

# Primary labral reconstruction in patients with femoroacetabular impingement, irreparable labral tears and severe acetabular chondral defects decreases the risk of conversion to total hip arthroplasty: a pair-matched study

David R. Maldonado<sup>1</sup>, Camille C. Go<sup>1</sup>, Joseph R. Laseter<sup>1,2</sup>, Ajay C. Lall<sup>1</sup>,  
Michael R. Kopschik<sup>3</sup> and Benjamin G. Domb<sup>1\*</sup> 

<sup>1</sup>American Hip Institute, 999 E Touhy Ave, Suite 450, Chicago, IL 60018, USA,

<sup>2</sup>Case Western Reserve University School of Medicine, Cleveland, OH 44106, USA and

<sup>3</sup>Medical University of South Carolina, Charleston, SC 29425, USA.

\*Correspondence to: B. G. Domb. E-mail: DrDomb@americanhipinstitute.org

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## ABSTRACT

In the presence of severe acetabular cartilage defects, the benefits of labral reconstruction (RECON) versus labral resection (RESEC) have not been determined. Prospectively collected data between October 2008 and December 2016 were retrospectively reviewed. Inclusion criteria were hip arthroscopy, acetabular Outerbridge grade III/IV, irreparable labral tears that underwent RECON or RESEC, and minimum 2-year postoperative measures for the modified Harris Hip Score, Non-Arthritic Hip Score, Hip Outcome Score–Sports Specific Subscale, International Hip Outcome Tool, Patient Satisfaction and Visual Analogue Scale for pain. Exclusion criteria included Tönnis grade >1, previous hip conditions or previous ipsilateral hip surgeries. A 1:1 matched-pair analysis was performed based on age  $\pm 5$  years, sex, body mass index  $\pm 5$  kg/m<sup>2</sup>, Tönnis grade, acetabular microfracture, femoral Outerbridge grade (0 or I compared with II, III or IV). Relative risk (RR) and conversion rate to total hip arthroplasty (THA) were calculated. A total of 38 RECON hips were successfully matched. Both groups demonstrated significant improvements in patient-reported outcomes (PROs). THA conversion was 5.3% and 21.1% for the RECON and RESEC groups, respectively ( $P = 0.04$ ). RECON was four times less likely to require THA conversion than the RESEC group (RR=4.0; 95% CI 0.91–17.63). In the setting of primary arthroscopic management of femoroacetabular impingement, irreparable labral tears and acetabular chondral lesions of Outerbridge III/IV, patients that underwent RECON and RESEC experienced significant improvement in PROs at minimum 2-year follow-up, and these functional scores were comparable when groups were matched. However, RR and rate to THA conversion were significantly higher in the RESEC group.

## INTRODUCTION

Femoroacetabular impingement (FAI) has been implicated as a major contributor to hip osteoarthritis [1–3]. Increased understanding of hip pathology and technological advancements have led to treating several conditions in a more effective and reproducible manner [4–9]. Nevertheless, patient selection is critical and may be one of the key variables related

to success following these procedures [10]. Arthritis has been indicated as a major cause of failure following hip arthroscopy. Conversion to total hip arthroplasty (THA) is usually necessary in this scenario, making THA one of the most common reoperations following arthroscopic hip surgery [1, 11–16].

Treatment of severe isolated acetabular cartilage damage is challenging and, even with new enhancing biologic

options, microfracture remains the main option [17–21]. Several authors have published favorable short-term results with microfracture with labral preservation and chondrolabral function restoration, but mostly after labral repair [22–25]. In the specific setting of an irreparable labral tear, reconstruction seems to be the preferred alternative in restoring labral function, potentially giving back cartilage protection and providing a possible ‘containing effect’ of the inherent uncontained acetabular cartilage defect [5, 19, 26–29]. However, it is also technically demanding, and there is currently a lack of evidence to justify reconstruction over segmental resection in this particular setting [9, 30–36]. Therefore, when arthroscopy reveals an irreparable labrum in the context of high-grade acetabular chondral damage, the surgeon may be uncertain whether reconstruction is worthwhile.

The purpose of this study was to compare conversion rates THA at minimum 2-year follow-up between two groups, labral reconstruction (RECON) versus labral resection (RESEC), which underwent primary hip arthroscopy for FAI, irreparable labral tears, and acetabular chondral lesions Outerbridge III/IV. We hypothesized that RECON in patients who underwent primary hip arthroscopy for FAI with findings of acetabular chondral lesions of Outerbridge III/IV and irreparable tears would lead to a lower relative risk (RR) and rate to conversion to THA at minimum 2-year follow-up when compared with a matched-pair labral RESEC group.

