Long-Term Outcomes of Primary Hip Arthroscopy With Labral Repair for Femoroacetabular Impingement

Results at Minimum 9-Year Follow-up

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Background: Hip arthroscopy continues to advance and become increasingly commonly performed. With the evolution of techniques and instrumentation, labral repair rather than debridement has emerged as the treatment of choice for labral pathology. There remains a lack of data on long-term outcomes after labral repair.

Purpose: To (1) evaluate long-term patient-reported outcomes of primary hip arthroscopy with labral repair for femoroacetabular impingement, (2) report achievement rates of Patient Acceptable Symptom State (PASS) and minimal clinically important difference (MCID), and (3) investigate rates of reoperation and progression to total hip arthroplasty (THA).

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

Methods: Prospectively collected data were reviewed for patients who underwent primary hip arthroscopy with labral repair between 2010 and 2013. Patients' medical records were reviewed for demographic characteristics, intraoperative findings, reoperation, and progression to THA. Patients were assessed pre- and postoperatively using the following scales: visual analog scale (VAS) for pain; Tegner activity scale; modified Harris Hip Score (mHHS); 12-item International Hip Outcome Tool (iHOT-12); Hip Outcome Score–Activities of Daily Living (HOS-ADL); HOS–Sport-Specific Subscale (HOS-SSS); and Non-Arthritic Hip Score. Patients were also surveyed for satisfaction, subjective improvement, and level of function.

Results: A total of 32 patients (n = 24 women; n = 8 men) with a mean age of 27.7 years (range, 13.6-51 years) were evaluated for a mean of 9.4 years (range, 9-12.1 years). Patients achieved significant mean improvements in VAS pain at rest of 2 points, VAS pain with use of 1.9, mHHS of 19.9 points, iHOT-12 of 33.5 points, HOS-ADL of 17.4 points, and HOS-SSS of 29.5 points ($P \leq .015$ for all). Eleven patients (34.4%) underwent reoperation and 4 (12.5%) progressed to THA during the study period. At the final follow-up, the MCID achievement rate was $\geq$68%, the PASS achievement rates ranged from 39% to 65%, and the mean patient satisfaction was 8.1 on a 1 to 10 scale, with 10 denoting most satisfied.

Conclusion: Patients demonstrated significant postoperative improvements in pain, mHHS, iHOT-12, HOS-ADL, and HOS-SSS scores at 9 years postoperatively. The all-cause reoperation rate was 34.4%, and 12.5% of patients progressed to THA.

Keywords: femoroacetabular impingement; impingement; hip arthroscopy; minimally invasive

Arthroscopic surgical techniques have become key orthopaedic innovations, allowing for highly accurate diagnosis and treatment of joint derangements without more invasive surgery. Portals for hip arthroscopy had been described as early as 1939 by Takagi[20]; however, implementation of hip arthroscopy as a clinical tool and treatment modality evolved decades later—given inherent challenges in achieving satisfactory access, visualization, and instrumentation. Increased understanding of hip pathologies, including femoroacetabular impingement (FAI),[2,6] labral tears,[15] and extra-articular conditions,[7,9,10] alongside technological advancements, have allowed for the rapid expansion of indications and applications for hip arthroscopy beyond the initial limited use for loose body removal, intra-articular debridement, and irrigation

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of septic arthritis. As such, contemporary management of labral tears with hip arthroscopy has shifted from labral debridement to repair and reconstruction in select cases and revisions.

A 2023 systematic review by Lee et al[14] on 12 studies representing 1344 hips demonstrated overall favorable outcomes for patients undergoing primary hip arthroscopy at a long-term follow-up ranging from 10 to 20 years. However, the authors reported highly variable rates of secondary arthroscopy and conversion to total hip arthroplasty (THA). A likely contributing factor to this finding is the number of labral tear treatment modalities available and implemented, with the systematic review including articles on labral excision/resection, debridement, and repair. Additionally, there was substantial heterogeneity in indication for hip arthroscopy, age of patients, and assessed patient-reported outcome measures (PROMs). Thus, further studies are needed to effectively counsel patients on the long-term outcomes and likelihood of secondary operations after primary hip arthroscopy with contemporary labral repair.

