

Arthroscopic labral reconstruction using fascia lata allograft: shuttle technique and minimum two-year results

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ABSTRACT

The purpose of this study was to describe the shuttle technique of acetabular labral reconstruction using allograft fascia lata and report minimum two-year clinical outcomes in a prospective patient cohort. We present a shuttle technique to introduce and fixate the allograft, by which the need to fix the free end of the graft from inside the joint is avoided. Between October 2010 and March 2014, 693 hip arthroscopic surgeries were performed by the senior author. Of these 693 patients, 34 patients underwent a labral reconstruction procedure using allograft fascia lata and the shuttle technique and met inclusion criteria. Outcome measures were collected at minimum two years postoperatively. 91.2% (31) of reconstruction patients were available for follow-up at minimum two years after surgery with 12.9% (4) of these patients converting to total hip arthroplasty at average time 27.9 months post-surgery. For the remaining reconstruction patients, mean mHHS increased from 64.0 preoperatively to 84.6 postoperatively ($P = 0.0015$), SF-12 Physical from 38.9 to 49.0 ($P = 0.0004$), SF-12 Mental from 49.5 to 55.6 ($P = 0.0095$), iHOT-12 from 36.4 to 68.1 ($P = 0.0017$), HOS-ADL from 62.6 to 81.6 ($P = 0.0032$) and HOS-SS from 32.9 to 65.7 ($P < 0.0001$). Arthroscopic acetabular labral reconstruction using fascia lata allograft and a shuttle technique appears to be an effective procedure for the treatment of labral pathology through minimum two-year follow-up. While it is difficult to discern the direct influence of the labral reconstructive procedure given the treatment of often concomitant intra-articular pathology, this patient cohort has fared similarly to other cohorts of labral reconstruction patients. No major adverse events are reported.

INTRODUCTION

The acetabular labrum provides an important role as an agent of hip stability, intra-articular fluid pressurization and force distribution [1, 2]. Labral tears are associated with hip joint pain and significant compromise of hip joint biomechanics [3–5]. Labral repair by re-fixation has been shown to be an effective technique for repairing a damaged acetabular labrum [6, 7]. However, acetabular labral tears cannot be repaired in all cases. When the labrum is beyond repair, two options exist, namely arthroscopic labral debridement or labral reconstruction.

Labral resection and debridement alone has been associated with less than optimal outcomes, with rates of good or excellent outcomes as low as 68% [8–14]. Removal of the damaged section of the acetabular labrum can eliminate the source of pain in the hip. However, debridement may disrupt the fluid seal normally provided by the labrum and alter the standard mechanics [5, 7]. It is unclear how this affects progression to osteoarthritis and need for total hip arthroplasty (THA).

Cadaveric investigations suggest that it may be possible to reconstruct the acetabular labrum and the hip joint