## MATERIALS AND METHODS

### Patient selection criteria

Following institutional review board approval, prospectively collected data of surgical procedures performed between October 2008 and December 2016 were retrospectively reviewed. Inclusion criteria were undergoing hip arthroscopy, intraoperative findings of acetabular Outerbridge grade III or IV chondral lesions, irreparable labral tears that underwent RECON or RESEC, and minimum 2-year postoperative measures for the following patient-reported outcomes (PROs): modified Harris Hip Score (mHHS) [37, 38], Non-Arthritic Hip Score (NAHS) [39], Hip Outcome Score–Sports Specific Subscale (HOS-SSS) [40–43], International Hip Outcome Tool (iHOT-12) [44], Patient Satisfaction (0–10, 0 = not satisfied, 10 = completely satisfied) and Visual Analogue Scale (VAS) for pain (0–10, 0 = no pain, 10 = extreme pain). Patients were excluded from the study if they had a Tönnis osteoarthritis grade >1, hip dysplasia [lateral center-edge angle (LCEA)  $\leq 18^\circ$ ], previous hip conditions, such as Legg–Calve–Perthes disease, slipped capital femoral

epiphysis and avascular necrosis, or any previous ipsilateral hip surgeries [45]. Revision surgeries and conversions to THA were documented.

### Participation in the American Hip Institute hip preservation registry

While the present study represents a unique analysis, data on some patients in this study may have been reported in other studies [46, 47].

### Matching protocol

A 1:1 match was performed between both groups based on age at surgery  $\pm 5$  years, sex, body mass index (BMI)  $\pm 5 \text{ kg m}^{-2}$ , Tönnis grade, acetabular microfracture performance, femoral Outerbridge grade (0 or I compared with II, III or IV) with both groups having acetabular Outerbridge grade III or IV cartilage lesions [20, 21].

### Clinical evaluation

All patients were examined by the senior author (B.G.D.). During the physical exams, anterior, lateral and posterior impingement tests were performed to help with diagnosing labral tears [10, 48, 49]. Patients underwent standard pre- and post-operative X-ray evaluation, which were reviewed by two-trained fellows and the senior author to determine pre-operative Tönnis osteoarthritis grade, LCEA, anterior center-edge angle (ACEA) and alpha angle [11, 50–52]. All patients received magnetic resonance arthrograms to confirm the diagnosis of a labral tear.

The X-ray views gathered included the anteroposterior (AP) pelvis in both supine and upright positions, the Dunn view at  $45^\circ$ , and the false profile view [50]. Radiographic measurements were taken by an orthopaedic surgeon. The AP pelvis radiograph was used to quantify the LCEA of Wiberg and to evaluate joint space, crossover sign, prominent ischial spine sign and posterior wall sign [53]. Pincer deformity was defined as a LCEA  $\geq 40^\circ$  [54]. The Dunn view was used to measure the alpha angle, with values greater than  $50^\circ$  suggesting femoral cam-type deformities [55]. The false profile view was used to measure the ACEA [56]. GE Healthcare’s Picture Archiving and Communication System (GE-PACS, Fairfield, CT, USA) was used for all radiograph measurements. The institution’s radiographic measurements have demonstrated inter-observer reliability in previous published studies [57–60].

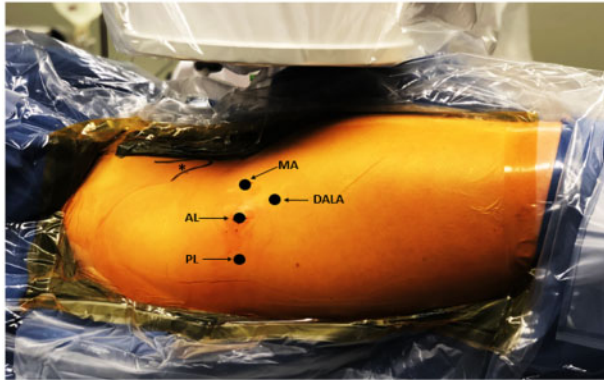
### Indications for hip arthroscopy

All patients were required to undergo conservative treatment, including rest, at least 3 months of physical therapy sessions and anti-inflammatory medications. After a trial of conservative treatment, if patients still presented with

painful symptoms that severely impacted their quality of life, they were scheduled for arthroscopic surgeries [61].

