

Arthroscopic Labral Treatment in Adolescents

Clinical Outcomes With Minimum 5-Year Follow-up

Jody M. Litrenta,^{*} MD, Brian H. Mu,[†] BA, Austin W. Chen,[‡] MD, Itay Perets,[§] MD, Victor Ortiz-Declet,^{||} MD, and Benjamin G. Domb,^{¶#} MD

Investigation performed at the American Hip Institute, Westmont, Illinois, USA

Background: The success of hip arthroscopy has led to increased application in younger populations. However, hip arthroscopy remains a challenging procedure, and its safety and efficacy in the adolescent population have been controversial. Most existing literature on outcomes in such patients contains only short-term follow-up, and a paucity of evidence is available regarding long-term outcomes in adolescents.

Purpose: To report on clinical outcomes at a minimum 5-year follow-up in patients younger than 18 years who underwent arthroscopic treatment of labral tears.

Study Design: Case series; Level of evidence, 4.

Methods: Data were prospectively collected and retrospectively reviewed on all patients younger than 18 years who underwent hip arthroscopy in a tertiary hip preservation setting at a single institution. Patients were excluded if they had previous ipsilateral hip conditions or surgery. All patients underwent either labral repair or debridement for treatment of a labral tear. Patient-reported outcome measures were recorded at 3 months and at 1, 2, or a minimum of 5 years. These included the modified Harris Hip Score (mHHS), Nonarthritic Hip Score, Hip Outcome Score–Sports Specific Subscale (HOS-SSS), visual analog scale, and patient satisfaction. Additionally, the abbreviated International Hip Outcome Tool and Short Form Health Survey were collected at latest follow-up.

Results: The study included 44 hips in 32 patients that underwent arthroscopic labral repair (86.4%) or labral debridement (13.6%) between April 2008 and April 2011, with latest follow-up at a mean of 69.2 months (range, 60.0–89.9 months) postoperatively. The average age at surgery was 16.3 years (range, 14.2–17.9 years), and 39 hips from female patients. Statistically significant improvements were seen in all patient-reported outcome measures from preoperative to minimum 5-year follow-up. Improvements were noted at 1-year follow-up and maintained at minimum 5-year follow-up. At the latest follow-up, the Patient Acceptable Symptomatic State was achieved in 95.5% of patients for the mHHS and 72.7% for the HOS-SSS. Two patients subsequently underwent secondary arthroscopy on the ipsilateral hip; however, the survivorship of all hips was 100%.

Conclusion: Hip arthroscopy for the treatment of labral tears in adolescents remains a technically challenging procedure that should be approached with appropriate caution. The results of the present study on a population treated in a specialized hip preservation center demonstrate that hip arthroscopy is a safe procedure with stable improvement in patient-reported outcome measures at 5 years.

Keywords: hip; hip arthroscopy; adolescents; midterm outcome scores

Hip preservation is a growing field with increasing clinical evidence to support and detail its applications. Arthroscopic techniques for treatment of labral tears, bony morphologic abnormalities, and instability in the hip have been described and used. Femoroacetabular impingement (FAI) is an increasingly recognized condition that causes pain, cartilage injury, and tearing of the hip labrum.² The goal

of hip arthroscopy is to treat labral tears and other symptomatic injuries that may lead to joint degeneration.⁹

FAI can manifest as cam- or pincer-type impingement or a mixture of the two. In cam-type impingement, an aspherical femoral head conflicts with the acetabulum in flexion and internal rotation. In pincer-type impingement, either overcoverage or retroversion of the acetabulum causes impingement between the femoral head and acetabulum. In both cases, these bony abnormalities damage the interposing labrum.²⁶ Successful treatment involves the treatment of labral tears and appropriate bony reshaping of cam or pincer impingement.

Hip arthroscopy has been very successful in the adult population,^{17,27} but its application in the adolescent population has been controversial. Adolescents represent a physically active population, with high demands on their hips and a need for particularly long-lasting results. Shorter follow-up in adolescents, including studies with 2-year results, have demonstrated good results.^{4,6,8,14,24} However, data with longer follow-up supporting the safety and benefits of hip arthroscopy are lacking. The purpose of this study is to report minimum 5-year outcomes for the treatment of labral tears in a group of adolescents.

