Technical Note

Arthroscopic Juvenile Allograft Cartilage Implantation for Cartilage Lesions of the Hip

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Abstract: Cartilage lesions in the hip are of high prevalence. Most of these lesions are treated with microfracture. Microfracture has relatively good subjective outcomes for smaller lesions; however, it is limited by the ability to reproduce hyaline cartilage, especially in older patients. For larger chondral defects, we present a technique using juvenile allograft cartilage implantation implanted arthroscopically to treat cartilage lesions in the hip. The purpose of this technical note is to describe the arthroscopic technique for treating chondral lesions in the hip with allograft juvenile cartilage.

Treatment of hip chondral lesions remains a challenge. This entity has no well-known optimal solution and, if left untreated, could have important deleterious effects on the joint.[1] Microfracture technique for chondral lesions in the hip has been well described.[2] Existing outcomes data in hip cartilage pathology is equivocal.[3] Patient selection is the key factor to achieve good results.[3] The majority of the indications for the microfracture technique have been extrapolated from knee procedures: patients <40 years old, body mass index <30, minimal osteoarthritis or Tönnis grade 0 to 1, and focal contained lesion size measuring <2 cm^2.[4]

However, no consensus currently exists regarding the appropriate and best treatment for larger chondral lesions. Particulated juvenile allograft cartilage (De Novo NT [natural tissue]; Zimmer, Warsaw, IN) is composed of juvenile immature chondrocytes, which have a greater metabolic activity level and propensity to regenerate hyaline-like cartilage. The proposed surgical technique allows for arthroscopic treatment of chondral lesions greater than 2 cm^2 in the hip, offering a 1-step procedure with particulated juvenile allograft cartilage.

Although multiple procedures have been described, the lack of a clear algorithm for treatment of large cartilage defects of the hip denotes the limited evidence available. To date, no treatment has been reported to be clearly superior. The purpose of this technical note is to describe the arthroscopic technique for treating chondral lesions in the hip with allograft juvenile cartilage.

Diagnosis

Diagnosis is based on patient's history and clinical presentation. The 2 most prevalent pathologies associated with chondral lesions are femoroacetabular impingement and hip dysplasia. Patients with hip femoroacetabular impingement will present with pain with FADIR (flexion adduction and internal rotation) and FABER (flexion abduction and external rotation) tests and limited flexion and internal rotation. Inversely, patients with hip dysplasia will have positive FADIR and FABER tests but with excessive range of motion, especially internal rotation and external rotation. No specific clinical test is associated with focal chondral lesion. Unfortunately, even thorough assessment of the preoperative radiographs and magnetic resonance imaging cannot always predict the status of the articular cartilage at the time of surgery.[5] With the continuing development of magnetic resonance imaging techniques such as T2 mapping and T1rho, great promises for early osteoarthritis assessment and more accurate diagnosis in cartilage are expected (Fig 1).[6]

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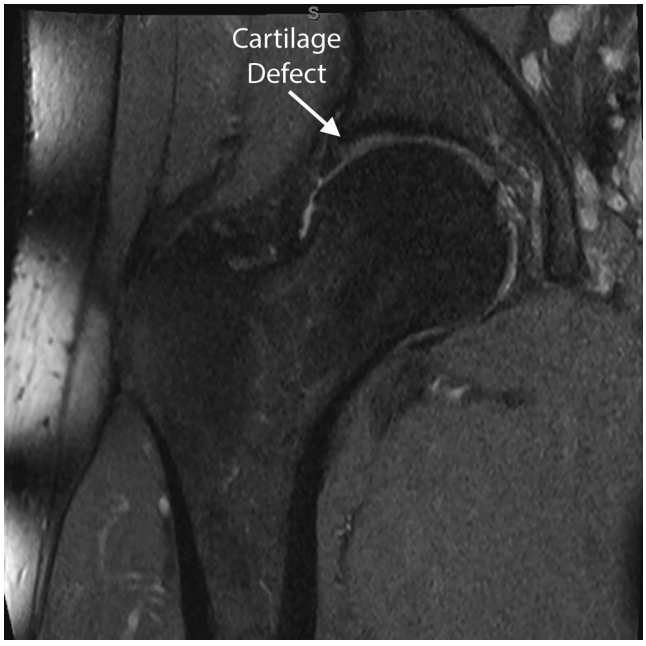

Fig 1. Coronal magnetic resonance image of a right hip showing a superolateral cartilage defect in the acetabulum.

