Strategies in managing the labrum

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Abstract: The acetabular labrum plays a vital role in normal biomechanics of the hip joint. Both nociceptive and proprioceptive fibers are present in the labrum and their presence determines the rationale behind surgical labral treatments. In patients with femoroacetabular impingement (FAI) syndrome, a variety of labral injuries are observed. These may be the source of significant motion- and position-related hip and/or groin pain. However, there is a high prevalence of asymptomatic labral tear in the general and athletic population. Non-surgical treatment for symptomatic individuals includes education, activity modification, physical therapy, non-opioid oral medications, and injections. In the event of non-surgical treatment failure in non-arthritic and non-dysplastic individuals, surgical treatment includes labral repair and correction of cam, pincer, and subspine morphologies, and capsular management. Labral reconstruction is usually a revision procedure. However, in select primary cases (ossified labrum, global overcoverage pincer, irreparable tear), a reconstruction (or debridement) may be performed.

Keywords: Labrum; femoroacetabular impingement syndrome (FAI syndrome); cam; capsule; hip

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Anatomy

Hip joint anatomy (form) and biomechanics (function) are significantly impacted by the fibrocartilaginous acetabular labrum. Largely oversimplified as a "ball-and-socket", the hip is a highly complex structure better described as a layered concept of four layers (1). In layer II (inert), the labrum, which increases the surface area (22%) and volume (33%) of acetabular coverage, provides a suction seal to the femoroacetabular articulation (2). The labrum increases socket depth and joint congruity, which leads to increased stability. Thus, the primary aim of labral surgery should be to anatomically restore its form and preserve its function.

The labral suction seal has been the source of much investigation. It is this fluid seal that permits production of a negative intra-articular pressure, enhancing joint stability (3). Synovial fluid transport out of the central compartment is directly controlled by the labrum *in vivo* (4). The seal, between the labrum and femoral head, is significantly affected by position (i.e., hip range of motion). Greater degrees of flexion and internal rotation and pivoting have been shown to increase fluid transport from the central to the peripheral compartment, negating the suction seal, and decreasing femoral head stability (4-6). Similarly, greater degrees of abduction change the shape of the labrum (length and cross-sectional area) and significantly increase its resultant strain (7). As femoroacetabular impingement (FAI) syndrome is a motion- and position-dependent entity, the "anterior impingement" position (flexion, adduction, and internal rotation) places the greatest strain on the anterolateral (AL) labrum (as does the lateral impingement position on the lateral labrum and does the posterior impingement position on the posterior labrum) (7,8). The "anterior to lateral" is the most common location for observation of acetabular labral tears due to cam and/or pincer morphology, whereas the "straight anterior "location is most commonly seen in patients with hip instability without dysplasia (9). In the setting of labral tears due to impingement, associated instability may also occur (10). Lastly, two distinct types of labral tears have been described; a partial to complete chondral-labral separation (Seldes 1) damage pattern, or a labral crush pattern with intrasubstance injury (Seldes 2) (2).

In addition to instability, labral tears are a common cause of hip and/or groin pain. There are a number of different nerve fibers present in the labrum and at the chondrolabral junction that account for this finding (11). The neural anatomy of the labrum plays an important role in understanding a patient's pain before and after surgery. In the normal labrum, free nerve endings (nociception) and nerve end corpuscle (Paccini, Golgi-Mazzoni, Ruffini, and Krause corpuscles; proprioception) are frequently identified from anterior to posterosuperior segments of the acetabulum (12-15). These fibers are primarily derived from the obturator nerve and the nerve to quadratus femoris. The nociceptive free nerve endings are predominantly found at the labral base, near the chondrolabral junction, decreasing further peripherally, most superficial on the labral surface (13). The continued presence of nociceptive fibers in a repaired labrum may permit residual post-operative pain due to the labrum. This is the principal rationalization for removal of native labral tissue and reconstruction with a neural graft (16). While removal of these nociceptive fibers is an advantage of labral reconstruction, the removal of proprioceptive mechanoreceptors may permit premature excessive early graft stress, increased failure risk, and should be considered during rehabilitation (16,17).

