Technical Note

Hip Capsular Plication With Crossed Mattress Stitch Configuration for a Revision Hip Arthroscopy in the Setting of Capsular Insufficiency

Robert B. Browning, M.D., Thomas D. Alter, M.S., Daniel Wichman, B.S., and Shane J. Nho, M.D., M.S.

Abstract: The hip capsule is an important static stabilizer of the hip joint. Perioperative capsular management during hip-preservation surgery is critical to maintain hip stability. Many biomechanical and clinical studies have demonstrated the importance of performing a comprehensive capsular closure to restore normal hip kinematics. For this reason, capsular closure or plication is now routine practice for many hip arthroscopists. The purpose of the technique is to describe a capsular plication technique using a mattress stitch configuration performed in the revision setting.

Over the past 2 decades, hip arthroscopy has become an increasingly popular method for the treatment of femoroacetabular impingement syndrome, with improvement shown in patient-reported outcomes.[1-4] To obtain adequate visualization of intra-articular pathology during hip arthroscopy, a capsulotomy is typically performed.[5] The hip capsule is one of the most important static stabilizers of the hip joint, allowing for complex biomechanical movements.[6] Previous biomechanical studies have shown that the iliofemoral ligament provides primary restraint during hip extension and external rotation.[7] In addition, studies have demonstrated increased joint mobility following unrepaired capsulotomy, theoretically leading to increased risk of hip instability.[8] Furthermore, 35% of patients undergoing revision surgery following hip arthroscopy were found to have unaddressed capsular insufficiency.[9] Due to the growing evidence on the effects of capsular management, most hip arthroscopists have implemented routine capsular closure or plication to restore normal hip biomechanics, improve stability and function, and prevent progressive chondrolabral injury.[5] In patients with risk factors for hip instability, including younger women, those with generalized ligamentous laxity, and those with intraoperative evidence of capsular redundancy, capsular plication is typically performed.[10] This Technical Note describes our technique for capsular plication with a mattress stitch configuration following a failed hip arthroscopy. This is indicated by clinical and imaging evidence of capsular instability following a primary hip arthroscopy. For patients who possess adequate capsular tissue and hip joint capsule laxity, this technique can be implemented to create greater joint stability and improve the patient's postoperative clinical and functional outcomes.

From the Section of Young Adult Hip Surgery, Division of Sports Medicine, Department of Orthopedic Surgery, Hip Preservation Center, Rush University Medical Center, Chicago, Illinois, U.S.A.

The authors report the following potential conflicts of interest or sources of funding: S.J.N. reports nonfinancial support from AlloSource; other from the American Orthopaedic Association and American Orthopaedic Society for Sports Medicine; nonfinancial support from Arthrex; other from Arthroscopy Association of North America; nonfinancial support from Athletico, DJ Orthopaedics, CONMED Linvatec, and Miomed; personal fees from Ossur; nonfinancial support from Smith & Nephew; and personal fees from Springer and Stryker, outside the submitted work. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Received February 21, 2021; accepted April 21, 2021.

Address correspondence to Thomas D. Alter, M.Sc., Department of Orthopedic Surgery, Rush University Medical Center, 1611 W Harrison St, Chicago, IL 60612. E-mail: nho.research@rushortho.com

2212-6287/21304

https://doi.org/10.1016/j.eats.2021.04.020

Surgical Technique (With Video Illustration)

Patient Setup and Diagnostic Arthroscopy

Full demonstration of our technique is seen in Video 1. The patient is placed in the supine position with a well-padded perineal post. Balanced suspension is applied to achieve adequate joint distraction which is confirmed by fluoroscopic imaging. A standard anterolateral portal

(ALP) is created with fluoroscopic assistance, with care taken to ensure ease of entrance into the joint parallel to the acetabular sourcil. A 70° arthroscope is then inserted into the joint and a modified mid-anterior portal (MMAP) is similarly created under direct visualization. The camera is then moved to the MMAP, verifying accurate placement of the ALP, as well as atraumatic entry with regard to the labrum. Diagnostic arthroscopy is performed to evaluate the labrum, ligamentum teres, acetabular and femoral head cartilage, and the state of the capsular tissue (hyperemic, deficient, synovitis, etc.) seen in Fig 1.