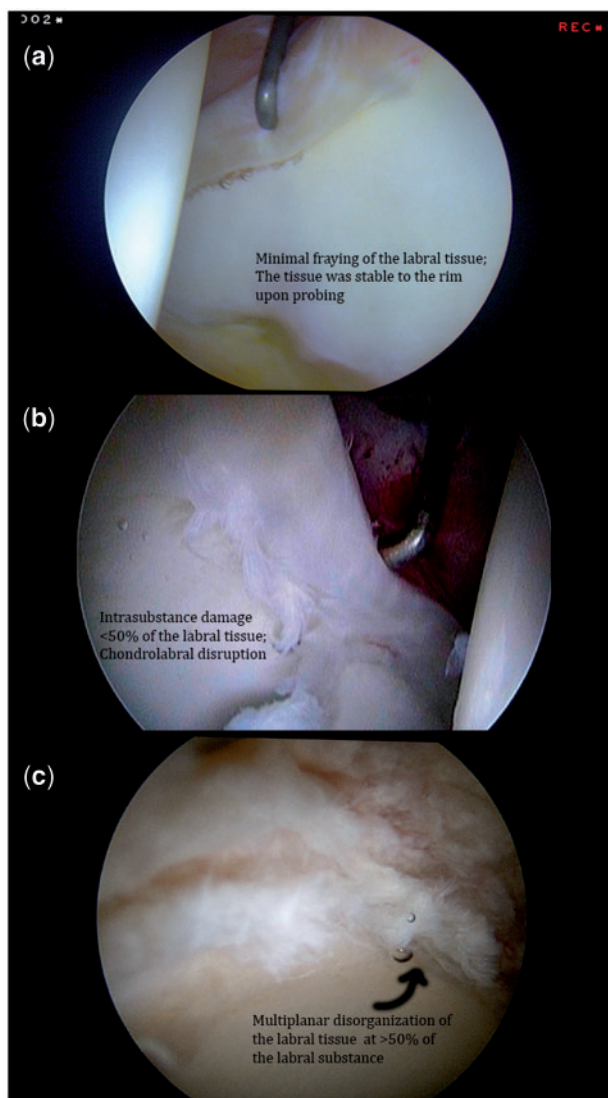


Fig. 1. (a) Mild complexity labral tear: No disruption of the labrum base or capsulolabral tissue; minor intrasubstance damage (fraying). (b) Moderate complexity labral tear: Disruption of the capsulolabral or labral base tissue; minimal intrasubstance damage (<50%). (c) Severe complexity labral tear: Disruption of labral base and capsulolabral integrity; significant (>50%) intrasubstance damage.

suction seal by replacing resected labral tissue with graft material [7, 15]. Acetabular labral reconstruction has also shown promising clinical outcomes [16–20]. However, this evidence is limited, and the role of reconstruction, particularly at the time of an index surgery, is not well defined. Additionally, labral reconstruction poses a high level of technical difficulty. Concerns related to prolonged duration of traction, difficulty with introduction and fixation of the graft, and possibility of iatrogenic injury have all in part limited its use.

The purpose of this study was to describe the shuttle technique of acetabular labrum reconstruction using fascia lata allograft and report its minimum two-year clinical outcomes in a prospective patient cohort. We present a shuttle technique to introduce and fixate the allograft, by which the need to fix the free end of the graft from inside the joint is avoided. We hypothesize that patients undergoing arthroscopic reconstruction of the acetabular labrum using fascia lata allograft via the shuttle technique see clinically significant improvements in validated outcome scores at two years postoperatively.

MATERIALS AND METHODS

Institutional review board approval was obtained for this study.

Clinical evaluation

Between October 2010 and March 2014, 693 patients were selected to undergo arthroscopic hip surgery based on a detailed history, physical examination and imaging studies. Data was collected prospectively on patients undergoing arthroscopic hip preservation surgery during this time. Criteria for undergoing hip arthroscopy included documented hip pain during physical examination, presence of persistent pain refractory to conservative treatment of at least three months duration, confirmed femoroacetabular impingement (FAI) on plain radiographs or computed tomography (CT), and confirmed labral tearing from magnetic resonance imaging (MRI). During physical examination, bone and soft tissue palpation was performed along with range of motion testing. A number of diagnostic tests for FAI were performed including the flexion, adduction and internal rotation (FADIR) impingement test and the flexion abduction, and external rotation (FABER) test [21]. A straight leg raise (SLR) test was performed to aid in isolating posterior and anterior sources of pain. Radiographic evaluation proceeded by way of several commonly used parameters for the assessment of the symptomatic, skeletally mature hip [22]. Presence of labral tearing, avascular necrosis and articular cartilage damage were gleaned from MRI findings.

The senior author's factors for not being eligible for arthroscopic surgery include age older than 70 and younger than 12. Additionally, patients were not candidates for surgery if radiographic imaging revealed Tönnis grade ≥ 2 /significant joint space narrowing (<50% of contralateral joint space at any point on the medial, central or lateral sourcil, or <2 mm of joint space at the medial, central or lateral sourcil), avascular necrosis or frank dysplasia (lateral center edge angle <18°).

Table I. Beck classification used for morphological assessment of acetabular articular cartilage damage

Grade	Description
0	None
1	Malacia, roughening of surface, fibrillation
2	Debonding, loss of fixation to the subchondral bone, macroscopically sound cartilage, carpet phenomenon
3	Cleavage, loss of fixation to the subchondral bone; frayed edges, thinning of the cartilage, flap
4	Defect, full-thickness defect

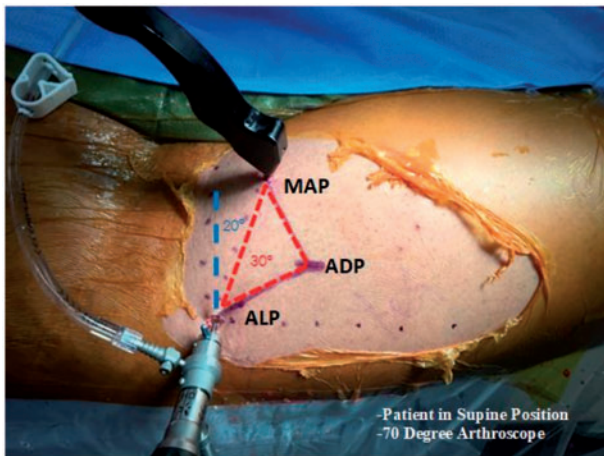


Fig. 2. Three-portal hip arthroscopy portal placement in a right hip; MAP, mid-anterior portal; ADP, accessory distal portal; ALP, anterolateral portal.

