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Arthroscopic Labral Reconstruction of the Hip: A Decade of Growing Evidence and Technical Evolution

Brian J. White, MD and Mackenzie M. Herzog, PhD, MPH†*

Summary: The field of hip arthroscopy has rapidly evolved over the past 2 decades. Originally, surgical treatment of the hip primarily involved resection of damaged tissue. More recently, arthroscopic surgical procedures that aim to preserve and restore the function of the labrum have been advocated and have shown superior results when compared with debridement or excision. Although labral repair has been largely adopted as a standard labral preservation procedure to treat labral tears, continued innovation in hip arthroscopy techniques and tools has paved the way for labral reconstruction as an alternative and even preferable treatment option. As the clinical field has developed and expanded, so too has the availability and quality of evidence on indications, treatments, and outcomes of hip arthroscopy procedures. The purpose of this manuscript is to review the current literature on indications, arthroscopic technique, and outcomes of arthroscopic acetabular labral reconstruction and provide the lead author's experience with arthroscopic labral reconstruction over the past decade. A growing body of evidence supports the potential to achieve positive patient-reported outcomes and low revision rates with labral reconstruction across different indications. These promising outcomes across a wide variety of settings and pathologies suggest that labral reconstruction can effectively increase function and decrease pain, making it an important hip preservation tool for the hip arthroscopist.

Key Words: hip arthroscopy—arthroscopic labral reconstruction—labral reconstruction with allograft.

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BACKGROUND

The field of hip arthroscopy has rapidly evolved over the past 2 decades. Although the first documented hip arthroscopy was performed in the 1930s, its use was largely limited to diagnosis and removal of loose bodies until the 1990s when utilization began to expand.[1] Treatment of intra-articular hip pathology, including labral tears and femoroacetabular impingement (FAI) is now common practice; from 2006 to 2010, a 600% increase in the number of hip arthroscopies performed was observed by American Board of Orthopaedic Surgery Part II examinees.[2]

Although labral repair has been largely adopted as a standard labral preservation procedure to treat labral tears,[3] continued innovation in hip arthroscopy techniques and tools has paved the way for labral reconstruction as an alternative and even preferable treatment option. Since our last review of the literature on labral reconstruction in 2015,[4] the availability and quality of evidence on indications, treatments, and outcomes of hip arthroscopy in general and labral reconstruction specifically has expanded. From 2011 through 2015, the number of publications on FAI alone increased by 3.5× and a shift was noted toward publications meeting a higher level of evidence.[5] In the last 2 years alone, at least 4 systematic reviews or consensus statements have been published focused on labral reconstruction.[6–9] The purpose of this manuscript is to review the current literature on indications, arthroscopic technique, and outcomes of arthroscopic acetabular labral reconstruction and provide the lead author's experience with arthroscopic labral reconstruction over the past decade.

INDICATIONS

The well-described importance of the labrum in maintaining normal hip function supports the potential indications for surgery to reconstruct the labrum in the setting of a tear or insufficiency. Most notably, a tear or insufficiency can lead to loss of fluid pressurization,[10] and labral reconstruction has been shown to improve fluid pressurization, improve stabilization, and decrease contact pressure.[10–12]

Historically labral reconstruction was typically reserved for specific revision settings.[13] Now, the lead author believes labral reconstruction should largely be considered the standard for revision procedures. Our study in 2016 compared outcomes among patients who underwent revision labral reconstruction versus revision labral re-repair showed a lower failure rate following revision labral reconstruction.[14] Among 113 hips that were followed for a mean of 2.6 years postoperatively, hips that underwent revision labral repair (7/15 hips, 50%) were 4.1 times (95% confidence interval: 1.9, 8.8 times) more likely to fail treatment than hips that underwent revision labral reconstruction (11/98 hips, 13%).[14] Subsequently, all hips presenting for revision labral treatment are indicated for labral reconstruction in the lead author's practice.

