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Technical Tips

Arthroscopic capsular repair using proximal advancement for instability following hip arthroscopic surgery: a case report

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ABSTRACT

Arthroscopic capsular reconstruction has been reported for joint capsule tear and joint instability after hip arthroscopic surgery. However, the procedure is complicated and requires proficiency. Herein, we present a case of mild dysplasia and instability following arthroscopic surgery performed against pain due to synovitis and labral injury. The patient refused osteotomy of the hip joint, so we performed hip arthroscopic surgery using a new method of arthroscopic capsular repair using proximal advancement. A 37-year-old woman underwent hip arthroscopic surgery two times at the right side and periacetabular osteotomy at the left side. She noticed instability of the right hip joint after the second hip arthroscopic surgery. For the joint capsular management at the second surgery, which was not suitable for capsular plication, arthroscopic capsular repair using proximal advancement was performed by lifting the distal capsule to the acetabular margin. This method is less technically demanding compared with capsular reconstruction, and it can securely achieve joint stability by retensioning the joint capsule and iliofemoral ligament. Patient-reported outcomes were assessed by modified Harris hip score (mHHS), non-arthritic hip score (NAHS) and visual analog scale (VAS). The patient reported an increase in the mHHS from 35.2 pre-operatively to 90.1, the NAHS increased from 50 pre-operatively to 88.7, and the VAS score improved from 9 points pre-operatively to 1 point at 2 years post-operatively. To our knowledge, this is the first report on arthroscopic capsular repair using proximal advancement in a patient with hip instability following hip arthroscopic surgery.

INTRODUCTION

The clinical outcomes of hip arthroscopic surgery for femoroacetabular impingement (FAI) were reportedly good [1]. With regard to hip arthroscopic surgery, some studies have reported that the clinical results for borderline developmental dysplasia of the hip (BDDH) and mild dysplasia are comparable to those for FAI [2–4], whereas others have reported that the clinical results for BDDH and mild dysplasia are inferior to those for FAI [5]. Therefore, the choice of hip arthroscopic surgery for BDDH and mild dysplasia remains unclear. Joint micro and macroinstability has been reported to be a serious complication after hip arthroscopic surgery [6, 7], and it may be caused by inappropriate capsular management approaches, such as lack of capsular closure or plication. If joint instability occurs following hip arthroscopic surgery, revision surgery is often performed to achieve stability of the hip joint. Arthroscopic capsular plication or reconstruction is selected as the approach for revision surgery [8]. In revision surgery, the capsule itself may have vulnerabilities; thus, reconstruction may be selected accordingly. However, arthroscopic capsular reconstruction requires complicated procedures and advanced skills [9, 10]. Herein, we present a case of mild dysplasia and instability following arthroscopic surgery performed for pain due to synovitis and labral injury. The patient refused osteotomy

of the hip joint, so we performed hip arthroscopic surgery using a new method of arthroscopic capsular repair using proximal advancement.

