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Operative Techniques in Orthopaedics

Anatomic Acetabular Labral Repair

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The important role of the acetabular labrum in maintaining stability and optimising fluid pressurisation of the hip joint is well recognised. Preservation and repair of the labrum is now considered an essential component of the arthroscopic management of labral tears and bony deformity correction in patients with symptomatic femoroacetabular impingement and hip dysplasia. Biomechanical studies have demonstrated improved stability and restoration of the sealing properties, vital for hydrostatic fluid pressurisation and reduction in cartilage contact forces, with labral repair. Clinical studies have shown labral repair, not only to have better results compared with debridement, but in conjunction with bony deformity correction, is durable, with successful medium to long-term outcome. Although a number of repair techniques have evolved to restore anatomy and function of the labrum, there are many deficiencies with traditional looped and pierced repair techniques including elevation and bunching, loss of fluid seal, rigidity of the labral body, low anchor positioning increasing risk of joint penetration, disruption of the important chondrolabral junction, and iatrogenic damage to labral tissue. Anatomic labral repair protects the intact chondrolabral junction and important fibrovascular attachments to the labrum; utilising a suspension repair technique the labral body is free from suture and iatrogenic injury, and remains stable but mobile to optimise the flap seal mechanism, vital for fluid pressurisation; the high anchor position reduces risk of joint penetration. Minimum 2-year clinical outcome demonstrates the excellent results from anatomic labral repair which protects and restores the anatomy, blood supply, and function of the labrum. This article describes the applied anatomy and the vital functions of the acetabular labrum, discusses the principles and controversies surrounding standard repair methods and details the operative technique, rationale and outcome for anatomic labral repair.

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KEYWORDS labral repair, hip arthroscopy, femoroacetabular impingement, fluid seal

Introduction

The acetabular labrum plays a vital role in maintaining stability and optimising both the fluid seal and hydrostatic pressurisation of the hip joint.[1] Labral injury is a common cause of nonarthritic hip pain, generally occurring as a consequence of progressive hip pathology in conditions such as femoroacetabular impingement (FAI) and acetabular dysplasia. Injury to the labrum may eventually compromise its important mechanical role with the development of micro-instability[2] and increased articular cartilage contact pressures[3,4] with eventual degeneration and progression to early osteoarthritis.

As knowledge of the essential role of the acetabular labrum has increased, optimal management of this structure has become an important focus for many hip arthroscopists, with preservation and repair becoming an integral component of the standard hip arthroscopy procedure. A recent systematic review reported that the incidence of performing labral repair has risen from 19% to 81% between 2009 and 2017.[5] Although labral debridement has been shown to have success in relieving symptoms from a torn labrum,[6,7] a number of patient-reported outcome, radiographic and biomechanical studies substantiate superior benefits of repairing and restoring labral anatomy, over debridement.[4,8-10]

Labral repair is primarily undertaken in conjunction with acetabuloplasty either to correct a global or focal pincer

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deformity or to create a bleeding bony bed to optimise healing of the labral base to the acetabular rim. Traditionally, access to the rim involved surgical detachment ('take down') of the labrum, from the acetabular rim and chondrolabral junction, to optimally visualise the acetabular margin for resection.[11,12] Techniques have evolved to protect the chondrolabral interface as this area has poor healing potential and an important role for stability and fluid sealing properties. Many methods of re-fixing the labrum to the rim have also developed in an attempt to preserve and restore the anatomy and optimise the function of the labrum.[11-13]

The purpose of this article is to discuss the current techniques available for acetabular labral repair with a focus on our preferred technique to restore normal labral anatomy as a component of arthroscopic FAI correction.

Anatomical Considerations of the Acetabular Labrum

The acetabular labrum is a fibrocartilage structure which circumferentially surrounds the acetabulum with an attachment to the transverse acetabular ligament anteriorly and posteriorly. Collagen fibres of the labrum are attached parallel to the acetabulum anteriorly while posteriorly the fibres are attached in a more perpendicular orientation.[14] The parallel orientation of collagen fibres anteriorly may create a relative weakness in labral attachment particularly at the chondrolabral junction, a common site for labral tears.[15]

The blood supply to the acetabular labrum is relatively poor which has important implications for healing and repair. The adjacent vascular network originates from radial branches of a periacetabular vascular ring which is supplied primarily from the superior and inferior gluteal arteries. From this vascular ring, the branches extend on the periosteal surface toward the hip capsule where they penetrate the capsule near its insertion above the acetabular rim, extending towards the capsular surface of the labrum and terminating near its free edge.[16] A thin fibrous cuff facilitates attachment of the nonarticular base of the labrum onto the vascular connective tissue of the acetabulum.

The chondrolabral junction which transitions from articular cartilage to fibrocartilage of the labrum is particularly avascular due to its location. Healing potential is therefore greater on the capsular side compared to the articular side of the labrum.[11] Labral repair techniques preserving the chondrolabral junction should also aim to protect the fibrovascular tissue containing the periacetabular and radial arterioles to maximise healing potential.

The labrum is highly innervated particularly within the superficial layers of the anterosuperior and posterosuperior zones,[17,18] providing both nociceptive as well as proprioceptive functions. Debridement of labral tears may result in substantial pain relief not solely from the removal of damaged labral tissue but also by eliminating the nociceptor response to the injury; repair, however, may be more beneficial in the longer term[18] by retaining the important proprioceptive properties of the labrum.

The size of the labrum is variable and may be associated with the degree of abnormal bony morphology. Dysplastic hips and those where there is an inherent instability commonly have a hypertrophic labrum[19,20] and in hips with chronic and larger pincer deformities, the labrum in some cases may be smaller in size. The size of the labrum may therefore influence the type of labral repair technique utilised.

Biomechanical Properties

The labrum is considered a major hip stabiliser[21] through a number of important contributions. As an extension to the bony acetabular rim, it increases acetabular volume by 21% and articular surface area by 28%.[22]

An intact labrum assists to resist hip subluxation and is preventative of dislocation particularly in more extreme hip joint positions.[23] A study using biplane fluoroscopy identified a progressive and significant increase in external rotation and anterior translation upon sectioning of the labrum (following iliofemoral ligament sectioning) highlighting the labrum as an important secondary stabilizer;[10] subsequent labral repair was successful in significantly reducing anterior translation and more importantly, when performed in conjunction with capsular repair, adequately restored hip joint mechanics. Labral deficiency can therefore compromise function potentially introducing micro-instability which is becoming increasingly recognised as a contributing source to symptoms.[2,24]

The labrum also provides a suction sealing effect[3,25,26] which regulates and maintains a thin fluid layer and optimal pressurization between the femoral head and acetabulum thus allowing for weight-bearing with low joint contact stresses.[3,15]

In the absence of a labrum there is a propensity towards increased displacement of, and deformation at, the cartilage edge of the articular surface, resulting in higher stress-strain conditions in the cartilage.[4] In more concentrated loading regions, susceptible to higher articular cartilage strains, an uncompromised labrum plays an important role in the distribution of strain in these areas.[27]

Global or focal labral deficiency may result in an increase in joint friction potentially as a result of an insufficient sealing of the joint[28] enabling fluid exudation from the joint space.[1] Subsequent articular cartilage degeneration,[28-30] may potentially progress to osteoarthritis. While hip labral repair has been shown to significantly decrease the fluid efflux compared to torn, partially resected and reconstructed conditions,[26] there is currently no evidence to suggest that this function is restored to the level of an intact, undisrupted labrum.