Intraoperative evaluation

The decision whether or not to perform labral reconstruction was made after arthroscopic examination. Indications for reconstruction included moderate to severe complexity of labral tearing (Fig. 1), intrasubstance degeneration of greater than 50% of labral substance, hypoplastic labral tissue <3 mm diameter, previous labral surgery with deficient tissue, labral tearing in the segment of an os acetabuli, extensive labral bruising, rim ossification and most commonly, a combination of these factors [17]. Complexity of labral tearing was graded as either none, mild, moderate or severe (Fig. 1). This classification system has been defined by the senior author in conjunction with other members of an ongoing multicenter study. The system takes into account both labral tissue quality and rim stability. Substantial intraobserver reliability for this classification scheme has been reported previously ($\kappa = 0.66$) [23]. Acetabular articular cartilage damage grading was performed for all patients using the Beck classification system (Table I). The Beck classification was chosen because of

its published intraobserver reliability in grading acetabular cartilage lesions ($\kappa = 0.80$, 77.5% agreement rate) [24]. All grading was done by the senior author (D.S.C.). Intraoperative findings and procedures were recorded by an assistant in response to dictation from the senior author immediately after surgery.

Surgical technique

Three-portal hip arthroscopic surgery is performed in the supine position with a 70 degree arthroscope (Fig. 2). The labral segment deemed irreparable is completely resected (Fig. 3). Freeze-dried fascia lata from the University of Miami tissue bank is tubularized using 2-0 vicryl suture (Fig. 4).

Visualizing via the anterolateral portal (ALP), a percutaneous 1.45 mm diameter JuggerKnot anchor (Zimmer Biomet, Warsaw, IN) is placed with a BLACK striped suture through the accessory distal portal (ADP) at the anteromedial extent of the labrum reconstruction (Fig. 5a). While visualizing from the mid-anterior portal (MAP), a second anchor is placed with a BLUE striped suture through a labral repair cannula at the ALP to the posterolateral extent of the reconstruction (Fig. 5b).

The arthroscope is then placed in the ADP and a second labral repair cannula is placed at the MAP. One of the anteromedial anchor suture limbs (BLACK) is passed through the MAP and the other is passed through the ALP (Fig. 6). The limb from the anteromedial anchor located in the ALP is used to measure the number of crossing lines between the two anchors. The overall length of the reconstruction can then be calculated (Fig. 3b).

One limb from each suture anchor passing through the ALP is tied to the graft using a free needle, allowing enough space for suture tying (Fig. 6). The limb from the MAP is pulled and fully seated into the anteromedial anchor first, followed by the limb exiting the ALP. The graft is introduced halfway into the joint to check and avoid suture crossing. The limb connected to the anteromedial

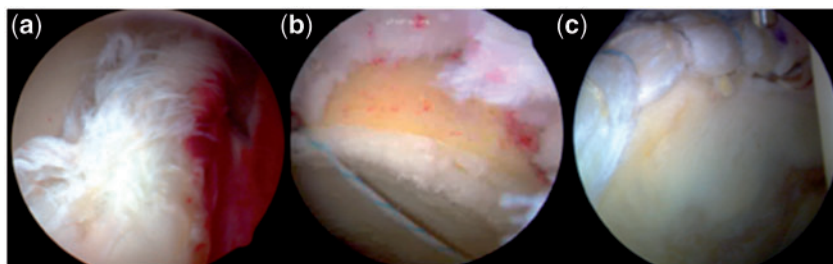


Fig. 3. (a) An irreparable labrum demonstrating complex tearing and degeneration. (b) Determining the length of the defect intraoperatively (effectively the chord length multiplied by 1.3). (c) Completed labral reconstruction.



Fig. 4. Fascia lata allograft tubularized using 2-0 vicryl suture and measured to size of the lesion.

anchor is not fully seated until suture crossing has been checked and corrected if needed (Fig. 7a). The ends of the reconstruction are tied using a standard knot-tying technique. Standard reverse half hitches are used for all knots. Similar to standard labral repair, the segment in between is tied with suture anchors (Fig. 7b). On average for the senior author's cases, 3.2 anchors are used.

Post-Op rehabilitation

Following surgery, patients were kept at 20 lb of weight bearing with 4–6 h daily of continuous passive motion. This protocol was continued for four weeks. For patients who underwent microfracture, toe-touch weight bearing and continuous passive motion continued until six weeks. An anti-rotation bolster to prevent external rotation of the hip was used for the first three weeks after surgery.

