

Arthroscopic Hip Capsular Plication With Augmentation Using a Bioinductive Collagen Implant



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Abstract: With advancements in arthroscopic techniques and instrumentation, hip arthroscopy has become an increasingly used technique to treat soft-tissue and osseous pathologies about the hip. Patient predisposition to labral and capsular injuries can present as femoroacetabular impingement or hip dysplasia, sometimes in combination. Capsular management continues to be a topic of debate, with capsular repair becoming the standard of care in most cases. Furthermore, in cases of borderline dysplasia and microinstability, considerations for not only capsular repair but with plication has shown significant clinical success. Although plication in this setting has shown promise, given a 20% failure rate, we suggest capsular augmentation to bolster the repair. We present a technique of capsular augmentation using a bioinductive collagen implant (Smith & Nephew) to improve the capsular integrity following repair and plication. The benefits of this implant are easy delivery through standard arthroscopic portals and secure fixation to the capsular tissue. These implants have a proven track record in the shoulder and serve as a scaffold for improved tissue quality, and their application in hip arthroscopy has potential by increasing the integrity of the capsular repair. Future studies are needed to address the clinical outcomes of this technique.

Arthroscopic surgery of the hip continues to expand its list of indications and is a proven technique to treat various soft-tissue and osseous conditions about the hip. Femoroacetabular impingement and labral injuries are common indications for hip arthroscopy, with excellent results.¹ There are various techniques and opinions on how best to manage the capsule following surgery; however, there is growing evidence that some form of capsular closure leads to better outcomes.^{2,3} With improved technology and techniques, there has been a growing interest in managing patients with hip dysplasia with arthroscopic surgery. Capsular management is a critical component of the surgery in these patients and must be carefully executed for a successful outcome.

In cases of severe dysplasia as defined by a lateral center edge angle $<18^\circ$, periacetabular osteotomy remains the procedure of choice with good-to-excellent long-term outcomes.⁴ Borderline dysplasia (lateral center edge angle 20° - 25°) is a known cause of microinstability and can be a source of persistent symptoms with nonoperative management. In these cases, hip arthroscopy to address any labral injury along with capsular plication is a proven technique to improve outcomes.⁵⁻⁷ Unfortunately, despite improved awareness and advanced techniques, 1 in 5 patients continues to be symptomatic with capsular plication.⁸ Stringent patient selection is important when considering arthroscopic surgery for symptomatic patients with borderline dysplasia.

Bioinductive bovine collagen implants have come on the market in recent years, and their use has been primarily in the shoulder for rotator cuff repair.⁹ Their proposed benefit is to improve the biologic environment and promote collagen formation. Histologic evaluation has demonstrated newly regenerated connective tissue, with no evidence of the collagen implant 6 months following implantation.¹⁰ Clinical studies have shown improved healing rates and tendon thickness with no adverse outcomes in their use in the rotator cuff. Specifically, there have been no inflammatory reactions noted with their use.^{11,12} Increased tissue thickness by as little as 2 mm has been shown to

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Table 1. Advantages and Potential Disadvantages

Advantages	
Proven safety with use in the shoulder with minimal risk	
Potential for increased capsular tissue thickness and stability	
Facile delivery system with secure fixation through existing portals	
Disadvantages	
Cost may prohibit routine use	
Potential for inflammatory reaction	
Tissue thickness may not lead to improve stability	
Significantly increased thickness could lead to stiffness and limited mobility	

decrease intratendinous strain by as much as 47% in finite element analysis.¹³ Given its proven safety and benefit of improving the biologic environment, we feel it has great potential in hip arthroscopy, particularly with capsule management by similarly increase capsular tissue thickness. We present a method of using a bioinductive collagen implant to augment capsular tissue in the setting of borderline dysplasia after plication of the capsule. Additional advantages and a potential disadvantage are described (Table 1).