In addition, the space for primary labral reconstruction has become more clearly defined.[9,15–17] In 2018, 12 high-volume hip arthroscopists were surveyed on indications for primary labral reconstruction.[9] The most common indication selected was a calcified labrum, followed by poor quality labral tissue.[9] In the literature, insufficient labral tissue and irreparable labral pathology are most commonly cited as indications for labral reconstruction over repair (Fig. 1).[6,8,13,18] In cases when the labral tissue is insufficient, a labral repair may not adequately restore fluid pressurization and stabilization.[10,11] In terms of size, a labrum < 2 to 3 mm or > 8 mm is indicated for primary reconstruction (Fig. 2).[6,19] Other indications for labral reconstruction include hypoplastic labrum,[9] capsulolabral adhesions from prior surgery,[20] rim ossification or acetabular over coverage,[18] and advancing patient age.[8] The broad range of potential indications suggests that labral reconstruction provides an important procedure in the hip arthroscopist's toolbox for both

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For reprint requests, or additional information and guidance on the techniques described in the article, please contact Brian J. White, MD, at prismresearchconsulting@gmail.com or by mail at Western Orthopaedics, 1830 Franklin Street, Suite 450, Denver, CO 80218-1217. You may inquire whether the author(s) will agree to phone conferences and/or visits regarding these techniques.

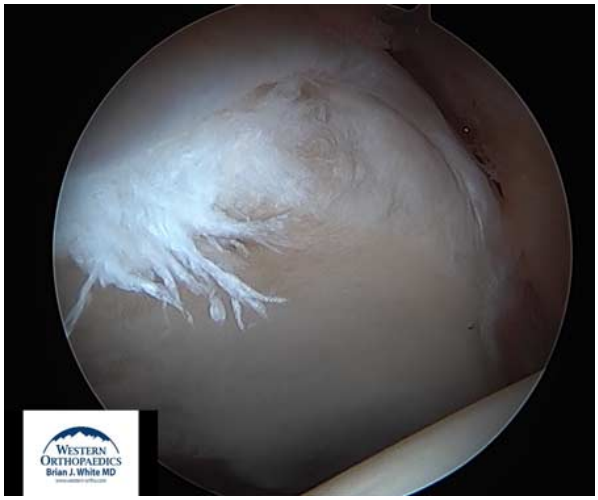

FIGURE 1. View from the AL portal in a right hip of a small, shredded acetabular labrum. AL indicates anterolateral. Copyright [Brian J. White, MD], [Western Orthopaedics]. All permission requests for this image should be made to the copyright holder.

primary and revision settings to preserve and restore labral function. In the lead author's practice, indications for primary labral reconstruction include recalcitrant hip pain that failed nonoperative treatment, preserved joint space (> 2 to 3 mm) and labral pathology diagnosed by clinical examination, diagnostic injection, and/or magnetic resonance imaging.

ARTHROSCOPIC TECHNIQUE

The lead author's technique for allograft labral reconstruction has been modified slightly since the original description.[21] These modifications were made to ensure that the labral graft consistently creates a perfect seal with the femoral head in all quadrants of the acetabulum as well to make the graft longer and truly circumferential.

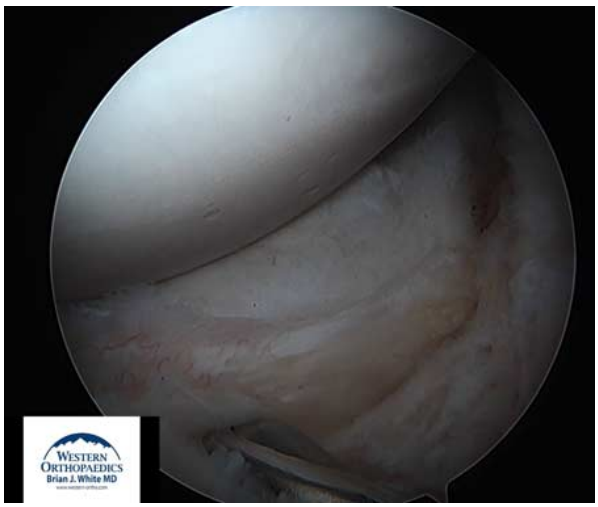

FIGURE 2. Upside down view from the AM portal in the same right hip that is reduced showing a very small (1 to 2 mm) labrum, chronically everted and forming no seal with the femoral head. AM indicates anteromedial. Copyright [Brian J. White, MD], [Western Orthopaedics]. All permission requests for this image should be made to the copyright holder.