The purpose of this study was to (1) evaluate long-term patient-reported outcomes of primary hip arthroscopy with labral repair for FAI, (2) report achievement rates of Patient Acceptable Symptom State (PASS) and minimal clinically important difference (MCID), and (3) investigate rates of reoperation and progression to THA.

METHODS

After receiving institutional review board approval, we prospectively gathered and reviewed patient data from an online hip arthroscopy database (Outcomes Based Electronic Research Database) for primary hip arthroscopies with labral repair performed between 2010 and 2013. The inclusion criteria consisted of patients who underwent primary hip arthroscopy with labral repair. The exclusion criteria consisted of patients who (1) had labral debridement, (2) underwent a revision hip arthroscopy, (3) had concomitant periacetabular osteotomy (PAO), or (4) did not have recorded preoperative PROMs in the database.

Of 40 initial patients, 8 were lost to follow-up, leaving 32 (80%) in the final cohort who met the study criteria and had at least 9 years of follow-up data (Figure 1).

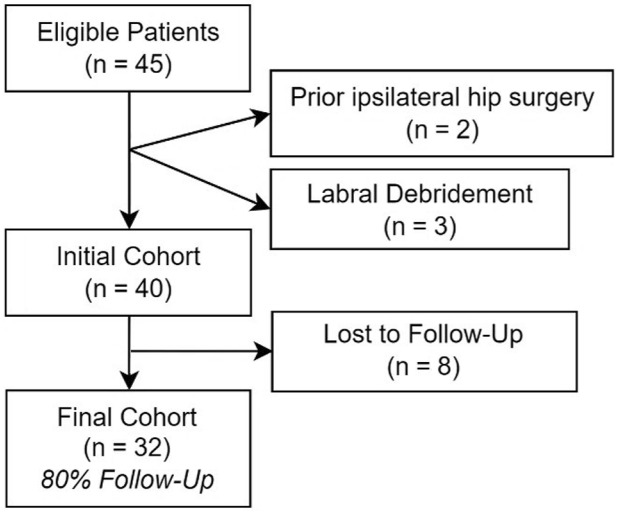

Figure 1. Patient selection flowchart.

All patients who underwent surgery had failed prior nonoperative management, including anti-inflammatory drugs, activity modifications, and physical therapy. Diagnostic ultrasound-guided anesthetic injections were performed in cases without a clear intra-articular cause of pain. All surgeries were performed by 1 of the 2 orthopaedic sports fellowship-trained senior authors (A.J.K. and B.A.L.). Also, 2 to 3 standard portals (anterolateral, midanterior, distal anterolateral, and/or posterolateral) were used during the entire procedure to assess and treat the patient. After establishing standard portals, an interportal capsulotomy was performed to allow for a complete evaluation of the central compartment of the hip. In the central compartment, significant and apparent pathologies were addressed accordingly. Chondromalacia and unstable chondral flaps were debrided down to a stable border using a combination of arthroscopic shavers and radiofrequency ablators. Microfracture, osteochondral autografts, and osteochondral allografts were not performed in this cohort. Attention was then directed to peripheral compartment pathologies, with femoral neck and acetabular osteoplasty performed to treat cam- or pincer-type lesions and iliopsoas lengthening for patients with reproducible symptoms consistent with snapping hip syndrome during their

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preoperative visit. If necessary for further visualization and access, a T-capsulotomy was performed. During this study, capsular repair was not routinely performed and was decided on a case-by-case basis by the surgeon's perceived laxity, ease of joint distractibility, or evidence of hypermobility.