Indications and Contraindications

Particulated juvenile allograft cartilage (De Novo NT; Zimmer) should be considered in patients older than 40 years with chondral lesions greater than 2 cm^2 (Fig 2). It should not be considered in patients with osteoarthritis (Tönnis grade >2).

Surgical Technique

Operating Room Preparation. We perform hip arthroscopy using a standard traction table with the patient in the supine position without perineal post as previously described (Fig 3).[7] The patient is typically placed under general anesthesia. Hypotensive anesthesia allows a lower pump pressure and improves arthroscopic visualization.[8] The patient is placed on a hip arthroscopic bed (Hip Bed, Spider 2 Limb Positioner; Smith & Nephew) and moved down the table such that the perineum is located 7 to 10 cm proximal to the location of the traction post. The patient is placed in 15° of Trendelenburg. The operative extremity is positioned in adduction, with the hip flexed to 10° and the femur internally rotated. The contralateral leg is abducted in 45° to allow the C arm in between the legs.

Portal Placement. Standard anterolateral, midanterior, and distal anterolateral accessory portals are used for this technique as previously described.[9] A 20-gauge spinal needle is used to vent the hip during gentle distraction. Traction is then applied. Anterolateral and midanterior portals are established. A 70° arthroscope is used through the whole procedure. Diagnostic arthroscopy is carried out, and the quality of the chondral lesion is characterized. If the cartilage lesion is bigger than 2 cm^2, a decision to proceed with allograft juvenile cartilage (De Novo NT; Zimmer) is considered (Video 1).

Fig 2. Juvenile minced cartilage before use.

Preparation of the Lesion. The lesion should be prepared similar to how a chondral defect is prepared for microfracture. If an unstable chondral flap is present, it should be removed and the bony bed prepared in a standard fashion (Fig 4).

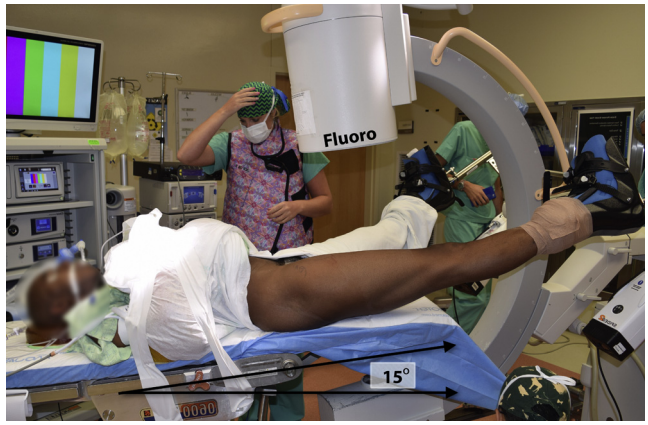

Fig 3. Patient positioning in the supine position without perineal post (with 15° of caudal tilt) for a left hip arthroscopy.