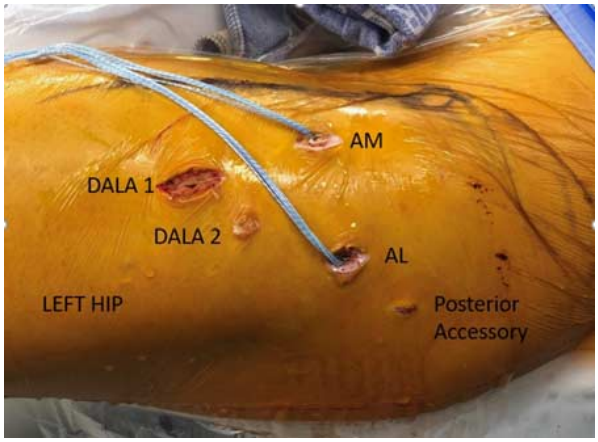

FIGURE 3. Left hip showing the 5 portals recommended for the front-to-back circumferential labral reconstruction technique. AL indicates anterolateral; AM, anteromedial; DALA, distal anterolateral accessory.

The most critical aspect of the procedure involves the meticulous preparation of the femoral head/neck junction and the acetabular rim for the treatment of FAI. The femoral head neck junction is meticulously re-shaped to create an anatomic shape that will fit properly in the acetabulum and will not impinge against the labral graft with increasing hip flexion and rotation. Torn, degenerative labral tissue is removed from the origin of the transverse acetabular ligament anteroinferiorly (7:30 on left hips, 4:30 on right hips) to the most posteroinferior aspect of the acetabulum (3:30 on left hips, 9:00 on right hips). The acetabulum must be prepared as well; any pincer or over coverage must be resected for the same purpose. In the absence of true pincer morphology, the acetabular rim must at least be prepared or excoriated to create bleeding bone that will allow for graft incorporation. Great care must be taken when the acetabular rim is prepared to avoid over resection and iatrogenic dysplasia.

Once the bony work is complete, anchors are placed around the entire acetabular rim, placed roughly 10 to 12 mm apart (Q-Fix; Smith and Nephew). These are placed from 1 of 2 distal anterolateral accessory (DALA) portals to allow access to both the anterior and posterior aspects of the acetabulum (Fig. 3). Anchors must be placed as close to the cartilage border as possible to avoid eversion of the labral graft. All anchors are placed before the graft is brought into the joint, as the exposure is best and spacing between anchors and anchor position can be optimized (Figs. 4A, D). Once all of the anchors are placed, 2 small drill holes (0.6 mm in diameter) are placed between the anchor sites, called vascular channels, to encourage biological incorporation of the graft, especially in areas where the acetabular edge could only be excoriated to conserve cup volume. The graft is then introduced into the joint.

A frozen fascia allograft (AlloSource) is the preferred labral graft for the lead author. A survey of high-volume hip arthroscopists also noted that 91.7% of surgeons surveyed preferred allograft tissue over autograft.[9] The length is determined by measuring from the front to the back of the labral defect with a 4 mm wide elevator and adding roughly 3 to 4 cm to accommodate for undulations on the acetabular rim. Once the length is determined, the graft is fashioned by tubularizing the fascia. It is folded in thirds or quarters and a 2-0 Vicryl is passed with several small bites across either end of the graft like an accordion to begin the tubularization process. These sutures

