Journal of Hip Preservation Surgery Vol. 5, No. 4, pp. 329–338
doi: 10.1093/jhps/hny033
Advance Access Publication 27 September 2018
Review article

OXFORD

Graft choices for acetabular labral reconstruction

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Submitted 11 May 2018; revised version accepted 8 July 2018

ABSTRACT

The acetabular labrum plays a key role in maintaining hip function and minimizing hip degeneration. Once thought to be a rare pathology, advances in imaging have led to an increase in the number of diagnosed labral tears. While still a relatively new field, labral reconstruction surgery is an option for tears that are irreparable or require revision after primary repair. Various autograft and allograft options exist when considering labral reconstruction. The first labral reconstruction surgery was described using the ligamentum teres capitis, and has since evolved, incorporating more graft sources and reconstructive techniques. The purpose of this review is to assess and describe the different graft sources and technique currently implemented by hip surgeons. Moreover, this review attempts to determine whether a single labral reconstructive graft type is superior to the others. Techniques using the Ligamentum teres capitis autograft, ITB autograft, gracilis autograft, quadriceps tendon autograft, capsular autograft, semitendinosus allograft, indirect head of the rectus femoris autograft, peroneus brevis tendon allograft and Tensor fascia lata allograft were found. Scoring was available on 5 out of the 9 graft types. The advantages and disadvantages of each graft source is described as a comparative tool. No single graft type has shown increased benefit in acetabular labral reconstruction. The lack of uniform outcome measurements hinders comparison of reported outcomes. Surgeons should make an informed decision based on their experience as well as the patient's history and needs when choosing which graft type would be best suited for their patients.

INTRODUCTION

The acetabular labrum is a vital structure for the maintenance and function of the hip joint. The acetabular labrum's mechanical role is to increase the effective surface area of the joint by deepening the acetabular socket [1]. Furthermore, the labrum acts as a gasket, creating a suction seal around the femoral head, promoting joint stability, lubrication and decreasing joint contact pressures [2]. Labral injury has been associated with early degenerative hip disease [3]. Labral injury is theorized to disturb the labral suction seal and allow for increased joint reactive forces by destabilizing the joint and reducing joint lubrication [4]. While once thought to be a relatively uncommon injury, advances in imaging and arthroscopic techniques have led to an increase in the diagnoses and treatment of symptomatic acetabular labral tears [5]. Surgical procedures designed to treat symptomatic acetabular labral tears are intended to both reduce symptoms and to restore labral function, possibly preventing or delaying the development of hip pathology [4]. Labral repair procedures are designed to restore function to the acetabular labrum and have been associated with better outcomes when compared with labral resection procedures which do not restore labral function [6]. In the case of large irreparable labral tears primary repair may not be possible due to the severity of damage and the quality of the remnant labral tissue [7]. In these cases, labral reconstruction may be performed to improve symptoms and restore labral function [8].

Labral reconstruction was first described using a ligamentum teres capitis graft through an open approach with hip disarticulation by Sierra *et al.* in 2009 [9]. Since then, multiple iterations of this surgery have been described using various approaches and numerous graft sources [10–17]. These techniques use a variety of graft sources, which are chosen based on the demands of the patient, patient preference, availability of cadaveric allograft and the surgeons' preferences or experience. As hip preservation surgery has become increasingly popular, more surgeons are preforming these challenging procedures and reporting their outcomes. Good early and midterm outcomes have been reported in the literature for labral reconstruction surgery and interest in these procedures continues to grow. The purpose of this review article is to describe current concepts in acetabular labral reconstruction surgery in concert with the relevant anatomy, biomechanical considerations, imaging modalities, surgical techniques, possible graft sources and reported outcomes of labral reconstruction surgery.

ANATOMY AND BIOMECHANICS

The acetabular labrum is a fibrocartilaginous structure that originates from the acetabular rim [18]. The labrum also contains indirect attachments to the acetabular cartilage through a transitional zone [18]. The labrum's thickness is the measured diameter width in the anterior posterior plane while the height is measured as a function of how much it extends outward from the acetabular rim. The labrum is thicker in its posterior region and thinner and wider in its anterior region [19]. The average labral thickness ranges from 2 to 3 mm [20], and the height of the acetabular labrum spans between 2.9 and 6.5 mm. Labral width ranges from 2.7 to 5.5 mm [19]. Studies of labral anatomy are most often performed on cadaveric samples from elderly individuals and reported findings of labral architecture may be subject to nonpathologic age-related changes.

