Labral Refixation: Current Techniques and Indications

Marc J. Philippon, MD • Karen K. Briggs, MPH • Teddy Fagrelus, BA • Dianna Patterson, BA

Received: 25 January 2012/Accepted: 22 June 2012/Published online: 7 September 2012
© Hospital for Special Surgery 2012

Abstract *Background:* Labral tears have been associated with femoroacetabular impingement, instability, sports-related activity or trauma, capsular laxity or hypermobility, dysplasia, and degeneration. Disruption of the labrum increases the rate of acetabular cartilage compression and the contact stress between the femoral and acetabular cartilage. If left untreated, these lesions will alter normal hip joint function and may eventually lead to osteoarthritis. *Methods:* For the labrum with adequate tissue (>7 mm), the labrum is repaired if it is detached or torn. If the labrum is bruised, a rim reduction and repair is performed, especially in the presence of cartilage damage and the labral–chondral junction. Labri are debrided only if there is enough substance to maintain the function of the labrum. Care must be taken to fix the labrum so that it provides adequate seal with the femoral head. *Results:* Two-year outcome on 122 patients who underwent arthroscopic treatment for femoroacetabular impingement and chondrolabral dysfunction showed that, overall, most patients showed an improvement in symptoms and function and were satisfied with the results. Independent predictors of improved outcomes were joint space >2 mm and repair of labral pathology instead of debridement. Several other studies have shown excellent results following labral refixation and repair. *Conclusions:* Labral tears have been associated with femoroacetabular impingement, instability,

sports-related activity or trauma, capsular laxity or hypermobility, dysplasia, and degeneration. Untreated labral tears can result in premature osteoarthritis of the hip. Debridement only used to be the standard of care, but excellent results reveal arthroscopic labral repair and refixation are an option with good outcomes.

Keywords labral tear · labral refixation · femoroacetabular impingement · acetabular rim

Introduction

The hip labrum is a fibrocartilaginous structure that surrounds the acetabular socket. It plays a key role in the hip by providing stability, maintenance of the suction seal, regulation of flow of synovial fluid, and assistance in force distribution for load bearing [1, 8–11]. In the absence of a labrum or a loss of labral integrity, stability at the hip joint will be diminished [5]. Labral tears have been associated with femoroacetabular impingement, instability, sports-related activity or trauma, capsular laxity or hypermobility, dysplasia, and degeneration [4, 6, 12, 14, 21, 22]. When they occur, most labral tears are in the anterior portion of the labrum [18], although they may occur in multiple regions of the hip. Disruption of the labrum increases the rate of acetabular cartilage compression and the contact stress between the femoral and acetabular cartilage [9]. If left untreated, these lesions will alter normal hip joint function and may eventually lead to osteoarthritis [18, 19].

Several studies have looked at the ability of the labrum to heal with repair. In an ovine study, labral resection was compared to labral repair [24]. The labral resection group showed joint effusion and inflammation while the labral repair group showed a stable healed labrum. The study showed that the labrum lesion was being repaired by a fibrovascular scar migrating from the capsular surface of the labrum. The study showed that arthroscopically repaired acetabular–labral lesions in sheep were capable of healing via fibrovascular repair tissue or direct reattachment via new bone formation (or both). This provided the rationale for labral refixation.

M. J. Philippon, MD (✉) • K. K. Briggs, MPH • T. Fagrelus, BA •
D. Patterson, BA
Steadman Philippon Research Institute,
181 W. Meadow Dr., Suite 1000,
Vail, CO 81657, USA
e-mail: drphilippon@sprivail.org

M. J. Philippon, MD
The Steadman Clinic,
Vail, CO, USA

M. J. Philippon, MD
Department of Surgery,
McMasters University,
Hamilton, Ontario, Canada

Indications and Technique

Patients with a labral lesion often report symptoms of anterior hip and groin pain, locking, giving away, and catching [3]. A study of hip joint kinematics showed that on physical examination, a labral tear causes increases in range of motion of the hip in external rotation and abduction under constant torque conditions [5] and may also contribute to hip instability [23]. A common physical examination finding in patients with labral tears is a positive anterior impingement test [3]. Other tests frequently used are the posterior hip impingement test, flexion abduction external rotation distance test, and the log roll test. In addition, range of motion of the hip is documented. Anterior–posterior radiographs are used to measure joint space and determine the presence of pincer impingement. A joint space of 2 mm or less is considered a contraindication for hip arthroscopy [25]. Cross-table lateral radiographs evaluate the femoral head neck junction offset and measure the alpha angle. MRI is also used to evaluate the alpha angle in addition to evaluating the chondral surfaces and the labrum. Other structures can also be evaluated by MRI, including the ligamentum teres and the capsule.