### Surgical techniques

Hip arthroscopies were completed in the supine position with patients on a traction table. After prepping and draping in the standard sterile manner, portals to access the joint capsule were created, including standard anterolateral and mid-anterior portals. The decision-making algorithm

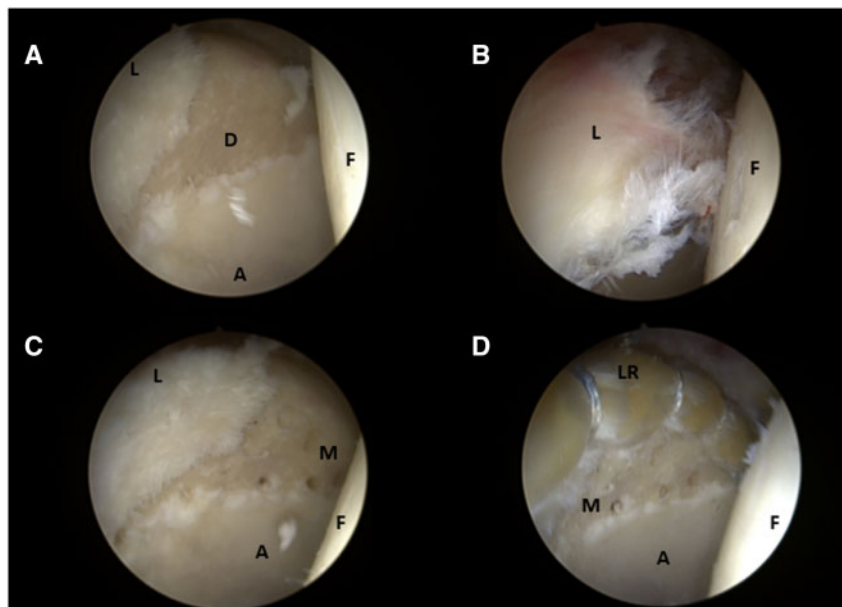


**Fig. 1.** Hip arthroscopy portals. Right hip with patient in supine position, the patient head is to the left. AL, anterolateral; MA, mid-anterior portal; DALA, distal anterolateral accessory; PL, posterolateral. \*Anterior inferior iliac spine.

for labral reconstruction was previously published elsewhere [5]. Nevertheless, the labral reconstruction decision was made intraoperatively by the senior author (B.G.D.). Patients were considered for labral reconstruction in case of segmental labral defects or irreparable labral tears. When RECON was selected, additional distal anterolateral accessory and posterolateral portals were created (Fig. 1). Before any surgical procedure, a diagnostic arthroscopy was conducted; cartilage damage was classified according to the acetabulum labrum articular disruption (ALAD) and Outerbridge systems [20, 21, 62].

Labral reconstruction was performed according to the technique published by the senior author (B.G.D.) [63] (Fig. 2). Initially, the senior author used gracilis autograft taken from the ipsilateral knee, but he later transitioned to exclusively using allograft [46, 47, 64, 65].

Additional procedures were performed depending on the specific findings for a given patient. For example, some patients were treated with ligamentum teres (LT) debridement using a radiofrequency tool to address tearing of the LT [57, 66–68]. Patients who reported painful internal snapping were treated with an iliopsoas fractional lengthening [69–72]. Acetabular and femoral head deformities were corrected using a burr under fluoroscopic guidance to reproduce normal anatomy. For acetabular bony exposure and pincer correction, capsule was elevated off the



**Fig. 2.** Intraoperative view, ‘before and after’ labral reconstruction and microfracture. Right hip, view from the anterolateral portal with 70° arthroscope. (A) Perspective showing cartilage defect from the 12:30 to the 2 o’clock position; (B) perspective showing irreparable labral tear. (C) Microfracture final product prior to labral reconstruction. (D) Perspective showing labral reconstruction from the 11:30 to the 3 o’clock position. L, irreparable labral tear; F, femoral head, A, acetabulum; D, cartilage defect; M, microfracture; LR, labrum reconstructed.

acetabular rim in the region of pincer impingement using radiofrequency. A high-speed 5.5-mm bur was then used to trim the acetabular rim while leaving the chondrolabral junction intact. Minimal rim trimming was achieving, 1–2 mm, in cases with LCEA between 25° and 39° [61, 73]. With formal pincer deformities acetabular trimming was extended under fluoroscopy and direct visualization as described by Philippon *et al.* [74]. In cases of micro-instability and capsular laxity, the senior author performed a capsular plication [75–80]. Acetabular microfracture was carried out for full thickness chondral lesions [20, 22, 36, 81].

### Surgical outcomes

Within 1 month prior to surgery, preoperative questionnaires were completed by all patients to establish baseline scores for mHHS, NAHS, HOS-SSS and VAS for pain. PROs were collected at 3 months postoperatively, 1 year postoperatively and annually thereafter. Scores were automatically calculated, stored and encrypted in our institution's database. The iHOT-12 measure was documented only at follow-up appointments for patients in this study. Mean change in mHHS and HOS-SSS was calculated in both groups to determine whether patients achieved the minimal clinically important difference (MCID) defined as an eight and six-point difference between mean postoperative and preoperative scores ( $\Delta$ ), respectively [82]. The frequency of patients achieving the patient acceptable symptomatic states (PASS) of mHHS  $\geq 74$ , and HOS-SSS  $\geq 75$  at minimum 2-year follow-up was also calculated [82, 83].