In addition to the importance of neural supply to a torn or healing labrum, vascular supply is equally essential. The labral blood supply is derived from the radial branches of the periacetabular periosteal ring, which come from the superior and inferior gluteal arteries (18). These vessels travel on the iliac periosteum, penetrate the capsule near the capsular insertion above the acetabular rim, continue on a loose connective tissue layer on the capsular side of the labrum, and terminate at the free edge of the labrum. There is no vascular contribution to the labrum from the capsule, synovium, or osseous acetabular rim. Macroscopic and histologic assessments have revealed stable repair healing and retention of the normal triangular shape without residual detachment (19). Additionally, neovascularization has been observed near the sutures supporting the repair. Further, although cam and pincer morphology associated with FAI syndrome and labral tears has been traditionally thought to be a purely "wear-and-tear" mechanical phenomenon, it has been significantly associated with inflammation and neovascularization as well (20-22). Labral biopsy specimens, obtained during hip arthroscopy or open osteoplasty for FAI syndrome and labral tear, have shown significantly greater macrophage (via CD68, CD206, IL-13), T-cells (CD3), mast cells, and vascular endothelium [CD34, vascular endothelial growth factor (VEGF)] than osteoarthritis labra (20). In addition, messenger ribonucleic acid (mRNA) expression of chemokines (IL-8, CXCL1, CXCL3, CXCL6, CCL3, CCL3L1), matrix-degrading [matrix metalloproteinase (MMP)-13 and ADAMTS-4], and structural matrix [COL2A1 (collagen, type II, alpha) and ACAN (aggrecan)] genes was higher in FAI syndrome hips than normal controls or hips with osteoarthritis (21).

Based on this anatomy of the labrum, surgical management has the potential to greatly affect its function. In the laboratory, labral tear (12 o'clock and 3 o'clock; 35 mm length), partial resection, and complete resection significantly decrease intra-articular fluid pressurization and maximal distraction force versus the intact labrum, respectively (3). Further, due to the role of the labrum in central compartment fluid pressurization and suction seal retention, a loss of labral function via focal and complete labrectomy significantly increases articular cartilage friction due to fluid exudation (23). Although labral repair using a pierced labral base refixation technique provides significantly greater increase in pressurization and maximum negative pressure generation versus a looped circumferential suture (3,24), no difference in clinical outcomes has been observed (25). Labral reconstruction with iliotibial band graft has been shown to increase pressurization similar to that of the intact labral state (3). However, labral reconstruction can improve distraction force (*vs.* partial labral resection), but not back to that of the intact labral state (24).

Patient evaluation

A thorough evaluation of the patient's chief complaint and history of present illness should be combined with a comprehensive and systematic physical examination. Importantly, then and only then, can imaging [plain radiographs, magnetic resonance imaging (MRI), computed tomography (CT), or ultrasonography] be interpreted and a diagnosis rendered. This triad of patient symptoms, clinical physical examination signs, and imaging can be used to make a diagnosis of FAI syndrome per the Warwick Agreement (26). Symptoms are typically motion- and/or position-related hip and/or groin pain (can also be anterior thigh, lateral hip, buttock, and/or back). This is frequently described as a "C" sign or "between the fingers" sign. Clinical signs typically involve a combination of impingement maneuvers and range of motion assessment (*Table 1*). Loss of flexion, internal rotation, and the sum

Table 1 Common physical examination impingement tests

Impingement test	Physical examination maneuver
Anterior	Flexion, adduction, internal rotation (FADIR)
Subspine	Straight sagittal plane maximal flexion
Lateral	Straight coronal plane maximal abduction with permissive limb external rotation
Trochanteric-pelvic	Straight coronal plane maximal abduction with forced limb internal rotation
Posterior	Extension, external rotation
Iliopsoas	Resisted hip flexion with hip at 90 degrees (and contralateral hip held by patient at maximal flexion)

of internal and external rotation are frequently observed. The presence of cam morphology significantly decreases flexion, while a relative loss of femoral version significantly decreases internal rotation (27). Femoral version assessment is best assessed with a combination of gait analysis, foot-progression, and seated, supine, and prone internal and external rotation measurement. This is frequently combined with advanced imaging version measurement. Imaging assessment includes a combination of two-dimensional planar (plain radiographs, MRI, CT) and three-dimensional imaging (MRI, CT) (*Figure 1*). Clinicians must be cognizant of the high prevalence of asymptomatic imaging abnormalities in the general population and in specific athletic groups (29). The prevalence of labral tear has been reported to be approximately 62% (95% CI: 47% to 75%) in symptomatic individuals and 54% (95% CI: 41% to 66%) in asymptomatic individuals (30). Thus, clinicians must "treat the patient, not the X-ray". Nonetheless, in individuals with FAI Syndrome, MRI (with or without arthrogram) is not a perfect imaging modality for detection of labral injury (sensitivity ranges from 50% to 90%) (*Figure 2*) (31,32). Higher magnet strength (greater than 1.5-Tesla), addition of radial series, oblique sagittal and oblique axial series, and arthrography increase the sensitivity of labral tear detection. Although intra-articular local anesthetic injections may be used as a diagnostic modality, their utility in prediction of post-operative labral surgery outcome after a positive injection response is limited (33-35). However, a negative response to injection is a strong predictor of a negative response to arthroscopic hip preservation labral surgery (36,37).

