Minimum 5-Year Outcomes of Arthroscopic Hip Labral Reconstruction With Nested Matched-Pair Benchmarking Against a Labral Repair Control Group

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Background: Labral reconstruction has demonstrated short-term benefit for the treatment of irreparable labral tears. Nonetheless, there is a scarcity of evidence for midterm outcomes of this treatment.

Hypotheses: Arthroscopic segmental reconstruction in the setting of irreparable labral tears would show improvement in patient-reported outcomes (PROs) and high patient satisfaction at minimum 5-year follow-up. Second, primary labral reconstruction (PLRECON) would result in similar improvement in PROs at minimum 5-year follow-up when compared with a matched-pair primary labral repair (PLREPAIR) control group.

Study Design: Cohort study; Level of evidence, 3.

Methods: Data from February 2008 to April 2013 were retrospectively reviewed. Patients were included if they underwent hip arthroscopy for segmental labral reconstruction in the setting of irreparable labral tear and femoroacetabular impingement, with minimum 5-year follow-up for modified Harris Hip Score, Nonarthritic Hip Score, Hip Outcome Score–Sports Specific Subscale, patient satisfaction, and visual analog scale for pain. Exclusion criteria were Tönnis osteoarthritis grade >1, prior hip conditions, or workers' compensation claims. PLRECON cases were matched in a 1:3 ratio to a PLREPAIR control group based on age ±5 years, sex, and body mass index ±5 kg/m^2.

Results: Twenty-eight patients were eligible for the study, of which 23 (82.14%) had minimum 5-year follow-up. The authors found significant improvement from preoperative to latest follow-up in all outcome measures recorded: 17.8-point increase in modified Harris Hip Score (P = .002), 22-point increase in Nonarthritic Hip Score (P < .001), 25.4-point increase in Hip Outcome Score–Sports Specific Subscale (P = .003), and a 2.9-point decrease in visual analog scale pain ratings (P < .001). Mean patient satisfaction was 7.1 out of 10. In the nested matched-pair analysis, 17 patients who underwent PLRECON were matched to a control group of 51 patients who underwent PLREPAIR. PLRECON demonstrated comparable survivorship and comparable improvements in all PROs with the exception of patient satisfaction (6.7 vs 8.5, P = .04).

Conclusion: Hip arthroscopy with segmental labral reconstruction resulted in significant improvement in PROs at minimum 5-year follow-up. PLRECON reached comparable functional outcomes when compared with a benchmark PLREPAIR control group but demonstrated lower patient satisfaction at latest follow-up.

Keywords: labral reconstruction; hip arthroscopy; labral tear; midterm outcomes

The function and importance of the labrum in hip biomechanics are well recognized.[4,16,20,37] Labral tears are the most common injury among patients undergoing hip arthroscopy, which makes labral management critical.[9,32,37] It was recently shown that labral repair and debridement are effective treatments for labral tears in the setting of symptomatic femoroacetabular impingement.[13,15,32] However, with the explosive modernization and innovation in hip arthroscopic tools and techniques, there has been a shift toward labral preservation procedures over simple debridement.[8,10,12,15,22]

Some authors suggested that labral preservation may be superior to labral excision.[10,25-27] Also, in the context of labral preservation, some studies indicated that labral reconstruction may produce outcomes similar to those of refixation at short-term follow-up.[31]

In general, labral reconstruction is most commonly performed in the setting of revision hip arthroscopy.[1,3,6,10,41] If a previous labral repair failed, it seems logical to assume that a different labral treatment—reconstruction—would be preferred over re-repair or excisional debridement.

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Several techniques and graft options have been proposed for this treatment, and there is ample evidence of graft healing in such cases.[6,12,17,19,29,41]

In primary surgery, labral preservation with refixation has been encouraged, especially for patients with acetabular bony insufficiency.[12,22,24,26,27] Interestingly, some authors suggested that primary labral reconstruction (PLRECON) may lead to a lower failure rate than primary labral repair (PLREPAIR).[40] However, we thought that more data are necessary before making this conclusion. A current decision-making algorithm for labral treatment advocates for PLREPAIR when there is sufficient quality labral tissue.[12] The purpose of this study was to report 5-year outcomes of patients who underwent hip arthroscopy with labral reconstruction and to compare 5-year outcomes between patients who underwent PLRECON and patients in a matched-pair control group who underwent PLREPAIR.

We hypothesized that patients who underwent arthroscopic segmental reconstruction in the setting of irreparable labral tear may expect improvement in patient-reported outcomes (PROs) and high patient satisfaction at minimum 5-year follow-up. Second, we hypothesized that PLRECON would result in similar improvement in PROs at 5-year follow-up when compared with PLREPAIR in a matched-pair control group.

METHODS

Patient Selection Criteria

With institutional review board approval, data from the American Hip Institute's Hip Preservation Registry were prospectively collected and retrospectively reviewed for all patients who underwent hip arthroscopy by the senior author (B.G.D.) between February 2008 and April 2013. The patient selection process is outlined in Figure 1. Patients were included if they underwent arthroscopic segmental labral reconstruction and had preoperative baseline scores for the following PROs measures: modified Harris Hip Score (mHHS), Nonarthritic Hip Score (NAHS), Hip Outcome Score–Sports Specific Subscale (HOS-SSS), patient satisfaction (0 = not satisfied, 10 = completely satisfied), and visual analog scale (VAS) for pain (0 = no pain, 10 = extreme pain). Patients were excluded if they had

Figure 1. Patient selection flowchart for study group.