Revision surgeries, RR and rate of conversion to THA were documented during assemblage of follow-up data. Patients who progressed towards symptomatic severe osteoarthritis were offered THA as a solution. Minimum 2-year follow-up was defined as having either required conversion to THA, all minimum 2-year scores or both. Revision surgeries and conversion to THA were considered an end-point outcome, postoperative scores for these patients were not included in the PROs analysis.

### Statistical analysis

Microsoft Excel was the primary tool used to conduct statistical analyses. The threshold for significance was set to  $P < 0.05$ . The Shapiro–Wilk test and  $F$ -test were used to evaluate normality and equality of variance for continuous data, respectively. Continuous data were analysed using paired or independent  $t$ -tests, Mann–Whitney  $U$  test or the Welch test.

Fisher's exact and Pearson's  $\chi^2$  tests were utilized to compare categorical sets of data.

An a priori power analysis was completed to calculate the number of patients necessary in the reconstruction and resection groups to realize a minimum of 80% power using a 1:1 matching ratio. Based on an expected mean difference in the mHHS of 10 and a standard deviation of 10 (Cohen  $d = 1.0$ ) it was determined that a minimum number of 17 patients would be required for each group [30].

## RESULTS

### Comparisons of patient demographics after matching

A total of 3303 hip arthroscopies were conducted during the study period. Of these cases, 55 RECON hips and 201 RESEC hips met the inclusion criteria and were eligible for 2-year follow-up. Fifty (90.9%) RECON hips and 191 (95.0%) RESEC hips had the necessary follow-up (Fig. 3). Thirty-eight RECON patients were successfully matched 1:1.

Demographics of the groups are shown in Table I. There were no significant differences between most of the demographic measures, except for LCEA, ACEA and time to follow up,  $P = 0.01$ ,  $< 0.01$  and  $0.04$ , respectively.

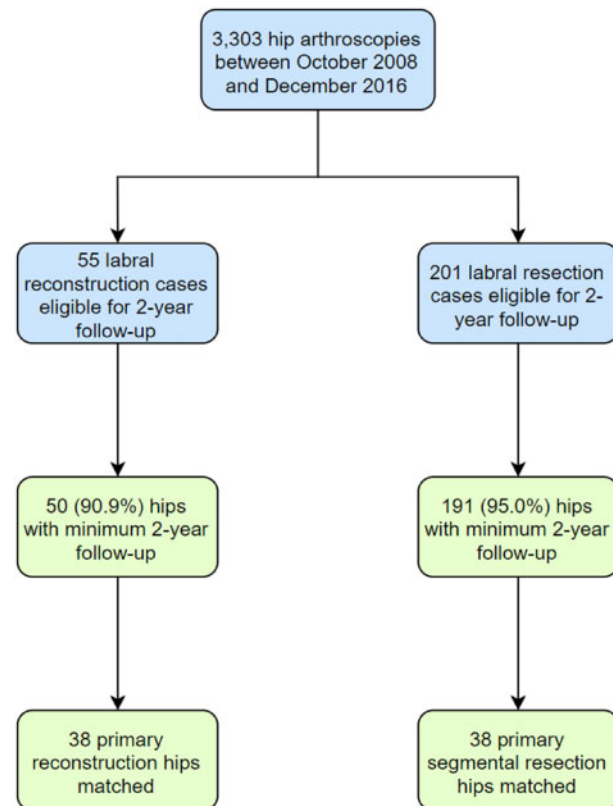


Fig. 3. Patient selection for study groups.

**Table I. Demographics of RECON and RESEC groups after matching**

	Reconstruction (n = 38)	Resection (n = 38)	P-value
Sex (male:female)	22:16	22:16	>0.99
Laterality (right:left)	19:19	19:19	>0.99
Age at surgery (years, mean, SD, range)	43.2 ± 6.7 (24.7, 56.1)	43.7 ± 7.5 (23.4, 59.7)	0.78
BMI (mean, SD, range)	28.3 ± 4.8 (19.7, 46.1)	26.9 ± 4.5 (19.2, 42.4)	0.18
Worker's compensation	3 (7.9%)	9 (23.7%)	0.06
Pre-operative Tönnis osteoarthritis grade			>0.99
0 (n, %)	29 (76.3%)	29 (76.3%)	
1 (n, %)	9 (23.7%)	9 (23.67%)	
Alpha angle (degrees, mean, SD, range)	63.3 ± 12.6 (39, 90)	66.2 ± 15.1 (34, 93)	0.36
LCEA (degrees, mean, SD, range)	<b>33.7 ± 5.1 (25, 42)</b>	<b>30.4 ± 5.8 (20, 48)</b>	<b>0.01</b>
ACEA (degrees, mean, SD, range)	<b>34.0 ± 5.7 (23, 43)</b>	<b>28.8 ± 5.6 (19, 40)</b>	<b>&lt;0.01</b>
Follow-up time (months, mean, SD, range)	<b>42.4 ± 19.7 (12, 93.1)</b>	<b>54.3 ± 29.7 (4.8, 108.1)</b>	<b>0.04</b>