CASE DESCRIPTION

The patient was a 37-year-old woman diagnosed with bilateral mild hip dysplasia and underwent right hip arthroscopic surgery twice due to synovitis and labral injury and left periacetabular osteotomy for acetabular dysplasia. With regard to the right hip joint, the first operation was performed in our hospital. The hip arthroscopic surgery was performed due to synovitis. Arthroscopic findings showed synovitis at the recessed portion around the labrum. Synovectomy was also performed. Management of the joint capsule involved only a small capsulotomy at each portal site, and capsular closure was not performed. She did not experience pain of the right hip joint after surgery. Her modified Harris hip score (mHHS) increased from 61.2 pre-operatively to 90.2 at 6 months post-operatively. As pain relapsed 1 year after surgery, right hip arthroscopic revision surgery was performed at another hospital because she moved to another location. Although the detailed course, diagnosis and criteria for treatment in other hospitals are unknown, she was presumed to undergo surgery for hip labral tear caused by cam-type FAI from the surgical procedures. However, cam lesions were not specifically detected before our initial operation at our hospital. For the joint capsule, inter-portal capsulotomy was performed. Subsequently, labral repair, cam osteochondroplasty and joint capsule closure (single stitch) were performed. However, she experienced right hip pain 6 months after the operation, and she noticed joint instability during weight bearing. Thus, she revisited our hospital. She was walking with a Lofstrand crutch, but she experienced instability and pain at the hip joint with weight bearing. On physical examination, the range of motion (ROM) of the hip joint were as follows (right/left): flexion, 80°/115°; abduction, 25°/35°; external rotation, 25°/40°; and internal rotation, 10°/30°. The ROM of internal and external rotation was measured at the flexion position of the hip joint. Additionally, ROM was limited because of severe pain present since the early stage. The anterior impingement test was positive in the right hip joint. The dial test and log-roll test for evaluating joint instability were positive only on the right side (Fig. 1). She underwent radiographic evaluation of the right hip with a supine anteroposterior (AP) pelvic radiographs (Fig. 2), 45° Dunn view, and false-profile view. The lateral-center-edge angle was 18°, acetabular inclination was 14°, alpha angle (45° Dunn view) was 31° and vertical-center-anterior margin angle was 20°. The radiograph showed no osteoarthritic changes at the right hip joint. For the left hip joint, slight joint space narrowing was observed. Magnetic resonance arthrography (MRA) revealed adhesions between the labrum and joint capsule, joint capsule, and cam osteochondroplasty site (Fig. 3). Additionally, no obvious labral injury and cartilage damage were found, but there was continuity of the joint capsule. She received conservative treatments, such as body trunk training, muscular strength training and different exercises for 6 months. However, her symptoms did not improve. She was informed about acetabular osteotomy and hip arthroscopy as surgical treatments, and she strongly desired hip arthroscopic surgery. She rejected periacetabular osteotomy because of the long time required to return to activities of daily living owing to the strong post-operative pain and muscle weakness. She was found to be a candidate for arthroscopic capsular plication or repair using the proximal capsule advancement method. The mHHS, non-arthritic hip score (NAHS) and visual analog scale (VAS) score were obtained pre-operatively, 1 year post-operatively and 2 years post-operatively.

Fig. 1. Pre-operative log-roll test. **(A)** Operative side (right) and **(B)** non-operative side (left). The log-roll test for evaluating joint instability is positive on the right side.

Arthroscopic findings and surgical technique

The patient was placed in the supine position, with the hip placed in 10° flexion, 15° internal rotation and neutral abduction. The leg was placed in a well-padded peroneal post, and the feet were well secured. Traction was applied under fluoroscopy, and the following two portals were created: anterolateral portal and mid-anterior portal (MAP). A Beaver blade was used for inter-portal capsulotomy, and diagnostic arthroscopy was performed. Arthroscopy revealed severe adhesions between the labrum and joint capsule, joint capsule, and cam osteochondroplasty site (Fig. 4A). We completely released the adhesion using a radiofrequency probe (VAPR: Johnson & Johnson, Raynum, MA) (Fig. 4B). The cartilage in the weight-bearing areas of the femur and acetabulum was almost intact (International Cartilage Repair Society classification Grade 1). The joint capsule (acetabular side) was more

Fig. 2. Pre-operative AP supine pelvic radiograph of the patient. The lateral-center-edge angles (right/left) were 18°/40°, and acetabular inclination (right/left) was 14°/−1°. The radiograph showed no osteoarthritic changes at the right hip joint. For the left hip joint, slight joint space narrowing was observed.

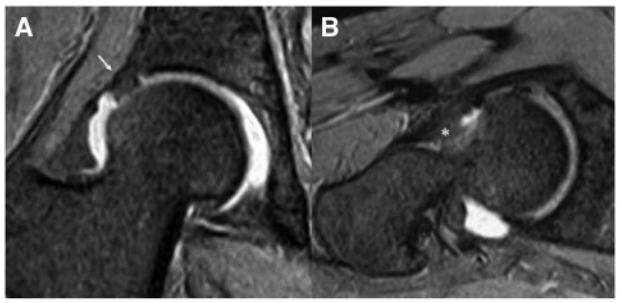

Fig. 3. MRA of the right hip. Coronal **(A)** and axial **(B)** T2*-weighted images. There was no leakage of the contrast agent from the joint. (A) showed adhesion between the labrum and the capsule (arrows); the capsule became thin. (B) showed adhesion between the capsule and the site where cam osteochondroplasty was performed (asterisks).