The patient is placed on a standard fracture table in the modified supine position for hip arthroscopy. The hip is placed in 15° of flexion, and the foot is internally rotated 35°, which brings the femoral neck parallel to the floor. In addition, there is 15° of lateral tilt, and the operative hip is in neutral abduction. The nonoperative hip is placed in 45° of abduction. For traction, complete muscular paralysis is achieved. Fifty pounds of traction creates 10 to 12 mm of joint space.

Two arthroscopic portals are established. The anteriolateral portal is at the anterior aspect of the superior margin of the greater trochanter. The midanterior portal is 7 to 8 cm distal to the anteriolateral portal at an angle of 45°. This location avoids the lateral femoral cutaneous nerve and minimizes trauma to hip flexors.

A systematic examination is performed to evaluate the hip joint. A dynamic exam is also performed to identify areas of impingement. The labrum is evaluated to determine the appropriate treatment. In order to repair a labral tear, adequate labrum must be available. With a small labrum (<7 mm), a torn labrum may require augmentation. For a small bruised labrum, treatment of the impingement will prevent further damage to the labrum. If the small labrum is detached, repair and/or augmentation may be required. For a labrum with adequate tissue (>7 mm), the labrum is repaired if it is detached or torn. If the labrum is bruised, a rim reduction and repair is performed, especially in the presence of cartilage damage and the labral–chondral junction [28]. Labri are debrided only if there is enough substance to maintain the function of the labrum.

Once the decision has been made to repair the labrum, the acetabular rim must be prepared. Prior to trimming the rim, the preoperative center edge should be considered to avoid over-resection (Fig. 1). In a study, the acetabular rim reduction was correlated with the preoperative and postoperative center–edge angle [28]. The acetabular depth was measured intraoperatively prior to rim trimming and after rim trimming using a graduated intraoperative ruler. The measurement was taken from the superior aspect of the cotyloid fossa to approximately the 12 o'clock position of

Fig. 1 Measurement of the acetabular depth intraoperatively is completed prior to rim trimming and after rim trimming using a graduated intraoperative ruler. This stage is critical to avoid over-resection

the lunate surface. The study showed that the change in the center–edge angle from preoperative to postoperative values could be estimated depending on how much rim was resected. The formula obtained from the regression model was change in the center–edge angle = $1.8 + (0.65 \times \text{rim reduction in millimeters})$. So, if 3 mm of rim is taken off, a change in the center–edge angle of 3.7° can be expected. This is important to measure and calculate in patients with low center–edge angle to avoid over-resection. A dynamic exam should be performed to determine the area of conflict.

The labrum is debrided of fraying and unhealthy tissue, leaving as much viable tissue as possible. In most cases, the labrum is detached, using an arthroscopic knife, to allow for a full resection of the bony overhang. The acetabular rim provides the support structure for the labrum. Reattaching the labrum to the resected rim also allows for more stability of the labrum. The acetabular rim is exposed using a mechanical shaver between the capsule and the labrum. To facilitate the rim trim, a suture can be placed around the labrum to gently lift it out of the way and provide better exposure for rim trimming (Fig. 2). The rim is trimmed

Fig. 2 A suture (small arrow) can be used to hold the labrum out of the way while the acetabular rim is trimmed

using a 5.5 burr. Typically, we resect to the end of the rim chondrosis. The rim trimming is completed using both portals. Commonly, a chondral defect exists at the location of the tear and near the rim (Fig. 3). During the rim trimming, the size of the chondral defect can be reduced by trimming the rim around the defect. When the labrum is sutured to the rim, the secured labrum will provide an excellent edge of the chondral defect that will contain the clot if microfracture is performed (Fig. 4).