Bold, statistically significant ( $P < 0.05$ ); RECON, labral reconstruction; RESEC, labral resection; SD, standard deviation; BMI, body mass index; LCEA, lateral center-edge angle; ACEA, anterior center-edge angle.

#### Comparisons of intraoperative findings between matched groups

Intraoperative findings are summarized in [Table II](#). There were no significant differences in intraoperative findings between the groups.

#### Comparisons of intraoperative procedures between matched groups

All patients underwent either segmental reconstruction or resection to treat their labral tears. Other procedures were often performed in addition to labral treatment in order to treat patients' reported painful hip symptoms ([Table III](#)). There were no significant differences in terms of capsular treatment between groups.

#### Comparison of PRO scores between matched groups

PROs from preoperative to latest follow-up were compared between the RECON and RESEC groups, and summarized in [Tables IV](#). Significant improvement from preoperative to latest follow-up for both groups ( $P < 0.001$ ) were found for mHHS, NAHS, HOS-SSS and VAS. There were no significant differences between RECON and RESEC for most of the follow-up PROs (NAHS,  $P = 0.19$ ; HOS-SSS,  $P = 0.10$ ) or all of the delta values ( $\Delta$ mHHS,  $P = 0.74$ ;  $\Delta$ NAHS,  $P = 0.52$ ;  $\Delta$ HOS-SSS,  $P = 0.41$ ;  $\Delta$ VAS,  $P = 0.80$ ).

In order to apply a clinical lens, PASS and MCID for mHHS and HOS-SSS are reported in [Table V](#).

#### Revision arthroscopy, RR and rate to conversion to THA after matching

[Table VI](#) summarizes the rate of revision arthroscopy and conversion rate of both groups. Two (5.3%) patients in each group underwent a revision surgery; no significant difference was obtained regarding this point ( $P > 0.99$ ). Nevertheless, a significant difference between groups in conversion to THA rate was noticed,  $P = 0.04$ ; two patients (5.3%) and eight patients (21.1%) required conversion to THA at 2 years in the RECON and RESEC groups, respectively.

Patients who underwent a segmental labral resection were four times more likely to require a THA procedure than a matched labral reconstruction group of patients (RR 4.0; 95% CI 0.91–17.6) ([Fig. 4](#)).

#### DISCUSSION

The current study demonstrated that in primary hip arthroscopy surgery for patients with symptomatic FAI and an irreparable labral tear in the setting of intraoperative findings of acetabular chondral lesions of Outerbridge III/IV, RECON and RESEC led to similar significant improvement in several PROs at minimum 2-year follow-up.

**Table II. Intraoperative findings noted during diagnostic arthroscopy for the RECON and RESEC groups after matching**

	Reconstruction (n = 38)	Resection (n = 38)	P-value
Seldes-defined labral tear (n, %)			0.25
Type 1	3 (7.9%)	8 (21.1%)	
Type 2	7 (18.4%)	7 (18.4%)	
Combined Types 1 and 2	28 (73.7%)	23 (60.5%)	
ALAD grade (n, %)			0.06
0	0	0	
1	0	0	
2	0	0	
3	35 (92.1%)	23 (60.5%)	
4	3(7.9%)	15 (39.5%)	
Acetabular Outerbridge grade (n, %)			0.60
0	0	0	
1	0	0	
2	0	0	
3	27 (71.1%)	20 (52.6%)	
4	11 (29.9%)	18 (47.4%)	
Femoral head Outerbridge grade (n, %)			0.51
0	35 (92.1%)	30 (78.9%)	
1	0	0	
2	1 (2.6%)	6 (15.8%)	
3	1 (2.6%)	1 (2.6%)	
4	1 (2.6%)	1 (2.6%)	

RECON, labral reconstruction; RESEC, labral resection; ALAD, acetabular labrum articular disruption.

Nevertheless, when THA conversion rate at minimum 2-year follow-up was analysed in both groups, it was significantly lower in the RECON group ( $P = 0.04$ ), with a survivorship of 94.7 versus 78.9% with RECON and RESEC, respectively. Patients who underwent RECON reported a 4.0 times less likelihood of conversion when compared with RESEC. These findings seem to confirm our hypothesis.