Indications and contra-indications

The indications for labral surgery include an adequate trial (minimum of 6 weeks to 3 months) and failure of non-surgical treatment. Further, the patient should be dissatisfied with the condition of their hip, meaning symptoms are unacceptable. Currently, there is no role for prophylactic hip preservation surgery in asymptomatic individuals with abnormal hip morphology and/or labral tear (38). Non-surgical measures may include education (activity modification), physical therapy, limited rest, non-opioid oral non-steroid anti-inflammatory medications and/or acetaminophen, and a variety of therapeutic injections (e.g., corticosteroid, platelet-rich plasma) (39). Physical therapy should emphasize posterior pelvic tilt to minimize dynamic impingement via gluteus maximus, rectus abdominis, and transversus abdominis activation; abductor control, optimized abductor/adductor strength ratio; optimized quadriceps/hamstring strength ratio; core and pelvic floor control. Improved sagittal balance with the spinopelvic alignment (with knowledge of pelvic incidence) should be stressed. Nonetheless, there is no evidence that has shown healing of labral injury or alteration of osseous morphology with any non-surgical measure. The majority (>90%) of labral tears are believed to be secondary to an osseous reason—cam, pincer, subspine, dysplastic, abnormal femoral version, abnormal neck-shaft angle morphologies (40-43). Even in the event of failure of physical therapy to sufficiently and satisfactorily relieve symptoms, the strength and/or motion gains achieved likely make post-operative therapy that much easier or more efficient due to the progression in therapeutic exercise learning curve.

Contraindications to labral surgery, as part of a comprehensive hip preservation procedure, are primarily contraindications to hip preservation surgery in general, rather than specifically to labral repair itself. Most labra, even those in advanced arthritic hips, can technically be "repaired". However, the outcomes of arthroscopic hip preservation surgery, including labral repair, are inferior in patients with advanced arthrosis (Tonnis grade 2 or 3;

Plain radiographs	MRI	CT	Ultrasonography
AP (anteroposterior)	Labral tear	Acetabular version	Dynamic assessment
Tonnis grade	Labral size, shape	Femoral version	Injection guidance
Joint space distance (mm)	Paralabral cyst	McKibbin Index	Labral tear
Lateral center edge angle	Subchondral acetabular cyst	Omega surface/zone	Effusion
Tonnis angle	Femoral impingement cyst	Three-dimensional anatomy	Capsular thickness
Coxa profunda	Subchondral marrow edema	Osseous/cortical sclerosis	Iliopsoas snapping
Protrusio acetabulae	Stress fracture	Ischiofemoral impingement	Iliotibial band snapping
Crossover sign	Effusion	Injection guidance	Tendon tear, tendinopathy
Posterior wall sign	Articular cartilage injury		Ischiofemoral impingement
Ischial spine sign	Omega angle		Inguinal canal
Femoral head extrusion index	Synovial thickness		
Alpha angle	Capsular thickness		
Shenton's line	Capsular volume (if MRA)		
Head-center distance	Benign bony lesions		
Dunn 45	Malignant bony lesions		
Alpha angle	Benign soft tissue lesions		
Head-neck offset	Malignant soft tissue lesions		
Head-neck offset ratio	Tendon tear, tendinopathy		
Triangular index	Muscle atrophy		
False profile	Muscle fatty degeneration		
Anterior center edge angle	Ischiofemoral impingement		
AIIS type	Athletic pubalgia (Doha)*		
	Intra-pelvic sources (GI, GU, OB-GYN)		

Figure 1 Plain radiograph, MRI, CT, and ultrasonography imaging evaluation parameters in patients with suspected labral injury. *, Doha agreement assessment of athletic groin pain includes adductor, iliopsoas, inguinal, and pubic sources of pain (28). MRI, magnetic resonance imaging; CT, computed tomography; AIIS, anterior inferior iliac spine; MRA, magnetic resonance arthrography; GI, gastrointestinal; GU, genitourinary; OB-GYN, obstetric-gynecologic.

joint space distance on weight-bearing anteroposterior pelvic radiograph less than 2.0 to 2.5 mm) (44,45). Thus, arthritis is a relative contraindication to labral repair. Arthroplasty is the more appropriate surgical treatment in advanced hip arthrosis. Dysplasia (defined via multiple imaging modalities and parameters: lateral center edge angle less than 18–20 degrees, anterior center edge angle less than 18–20 degrees, Tonnis angle greater than 15 degrees, femoral head extrusion index greater than 25%) is a relative contraindication to isolated "labral repair". A broken Shenton's line or excessive femoral head lateralization/subluxation are absolute contraindications to isolated labral repair, unless performed in conjunction (simultaneous or staged) periacetabular osteotomy. Patients with asymptomatic labral tears are contraindicated (absolute) for labral repair.