The anatomy of the acetabular labrum serves to support the labrums role as a stabilizer of the hip joint (Fig. 1) and increases the surface area in the femero-acetabular articulation [1, 21]. Furthermore, the labrum increases the contact surface area between the acetabulum and femoral head by 28% and deepens the acetabular volume by 21%, thus acting to stabilize the joint at various ranges of motion. Petersen *et al.* [22] found that the lateral labral length is inversely correlated with the lateral center edge angle of Wiberg, suggesting that labral coverage increases as acetabular coverage decreases. This finding may demonstrate how the labral coverage can augment bony coverage of the femoral head. Crawford *et al.* [23] demonstrated that a labral defect decreases stability in the extreme positions of the femero-acetabular articulation. Moreover, Crawford showed that in the presence of a labral defect the force required to dislocate the femur decreases by 60% relative to the femoral dislocation force required when the labrum is intact.

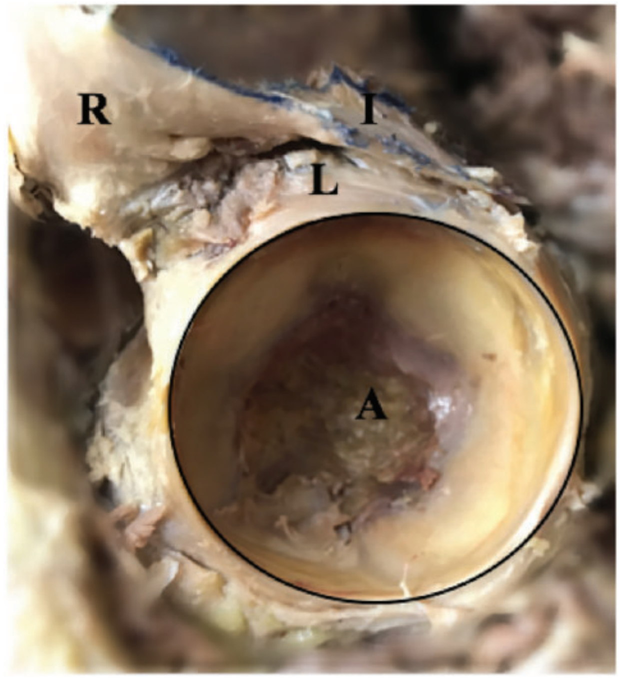

Fig. 1. A cadaveric dislocated left hip after dissection with the capsule removed shows the acetabular socket [A], labrum [solid line L], direct head of the rectus femoris tendon [R] and the indirect head of the rectus femoris tendon [I].

In addition to increasing the force required to dislocate the femur the labrum also reduces femero-acetabular contact pressures. In the absence of an acetabular labrum and the suction seal provided by the labrum, synovial fluid is not confined to the joint. Reduced synovial fluid in the joint and the absence of the labral suction seal results in increased contact pressures in the femero-acetabular articulation and ultimately more mechanical stress on weight bearing cartilage surfaces and ultimately cartilage degeneration [24, 25].

INDICATIONS FOR LABRAL RECONSTRUCTION

Nonoperative or conservative management of labral tears may include modalities such as physical therapy, nonsteroidal anti-inflammatory medications, rest, activity modification and steroid injections. Currently no long-term follow-up data on the outcomes of conservative management of large irreparable labral tears has been published. Surgical indications for labral reconstruction include: (i) symptomatic hip pain consistent with labral pathology, (ii) a failed trial of conservative management, (iii) radiographic evidence of labral pathology demonstrated with advanced imaging modalities such as magnetic resonance imaging (MRI) or magnetic resonance arthrography (MRA) or on diagnostic arthroscopy which is often the first step in the reconstruction procedure and (iv) a native labrum that is deemed unsuitable for labral repair.