METHODS

Data Collection

This is a retrospective review of a single surgeon's prospectively gathered data. All patients participated in the American Hip Institute Hip Preservation Registry. Although the present study represents a unique analysis, data on some patients in this study may have been reported in other studies.^{1,6,14,22} All data collection received institutional review board approval. The inclusion criteria were patients younger than 18 years at the time of surgery for labral tear who had a minimum of 5 years of follow-up. Surgery was indicated for all patients who had symptoms for a minimum of 3 months despite nonoperative treatment and for whom magnetic resonance imaging demonstrated a labral tear. Nonoperative treatment included activity modification and physical therapy. Patients were excluded if they had a preoperative Tönnis grade greater than 1 or a previous ipsilateral hip surgery or condition such as fracture, avascular necrosis, Ehlers-Danlos syndrome, or Legg-Calvé-Perthes disease. No exclusions were made based on preoperative center-edge angles.

Three patient-reported outcome (PRO) measures were used: the modified Harris Hip Score (mHHS), Nonarthritic Hip Score, and Hip Outcome Score—Sports Specific Subscale (HOS-SSS). A recent study that reported on the Patient Acceptable Symptomatic State (PASS) identified thresholds in these outcome measures that correlated with patient satisfaction at 1 year after hip preservation surgery. These thresholds were 74 for the mHHS, 87 for the HOS Activities of Daily Living scale, and 74 for HOS-SSS.⁵ Therefore, we selected these values as goals for

this study at a minimum 5-year follow-up. In addition, the abbreviated International Hip Outcome Tool (iHOT-12) and 12-Item Short Form Health Survey (SF-12) were administered at latest follow-up.

Pain was measured on the visual analog scale (VAS), and patient satisfaction was similarly quantified on a 0 to 10 scale. The use of this scale to measure patient satisfaction is a concise, subjective representation of patient outcome and has been used after arthroscopy, including hip arthroscopy.^{19,20} Complications and secondary hip surgeries were noted. These data were collected through patient questionnaires in clinic, by encrypted email, or by telephone at 3 months and annually postoperatively.

Surgery

All hip arthroscopic surgeries were performed by the senior surgeon (B.G.D.). During surgery, the patient was positioned supine on a traction table. Three portals (anterolateral, mid-anterior, and distal lateral accessory) were used to complete the procedure. A diagnostic arthroscopy was performed, and comprehensive intraoperative data were recorded. This included a description of the labral tear by Seldes classification,²⁸ cartilage status according to acetabular labrum articular disruption and Outerbridge grade, the status of the ligamentum, and any other intra-articular findings.

Labral tears were generally repaired whenever possible and appropriate. Selective debridement with labral preservation was performed for stable labra with minimal fraying or for irreparable labral tears. Repair was performed with a simple looped suture technique or by labral base refixation per the surgeon's discretion.¹⁶ Our institution has reported successful outcomes using labral base repair based on PROs and survivorship at 5 years, and therefore we did not expect the repair technique to independently influence results.¹³ During the time period of this study, the senior surgeon performed femoroplasty for cam lesions with alpha angle greater than 55° or with evidence of impingement intraoperatively. Acetabuloplasty was used to decrease areas of overhang visible on preoperative radiographs. Iliopsoas fractional lengthening was performed for patients with painful internal snapping. The intraportal capsulotomy was closed depending on the senior surgeon's discretion. All patients treated before 2009 underwent

#Address correspondence to Benjamin G. Domb, MD, American Hip Institute, 1010 Executive Court, Suite 250, Westmont, IL 60559, USA (email: drdomb@americanhipinstitute.org).

*New York University Orthopaedic Surgery Associates, New York, New York, USA.

†Rosalind Franklin University of Medicine and Science, North Chicago, Illinois, USA.

‡Boulder Center for Orthopedics, Boulder, Colorado, USA.

§Hadassah Hebrew University Hospital, Jerusalem, Israel.

||Sovereign Medical Group, Glen Rock, New Jersey, USA.

¶American Hip Institute, Westmont, Illinois, USA.

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TABLE 1
Preoperative Demographic and Radiographic Data

Demographic Characteristic	
Patients, n	32
Hips, n	44
Left, n (%)	19 (43.2)
Right, n (%)	25 (56.8)
Sex	
Female, n (%)	39 (88.6)
Male, n (%)	5 (11.4)
Age at surgery, y, mean ± SD (range)	16.3 ± 0.9 (14.2-17.9)
Body mass index, mean ± SD (range)	20.4 ± 1.8 (17.6-24.7)
Follow-up time, mo, mean ± SD (range)	69.2 ± 8.1 (60.0-89.9)
Follow-up percentage	80.0
Radiographic measurements, deg, mean ± SD (range)	
Alpha angle	59.8 ± 9.6 (38-80)
Lateral center-edge angle	29.7 ± 5.4 (21-43)
Acetabular center-edge angle	31.5 ± 7.2 (20-45)