Byrd *et al.* published their results at 10-year follow-up with labral debridement in 26 patients, of which 10 had intra-operative findings of an acetabular chondral lesion with Outerbridge grade III/IV [3]. They found significant

improvement in mHHS, with a *delta* value of 29 points, and concluded that selective debridement of symptomatic tears may lead to favorable long-term results. However, as the authors and others have pointed out, arthritis was a poor prognostic indicator [11]. Debridement may still have a role for labral treatment in appropriate cases, as has been previously published [84]. In the present study, the RESEC group showed significant improvement not only in mHHS, but also in NAHS, HOS-SSS, VAS and patient satisfaction compared with a preoperative baseline. It seems that RESEC may be a valid short-term alternative with respect to PRO improvement.

**Table III. Intraoperative procedures reported during hip arthroscopy for the RECON and RESEC groups**

	Reconstruction (n = 38)	Resection (n = 38)	P-value
Labral treatment			<b>&lt;0.001</b>
Simple and base repair	0	0	
Reconstruction	38 (100%)	0	
Debridement/resection	0	38 (100%)	
Acetabular microfracture	11 (28.9%)	11 (28.9%)	>0.99
Capsular treatment			0.09
Release	26 (68.4%)	33 (86.8%)	
Plication	12 (31.8%)	5 (13.2%)	
Ligamentum teres debridement	<b>8 (21.1%)</b>	<b>21 (55.3%)</b>	<b>0.005</b>
FAI			<b>&lt;0.001</b>
Isolated femoroplasty	0	18 (47.4%)	
Isolated acetabuloplasty	0	0	
Combined acetabuloplasty and femoroplasty	38 (100%)	16 (42.1%)	
Iliopsoas fractional lengthening	12 (31.6%)	9 (23.7%)	0.61
Synovectomy	1 (3.6%)	5 (13.2%)	0.20
Notchplasty	5 (13.2%)	8 (21.1%)	0.54

Bold, statistically significant ( $P < 0.05$ ); RECON, labral reconstruction; RESEC, labral resection; FAI, femoroacetabular impingement.

Nevertheless, Menge *et al.* recently reported their results, also with 10-year follow-up, and found that labral debridement may be associated with a significantly higher risk of conversion to THA compared with labral repair when the analysis was controlled for microfracture [2]. This suggests that restoration of the chondrolabral complex could be a key factor in diminishing THA conversion risk (Figs 4 and 5). This finding may explain why our results showed that, even without short-term PRO differences, patients who underwent RESEC were 4.0 times more likely to require THA conversion than those who underwent RECON in the setting of FAI, irreparable labral tears and severe acetabular cartilage defects. Furthermore, cartilage status may contribute to high rates of THA (21.1%) for patients that underwent RESEC compared with the general population. Severe damage to either the acetabulum or the femoral head have been implicated as predictors of failure [27, 85].

Previously, the senior author-reported outcomes in 22 patients following arthroscopic segmental labral reconstruction with minimum 2-year follow-up [63]. In this

cohort, only one patient had an intraoperative finding of acetabular cartilage damage Outerbridge IV, and only three patients required acetabular microfracture. This case-series reported significant improvement in postoperative PROs and VAS. Furthermore, Domb *et al.* also compared 11 RECON patients versus 22 RESEC patients using pre-operative NAHS and sex as matching variables [30]. Both groups reached significant improvement in all postoperative PROs with no significant difference between the two groups, however the *delta* value for NAHS and HOS-ADL were significantly higher in the RECON group, which may suggest that RECON may be superior to RESEC. The current study involved 37 exclusively primary RECON hips that were pair-matched based on age at surgery, sex, BMI, Tönnis grade and acetabular microfracture performance.

By including microfracture as a matching criterion, we tried to minimize the potential procedure confounding effect on the results. Several authors have published good short to mid-term outcomes with microfracture for the management of severe acetabular chondral defects during hip arthroscopy for FAI correction [22, 25, 36, 60, 81, 86].