The current literature defines guidelines to assist in determining if a patients' native labrum would be amenable to labral repair or if labral reconstruction surgery is indicated. In the case of large or irreparable labral tears where insufficient native labral tissue is available for repair, labral reconstruction is indicated [7, 9, 10, 13, 26–31]. Specifically, when less than 2–3 mm of healthy native labrum tissue is visualized during the diagnostic arthroscopy or if the surgeon is concerned that the labrum would not supply an adequate suction seal with the femoral head, reconstruction should be considered [2, 32–34]. Conversely, White and Herzog [33] published a review paper that has suggested the labral size of greater than 8 mm in width may be an indication for labral reconstruction due to the fact that it may not allow for optimal healing or restoration of the labral suction seal, however as pointed out in that paper there is no clear support for this in the literature.

Further indications for labral reconstruction include capsulolabral adhesions secondary to prior hip surgeries. In the case of adhesions, scare tissue may be integrated into the labrum and excision might damage the native labrum necessitating reconstruction [7]. Regardless of the source of labral damage, iatrogenic damage during acetabuloplasty, secondary to labral ossification, femoral acetabular impingement (FAI) or other causes, labral reconstruction should be considered when large irreparable labral tears are diagnosed in symptomatic patients amenable to operative intervention (Table I).

Contraindications for labral reconstruction surgery includes a large irreparable labral tear in a patient with advanced osteoarthritis that may be contributing hip pain [26, 33]. Joint space narrowing resulting in a joint space of $\leq$2 mm is also a contraindication for labral reconstruction [7]. In addition, patients with Tönnis grade osteoarthritis $\geq$2 may be contraindicated for labral reconstruction. This has not been clearly sighted as a contraindication in the literature however, many authors have excluded patients from retrospective studies of labral reconstruction if their Tönnis grade was $\geq$2. Finally, although no specific age has been outlined as a contraindication to labral reconstruction, patient age should be considered prior to surgery.

Table I. Indications for labral reconstruction surgery

Indications	• Labral tissue is of poor quality
	• Symptomatic hip pain consistent with labral pathology
	• Radiographic evidence of labral pathology
	• Failed trial of conservative management
	• Insufficient labral tissue exists to repair
	• Hypotrophic labrum (width <5 mm) [7]
	• Labral tissue too large to achieve joint compression (>8 mm)
	• Failed prior hips surgery (revision surgery)
Contraindications	• Preoperative joint space ≤2 mm [7, 13]

IMAGING OF IRREPARABLE LABRAL TEARS

Imaging plays an essential role in the diagnostic workup of irreparable labral tears. Imaging assists the surgeon by affirming the diagnosis of a labral tear made based on patient's history and physical exam. Furthermore, the various forms of imaging assist in characterizing pathology, preoperative planning and intraoperative decision making. Radiographs, computed tomography (CT) and MRI all have specific roles in assessment of labral tears in a hip joint compatible with reconstruction.

Plain film radiographs are widely available, and can assess for pathological bony structures that contribute to labral injury. In a patient with FAI, cam or pincer deformities may be apparent on plain film radiographs. Low anterior inferior iliac spine [35] and other bony contributors to intra or extra-capsular impingement may be seen as well. Preoperative assessment should include standard anteroposterior pelvis and frog-leg lateral or Dunn lateral radiographs, in addition to other views based on the surgeons' experience and the history or physical exam. Plain radiographs with joint space of <2 mm will generally exclude a patient from labral reconstruction.

CT is the imaging modality of choice to accurately describe the location and topography of the bony lesion in FAI. CT allows for further analysis of deformities detected on plain radiographs and allows for better preoperative planning [36]. CT may reveal occult arthritic changes not seen on plain radiographs, such as small subchondral cysts. However, exposure to radiation remains a concern with CT. Considering that MRI arthrography offers enhanced assessment of soft tissues in patients with suspicion of labral tears, surgeons may prefer to forgo CT imaging in favor of MRI as the imaging modality of choice in patients with a suspected labral tear.

Both MRI and MRA have been shown to provide adequate results in detecting acetabular labral tears in adults. MRA has been shown to have a higher sensitivity for detecting labral tears while MRI has higher specificity [37]. There are many radiographic signs that suggest labral tears on MRI and MRA imaging. Slight labral irregularities or distortions on MRA may represent a tear [38]. Additionally, tears of the acetabular labrum can be identified by a high signal intensity on T2-weighted imaging or show contrast material extending into the labral substance or the acetabular junction [38] (Fig. 2). The gold standard for the diagnosis of labral tears remains diagnostic arthroscopy. Diagnostic arthroscopy is most often performed as the first portion of the therapeutic procedure intended to address the pathology. Operative plans should remain flexible and account for discrepancies between radiographic imaging and what is visualized via arthroscopy [39].