Pincer Deformity Correction: Labral Takedown

In order to achieve and maintain optimal restoration of acetabular labral anatomy, a sufficient and comprehensive arthroscopic acetabuloplasty must be performed for the treatment of cases of pincer and mixed impingement. This may include addressing large global pincer deformities but more commonly necessitates correction of localised anterior rim abnormalities. Such focal rim abnormalities lying beneath the labrum and

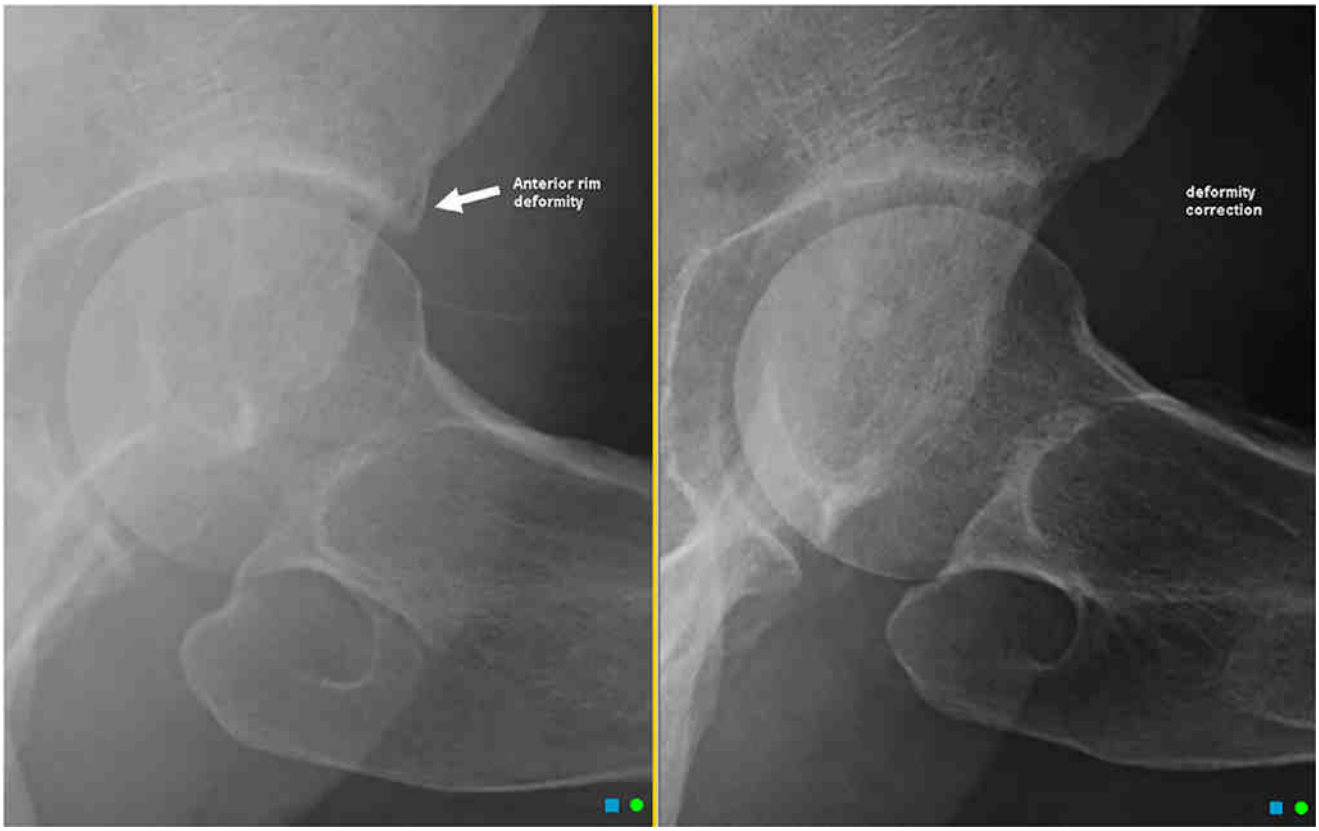

Figure 1 (left) Localised anterior rim abnormality ('stone under the carpet'); (right) arthroscopic rim deformity correction.

inducing impingement are analogous to the presence of a 'stone under the carpet' (Fig. 1) and are also common in cases with anterior dysplasia and instability and in all such cases should be clearly identified and carefully removed.

To adequately visualise the rim of the acetabulum the labrum needs to be displaced away from the bony rim and this has traditionally been undertaken with surgical separation of the chondrolabral junction using radiofrequency (RF) or a beaver blade.

In hips where the chondrolabral junction is found to be intact, surgical detachment of the labrum at this transition zone required to facilitate acetabuloplasty may have negative iatrogenic implications for the stability of the labrum and in subsequent healing post arthroscopy. In an ovine experimental model, Philippon et al[31] concluded that healing of surgically detached labrum was incomplete with a shallow superficial cleft remaining at the junction of the labrum and the articular surface of the acetabulum. The technique used to access or expose the acetabular rim should therefore take this into consideration.

The ability to perform acetabuloplasty while at the same time preserving and protecting the chondrolabral junction may be more beneficial in terms of restoring normal anatomy. A number of techniques have evolved to facilitate this. The in-round labral repair technique allows for contouring of the underlying pincer deformity without compromising the contiguous transition zone between the articular surface of the acetabulum and the labrum.[32] The 'anterior profile view' and the 'upper deck' views are 2 perspectives which facilitate optimal visualisation of acetabuloplasty without labral detachment[13,33] (Fig. 2).

Our preferred technique involves a 'peel-back' reflection rather than 'take-down' detachment which enables preservation of the chondrolabral junction as well as sensitive consideration given to the vascular network and subsequent healing capacity of the labrum itself, which are often compromised in cases of labral detachment techniques.[13]

Arthroscopic Labral Repair

A number of different repair techniques are available to re-fix the labrum to the acetabular rim.[11-13] Most techniques reported are a subtle variation on 3 main distinct technique types: simple looped (around the body), pierced repair (through the body) and suspension repair (body free of suture). The choice of which repair type to use depends on the size, quality and consistency of the labrum, the integrity of the chondrolabral junction and the underlying nature and extent of the hip pathology (FAI or dysplasia).

The simple looped technique is a commonly utilised technique for both labral repair and labral reconstruction. The looped repair places the suture entirely around the body of the labrum and tensions the sutures to stabilise the repair to the anchor insertion in the acetabular rim. The looped repair however has a number of significant deficiencies: to pass suture around the body of the labrum requires disruption of the chondrolabral junction at each point of

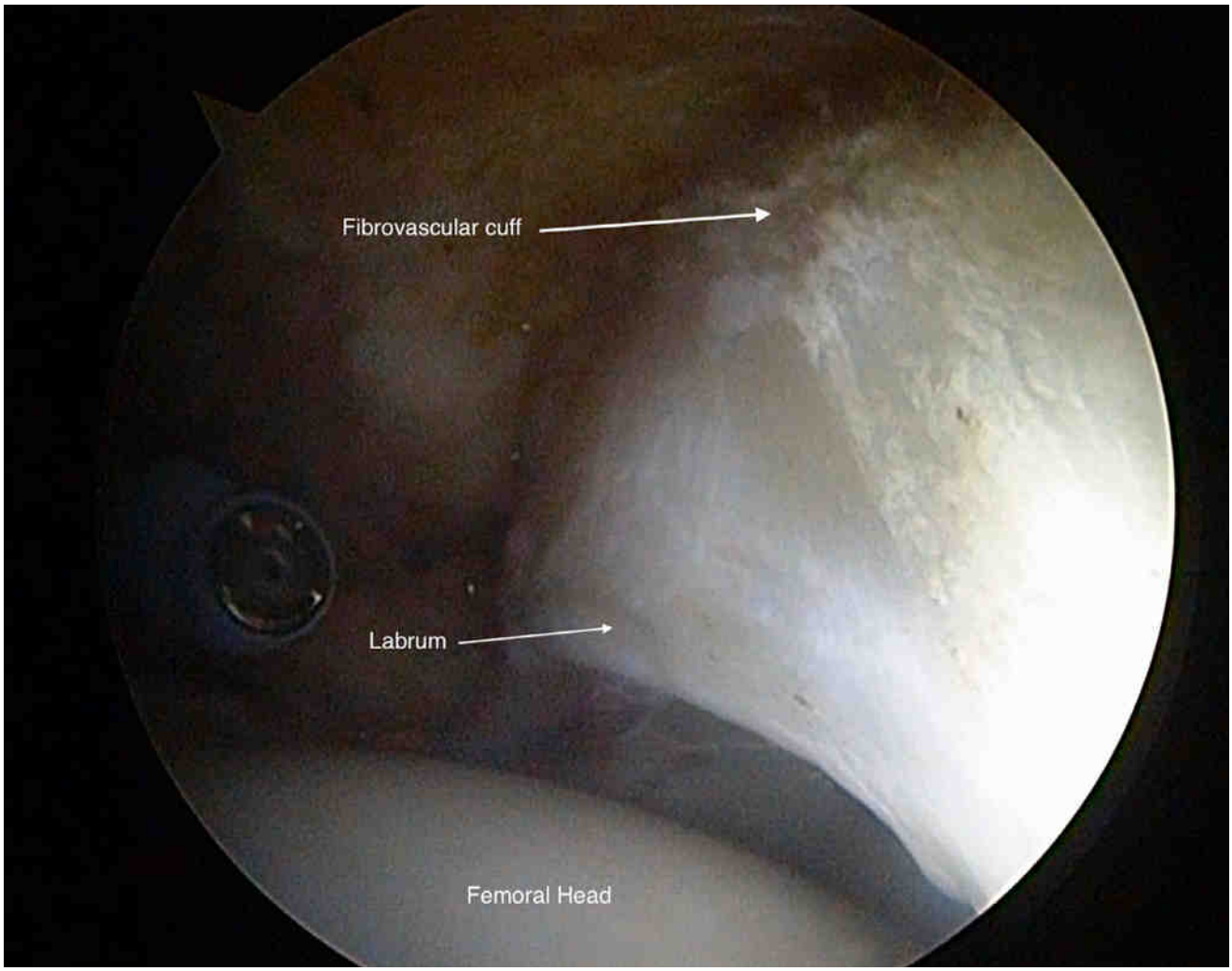

Figure 2 Distracted left hip joint. 'Anterior profile view' as seen from the anterolateral portal. The fibrovascular tissue is clearly observed at the superior edge of the labrum.

anchor fixation (with multiple anchors this leads to significant disruption of this important interface. Surgical disruption is performed as a component of labral takedown (beaver blade/RF probe) or using piercing suture passing instruments to introduce and retrieve the suture through the chondrolabral junction.