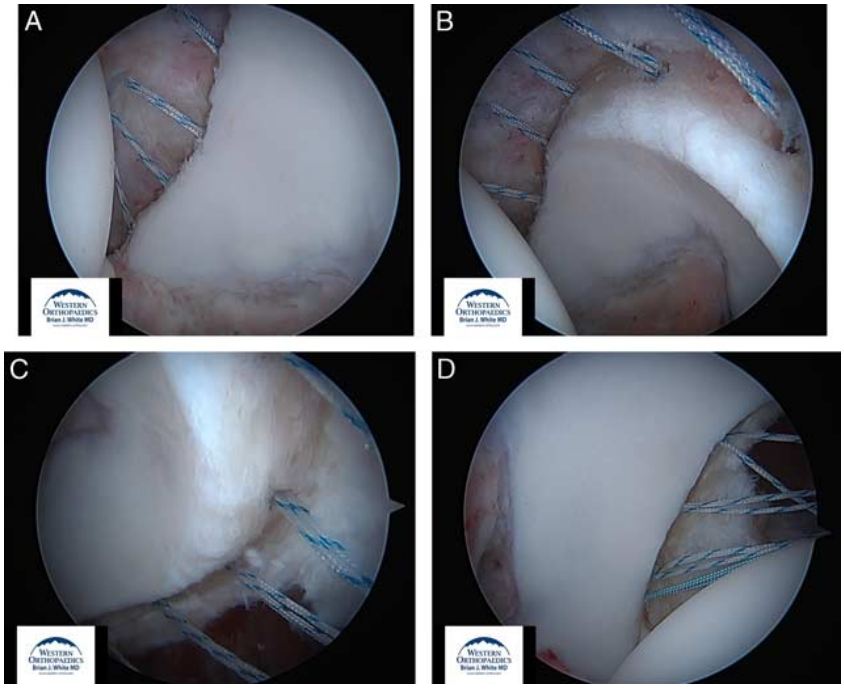

FIGURE 4. A, View from the AL portal in a left hip of the anteroinferior acetabulum from roughly 7:30 to 10:00. B, View from the AL portal of the anterosuperior acetabulum from roughly 9:00 to 12:00. C, View from the AM portal of the posterosuperior acetabulum from roughly 11:30 to 2:30. D, View from the AM portal of the posteroinferior acetabulum from roughly 1:30 to 4:00. AL indicates anterolateral; AM, anteromedial. Copyright [Brian J. White, MD], [Western Orthopaedics]. All permission requests for this image should be made to the copyright holder.

are then secured to a graft master to maintain tension on the graft. A baseball stitch with 2-0 Vicryl is then run from the front to the back of the graft with occasional circumferential wraps to compress the fascia and prepare the graft for implantation. Optimal final diameter of the graft is 5 to 5½ mm once tightly compressed (Fig. 5).

FIGURE 5. 13 cm prepared frozen fascia allograft (Allosource, Centennial, CO).

The graft is transported into the joint by a cannula placed from an anterior DALA portal. The most anteroinferior anchor is used for this. One suture limb is lengthened and placed through the graft in figure of 8 fashion and a knot is tied to secure it. The shortened limb or post suture is then pulled, and as the graft is secured to the nonpost suture, this transports the graft into the joint. Occasionally, in tight, retroverted or deep cups where anteroinferior access in traction is limited, the lowest anchors can be placed in the peripheral compartment and the graft can be transported via this access as well. Once the graft is in the joint it is provisionally positioned on the acetabular rim. Tension is maintained on the graft by a probe placed through the anteromedial (AM) portal. Sutures are then secured for the first 2 or 3 anchors. The remaining sutures are passed at the anterior superior, lateral and posterior aspects of the acetabulum but not tied, and are passed through the AM and anterolateral (AL) portals. This is done to tension the graft around the anterosuperior aspect of the cup. This zone occasionally can be problematic for creating a seal with the femoral head as it represents the transition from the vertical aspect of the anterior wall of the cup to the horizontal aspect of the lateral cup.

With the anteroinferior aspect of the labral graft secured and all of the sutures passed, the graft is tensioned and the final length is assessed posteroinferiorly. The graft is then cut in the joint to make sure the length is appropriate. To cut the graft, an additional portal is required for longer grafts. It is made posterior and slightly proximal to the AL portal to cut the graft with a beaver blade as it is held under tension with a grasper from the AL portal. On average, complete grafts are 11 to 14½ cm long (Figs. 6A, B).

