Allograft Use in Arthroscopic Labral Reconstruction of the Hip With Front-to-Back Fixation Technique: Minimum 2-Year Follow-up

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Purpose: To present minimum 2-year outcomes in patients who underwent a modified technique for arthroscopic labral reconstruction using iliotibial band allograft tissue and a front-to-back fixation. **Methods:** From April 2011 to July 2012, all consecutive arthroscopic labral reconstruction patients were included in this Institutional Review Board–approved, prospective case series study. Inclusion criteria were arthroscopic iliotibial band allograft labral reconstruction performed by a single surgeon, age ≥16 years at the time of arthroscopy, and a minimum of 2 years of follow-up. Patients completed subjective questionnaires both preoperatively and postoperatively, including Modified Harris Hip Score (MHHS), the Lower Extremity Function Score (LEFS), Visual Analogue Scale (VAS) pain scores, and patient satisfaction. A modified front-to-back fixation technique for labral reconstruction was used. **Results:** One hundred fifty-two hips (142 patients) met the inclusion criteria for this study; 131 hips (86.2%) had complete follow-up at a minimum of 2 years, and 21 hips (13.8%) were lost to follow-up or had incomplete data during the study period. Seventy hips had concomitant procedures performed; 27 microfracture, 30 chondroplasty, 26 psoas release, 5 os acetabuli resection, and 3 Ganz osteotomy. Overall, 18 hips (13.7%) required revision procedures at a mean of 17 months (range, 1 to 37 months) after the labral reconstruction. In the remaining 113 hips, there was significant improvement in all outcome measures from preoperative to most recent follow-up ($P < .0001$). The mean MHHS improved by 34 points ($P < .0001$), and the mean LEFS improved by 27 points ($P < .0001$). The mean VAS pain score improved by 3 points at rest ($P < .0001$), 4 points with average pain with daily activities ($P < .0001$), and 5 points with sport ($P < .0001$). Patients reported an overall satisfaction of 9 (range, 1 to 10). **Conclusions:** Arthroscopic iliotibial band allograft labral reconstruction of the hip shows promising outcomes at minimum 2-year follow-up. **Level of Evidence:** Level IV, therapeutic case series.

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The understanding of the hip joint and associated pain has evolved continuously over the past decade. Originally, arthroscopic procedures described debridement and resection of damaged labral tissue. Given that a circumferentially intact labrum is now deemed imperative to the functionality and longevity of the hip joint,[1-4] surgical techniques such as labral repair and treatment of femoroacetabular impingement (FAI) have evolved with an emphasis on preserving labral tissue.[5-7] Comparative studies show greater improvement in pain relief, function, and return to sport in patients undergoing labral preservation procedures compared with labral resection procedures.[8-11] Additionally, procedures that restore the natural hip anatomy, such as labral repair and FAI correction, have provided sufficient long-term reduction in pain and increase in function in patients with hip pain.[2,7,12] Consequently, a growing emphasis has been placed on restoring proper hip anatomy after injury or degeneration.[13-17]

Outcomes from surgery to repair damage to the labrum and restore bony anatomy are promising[6,18]; however, there exists a population of patients whose labral tissue is less suitable for repair techniques. The lead author

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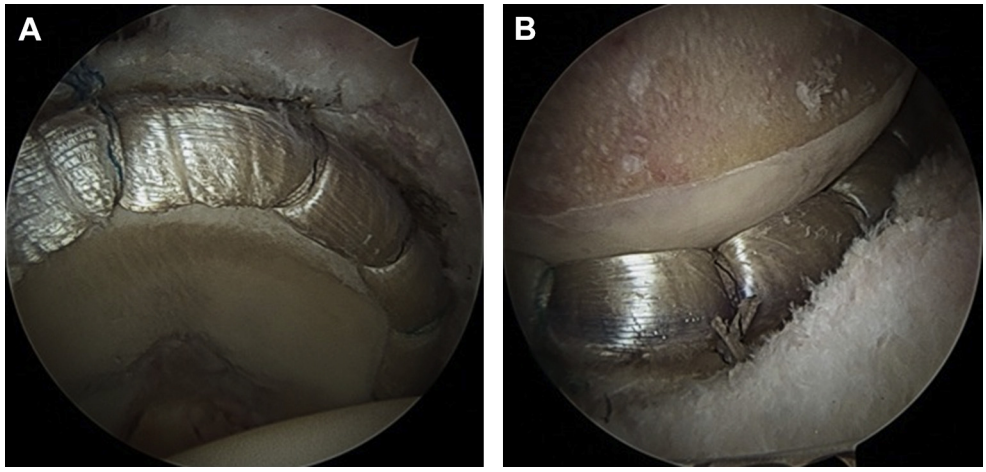