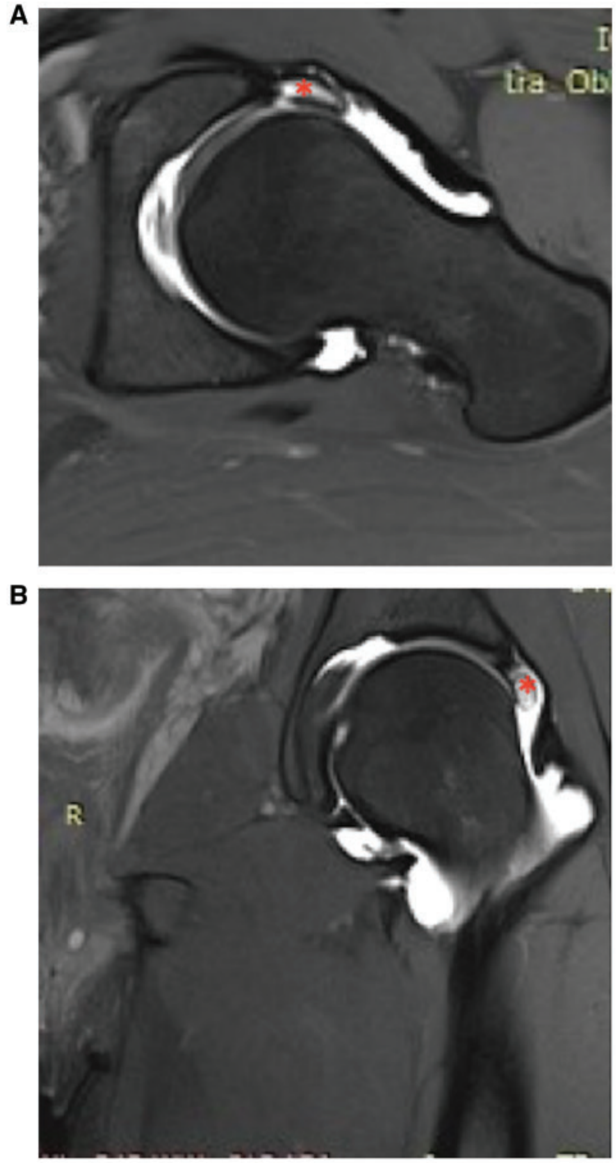

Fig. 2. (**A**) An axial MR arthrogram and (**B**) a coronal MR arthrogram show labral tear with contrast material extending beyond the joint space. A red asterisk depicts a folded labrum surrounded by contrast material in both images.

GRAFT CHOICE AND SURGICAL TECHNIQUES

Graft choice considerations

When indicated, the torn labrum should undergo primary repair. When it is unfeasible to preform labral repair, labral reconstruction using either an autograft or allograft may be warranted (Table II). Autografts may be harvested near the operative site and considered local autografts, which do not require additional surgical incisions to harvest the graft (e.g. ligamentum teres, reflected head of the rectus femoris, capsular graft), or have remote harvest sites, requiring separate incisions to harvest the tendon graft (e.g. tensor fascia lata, quadriceps and hamstrings). The purported advantages of autografts over allografts include a lower infection rate, no risk of disease transmission or immune reaction and lower cost [11, 17]. An additional benefit of autograft use is their ability to histologically convert to fibrocartilage tissue after integration with the local tissue [44]. Allografts on the other hand may allow surgeons to tailor the graft width, thickness and length to their reconstructive needs, whereas certain autograft may result in inadequate graft size or morphology [33]. Furthermore, allografts provide the added benefit of not having donor-site morbidity [45]. The choice of graft type must be approached in a case-specific manner, with the patient's specific needs in mind. For instance, if a patient has had a prior skin graft on the thigh, harvesting the quadriceps tendon may not be a viable option.