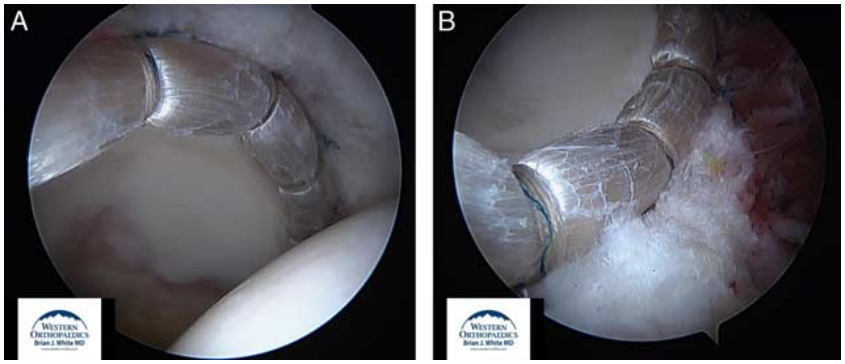

FIGURE 6. A, View from the AL portal of the same right hip showing a 12.5 cm frozen fascia lata allograft fixed with 11 anchors. B, Upside down view from the AM portal of the same right hip showing a 12.5 cm frozen fascia lata allograft going down the posterior aspect of the acetabulum. AL indicates anterolateral; AM, anteromedial. Copyright [Brian J. White, MD], [Western Orthopaedics]. All permission requests for this image should be made to the copyright holder.

Two anchors are placed at the most posteroinferior aspect of the acetabulum within a few millimeters of each other. The most distal anchor is passed through the graft with an Elite Pass (Smith and Nephew). This is then tied and the adjacent anchor is tied circumferentially around the graft, because the distal suture was passed through the graft it cannot slide over the end of the graft. The camera is then placed in the AL portal and a cannula is placed in the more posterior DALA portal. Before this, the camera was in the AL portal for anterior work and in the AM portal for posterior work, and tying is generally performed from the 2 DALA portals. Traction is taken down and the graft is reduced to the edge of the acetabulum by the femoral head. All remaining anchors and sutures are tied and secured in the peripheral compartment to rigidly fix the graft. It is imperative that the secured graft forms a perfect seal with the femoral head in all locations (Fig. 7). This is confirmed and dynamic testing is performed to ensure there is no impingement of the graft with hip rotation. The anterior portion of the 3 to 4 cm capsulotomy is closed with 1 or 2 sutures depending on the degree of baseline capsular laxity with a #1 Vicryl suture passed with a Zimmer Biomet Dragon Tongue for a side to side closure.

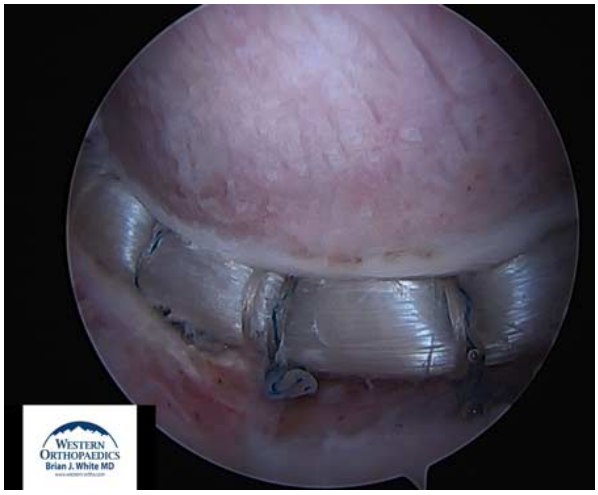

FIGURE 7. Upside down view from the AM portal of the same right hip that is reduced showing the graft now providing a perfect seal with the femoral head. AM indicates anteromedial. Copyright [Brian J. White, MD], [Western Orthopaedics]. All permission requests for this image should be made to the copyright holder.

OUTCOMES

Reports of outcomes following arthroscopic labral reconstruction have increased in recent years, with 6 publications in 2018 alone,[16,17,22–25] compared with 7 previously identified by our research team from 2010 to 2016.[4] Of the 15 total studies included in our review to-date, we identified 7 publications of outcomes following reconstruction with allograft and 8 publications following reconstruction with autograft (Table 1).[6–8]

Overall, labral reconstruction led to improvements in patient-reported outcomes following surgery and low revision rate (Table 1).[6–8] Of the 1262 hips included in the studies that we reviewed, ~11% were reported to have been converted to total hip arthroplasty (Table 1).[6–8] Among hips that did not fail treatment, the average improvement in the Modified Harris Hip Score (MHHS) was 27 points from preoperative (mean = 59, SD = 6) to postoperative (mean = 86, SD = 4; Table 1).[6–8] This average improvement of 27 points in the MHHS suggests that most patients met the Minimal Clinical Important Difference for improvement in hip function as defined by Chahal et al.[32]