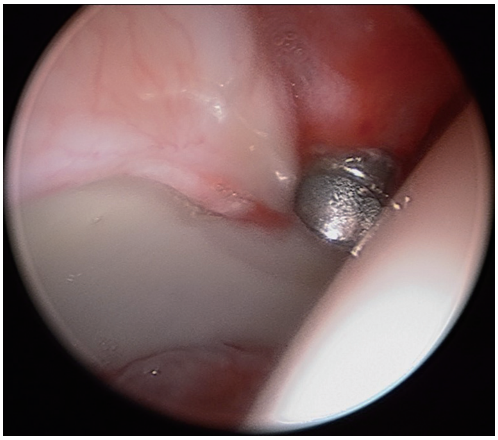

Figure 2 Right hip arthroscopy of 27-year-old female, viewing from AL portal. Three separate MRI studies of her hip within 8 months prior to surgery [two with arthrogram (1.5-Tesla and 3.0-Tesla) and one without (3.0-Tesla)] all had radiology reports of "no labral tear", in addition to the author's direct image analysis also concluding "no labral tear". Arthroscopic evaluation clearly illustrates a labral tear from approximately 12 o'clock to 3 o'clock. MRI, magnetic resonance imaging; AL, anterolateral.

Author's preferred technique for labral surgery

Patient positioning

The patient is positioned on a traction table (Advanced Supine Hip Positioning System with two Universal Hip Distractors and two Active Heel Traction Boots; Smith & Nephew, Andover, MA, USA). General anesthesia and muscle paralysis assists in force reduction to obtain sufficient distraction (greater than 10 mm) for atraumatic hip joint entry with a 70-degree arthroscope. Postless, gravity-assisted options for traction are available, but do require Trendelenburg positioning, a friction-based pad to prevent patient slippage, and adjustment in hand position during surgery, with its own associated learning curve (46). Since the most common complication of hip arthroscopy is iatrogenic chondrolabral injury (during portal placement), proper portal placement begins with meticulous patient positioning. Per Dr. Thomas Byrd, "*Proper positioning gives you a reasonable chance to do well, while poor positioning guarantees failure*" (personal communication). The risk of iatrogenic injury can be minimized, or even eliminated, with certain technical pearls (47-49). The hip arthroscopy learning curve, quantified via reduction in complication, reoperation, or total hip arthroplasty conversion rates, can be as little as 20 or as many as 519 independent hip arthroscopy surgeries (50-52).

Examination under anesthesia

A range of motion examination under anesthesia is performed, with attention paid to both hips, assessing hip flexion, internal and external rotation at 90 degrees of hip flexion, and abduction. A fluoroscopic examination can also be performed to better localize impingement pre- and post-correction of abnormal morphology. In addition to cam and/or pincer impingement, extra-articular sources of impingement, including ischiofemoral and trochanteric-pelvic impingement, can also be observed. External rotation recoil, dial, and axial distraction (with fluoroscopy) can assist with instability diagnoses. The presence of a vacuum sign can indicate a loss of the suction seal, primarily secondary to labral tear or deficiency (24).

Portal placement and capsulotomy

The AL portal is the first portal created, with fluoroscopic guidance and a 17-gauge spinal needle, to enter the joint at approximately the 12:30 position on the clockface. A 4.5-mm cannula is placed, using Seldinger technique, and a 70-degree arthroscope introduced into the joint. The author prefers dry arthroscopy until at least part of the interportal capsulotomy is created, to avoid a "red-out" or "pink-out" (a mixture of blood and fluid), which can obscure visualization. The anterior triangle needs to be visualized in order to accurately place a modified mid-anterior portal (MMAP) at the 2:30 to 3:00 position. If synovial fluid and/or tissue obscures visualization, then the scope should be removed, cannula retained, and the lens lightly wiped and re-inserted. Alternatively, a syringe of air may be injected into the joint to clear the field of view, or the syringe may be used to aspirate an effusion for improved visualization. Inability to obtain sufficient distraction and a large hypertrophic labrum (*Figure 3A-C*) make visualization of the anterior triangle and MMAP creation more challenging. Interportal capsulotomy is created using a 4.0-mm Beaver Blade (Smith & Nephew, Andover, MA, USA). The capsulotomy should be at least 7 to 8 mm away from the labrum, in order to preserve as much proximal capsular tissue as possible for closure at case conclusion—the key to repairing the capsule is preparing the capsule. The length of the capsulotomy needs to be big enough to adequately visualize the pathology in need of treatment, but no larger (on average, capsulotomy length is 2.0 cm length). A capsular suspension technique helps to lift the capsule