Surgical Technique

Preoperative Planning

The patient's history should be thoroughly reviewed and history of any traumatic events, repetitive sporting or physical activity, connective tissue disorder, or previous surgery should be noted in the patient's chart. A careful examination should be performed with



Fig 1. Patient positioning on a Pivot Guardian Distraction System (Stryker, Kalamazoo, MI). This is a post-free setup that places the patient in approximately 15° of Trendelenburg while resting on a friction pad that uses the patient's body weight for countertraction. This reduces the perineal complications of the traditional post tables; however, the angle of the pelvis must be taken into consideration when establishing portals to adjust for the change in joint orientation.

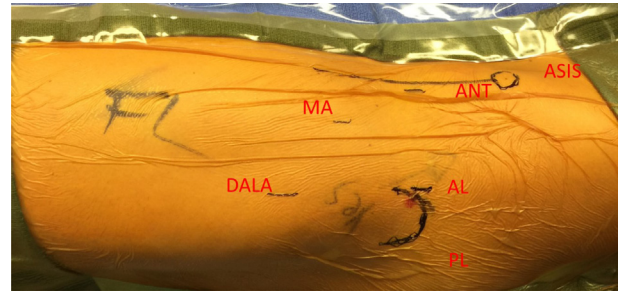


Fig. 2. Arthroscopic portals used in hip arthroscopy of a left hip in the supine position. For this procedure, we routinely use the AL as the primary viewing portal the MA portal as the working portal and the DALA portal to deliver the bio-inductive implant. (AL, anterior lateral portal; ANT, anterior portal; ASIS, anterior superior iliac spine; DALA, distal anterior lateral accessory portal; MA, mid-anterior portal; PL, posterior lateral portal.)

emphasis on the apprehension test, asymmetry in the figure-4, and log roll to assess capsular integrity. Standard plain films should be obtained to assess for dysplasia and femoroacetabular impingement. Advanced imaging with magnetic resonance imaging can be helpful to identify capsulolabral pathology and capsular redundancy. It is important to identify patients who would benefit from capsular augmentation prior to surgery so the implant is available.



Fig 3. Tagging stitch placed in the capsule via the MA portal while viewing from the AL portal in a right hip. This stitch can be secured outside of the portal with a clamp with to retract the capsular tissue aiding in the visualization of the capsulolabral junction, potentially decrease the size of the capsulotomy and to prevent iatrogenic injury to the tissue with subsequent introduction and removal of arthroscopic instruments. (AL, anterior lateral portal; MA, mid-anterior portal.)

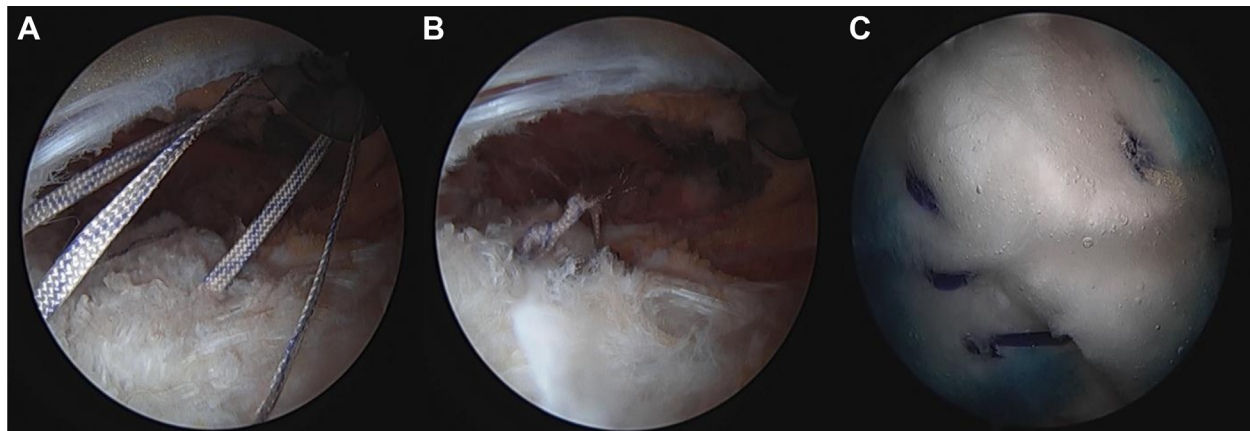


Fig 4. Viewing from the AL portal with (A) sutures tapes placed in capsulotomy for plication are (B) tied to perform inferior capsular shift as described in Fig 4. and subsequently (C) bioinductive implant placed and secured in place with PLA staples via the MA portal. (AL, anterior lateral portal; MA, mid-anterior portal; PLA, polylactic acid.)