Tönnis grade osteoarthritis >1, previous ipsilateral hip conditions, frank dysplasia (lateral edge-center angle <18°), or active workers' compensation claims.

Participation in the American Hip Institute's 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.[10,36]

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Primary Reconstruction Subanalysis: Matching Process

Subanalysis was performed on patients who had undergone PLRECON. To do so, an additional exclusion criterion was applied, which omitted any patients who had undergone prior ipsilateral surgery. This group was pair matched to a control group of patients who satisfied the same inclusion and exclusion criteria but underwent labral repair. To increase the power of the study, each primary reconstruction case was matched to 3 controls (1:3 matching) based on age at surgery ±5 years, sex, and body mass index ±5 kg/m^2.

Surgical Indications

All the patients were examined by the senior author and underwent standard pre- and postoperative radiographic evaluation, which included upright and supine anteroposterior pelvic, modified Dunn, and false-profile views, with all measurements performed with GE Healthcare's picture archiving and communication system. Osteoarthritis was graded with the Tönnis classification.[9] Preoperative magnetic resonance imaging or arthrogram was also performed on all patients.

All patients with symptomatic femoroacetabular impingement and labral tear diagnosis were required to pursue nonoperative treatment, including physical therapy, rest, activity modification, and anti-inflammatory medications. Patients were recommended for surgery if they failed at least 3 months of this nonoperative treatment.

Surgical Technique

All surgery was performed with the patient under general anesthesia in the supine position. Anterolateral and mid-anterior accessory portals were created. After an interportal capsulotomy was performed, diagnostic arthroscopy was carried out to assess the health of the ligamentum teres, labrum, and intra-articular cartilage surfaces. Damage was graded according to the following classification systems: Domb and Villar for the ligamentum teres,[2,21] Seldes for the labrum,[39] and ALAD (acetabular labrum articular disruption) and Outerbridge for articular cartilage damage and cartilage lesions, respectively.[34]

Any intra-articular pathologies were addressed per this diagnostic arthroscopy. Acetabuloplasty, when indicated, was performed with a 5.5-mm bur under fluoroscopic guidance to address pincer deformity. Similarly, femoroplasty was performed to address cam deformity, also under fluoroscopic guidance. A 2.0-mm diameter arthroscopic drill was used to perform a microfracture in the case of extensive cartilage damage. Iliopsoas fractional lengthening was performed on patients who had documented painful internal snapping. At the end of each procedure, patients were treated with capsular release, repair, or plication depending on the individual's range of motion, generalized ligamentous laxity, and acetabular bony morphology.

Decision of whether to repair or reconstruct the labrum was made intraoperatively by the senior author. Patients were considered for labral reconstruction if segmental labral defects and/or nonviable labral tissue was found during the diagnostic arthroscopy (Figure 2). Segmental labral reconstruction was performed according to a previously published technique.[6,10,38] As described in this study, once the decision was made to reconstruct the labrum, the nonviable, calcified, and/or irreparable labral tissue was debrided from the segmental defect. Acetabular bone trimming was performed to create a bleeding bed of bone for grafting, a process that took into account the patient's lateral and anterior center-edge angles to avoid iatrogenic instability.[30] The final defect was then measured with a calibrate probe. The graft was prepared and inserted into the joint, anchored first medially to posteriorly (2.9-mm PEEK PushLock Anchor; Arthrex) and then medially to laterally (2.9-mm PEEK PushLock Anchor). Traction was released in all cases to assess for restoration of the suction seal between the labrum and the femoral head (Figure 3).

Rehabilitation

For the first 6 weeks after surgery, patients who underwent labral reconstruction used crutches with partial weightbearing (20 lb [9 kg]) and a hip brace (DonJoy X-Act ROM Hip Brace; DJO Global). Physical therapy was initiated 6 weeks after surgery, and patients were instructed to begin using a stationary bike or continuous passive motion machine daily, immediately after surgery. For patients who underwent labral repair, crutches and brace were used for only 2 weeks, and physical therapy and continuous passive motion machine use began immediately after surgery.

Surgical Outcomes

Preoperative questionnaires were completed by all patients in the month before surgery, which included mHHS, NAHS, HOS-SSS, and VAS scores. These same surgical outcomes were evaluated postoperatively, in addition to patient satisfaction ratings and the International Hip Outcome Tool–12, Veterans RAND 12-Item Health Survey, and 12-Item Short Form Health Survey. These postoperative measures were collected at 3 months after surgery, at 1 year, and annually thereafter. Scores were automatically calculated, stored, and encrypted in our institution's database. The patient acceptable symptomatic states (PASSs) for the mHHS and HOS-SSS at minimum 5-year follow-up were calculated for all patients in this study, with the cutoff values of 74 and 75 points, respectively.[28] Mean change in the mHHS and HOS-SSS were also calculated to ascertain the minimal important change (MIC) and the minimal clinically important difference (MCID), defined as an improvement of 6 and 8 points, respectively.[28] Survivorship rates and revision surgery were routinely documented during the collection of follow-up data.