Capsulotomy and Identification of Pathology

Once the ALP is deemed adequate, the Samurai blade (Stryker, Kalamazoo, MI) is brought through the ALP and the interportal capsulotomy is performed through the iliofemoral ligament (Fig 2). Once the capsulotomy has reached the camera, the camera is moved back to the ALP and the Samurai is used via the MMAP to complete the interportal capsulotomy for ease of instrumentation throughout the procedure. A tagging stitch is then placed via the MMAP to tag the acetabular leaflet of the capsulotomy and apply traction to enhance visualization of the capsulolabral recess and assess the quality of the labrum and capsule. At this point a 4.0-mm full radius arthroscopic shaver (Stryker) is used to demarcate the capsulolabral junction, followed by radiofrequency ablation as needed to further develop this interval. In this instance, the labrum displays evidence of a failed previous repair with a labral tear between the 12- and 4-o'clock positions. Probing the hip capsule during diagnostic arthroscopy revealed thinned and redundant tissue.

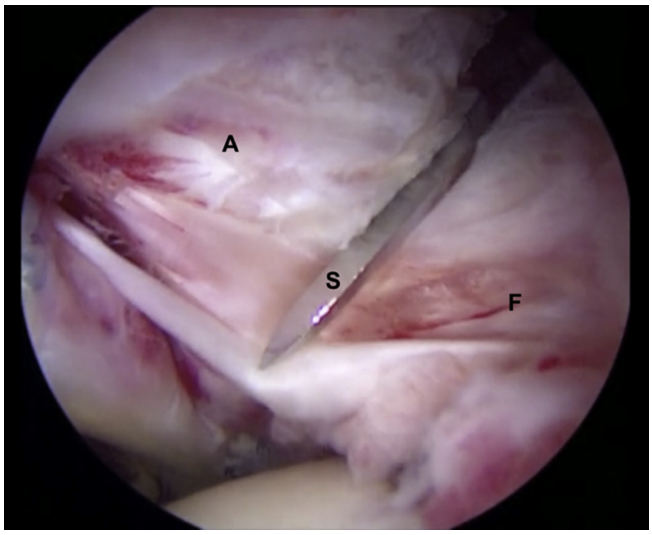

Fig 2. View of a right hip from the anterolateral portal with 70° arthroscope demonstrating the re-creation of the interportal capsulotomy through the iliofemoral ligament with a Samurai blade (S). The femoral side (F) and acetabular side (A) of the capsulotomy are indicated for orientation.

Labral Repair

Once adequate visualization of the capsulolabral junction is attained and the boundary of the labral tear is established, attention is turned to fixation of the superior labrum. A cannula (8 × 90-mm CLEAR-TRAC CANNULA; Smith & Nephew, Memphis, TN) is established into the ALP. With the arthroscope in the MMAP, a drill guide is placed in the ALP onto subchondral bone. We advocate placing the suture anchor as close to the subchondral bone as possible without penetrating the articular cartilage surface. Once the drill

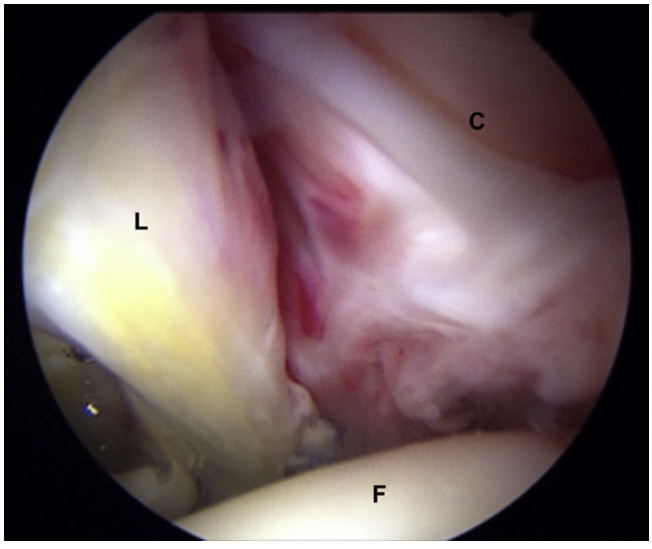

Fig 1. View of a right hip from the modified mid-anterior portal with 70° arthroscope detailing the state of the labrum (L), intra-articular cartilage (F), and capsular tissue (C). Here, postoperative changes are seen in the capsular tissue.