The medical charts of the included patients were individually reviewed for demographic characteristics, Outerbridge grade, acetabular labral articular disruption (ALAD) classification, intraoperative procedures, reoperations or revisions, and progression to THA. Patients who progressed to a revision hip arthroscopy, subsequent open hip surgery, or THA were considered to have met a clinical endpoint. Postoperative PROMs were collected from patients who had not met a clinical endpoint using the online survey database web application Research Electronic Data Capture (REDCap; Vanderbilt University) or through telephone calls. Collected scores included Visual Analog Scale (VAS) at rest and with use, Tegner activity scale, Hip Outcome Score–Activities of Daily Living (HOS-ADL), Sport-Specific Subscale (SSS),[16] modified Harris Hip Score (mHHS), Nonarthritic Hip Score,[21] and the 12-item International Hip Outcome Tool (iHOT-12).[8] Subjective postoperative improvement was rated with a 5-point Likert scale, ranging from *significantly worsened* to *significantly improved*. Satisfaction with surgery was rated from 0 (*not at all satisfied*) to 10 (*most satisfied*). We also recorded the percentage of patients who achieved the MCID and PASS thresholds for the following measures based on previous studies[5,11,12,19]: mHHS (MCID, 8 points; PASS, 74); HOS-ADL (MCID, 5 points; PASS, 87); HOS-SSS (MCID, 6 points; PASS, 75); and iHOT-12 (MCID, 13 points; PASS, 75.2). Patients without contact information and those who did not respond to multiple attempts at contact were considered lost to follow-up. The overall outcome score completion rate was ≥81%.

Statistical Analysis

Demographic data, intraoperative procedures, and pre- and postoperative PROMs were recorded as means with standard deviations or the total number with the percentage of the total. The Mann-Whitney *U* test was used to compare differences between pre- and postoperative PROM scores. All statistical tests were 2-sided, and $P < .05$ was considered statistically significant. Statistical analysis was performed using Microsoft Excel and RStudio (RStudio PBC) with R Version 4.2.1 (R Foundation for Statistical Computing).

RESULTS

Study Population

Table 1 shows the characteristics of the 32 patients (n = 32 hips) included in the study. The mean follow-up was 9.4 years (range, 9-12.1 years). There were 24 (75%) women and 8 (25%) men, with a mean age at the time of surgery of 27.7 ± 11.8 years (range, 13.6-511 years) and a mean body mass index of 26.6 ± 5.6 kg/m^2 (range, 17.8-46 kg/m^2) (Table 1). All patients underwent surgery for a primary indication of FAI and associated labral tear. There were 8 (25%) patients with borderline acetabular dysplasia, defined as a lateral center-edge angle (LCEA) between 20° and 25°. At the time of surgery, the mean ALAD grade was 2.7 ± 0.8, with all 32 patients (100%) undergoing primary labral repair, with a mean of 3.3 ± 0.5 anchors. Fourteen patients (43.8%) had chondromalacia of the acetabulum, with a mean Outerbridge grade of 2.4 ± 1. Two patients (6.3%) had chondromalacia of the femoral head, both with an Outerbridge grade of 2.

TABLE 1
Patient Characteristics and Imaging Findings (N = 32 Patients)[a]

Variable	Value
Age at surgery, y	27.7 ± 11.8 (13-51)
Sex	
Male	8 (25)
Female	24 (75)
Laterality	
Left	18 (56.3)
Right	14 (43.8)
BMI, kg/m^2	26.6 ± 5.6 (17.8-46)
LCEA, deg	30.8 ± 5.6 (21.6-41.5)
Alpha angle, deg	72.1 ± 13.1 (47.6-104.6)
Tönnis grade	0.5 ± 0.5 (0-1)

[a]Data are reported as mean ± SD (range) or n (%). BMI, body mass index; LCEA, lateral center-edge angle.

Femoral neck osteoplasties were performed in all 32 (100%) patients, acetabular osteoplasties in 30 (93.8%), and iliopsoas lengthening/release in 12 (37.5%). An interportal capsulotomy was performed in 28 (87.5%) patients and T-capsulotomy was performed in 4 (12.5%) patients, with subsequent repair being performed in 8 of the interportal (28.6%) and 2 of the T-capsulotomy (50%) patients. A minority of patients underwent additional arthroscopic procedures (Table 2).