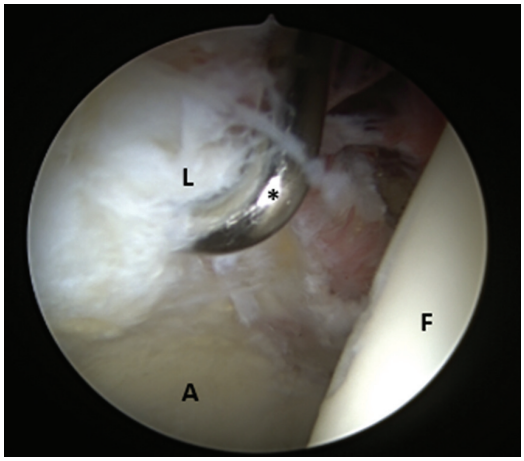

Figure 2. Irreparable labral tear. Right hip, as viewed from the anterolateral portal with a 70° arthroscope, with the probe (asterisk) coming from the midanterior portal. A, acetabulum; F, femoral head; L, labral tear.

Statistical Analysis

Statistical analyses were conducted with Microsoft Excel. For continuous data, the Shapiro-Wilk and *F* test were used to evaluate normality and equal variance, respectively. Differences between pre- and postoperative scores for each group were assessed with 2-tailed paired *t* tests. Fisher exact and chi-square tests were utilized to compare categorical sets of data. Ranges, SDs, proportions, and means were also calculated with Microsoft Excel. The threshold for significance was set to $P = .05$ for this study.

RESULTS

Patient Demographics

A total of 28 patients satisfied the inclusion and exclusion criteria, of which 23 (82.14%) had minimum 5-year follow-up (Figure 1). Demographic data for these patients are provided in Table 1. There were 11 female (47.8%) and 12 male (52.2%) patients. The mean age at surgery, body mass index, and follow-up time was 35.2 years, 24.8 kg/m^2, and 67.2 months.

Intraoperative Findings and Procedures

Intraoperative findings and surgical procedures for this cohort are summarized in Tables 2 and 3. There were 6 (26.1%) type I tears, 7 (30.4%) type II tears, and 10 (43.5%) combined type I and II tears. There were 18 patients (78.3%) with ALAD cartilage damage of grade $\geq$2, 18 (78.3%) with acetabular Outerbridge defects of grade $\geq$2, and 4 (17.4%) with femoral head Outerbridge defects of grade $\geq$2.

A capsular repair was performed on 10 patients (43.5%), femoroplasty on 18 (78.3%), and acetabular microfracture on 2 (8.7%). Seven patients (30.4%) underwent ligamentum teres debridement; 12 (52.2%) had an iliopsoas fractional lengthening; and 1 (4.3%) was treated with trochanteric bursectomy.

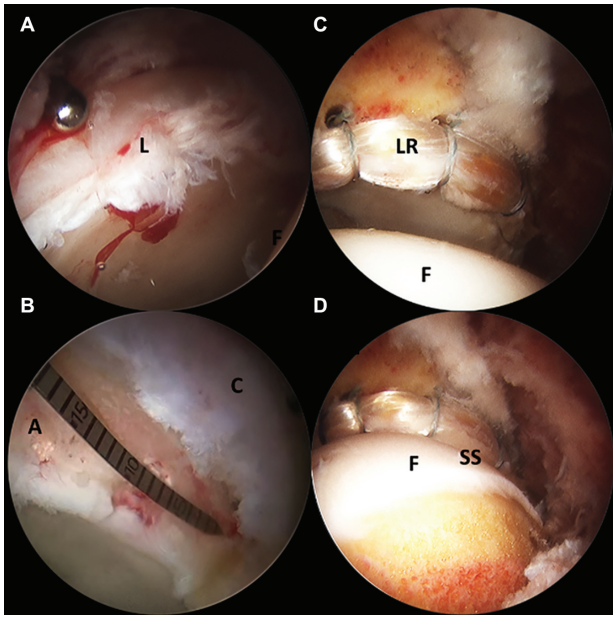

Figure 3. Before-and-after segmental labral reconstruction in the setting of an irreparable labral tear. Right hip, as viewed from the anterolateral portal with a 70° arthroscope. Before reconstruction: (A) perspective showing labral tear from the 12- to 2-o'clock position; (B) measure of the defect. After reconstruction: (C) perspective from the 12- to 3-o'clock position; (D) restoration of the suction seal. A, acetabulum (segmental defect); C, capsule; F, femoral head; L, irreparable labral tear; LR, labrum reconstructed; SS, suction seal.

TABLE 1
Demographics of Patients Who Underwent Segmental Labral Reconstruction With Minimum 5-Year Follow-up

	n (%) or Mean ± SD (Range)
Hips included in study	
Left	11 (47.8)
Right	12 (52.2)
Sex	
Male	11 (47.8)
Female	12 (52.2)
Age at surgery, y	35.2 ± 11.9 (15.5-61.9)
Body mass index, kg/m^2	24.8 ± 4 (18.1-32.5)
Follow-up, mo	67.2 ± 7.7 (60-89.3)

Surgical Outcomes

Table 4 depicts the PRO scores measured preoperatively and at least 5 years postoperatively. All patients improved significantly from preoperative to latest follow-up in