Fig 1. Final view of an 8-cm acetabular labral reconstruction from frozen fascia lata allograft fixed with 7 anchors (A) viewed in traction and (B) with the joint reduced showing a perfect seal between the labral reconstruction and the femoral head.

(B.J.W.) has found that more challenging situations present when the labral damage is too severe or the tissue itself is too large or degenerative (>10 mm) or too small or diminutive (<3 mm). Revision procedures also offer a challenge, as previous labral repairs are often scarred into the hip capsule. It is often not possible to excise adequate scar tissue and retain enough labral tissue that is suitable for repair. While repair techniques may be possible in these situations, the lead author feels that the ability of the tissue to heal and become painless or to provide adequate stability may be compromised.

In 2010, Philippon et al.[10] reported an alternative treatment for patients presenting with irreparable labral tears. That procedure used an iliotibial band autograft to arthroscopically reconstruct the labrum. More recently, other techniques for arthroscopic labral reconstruction have been reported, including reconstruction with autograft gracilis tendon,[19,20] autograft quadriceps tendon,[21] hamstring allograft,[22] and local capsular autograft.[23] The purpose of this study was to present minimum 2-year outcomes in patients who underwent a modified technique for arthroscopic labral reconstruction using iliotibial band allograft tissue and a front-to-back fixation. We hypothesize that the modified labral reconstruction technique using allograft tissue will provide relief of symptoms equitable to those previously reported in patients undergoing labral reconstruction with autograft.

Methods

Participant Selection

From April 2011 to July 2012, all consecutive arthroscopic labral reconstruction patients from a single surgeon (B.J.W.) were identified and invited to participate in this Institutional Review Board–approved, prospective case series study of patient-reported outcomes. All patients who presented for treatment of hip pathology and who were suspected to have an acetabular labral tear were approached during the preoperative visit to participate in this research study. Inclusion criteria were age ≥16 years at the time of arthroscopy and a minimum of 2 years' follow-up since arthroscopy. Patients with less than 2 years since arthroscopy were excluded. Patients were not excluded if they had previous ipsilateral hip surgery or concomitant procedures performed at the time of the index hip arthroscopy.

Preoperative diagnosis was based on clinical examination findings and magnetic resonance imaging. Indications for hip arthroscopy were preserved joint space (Tonnis grade 0 or 1), reproduction of pain with anterior impingement maneuver, failure of nonoperative treatment, and magnetic resonance imaging–confirmed labral tear or high clinical suspicion of labral tear, including positive diagnostic injection. Patients who consented to participate were enrolled in the study at the preoperative visit, and outcomes data were prospectively collected in the single surgeon's hip arthroscopy outcomes database. Patients remained in the study if they underwent arthroscopic iliotibial band allograft labral reconstruction at the time of hip arthroscopy. Patients who did not undergo arthroscopic iliotibial band allograft labral reconstruction were excluded.

Indications for labral reconstruction at the time of arthroscopy were labral tissue >8 mm or <2 to 3 mm or irreparable labral tear, as determined subjectively by the surgeon at the time of arthroscopy. In general, a labrum that could not be repaired using current techniques (repair with anchors or debridement) to restore the circumferential hoop stresses required by the hip joint was considered to be irreparable.