Commonly described allograft tendons include the gracilis, semitendinosus and the iliotibial band (ITB). Some commonly described autograft tissues include the gracilis, semitendinosus, acetabular capsule, indirect head of the rectus femoris and quadriceps tendon [10, 12, 13, 43, 46, 47]. Ayeni *et al.* [26] performed a review comparing several graft sources, including the ITB, gracilis tendon, and

Table II. Autografts used for acetabular labrum reconstruction

Study	*Date*	*Graft type*	*Number of patients*	*Δ change in outcome scores*
Sierra and Trousdale [9]	2009	Ligamentum teres capitis	5	UCLA 3.2
Walker *et al.* [30]	2012	Ligamentum teres 9 hips	19 (20 hips)	UCLA post-op score 8.5 (range 5–10) (no preoperative scores given)
		Fascia lata 11 hips		
Philippon *et al.* [13]	2010	ITB	47	mHHS 23
Deshmane *et al.* [27]	2013	ITB	2 cases	VHS 61
				VHS 49
Boykin et al. [40]	2013	ITB	21 (23 hips)	mHHS 16.4
				HOS-ADLS 8.6
				HOS-SSS 20.8
Geyer *et al.* [7]	2013	ITB	75 (76 hips)	mHHS 24.1
				HOS-ADLS 12
				HOS-SSS 26
White *et al.* [31]	2016	ITB	142 (152 hips)	mHHS 34
				LEFS 27
				VAS 3
Matsuda and Burchette [10]	2013	Gracilis	8	NAHS 50.5
Chandrasekaran *et al.* [41]	2017	Gracilis autograft or Semitendinosus allograft	22	mHHS 11
				HOS-ADLS 22.2
				HOS-SSS 23.1
				NAHS 19.1
Park and Ko [12]	2013	Quadriceps	1 (case report)	mHHS 25
				WOMAC 34
Sampson [42]	2013	Indirect head of the rectus femoris	31 (31 hips)	mHHS 18.2
Amar *et al.* [43]	2017	Indirect head of the rectus femoris	22	mHHS 29
Rathi and Mazek [14]	2017	Fascia lata	10	mHHS 36

Note: Articles included were either pioneer articles using a particular graft source or had published outcomes.

HOS-ADLS, hip outcome score—activities of daily living subscale; HOS-SSS, hip outcome score—sports-specific subscale; mHHS, modified Harris Hip Score; LEFS, Lower Extremity Function Score; NAHS, nonarthritic hip score; UCLA, University of California, Los Angeles; VAS, Visual Analogue Scale; VHS, Vail Hip Score; WOMAC, Western Ontario and McMaster Universities Arthritis Index.

ligamentum teres, and found that similar biomechanical properties of all the studied tendons. The authors concluded that no one graft material conveyed specific advantages over the others. Regardless of graft type, the graft must be of optimal dimensions and morphology to reestablish the femor-acetabular suction seal. Grafts insufficient in size can present challenges when fixing the graft to the acetabular rim. To prevent this, measurements of the defect

Fig. 3. Shows the direct measurement of a labral defect using a special arthroscopic measuring tool.

must be taken, and are generally conducted via measurement of the prepared acetabular rim using suture length, or by direct measurement of the defect using an instrument of known length such as a burr or a tissues elevator incrementally, or by means of a special arthroscopic measuring tool [28, 41, 45, 48] (Fig. 3).

Surgical management

While reconstructive techniques vary amongst surgeons, the general technique for labral reconstruction follows similar principles. Diagnostic arthroscopy is performed prior to labral reconstruction to evaluate the labral tear, assess and treat any additional intra- or extra-articular pathologies. This is most often accomplished using standard anterolateral and mid-anterior portals with a 70° arthroscope. The labral tissue is debrided to healthy borders, and attempts are made to maintain a small defect. In order to promote graft-to-bone healing, a burr is used to reach a bed of bleeding bone in preparation for graft placement [45].

The labral defect is measured and the graft is prepared such that it covers the defect. It is generally recommended to prepare the graft 30–40% longer and wider than the actual labral defect, allowing for easier graft placement [13, 45]. Excess tissue can be resected after reconstruction is complete [33]. The graft is then anchored to the defect and suture anchors are placed sequentially at regular intervals to securely fix the graft to the acetabular rim [45, 46]. After reconstruction, hip traction is released and a dynamic examination of the hip is performed to confirm restoration of the labral suction seal.