TABLE 2
Intraoperative Findings Noted During Diagnostic Arthroscopy for Patients With Segmental Labral Reconstruction With Minimum 5-Year Follow-up[a]

	n (%)
Seldes	
0	0 (0)
I	6 (26.1)
II	7 (30.4)
I and II	10 (43.5)
ALAD	
0	1 (4.3)
1	4 (17.4)
2	7 (30.4)
3	11 (47.8)
4	0 (0)
Outerbridge: acetabulum	
0	1 (4.3)
1	4 (17.4)
2	8 (34.8)
3	6 (26.1)
4	4 (17.4)
Outerbridge: femoral head	
0	19 (82.6)
1	0 (0)
2	3 (13)
3	0 (0)
4	1 (4.3)
LT percentile class: Domb	
0: 0	12 (52.2)
1: 0 to <50	5 (21.7)
2: 50 to <100	6 (26.1)
3: 100	0 (0)
LT Villar class	
0: No tear	12 (52.2)
1: Complete tear	0 (0)
2: Partial tear	8 (34.8)
3: Degenerative tear	3 (13)

[a]ALAD, acetabular labrum articular disruption; LT, ligamentum teres.

TABLE 3
Intraoperative Procedures Among Patients With Segmental Labral Reconstruction With Minimum 5-Year Follow-up

	n (%)
Labral treatment	
Debridement	0 (0)
Repair	0 (0)
Reconstruction	23 (100)
None	0 (0)
Capsular treatment	
Repair	10 (43.5)
Release	13 (56.5)
Acetabuloplasty	23 (100)
Femoroplasty	18 (78.3)
Acetabular microfracture	2 (8.7)
Femoral head microfracture	0 (0)
Ligamentum teres debridement	7 (30.4)
Iliopsoas fractional lengthening	12 (52.2)
Trochanteric bursectomy	1 (4.3)
Gluteus medius repair	0 (0)

mHHS, NAHS, HOS-SSS, and VAS scores. Mean mHHS improved by 17.8 points ($P = .002$), NAHS by 22.0 points ($P < .001$), HOS-SSS by 25.4 points ($P = .003$), and VAS by 2.9 points ($P < .001$). Mean patient satisfaction was 7.1 points on a 10-point scale.

Fourteen patients (70.0%) realized improvement that met or exceeded the MIC for the mHHS, and 13 (65.0%) achieved the PASS for this questionnaire. Of those patients with pre- and postoperative scores for the HOS-SSS, 15 (70.0%) achieved the PASS, and 9 (65.0%) had improvement that met the threshold for the MCID for this outcome measure.

Analysis also demonstrated no significant differences between 2-year and minimum 5-year outcomes in any of the measures collected (for trends, see Figures 4 and 5).

Secondary Procedures

Four patients (17.4%) underwent secondary arthroscopies at a mean 17.7 ± 10.6 months (range, 5.8-31.5 months) after their index surgery. Three patients undergoing PLRECON (13.0%) converted to total hip arthroplasty (THA).

Nested Matched-Pair Comparison

Additional evaluation of the reconstruction outcomes was conducted with a matched-pair analysis. Patients who had undergone prior ipsilateral hip surgery were excluded from the original cohort, leaving 17 patients who underwent primary reconstruction. To increase the power of this study, these individuals were pair matched in a 1:3 ratio to 51 patients who underwent PLREPAIR (see Figure 1).

As shown in Tables 5 to 7, there were no significant differences between the PLRECON and PLREPAIR groups in any demographic data or intraoperative findings ($P > .05$). There were also no significant differences in the surgical procedures performed ($P > .05$), aside from iliopsoas fractional lengthening ($P = .034$).

Both groups demonstrated significant improvement from preoperative to latest follow-up in all PROs measured at these time points ($P < .05$). None of these improvements were significantly different between groups ($P > .05$). The proportion of patients who achieved the MIC for the mHHS, the MCID for the HOS-SSS, or the PASS for either questionnaire was not significantly different between PLRECON and PLREPAIR ($P > .05$). There was a significant difference between groups in patient satisfaction ratings (reconstruction, 6.7 points; repair, 8.5 points; $P = .04$). These results are illustrated in Tables 8 and 9.

As depicted in Table 10, the frequency of requiring secondary arthroscopy ($P = .635$) and the duration to these arthroscopies ($P = .927$) were not significantly different between groups. The conversion of patients who received reconstruction to THA is illustrated in the Kaplan-Meier

TABLE 4
Improvements in Patient-Reported Outcomes and Patient Satisfaction at Latest Follow-up: Patients With Segmental Labral Reconstruction With Minimum 5-Year Follow-up[a]

	Mean ± SD (Range)
mHHS	
Preoperative	60.2 ± 19.6 (14 to 96)
Latest	80.2 ± 19.1 (28 to 100)
P value[b]	.0017
Delta	17.8 ± 22.2 (−25 to 65)
NAHS	
Preoperative	55.2 ± 17.3 (22.5 to 84)
Latest	78.8 ± 21.6 (17.5 to 100)
P value	.0003
Delta	22 ± 19.6 (−21.8 to 60)
HOS-SSS	
Preoperative	37.3 ± 24.2 (5.6 to 83)
Latest	65.5 ± 29.6 (2.8 to 100)
P value	.003
Delta	25.4 ± 33.1 (−55.7 to 72.1)
VAS	
Preoperative	6 ± 2.7 (0 to 10)
Latest	2.7 ± 2.7 (0 to 10)
P value	.0005
Delta	–2.9 ± 3.3 (−10 to 3)
iHOT-12	67.1 ± 28.8 (5.3 to 100)
SF-12	
Mental	58.8 ± 4.5 (47.1 to 68.8)
Physical	47.2 ± 9.3 (24.2 to 56.6)
VR-12	
Mental	62.6 ± 4.4 (52.7 to 68.4)
Physical	48.5 ± 9 (27 to 57.5)
Patient satisfaction	7.1 ± 3 (0 to 10)