fragile than normal. We attempted joint capsular plication, but the procedure could not be performed because of acetabular side joint capsule fragility (Fig. 5A). We further confirmed that the distal joint capsule can be lifted to the acetabular edge. Therefore, arthroscopic capsular repair using the proximal advancement method was performed. The proximal joint capsule was removed (Fig. 5B), and minimal acetabular rim decortication (<1 mm) was performed using a motorized round burr (Smith & Nephew, Andover, MA) under fluoroscopic guidance. Subsequently, we inserted 2.3-mm suture anchors (Osteoraptors, Smith & Nephew) into the joint capsular insertional footprint of the acetabular margin (Figs 4C and 5C). Four suture anchors were used in the procedure. We created a third portal (proximal MAP [PMAP]). An Accu-Pass Suture Shuttle (Smith & Nephew) was inserted from the MAP and passed through the distal joint capsule (Fig. 4D). The looped thread from the Accu-Pass Suture Shuttle was grasped using a grasper inserted from the PMAP (Fig. 4E). The anchor thread penetrated the distal joint capsule through its looped thread. This suture relay technique was repeated for a total of eight times (Fig. 5C), and the joint capsule was repaired with a horizontal mattress suture for each anchor (four stitches) (Figs 4F and 5D). At that time, restoration was performed with the hip in 20° flexion and 10° internal rotation to obtain tension in the joint capsule and joint stability after surgery. The dial test and log-roll test were negative immediately after the surgery.

Post-operative rehabilitation

After the surgery, the patient was restricted to toe-touch weight bearing for 4 weeks with ROM encouragement, but extension and external rotation were avoided to protect the capsular repair. For 4 weeks after surgery, extension to −10° was limited to 10° external rotation. Then, ROM was gradually improved without limitation regardless of pain. We also used passive hip circumduction motions to prevent adhesions from the day after surgery. At 8 weeks post-operatively, the patient achieved almost normal ROM (flexion 110°; abduction, 35°; external rotation, 35°; internal rotation, 25°) and was able to walk with full weight bearing. Additionally, she reported sustained resolution of her subjective feeling of instability at that time of weight bearing.

Clinical results

The patient reported an increase in the mHHS from 35.2 pre-operatively to 85.8 at 1 year post-operatively and 90.1 at 2 years post-operatively. The NAHS increased from 50 pre-operatively to 85 at 1 year post-operatively and 88.7 at 2 years post-operatively. The VAS score improved from 9 points pre-operatively to 2 points at 1 year post-operatively and 1 point at 2 years post-operatively. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki. The patient provided informed consent for the publication of this case and accompanying images.

DISCUSSION

The gold standard of surgical treatment for hip dysplasia is periacetabular osteotomy because pre-operative acetabular undercoverage can create an environment susceptible to instability. However, as hip arthroscopic surgery becomes widespread, surgical indication to the BDDH and mild dysplasia has not been clarified. Hatakeyama *et al.* [11] reported that the predictors of poor clinical outcomes after hip arthroscopic surgery for BDDH were age (>42 years),