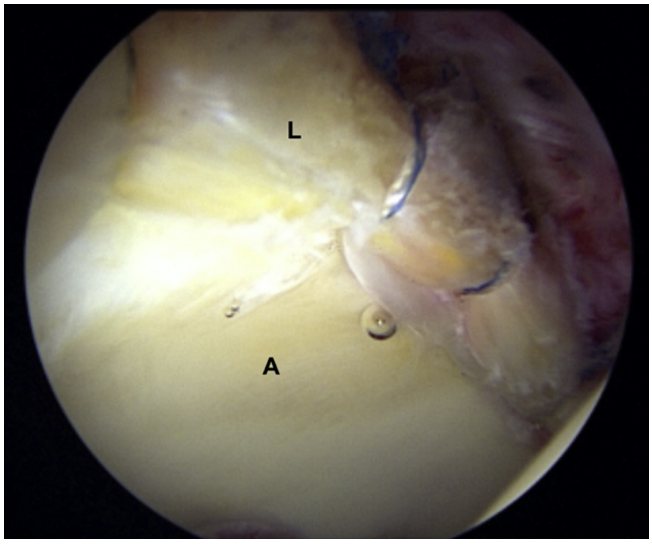

Fig 3. View of a right hip from the modified mid-anterior portal with 70° arthroscope demonstrating the final labral repair. The labrum (L) and acetabulum (A) are indicated for orientation.

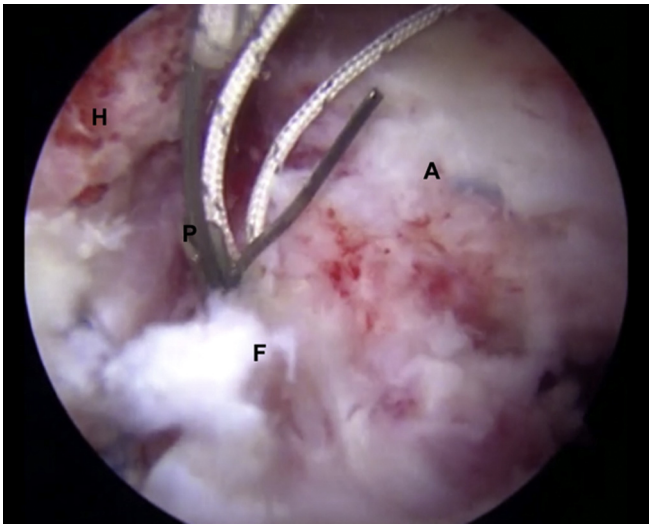

Fig 4. View of a right hip from the modified mid-anterior portal with 70° arthroscope demonstrating initial penetration of suture through the femoral side of the capsulotomy (F). The acetabular side is indicated as (A), the femoral head is indicated with an (H), and the tissue penetrator is indicated as (P).

guide is in the anatomic position, the arthroscope is placed in the joint to visualize the acetabular cartilage as the drill is advanced into the subchondral bone. Two double-loaded 2.3-mm NanoTack suture anchors (Stryker) are inserted into the bone socket with a mallet. Through the ALP, 1 suture limb is passed through the labrum at the chondrolabral junction using a tissue-penetrating device (NanoPass Reach Suture Passer; Stryker) and retrieved about 2 to 4 mm from