Data Collection

Patients completed subjective questionnaires regarding hip pain and function both preoperatively and postoperatively. Preoperative questionnaires were completed at the preoperative clinic visit as a standard of care for all patients who underwent hip arthroscopy. Postoperative questionnaires were completed annually, either at a clinic visit or by mail. Questionnaires collected included the Modified Harris Hip Score (MHHS),[24] the Lower

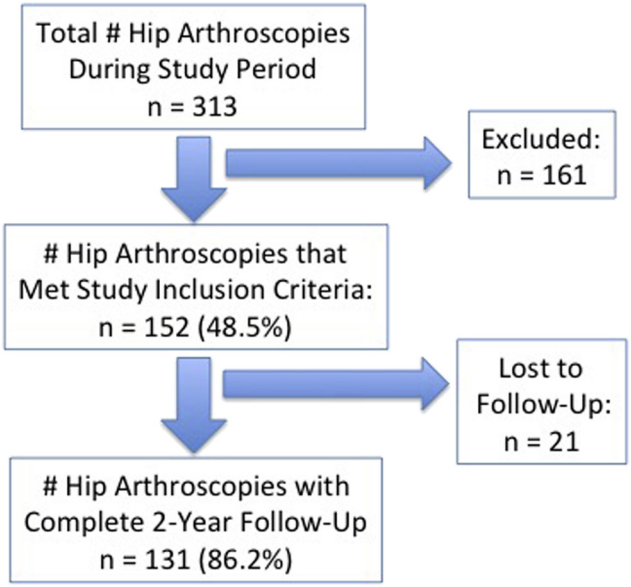

Fig 2. Flow diagram indicating the total number of hip arthroscopies performed during the study period, the subset that met the specific inclusion criteria for this study, and the percentage where follow-up was obtained. The final study population consists of the 131 hips that met the inclusion criteria and had complete, minimum 2-year follow-up.

Extremity Function Score (LEFS),[25] a Visual Analogue Scale (VAS) for average pain at rest, average pain with daily activities (ADL), average pain with athletic activities, and patient-rated overall satisfaction on a scale from 1 to 10 (10, extremely satisfied). If data were missing for an outcome measure, the outcome score was not calculated. Patients who were missing more than one outcome score (MHHS, LEFS, or VAS) were considered to have incomplete follow-up and were not included in the analysis of follow-up data. Improvement in patient score was calculated using the final postoperative score available compared with the preoperative score.

Clinical and radiographic measures were performed by the lead author and were also recorded for this study. Specifically, preoperative and postoperative joint space measurements using 2 consistent points of reference, the lateral edge of the joint and a point 2 cm medial, were obtained. Intraoperatively, details of the surgical procedure were recorded, including assessment of cartilage damage, quality of the labral tissue, degree and location of impingement, damage to the capsule, and concomitant procedures. Measures of graft length and number of anchors used were also recorded.

Surgical Technique

The surgical technique was modified from the original report of arthroscopic labral reconstruction.[10] Briefly, 3 portals were used to perform the procedure, including an antrolateral portal, a midanterior portal, and a third accessory portal that was placed 4 to 5 cm distal and 2 to 3 cm posterior to the anteromedial portal. These portals were necessary to maintain graft tension during the front-to-back fixation. All labral tissue was excised before reconstruction, and the labral defect was measured to determine the appropriate graft length. The graft length was then overestimated by 1 cm, to prevent the graft from being too short. Anchors were placed 11 to 14 mm apart on the acetabular rim. Freeze-dried or frozen iliotibial band allograft was used to create a graft that was approximately 5 to 6 mm in diameter. The graft was secured from anterior to posterior (front-to-back), and then the graft length was assessed. Excess graft was cut with a beaver blade while maintaining graft tension. Traction was then taken down, and the graft was inspected in the peripheral compartment to ensure there was a complete, continuous seal between the graft and the femoral head (Fig 1). To finish the procedure, the joint was dynamically tested, and the anterior portion of a standard 3 to 4 cm capsulotomy was closed.

Postoperative Management

The rehabilitation program after labral reconstruction was similar to that after labral repair. Patients were cautioned regarding the aneural properties of their graft. Patients began a supervised physical therapy program within 1 week of surgery and maintained 30% weight bearing for 4 weeks, 20% weight bearing for 6 weeks for a concomitant microfracture procedure.

Statistical Analysis

All analyses were conducted using SAS 9.3 (Cary, NC, U.S.A.). Descriptive statistics were computed for all variables of interest, including means and standard errors. Change in subjective scores from preoperative to postoperative was analyzed using paired *t*-test because the data were normally distributed. Two-sample *t*-test and χ^2- test were used to assess a difference in several variables between failures and nonfailures. Statistical significance was defined as $P < .05$.