Tensioning of the looped suture results in bunching and elevation of the labrum which leads to a tight restricted labrum at anchor insertion sites, this may greatly reduce ability of the labrum to function as a secondary stabiliser and more importantly reduces its ability to act as a mobile flap seal jeopardising the lubrication and pressurisation function of the labrum. To avoid significant elevation of the labrum, the anchor needs to be positioned close to the articular surface which increases the risk of articular cartilage penetration by the drill or the anchor. The elevation of the labrum also pulls the labrum away from the chondrolabral interface increasing the chondrolabral separation (Fig. 3a). The exposed suture material looped around the labrum may also result in abrasion of the femoral head surface and may increase the formation of adhesions.[34]

The labral base repair was developed to improve on the perceived deficiencies of the simple looped technique; passing the suture through the chondrolabral junction using a piercing suture-passing forceps and retrieving the suture through the base of the labral body prevents circumferential bunching, preserving the distal triangular tip of the labrum but still results in significant intrasubstance damage to the chondrolabral junction and to the body of the labrum; elevation will still occur if the suture anchor is not positioned close to the joint surface increasing the risk of joint penetration. Tensioning of the suture will fix much of the body of the labrum to the acetabular rim at anchor points removing the mobile flap seal properties (Fig. 3b). Vertical and horizontal mattress repairs have similar issues with elevation and restriction of mobility of the body.

Our preferred labral repair technique utilises a suspension principle and protects the integrity of the chondrolabral junction which affords increased stability to the repair. The periosteal fibrovascular tissue attached to the capsular side of the labrum is preserved with the labrum carefully reflected from its bony attachment to the rim, the interface between the upper edge of the labrum and this fibrovascular tissue is

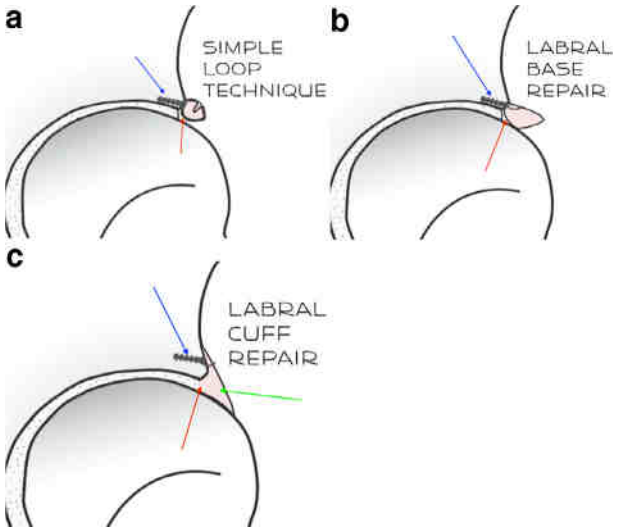

Figure 3 (a-c). Blue arrow demonstrates the low screw positioning in the simple loop (a) and base repair (b) while a higher, safer position is demonstrated in the suspension cuff repair (c). Red arrow demonstrates the chondrolabral junction disrupted in loop (a) and base repair (b) while undisrupted in the suspension cuff repair (c); Green arrow demonstrates an anatomical repair of the labrum and restoration of the seal using the suspension cuff repair technique (c). (Color version of figure is available online.)

used to pass the suture avoiding piercing or looping the body of the labrum. A higher anchor position is desirable away from the articular edge to improve tensioning of the repair protecting against joint penetration. The body of the labrum remains free from suture, minimising elevation and without bunching, permitting normal mobility of the body optimising the flap seal mechanism (Fig. 3c). The suspension cuff repair optimises restoration of normal labral anatomy, vascularity and function.

The differences between deficiencies in the looped repair technique and the anatomic repair using a suspension cuff technique (Fig. 4a and b) can be seen clearly at revision surgery (Fig. 5).

Occasionally, a suspension-type labral repair is not suitable. In cases with significant instability or dysplasia where the labrum is very bulky, hypertrophic and unstable, it may be more beneficial to use a looped repair to maximise stability and an element of elevation may be desirable to lift and support the labrum to avoid catching and pinching of the oversized labrum between the acetabular rim and femoral neck. In cases where the labrum is particularly small or ossified, proceeding with a labral graft reconstruction may be more appropriate.

Operative Technique: Anatomic Labral Repair

The patient is positioned supine on the operating table with a well-padded perineal post positioned between the legs. Each foot is generously padded and firmly restrained into a leather boot attached to an approved mechanical hip distractor system. The procedure is undertaken with image intensifier support throughout. The surface anatomy is outlined using dry skin markers (Fig. 6a) and the operative field is cleansed using betadine skin preparation and then isolated with surgical drapes (Fig. 6b).

A 17-gauge metal spinal needle is positioned on the skin, one finger breadth anterior to the 'anterolateral corner' of the greater trochanter and gently introduced into the hip joint under image intensifier guidance (Fig. 6c); the needle is passed through the anterolateral hip capsule avoiding the femoral head (Fig. 6d) and 30-40 mL of saline fluid is injected into the joint to permit further joint distension (Fig. 6e). The spinal needle is withdrawn and re-inserted to ensure the needle does not penetrate the labrum and an anterolateral portal is developed at this site; a modified mid-anterior portal is subsequently

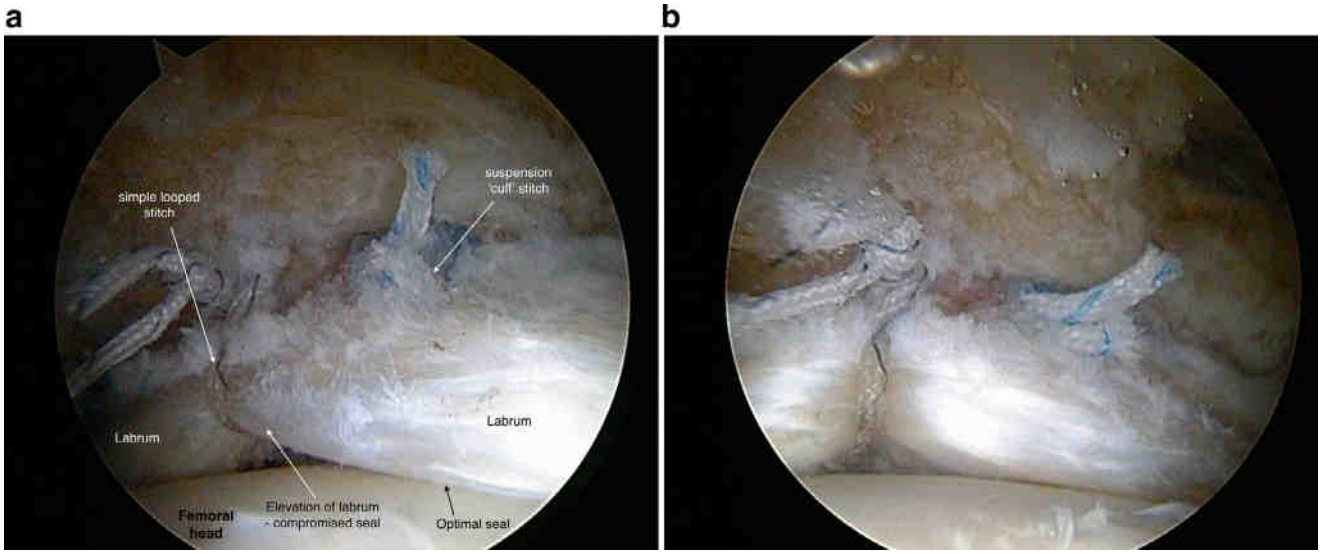

Figure 4 (a) View from the anterolateral portal; (b) view from the anterior portal. Demonstrating bunching and elevation resulting from a tensioned loop repair, compromising the seal compared with an adjacent anatomic suspension repair optimizing the seal over the femoral head.