TABLE 2
Intraoperative Findings

Finding	n (%)
Labral tear	
Seldes I	22 (50.0)
Seldes II	10 (22.7)
Seldes I and II	12 (27.3)
Acetabular labrum articular disruption grade	
0	9 (20.5)
1	19 (43.2)
2	14 (31.8)
3	2 (4.5)
4	0 (0.0)
Acetabular Outerbridge grade	
0	7 (15.9)
I	20 (45.5)
II	15 (34.1)
III	2 (4.5)
IV	0 (0.0)
Femoral head Outerbridge grade	
0	37 (84.1)
I	2 (4.5)
II	1 (2.3)
III	3 (6.8)
IV	1 (2.3)
Ligamentum teres tear	
Partial	10 (22.7)
Complete	1 (2.3)

release, meaning no closure was attempted, since the senior author was not yet performing this procedure. Subsequently, closure was performed for patients who demonstrated ligamentous laxity based on the Beighton score or lateral center-edge angle less than 30°.

Postoperative Protocol

Weightbearing was restricted for a minimum of 2 weeks. Each patient wore a hip brace (DJO Global) for 2 weeks

after surgery to restrict hip range of motion. All patients were enrolled in formal physical therapy for a minimum of 3 months as they progressed to return to activity.

Statistical Analysis

Preoperative PROs and VAS scores were compared with 5-year scores to assess for statistically significant improvements. Shapiro-Wilk tests were used to determine whether the data were normally distributed. For normally distributed data, 2-tailed *t* tests were used; for nonnormally distributed data, Mann-Whitney *U* test was used. Significance was set to a *P* value of less than .05.

RESULTS

Between April 2008 and April 2011, 55 hip arthroscopic surgeries were performed in patients eligible for this study. The rate of follow-up for this group was 80.0%, as 44 hips in 32 patients were followed for an average of 69.2 months (range, 60.0-89.9 months). The average age at surgery was 16.3 years (range, 14.2-17.9 years), and the group was predominantly female, with 39 female and 5 male hips. Demographic data are presented in Table 1.

Intraoperative Findings and Concomitant Procedures

All patients had a documented labral tear that was classified according to the Seldes classification. High-grade cartilage lesions were relatively uncommon, with Outerbridge grade II or higher noted on the acetabulum and femoral head in 38.6% and 11.4% of hips, respectively (see Table 2).

The labrum was repaired in the majority of cases (86.4%) and was debrided in the remainder. The most common concomitant procedure performed was acetabuloplasty, which occurred in 88.6% of hips. A large percentage also underwent iliopsoas fractional lengthening (77.3%), and a relatively smaller percentage underwent femoroplasty (36.4%). No patients had full-thickness cartilage damage requiring microfracture. The capsule was repaired in 86.4% of hips. Additional details on concomitant procedures are shown in Table 3.

All patients had a preoperative Tönnis grade of 0. At latest radiographic follow-up, no patients were found to have progression of arthritic changes.

Patient-Reported Outcomes

Statistically significant improvements were seen in all PROs collected from preoperative baseline to minimum 5-year follow-up (Figure 1). In addition, patients had a significant decrease in pain, according to VAS score, and patient satisfaction at latest follow-up was 8.6 (Figure 2). Mean iHOT-12 at latest follow-up was 81.5 ± 14.9, and mean SF-12 was 55.5 ± 7.2. Recovery curves demonstrated that the highest scores were recorded at 1-year follow-up. These results were found to be durable into the midterm,