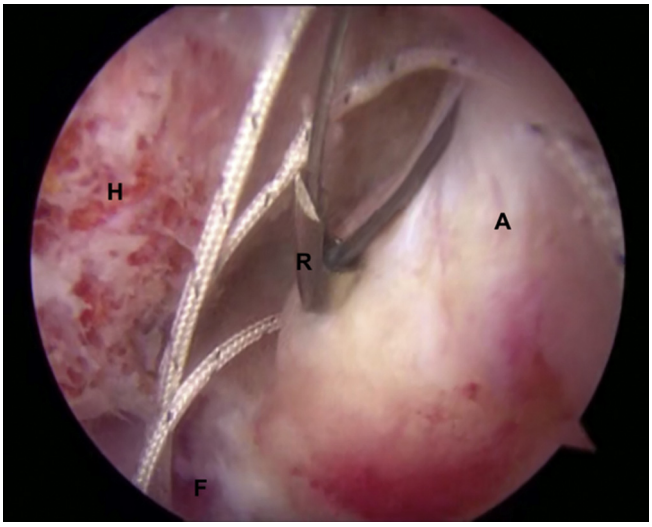

Fig 5. View of a right hip from the modified mid-anterior portal with 70° arthroscope demonstrating suture retrieval through the acetabular side of the capsulotomy (A). The femoral side is indicated as (F), the femoral head is indicated with an (H), and the suture retrieval device is indicated (R). This represents the second suture retrieval in the crossed mattress stitch shown.

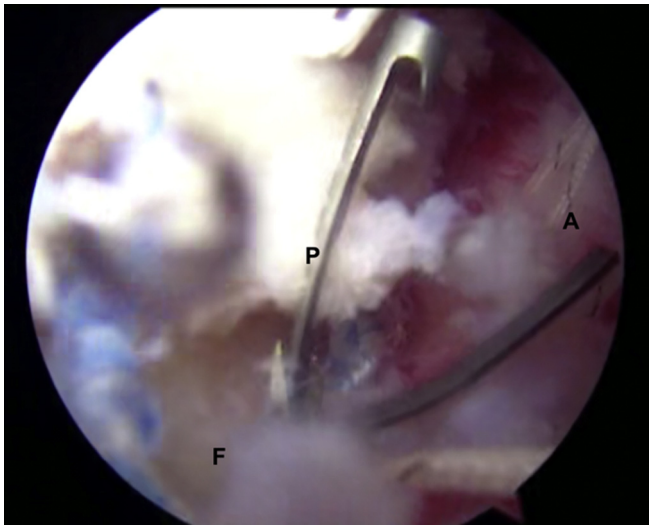

Fig 6. View of a right hip from the modified mid-anterior portal with 70° arthroscope demonstrating suture passing through the femoral side (F) of the capsulotomy. The acetabular side is indicated as (A) and the penetrator is indicated (P). This represents the second suture passed in the second of 3 crossed suture constructs.

initial penetration through the labral base, creating a horizontal mattress stitch to provide an anatomic repair (Fig 3). We then routinely establish a distal anterolateral accessory portal. This is in line with the ALP and approximately 4 cm distal. With the arthroscope in the ALP, a spinal needle is used to establish the distal anterolateral accessory portal, aiming for the acetabular rim. A guidewire is passed through the spinal needle,

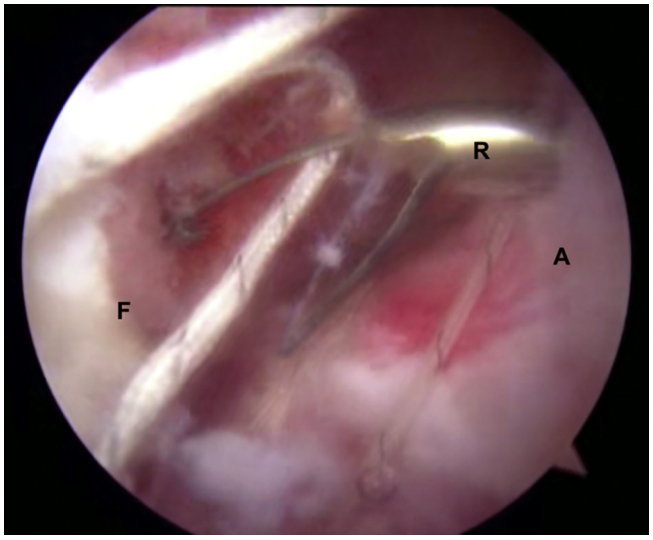

Fig 7. View of a right hip from the modified mid-anterior portal with 70° arthroscope demonstrating suture retrieval through the acetabular side (F) of the capsulotomy. The femoral side is indicated as (F) and the suture retriever is indicated (R). This image depicts the retrieval of the suture seen passed in Figure 6.

