<sup>8</sup> but these results appear to decline with longer-term follow-up.<sup>9</sup> Several new strategies have been aimed in the hip at improving or augmenting traditional microfracture to achieve more consistent success.<sup>10-15</sup> Successful outcomes using autologous matrix-induced chondrogenesis in the hip were demonstrated by de Girolamo et al.<sup>16</sup> with improvements maintained 8 years after surgery, in contrast to deteriorating outcomes in a comparison group that underwent microfracture alone. Autologous matrix-induced chondrogenesis is a single-step procedure in which the microfracture technique has been enhanced by the use of a biodegradable type I/III collagen matrix.

**Table 1.** Indications and Contraindications of ChondroFiller in the Hip

Indications
Patients with full-thickness chondral lesions greater than 200 mm and smaller than 450 mm with minimal or no subchondral bone involvement, whose symptoms persist after an adequate trial of nonoperative management
Well-contained lesion
Contraindications
Patients with osteoarthritis (Tönnis grade >2)
Metabolic arthropathy
Patient allergy to collagen
Infections, inflammatory arthritis, tumors
Patients who are not able to comply with the rehabilitation protocol.

Collagen matrices have previously been shown to support chondrogenic differentiation of mesenchymal stem cells<sup>17</sup> and to maintain chondrocyte phenotype,<sup>18</sup> particularly when the matrix is composed of collagen types I and III.<sup>19</sup> In recent years, there has been increasing interest in cell-free repair approaches.<sup>20</sup> In contrast to conventional cartilage treatments, such as bone-cartilage or cartilage cell transplantation, with cell-free biological implants there is no need for expensive cell collection and long waiting times for cell cultivation. For complete defect filling, only 1 surgical procedure is required. Thus this therapy is significantly cheaper and time-saving from which, in the end, patient, doctor, and health insurance benefit. ChondroFiller liquid is a cell-free type I collagen implant, based on rat tail collagen for treatment of cartilage damage. ChondroFiller serves as a placeholder for the migrating cells of the surrounding tissue and offers an option for cartilage defects without the need for a membrane as scaffold material in patients with large full-thickness acetabular cartilage defects. The collagen type I concentration in ChondroFiller liquid is 8 mg/mL, and 2 forms are available: the liquid and gel form. The liquid form hardens within the cartilage defect and can be applied in a prepared cartilage defect by arthroscopic procedure. The basic principle of ChondroFiller is to fill the cartilage defect with a matrix structure, providing a scaffold for chondrocytes to

**Table 2.** Advantages and Limitations of ChondroFiller in the Hip

Advantages
Single-stage procedure
Storable and ready to use
Easy injection process with the needle and curette technique
Relatively low cost
Limitations
Surgeons experienced in hip arthroscopy
Longer traction to ensure a proper adhesion can cause transient pudendal nerve neuropraxia
Uncontained or very large lesions
Limited short- and long-term outcome data

**Table 3.** Pearls and Pitfalls of ChondroFiller in the Hip

Pearls
A “contained defect” situation is important and might require labral repair.
The implantation should be performed near the end of the overall procedure to secure the collagen gel within the joint and prevent washout.
Dry area before implanting.
Hypotensive anesthesia and the use of tranexamic acid (10 mg/kg bolus 30 minutes before surgery) to control bleeding improves arthroscopic visualization during the implantation.
Avoid delivering too much product into the defect.
Careful contouring of the chondral product into the defect site to confirm anatomic fill without convexity is critical.
Pitfalls
When adjusting needle trajectory, caution should be taken not to break the needle.
Failure to appropriately prepare the chondral defect may prevent adequate incorporation of the chondral product.
Once traction is removed, reapplying traction should be avoided.

migrate from the perilesional tissue, enabling attachment, proliferation, and extracellular matrix production. Migration of chondrocytes has been reported in collagen-based matrices in vivo and in vitro.<sup>21-24</sup> In animal tests with different cartilage repair techniques, Schneider et al.<sup>22</sup> demonstrated a high quality regenerate tissue by using acellular collagen type I scaffolds. The quality of these tissues was equal to that of cellular scaffolds. ChondroFiller has been used for the treatment of focal knee and ankle chondral defects with good and promising early clinical and radiological data providing short-term significant pain relief and functional improvement with no negative events, adverse reactions, or postoperative complications.<sup>25-28</sup> In the hip from a technical standpoint, the ability to deliver any kind of biologics, fluid solution, or grafts in the base of the defect arthroscopically can be difficult to perform because the joint is deep, surrounded by bulky muscles, the shape of the acetabulum is unfavorable, the femoral head may obstruct proper positioning, and obtaining adequate access remains an inherent challenge. Long and malleable needles are usually used to release this kind of product, and correct needle trajectory is paramount. Distance between the tip of the needle and the area to be filled should be minimal, and in many cases the use of a needle determines that there is a certain distance between it and the area to be treated, decreasing the efficiency of the delivery. We can bend the needle to reach the lesion, but they are weak and this is not enough in some cases such as in pincer difficult cases. Using a curette as a guide for the needle makes the injection technique more reproducible and efficient and prevents or decreases flowing away of any injected liquid from the defect area. The accessibility to the chondral lesion is easier with this technique and is technically simple,

inexpensive, and reproducible. The needle and curette technique can also be used for other difficult chondral defects locations such as in the retropatellar and glenohumeral joints or in the talar bone. Indications and contraindications of our technique can be found in Table 1. Advantages and disadvantages of the technique are described in Table 2. Pearls and pitfalls are listed in Table 3.

### Conclusion

Injectable ChondroFiller is a viable procedure treating full-thickness acetabular cartilage defects, leading to promising results, but long-term outcome studies and trials are needed to better judge the effectiveness of this treatment in the hip. The use of the needle and curette technique reduces the risk of poor delivery and improves to a great degree the injection technique.

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