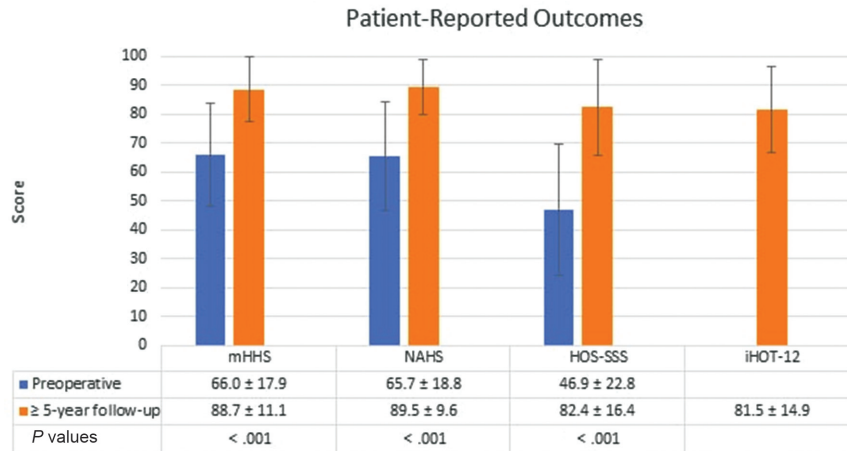


Figure 1. Statistically significant improvements in all patient-reported outcomes collected at preoperative baseline and minimum 5-year follow-up. HOS-SSS, Hip Outcome Score–Sports Specific Subscale; iHOT-12, abbreviated International Hip Outcome Tool; mHHS, modified Harris Hip Score; NAHS, Nonarthritic Hip Score.

TABLE 3
Procedures

Procedure	No. of Hips (%)
Labral treatment	
Debridement	6 (13.6)
Repair	38 (86.4)
Capsular release	6 (13.6)
Ligamentum teres debridement	11 (25.0)
Femoral head osteoplasty	16 (36.4)
Acetabular osteoplasty	39 (88.6)
Trochanteric bursectomy	0 (0.0)
Capsular repair/plication	38 (86.4)
Synovectomy	5 (11.4)
Loose body removal	1 (2.3)
Gluteus medius/minimus repair	0 (0.0)
Iliopsoas fractional lengthening	34 (77.3)
Notchplasty	0 (0.0)
Femoral head microfracture	0 (0.0)
Acetabular microfracture	0 (0.0)

with no statistically significant differences in scores between 1-year, 2-year, and minimum 5-year follow-up (Figures 3 and 4). At latest follow-up, 42 (95.5%) hips had achieved the PASS for mHHS and 32 (72.7%) for HOS-SSS.⁵

Many patients participated in sports—in most cases, high school athletic teams. Of the 32 patients, 29 were involved in athletics. At final follow-up, 13 patients continued to participate in sports: 7 at the same level of competitiveness, 3 at a higher level, and 3 at a lower level. Of these, 2 patients noted a desire to prevent hip symptoms as a reason for decreased participation. The majority of the remainder of patients no longer participating in organized sports cited lifestyle transition, such as high school graduation, as the reason.

Postoperative complications were experienced by 3 patients. These complications included 2 complaints of lateral thigh numbness, 1 of which resolved, and 1 superficial

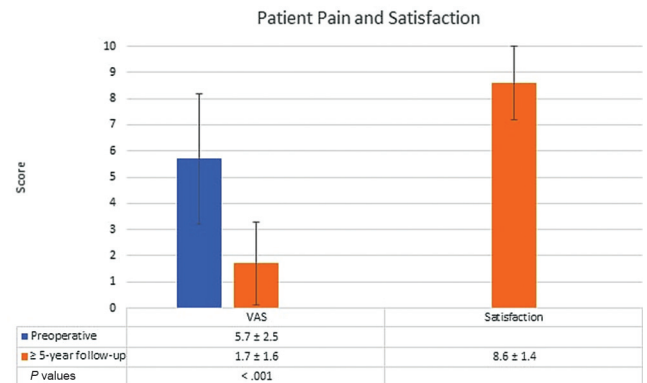


Figure 2. Statistically significant improvements in visual analog scale (VAS) scores collected at preoperative baseline and minimum 5-year follow-up.

infection treated successfully with antibiotics. Additionally, 2 patients underwent revision arthroscopy for continued hip pain.

DISCUSSION

This study demonstrated statistically significant improvements in PROs, with a high rate of achieving PASS and low rates of complications and revision surgery. Recovery curves demonstrated that maximum improvement was reached at 1 year and was well-maintained at 5 years. To our knowledge, this is first study to present minimum 5-year outcomes of labral repair in adolescents with FAI. The adolescent hip provides a unique challenge for the orthopaedic surgeon because of the biomechanical demands of young, active individuals. Our data support the use of hip arthroscopy to treat labral tears as a meaningful intervention in this population.