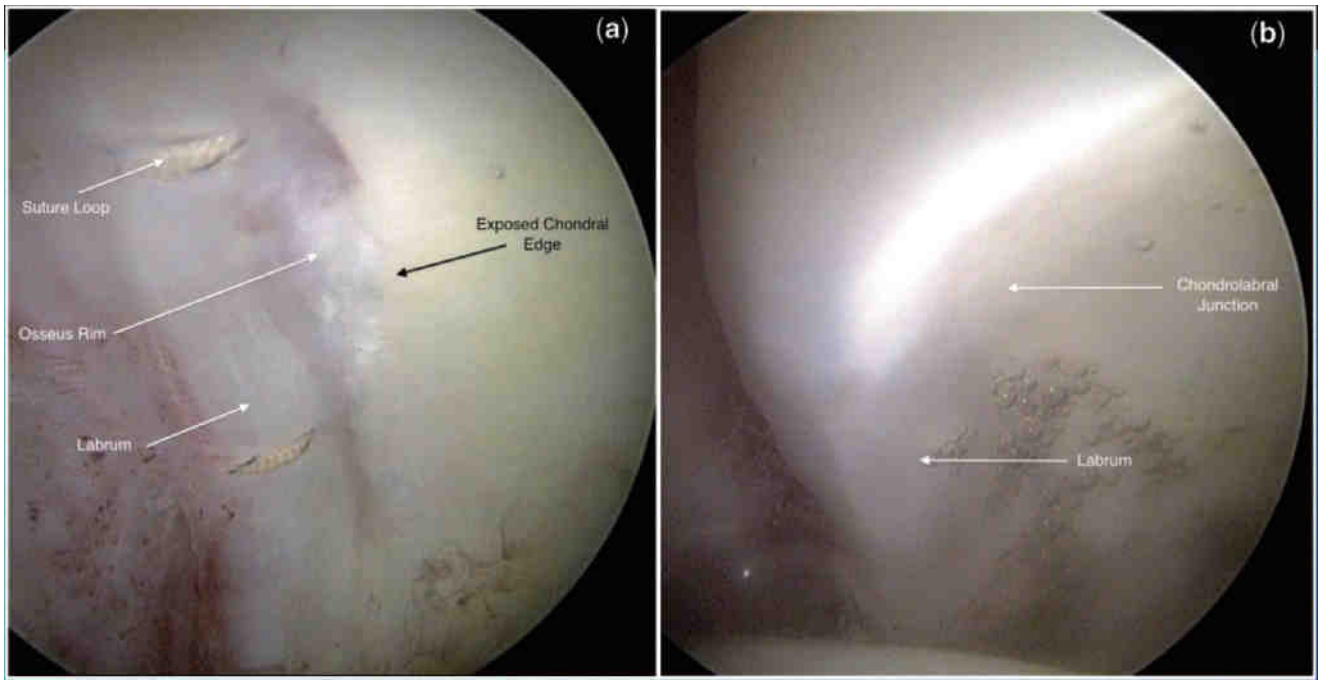

Figure 5 (a) Repeat hip arthroscopy at 1 year following a simple looped labral repair demonstrates poor chondrolabral healing with separation, exposed subchondral bone and elevation of a bunched labrum restricting function as a mobile seal. (b) Repeat hip arthroscopy at 1 year following a suspension labral cuff repair demonstrates a preserved and anatomical chondrolabral junction with the body of the labrum free from suture, permitting optimal function as a 'flap seal'. Taken from ref.[13]

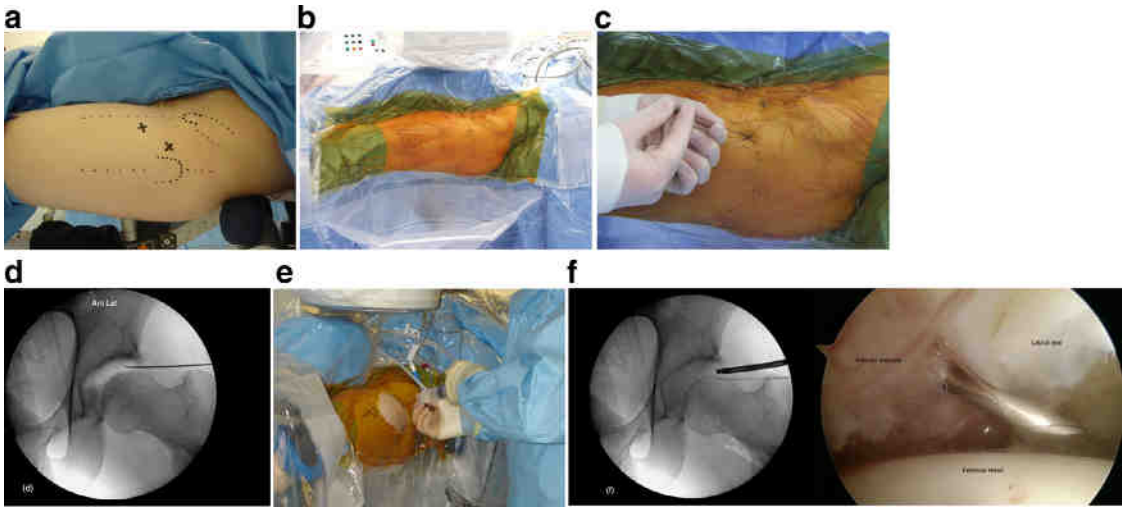

Figure 6 (a-f)—(a) Surface anatomy of a left hip outlined with dry skin markers demonstrating anterolateral and modified mid anterior portal positions relative to bony anatomy; (b) operative field cleansed using iodine-based skin preparation and isolated using surgical drapes; image intensifier positioned for screening (top of picture) (c) 17-gauge metal spinal needle is positioned on the skin anterior to the 'anterolateral corner' of the greater trochanter; (d) x-ray image demonstrating the needle being passed safely through the anterolateral hip capsule under distraction; (e) 30-40 mL of saline fluid is injected into the joint to permit further joint distension; (f) a modified mid-anterior portal is subsequently established under both x-ray and direct arthroscopic vision.

established under both x-ray and direct arthroscopic vision (Fig. 6f); 2 portals are required for all anatomic labral repair cases.

A partial interportal capsulotomy is initially undertaken preserving a central capsular bridge between portals to minimise postoperative capsular instability.

Initial inspection of the labrum and chondrolabral junction is undertaken; although the type and extent of chondrolabral pathology may be estimated at this stage, the true nature of the pathology cannot be fully determined until chondrolabral reflection ('peel back') has been undertaken.

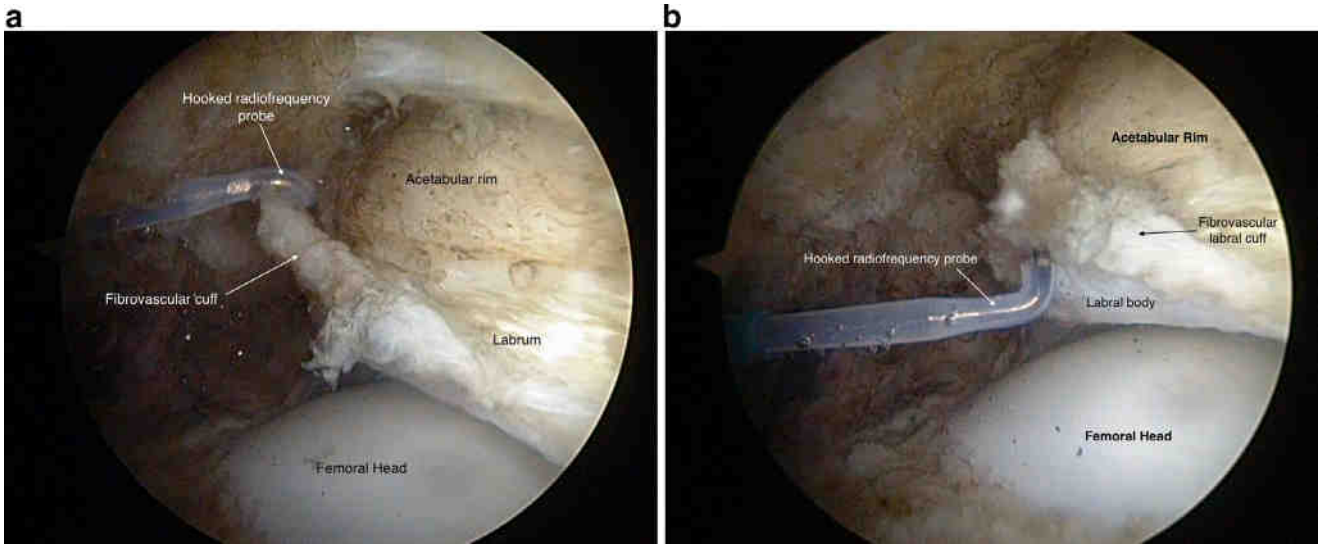

Figure 7 (a-b)—A hooked RF probe is utilised to carefully reflect and 'peel back' the fibrovascular tissue and the labrum as a single unit from the acetabular rim, preserving the chondrolabral junction.