Physical therapy was prescribed initially to promote passive movements and ultimately to promote active movements and strength, with internal rotation initiated immediately after surgery and external rotation initiated at three weeks after surgery. Also recommended were passive hip 'pendulums' or circumduction movements to prevent adhesion formation [25]. Heterotopic ossification prophylaxis was routinely administered, with the use of naproxen

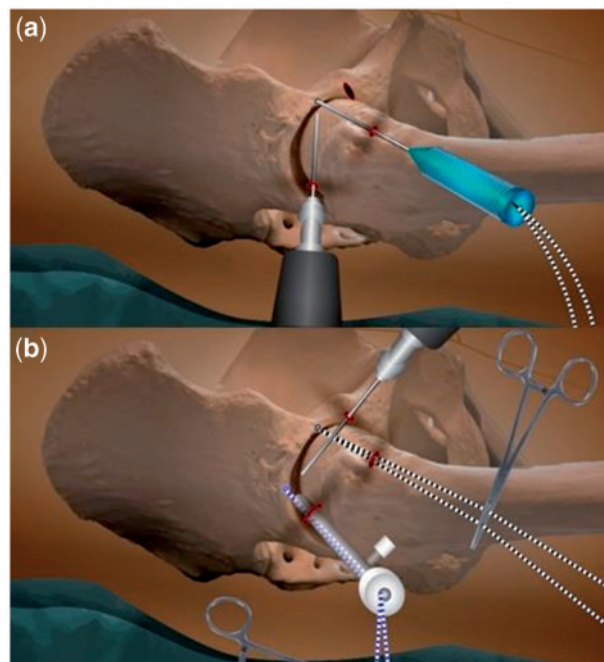


Fig. 5. (a) Percutaneous insertion of anchor at anteromedial extent of defect through ADP with black striped suture. (b) Insertion of second blue anchor at posterolateral extent of defect.

for a minimum of four weeks, and up to six weeks postoperatively. For patients who were unable to tolerate NSAIDs, a single dose of radiation was administered.

Patient-reported outcomes

Baseline and postoperative patient-reported data was collected using the modified Harris Hip Score (mHHS), Short Form-12 Health Survey (SF-12), International Hip Outcome Tool-12 (iHOT-12), and the Hip Outcome Score (HOS). Preoperative patient data was collected in the clinic on paper at the time of presurgical evaluation. Postoperative scores were recorded at minimum two-years out of surgery. In order to get in touch with patients at the

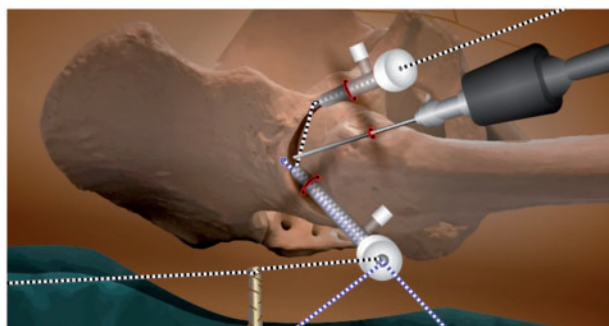


Fig. 6. Shuttle technique setup: A cannula is placed in the MAP and one limb from the black anchor suture is passed through the ALP and MAP. One limb from each suture anchor is tied to the ends of the allograft.

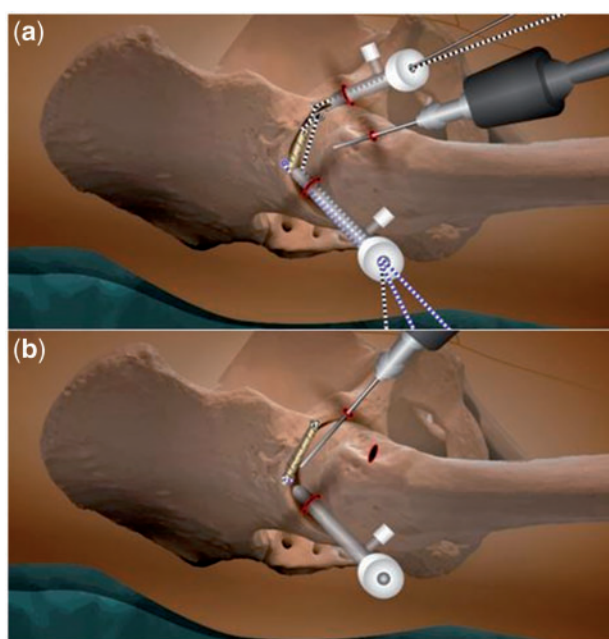


Fig. 7. (a) The graft is inserted halfway into the joint and suture crossing is assessed. (b) The graft is fixated first at the anteromedial end then at the posterolateral end. Anchors are placed in standard repair fashion.

time of follow-up, patient-reported outcome measures were delivered in a number of ways: through a web-based HIPAA compliant database, telephone interview, and mailings.