Patient Positioning

The procedure can be performed in both the supine and lateral techniques. The authors use a post-less table with the patient supine in 10° of Trendelenburg to avoid injury to the pudendal nerve (Fig 1).

The patient is then induced under general anesthesia and the legs placed in well-padded boots and secured to the operative table with the legs in neutral rotation. The c-arm is then brought in from the contralateral side and an anteroposterior fluoroscopic image of the operative hip is obtained. A spinal needle is then used to create an air arthrogram and traction applied to create distraction of the hip joint.

The operative extremity is then prepped and draped in the usual sterile fashion. Bony landmarks and planned arthroscopic portals are marked on the patient's skin (Fig 2).

Portal Placement

An anterolateral portal is then established with a spinal needle and placement confirmed on fluoroscopy.

A nitinol guidewire is then threaded into the joint against the medial wall and, following incision, a trocar is placed for the primary viewing portal of the central compartment. A 70° arthroscope is then inserted and the anterior triangle identified for secondary portal placement. A spinal needle is then inserted under direct visualization and the mid-anterior portal established in a similar fashion.

Diagnostic and Operative Arthroscopy

We then perform an interportal capsulotomy and place tagging stitches in the capsular tissue (Fig 3). This allows for mobility to visualize the central compartment. With the camera in the anterior lateral portal, the anterior and posterior acetabular wall, cotyloid space, and stellate crease can be easily identified with the 70° arthroscope. From this portal, the chondrolabral junction and acetabular rim can be examined and any pathology readily identifiable.



Fig 5. Capsular closure performed using an inferior shift mechanism to accentuate the screw home mechanism of the iliofemoral ligament. This is achieved by placing the medial (acetabular side) passes superior to the lateral (femoral side) passes in either a simple or figure-of-eight fashion. Reproduced with permission.⁵

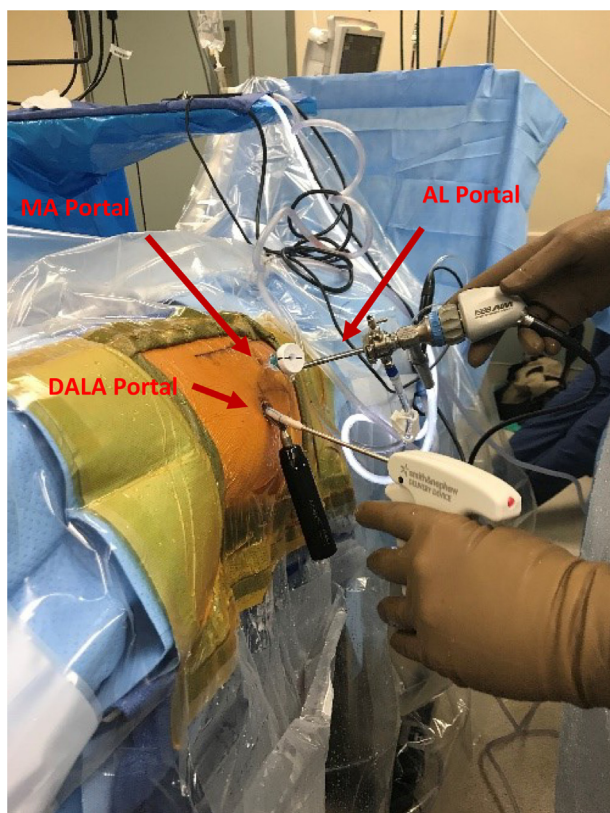


Fig 6. Outside view of the delivery device inserted through DALA portal before deployment in the peripheral compartment. A half-pipe cannula sled device is placed into the portal first to assist in the delivery of the implant. A cannula is also placed in the MA portal to help facilitate the delivery of the PLA staple device when securing the implant to the capsular tissue. The arthroscope is placed in the standard AL viewing portal. (AL, anterior lateral portal; DALA, distal anterior lateral accessory portal; MA, mid-anterior portal; PLA, poly-lactic acid.)