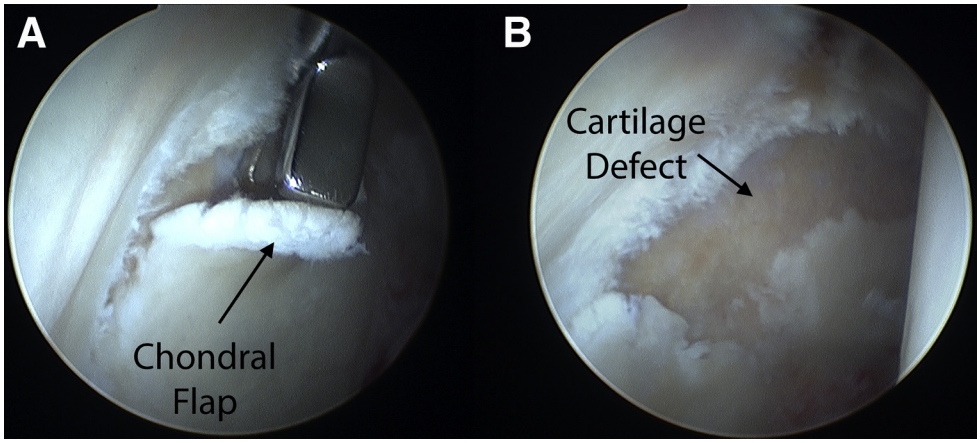

Fig 4. Arthroscopic image (midanterior portal view) of the superolateral aspect of a right hip showing a (A) cartilage flap being removed and the (B) final cartilage defect after removal of the flap.

A curette is used to create a well-defined vertical defect perimeter. It is important to clear the defect base carefully to remove the calcified cartilage layer. However, avoid violating the subchondral cortical bone. If subchondral bone bleeding occurs, it must be stopped before implantation of the allograft. Fibrin sealant (Tisseel; Baxter, Westlake Village, CA) may help facilitate this. Irrigate the defect and surrounding cartilage frequently with normal saline to prevent cartilage desiccation (Table 1).

Associated Lesions. Once the cartilage lesion is prepared, labrum repair is performed if necessary. Traction is then released and femoral osteochondroplasty is performed as well. After femoral osteochondroplasty is done, the leg is placed in traction again to visualize the central compartment.

Implantation of the Juvenile Allograft Cartilage. Before implantation, the joint must be dried. We normally use a Frazier suction tube through the midanterior portal attached to the suction. The joint must be dried for approximately 5 minutes. If excessive bleeding is noted, additional Q-tips can be used. It is important to keep drying the bed until the implantation of the juvenile allograft is done. Once the bed is dry, an initial thin layer of Tisseel fibrin sealant is placed in the bed using a preloaded syringe through the midanterior portal. The juvenile allograft cartilage is preloaded in a curved drill guide normally used for anchor drilling. With arthroscopic visualization, the allograft cartilage is layered into the cartilage lesion, with care taken to fill the depth up to the native cartilage level. A second layer of Tisseel (fibrin glue) is then applied on top of the inserted graft. The Tisseel (fibrin glue) is left dry for approximately 8 minutes. A probe is then inserted to ensure that the graft with the Tisseel (fibrin glue) is dry and solid (Fig 5). The patient is then taken out from traction. Fluid is reestablished and capsule closure is performed.

Postoperative Protocol. The postoperative rehabilitation is patient specific and depends on concomitant procedures that were performed in addition to the allograft cartilage. The first 2 weeks following surgery, stationary bike with no resistance is indicated. Patients remain nonweight bearing (NWB) for 6 weeks. Limited range of motion to 90° of flexion and no external rotation is also indicated during this time period. Patients are allowed to progress within a pain-free zone for the subsequent weeks. Patients are indicated to take aspirin 325 mg twice daily for 3 weeks to prevent blood clots. Indomethacin 75 mg sustained release is indicated twice daily for 10 days to prevent heterotopic ossification (HO). Moreover, ice machine is indicated for the first 2 weeks to reduce pain and swelling. When the patient is fully weight bearing and achieves full range of motion, therapy is advanced. Gentle strengthening exercises begin with a stationary bicycle and isometrics. As strengthening progresses, patients start using an elliptical machine and slide board and perform hip girdle (gluteus medius) strengthening. When range of motion and strength are satisfactory, sport-specific training can be started. Patients go back to all activities between 3 and 6 months postoperation (Table 2).