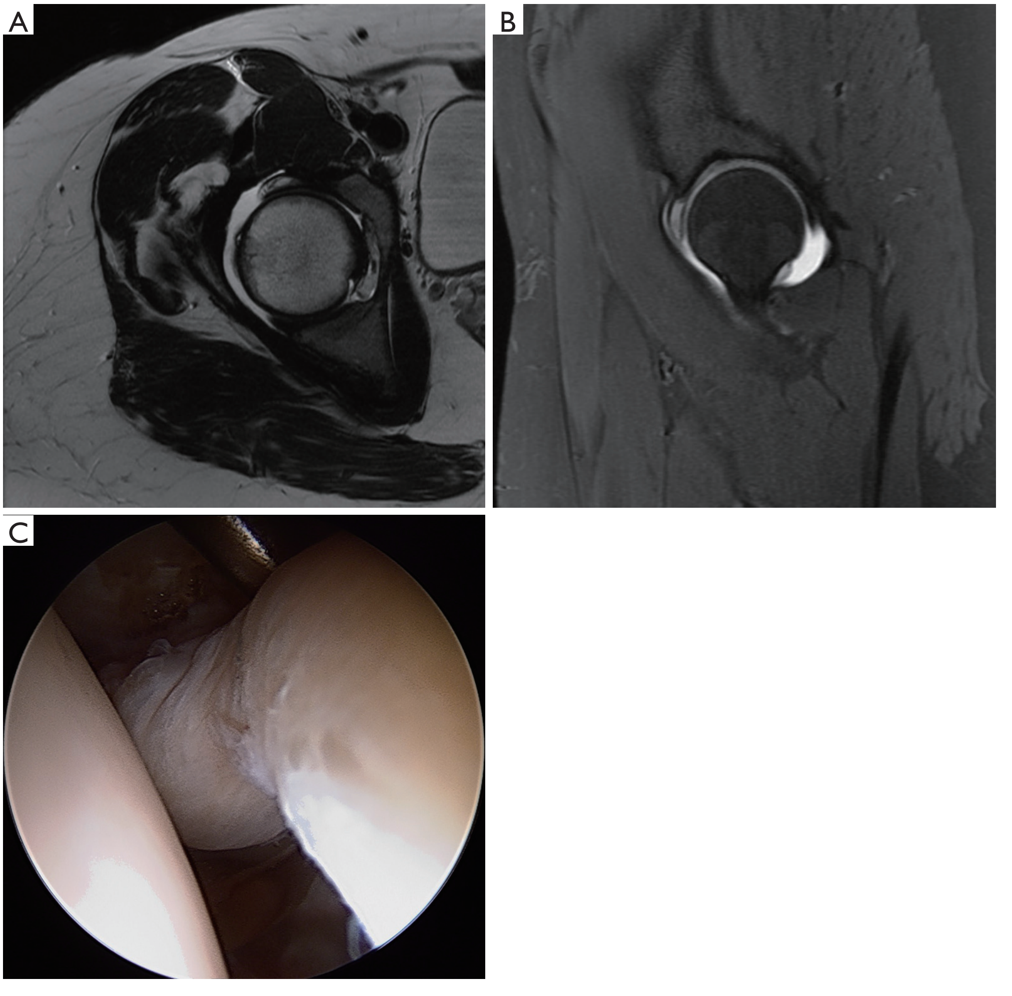

Figure 3 Obtaining excellent central compartment visualization is necessary to perform a proper labral repair. Large hypertrophic labra may preclude easy comprehensive visualization. (A) Right hip T1-weighted axial MRI with arthrogram of a 22-year-old female with Ehlers-Danlos syndrome demonstrating a large hypertrophic globular labrum; (B) same patient with a T2-weighted sagittal MRI with re-demonstration of large hypertrophic globular labrum; (C) left hip arthroscopy, viewing from AL portal, of 31-year-old non-dysplastic female with generalized joint hypermobility (8/9 Beighton) demonstrating large hypertrophic labrum. MRI, magnetic resonance imaging; AL, anterolateral.

(without iatrogenic capsulectomy for visualization) and visualize the acetabular rim and subspine region (53). Central compartment diagnostic arthroscopy then ensues once the interportal capsular incision is completed.

Labral repair

Acetabuloplasty rim trim is performed to treat pincer impingement (focal loss of cranial acetabular anteversion, retroversion, global pincer impingement) (*Figure 4*). If no pincer treatment is performed, then a minimal (less than 1 mm) rim decortication may be performed to smooth the rim for easier labral anchor placement, in addition to improved osseous vascular response to labral repair/refixation healing. No short-term clinical outcome difference has been observed with labral detachment and repair versus labral repair *in situ* without detachment (54). Labral repair can be performed using two or three portals. The author prefers a three-portal technique, with the addition of a spinal needle-localized distal anterolateral accessory (DALA) portal, placed approximately 4 to 5 cm distal to the AL portal. Suture anchor insertion needs to be performed without articular cartilage

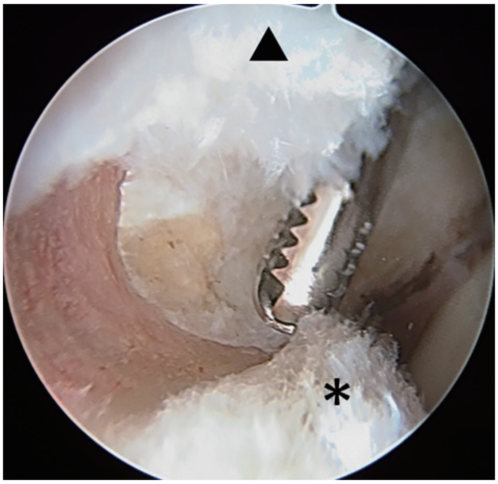

Figure 4 Right hip arthroscopy, viewing from AL portal. Following acetabuloplasty rim resection and subspine decompression with complete preservation of the capsule proximal to the interportal capsulotomy. Asterisk (*) indicates labrum; arrowhead indicates capsule. Visualization of the rim is excellent between 12 o'clock and 3 o'clock. This permits accurate rim treatment and anchor placement. AL, anterolateral.