The camera is placed in a high, lateral position between the capsule and the labrum to permit an 'anterior profile view' from 11 to 4 o-clock (Fig. 2). In this position, the periosteal fibrovascular tissue can be clearly observed covering the acetabular rim and blending with the capsule superiorly and the labrum inferiorly. Using a hooked RF probe (Vulcan™ Ligament Chisel probe, Smith & Nephew, Warsaw, Indiana), this fibrovascular tissue is carefully reflected from the acetabular rim moving caudally along the rim and eventually peeling back this fibrovascular tissue, labrum and chondrolabral interface from the acetabular rim en-masse (Fig. 7a and b). In younger patients, this fibrovascular tissue is thick and relatively strong; in older patients or those with very large anterolateral pincer deformities, this tissue may be thin and a rim of capsule may be reflected in addition, to add strength to reflected tissue.

The bony profile of the anterolateral rim can now be clearly observed and rim deformity can be corrected using a 4 mm mechanical burr (Fig. 8a and b). The extent of the acetabular resection is guided by a number of factors: the resected acetabular rim should be flat from 12 to 4 o' clock with no step or prominence, the resected rim should be confluent with the base of the anterior inferior iliac spine, bony resection should extend just proximal to the level of the chondrolabral junction and imaging should guide resection to preoperatively planned level.

The hooked probe can be used to continue to 'peel back' the chondral surface from the acetabular roof as required so

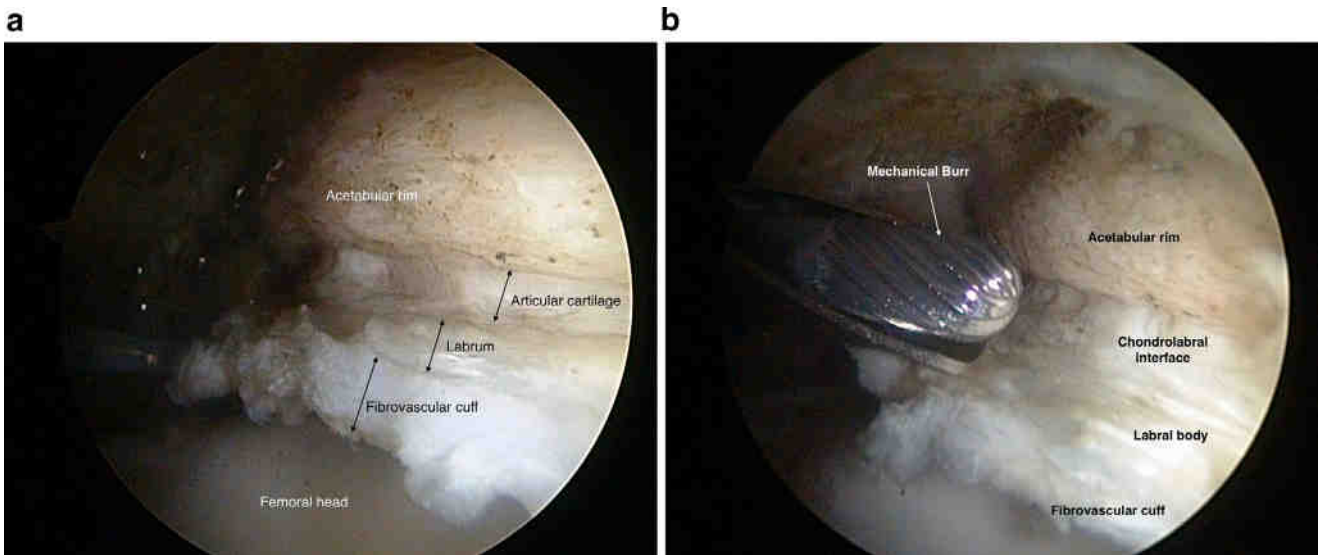

Figure 8 (a-b)—(a) The prominent rim deformity can be observed clearly; the posterior surface of the articular cartilage, labrum, and fibrovascular cuff are demonstrated, with an intact chondrolabral junction evident; (b) A 4-mm mechanical burr is utilised for acetabular rim deformity resection.

the acetabular rim at all times is clearly visualised to prevent under-resection of the rim deformity. The 'peel back' technique also permits excellent visualisation and safe enucleation of rim fractures broken from the acetabular rim, with continued preservation of the chondrolabral junction.

Once the acetabular rim recession has been completed, refixation of the labrum to the acetabular rim must be undertaken.

Two suture anchors will almost always suffice for the purposes of anatomic labral repair, the first positioned along the clock face at 1 o' clock and then second at 3 o' clock. In this region, the thickness of the rim is sufficient for the anchors to be placed well away from the articular surface to avoid penetration (Fig. 9).

The aim of the anatomic repair is to minimise the amount of suture passed through the labrum as much as possible. If there is sufficient fibrovascular cuff/capsular tissue, then placing suture only through this tissue will permit a suspension type repair of the labrum back to the acetabular rim; if there is insufficient fibrovascular tissue available then the very edge of the labral body may be utilised for repair. The suture is never placed around or directly through the body of the labrum.

To do this, a spinal needle is passed retrograde through the cuff/body interface (Fig. 10a) and 2 limbs of a looped No.1 polydioxanone (PDS) suture are shuttled through the needle into the joint (Fig. 10b) and the needle is withdrawn leaving the suture in place. A grasper is used to retrieve the suture limbs and pull them back out of the joint (Fig. 10c). The lower limb of the nonabsorbable suture of the anchor is passed through the PDS loop and the PDS suture is slowly extracted pulling through the nonabsorbable suture through the cuff/body interface and leaving it in place (Fig. 10d). Using a sliding knot, the labrum is repaired back to the rim of the acetabulum with tension on the chondrolabral junction. The same technique is followed again to place the second suture (Fig. 10e-f). The labrum and the chondrolabral junction is examined with a probe to ensure the stability of the fixation and traction is subsequently removed to visualise the restoration of the labral flap seal (Fig. 11a and b).

Cam deformity correction is undertaken as required (Fig. 12) and the interportal capsulotomy is carefully apposed with the hip in 20° flexion using 2 interrupted nonabsorbable sutures.

Postoperative Rehabilitation

Patients are provided with a self-administered structured home exercise/rehabilitation programme for 12 weeks.

Patients are mobilised the evening of surgery partial weightbearing as comfortable with crutches. Gait is normalised and crutches are removed by day 5. Patients may return to work 10 days postsurgery. Once incisions have healed (usually day 10), patients are encouraged to attend the swimming pool as often as possible for hydrotherapy introducing breaststroke at week 4. Running can begin at 6 weeks, sprinting at 8 weeks and a full return to sports training 10-12 weeks postsurgery.

Figure 9 Anterolateral view of left hip: Two anchors are inserted at a safe distance from articular surface at the 1 and 3 o' clock positions (when considering a right hip).