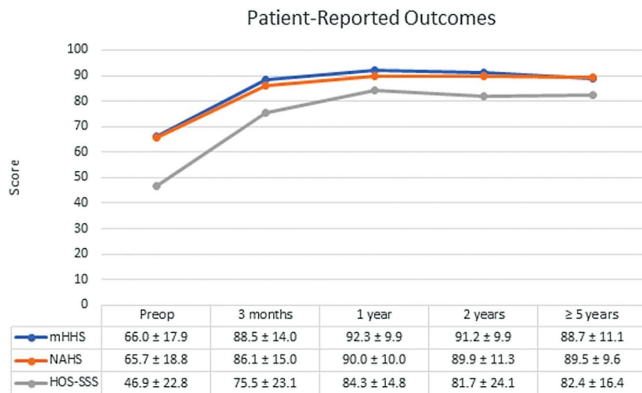


Figure 3. Recovery curves of all patient-reported outcomes collected at preoperative baseline and all postoperative follow-up points. HOS-SSS, Hip Outcome Score–Sports Specific Subscale; mHHS, modified Harris Hip Score; NAHS, Non-arthritic Hip Score.

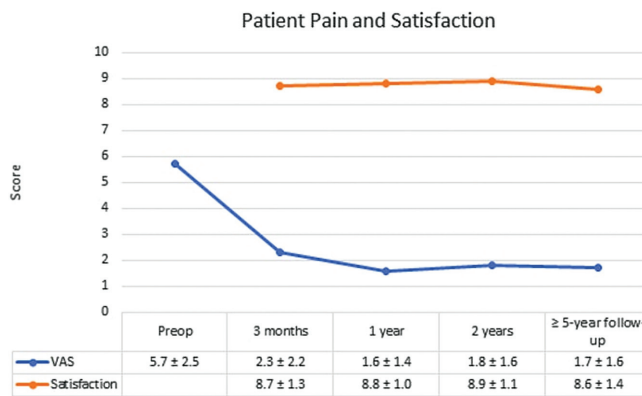


Figure 4. Recovery curves of visual analog scale (VAS) scores collected at preoperative baseline and all postoperative follow-up points.

The goal of hip arthroscopy for symptomatic labral tears is to improve pain and function in the short term as well as prevent development of early arthritis. The improvements in pain and function we report are in agreement with other studies in adolescents with shorter follow-up.^{4,21,25} Byrd et al⁴ reported the outcomes of hip arthroscopy in adolescents that included some with 5-year follow-up. These patients likewise had sustained improvements in the mHHS at 5 years. In addition to the gains that our patients experienced, no radiographic progression of arthritis was found. Although this is not surprising in this young population, it is still important to monitor for early changes at this point in follow-up.

A number of concomitant arthroscopic procedures were performed in addition to treatment of labral tears (Table 3). Although this study provides strong support for treatment of labral tears, debate continues regarding other arthroscopic procedures. Among the most controversial may be iliopsoas fractional lengthening and treatment of

the capsule. Iliopsoas fractional lengthening has been shown to successfully treat a symptomatic snapping hip in the adolescent population.¹⁰ However, some research indicates that this procedure may be associated with hip flexor weakness³ and may be even be destabilizing in patients with increased femoral anteversion.¹⁵ The growing trend with regard to capsular treatment is capsular repair,¹⁸ and extensive work at our institution has likewise established the biomechanical basis and clinical outcomes of routine capsular closure and of capsular plication in cases of microinstability. The majority of patients in this study underwent capsular closure.^{7,11,12} It has not yet been elucidated whether capsular release may still have a role in certain scenarios. Future research with larger numbers may be better able to answer these questions.

The study has several strengths. The surgical technique was uniform in that a single surgeon performed these procedures at a tertiary hip preservation center. The study included a minimum 5-year follow-up that supports hip arthroscopy for treatment of labral tears in adolescents. Our institution has published other studies that report good 2-year outcomes of adolescents included in this group at 5 years.^{1,6,14,22} Our current results show sustained improvement using multiple PROs, which clinimetric studies advocate is superior to any single score.²³

The limitations are that, even with this duration of follow-up, the development of early degenerative arthritis may still not yet be uncovered. Ideally, this young population needs even longer follow-up to truly establish the benefits of arthroscopy for this purpose. Although our sample represents 80.0% follow-up at a minimum of 5 years, it is a small group of 44 cases in 32 patients. Larger studies, even multicenter studies, may be appropriate to provide more detail about hip arthroscopy in adolescents for the treatment of labral tears and other concomitant intra-articular injury. Most patients in our sample were female. Sex-based differences in hip injury and recovery are areas of interest for further investigation, which would benefit from a larger or more balanced study population.

CONCLUSION

Hip arthroscopy for the treatment of labral tears in adolescents remains a technically challenging procedure that should be approached with appropriate caution. The results of the present study on a population treated in a specialized hip preservation center demonstrate that hip arthroscopy is a safe procedure with stable improvement in patient-reported outcome measures at a minimum of 5 years postoperatively.

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