[a]HOS-SSS, Hip Outcome Score–Sports Specific Subscale; iHOT-12, International Hip Outcome Tool–12; mHHS, modified Harris Hip Score; NAHS, Nonarthritic Hip Score; SF-12, Short Form–12; VAS, visual analog scale; VR-12, Veterans RAND 12-Item Health Survey.
[b]*P* values: pre- vs postoperative.

curve (Figure 6). The frequency of conversion to THA was not significantly different either ($P > .999$).

DISCUSSION

This study demonstrated that arthroscopic labral reconstruction in the context of irreparable tears or nonviable labral tissue results in durable and improved PROs at minimum 5-year follow-up. From a more clinical perspective, after this procedure 65% of patients achieved the PASS for the mHHS, and 70% achieved the PASS for the HOS-SSS. Additionally, the current study demonstrated that patients undergoing PLRECON had similar improvement in PROs at 5 years when compared with a PLREPAIR matched-pair group. No significant differences were found between groups in the extent of their improvement in PROs; however, there was a significant difference in patient satisfaction ratings ($P = .0402$), which favored PLREPAIR. According to our

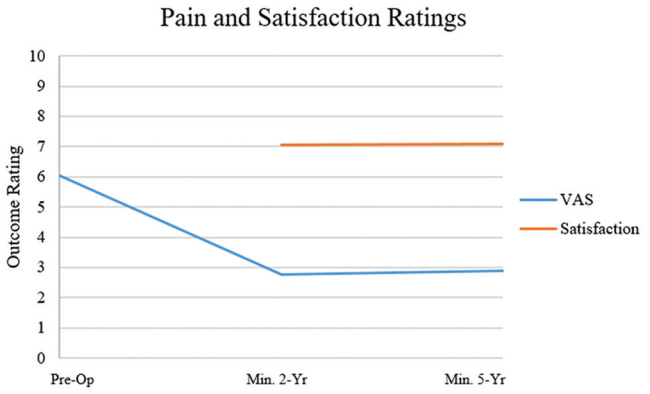

Figure 4. Visual analog scale and patient satisfaction comparison between preoperative and minimum 2- and 5-year follow-up for patients undergoing segmental labral reconstruction. VAS, visual analog scale for pain.

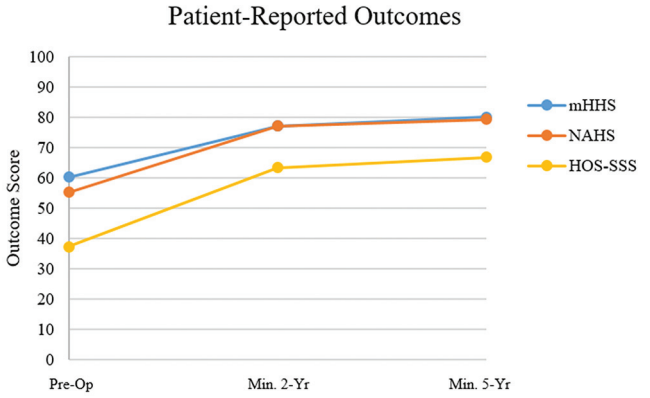

Figure 5. Patient-reported outcome comparison between preoperative and minimum 2- and 5-year follow-up for patients undergoing segmental labral reconstruction. HOS-SSS, Hip Outcome Score–Sports Specific Subscale; mHHS, modified Harris Hip Score; NAHS, Nonarthritic Hip Score.

results, in the setting of primary hip arthroscopy, surgeons and patients may expect comparable PROs between labral reconstruction and labral repair at midterm follow-up. This finding suggests that—at least in cases of viable labral tissue and/or reparable tears—primary repair remains a stronger treatment option.

Moya et al[33] reported results of labral reconstruction for 20 patients with a mean follow-up of 5.1 years. In their analysis, 16 patients underwent mini-open surgery, and 4 underwent open surgical dislocation. The authors reported a 39-point improvement in the NAHS, with 85% of patients having satisfactory results. The current study reported significant improvement in PROs—not only with the NAHS but with multiple validated functional hip outcome scores.

Regarding arthroscopic labral reconstruction, Geyer et al[18] reported results with an iliotibial band autograft

TABLE 5
Demographics of Primary Labral Segmental Reconstruction and Primary Labral Repair Patients With Minimum 5-Year Follow-up[a]

	Primary Reconstruction (n = 17)	Primary Repair (n = 51)	*P* Value
Hips included in study, n (%)			
Left	13 (76.5)	27 (52.9)	.1536
Right	4 (23.5)	24 (47.1)	
Sex, n (%)			
Male	9 (52.9)	27 (52.9)	>.999
Female	8 (47.1)	24 (47.1)	
Age at surgery, y	36.1 ± 12.9 (15.5-61.9)	36 ± 12.8 (15-63.9)	.9605
Body mass index, kg/m^2	25.7 ± 4.1 (19.3-32.5)	25.3 ± 4.1 (18.1-34.4)	.7687
Follow-up, mo	66 ± 6.4 (60-84)	71 ± 15.6 (3.9-108)	.0533

[a]Data reported as mean ± SD (range), unless otherwise noted.