Statistical analysis

A threshold for statistical significance was established as 0.05 for all analyses. Statistical analysis was performed using SPSS (IBM Corp. Armonk, NY). Means and standard deviations were calculated for age, BMI, months to follow-up, and

Table II. Demographics of allograft reconstruction study group

Age	43.7 ± 9.2 (20–66)
Gender	
Male	35.5% (11)
Female	64.5% (20)
BMI	24.2 ± 4.0 (17–31)
Laterality	
Left	38.7% (12)
Right	61.3% (19)
Tönnis grade	
0	77.4% (24)
1	22.6% (7)
Revision surgery	19.4% (6)
Months to follow-up	31.6 ± 7.1 (24–46)
Failure rate	
Conversion to THA	12.9% (4)
Need for revision arthroscopy	0.0% (0)
Time to failure (months)	27.9 ± 7.8 (18–36)

Table III. Intraoperative findings of allograft reconstruction study group

<i>Intraoperative finding</i>	<i>% of Reconstruction group</i>
Acetabular articular cartilage damage	
Grade 0	6.5 (2)
Grade 1	6.5 (2)
Grade 2	38.7 (12)
Grade 3	35.5 (11)
Grade 4	12.9 (4)
Labral tear complexity	
None	0.0 (0)
Mild	29.0 (9)
Moderate	25.8 (8)
Severe	45.2 (14)
Os acetabuli	6.5 (2)

Table IV. Additional procedures performed in allograft reconstruction study group

Procedure type	% of reconstruction group
Femoral osteoplasty	83.9 (26)
Acetabular rim trimming	80.6 (25)
Acetabular chondroplasty	48.4 (15)
Acetabular microfracture	29.0 (9)
Synovectomy	83.9 (26)
Ligamentum teres debridement	87.1 (27)
Loose body removal	12.9 (4)
Troch Burssectomy	3.2 (1)
Iliopsoas release	6.5 (2)
Capsular closure	67.8 (21)
Capsular plication	29.0 (9)
Capsular release	3.2 (1)

preoperative and minimum two-year postoperative outcome scores. Normal distribution of the data was determined by the Shapiro–Wilk test. Paired sample *t*-tests were used to compare preoperative and postoperative scores. A previous study on subjects undergoing segmental labral reconstruction found HOS-ADL scores improved on average by 19 points [26]. With standard deviation of the baseline HOS-ADL scores in our patient cohort equal to 20, a power analysis was performed, identifying that a minimum of 11 labral reconstruction subjects would be needed to achieve a statistically significant difference with $\alpha < 0.05$ and power of 0.8.

RESULTS

Patient demographics

Of the 693 hip arthroscopies performed by the senior author between October 2010 and March 2014, 35 patients underwent a segmental labral reconstruction procedure using allograft fascia lata and the shuttle technique and consented to study participation and completion of preoperative patient-reported outcome surveys. One patient was excluded from the study cohort postoperatively because he suffered a traumatic injury involving an acetabular fracture. The remaining 34 patient cohort was followed prospectively from the time of labral reconstruction through minimum two-years postoperatively. Of these 34 patients, 31(91.2%) were available for follow-up at

average time 31.6 months post-surgery (range, 24–46 months). Patient demographics are presented in Table II. No patients had bilateral reconstruction.

Preoperative and intraoperative findings

About 77.4% (24/31) of the study group presented with Tönnis Grade 0 hips on preoperative radiograph, with the remaining patients demonstrating Tönnis Grade 1 changes (Table II). A total of 48.4% (15) of patients demonstrated high grade (Beck grades 3–4) acetabular articular cartilage damage at the time of arthroscopic examination and 71.0% (22) of patients showed moderate or severe complexity of labral tearing (Table III). Among the nine patients reconstructed with mild complexity tearing of the labrum, the tissue was either (1) severely hypoplastic or inadequately promoting the suction seal (1 patient), completely ossified (2 patients) or segmentally deficient from prior debridement (six patients).

Treatment

Reconstruction was performed as revision surgery in 19.4% (6) of cases (Table II). The most common procedure performed concomitant to labral reconstruction was a ligamentum teres debridement, performed in 87.1% of cases. Average graft length was 46 mm (range, 32–70). Capsular closure was performed more commonly (67.8%) than release or plication (Table IV).