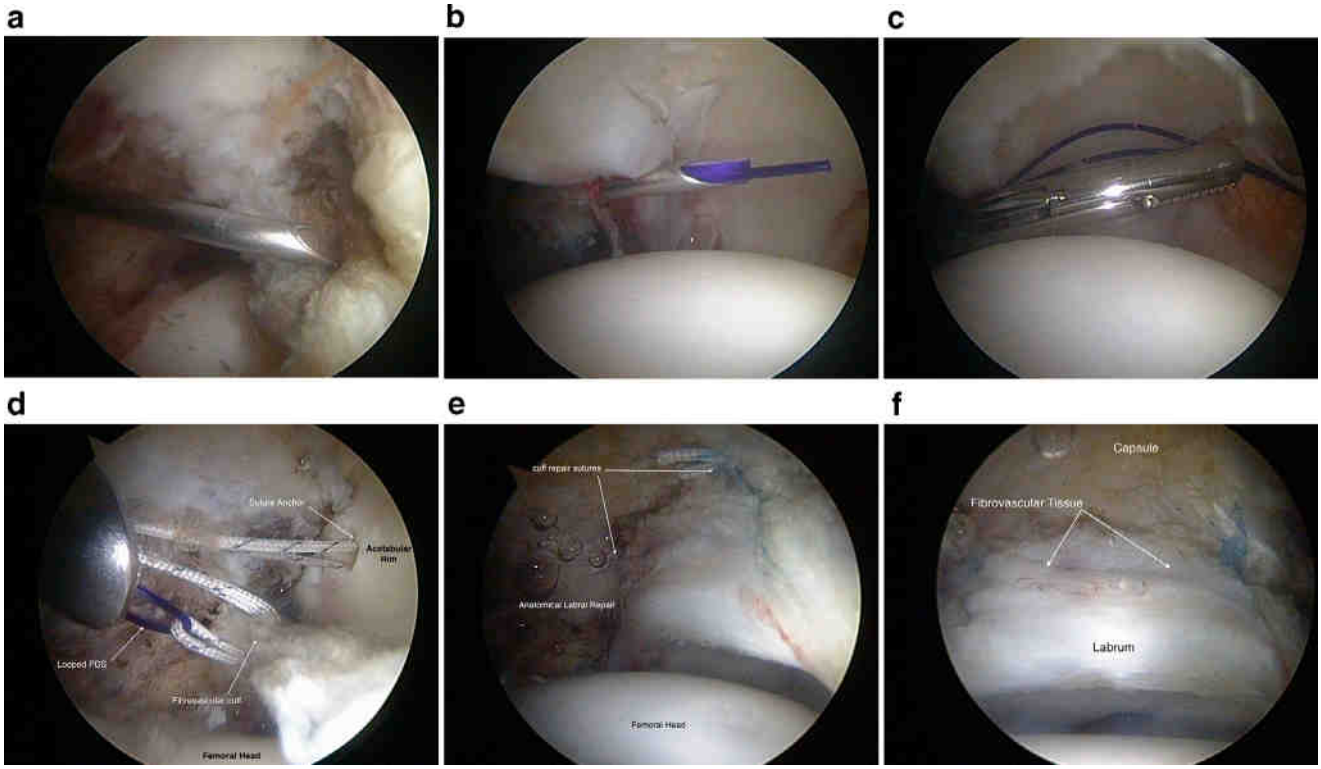

Figure 10 (a-f)—Anterolateral view of left hip (a) 17-gauge spinal needle passed retrograde through the cuff-labral interface; (b) looped PDS shuttled through spinal needle into central compartment; (c) grasper used to retrieve suture limbs; (d) lower limb of the nonabsorbable suture of anchor passed through the PDS loop and suture extracted; (e) sliding knot utilised to position labrum firmly back to the rim; (f) suspension labral repair with preserved fibrovascular cuff.

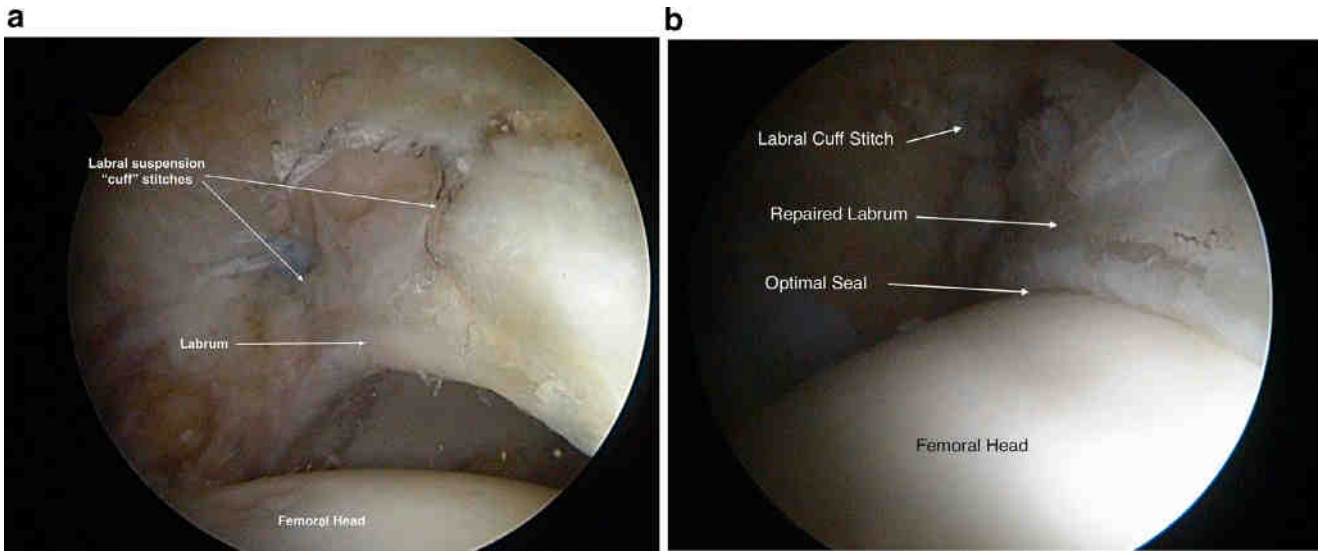

Figure 11 (a and b)—Anterolateral view of left hip (a) repair completed with traction on; (b) once traction is fully released optimal seal is restored over femoral head.

Outcomes

While the optimal labral management technique has yet to be determined, there are a large number of mid- and long-term outcome studies which demonstrate an overall improved clinical outcome where labral repair is performed.[6,7] Moreover, repairing the injured labrum has been shown to achieve superior clinical outcomes over results from labral debridement.[8,35,36]

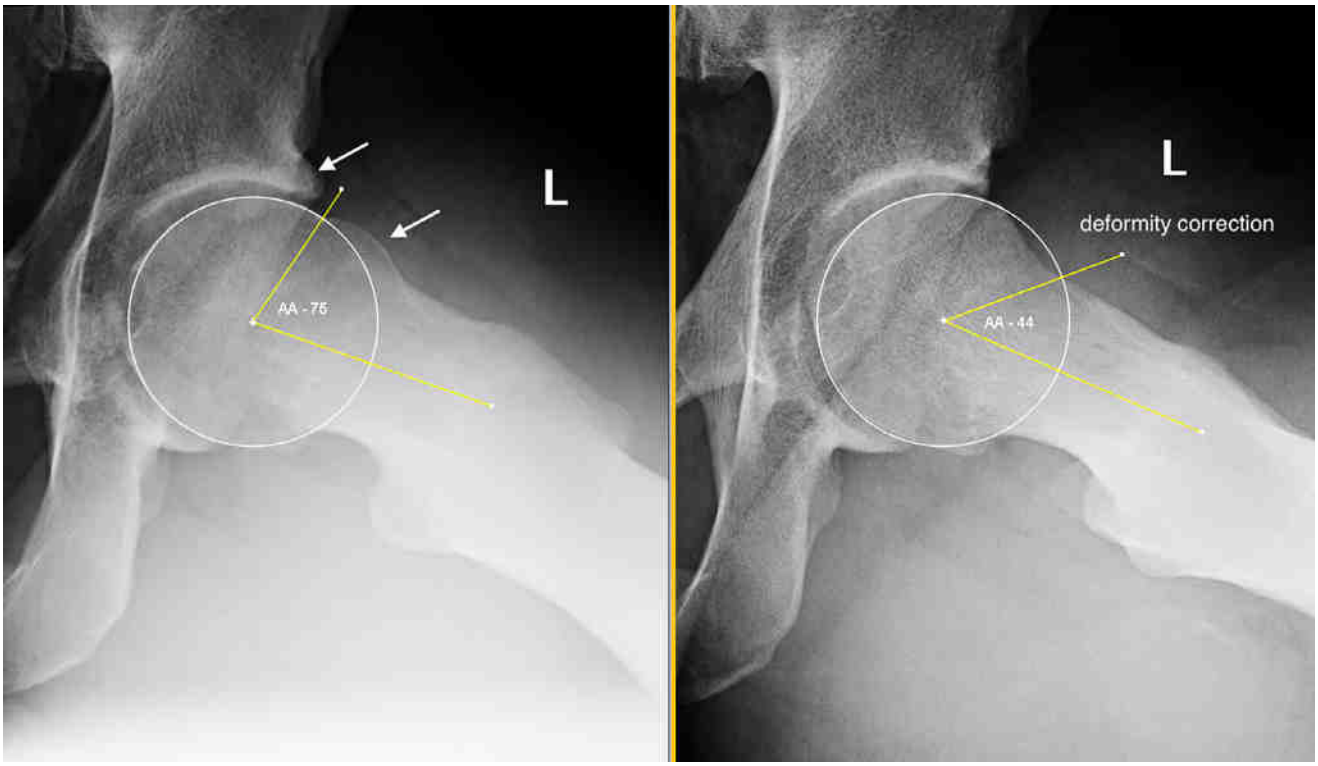

Figure 12 Ninety degree Dunn x-ray view demonstrating pre- and postoperative rim and cam bony deformity correction.

Impact of Repair Type

The clinical and biomechanical results of the looped and pierced repair techniques have been compared. Sawyer et al[37] demonstrated a statistically and clinically equivalent Hip Outcome Score – Activities of Daily Living at a mean 3 years' follow-up when comparing looped vs pierces techniques. There was also no significant difference observed in failure or revision rates between repair types. Similarly, Jackson et al[38] in a separate study found there to be no difference between these 2 particular repair techniques when assessed across a number of patient-reported outcome measures or in terms of rates of revision surgery at mean 2.5 years' follow-up.