TABLE 6
Intraoperative Findings Noted During Diagnostic Arthroscopy in Primary Labral Segmental Reconstruction and Primary Labral Repair: Patients With Minimum 5-Year Follow-up[a]

	Primary Reconstruction	Primary Repair	*P* Value
Seldes			.0892
0	0 (0)	0 (0)	
I	6 (35.3)	33 (64.7)	
II	5 (29.4)	8 (15.7)	
I and II	6 (35.3)	10 (19.6)	
ALAD			.1308
0	1 (5.9)	5 (9.8)	
1	3 (17.6)	11 (21.6)	
2	4 (23.5)	22 (43.1)	
3	9 (52.9)	10 (19.6)	
4	0 (0)	3 (5.9)	
Outerbridge: acetabulum			.3051
0	1 (5.9)	1 (2.0)	
1	3 (17.6)	14 (27.5)	
2	5 (29.4)	22 (43.1)	
3	5 (29.4)	11 (21.6)	
4	3 (17.6)	3 (5.9)	
Outerbridge: femoral head			.6351
0	15 (88.2)	36 (70.6)	
1	0 (0)	0 (0)	
2	2 (11.8)	7 (13.7)	
3	0 (0)	4 (7.8)	
4	0 (0)	4 (7.8)	
LT percentile class: Domb			.4647
0: 0	10 (58.8)	23 (45.1)	
1: 0 to <50	2 (11.8)	14 (27.5)	
2: 50 to <100	5 (29.4)	11 (21.6)	
3: 100	0 (0)	3 (5.9)	
LT Villar class			.4579
0: No tear	10 (58.8)	23 (45.1)	
1: Complete tear	0 (0)	3 (5.9)	
2: Partial tear	5 (29.4)	22 (43.1)	
3: Degenerative tear	2 (11.8)	3 (5.9)	

[a]Data reported as n (%), unless otherwise noted. ALAD, acetabular labrum articular disruption; LT, ligamentum teres.

TABLE 7
Intraoperative Procedures Performed During Arthroscopy in Primary Labral Segmental Reconstruction and Primary Labral Repair: Patients With Minimum 5-Year Follow-up[a]

	Primary Reconstruction	Primary Repair	*P* Value
Labral treatment			<.001
Debridement	0 (0)	0 (0)	
Repair	0 (0)	51 (100)	
Reconstruction	17 (100)	0 (0)	
None	0 (0)	0 (0)	
Capsular treatment			.4048
Repair	6 (35.3)	25 (49.0)	
Release	11 (64.7)	26 (51.0)	
Acetabuloplasty	17 (100)	44 (86.3)	.1794
Femoroplasty	14 (82.4)	44 (86.3)	.7022
Acetabular microfracture	2 (11.8)	5 (9.8)	>.999
Ligamentum teres debridement	5 (29.4)	19 (37.3)	.7704
Iliopsoas fractional lengthening	9 (52.9)	12 (23.5)	.0341
Trochanteric bursectomy	1 (5.9)	3 (5.9)	>.999
Gluteus medius repair	0 (0)	1 (2.0)	>.999

[a]Values are presented as n (%).

TABLE 8
Improvements in Patient-Reported Outcomes and Patient Satisfaction at Latest Follow-up[a]

	Primary Reconstruction	Primary Repair	*P* Value
mHHS			
Preoperative	63.5 ± 18.2 (30.8 to 96)	64.6 ± 16.1 (21 to 97)	.8089
Latest	83.9 ± 14.9 (61 to 100)	87.4 ± 15.3 (40 to 100)	.3631
P value[b]	.003	—	
Delta	18.7 ± 18.2 (–11 to 51)	21.9 ± 18.6 (–20 to 73)	.5594
NAHS			
Preoperative	57.9 ± 16.1 (22.5 to 84)	59.7 ± 19.7 (16 to 96)	.733
Latest	82 ± 16.9 (46.3 to 100)	86.9 ± 16.5 (46.25 to 100)	.2026
P value	.0003	—	
Delta	22.8 ± 17.1 (–21.8 to 43.3)	26.5 ± 17.9 (–10 to 61)	.7559
HOS-SSS			
Preoperative	39.5 ± 24.1 (5.6 to 83)	40.3 ± 24.8 (0 to 94)	.9071
Latest	69.3 ± 26 (8.3 to 100)	77.2 ± 23.8 (22.2222 to 100)	.3099
P value	.0021	—	
Delta	27.7 ± 33.2 (–55.7 to 70.5)	36.2 ± 26.7 (–13.89 to 89)	.3257
VAS			
Preoperative	5.9 ± 2.8 (0 to 10)	6.4 ± 2.2 (0 to 10)	.439
Latest	2.2 ± 2.2 (0 to 7)	2 ± 2.2 (0 to 8.9)	.7859
P value	.0003	—	
Delta	–3.3 ± 3.3 (–10 to 1)	–4.5 ± 3.1 (–10 to 2)	.209
iHOT-12	70.6 ± 25.7 (16.8 to 100)	75.9 ± 24.6 (0 to 100)	.4941
SF-12			
Mental	59 ± 4 (52.3 to 68.8)	56.1 ± 6.5 (35 to 63.7)	.2798
Physical	49.2 ± 7.4 (36.5 to 56.6)	50.7 ± 8.9 (27.2 to 62.3)	.4477
VR-12			
Mental	62.8 ± 4 (55.5 to 68.4)	61.3 ± 6.5 (43.6 to 66.8)	.6106
Physical	50.5 ± 6.8 (40.4 to 57.5)	52 ± 8.5 (30.3 to 61.8)	.3483
Patient satisfaction	6.7 ± 3.4 (0 to 10)	8.5 ± 1.7 (3 to 10)	.0402