Complications

No major post-operative complications (e.g. deep vein thrombosis, osteonecrosis, instrument failure, vascular injury, femoral neck fracture, abdominal compartment syndrome) were noted. One patient had a superficial portal infection, which resolved with oral antibiotics and local wound care.

Failure rate and patient-reported outcomes

Failure rate, defined as need for revision arthroscopy or conversion to THA, was observed in 12.9% (4) of reconstruction study patients available for follow-up. All four patients progressed to THA (Table V). The average time to conversion was 27.9 months (range, 18–36 months). No patients progressed to revision arthroscopy. The patients available for follow-up at minimum two-years without conversion to THA saw statistically significant mean group improvements in all PROs from baseline to follow-up ($P = 0.0095$ to <0.0001) (Table VI).

DISCUSSION

This prospective evaluation of outcomes after an all-arthroscopic segmental reconstruction of the acetabular

Table V. Descriptors of patients converting to THA

Patient number	Age	Gender	BMI	Revision arthroscopy?	Tönnis grade	Procedures concomitant to reconstruction	Articular cartilage damage grade	Labral pathology	Preoperative outcome scores
1	41	Male	24.9	No	0	Rim trimming, femoroplasty, acetabular chondroplasty, ligamentum teres debridement, synovectomy, capsular closure	3	Bruising, degeneration, moderate complexity tearing, hypoplasticity	mHHS: 48.4 SF-12 Physical: 26.9 SF-12 Mental: 56.5 iHOT-12: 20.6 HOS-ADL: 38.2 HOS-Sports: 12.5
2	46	Male	31.7	No	0	Rim trimming, femoroplasty, ligamentum teres debridement, synovectomy, capsular closure	2	Bruising, degeneration, ossification	mHHS: 28.6 SF-12 Physical: 24.9 SF-12 Mental: 60.0 iHOT-12: 18.6 HOS-ADL: 38.2 HOS-Sports: 0.0
3	39	Male	31.2	Yes	1	Rim trimming, femoroplasty, synovectomy, capsular closure	3	Bruising, degeneration, hypoplasticity	mHHS: 11.0 SF-12 Physical: 24.0 SF-12 Mental: 19.1 iHOT-12: 4.4 HOS-ADL: 5.9 HOS-Sports: 0.0
4	38	Male	27.5	No	0	Rim trimming, femoroplasty, acetabular microfracture, ligamentum teres debridement, synovectomy, loose body removal, capsular closure	4	Bruising, degeneration, moderate complexity tearing, hypoplasticity	mHHS: 17.7 SF-12 Physical: 20.4 SF-12 Mental: 63.4 iHOT-12: 16.8 HOS-ADL: 45.3 HOS-Sports: 10.7

labrum demonstrates significant group improvements in all patient-reported outcome measures, with 12.9% of patients undergoing conversion to THA at minimum two-year follow-up. The four patients who converted to THA were all male, 75% (3/4) had high grade (grade 3–4) acetabular articular cartilage damage, and 50% (2/4) were obese (BMIs of 31.2 and 31.7). Additionally, on all scoring measures except the SF-12 Mental Component, the four conversion patients had preoperative outcome scores well below the average preoperative scores of non-conversion patients

(Table V). A more complete analysis of differences in demographics, preoperative scores and intraoperative findings between failure and non-failure patients was not possible given the small size of the study cohort requiring arthroplasty at minimum two-year follow-up.

The minimal clinically important difference (MCID) has been defined as the minimum perceptible change for a patient in an outcome scoring system measured before and after some intervention. The MCID for mHHS has been reported by Kemp *et al.* as 8 in the setting of hip

Table VI. Patient-reported outcome scores for allograft reconstruction study group

Scoring measure	Outcome score (SD)	P-value
mHHS		
Preoperative	64.0 (20.2)	0.0015
2+ years postoperative	84.6 (19.5)	
SF-12 Physical		
Preoperative	38.9 (9.9)	0.0004
2+ years postoperative	49.0 (10.0)	
SF-12 Mental		
Preoperative	49.5 (12.9)	0.0095
2+ years postoperative	55.6 (6.8)	
iHOT-12 ^a		
Preoperative	36.4 (19.8)	0.0017
2+ years postoperative	68.1 (28.4)	
HOS-ADL		
Preoperative	62.6 (20.1)	0.0032
2+ years postoperative	81.6 (22.2)	
HOS-Sports		
Preoperative	32.9 (28.9)	<0.0001
2+ years postoperative	65.7 (35.5)	

Note: mHHS, modified Harris Hip Score; SF-12 Physical, short form-12 physical component; SF-12 Mental, short form-12 mental component; iHOT-12, international hip outcome tool-12; HOS-ADL, hip outcome score activities of daily living scale; HOS-Sports, hip outcome score sports scale.