Following adequate rim resection, the labrum is reattached. The labrum is reattached to the acetabular bone using suture anchors. They are placed 2 to 3 mm below the cartilage surface (Fig. 5). The angle of placement is important to avoid penetrating the articular surface with the anchor. Since the acetabular rim is not uniform, it is important to know the limits for inserting sutures and different positions around the labrum. In a study by Lertwanich et al., they defined a safety margin for suture anchor insertion in the labrum and determined the effect of rim trimming [17]. The authors used the acetabular rim angle, which was defined as two straight lines of fixed length that started at the acetabular rim and touched the subchondral bone margin on one side and the outer cortex on the acetabulum on the other side, which was measured on CT slices of the acetabulum. A larger acetabular rim angle meant a higher safety margin for inserting the suture anchor. The rim angle was dependent on the clock position, the drill depth, and the amount of rim trimming. When placing suture anchors, these factors should be considered to avoid penetration of the cartilage surface. The labrum is then sutured to the rim. Sutures are placed around the labrum in a loop fashion or passed through the labrum in a piercing fashion (Fig. 6). The type of suture is based on the quality of the labral tissue. If the labrum is hypotrophic, passing the suture through the body of the labrum may cause the tissue to rip. The suture placement is done to recreate the acetabular labral seal by carefully balancing the reduction of the labrum so as not to invert or evert the labrum. To achieve this balance, the loop sutures tend to evert the labrum while the pass-through sutures tend to invert the labrum. Combinations of these sutures allow the surgeon to manipulate the labrum so it sits correctly and acts as a gasket to provide a suction seal. The knots must be placed on the capsular side to ensure that they do not contact

Fig. 3. A cartilage defect of the acetabulum is seen adjacent to the pincer impingement. During the rim trimming, the size of the chondral defect can be reduced by trimming the rim around the defect

Fig. 4. A repaired labrum suture to the acetabular rim with an adjacent cartilage defect. When microfractured, the sutured labrum provides an excellent rim to help contain the clot

adjacent cartilage. When the repair is completed, traction is released, and the hip is again taken through a dynamic exam. If the labrum appears unstable at any point, more anchors are necessary.

In order for the labral repair to be successful, other pathologies also need to be addressed. Impingement must be addressed to protect the labral repair. For cam impingement, the peripheral compartment is inspected and the osseous bump is visualized (Fig. 7). A femoral neck osteoplasty is performed followed by a dynamic exam in flexion, extension, abduction, and adduction to determine if the impingement no longer exists.

Results

Studies documenting the outcomes of hip arthroscopy are becoming more frequent in the literature. Several studies have shown that labral repair has better outcomes compared to debridement [7, 15, 25, 27]. In 2009, we published a 2-year outcome on 122 patients who underwent arthroscopic treatment for femoroacetabular impingement (FAI) and chondrolabral dysfunction [25]. The average age was 40 years and the average follow-up was 2.3 years with a

Fig. 5. Suture anchors are placed perpendicular to the acetabular rim

Fig. 6. **a** For loop sutures, a rounded suture passer is used to move the suture under and over the labrum. **b** For through sutures, a sharp suture passer is used to pierce the labrum and pass the suture through

range of 2 to 2.7 years. The results are that, overall, most patients showed an improvement in symptoms and function and were satisfied with the results. All patients who were not retired or in school returned to work within 5 weeks. Independent predictors of improved outcomes were joint space >2 mm and repair of labral pathology instead of debridement. Larson et al. compared a group of patients who underwent arthroscopic debridement to a group who underwent labral refixation [15]. The debridement group had lower postoperative modified Harris hip scores. In the labral fixation group, 90% of the patients reported good to excellent results while only 67% of the debridement group reported good to excellent results. A group of professional hockey players underwent rim trimming and suture repair. All players returned to skating at an average of 3.8 months following surgery. In comparison, a group of professional hockey players underwent open treatment of FAI. Only 60% returned to hockey, and they returned to skating at an average of 9.9 months.