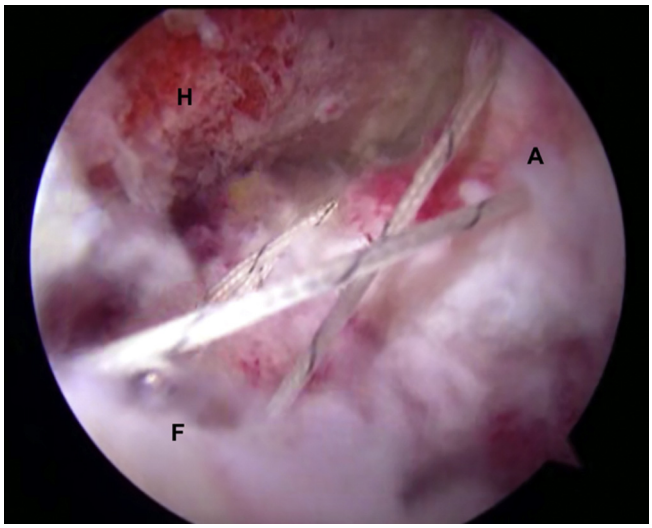

Fig 8. View of a right hip from the modified mid-anterior portal with 70° arthroscope demonstrating 2 untied crossed mattress stitch constructs. The acetabular (A) and femoral side (F) are indicated. The femoral head is labeled (H) for orientation.

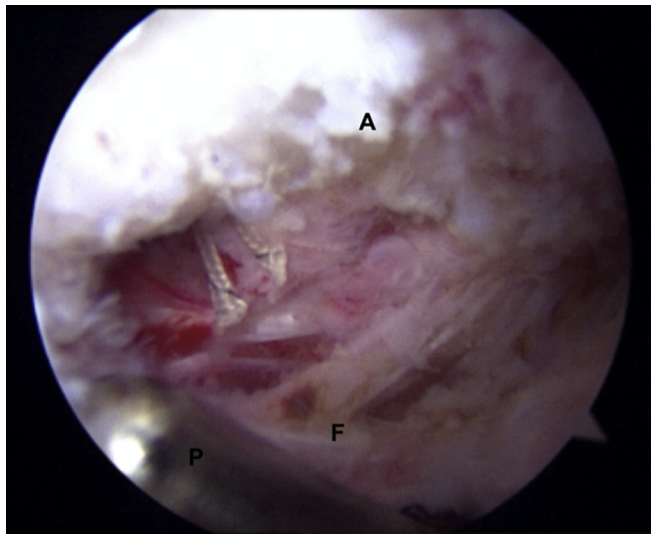

Fig 10. An arthroscopic probe (P) is used to ensure a watertight seal in the final capsular construct. The acetabular and femoral sides of the capsulotomy are indicated with (A) and (F), respectively.

and a drill guide can be passed over the guidewire. The anterior labral tear is addressed in similar fashion. Typically, 3 to 4 suture anchors are placed for labral fixation.

Femoral Osteochondroplasty

To address the peripheral compartment, the camera is moved back to the MMAP, traction is released, and the limb is flexed to approximately 45°, allowing for improved visualization within the peripheral compartment of the hip. Often in cases of capsular insufficiency the horizontal capsulotomy with the aid of traction stitches is sufficient to gain adequate visualization of the femoral neck, however a T-capsulotomy can be added if necessary. Once the capsule is retracted, a balanced cam resection is performed with the aid of fluoroscopy. A dynamic arthroscopic and fluoroscopic evaluation in then performed to confirm no residual deformity is present.