LIGAMENTUM TERES CAPITIS

Reconstruction using the ligamentum teres capitis was first described by Sierra and Trousdale [9] in 2009 using an open surgical approach with hip disarticulation. This approach offers excellent visualization of the femoral head and acetabulum however, due to the extensile nature of this approach it is not often the preferred approach. The ligamentum teres graft is separated from the fovea of the femoral head sharply. The graft is cleaned of synovial tissue and prepared for reconstruction. If the labral defect is larger than the harvested ligament, the graft can be opened longitudinally to virtually double the graft size. The harvested ligamentum teres capitis is then anchored to the native labrum and sutures are placed 7–10 mm apart to secure the graft. Two studies report the outcomes of labral reconstruction using the ligamentum teres capitus. In the first, Sierra and Trousdale [9] reported that all patients had symptomatic improvement and an average of a 3.2 point increase in UCLA scores, from 5 preoperatively to 8.2 postoperatively. Similarly, the second study reported an average postoperative UCLA score of 8.5, although preoperative scores were not reported [30].

ILIOTIBIAL BAND AUTOGRAFTS

The ITB autograft for labral reconstruction was first described by Philippon *et al.* in 2010 [13]. This technique was noted for the proximity to the arthroscopic portals to the graft harvest cite. When the patient's extremity is placed in full extension and internal rotation optimal exposure of the ITB is achieved for harvesting. A longitudinal incision is made along the axis of the proximal femur, starting adjacent to the anterolateral portal ideally at the junction of the anterior two-thirds and posterior one-third of the ITB. A rectangular graft is harvested, debrided of any residual tissue and tubularized before it is anchored to the acetabular rim through the mid-lateral portal.

Using this technique, Philippon *et al.* [13] demonstrated an average modified Harris Hip Score (mHHS) improvement of 23 points, from 62 preoperatively to 85 postoperatively. White *et al.* [31] reported an improvement of 34 points in the mHHS using the same graft though a modified approach and an improvement of 27 points in the Lower Extremity Function Score (LEFS) and 3 points in Visual Analogue Scale (VAS) pain scores.

GRACILIS AUTOGRAFTS

Matsuda first described labral reconstruction using a gracilis autograft in 2012 [49]. The gracilis autograft has the benefit of having a relatively simple graft harvest and preparation. However, incisional knee pain lasting an average of

2.4 weeks postoperatively has been reported with this technique [10].

The gracilis autograph is harvested through small vertical knee incision just medial and distal to the tibial tubercle. The graft should be about 2 cm longer than the span of the labral defect. The prepared graft is delivered into the hip through a modified midanterior portal. Matsuda *et al.* demonstrated improvements in the nonarthritic hip score (NAHS) of 50.5 points, from 41.9 preoperatively to 92.4 postoperatively using this technique [10]. When comparing NAHS scores of patients who underwent labral repair, the authors demonstrated improvements in NAHS scores of 22.5 points, from 55.4 to 77.9. The authors concluded that in their patient population labral reconstruction with a gracilis autografts was superior to labral repair in terms of patient reported outcome scores [10].

QUADRICEPS TENDON AUTOGRAFT

Acetabular labrum reconstruction using the quadriceps tendon was first described in 2013 by Park and Ko [12]. Due to the size of the quadriceps tendon, it can be used to reconstruct larger labral defects. Despite the quadriceps tendons strong tensile strength, the tendon is known to be weak under shearing forces, creating a challenge when attempting to manipulate the graft during anchoring [12].

To harvest the quadriceps tendon, a small longitudinal incision is made at the distal thigh near the patella. The upper three layers of the tendon are used, with a width of 7 mm, and a length matching the labral deficiency. To preserve normal function of the quadriceps tendon, the vastus intermedius should not be excised during the harvesting. The prepared tendon is inserted into the hip and attached at the two suture anchors. In a case study by Park and Ko, the results of reconstruction with the quadriceps tendon 3 months postoperatively showed a 25 point increase in the mHHS from 58 to 83 and a 34 point decrease in the Western Ontario and McMaster Universities Arthritis Index (WOMAC) score from 49 to 15.