Results

Between April 2011 and July 2012, 313 hip arthroscopies were performed by the lead author. Of the 313 hip arthroscopies performed, 152 hips (48.6%; 142 patients) met the inclusion criteria for this study and 131 (86.2%) had complete follow-up data after the index procedure (Fig 2). Twenty-one hips (13.8%) were lost to follow-up or had incomplete data during the study period.

Among the series of 131 hips, there were 69 female patients (72 hips) and 54 male patients (59 hips). There were 58 left hips and 73 right hips. The mean age at the time of surgery was 39 years (range, 16 to 58 years). No patient had less than 2 mm joint space preoperatively. The mean preoperative joint space laterally was 4.4 mm

Table 1. Comparison of Preoperative With Postoperative Subjective Scores for Hips Not Requiring Revision (n = 113)

Outcome Measure	n*	Preoperative	Postoperative	Change	95% Confidence Interval
Modified Harris Hip Score	112	54	88	34	30, 37
Lower Extremity Function Score	112	41	68	27	23, 30
Pain VAS at rest	110	5	2	3	2, 3
Pain VAS with average pain with daily activities	109	6	2	4	3, 4
Pain VAS with sport	108	8	3	5	4, 5

NOTE. $P < .0001$ for all comparisons.

VAS, Visual Analogue Scale.

*The total number of hips that completed follow-up was 113; however, some patients were missing values for individual outcome measures that resulted in an inability to calculate a score. No patient was missing more than one individual outcome score. The table reflects the number of hips that had both preoperative and postoperative scores available for each individual outcome measure.

(range, 3.0 to 6.5 mm), and the mean preoperative joint space medially was 4.3 mm (range, 2.0 to 5.5 mm).

Ninety-nine patients had no previous labral treatment and underwent primary labral reconstruction, and 32 had previous labral surgery before the index procedure. Of the 32 who had previous labral surgery, 24 had previous arthroscopic labral repair, 6 arthroscopic labral debridement, and 2 open dislocation, with one labral repair and one labral debridement.

All patients underwent labral reconstruction, with 26 frozen allografts and 105 freeze dried allografts. Eighty-four hips had deficient labral tissue (<3 mm), 45 had hypertrophic (>10 mm) and degenerative labral tissue, and in 2 the labrum was completely ossified. The mean labral width was 6 mm (range, 1 to 12 mm). The mean number of anchors used for the reconstruction was 6 (range, 3 to 8), and the mean graft size was 6 cm (range, 4 to 7.5 cm). At the time of the index procedure, 103 hips underwent treatment of mixed-type FAI, 4 underwent treatment of a pincer lesion only, and 15 underwent treatment of cam lesion only. Additionally, 70 hips had concomitant procedures performed: 27 microfracture, 30 chondroplasty, 26 psoas release, 5 os acetabuli resection, and 3 Ganz osteotomy.

Postoperatively, there were 7 patients (6.6%) who had short-term complications, including 2 with hip flexor tendonitis, 2 with deep vein thrombosis, one with infection, one with mild motor nerve injury of the foot, and one with significant sacroiliac joint pain, all of which resolved with no long-term sequelae. There were 4 female patients and 3 male patients with complications. There was no significant difference in age between the patients who had a complication compared with those who did not, although those with a complication were slightly older (43.0 years *v* 38.6 years; $P = .3006$). The patients with deep vein thrombosis were both older than the mean of the total study population, ages 44 and 55 years at the time of surgery.

Overall, 13 hips (9.9%) had progressive arthritis that required total hip arthroplasty (THA) at a mean of 15 months (range, 1 to 24 months) after the index procedure, and 5 hips (3.8%) underwent other revision procedures at a mean of 23 months (range, 14 to 37 months) after the index procedure. The other revision procedures included 4 revision arthroscopic reconstructions and one open dislocation with osteoplasty and debridement. The distribution of patients who progressed to THA or required revision procedure was evenly distributed throughout the 16-month study period.