penetration (subchondral bone violation) or psoas tunnel perforation. The rates of articular surface penetration (4.0% mid-anterior *vs.* 5.0% DALA; P>0.999) or psoas tunnel perforation (4.2% mid-anterior *vs.* 11.6% DALA; P>0.25), in a cadaveric model, have not been shown to be significantly different (55). For anchor placement between 11 o'clock and 4 o'clock, the author utilizes the DALA portal. Anterior to the 4 o'clock position, a trans-capsular approach via MMAP is utilized. Posterior to 11 o'clock, a fourth portal [posterolateral (PL)] is created and used to perform posterior labral repair (less common) or reconstruction (more common). The author prefers an all-suture anchor construct for labral repair (Q-fix, Smith & Nephew, Andover, MA, USA). This particular anchor has demonstrated a 1.6% incidence of intra-operative anchor pullout over 434 cases (18 months) with 4.6 anchors placed per case (range, 1 to 8; total 2,007 anchors used) (56). This anchor has an active spherical deployment to approximately 3.5 to 4.0 mm diameter (utilizes a 1.8-mm drill that penetrates 22 mm deep), rather than a "pull-back" design. Typically, three to six anchors are used per case, spaced at least 7 mm apart (*Figure 5*). Most anchors are drilled and placed on the back side of the labrum (capsular non-articular side). Depending on the exact location of the clockface where the anchor is to be placed and the exact angle of the straight drill and anchor deployment mechanism, most anchors are placed approximately 2.0 to 2.5 mm off the chondro-osseous junction (acetabular rim). As the all-suture anchor actively expands to a 4.0 mm diameter (2.0 mm radius) and the drill/anchor diverge from the subchondral plate, a safe distance to avoid articular surface disruption is a minimum of 2.0 mm (57). Alternatively, an articular-sided approach may also be used where the bone is thinnest and subchondral bone violation (articular cartilage damage) or psoas fossa penetration is possible and at risk (*Figure 6*). Additionally, if an angle of anchor insertion or rim thickness does not permit anchor placement with a straight guide system, curved systems are available to place anchors. A curved system has been shown to be significantly more effective in increasing the angle of insertion of suture anchors and increasing the distance of the suture anchor tip to the articular cartilage at the 1 o'clock position on the clockface (58). The author prefers and usually (>99%) uses a straight system, but does have a curved system available if needed (Q-fix CURVED, Smith & Nephew, Andover, MA, USA).

Once the anchor is placed, the suture configuration must be selected. The two primary available constructs are a circumferential looped repair (the suture wraps completely around the labrum) and a labral base refixation pierced repair (the suture goes through the labral substance. If the labrum is small (less than 4–5 mm) or of poor quality, then a circumferential looped repair may be a better choice. If the labrum is hypertrophic (greater than 10–12 mm), then a circumferential looped repair may also be a better option. If the labral tissue is of sufficient quality and is sized "not too big or too small", then a labral base refixation pierced repair may be a better choice. Opponents of the looped repair espouse that the labral base refixation pierced technique does not evert the labrum and better restores the suction seal as it does not "spot-weld" the labrum at each suture location (59). Opponents of the labral base refixation pierced technique claim that the suction seal is still restored with the looped technique and that the pierced technique may damage the labral substance and the suture may rip through or pull out (60). Although in the laboratory, a labral base refixation technique does restore the normal triangular shape of the labrum better and pressurizes the joint more than the looped repair, no difference in clinical outcome has been observed (3,25).