INDIRECT HEAD OF THE RECTUS FEMORIS TENDON

Labral reconstruction using the indirect head of the rectus femoris tendon was first described by Sampson [42] in 2013. This technique was later modified by Rath *et al.* [16] in 2016. The indirect head of the recuts femoris measures 47.7 mm ($\pm$4.4) $\times$ 16.8 mm ($\pm$2.2). This limits the applications of this graft for use in patients with suitable defects [50]. As the indirect head of the rectus femoris tendon is in close proximity to the acetabular labrum, this technique does not require additional portals or incisions to harvest the graft, limiting donor-site morbidity [41]. A small window at the origin of the anterolateral capsule allows exposure of the indirect head of the rectus femoris. The tendon is split longitudinally keeping the desired width of graft while the muscular attachment is left intact. The graft is then anchored overlying the labral defect, using the muscular attachment to keep tension in the graft. Once the graft has covered the defect, the muscular attachment is detached and side-to-side anastomosis of the remaining labrum is performed.

Sampson [42] reported an average mHHS improvement of 18.2, from 65.3 preoperatively to 83.5 postoperatively, on 31 hips that underwent reconstruction using the indirect head of the rectus femoris tendon. Similarly, Amar *et al.* [43] reported improvements in mHHS scores in 22 hips after labral reconstructions using the indirect head of the rectus femoris tendon, demonstrating a median mHHS improvement of 29.0, from 67.1 preoperatively to 97.9 postoperatively.

CAPSULAR GRAFT

Labral reconstruction using a capsular autograft was first described by Domb *et al.* [17] in 2014. Capsular autografts have the added benefit avoiding donor-site morbidity and preserving local blood supply to the graft tissue. Furthermore, the proximity of the capsule's location to the damaged labrum facilitates the procedure, not necessitating separate skin incisions to harvest the graft [17, 51]. While capsular grafts may be an option for small or segmental labral defects, the limited size of the capsule graft and inability to close the capsule after reconstruction may lead to potential instability and is contraindicated in patients in whom capsular closure is indicated, such as patients with acetabular dysplasia or borderline dysplasia [17].

A mid-anterior portal, distal mid-anterior portal and anterolateral portal are used for the diagnostic arthroscopy, graft harvesting and reconstruction in this technique. Using cautery, the capsule is elevated from the bony rim, ensuring preservation of the capsule adjacent to the acetabulum. Anchors are placed at the terminal ends of the labral defect with additional anchors spaced 5–8 mm apart around the labral tear. The capsule is secured using a mattress suture technique. Care must be taken not to pass sutures too close to the free edge of the capsular tissue. Doing so will result in bunching of the capsule, preventing it from extending past the acetabular rim. Excess capsular tissue is trimmed with a suction shaver after the capsular graft is secured. No outcome scores have been reported on this technique thus far.

SEMITENDINOSUS ALLOGRAFT

Redmond *et al.* [15] first described labral reconstruction using the semitendinosus allograft in 2015. The authors reported on the potential benefits of avoiding morbidity associated with allograft harvesting. These included post-operative knee pain and possible improved recovery when using autograft. Additionally, the semitendinosus allograft requires minimal time for graft preparation. However, the semitendinosus graft is typically doubled over which necessitates a graft of at least twice the length of the labral defect.

PERONEUS BREVIS TENDON ALLOGRAFT

Moya *et al.* [11] first described labral reconstruction using the peroneus brevis tendon in 2016. The use of this allograft is associated with decreased operating time and predictable graft size and quality. Due to the large size of the graft, a single massive circumferential reconstruction may be performed. Multiple suture anchors are placed on the acetabular rim 7–10 mm apart. The graft is then placed on the defect and sutured. Additional sutures may be placed as needed. No outcomes have been reported on this technique thus far.

TENSOR FASCIA LATA ALLOGRAFT

Labral reconstruction using the tensor fascia lata was described by Rathi and Mazek [14] in 2017. The benefit of this graft choice is the versatility of the graft in terms of adjusting the grafts diameter (Fig. 4A and B). The graft is introduced into the hip joint via the mid-anterior portal using a transport suture. Anchors are used to secure the graft to the acetabular rim, taking care to avoid gaps between the native labrum and the graft. Rathi and Mazek [14] reported mHHS improvements from 58 (55–60) preoperatively to 95 (91–98) postoperatively at mean follow-up of 23 months (range: 16–36 months).