^aiHOT-12 was not developed until midway through data collection (2012), and consequently only reflects the clinical outcomes of $n = 22$ of the study patients.

arthroscopy, and the MCIDs for the HOS-ADL and HOS-SS have been reported by Philippon and Martin as 9 and 6, respectively [27, 28]. We report mean group improvement of 20.6 points in the mHHS, 19.0 points in the HOS-ADL and 32.8 in the HOS-SS for this study group. A review of published outcomes on acetabular labral reconstruction revealed outcomes similar to the results of this study (Table VII) [16, 26, 29–37]. Philippon et al. published the first outcomes of arthroscopic labrum reconstruction in a 47 patient cohort using iliotibial band autograft and a segmental reconstruction technique, reporting mean mHHS increase from 62 preoperatively to 85 postoperatively and a 9% progression to THA [33]. White and colleagues

report the largest cohort (152 hips) having undergone complete arthroscopic labral reconstruction using an iliotibial band allograft and a front-to-back fixation technique [29]. In this cohort, mHHS increased from 54 preoperatively to 88 postoperatively and a 10% progression to THA was observed, compared with 64, 85 and 12.9% respectively in our study (Table VII).

Indications for reconstruction at the time of primary arthroscopic intervention for treatment of labral pathology are unclear. The shuttle technique was developed as an alternative fixation technique to avoid fixation of the free end of the graft within the joint and to replace damaged segments of the native labrum. This technique provides the advantage over a free-end fixation technique of positioning of anchors at the exact desired location on the acetabular rim, immediately adjacent to the native labral tissue. Disadvantages of the free-end fixation technique include the need to capture the free end of the graft (e.g. floating into the center of the joint), the need to penetrate the tightly wrapped fascia lata with a suture passing device, and the need to cut the graft from within the joint arthroscopically in order to match the length of the defect.

Segmental reconstruction of the labrum allows for replacement of the specific segment of tissue deemed irreparable. An alternative front-to-back technique, as described in detail by BJ White, is performed by first tubularizing allograft and then measuring it such that it exceeds the extent of the damaged labrum. By this technique, the graft is fixated from front-to-back, and, from *within the joint*, excess graft is removed before posterior anchoring. This approach strives for complete replacement of the damaged labrum. Promising results have been published using this technique, including in the setting of direct comparison with labral repair [24, 38, 39]. The theoretical advantages of segmental reconstruction over the front-to-back technique include improved graft incorporation to bone and less immune response, although these factors were not specifically studied, nor have been studied previously. A proposed disadvantage of segmental reconstruction when compared to the front-to-back approach is the technique's inability to allow for graft length adjustment once it is sutured from outside the joint. This can lead to mismatch between graft length and size of labral defect and consequent graft bunching or stretching. Additionally the graft introduced segmentally may fail to heal at the native graft-labral interface.

To our knowledge, no studies to date have directly compared allograft and autograft reconstruction of the acetabular labrum. Suggested advantages of allograft reconstruction include avoidance of donor site morbidity,

Table VII. A comparison of published outcomes of acetabular labrum reconstruction

Study	n	Graft type	Surgical technique	Age	Follow-up	Preoperative outcome scores	Postoperative outcomes
Carreira <i>et al.</i> unpublished	34	Fascia lata allograft	Fixation: Shuttle Type: Segmental Portals: 3	44 years (20–66)	32 months (24–46)	mHHS: 64 HOS-ADL: 63 HOS-Sports: 33 SF-12 Physical: 39 SF-12 Mental: 49 iHOT-12: 36	mHHS: 85 HOS-ADL: 82 HOS-Sports: 66 SF-12 Physical: 49 SF-12 Mental: 56 iHOT-12: 68 THA: 12.9% (4/31)
Chandrasekaran <i>et al.</i> [26]	22	Semitendinosus allograft/gracilis autograft	Fixation: Outside-in Type: Segmental Portals: 3	32 years (15–45)	29 months	mHHS: 64 HOS-ADL: 64 HOS-Sports: 42 NAHS: 59 VAS: 6	mHHS: 75 HOS-ADL: 81 HOS-Sports: 65 NAHS: 78 VAS: 3 THA: 4.5% (1/22)
White <i>et al.</i> [29]	152	Iliotibial band allograft	Fixation: Front-to-back Type: Complete Portals: 3	39 years (16–58)	28 months (24–39)	mHHS: 54 LEFS: 41 VAS-Rest: 5 VAS-ADLs: 6 VAS-Sport: 8	mHHS: 88 LEFS: 68 VAS-Rest: 2 VAS-ADLs: 2 VAS-Sport: 3 Satisfaction: 9/10 THA: 10% (13/131)
Domb <i>et al.</i> [16]	11	Gracilis tendon autograft	Fixation: Outside-in Type: Segmental Portals: 3	33 years (18–45)	26 months (24–32)	mHHS: 55 NAHS: 53 HOS-ADL: 59 HOS-Sports: 39 VAS: 7	mHHS: 82 NAHS: 78 HOS-ADL: 80 HOS-Sports: 60 VAS: 3 Satisfaction: 8/10 THA: 0.0% (0/11)
Geyer <i>et al.</i> [30]	76	Iliotibial band autograft	Fixation: Outside-in Type: Segmental Portals: 2	39 years (18–64)	49 months (36–70)	mHHS: 59 HOS-ADL: 69 HOS-Sports: 41 SF-12 Physical: 42 SF-12 Mental: 55	mHHS: 83 HOS-ADL: 81 HOS-Sports: 67 SF-12 Physical: 50 SF-12 Mental: 53 Satisfaction: 8/10 THA: 24% (18/76)
Boykin <i>et al.</i> [31]	23	Iliotibial band autograft	Fixation: Outside-in Type: Segmental Portals: 2	28 years (19–41)	41 months (20–74)	mHHS: 67 HOS-ADL: 77 HOS-Sports: 56 SF-12 Physical: 44 SF-12 Mental: 49	mHHS: 84 HOS-ADL: 85 HOS-Sports: 77 SF-12 Physical: 51 SF-12 Mental: 54 Satisfaction: 8/10 THA: 8.7% (2/23)