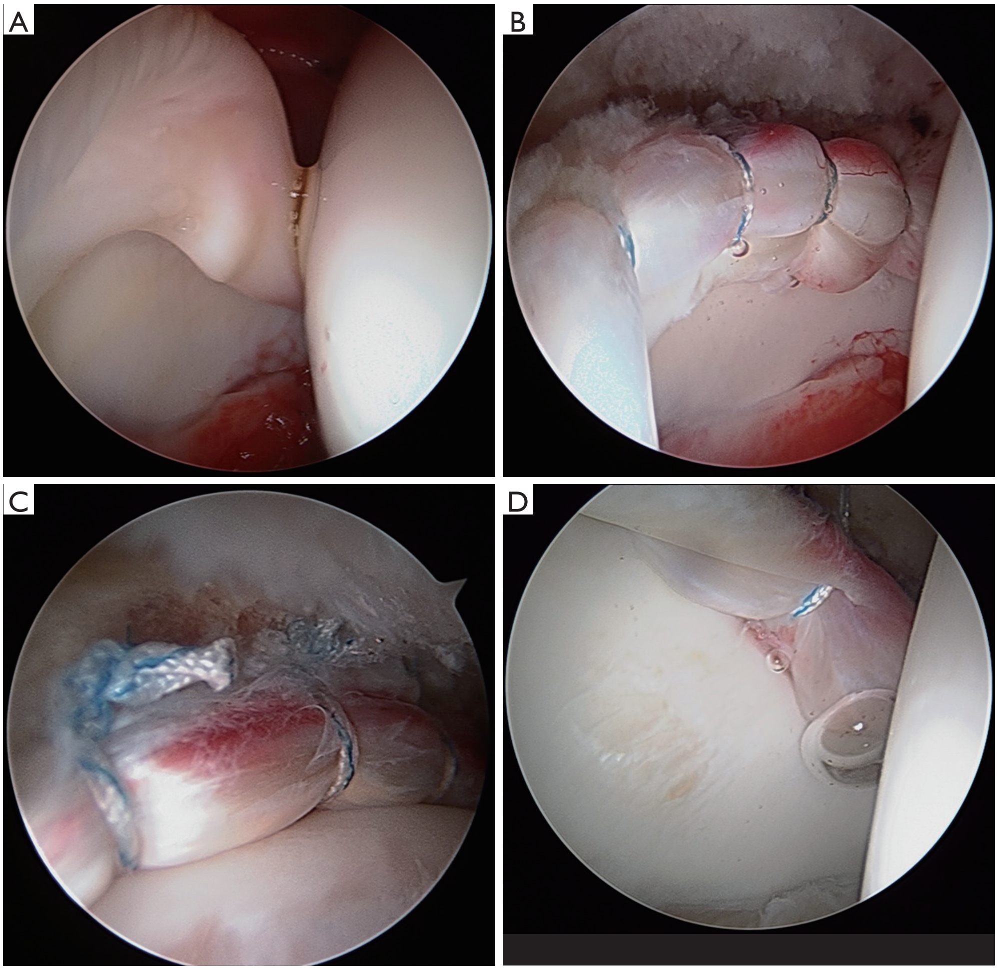

Figure 5 Suture anchor repair of anterior-to-lateral labral tears stabilize the torn labrum and anatomically reattach the labrum to the acetabular rim, in an attempt to best restore the suction seal. (A) Right hip arthroscopy, viewing from AL portal in 22-year-old female ballet dancer. A hypertrophic anterior labral tear is observed; (B) same patient as in (A), with a five-anchor circumferential looped labral repair; (C) right hip arthroscopy, viewing from MMAP, illustrating suction seal in a circumferential looped repair; (D) right hip arthroscopy, viewing from AL portal, with a pierced labral base refixation technique at the 3 o'clock position. MMAP, modified mid-anterior portal; AL, anterolateral.

Labral reconstruction

In the revision setting of labral deficiency after a previous debridement or failed repair, an arthroscopic labral reconstruction may be indicated. In the primary setting with a calcified/ossified labrum, global overcoverage pincer impingement, or an irreparable labral tear, although controversial, a primary arthroscopic labral reconstruction may be performed. However, the author prefers a labral debridement if restoration of the arthroscopic suction seal is observed. If no suction seal is observed, then a labral reconstruction may be indicated. Two techniques of labral reconstruction may be performed: one, a segmental reconstruction of the damaged/missing segment of labrum; two, a complete front-to-back reconstruction. No biomechanical studies have compared these two techniques in the ability to restore femoral head stability in the acetabulum—pressurization or resistance to distraction. No biomechanical studies have compared all graft types—autograft versus allograft. The author prefers an allograft peroneus longus, approximately 5.5 mm in diameter. The reasons for this selection are the relative resistance to swelling once placed in the arthroscopic environment, the quick efficient preparation time (less than 1 minute) that