The lead author has performed over 3000 allograft labral reconstructions in the past decade (July 2009 to February 2020) across both primary and revision settings. From 2009 through 2011, the lead author performed both labral repair and labral reconstruction procedures, where complete labral reconstruction was preferred for patients with insufficient labral tissue or an irreparable labral tear. In 2012, the lead author noted an unacceptable failure rate among patients who underwent labral repair as compared with those who underwent labral reconstruction and began performing only labral reconstruction in all cases. Currently, this represents a unique, high volume practice focusing exclusively on labral reconstruction for all hip arthroscopy operations. Need for revision procedures has been notably lower among labral reconstruction cases when compared with labral repair in his practice.[14,16,27]

The strongest evidence to support primary labral reconstruction over primary labral repair comes from a direct comparison of the 2 treatment options in the same patient, where one hip underwent primary labral reconstruction and the other hip underwent primary labral repair.[16] Of the 29 patients in this unique situation, no labral reconstruction hip required a revision surgery while 9 (31%) of the labral repair hips underwent revision during a mean follow-up time of over 2 years and 100% follow-up.[16] All patients who failed labral repair chose to undergo arthroscopic labral reconstruction as the revision procedure.[16] More recently, the lead author showed that revision rates were significantly lower among patients aged

TABLE 1. Published Arthroscopic Labral Reconstruction Outcomes

Study	Complete vs. Segmental	Graft	N	Sex	Age	Follow-up	Convert to THA	Average Preoperative MHHS	Average Postoperative MHHS
Allograft									
Carreira et al[22]	Segmental	Tensor fascia lata	31	11 M 20 F	44 y (20-66 y)	32 mo (24-46 mo)	4 (13%)	64	85
Rathi and Mazek[26]	Segmental	Tensor fascia lata	10	10 M	35 y (26-44 y)	23 mo (16-36 mo)	None reported	58	95
Scanaliato et al[17]	Complete	Tensor fascia lata	63	26 M 37 F	43 y	24 mo (22-26 mo)	2 (3%)	60	81
White et al[27]	Complete	Iliotibial band	152	64 M 78 F	39 y (16-58 y)	28 mo (24-39 mo)	13 (10%)	54	88
White et al[14]	Complete	Iliotibial band	90	26 M 72 F	35 y (16-60 y)	28 mo (24-48 mo)	Not reported	49	81
White et al[16]	Complete	Iliotibial band	58	6 M 23 F	33 y (15-52 y)	56 mo (26-85 mo)	None reported	58	88
White et al[28]	Complete	Iliotibial band	270	53 M 217 F	41 y (30-65 y)	44 mo	10 (4%)	51	88
Autograft									
Amar et al[24]	Complete	Rectus femoris	22	19 M 12 F	42 y (22-68 y)	32 mo (2-72 mo)	2 (9%)	67	92
Boykin et al[29]	Segmental	Iliotibial band	21	19 M 0 F	28 y (19-41 y)	41 mo (20-74 mo)	2 (10%)	67	84
Domb et al[30]	Segmental	Gracilis	11	7 M 4 F	33 y (18-45 y)	26 mo (24-32 mo)	None reported	55	82
Geyer et al[20]	Segmental	Iliotibial band	76	42 M 33 F	39 y (18-64 y)	49 mo (36-70 mo)	18 (24%) +1 (1%) resurface	59	83
Lebus et al[25]	Segmental	Iliotibial band	317	170 M 141 F	35 y (15-71 y)	44 mo (24-136 mo)	42 (13%)	65	85
Philippon et al[13]	Segmental	Iliotibial band	47	32 M 15 F	37 y (18-55 y)	18 mo (12-32 mo)	4 (9%)	62	85
Philippon et al[31]	Segmental	Iliotibial band	187	110 M 77 F	35 y	44 mo	27 (14%)	Not reported	80
Rathi and Mazek[23]	Segmental	Rectus femoris	7	5 M 2 F	35 y (25-41 y)	15 mo (12-18 mo)	None reported	56	93

F indicates female; M, male; MHHS, Modified Harris Hip Score; THA, total hip arthroplasty.