[a]Data reported as mean ± SD (range), unless otherwise noted. HOS-SSS, Hip Outcome Score–Sports Specific Subscale; iHOT-12, International Hip Outcome Tool–12; mHHS, modified Harris Hip Score; NAHS, Nonarthritic Hip Score; SF-12, 12-Item Short Form Health Survey; VAS, visual analog scale; VR-12, Veterans RAND 12-Item Health Survey.

[b]*P* values: Comparisons are performed independently between groups—primary labral segmental reconstruction vs primary labral repair—with minimum 5-year follow-up.

TABLE 9
Primary Segmental Labral Reconstruction and Primary Labral Repair With Minimum 5-Year Follow-up Reaching the MIC and PASS for the mHHS and the MCID and PASS for the HOS-SSS[a]

	Primary Reconstruction	Primary Repair	*P* Value
mHHS			
MIC: 8	11 (73.3)	34 (77.3)	.7235
PASS: 74	10 (66.7)	37 (84.1)	.1307
HOS-SSS			
MCID: 6	12 (73.3)	33 (80.5)	>.999
PASS: 75	7 (66.7)	25 (59.5)	.5456

[a]Data reported as n (%), unless otherwise noted. HOS-SSS, Hip Outcome Score–Sports Specific Subscale; MCID, minimal clinically important difference; mHHS, modified Harris Hip Score; MIC, minimal important change; PASS, patient acceptable symptomatic state.

TABLE 10
Rates of Revision, Time to Revision, and Rates of Conversion to THA: Patients With Primary Segmental Labral Reconstruction and Primary Labral Repair With Minimum 5-Year Follow-up[a]

	Primary Reconstruction	Primary Repair	*P* Value
Secondary arthroscopy, n (%)	2 (11.8)	4 (7.8)	.6352
Time to secondary arthroscopy, mean ± SD (range), mo	18.7 ± 18.2 (5.8-31.5)	17 ± 20 (2.8-46.3)	.9265
Total hip replacement, n (%)	3 (13.0)	7 (13.7)	>.999

[a]THA, total hip arthroplasty.

and minimum 3-year follow-up and documented significant improvement in the mHHS and HOS-SSS. The authors also cited a 25% conversion rate to THA. Many of the patients did have a joint space <2 mm, which may have resulted in an increased failure rate of the reconstruction procedures. Our conversion rate to THA in the reconstruction group was 13% at 5-year follow-up. Patient selection criteria regarding preoperative cartilage health and extent of arthritis may explain this difference.[11,32]

Good short-term outcomes with arthroscopic labral reconstruction were previously published.[10] Our results showed that these improvement can be expected at mid-term follow-up.

Matsuda and Burchette[31] compared their labral reconstruction results with a matched-pair labral refixation group, with matches made per age and preoperative NAHS score. The authors reported no differences between groups and concluded that patients undergoing labral reconstruction may not necessarily have inferior outcomes when compared with patients undergoing labral refixation, despite initially more severe labral insufficiency. These results are similar to those of the present study. However, we thought that the matching process should be rigorous to minimize the effect of confounding variables, especially with a very small sample size.

Labral reconstruction is usually not the first labral preservation treatment in the setting of primary hip arthroscopy; rather, it is more common in revision surgery.[1] A previous study reported that labral reconstruction for segmental defects was a strong predictor of success in revision surgery.[14] Labral reconstruction versus repair in revision surgery was a subject explored by White et al.[41] They concluded that patients who underwent revision hip arthroscopy with re-repair were 2.6 times more likely to fail than patients who underwent revision with labral reconstruction. Nonetheless, in certain cases, as with irreparable or mostly calcified labra, primary reconstruction may be a more feasible alternative than complete debridement or excision.[6,10,17]

Systematic labral reconstruction has been proposed. White et al[40] presented an interesting study comparing primary reconstruction and primary repair at a mean follow-up of 40 months. They found that repair was 31% more likely than reconstruction to fail. In contrast, our study was not able to demonstrate the superiority of either technique in the setting of primary hip arthroscopy at mid-term follow-up. In fact, labral repair remains the gold standard in our treatment algorithm for primary arthroscopies, as supported with data showing excellent results and outcomes at short-, mid-, and long-term follow-up.[5,15,22,32]

Labral reconstruction is perhaps one of the most challenging procedures in hip arthroscopy, and the senior author's technique has evolved over the years owing to advancements in technology, experience, and expertise. Precise measurement of the segmental labral defect was previously required, and there was concern for the potential error of graft mismatching (see Figure 3). However, with circumferential labral reconstruction, the intra-articular graft customization eliminates this variable (Figure 7). Also, the use of knotless technology and a knotless pull-through technique maximizes the efficiency of the procedure itself.[35]