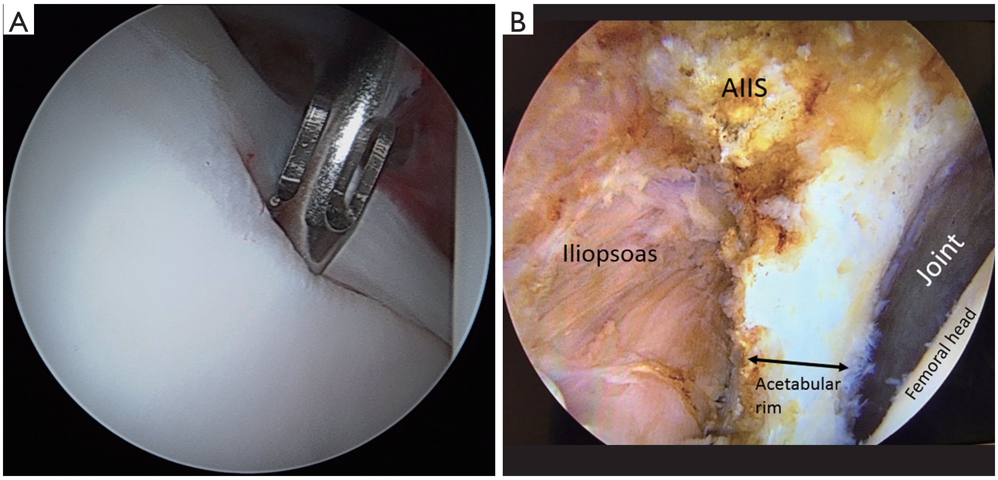

Figure 6 Anterior labral repairs further medial than 3 o'clock (superior margin of psoas groove) require a high degree of accuracy due to the acetabular rim anatomy. (A) Right hip arthroscopy, viewing from AL portal in 17-year-old female cheerleader. An articular-sided approach may be used when visualization behind the labrum (capsular side) is more challenging and the bone is thinner; (B) cadaveric specimen, left hip arthroscopy, viewing from MMAP, illustrating the thickness of the acetabular rim at the 3 o'clock to 4 o'clock position. If the anchor is placed too far medial, then psoas penetration may occur. If the anchor is placed too close to the joint, then articular surface injury may occur. Labral anchor placement must be highly accurate and precise at this location. AIIS, anterior inferior iliac spine; MMAP, modified mid-anterior portal; AL, anterolateral.

does not require an assistant, its durability to handling in the joint, and its firm composition that reduces/prevents "spot-welding" of looped suture. In the revision setting with labral deficiency, the author prefers a complete reconstruction from front-to-back (17,61). Acetabular rim length, in males and females, is variable and ranges from 13 to 16 cm (62). Typical graft lengths range from 9 to 13.5 cm. Anchors are placed from anterior to posterior, placed all at the same time, then passed and tied sequentially (as opposed to placing and tying one at a time). Anchors are spaced approximately one cm apart. The anterior two anchors are typically placed through the MMAP with a transcapsular approach rather than through the interportal capsulotomy. This avoids excessive fluid extravasation into the iliopsoas fossa and retains iliofemoral ligament integrity better than a more extended interportal cut. From approximately 3 o'clock to 11 o'clock, anchors are placed through the DALA portal. Anchors posterior to 11 o'clock are placed through a PL portal.

At the conclusion of labral management, traction is discontinued and the peripheral compartment is entered. A "T" capsulotomy is preferred, as it best offers visualization of the femoral head neck junction (63). Comprehensive cam correction is performed and completion is verified with an arthroscopic dynamic examination. Fluoroscopic dynamic examination may also be performed. However, this is associated with excessive radiation exposure, may be unnecessary, and is not significantly better than an arthroscopic dynamic examination (64). The T capsulotomy is closed side-to-side with high-strength non-absorbable #2 suture. Typically, this is either three or four sutures. The interportal capsulotomy is usually closed next (>98% of the time), with high-strength non-absorbable non-kevlar tape suture. If the patient is at risk for post-operative microinstability, then plication with greater bites of suture and an inferior capsular shift performed. Depending on capsulotomy size (usually 2 cm), two to four tapes may be used.

Post-operative management

A hinged hip brace is applied in the operating room, with 90 degrees flexion and 0 degree abduction as ends of permitted motion. The brace is recommended for 4 weeks. Derotational boots are applied and used for 2 weeks following surgery at night time. These prevent excessive external rotation while the hip is extended. Crutch-assisted partial (~20 pounds) weight-bearing is recommended for 4 weeks. At 4 weeks, an attempt of weight-bearing as tolerated is made. If no limp is observed or perceived, crutches are discontinued. Two crutches are continued until normal gait is achieved. There is no one crutch transition between two and zero crutches. Continuous passive motion (CPM) machine is recommended for 2 weeks following surgery. Compression-cryotherapy is recommended for 3 weeks following surgery. Formal physical therapy is recommended to commence on post-operative day #1. Gentle passive motion, circumduction exercises, limited rotation, and minimized iliopsoas activation are recommended.

Conclusions

The acetabular labrum serves an important biomechanical function in the hip. In patients with FAI syndrome, a variety of labral injuries are frequently observed. These may be the source of significant motion- and position-related hip and/or groin pain. However, there is a high prevalence of asymptomatic labral tear in the general and athletic population. Non-surgical treatment for symptomatic individuals includes education, activity modification, physical therapy, non-opioid oral medications, and injections. In the event of non-surgical treatment failure in non-arthritic and non-dysplastic individuals, surgical treatment includes labral repair and correction of cam, pincer, and subspine morphologies, and capsular management. Labral reconstruction is usually a revision procedure. However, in select primary cases (ossified labrum, global overcoverage pincer, irreparable tear), a reconstruction (or debridement) may be performed.

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