Patient-Reported Outcome Measures

At the final follow-up, the all-cause reoperation rate was 34.4%, with 11 of 32 patients undergoing any subsequent hip surgery. Patients who did not progress to a clinical endpoint demonstrated statistically significant postoperative improvements in the following scales as compared with their preoperative baseline: visual analog scale (VAS) pain at rest (Δ2 points; $P = .003$); VAS pain with use (Δ1.9 points; $P = .015$); mHHS (Δ19.9 points; $P < .001$); iHOT-12 (Δ33.5 points; $P = .001$); HOS-ADL (Δ17.4 points; $P = .002$); and HOS-SSS (Δ29.5 points; $P < .001$) (Table 3). Twelve of the 17 (71%) survey respondents met the MCID for the mHHS, 13 of 19 (68%) for the HOS-ADL, 12 of 17 (70.6%) for the HOS-SSS, and 8 of 11 (73%) for the iHOT-12. Eleven of 17 (65%) survey respondents met the PASS threshold for the mHHS, 10 of 19 (53%) for the HOS-ADL, 10 of 19 (53%) for the HOS-SSS, and 7 of 18 (39%) for the iHOT-12 (Table 3).

TABLE 2
Intraoperative Findings and Procedures (N = 32 Patients)[a]

	Value
Finding	
Labral tear	32 (100)
ALAD grade	2.7 ± 0.6
Acetabular chondromalacia[b]	14 (43.8)
Femoral head chondromalacia[c]	2 (6.3)
Procedure	
Labral repair	32 (100)
No. of anchors used	3.3 ± 0.5
Cam lesion resection (femoral neck osteoplasty)	32 (100)
Pincer lesion resection (acetabular osteoplasty)	30 (93.8)
Iliopsoas lengthening/release	12 (37.5)
Capsular repair	10 (31.3)
Other procedures	
Os acetabuli resection	2 (6.3)
Ligamentum teres debridement	3 (9.4)
Acetabular cyst debridement	1 (3.1)
Trochanteric bursectomy	1 (3.1)
Gluteus medius calcific tendinitis decompression	1 (3.1)

[a]Data are reported as mean ± SD or n (%). ALAD, acetabular labrum articular disruption.
[b]Mean ± SD Outerbridge grade, 2.4 ± 1.
[c]Outerbridge grade 2.

The mean patient satisfaction was 8.1 ± 2.8 (median, 9 [interquartile range, 7.5-10]). Of patients who did not need revision procedures or arthroplasty, 67% reported that their hip was mildly or significantly improved with surgery (Table 4). Regarding level of function, 71% of patients felt their hip was normal or nearly normal.

Reoperation and Conversion to THA

For first-time reoperations, 8 patients underwent revision hip arthroscopy at a mean of 2.6 years (range, 0.5-8.4 years) postoperatively, 1 patient went on to PAO for borderline hip dysplasia (LCEA, 21.6°) at 1.6 years after primary hip arthroscopy, and 2 converted to THA at 1.1 and 8.3 years after primary arthroscopy. Of the 8 patients who underwent revision arthroscopy as a first-time reoperation, 1 patient subsequently underwent repeat revision arthroscopy, 1 converted to PAO (LCEA, 21.2; Tönnis angle, 12.9°), and 2 patients converted to THA at 4.9 and 3.4 years after their primary hip arthroscopy. Therefore, at the final follow-up, 4 patients had converted to THA for an overall arthroplasty rate of 12.5%. There were no significant differences in Tönnis grades between patients who underwent any subsequent reoperation and those who did not (P = .712). However, patients who converted to THA did have significantly greater Tönnis grades than patients not undergoing THA (1 ± 0 vs 0.4 ± 0.5; P = .038).

DISCUSSION

Our study aimed to evaluate long-term patient-reported outcomes of primary hip arthroscopy with labral repair, report achievement rates of PASS and MCID, and investigate rates of reoperation and progression to THA. Our main finding was that patients who did not progress to a clinical endpoint demonstrated durable and significant improvements in VAS, mHHS, iHOT-12, HOS-ADL, and HOS-SSS scores at a mean 9.4-year follow-up. Additionally, these patients showed satisfactory MCID and PASS achievement rates. There was an all-cause reoperation rate of 34.4%, with 12.5% of patients converting to THA. Notably, the outcomes of this study must be considered in the context of the rate of reoperation and progression to THA. These results are clinically relevant because they contribute to the lack of available literature regarding comprehensive long-term outcomes after primary hip arthroscopy with contemporary techniques such as labral repair.