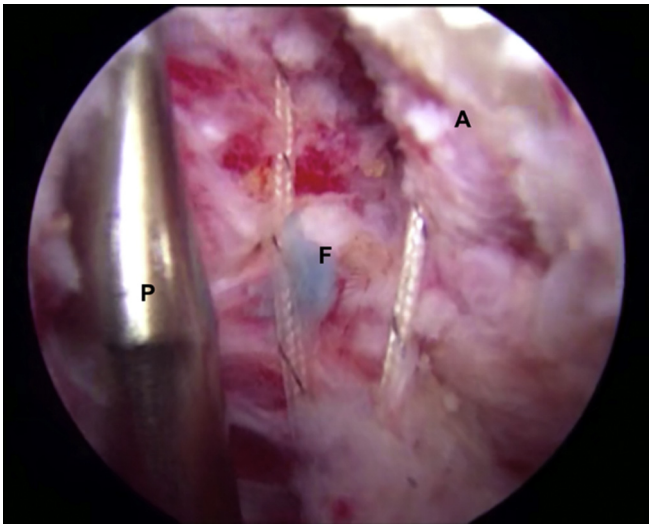

Fig 9. An arthroscopic probe (P) is used to validate the watertight seal created by the previous suture. The acetabular and femoral sides of the capsulotomy are indicated with (A) and (F), respectively.

Table 1. Pearls and Pitfalls

Pearls	Pitfalls
Perform capsulotomy close to femoral head to ensure adequate acetabular capsular leaflet for plication	Inadequate acetabular capsular leaflet will weaken plication and increase risk for failure
Perform capsular closure at 30° of hip flexion	Performing capsular closure with increased flexion or extension may result in an overly loose or tight capsule
Identify and correct overlapping or looped sutures before placing subsequent sutures	Suture management will otherwise become burdensome
Instrumentation and suture passage are typically easiest if performed through the AL portal	Technically demanding for inexperienced hip surgeons
All sutures are passed across the horizontal capsulotomy, before arthroscopic knot tying, allowing for better visualization.	Tying suture sequentially will impair visualization of subsequent suture passage.
Avoid hip extension or external rotation during early postoperative rehabilitation.	Failure to avoid hip extension may put tension on the anterior capsule.

AL, anterolateral portal.

Table 2. Advantages and Disadvantages

Advantages	Disadvantages
Capsular plication improves capsular tightness and integrity	Potentially longer surgical time due to technically challenging procedure
The technique follows a systemic order and is reproducible	Suture management can be challenging

Capsular Plication

Following diagnosis and treatment of both central and peripheral compartment pathology, the capsular plication is performed (Figs 4-8). An arthroscopic grasper is used once more to confirm that the femoral capsular leaflet can be reduced to any remnant acetabular tissue and the acetabular rim, ensuring graft augmentation is not needed. For this aspect of the procedure, the camera is in the MMAP. A slingshot device (SlingShot; Stryker Sports Medicine; Greenwood Village, CO) is used via the ALP to pass the suture from the anchor through both the remnant acetabular capsular leaflet and retrieved through the femoral sided leaflet for the first suture passage. Next, the last retrieved suture from the femoral leaflet is pulled through the cannula so that two-thirds of the suture is out of the cannula. The SlingShot is then passed through the cannula by cinching the suture to allow for the minimum amount needed to pass through the acetabular side. Finally, the SlingShot is passed through the acetabular leaflet to retrieve the passed suture to complete the figure of 8 technique.

The suture is retrieved from the same portal to ensure proper soft-tissue tension and tied using arthroscopic tying techniques. Each suture is passed before tying, to improve visualization of the capsular defect and for suture passage. These steps are repeated, depending on the size of the capsular defect. Generally, there are 4 stitches used for a 4- to 6-cm capsular incision. In contrast to capsular closure, larger bites are taken on the distal side of the capsule, leading to an inferior capsular shift and increasing capsule tightness upon tying. Once all the suture within the construct has been tied, final inspection and probing of the repair is performed with a switching stick to ensure watertight plication (Figs 9 and 10). Pearls and pitfalls and advantages/disadvantages of the procedure are described in Tables 1 and 2.