**Table IV. Improvements in patient-reported outcomes and patient satisfaction at latest follow-up**

	Reconstruction (n = 34)	Resection (n = 28)	P-value
mHHS (mean, SD)			
Preoperative	65.1 ± 17.7	55.5 ± 15.4	<b>0.03</b>
Minimum 2-year postoperative	86.7 ± 19	75.8 ± 20.5	<b>0.04</b>
Preoperative versus minimum 2-year postoperative P-value	<b>&lt;0.001</b>	<b>&lt;0.001</b>	
Change from preoperative to minimum 2-year postoperative (Δ)	21.6 ± 16.1	20.2 ± 15.1	0.74
NAHS (mean, SD)			
Preoperative	62.2 ± 18	52.3 ± 19.3	<b>0.05</b>
Minimum 2-year postoperative	84.9 ± 19.1	77.8 ± 20.3	0.19
Preoperative versus minimum 2-year postoperative P-value	<b>&lt;0.001</b>	<b>&lt;0.001</b>	
Change from preoperative to minimum 2-year postoperative (Δ)	22.7 ± 14.8	25.5 ± 17.2	0.52
HOS-SSS (mean, SD)			
Preoperative	40.8 ± 25.9	34.6 ± 22.7	0.35
Minimum 2-year postoperative	77.0 ± 26.0	63.1 ± 32.3	0.10
Preoperative versus minimum 2-year postoperative P-value	<b>&lt;0.001</b>	<b>&lt;0.001</b>	
Change from preoperative to minimum 2-year postoperative (Δ)	33.8 ± 25.2	26.6 ± 33.9	0.41
VAS (mean, SD)			
Preoperative	5.1 ± 2.1	5.9 ± 2.4	0.19
Minimum 2-year postoperative	1.9 ± 2.3	2.6 ± 2.3	0.28
Preoperative versus minimum 2-year postoperative P-value	<b>&lt;0.001</b>	<b>&lt;0.001</b>	
Change from preoperative to minimum 2-year postoperative (Δ)	-3.1 ± 2.1	-3.3 ± 2.6	0.80
iHot-12 (mean, SD)	75.7 ± 25.7	67.4 ± 22.7	0.22
Patient satisfaction (mean, SD)	8.5 ± 1.8	7.9 ± 2.4	0.31

Bold, statistically significant ( $P < 0.05$ ); mHHS, modified Harris Hip Score; SD, standard deviation; NAHS, Non-Arthritic Hip Score; HOS-SSS, Hip Outcome Score—Sports Specific Subscale; VAS, Visual Analogue Scale, iHOT-12, International Hip Outcome Tool-12; Δ, delta-value.

Comparisons were performed independently between matched groups.

**Table V. Reported PASS and MCID for mHHS and HOS-SSS for both groups after matching**

	Reconstruction (n = 34)	Resection (n = 28)	P-value
mHHS MCID	26 (76.5%)	20 (71.4%)	0.65
mHHS PASS	21 (61.2%)	16 (57.1%)	0.71
HOS-SSS MCID	26 (76.5%)	19 (67.9%)	0.44
HOS-SSS PASS	19 (55.9%)	12 (42.9%)	0.30

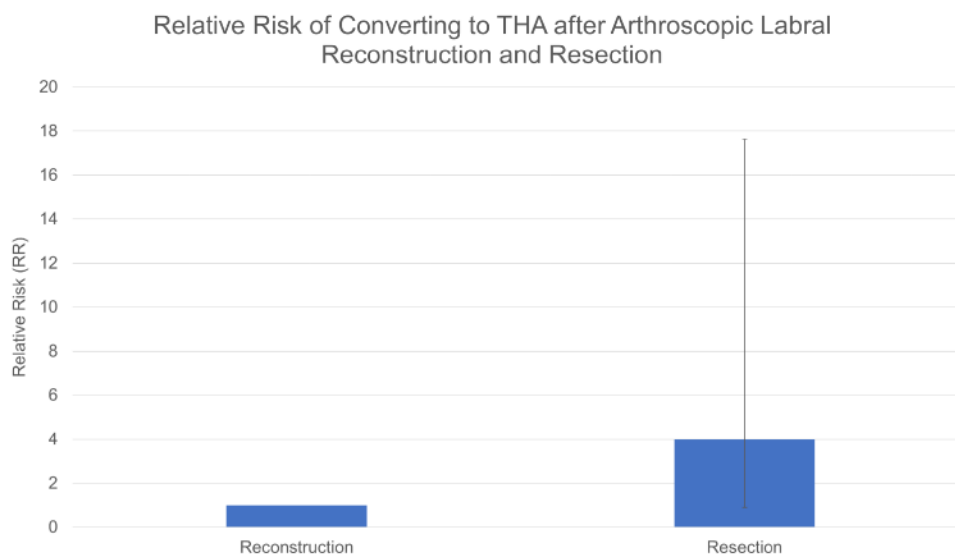
mHHS, modified Harris Hip Score; HOS-SSS, Hip Outcome Score – Sports Specific Subscale; MCID, minimal clinically important difference; PASS, patient acceptable symptomatic state.



**Table VI. Comparisons of rates of revision, time to revision, rates of conversion to THA, and time to THA at the 2-year time point between matched groups**

	Reconstruction (n = 38)	Resection (n = 38)	P-value
Revision arthroscopies (n, %)	2 (5.3%)	2 (5.3%)	>0.99
Time to revision (months, mean, SD, range)	13.7 ± 11.1 (5.8, 21.5)	12.5 ± 0.4 (12.2, 12.7)	0.89
Conversion to THA (n, %)	<b>2 (5.3%)</b>	<b>8 (21.1%)</b>	<b>0.04</b>
Time to THA (months, mean, SD, range)	14.2 ± 4.5 (11.0, 17.3)	16.7 ± 5.3 (9.5, 24.0)	0.55

Bold, statistically significant ( $P < 0.05$ ); THA, total hip arthroplasty; SD, standard deviation.