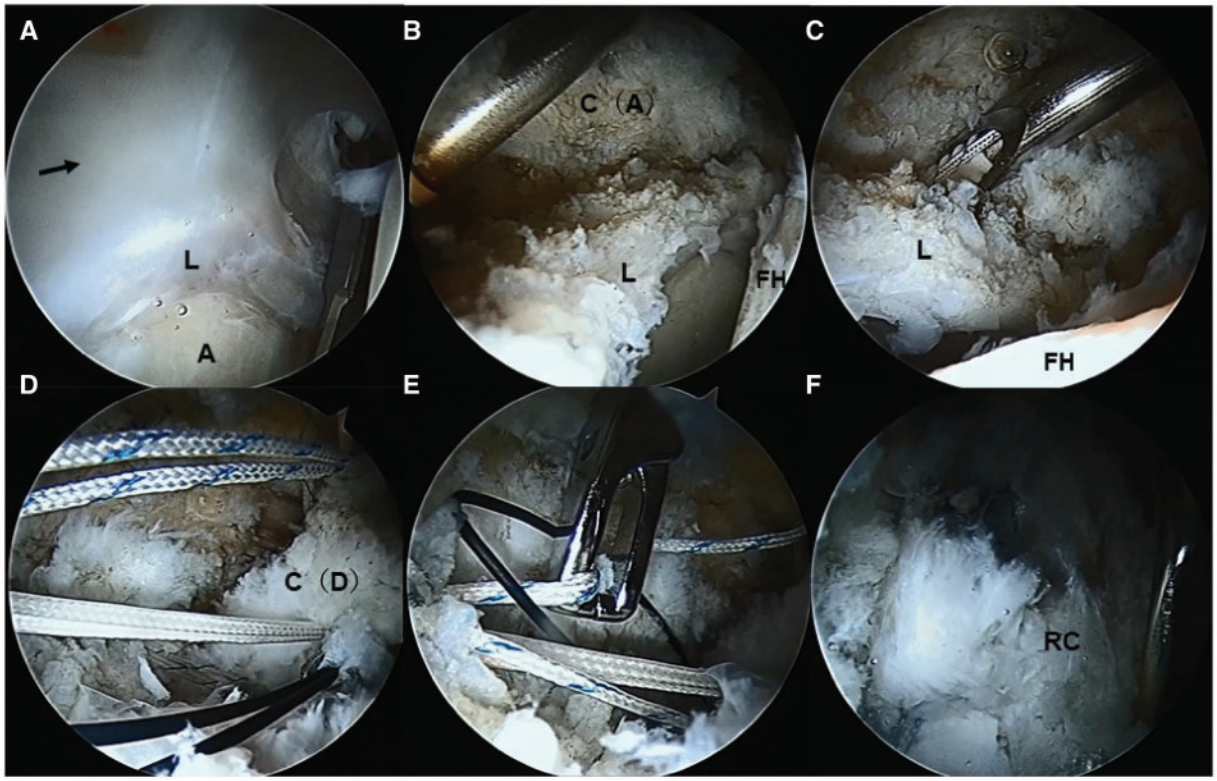

Fig. 4. Arthroscopic findings. **(A)** Severe adhesion between the anterosuperior labrum and joint capsule (arrow). **(B)** After adhesion release with a radiofrequency probe. **(C)** The suture anchor is inserted into the capsular footprint of the acetabular margin. **(D)** An Accu-Pass Suture Shuttle (Smith & Nephew, Andover, MA) is inserted from the MAP and passed through the distal joint capsule. **(E)** The looped thread from the Accu-Pass Suture Shuttle is grasped using a grasper inserted from the PMAP. **(F)** The joint capsule is repaired with a horizontal mattress suture for each anchor (four stitches). A, acetabulum; C(A), capsule (acetabular side); C(D), capsule (distal side); L, labrum; FH, femoral head; MAP, mid-anterior portal; PMAP, proximal mid-anterior portal; RC, repaired capsule.

a broken Shenton line/severe cartilage damage, AI $>15^{\circ}$, and vertical-center-anterior margin angle $<17^{\circ}$.

The most important factor in hip arthroscopic surgery for mild dysplasia and BDDH is joint capsular management. The capsule plays an important static role in joint stability. The iliofemoral ligament is the strongest of the three ligaments, primarily acting to resist external rotation and extension of the hip joint [12]. Although some degree of capsular incision is necessary for visualization during hip arthroscopy, the capsule plays a static role in joint stability. Thus, we must avoid unnecessary capsulectomy especially in mild dysplasia and BDDH. An unrepaired interportal capsular cut would be unable to resist anterior instability with the hip extended and externally rotated. This could predispose to both macro- and micro-instability, in which the femoral head translates as well as rotates, in the acetabulum [13]. Wylie *et al.* [6] reported on 20 hips that underwent revision surgery for joint instability among 1110 hips that underwent hip arthroscopic surgery. The mean lateral-center-edge angle was 25°. In total 12 hips did not receive any stitches for joint capsular closure, 4 hips received 1 stitch and 4 received 2 stitches. Additionally, no patient required revision surgery because of instability associated with joint capsular closure with more than 3 stitches. Therefore, when inter-portal capsulotomy is performed, adequate capsular management is important.

The main symptoms in this case were pain accompanying the early stage of ROM and instability of the hip joint. The only treatments performed on this case were joint capsular repair using proximal advancement and release of adhesion. Since the log-roll test and dial test became negative immediately after the operation, the pain early in the ROM was reduced from the day after surgery, so we suspected that the patient had pain accompanying adhesion and joint instability due to a patulous capsule following inadequate capsular management (capsular closure with one stich only). Although it is rare that such symptoms of adhesion