In a recent MRI study, cartilage strain was compared in cadavers with a torn labrum, a repaired labrum, and a resected labrum [2]. The study showed that a labral repair resulted in a 2% decrease in cartilage strain and a resection caused a 4% increase in cartilage strain. This emphasizes the importance of maintaining labral tissue. The labrum also contributes to the stability of the joint. In addition, a recent

study has shown that the acetabular labrum plays a significant role as a secondary stabilizer with increased external rotation and anterior translation when the labrum is torn [20]. The study also showed that repair of the labrum in addition to the iliofemoral ligament provides significant decreased translation and external rotation [20].

Discussion

Until 2001, debridement was the standard of care for operative management of labral tears. However, histologic examination of the resected labra showed degeneration between the base of the labrum and the border of the acetabular cartilage [13]. These findings prompted modifications to surgical techniques that preserve more of the acetabular rim while just debriding the degenerated portion of the labrum. Since then, hip arthroscopy and labral refixation have resulted in good outcomes and high levels of patient satisfaction. In 2005, and again later in 2006, a technique for arthroscopic labral refixation with rim trimming was published [14, 26]. In 2009, labral refixation was shown to be superior to debridement in open treatment [15]. Patients demonstrated shorter recovery periods and superior clinical and radiographic results at 1 and 2 years postoperatively [7]. Although results were preliminary, their recommendation was refixation of the intact portion of the labrum following trimming of the acetabular rim during surgical treatment of FAI. In comparison to labral debridement, arthroscopic labral refixation has shown superior results in multiple studies. Philippon et al. showed that labral repair during hip arthroscopy for FAI with associated chondrolabral dysfunction yields better outcomes than labral debridement [25]. In a study by Larson et al., it was shown that labral refixation resulted in better modified Harris hip scores and a greater percentage of good to excellent results [16]. Furthermore, they identified a trend toward fewer progressive degenerative changes at early follow-up in labral refixation compared with labral debridements [16].

Fig. 7. View of a bony abnormality on the femoral neck associated with cam impingement

Disclosures The institutions of the one or more of the authors (KKB, MJP, TF, DP) have received funding from a commercial entity related to this work. The institutions of the one or more of the authors (TF, KKB, DP, MJP, have received funding from a commercial entity outside of the work. One or more of the authors (MJP) certifies that he or she has or may receive payments or benefits from a commercial entity outside of the work.

Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

References

1. Adeeb S, Ali A, Shrive N, Frank C, Smith D. Modelling the behaviour of ligaments: a technical note. *Comput Methods Biomech Biomed Engin.* 2004;7(1):33–42.
2. Apprich S, Mamisch TC, Welsch GH, Bonel H, Siebenrock KA, Kim YJ, Trattnig S, Dudda M. Evaluation of articular cartilage in patients with femoroacetabular impingement (FAI) using T2* mapping at different time points at 3.0 Tesla MRI: a feasibility study. *Skeletal Radiol.* 2012;41:987–95.
3. Burnett RS, Della Rocca GJ, Prather H, Curry M, Maloney WJ, Clohisy JC. Clinical presentation of patients with tears of the acetabular labrum. *J Bone Joint Surg Am.* 2006;88(7):1448–1457.
4. Byrd JW, Jones KS. Hip arthroscopy in the presence of dysplasia. *Arthroscopy.* 2003;19:1055–1060.
5. Crawford MJ, Dy CJ, Alexander JW, Thompson M, Schroder SJ, Vega CE, Patel RV, Miller AR, McCarthy JC, Lowe WR, Noble PC. The 2007 Frank Stinchfield Award. The biomechanics of the hip labrum and the stability of the hip. *Clin Orthop Relat Res.* 2007;465:16–22.
6. Dorell JH, Catterall A. The torn acetabular labrum. *J Bone Joint Surg Br.* 1986;68:400–403.
7. Espinosa N, Rothenfluh DA, Beck M, Ganz R, Leunig M. Treatment of femoro-acetabular impingement: preliminary results of labral refixation. *J Bone Joint Surg Am.* 2006;88(5):925–35.
8. Ferguson SJ, Bryant JT, Ganz R, Ito K. The acetabular labrum seal: A poroelastic finite element model. *Clin Biomech.* 2000; 15:463–468.
9. Ferguson SJ, Bryant JT, Ganz R, Ito K. The influence of the acetabular labrum on hip joint cartilage consolidation: A poroelastic finite element model. *J Biomech.* 2000;33:953–960.
10. Ferguson SJ, Bryant JT, Ganz R, Ito K. An in vitro investigation of the acetabular labral seal in hip joint mechanics. *J Biomech.* 2003;36:171–178.
11. Ferguson SJ, Bryant JT, Ito K. The material properties of the bovine acetabular labrum. *J Orthop Res.* 2001;19:887–96.
12. 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.
13. Ito K, Leunig M, Ganz R. Histopathologic features of the acetabular labrum in femoroacetabular impingement. *Clin Orthop Relat Res.* 2004;429:262–71.
14. Kelly BT, Weiland DE, Schenker M, et al. Arthroscopic labral repair in the hip: surgical technique and review of the literature. *Arthroscopy.* 2005;21(12):1496–504.
15. Larson CM, Givens MR. Arthroscopic debridement versus refixation of the acetabular labrum associated with femoroacetabular impingement. *Arthroscopy.* 2009;25(4):369–76.
16. Larson CM, Wulf CA. Intraoperative fluoroscopy for evaluation of bony resection during arthroscopic management of femoroacetabular impingement in the supine position. *Arthroscopy.* 2009;25(10):1183–92.
17. Lertwanich P, Egnisman L, Torrey MR, Giphart JE, Philippon MJ. Defining a safety margin for labral suture anchor insertion using the acetabular rim angle. *Am J Sports Med.* 2011;39 Suppl:111 S–6 S.
18. McCarthy JC, Noble PC, Schuck MR, Wright J, Lee J. The role of labral lesions to development of early degenerative hip disease. *Clin Orthop Relat Res.* 2001:25–37.
19. McCarthy JC, Noble PC, Schuck MR, Wright J, Lee J. The watershed labral lesion: Its relationship to early arthritis of the hip. *J Arthroplasty.* 2001;16:S81–S87.
20. Myers CA, Register BC, Lertwanich P, Egnisman L, Pennington WW, Giphart JE, LaPrade RF, Philippon MJ. Role of the acetabular labrum and the iliofemoral ligament in hip stability: an in vitro biplane fluoroscopy study. *Am J Sports Med.* 2011;39 Suppl:85 S–91 S.
21. Philippon MJ. Arthroscopic capsulorrhaphy of the hip: A review of 12 cases. *Arthroscopy.* 2000;16:416 (abstr).
22. Philippon MJ. The role of arthroscopic thermal capsulorrhaphy in the hip. *Clin Sports Med.* 2001;20:817–829.
23. Philippon MJ. New frontiers in hip arthroscopy: the role of arthroscopic hip labral repair and capsulorrhaphy in the treatment of hip disorders. *Instr Course Lect.* 2006;55:309–16.
24. Philippon MJ, Arnoczky SP, Torrey A. Arthroscopic repair of the acetabular labrum: a histologic assessment of healing in an ovine model. *Arthroscopy.* 2007;23(4):376–80.
25. Philippon MJ, Briggs KK, Yen YM, Kuppersmith DA. Outcomes following hip arthroscopy for femoroacetabular impingement with associated chondrolabral dysfunction: minimum two-year follow-up. *J Bone Joint Surg Br.* 2009 Jan;91(1):16–23.
26. Philippon MJ, Schenker ML. A new method for acetabular rim trimming and labral repair. *Clin Sports Med.* 2006;25(2):293–7.
27. Philippon MJ, Stubbs AJ, Schenker ML, Maxwell RB, Ganz R, Leunig M. Arthroscopic management of femoroacetabular impingement: osteoplasty technique and literature review. *Am J Sports Med.* 2007 Sep;35(9):1571–80.
28. Philippon MJ, Wolff AB, Briggs KK, Zehms CT, Kuppersmith DA. Acetabular rim reduction for the treatment of femoroacetabular impingement correlates with preoperative and postoperative center-edge angle. *Arthroscopy.* 2010;26(6):757–61.