Table 1. Pearls and Pitfalls

Pearls	Pitfalls
Correct portal placement allows for improved visualization. Accessory portals can be made to achieve better visualization and comfort to work.	Improper visualization can lead to a defective bony bed preparation.
Careful drying of the lesion is vital to enhance this technique's results.	Wet surface might fail to retain the product efficiently.
Fill the defect up to the cartilage level or lower.	Filling the defect over the cartilage might create friction and cartilage overgrowth.

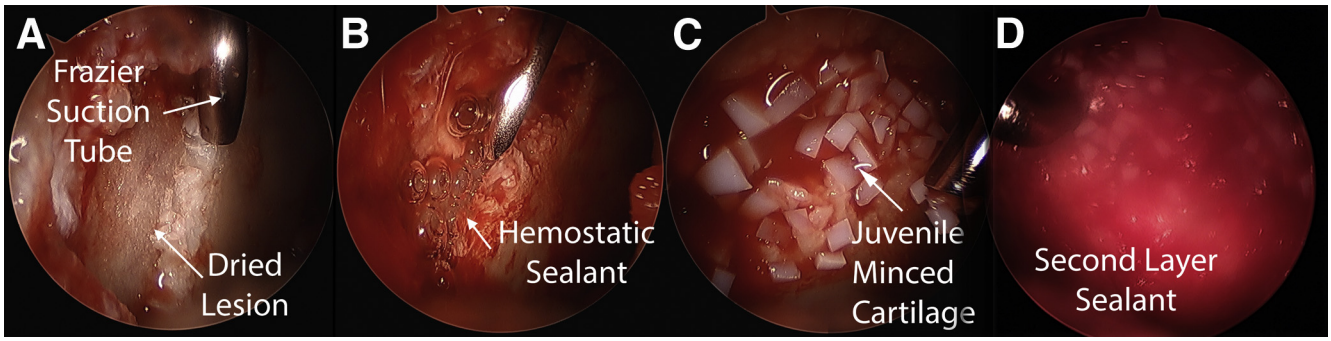

Fig 5. Arthroscopic sequence (midanterior portal in a right hip) demonstrating (A) a Frazier suction tube attached to the suction to dry the lesion for approximately 5 minutes. (B) Once dried, an initial thin layer of Tisseel is implanted and (C) the juvenile allograft cartilage is inserted with a curved drill guide into the defect. (D) Finally, a second layer of Tisseel is applied on top of the graft.

Discussion

This article details our preferred technique for treatment of medium to large cartilage lesions (>2 cm^2) in the hip in patients without significant osteoarthritis. Adult articular cartilage has limited capacity for self-repair. Untreated focal defects begin a cycle of cartilage breakdown, arthritic degeneration, and, ultimately, the need for joint replacement.[3] Microfracture has been well described with relative good functional outcomes for chondral lesions in the hip with limited indication parameters: patients <40 years old, body mass index <30, minimal osteoarthritis or Tönnis grade 0 to 1, and focal contained lesion size measuring <2 cm^2.[3]

Microfracture is the most popular cartilage repair technique used in the hip. Philippon et al.[10] performed microfracture in 9 patients for the treatment of full-thickness chondral defects of the acetabulum. The authors performed a revision arthroscopy in these patients for a variety of procedures and reported the percentage fill of the primary defect and repair grade.[10] Eight of the 9 patients had 95% to 100% coverage of an acetabular chondral lesion with grade 1 or 2 appearance of the repair product at an average of 20 months' follow-up.[10]