A cadaveric study evaluating the biomechanical sealing function using differing repair techniques as measured in terms of distraction and hip joint centre displacement favoured a pierced (vertical mattress) suture technique over looped suture repair.[39] Similarly, Philippon et al[1] also found an improved restoration of fluid pressurization with pierced labral repair as compared to looped repair.

Impact of Anchor Type

A great variety of labral repair anchor constructs are now available including traditional knotted, knotless and all-suture. The use of knotless anchors is increasing mainly due to anecdotal reports of potential complications linked to a knot stack such as intra-articular adhesions, chondral damage, soft tissue impingement (iliopsoas, reflected rectus). Knotless systems may potentially improve control of tensioning which may result in less eversion of the labrum and ease of use may reduce operation time.[40] Although they may have a slight potential biomechanical advantage with respect to slippage when under physiological loads compared to more traditional knotted anchors there is no evidence supporting any clinical benefit with the use of the knotless construct.[40]

Similarly, biomechanical studies have been undertaken to assess differences between commonly utilised traditional polyether-ether ketone (PEEK) anchors for labral repair; no statistically significant difference in load-to-failure values or displacement distances under cyclical loading was observed for specific hip designed anchors.[41] All suture designs are potentially desirable due to their small size however biomechanical studies have demonstrated superior qualities of traditional PEEK anchors in high-density bone.[42]

At present, there is no clinical evidence which would support the superiority of one hip anchor type over another and choice of anchor utilised for acetabular labral repair is largely based on surgical experience and preference.

Chondrolabral Preservation

In a prospective comparative study, outcomes from patients who underwent arthroscopic acetabuloplasty and labral refixation with and without labral detachment were compared.[43] Access to the pincer deformity involved elevation of the capsule off the acetabular rim in the region of pincer deformity where the chondrolabral (CL) junction was intact and the labrum was subsequently re-fixated (Group 1).

Table 1 (Top) 2-Year Median Postoperative Patient-Reported Outcome Measures (PROMs) (Interquartile Range). (Bottom) Achievability Between Groups of Calculated Minimal Clinically Important Difference (MCID)

		CL Detached	CL Intact	*P* Value
PROMs	mHHS	(n = 110) 96 (86-100)	(n = 341) 96 (93-100)	0.039
	UCLA	(n = 112) 9 (7-10)	(n = 341) 10 (7-10)	0.007
	SF36	(n = 80) 89 (76-93)	(n = 246) 90 (79-95)	0.113
	WOMAC	(n = 72) 5 (0-12)	(n = 236) 3 (0-11)	0.484
MCID	mHHS (7.5 points)	89.3%	87.1%	0.599
	UCLA (1.4 points)	64.6%	76.6%	0.037
	SF36 (9.9 points)	70.4%	64.1%	0.329
	WOMAC (9 points)	71.9%	74.9%	0.664

mHHS, modified Harris Hip Score; SF36, short form-36; UCLA, University of California Los Angeles Activity Scale; Activity Scale; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

Where disruption of the CL junction was required for acetabular rim resection, the labrum was detached (Group 2). There was no significant difference between groups at 2 years post-op for any of the PROMs, change in scores from baseline or in rate of revision surgery.

Additional studies focusing on preserving the chondrolabral junction, while lacking a comparative study group, do report good to excellent clinical outcomes following acetabuloplasty where the chondrolabral junction is preserved. Comba et al[44] retrospectively evaluated cases who underwent acetabuloplasty for focal pincer FAI at minimum 2-years' post-arthroscopy. Their study comprised a predominantly male cohort (81%), 90% combined FAI with an intact chondrolabral union and viewable overhang rim which was resected without detaching the labrum. Good clinical outcomes in terms of functional scores, pain and satisfaction were reported. Similarly, Ilizilaturri et al[45] reported a statistically significant improvement from pre-op to post-op in WOMAC score in their 'over-the-top' technique investigating acetabuloplasty without labral detachment. In a more recent study from Webb et al,[34] in cases where chondrolabral preservation without labral repair was undertaken, there was a statistically significant reduction in the proportion of patients undergoing revision surgery due to capsulolabral adhesions (a reduction from 46% to 17%). The reduction in adhesions was attributed the avoidance for the need for drilling and insertion of suture anchors, the presence of which may influence an increased inflammatory response, bleeding and bone release of marrow cells stimulating adhesion formation.

Syed and Martin[46] preserved the chondrolabral junction using an 'in-round' technique[47] with subsequent repair performed using vertical mattress stitches where possible or looped sutures in cases of labral insufficiency. Eighty-four per cent good to excellent post-op results were reported; however, no statistical analyses were reported.

In a prospective series of 107 consecutive cases of pincer or mixed FAI, arthroscopic anatomic labral repair was performed using a suspension 'cuff' refixation with preservation of the chondrolabral interface.[13] The 2-year clinical outcome reported was superior to similar clinical studies utilising either looped or base repair techniques. Although the groups in these studies are not directly comparable, the higher outcome postoperatively may support the importance of preserving the CL junction and utilising an anatomic labral repair technique.

A retrospective review of prospectively collected data from our institutional hip registry was undertaken for all FAI corrective hip arthroscopy cases with labral repair between June 2012 and October 2017 with complete minimum 2-year follow-up. Exclusion criteria included revision HA cases, lateral centre-edge angle <20°, pre-existing hip conditions and Tonnis >1 at time of surgery. We established 2 comparative groups based on the integrity of the chondrolabral junction: Group A (n = 116; chondrolabral disruption and loop-type labral repair) vs Group B (n = 360; chondrolabral intact and anatomic labral repair). Group A had a higher mean age than Group B (35 years vs 27.4 years). PROMs and achievability of calculated minimal clinically important difference was assessed between groups with the anatomic repair group having a statistically higher activity level and modified Harris Hip Score distribution (Table 1). Although there was no difference between repeat hip arthroscopy rate (P = 0.984), there was a significant difference in the conversion to total hip arthroplasty (THR) between groups: Group A 3.4%, Group B 0.6% (P = 0.033)[48]

The results of this observational study indicate that disruption of the chondrolabral junction is associated with poorer return to full activity and higher progression of pathology to THR despite all cases having Tonnis grade 0 or 1. Preserving the chondrolabral junction when intact and undertaking an anatomic labral repair leads to excellent clinical outcome at 2 years postsurgery.

Conclusion

The important roles of the acetabular labrum in maintaining stability and optimising the fluid sealing and hydrostatic pressurisation functions in the hip joint are now well recognised. The numerous benefits in preserving and repairing the labrum over debridement have been demonstrated in a number of biomechanical and clinical outcome studies. Good long-term outcome from repairing the labrum in conjunction with FAI correction has recently been reported.

Anatomic labral repair involves protecting the important chondrolabral interface and vascular network during labral

takedown and acetabuloplasty, and utilising a suspension-type repair to re-fix the labrum to the acetabular rim. This technique optimises the stability of the labral repair and the healing potential for labral tearing while minimising the risk of anchor penetration, bunching and elevation of the labrum and maintains a suture-free mobile labral body protecting the vital fluid seal to the hip.

Excellent clinical outcome with a high return to full activity has been demonstrated at a minimum of 2 years postsurgery using this anatomic approach to preservation and labral repair.