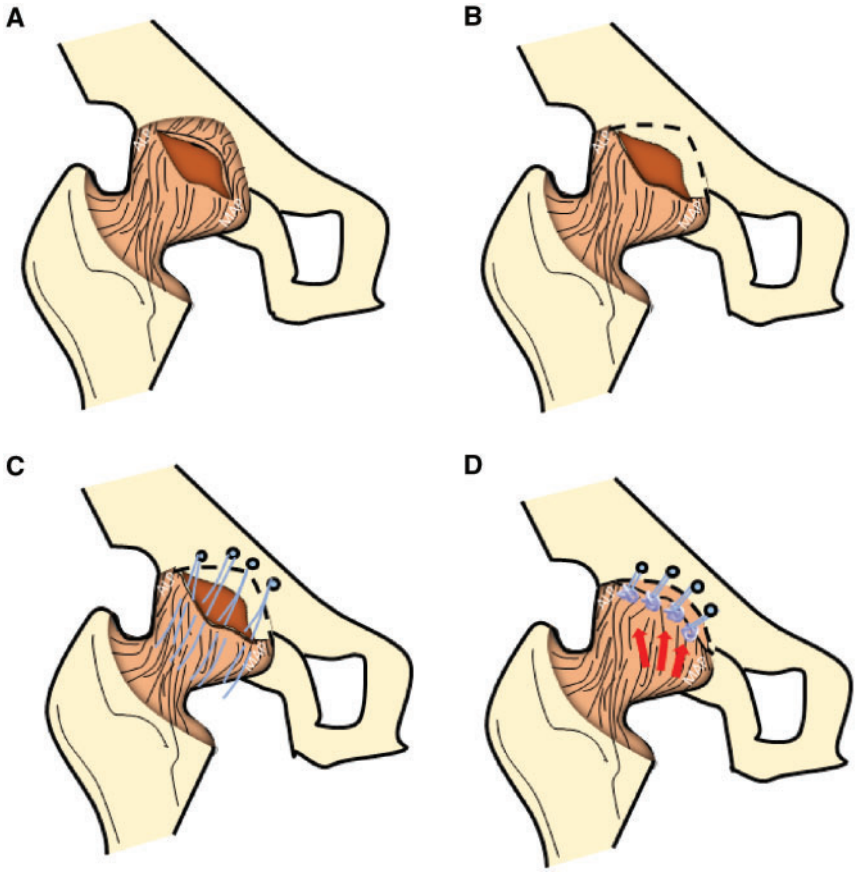

Fig. 5. Procedure illustration of capsular repair using proximal advancement. **(A)** Inter-portal capsulotomy between ALP and MAP. The proximal joint capsule was fragile. **(B)** The proximal joint capsule was removed. **(C)** The four suture anchors were inserted into the capsular footprint of the acetabular margin. The anchor thread penetrated the distal joint capsule through its looped thread. This suture relay technique was repeated for a total of eight times. **(D)** The joint capsule is repaired with a horizontal mattress suture for each anchor (four stitches). ALP, anterolateral portal; MAP, mid-anterior portal.

and instability are mixed, careful interview and examination are important.

Another possible arthroscopic procedure in this case is arthroscopic joint capsular reconstruction. Philipon *et al.* [14] reported the usefulness of joint capsular reconstruction in a biomechanical study. Mei-Dan *et al.* [8] and Trindade *et al.* [15] reported that joint capsule reconstruction is clinically useful when joint capsular defects occur. When compared with reconstructive surgery, this procedure requires no reconstructive graft, and there is low invasion than reconstruction. Therefore, if joint capsule restoration by proximal advancement was possible, this procedure becomes a treatment option similar to reconstruction. However, the indication of this surgical procedure is the most important factor, especially for cases of mild underacetabular coverage (mild dysplasia and BDDH). This technique is limited to revision hip arthroscopic cases where the distal joint capsule can be lifted to the acetabular margin, particularly when the proximal side has joint capsule dysfunction. However, there is also a risk of flexion contracture after the surgery when joint capsule advancement was performed at an excessive hip flexion position. In this case, joint capsule repair was performed at 20° flexion, but flexion contracture after surgery did not occur. From this case, when performing this new procedure, it should be limited within 20° of flexion, and joint capsular repair at excessive flexion position has a risk of flexion contracture. Thus, by understanding this fact, it is beneficial for the surgeon to have many surgical options.

This was confirmed from the fact that the post-operative log-roll test result became negative after joint capsule repair and joint stability was achieved. The post-operative clinical outcomes (mHHS, NAHS and VAS scores) improved with this method. Furthermore, there was no limitation of the hip joint ROM after surgery.

With the establishment of hip arthroscopic indications and surgical techniques, more hip arthroscopic surgeries are expected to be performed in the future. Therefore, there is a concern that the number of cases with joint instability due to joint capsule dysfunction and joint capsule defects after surgery will increase. The joint capsule repair technique using proximal advancement method may be useful for joint instability following hip arthroscopy.

CONFLICT OF INTEREST STATEMENT

None declared.

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