Additional cartilage techniques for larger chondral defects in the hip include ACI and MACI technique. Fontana et al.[11] studied arthroscopic autologous chondrocyte transplantation (ACT) compared with simple arthroscopic debridement in a controlled retrospective study of 30 patients affected by hip chondropathy. There were 15 patients in the ACT group and 15 in the simple arthroscopic debridement group.[11] The ACT and simple debridement groups had an average preoperative Harris Hip scores of 48.3 and 46, respectively.[11] The postoperative Harris Hip score of 87.4 was significantly higher in the ACT group compared with the simple debridement score (56.3).[11] The authors concluded that the ACT procedure is useful in the treatment of acetabular chondral defects.[11]

Osteochondral allograft transplantation in the hip has also been used to treat focal chondral lesions. Most of the time, this procedure is used for focal chondral lesions located in the femoral head, and good outcomes have been reported in the literature.[12,13] None of these procedures were done arthroscopically. Evans and Providence[12] describe a case report of a 32-year-old male with an osteochondral defect measuring 2.5 cm^2. After 12 months of nonoperative treatment, the authors reconstructed the articular defect with a fresh-stored osteochondral allograft using a size-matched femoral head donor.[12] At 12 months' follow-up, the patient had full range of painless motion, and the Harris Hip score had improved from 69 points preoperatively to 94 points postoperatively.[12] Krych et al.[13] performed osteochondral allograft transplantation in a 24-year-old woman and a 32-year-old man presenting with focal osteochondral defects of the acetabulum. Both patients improved their Harris Hip scores from 75 and 79 preoperatively, respectively, to 97 and 100 postoperatively, respectively, with no signs of progressive joint space narrowing compared with preoperative imaging.[13]

Particulated juvenile cartilage allograft (the DeNovo NT graft [Zimmer]) is a cartilaginous tissue graft obtained from allograft donors younger than 13 years. Because of the young age of the donors for this graft, the DeNovo NT Graft consists of scaffold-free living articular cartilage, displaying biochemical properties similar to those of articular cartilage found in young,

Table 2. Advantages and Limitations

Advantages	Limitations
High chondrogenic capacity	Price
Single-stage procedure	
Big cartilage defects (>2 cm^2)	Potential immunologic reaction
No need to harvest tissue or cells from areas of undamaged cartilage	
Does not require violation of subchondral bone	

healthy joints. Furthermore, the De Novo NT system has the following advantages: it is a single-stage procedure with no donor site morbidity and can be implanted arthroscopically. De Novo NT has been extensively used for knee chondral lesions and arthroscopically for the ankle in lesions where microfracture is not indicated (>2 cm^2). Clinical results of De Novo NT are encouraging, showing cartilage regeneration after 24 months postimplantation in 4 patients with 2-year follow-up with average knee cartilage lesion size 2.71 ± 1.23 cm^2.[14] The Knee Injury and Osteoarthritis Outcome Score, International Knee Documentation Committee, and visual analog scale scores demonstrate clear improvements at the 24-month follow-up period.

To our knowledge, this is the first technical note of allograft juvenile cartilage (De Novo NT graft) applied arthroscopically for hip chondral lesions. Indications are similar to microfracture. However, we leave this type of therapy for older patients (>40 years old) with medium to big chondral lesions >2 cm^2, where regeneration after microfracture is normally reduced compared with younger patients. The key to the success of this technique is to perform it with a completely dry implantation bed. We normally perform it at the end of the surgery, when both the central and peripheral compartments are already treated. The graft should be delivered once the defect is dry. A curved anchor guide can be used to deliver the graft into the defect.

Juvenile allograft cartilage implantation is an option to treat medium to large chondral lesions (>2 cm^2) in the hip. This technique has some advantages over microfracture: it has better chondrogenic capacity and can be used in medium to bigger lesions and in patients older than 40 years. Disadvantages include the risk of using an allograft tissue and the lack of long-term outcome. This technique has also some advantages over ACT, including a single-stage procedure, no donor site morbidity, and can be implanted arthroscopically. Long-term clinical studies and trials are needed to determine the true efficacy of this therapy.

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