One hundred thirteen hips (107 patients) did not require revision and had complete follow-up questionnaires at a mean of 28 months (range, 24 to 39 months) after the index procedure. No patient was missing more than one of the selected outcome measure scores (MHHS, LEFS, or VAS). For each individual outcome measure, the number of patients who had a complete score calculated for the measure, both preoperatively and postoperatively, are listed in Table 1. For these patients, there was significant improvement in all outcome measures from preoperative to most recent follow-up (Table 1). The mean MHHS improved by 34 points, and the mean LEFS improved by 27 points. The mean VAS pain score improved by 3 points at rest, 4 points with ADL, and 5 points with sport. Patients reported an overall satisfaction of 9 (range, 1 to 10).

Results of comparison between the hips that required revision and those that did not showed that hips that required revision had significantly lower preoperative MHHS (40 *v* 54; $P = .0003$) and LEFS (32 *v* 41; $P = .0174$) and had significantly higher VAS pain scores at rest (6 *v* 5; $P = .0344$) and with ADL (8 *v* 6; $P = .0002$) compared with the hips that did not require revision. In addition, hips that required revision were more likely to have undergone previous open dislocation procedure (11% *v* 0%; $P = .0004$). Three hips underwent previous open dislocation procedure before the index procedure. Follow-up was available on 2 of the 3 hips, and both required a revision procedure after the index labral reconstruction. One hip converted to THA, and one hip underwent revision reconstruction.

Discussion

The results of this study show that this modified technique for arthroscopic labral reconstruction yields promising minimum 2-year patient outcomes and a revision

rate that is comparable to that in the existing literature. The mean MHHS improved by 34 points ($P < .0001$), and the mean LEFS improved by 27 points ($P < .0001$). Patients reported lower pain at rest ($P < .0001$), with ADLs ($P < .0001$), and with sport ($P < .0001$) postoperatively. Patients also reported an overall satisfaction of 9 (range, 1 to 10).

Thirteen hips (9.9%) progressed to THA, and 5 hips (3.8%) underwent another revision procedure. The 9.9% rate of conversion to THA is comparable to the 9% rate of THA conversion previously identified among patients who underwent arthroscopic labral reconstruction.[10] An analysis of the distribution of revisions throughout the study period suggested that the surgeries that went on to require THA or revision procedure were evenly distributed throughout the 16-month study period. In addition, the lead author, who performed all procedures, had 3 years of experience performing this procedure at the start of study enrollment. Therefore, it is unlikely that the revisions were related to learning curve or other temporal trend. The hips that required revision did have significantly lower subjective scores, on average, preoperatively, suggesting more symptoms and disability than with successful patients. In addition, hips that underwent previous open surgical dislocation with labral treatment were more likely to require revision. For the majority of hips, labral reconstruction with iliotibial band allograft offered a solution to the presenting problem. However, in some hips, particularly in those with more intra-articular damage, decreased range of motion, more pain, and significant functional limitations, the labral reconstruction offered only a temporary solution to this complex problem, and those patients required subsequent revision. In patients who present with complex hip problems and significant disability, a more guarded prognosis should be considered.

The outcomes obtained from this case series showed similar improvement in patient-reported outcomes to patients undergoing other methods of labral reconstruction.[10,26] Additionally, the identified revision rate of 13.7% is comparable to previously reported failure rates at similar follow-up duration.[10,26] Early results reported from the original study of arthroscopic labral reconstruction showed an average 23-point improvement in MHHS from preoperative to a mean of 18 months postoperative and a low rate (9%) of conversion to THA.[10] Midterm outcomes at an average of 49 months (range, 36 to 70 months) continued to show high patient-reported outcome scores but an increased rate of conversion to THA of 25%.[27] In addition, Boykin et al.[28] reported excellent outcomes and high rate of return to play among elite athletes after arthroscopic labral reconstruction.

Our outcomes, including an average 34-point improvement in MHHS and an average 27-point improvement in LEFS, are also comparable or better than results reported from acetabular labral repair. In a recent study of outcomes among primary labral repair patients, the MHHS improved 18.9 points on average from preoperative to 2 years postoperative.[29] Another study of results comparing labral refixation with labral debridement reported an MHHS improvement of 29.8 points in the refixation group and 20.2 points in the debridement group.[30] In addition, the mean VAS improved approximately 5 points in both groups.