Strengths of the current study include the use of multiple validated functional hip outcome scores, including the mHHS, NAHS, and HOS-SSS, as well as pain and patient satisfaction ratings. Second, analysis of the frequency of achieving the PASS, MIC, and MCID gives

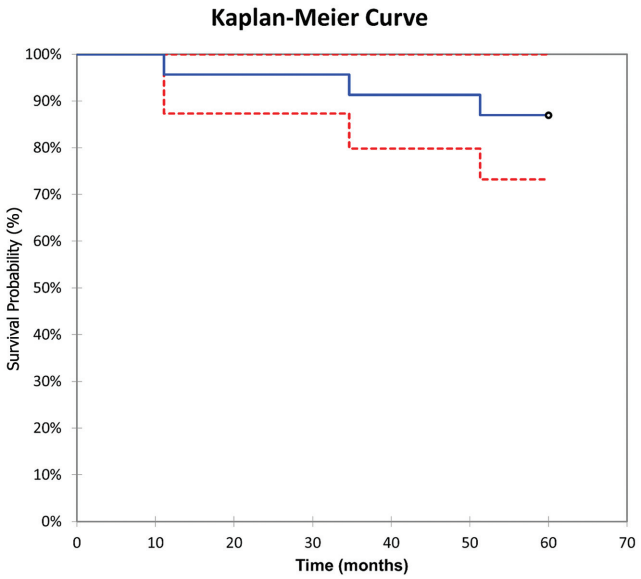

Figure 6. Conversion to total hip arthroplasty: Kaplan-Meier survivorship curve for patients who underwent labral reconstruction. Blue line, mean survival rate; red lines, 95% CI.

more clinical meaning to our results. Third, this study includes a nested matched-pair analysis comparing PLRECON with a benchmark control group of labral repairs. This controls for some potential confounders, such as age, sex, and body mass index. Fourth, this study is among the few to report PROs among patients who underwent hip arthroscopy for labral reconstruction with minimum 5-year follow-up.

Limitations

There are limitations to our study, which must be acknowledged. It was based on a former segmental labral reconstruction technique, and we have since employed a novel and likely far superior reconstruction technique. Additionally, although we utilized a matched-pair study design, this study is nonrandomized. As such, confounding variables may have influenced our results. This study is also retrospective, which introduces some bias; however, this bias is limited given the prospective collection of all data. Analysis was based on a single high-volume surgeon who specializes in hip preservation, which limits the generalizability of our results.[7,23] Longer follow-up is also needed to determine the durability of our findings. Furthermore, the decision between labral reconstruction and repair, in both primary and revision cases, is based on the senior author's expertise, which may introduce bias. Although no significant differences were found between arthroscopic findings and procedures—with the obvious exception of labral pathology and treatment—these variables were not incorporated into the matching process and so introduce potential confounding bias. Based on the small sample size for revision reconstruction, subanalysis

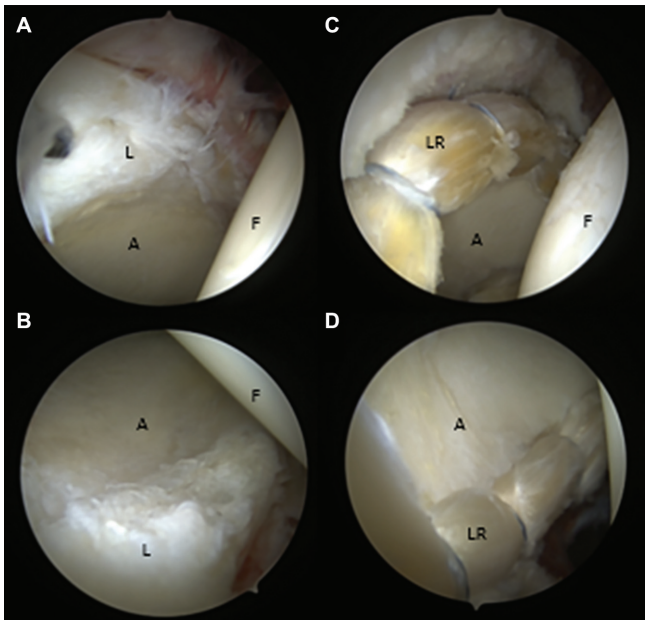

Figure 7. Before-and-after circumferential labral reconstruction in the setting of an irreparable labral tear. Right hip, as viewed from the anterolateral portal with a 70° arthroscope. Before reconstruction: (A) perspective showing labral tear from the 12- to 3-o'clock position; (B) perspective showing labral tear from the 11- to 7-o'clock position. After reconstruction: (C) perspective from the 12- to 3-o'clock position; (D) perspective from the 11- to 7-o'clock position. A, acetabulum; F, femoral head; L, irreparable labral tear; LR, labrum reconstructed.

in a matched-pair design was not possible for this population of patients. Finally, since conversion to THA was considered an endpoint outcome, postoperative scores for these patients were not included in the PRO analysis.

CONCLUSION

Hip arthroscopy with segmental labral reconstruction resulted in significant improvement in PROs at minimum 5-year follow-up. PLRECON reached functional outcomes comparable with those of a benchmark PLREPAIR control group but demonstrated lower patient satisfaction at latest follow-up.

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