In this study, survey respondents reported significant improvements across multiple PROMs, including VAS at

TABLE 3
Outcome Scores and MCID/PASS Achievement[a]

Outcome Measure	Preoperative	Postoperative	$\Delta_{\text{Post vs Pre}}$	P	Achieved MCID[b]	Achieved PASS[c]
VAS pain at rest	4.1 ± 2.3	2.1 ± 1.6	−2	**.003**	—	—
VAS pain with use	5.7 ± 2.7	3.8 ± 2.4	−1.9	**.015**	—	—
Tegner activity scale	5.2 ± 2.8	4.4 ± 1.5	−0.8	.265	—	—
mHHS	62.6 ± 13.5	82.5 ± 15.5	19.9	**<.001**	12/17 (70.6)	11/17 (64.7)
iHOT-12	31 ± 13.1	64.5 ± 29.2	33.5	**.001**	8/11 (72.7)	7/18 (38.9)
HOS-ADL	66.2 ± 13.6	83.6 ± 18.6	17.4	**.002**	13/19 (68.4)	10/19 (52.6)
HOS-SSS	45.3 ± 17.4	74.8 ± 25.9	29.5	**<.001**	12/17 (70.6)	10/19 (52.6)
NAHS	56.9 ± 9.8[d]	83.3 ± 17.5	26.4	.088	—	—

[a]Data are reported as mean ± SD or n/total (%) unless otherwise indicated. Bold P values indicate statistically significant differences between pre- and postoperative values ($P < .05$). Dashes indicate irrelevant areas. HOS-ADL, Hip Outcome Score–Activities of Daily Living; HOS-SSS, Hip Outcome Score–Sports-Specific Subscale; iHOT-12, 12-item International Hip Outcome Tool; MCID, minimal clinically important difference; mHHS, modified Harris Hip Score; NAHS, Nonarthritic Hip Score; PASS, Patient Acceptable Symptom State; Pre, preoperative; Post, postoperative; PROMs, patient-reported outcome measures; VAS, visual analog scale.
[b]Total is the number of respondents with both pre- and postoperative PROMs.
[c]Total is the number of respondents with postoperative PROMs.
[d]Only 2 patients reported preoperative values.

TABLE 4
Patient Satisfaction, Subjective Improvement, and Level of Function[a]

Outcome Measure	Respondents
Surgery satisfaction (range, 1-10)	8.1 ± 2.8
Subjective improvement (n = 21[b])	
Significantly improved	9 (42.9)
Mildly improved	5 (23.8)
No change	2 (9.5)
Mildly worsened	1 (4.8)
Significantly worsened	1 (4.8)
Nonrespondents	3 (14.3)
Current level of function (n = 21[b])	
Normal	5 (23.8)
Nearly normal	10 (47.6)
Abnormal	4 (19)
Severely abnormal	0 (0)
Nonrespondents	2 (9.5)

[a]Data are reported as mean ± SD or n (%).
[b]Percentage totals are based on number of respondents for each questionnaire.

rest and with use, mHHS, iHOT-12, and HOS-ADL. A recent study by Beals et al[1] on 38 hips with borderline dysplasia reported the mean postoperative mHHS of 83, HOS-ADL of 87, and HOS-SSS of 76 at a mean of 12 years postoperatively. The scores published by their group closely mirror those found in our study. Similarly, Menge et al[18] presented a series of 70 adolescent hips with a mean age of 16 years and mean postoperative PROMs of 88, 92, and 86 for the mHHS, HOS-ADL, and HOS-SSS, respectively, at a mean of 12 years postoperatively. While their observed PROM values are similar overall but higher than those observed in our study, theirs is a study of an adolescent patient population, which is likely more active and less generalizable than a general hip arthroscopy patient population. Our study is the first to directly evaluate pre- and postoperative iHOT-12 scores at a long-term follow-up for arthroscopic labral repair. This is clinically relevant given that the iHOT-12 has been shown to be less limited by ceiling effects than other hip scores such as the mHHS, HOS-ADL, and HOS-SSS.[3]