References

1. Philippon MJ, Nepple JJ, Campbell KJ, et al: The hip fluid seal-Part I: The effect of an acetabular labral tear, repair, resection and reconstruction on hip fluid pressurization. Knee Surg Sports Traumatol Arthrosc 22:722-729, 2014
2. Safran MR: Microinstability of the hip—Gaining acceptance. J Am Acad Orthop Surg 27:12-22, 2019
3. Ferguson SJ, Bryant JT, Ganz R, et al: The acetabular labrum seal: A poroelastic finite element model. Clin Biomech 15:463-468, 2000
4. Todd JN, Maak TG, Ateshian GA, et al: Hip chondrolabral mechanics during activities of daily living: Role of the labrum and interstitial fluid pressurization. J Biomech 69:113-120, 2018
5. Riff AJ, Kunze KN, Movassaghi K, et al: Systematic review of hip arthroscopy for femoroacetabular impingement: The importance of labral repair and capsular closure. Arthroscopy 35:646-656, 2019
6. Byrd JW, Jones KS: Hip arthroscopy for labral pathology: Prospective analysis with 10-year follow-up. Arthroscopy 25:365-368, 2009
7. Menge TJ, Briggs KK, Dornan GJ, et al: Survivorship and outcomes 10 years following hip arthroscopy for femoroacetabular impingement: Labral debridement compared with labral repair. J Bone Joint Surg Am 12:997-1004, 2017
8. Krych AJ, Thompson M, Knutson Z, et al: Arthroscopic labral repair versus selective labral debridement in female patients with femoroacetabular impingement: a prospective randomized study. Arthroscopy 29 (1):46-53, 2013
9. Espinosa N, Rothenfluh DA, Beck M, et al: Treatment of femoroacetabular impingement: Preliminary results of labral refixation. J Bone Joint Surg Am 88:925-935, 2006
10. Myers CA, Register BC, Lertwanich P, et al: Role of the acetabular labrum and the iliofemoral ligament in hip stability: An in vitro biplane fluoroscopy study. Am J Sports Med 39(1_suppl):85-91, 2011. https://doi.org/10.1177/0363546511412161
11. Kelly BT, Shapiro GS, Digiovanni CW, et al: Vascularity of the hip labrum: A cadaveric investigation. Arthroscopy 21:3-11, 2005
12. Fry R, Domb B: Labral base refixation in the hip: Rationale and technique for an anatomic approach to labral repair. Arthroscopy 26(9 Suppl):S81-S89, 2010
13. Carton PF, Filan D: Labral cuff refixation in the hip: Rationale and operative technique fir preserving the chondrolabral interface for labral repair: A case series. J Hip Preserv Surg 5:78-87, 2017
14. Grant AD, Sala DA, Davidovitch RI: The labrum: Structure, function, and injury with femoro-acetabular impingement. J Child Orthop 6:357-372, 2012
15. Hartigan DE, Perets I, Meghpara MB, et al: Biomechanics, anatomy, pathology, imaging and clinical evaluation of the acetabular labrum: Current concepts. JJSAKOS 3:148-154, 2018
16. Kalhor M, Horowitz K, Beck M, et al: Vascular supply to the acetabular labrum. J Bone Joint Surg Am 92:2570-2575, 2010
17. Gerhardt M, Johnson K, Atkinson R, et al: Characterisation and classification of the neural anatomy in the human hip joint. Hip Int 22:75-81, 2012
18. Alzaharni A, Bali K, Gudena R, et al: The innervation of the human acetabular labrum and hip joint: An anatomic study. BMC Musculoskelet Disord 15:41, 2014
19. Gupta A, Chandrasekaran S, Redmond JM, et al: Does labral size correlate with degree of acetabular dysplasia? Orthop J Sports Med 3. https://doi.org/10.1177/2325967115572573, 2015
20. Garabekyan T, Ashwell Z, Chadayammuri V, et al: Lateral acetabular coverage predicts the size of the hip labrum. Am J Sports Med 44:1582-1589, 2016
21. Nepple JJ, Philippon MJ, Campbell KJ, et al: The hip fluid seal—Part II: The effect of an acetabular labral tear, repair, resection, and reconstruction on hip stability to distraction. Knee Surg Sports Tramatol Arthrosc 22:730-736, 2014
22. Seldes RM, Tan V, Hunt J, et al: Anatomy, histologic features and vascularity of the adult acetabular labrum. Clin Orthop Relat Res 382:232-240, 2001
23. Bonnar TF, Colbrunn RW, Bottros JJ, et al: The contribution of the acetabular labrum to hip joint stability: A quantitative analysis using a dynamic three-dimensional robot model. J Biomech Eng 137:061012, 2015
24. Shibata KR, Matsuda S, Safran MR: Is there a distinct pattern to the acetabular labrum and articular cartilage damage in the non-dysplastic hip with instability? Knee Surg Sports Traumatol Arthrosc 25:84-93, 2017
25. Takechi H, Nagashima H, Ito S: Intra-articular pressure of the hip joint outside and inside the limbus. J Jpn Orthop Assoc 56:529-536, 1982
26. Cadet ER, Chan AK, Vorys GC, et al: Incestigation of the preservation of the fluid seal effect in the repaired, partially resected, and reconstructed acetabular labrum in a cadaveric hip model. Am J Sports Med 40:2218-2223, 2012
27. Kim Y, Giori NJ, Lee D, et al: Role of the acetabular labrum on articular cartilage consolidation patterns. Biomech Model Mechanobiol 18:479-489, 2019
28. Song Y, Ito H, Kourtis L, et al: Articular cartilage friction increases in hip joints after the removal of acetabular labrum. J Biomech 45:524-530, 2012
29. Ferguson SJ, Bryant JT, Ganz R, et al: An in vitro investigation of the acetabular labral seal in the hip joint mechanics. J Biomed 16:171-178, 2003
30. McCarthy JC, Noble PC, Schuck MR, et al: The watershed labral lesion. Its relationship to early arthritis of the hip. J Arthroplasty 16:81-87, 2001
31. Philippon MJ, Arnoczky SP, Torrie A: Arthroscopic repair of the acetabular labrum: A histologic assessment of healing in an ovine model. J Arthrosc Relat Surg 23:376-380, 2007
32. Malahias MA, Alexiades MM: The clinical outcome of chondrolabral-preserving arthroscopic acetabuloplastyfor pincer- or mixed-type femoroacetabular impingement: A systematic review. Musculoskelet Surg 103:207-214, 2019. https://doi.org/10.1007/s12306-019-00594
33. Ortiz-Declet V, Mu B, Chen AW, et al: The "bird's eye" and "upper deck" views in hip arthroscopy: Powerful arthroscopic perspectives for acetabuloplasty. Arthrosc Tech 7:e13-e16, 2018
34. Webb MSL, Devitt BM, O'Donnell JM: Preserving the chondrolabral junction reduces the rate of capsular adhesions. J Hip Preserv Surg 6:50-54, 2019. https://doi.org/10.1093/jhps/hnz005
35. Larson CM, Giveans MR, Stone RM: Arthroscopic debridement versus refixation of the acetabular labrum associated with femoroacetabular impingement: Mean 3.5-year follow-up. Am J Sports Med 40:1015-1021, 2012
36. Schilders E, Dimitrakopoulou A, Bismil Q, et al: Arthroscopic treatment of labral tears in femoroacetabular impingement: A comparative study of refixation and resection with a minimum two-year follow-up. J Bone Joint Surg Br 93:1027-1032, 2011
37. Sawyer GA, Briggs KK, Dornan GJ, et al: Clinical outcomes after arthroscopic hip labral repair using looped versus pierced suture techniques. Am J Sports Med 43:1683-1688, 2015
38. Jackson TJ, Hammarstedt JE, Vemula SP, et al: Acetabular labral base repair versus circumfrential suture repair: A matched-pair comparison of clinical outcomes. Arthroscopy 31:1716-1721, 2015

39. Signorelli C, Bonanzinga T, Lopomo N, et al: Evaluation of the sealing function of the acetabular labrum: An in vitro biomechanical study. Knee Surg Sports Traumatol Arthrosc 25:62-71, 2017. https://doi.org/10.1007/s00167-015-3851-x
40. Safran MR, Behn AW, Botser IB, et al: Knotless anchors in acetabular labral repair: A biomechanical comparison. Arthroscopy 35:70-76.e1, 2019
41. Ruiz-Suarez M, Aziz-Jacobo J, Barber FA: Cyclic load testing and ultimate failure strength of suture anchors in the acetabular rim. Arthroscopy 26:762-768, 2010
42. Douglass NP, Behn AW, Safran MR: Cyclic and load to failure properties of all-suture anchors in synthetic acetabular and glenoid cancellous bone. Arthroscopy 33:977-985.e5, 2017
43. Redmond JM, El Bitar YF, Gupta A, et al: Arthroscopic acetabuloplasty and labral refixation without labral detachment. Am J Sports Med 43:105-112, 2015
44. Comba FM, Slullitel PA, Bronenberg P, et al: Arthroscopic acetabuloplasty without labral detachment for focal pincer type impingement: A minimum 2 year follow-up. J Hip Preserv Surg 4, 2017. 154-152
45. Ilizaliturri VM, Joachin P, Marco Acuna M: Description and mid-term results of the 'over-the-top' technique for the treatment of the pincer deformity in femoroacetabular impingement. J Hip Preserv Surg 2:369-373, 2015
46. Syed HM, Martin SD: Arthroscopic acetabular recession with chondrolabral preservation. Am J Orthop 42:181-184, 2013
47. Skelly NW, Conway WK, Martin SD: "In-Round" labral repair after acetabular recession using intermittent traction. Arthrosc Tech 6:e1807-e1813, 2017. https://doi.org/10.1016/j.eats.2017.06.061
48. Carton P, Filan D: The impact of anatomic labral repair and preservation of the chondrolabral junction on clinical outcome. In: Institutional Conference Proceedings; 20192019