40 years and older who underwent labral reconstruction compared with those who underwent labral repair in a study of 318 patients with a minimum of 2 year follow-up.[28] Among these patients, those who underwent labral repair (17/82 hips, 22%) were 3.3 times (95% confidence interval: 1.3, 8.7 times) more likely to fail than patients who underwent labral reconstruction (10/136 hips, 8%).[28] When comparing patients aged 40 years and older who underwent labral reconstruction compared with patients 30 to 39 years old who underwent labral reconstruction, there was no difference in failure rate.[28] These patients represent a historically challenging population where high failure rates have been reported among other surgeons in labral repair studies, citing failure rates above 25% in patients over 40.[33,34] These results suggest that labral reconstruction may be beneficial in this population to reduce failure rate and improve function.

In addition, the lead author has observed greater improvements in patient-reported outcome scores among hips that underwent labral reconstruction,[14,16,27] above and beyond the average improvements noted in other studies assessing labral reconstruction outcomes[6–8] and above and beyond average improvements noted following labral repair and other treatments.[35] Specifically, the lead author has reported a 33 point average improvement in MHHS (range: 30 to 37),[14,16,27,28] compared with a 25 point average improvement noted among 10 studies reviewed (range: 17 to 37; Table 1)[13,17,20,22–26,29,30] and a 22 point average improvement noted in a previous systematic review of labral and FAI treatment outcomes.[35] For these reasons, the lead author performs only labral reconstruction procedures and has advocated for a shift in the hip arthroscopy field toward primary labral reconstruction given the consistently improved outcome scores noted, low revision rate, and ability to successfully treat a broader spectrum of patients; however, this stance is controversial at present. Some surgeons feel that labral repair should be the first-line treatment irrespective of tissue quality, and some consider labral reconstruction only in the setting of a salvage operation. There is concern that a labral reconstruction, especially when performed in a young patient, represents the final hip preservation surgery. Certainly, this is true if the index labral reconstruction was performed poorly, particularly when the acetabular rim is significantly over resected. However, when performed appropriately, the labral reconstruction can simply be revised with another graft in the event that a revision is required. The fore mentioned studies represent the clinical experience of the lead author. In his practice, labral reconstruction has been superior to labral repair, and he advocates for labral reconstruction to be considered as the primary treatment for significant labral pathology.

CONCLUSIONS

Given the important and well-established role that the acetabular labrum plays in hip joint biomechanics,[10–12] arthroscopic

labral reconstruction is an important treatment option that preserves and restores the function of the labrum. Labral reconstruction leads to improved patient function and low revision rate, at times above and beyond other labral preservation procedures,[6–8,10,11,13,14,16,18,27] and subsequently is gaining popularity and utilization for treating labral pathology across a number of indications.[6,8,9,13–20]

Although several surgical techniques and graft options have been published in the literature, the lead author prefers a complete front-to-back fixation technique with iliotibial band allograft, as described above and previously cited.[21] The primary advantages of this technique are that it allows the surgeon to reproducibly create a graft that is the correct size by creating a graft that is 1 to 2 cm longer than necessary and cutting it to the appropriate length inside of the joint. It is important to note that this procedure is technically demanding and requires adequate training in hip arthroscopy and proficiency in placing anchors around the entire acetabular rim. Results of previously published studies, including the experiences of the lead author described here, may not be generalizable to other surgeons or patient populations. Widespread utilization of this procedure is limited by the surgical time required, its imperfect fit in surgery centers, and the advanced experience and skill set required to perform it. The lead author welcomes individuals who are interested in learning more about this technique to visit and train at his practice.

A growing body of evidence supports the potential to achieve positive patient-reported outcomes and low revision rates with labral reconstruction across different indications.[6–8] Across the literature reviewed, the average improvement in the MHHS was 27 points and ~10% of procedures progressed to a future total hip arthroplasty,[6–8] and the lead author has reported results above and beyond these, including an average MHHS improvement of 32 points and significantly lower rate of revision compared with labral repair.[14,16,27] These promising outcomes across a wide variety of settings and pathologies suggest that labral reconstruction can effectively increase function and decrease pain, making it an important hip preservation tool for the highly proficient hip arthroscopist.

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