Providing a functioning labrum has been shown to be crucial in maintaining the longevity of the hip joint.[2] Labral reconstruction allows for many of the same benefits as labral repair.[10,24,31] Reconstruction maintains and preserves the intra-articular pressure seal, which keeps joint fluid inside the joint space.[3,4,32] Ultimately, reconstruction can also prevent microinstability and guard against exposure of the lateral acetabular cartilage to sheer forces. This is believed to help maintain healthy cartilage within the joint space.[33] Furthermore, a study of the hip fluid seal found that labral reconstruction of the hip significantly improved intra-articular fluid pressurization in a hip with a partially resected labrum.[3,4] That study suggests that labral reconstruction restores the natural hip anatomy, in terms of the fluid pressurization found in the hip, lending support for labral reconstruction techniques in patients with deficient labral tissue.

The modified labral reconstruction technique using iliotibial band allograft and a modified front-to-back fixation offers several benefits compared with existing labral reconstruction techniques. Allograft tissue allows for creation of a consistent graft of the correct width and length. In combination with the front-to-back fixation, this ensures that the graft is the proper size and that an adequate seal with the femoral head is obtained after the procedure. In addition, allograft eliminates the potential for morbidity at the site of the autograft harvest. Frequently, patients presenting with severely damaged labral tissue also have chondromalacia on the edge of the acetabulum.[34] The labral reconstruction procedure provides the added advantage of full exposure of the acetabular rim to allow for aggressive rim trimming. This allows for complete resection of the entire pincer lesion and often the entire portion of the cup that had cartilage damage, allowing for acetabular rim trimming back to normal cartilage and cup. The bleeding bone on the acetabular rim is an ideal location for graft incorporation as the graft is exposed primarily to compressive forces.

Labral reconstruction offers a powerful solution to a very complex problem. The labrum has immense value to a healthy joint. When a torn labrum is not repairable, consideration should be given to reconstruction. The use of allograft eliminates donor site morbidity and offers comparable results to autograft.[10] The front-to-back technique is an alternative fixation technique, which reproducibly yields the correct graft length.

Table 2. Comparison of Mean Change in Subjective Scores for Hips With Concomitant Procedures Compared With Hips Without Concomitant Procedures (n = 113)

Variable	Concomitant Procedures	No Concomitant Procedures	*P* Value
Mean satisfaction	9	9	.4436
Modified Harris Hip Score change	34	33	.8112
Lower Extremity Function Score change	28	26	.6234
Pain VAS at rest change	3	3	.5476
Pain VAS average pain with daily activities change	4	4	.5556
Pain VAS sport change	5	5	.6139

VAS, Visual Analogue Scale.

Excellent results can be obtained with this technique and graft source.

Limitations

A major limitation of the present study is that it does not include a control group to compare outcomes; however, these data can contribute to the literature on arthroscopic labral reconstruction and can be compared to previously reported case series on arthroscopic labral repair, arthroscopic labral debridement, and/or open intra-articular labral treatment. A related limitation is the risk for selection bias that is inherent in the case series study design. Although all patients who underwent labral reconstruction during the prespecified timeline were included in this analysis, there is the potential that these patients may not be generalizable to other hip patients. Also, while the percentage of patients who we were able to follow up with was high (86.2%), it is possible that the outcomes from the remaining 13.8% patients could have changed our findings. In addition, patients were not excluded if they had concomitant procedures performed. An analysis of patients with concomitant procedures compared with those without was performed to determine whether any significant differences existed between the groups. No significant differences were identified (Table 2), which lent support to including patients with concomitant procedures in the study population. Along the same lines, this study includes a fairly large case series of 152 hips that underwent arthroscopic labral reconstruction using one surgical technique; however, the sample size was not large enough to provide analysis of subgroups of the study population. In particular, owing to the limited number of young patients in this case series, we were unable to elaborate on this subgroup of patients. Future research should further analyze results in younger patients, patients with specific associated procedures, and patients with comorbidities. Finally, while this study presents a minimum follow-up of 2 years, these are also early outcomes, with a mean of 28 months. The early outcomes of this procedure are promising, but more research is needed to determine long-term outcomes of not only this technique but of all techniques for labral reconstruction.

Conclusions

Arthroscopic iliotibial band allograft labral reconstruction of the hip shows promising outcomes at a minimum of 2 years of follow-up.

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