(continued)

Table VII. (continued)

Study	n	Graft type	Surgical technique	Age	Follow-up	Preoperative outcome scores	Postoperative outcomes
Matsuda <i>et al.</i> [32]	8	Gracilis tendon autograft	Fixation: Outside-in Type: Segmental Portals: 2	35 years (18–58)	30 months (24–37)	NAHS: 42	NAHS: 92 Satisfaction: 7 'high', 1 'moderate' THA: 0.0% (0/8)
Philippon <i>et al.</i> [33]	47	Iliotibial band autograft	Fixation: Outside-in Type: Segmental Portals: 2	37 years (18–55)	18 months (12–32)	mHHS: 62	mHHS: 85 Satisfaction: 8/10 THA: 9% (4/47)

decreased surgical time and enhanced control over graft size and composition. Allograft reconstruction does carry the risk of disease transmission and/or rejection and is a costlier option than is reconstruction with autologous tissue. Time to graft incorporation is another important factor, and second-look arthroscopy in an autograft/allograft comparative study would be valuable.

Our patient population differs from several other labral reconstruction study cohorts in that we report a population with high rates of acetabular microfracture (29%), Tönnis grade 1 (22.6%) and high grade (grades 3–4) acetabular cartilage damage (49%) [16, 26, 36, 37]. This finding suggests patients with irreparable labral damage requiring labrum reconstruction may be more likely to have high grade cartilage damage, but controlled, comparative studies comparing labral reconstruction with debridement/repair are needed to answer this question.

LIMITATIONS

With three reconstruction patients lost to follow-up, there is the concern that these losses bias presented outcome scores and conversion rates. Also, no follow-up exists on graft incorporation either with MRI or second-look arthroscopies; therefore, the incorporation of the allograft is unknown. Because of the cohort size, no conclusions can be drawn as to how extent of cartilage damage affects outcome. Our reconstruction cohort demonstrated a high rate (49%) of significant articular cartilage damage (grades 3–4), but subgroup analysis was not sufficiently powered, as determined by a post-hoc power analysis. Lastly, the senior author completed all grading of pathology at the time of arthroscopy, and data was not collected on the interrater reliability of these intraoperative grades.

Given the paucity of high-quality literature on reconstructions of the acetabular labrum, further studies should

be directed at determining factors leading to the success and failure of labral repairs and reconstructions to form a basis by which clinicians may be guided to the most appropriate treatment for labral injuries. There is also a need for further studies comparing graft types and surgical techniques.

CONCLUSIONS

Arthroscopic acetabular labral reconstruction using fascia lata allograft and a shuttle technique appears to be an effective procedure for the treatment of labral pathology through minimum two-year follow-up. About 12.9% of patients converted to THA at average time 28 months post-surgery. While it is difficult to discern the direct influence of the labral reconstructive procedure given the treatment of often concomitant intra-articular pathology, this patient cohort has fared similarly to other cohorts of labral reconstruction patients. No major adverse events are reported.

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CONFLICT OF INTEREST STATEMENT

D.S.C. has received consulting, hospitality payments and speaking fees from Zimmer Biomet.

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