At this point, any labral and acetabular work is performed. Once the labrum is either repaired or reconstructed and acetabuloplasty completed, traction is released. At this point, any femoral work is completed. Fluoroscopy is used with the hip in flexion, extension, internal rotation, and external rotation to insure adequate resection of bone.

Capsular Repair and Augmentation (With Video Illustration)

Once completed, we routinely repair the capsule using a series of interrupted suture tape sutures in a figure-of-eight type fashion taking care not to incorporate the reflected head of the rectus (Fig 4; Video 1). In the setting of borderline dysplasia, capsular closure will be performed using an inferior shift method, accentuating the screw home mechanism of the iliofemoral ligament (Fig 5).⁵ For the placement of the bioinductive implant, if not previously established for

Table 2. Pearls and Pitfalls

- Use radiographic parameters (sourcil line, LCEA, ACEA, AI) and MRI (capsular redundancy) during the preoperative workup to screen for patients who may benefit from capsular augmentation ensuring the graft is available
- Establish the distal anterolateral accessory portal more distal and posterior to allow the implant to lay over tissue without significant manipulation
- Use the MA portal to deploy the polylactic acid staples—allows for perpendicular angle to secure the implant to the underlying capsular tissue

ACEA, anterior center-edge angle; AI, acetabular index; LCEA, lateral center edge angle; MA, mid-anterior; MRI, magnetic resonance imaging.

anchor placement, a distal anterolateral accessory portal is established (Fig 2).

Through this portal, the bioinductive collagen implant (Smith & Nephew, Andover, MA) is inserted into the peripheral compartment (Fig 6). It is critical that this portal is used to insure the bioinductive collagen implant can lay appropriately over the repaired capsular tissue, near the area of the iliocapsularis musculature (see Table 2 for additional pearls and pitfalls). The safety is then released and the trigger squeezed, which retracts the clear plastic tubing. This allows the implant to unfurl and fully deploy. The implant is then placed overlying the capsular repair and the main limb of the iliofemoral ligament. Once in optimal position, the tendon anchor inserter is placed in the canula of the mid-anterior portal. The graft is secured by squeezing the trigger while maintain downward pressure to deploy a polylactic acid staple (via the mid-anterior portal) into the graft and capturing the underlying capsular tissue. This is repeated on all 4 sides and the mid substance of the graft and the implant delivery instrument and tendon anchor inserter are removed. Additional staples are inserted as necessary (Fig 4; Video 1). Stability of the graft is then assessed. All arthroscopic instruments are removed, and the portals are closed with simple interrupted sutures.

Postoperative Course and Rehabilitation

Patients are allowed 50% partial weight bearing with crutches for ambulation for the first 3 weeks postoperatively. Patients also use foam boots at night for the first 7 days to avoid external rotation during sleep. Continuous passive motion is initiated at home with initial settings of 0 to 40° with an increase of 10° each week as tolerated, keeping hip flexion below 90°. Physical therapy is initiated after the first postoperative visit (between 10 and 12 days after surgery) to include range of motion exercises with light isometric strengthening. At 3 weeks postoperatively, patients progress to full weight bearing. Hip flexion greater than 90° is avoided for the first 6 weeks after surgery.

Patients are prescribed naproxen sodium 500 mg twice daily for the first 30 days for both pain control and heterotopic ossification prophylaxis.

Discussion

The technique described in this article is an effective way of augmenting the hip capsule tissue to promote healing and increase tissue thickness. We find it useful in cases of microinstability with borderline dysplasia to bolster the capsular tissue. The implant design facilitates easy delivery at the conclusion of the procedure adding minimal operative time. These implants have a proven safety track record when used in the shoulder for rotator cuff disease and the benefit of increasing tissue thickness as a bioinductive scaffold has previously been demonstrated.¹² We feel its application within the hip provides a similar benefit in increasing the integrity of the capsular tissue in cases of microinstability. Future studies are needed to validate the increased tissue thickness and clinical outcomes of this technique. The cost-effectiveness of its use also needs to be evaluated when considering its use.

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