**Fig. 4.** Comparison of risk of converting to THA between the reconstruction and resection groups. Relative risk=4.0 (95% CI 0.91–17.6); THA, total hip arthroplasty.

In general, labral preservation, most commonly repair, was selected to accomplish this goal [22, 23, 45, 81]. It seems logical to address chondrolabral dysfunction in order to contain bone marrow elements following microfracture procedures (Figs 2 and 4). MacInnis *et al.* described an arthroscopic technique for labral reconstruction using gracilis autograft along with microfracture and regeneration scaffold for patients with irreparable tears and uncontained acetabular chondral defects [19]. To our knowledge, the current study is among the few to analyse the impact of labral reconstruction in this specific scenario.

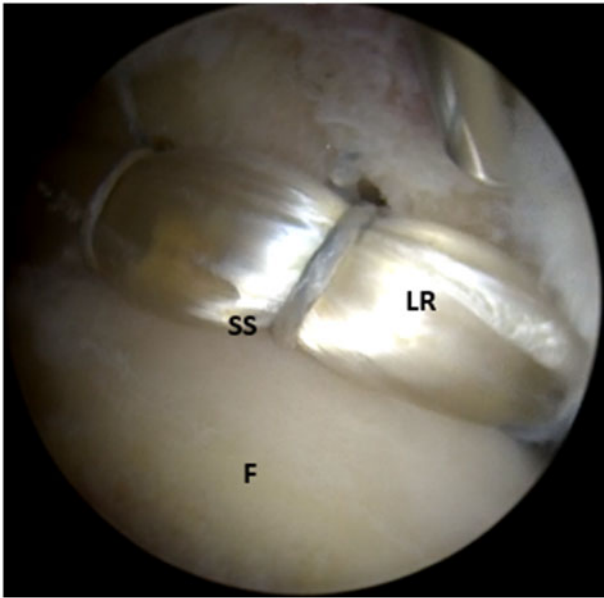
#### Strengths

There are several strengths to mention. The PROs used were designed specifically to detect outcomes in active patients with non-arthritic hips. Additionally, using multiple validated functional hip outcome scores increases the generalizability of our results. Secondly, statistical

significance does not necessarily equate to clinical significance, which was addressed by analysing the frequency of achieving PASS and MCID for mHHS and HOS-SSS. Thirdly, an a priori power analysis was conducted. Fourthly, a pair-matched analysis was included in order to minimize potential confounders such as age, gender or BMI. This study is one of few to compare RECON versus RESEC PROs, and conversion to THA in patients who underwent primary hip arthroscopy with severe intraoperative acetabular cartilage findings with minimum 2-year follow-up. The results may encourage restoration of the labral suction seal mechanism through labral reconstruction, even in the presence of severe cartilage acetabular defect.

#### Limitations

The findings of the current study highlight some limitations that must be acknowledged. Firstly, this was a non-randomized study. As such, confounding variables may



**Fig. 5.** Labral ‘suction seal’ restoration with labral reconstruction. Right hip, view from anterolateral portal with 70° arthroscope. F, femoral head; LR, labrum reconstructed; SS, suction seal.

have influenced our results. The retrospective nature introduces some bias; however, this bias is limited due to the prospective collection of all data. Secondly, resections were performed earlier in the senior author’s career than reconstructions, which may introduce bias from the learning curve. Thirdly, hips in the RECON group could only be matched 1:1 rather than 2:1 or 3:1 due to the strict matching protocol. Fourthly, this study included a single high-volume hip preservation surgeon, limiting the generalizability of the results, especially since hip arthroscopy and particularly labral reconstruction have been recognized as procedures with steep learning curves. Fifth, the labral treatment decision algorithm is based on the senior author’s expertise, which may introduce bias. Sixth, as this study analyzes short-term follow-up, the durability of these results in a longer time frame is necessary. Additionally, LCEA and ACEA were significantly different between groups. Finally, since revision surgeries and conversion to THA were considered an end-point outcome, postoperative scores for these patients were not included in the PROs analysis.

### CONCLUSION

In the setting of primary arthroscopic management of FAI, irreparable labral tears, and acetabular chondral lesions of Outerbridge III/IV, patients that underwent RECON and RESEC experienced significant improvement in PROs at minimum 2-year follow-up, and these functional scores

were comparable when groups were matched. However, RR and rate to THA conversion were significantly higher in the RESEC group.

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