As many studies use different scoring methods or none at all, it is difficult to statistically compare the available outcomes and create a reliable meta-analyses to offer insight into whether a single graft source is superior [9, 10, 12, 17, 43, 51]. Additionally, because labral reconstruction is a relatively new technique, there is scarce reporting of complications and failures of reconstructive procedures, and limited descriptions of long-term outcomes.

Current findings are nonconclusive regarding which graft choice is preferable to use over the other [26]. A biomechanical study by Ferro *et al.* [52] comparing multiple graft choices for labral reconstruction found that multiple graft choices exhibited the similar cyclic elongation behavior in response to stimulated physiologic forces as the native labrum. As such, surgeon preference, required graft size and patient-associated factors are the leading factors in determining which graft is optimal for labral reconstruction.

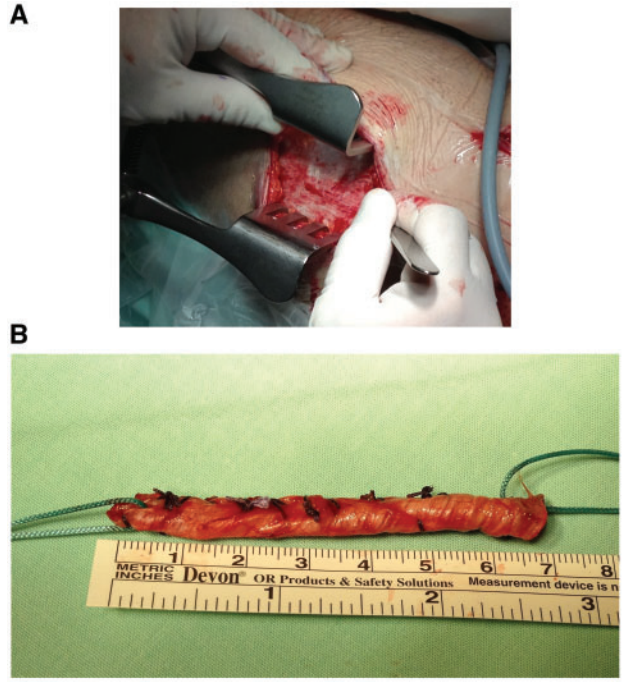

Fig. 4. (**A**) Depicts harvesting of the tensor fascia lata graft and (**B**) depicts the prepared and tubularized tensor fascia lata.

POSTOPERATIVE MANAGEMENT

While postoperative management of labral reconstructive surgery is very similar regardless of graft choice, subtle differences in the rehabilitation protocols do exist. Range of motion exercises to prevent or minimize the development of adhesions is routinely recommended postoperatively [12, 46, 47]. The use of a hip brace to limit rotation and flexion or extension may be recommended after reconstruction using ITB, quadriceps tendon, and in various capsular graft techniques for 3–6 weeks. This may not be necessary when performing reconstruction using other graft sources [12, 17, 46, 47].

Various protocols for postoperative weight bearing after labral reconstruction have been proposed. These range from toe-touch weigh bearing to immediate full weight bearing. Authors have reported allowing immediate full weight bearing after labral reconstruction using indirect head of the rectus femoris or capsule [43, 51], however many authors do not report their weight bearing protocols. Rath *et al.* [53] performed an international cross-sectional survey of the postoperative protocols of 26 high-volume hip arthroscopy specialized surgeons. The authors suggested immediate weight bearing as tolerated after labral reconstruction based on the work with caution in patients with such as borderline dysplasia or other sources of hip instability.

CONCLUSION

The acetabular labrum plays an important role in maintaining hip function and stability. Labral reconstruction surgery aims to restore labral function in patients with deficient labrums. When labral repair is not possible or has previously failed, labral reconstruction may be employed. Favorable clinical outcomes with short- and mid-term follow-up has been reported using various graft types and thus far no single graft source or surgical technique has been proven to be superior to others. The surgeon's preference and experience, as well as the patient's needs should determine the surgical technique and graft tissue chosen for labral reconstruction. Future biomechanical, basic science and long-term clinical studies regarding labral reconstruction are warranted.

ACKNOWLEDGEMENTS

The authors appreciatively acknowledge Benjamin Domb, MD for providing Figure 3 used in this review.

CONFLICT OF INTEREST STATEMENT

None declared.

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