This study reported an all-cause reoperation rate of 34.4% and a THA conversion rate of 12.5%. While outcomes data were not collected on patients who progressed to a clinical endpoint, it should be acknowledged that these patients likely did not have a satisfactory outcome at the time of their secondary operation. In the only currently available systematic review for long-term effects of hip arthroscopy, Lee et al[14] observed revision arthroscopy rates of 5% to 24% and THA conversion rates of 0% to 44%, with an overall secondary surgery rate of 9.1% to 44.1%, highlighting the heterogeneity of their sample. Of note, their inclusion of patients undergoing labral excision, resection, or debridement is particularly notable given that this has been demonstrated to have inferior outcomes to repair in prospective studies.[13] Therefore, our study contributes to available long-term results by providing a more homogeneous sample of patients undergoing arthroscopic labral repair, which is currently standard practice at our institution.

Our third aim was to evaluate the rates of achieving the PASS and MCID for our patient cohort. Rates of achieving the PASS varied, ranging from 39% to 65%, and rates of achieving the MCID ranged from 68% to 73%. The review by Lee et al[14] reported that published rates of achieving the PASS and MCID after primary hip arthroscopy at a long-term follow-up were similarly variable, with PASS rates ranging from 69% to 92% and MCID rates ranging from 72% to 94%. Our cohort had a lower rate of achieving the PASS and a similar rate of achieving the MCID. However, Lee et al indicated that the referenced cutoff values for the PASS and MCID in many studies result from calculations of patient cohorts with short- to mid-term postoperative data. They also noted that there is diversity in which PROMs were utilized. Zimmerer et al[22] reported newly calculated MCID and PASS values for the mHHS in patients at a minimum 10-year follow-up from primary hip arthroscopy for FAI, calculating significantly increased values for both (MCID, 19.6; PASS, 84.4). Given that most patients also reported subjective improvement and high satisfaction with surgery, further research is merited on long-term outcomes and the appropriate measurement tools.

Our limited sample size precluded subgroup analysis of our cohort, although multiple patient factors have been increasingly recognized as critical for outcomes. In particular, the role of primary hip arthroscopy for patients with borderline hip dysplasia is controversial. In the present study, 8 (25%) patients were noted to have borderline hip dysplasia, as defined by LCEA values between 20° and 25°. Although these patients increase the heterogeneity of our study, our findings still closely mirror the current literature as discussed above. Two of these patients, however, did undergo PAO as a result of persistent pain. One patient was noted to have a Tönnis angle of 12.9°. Since this study, we have learned that greater Tönnis angles portend a much-elevated risk for revision surgery, up to 84% in patients with a Tönnis angle[17] of >10°. During this study period, capsular repair was not routinely performed and instead decided on a case-by-case basis, with indications of perceived laxity, ease of joint distractibility, or evidence of hypermobility. Carbone et al[4] recently performed a systematic review, identifying 3 studies representing 406 hips, to compare early- and mid-term outcomes of patients with and without capsular repair. They found that in patients without dysplastic hips, capsular repair provided more significant improvements in PROMs and native hip survivorship. Accordingly, in our modern arthroscopy practice, we have converted to uniform capsular closure in the setting of hip arthroscopy.

Limitations

Our study is not without important limitations. First, patients defined as lost to follow-up may represent response bias. Second, not all PASS and MCID values have been validated in hip arthroscopy patients with a long-term follow-

up. Certainly, we expected activity levels, functional demands, and other variables to change for patients over the minimum 9-year follow-up. Finally, as hip arthroscopy continues to grow in volume and evolve, larger long-term sample sizes will be necessary for nuanced analysis and prognostication in this patient population.

CONCLUSION

In the present study, patients demonstrated significant postoperative improvements in VAS, mHHS, iHOT-12, HOS-ADL, and HOS-SSS scores at a mean of 9.4 years postoperatively, with overall satisfactory rates of reoperation and conversion to THA. The all-cause reoperation rate was 34.4%, and 12.5% of patients progressed to THA. These data support efficacious and durable outcomes of hip arthroscopy at a long-term follow-up.

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