Postoperative Protocol

Patients follow our standard postoperative protocol. A brace is worn to limit flexion to less than 90° and abduction to less than 30° for the first 3 weeks after surgery. In addition, hip extension and external rotation are avoided for the first 3 weeks to avoid placing tension on the anterior hip capsule. Patients are allowed to be weight-bearing up to 20 pounds on the surgical extremity with crutches for the first 3 to 4 weeks postoperatively. Patients complete physical therapy twice a week for the first 3 months of their recovery and are progressed through core, balance, and strengthening exercises. Patients are cleared with no restriction at approximately 6 months.

Discussion

Capsular closure following labral repair and corrective surgery for femoroacetabular impingement has become standard practice in modern hip arthroscopy.[5] In this Technical Note, we describe an alternative technique for capsular plication that can restore normal capsular structure in patients with capsular insufficiency. Specifically, patients with capsular insufficiency may benefit from the structural support provided by crossed mattress suture configuration. Previous Technical Notes have described capsular closure with sutures tied in a parallel fashion[11]; however, studies have demonstrated the mechanical advantage of using of a cross-mattress configuration.[12] Although standard capsular closure is adequate in most cases to restore normal hip biomechanics, capsular plication is necessary in patients with excess capsular laxity or microinstability of the joint. Although early results have been promising in our clinical practice, studies reporting medium- to long-term patient-reported outcomes are necessary to validate these results. Given our promising early results, we will continue to perform the figure of 8 technique for capsular plication in select patients with capsular insufficiency.

References

1. Ganz R, Parvizi J, Beck M, Leunig M, Nötzli H, Siebenrock KA. Femoroacetabular impingement: A cause for osteoarthritis of the hip. *Clin Orthop Relat Res* 2003:112-120.
2. Byrd JWT, Jones KS. Prospective analysis of hip arthroscopy with 10-year followup. *Clin Orthop Rel Res* 2010;468:741-746.
3. Bozic KJ, Chan V, Valone FH 3rd, Feeley BT, Vail TP. Trends in hip arthroscopy utilization in the United States. *J Arthroplasty* 2013;28:140-143.
4. Beck EC, Nwachukwu BU, Chahla J, et al. Patients with borderline hip dysplasia achieve clinically significant outcome after arthroscopic femoroacetabular impingement surgery: A case-control study with minimum 2-year follow-up. *Am J Sports Med* 2019;47:2636-2645.
5. Nho SJ, Beck EC, Kunze KN, Okoroha K, Suppauksorn S. Contemporary management of the hip capsule during arthroscopic hip preservation surgery. *Curr Rev Musculoskelet Med* 2019;12:260-270.
6. Abrams GD, Hart MA, Takami K, et al. Biomechanical evaluation of capsulotomy, capsulectomy, and capsular repair on hip rotation. *Arthroscopy* 2015;31:1511-1517.
7. Myers CA, Register BC, Lertwanich P, et al. Role of the acetabular labrum and the iliofemoral ligament in hip stability: an in vitro biplane fluoroscopy study. *Am J Sports Med* 2011:85S-91S (suppl 39).

8. Khair MM, Grzybowski JS, Kuhns BD, Wuerz TH, Shewman E, Nho SJ. The effect of capsulotomy and capsular repair on hip distraction: A cadaveric investigation. *Arthroscopy* 2017;33:559-565.
9. Philippon MJ, Schenker ML, Briggs KK, Kuppersmith DA, Maxwell RB, Stubbs AJ. Revision hip arthroscopy. *Am J Sports Med* 2007;35:1918-1921.
10. Chandrasekaran S, Gui C, Hutchinson MR, Lodhia P, Suarez-Ahedo C, Domb BG. Outcomes of endoscopic gluteus medius repair: Study of thirty-four patients with minimum two-year follow-up. *J Bone Joint Surg Am* 2015;97:1340-1347.
11. Beck EC, Alter T, Mehta N, et al. Contemporary hip capsular management and closure using a suture passing device. *Arthrosc Tech* 2019;8:e947-e952.
12. Nakama GY, Kaleka CC, Franciozi CE, et al. Biomechanical comparison of vertical mattress and cross-stitch suture techniques and single- and double-row configurations for the treatment of bucket-handle medial meniscal tears. *Am J Sports Med* 2019;47:1194-1202.