Labral Reconstruction

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A. J. Andrade

15.1 Introduction

The labrum is a fibrocartilaginous structure made of alternating layers of type I collagen and hyaline cartilage matrix orientated in the direction of functional stress.

There are three layers to the labrum:

- **A basal surface** that connects the labrum to the acetabular bony rim.
- **An internal** articular surface continuous with the acetabular articular surface.
- **An external** surface in continuity with the capsule.

The functions of the labrum are as follows:

- **To improve hip joint stability—**by deepening the socket and partially sealing the joint to create a negative intra-articular pressure. Creates the '**Fluid seal**'.
- **To increase joint congruity**—and reduces contact pressure so that frictional forces increase when the labrum is removed.

The blood supply to the labrum is from a periacetabular vascular ring formed by the superior and inferior gluteal arteries.

Labral tears are most commonly seen in the setting of femoroacetabular impingement, but can be seen with any condition affecting the hip.

15.2 Labral Repair

Labral repairs were first described by Ganz as part of the open surgical dislocation procedure he described [1, 2], and later arthroscopic techniques were popularised by Philippon [3–5].

When considering which particular technique to employ when carrying out labral repair, the shape of the labrum, the condition of the labrum and the age of the patient should be considered. Knotless and knotted anchors have been used, and there are no reported differences in outcome [6]. Similarly, there have been no reported differences between looped suture fixation and pierced suture techniques [7].

Labral repair has been shown to be an effective treatment option that leads to a greater improvement in pain, function and return to activity, particularly when compared with resection or debridement [8].

The success of labral repair does however depend on **addressing any underlying anatomical condition**, good surgical technique and having a well-motivated patient who undergoes a phased rehabilitation programme.

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15.3 Labral Reconstruction

There are however certain situations in which labral repair may be less effective:

- Where labral damage is too severe (complex tear with degeneration, ossified or segmental deficiency).
- When the labrum is too large (>10 mm).
- When the labrum is too diminutive (<3 mm).

In these situations, and also **when labral repair has failed** for whatever reason, labral reconstruction has been proposed as a means of restoring the integrity of the chondrolabral junction.

The distribution of **nociceptive innervation in the labrum** and the presence of the free nerve endings and nerve end organs predominantly on the articular side of the labrum [9, 10] help to explain one of the theories of how the labrum can act as a pain generator. Retaining the labrum with labral repair therefore can lead to retention of the pain generator, with resultant ongoing pain. In contrast, labral debridement or resection can therefore in this way result in pain resolution.

Labral reconstruction, where the pain generator is resected and replaced with a graft, has the distinct advantage of then also restoring the function of the labrum and chondrolabral junction. This restores the fluid seal and provides improvements in stability, and reduction in hip contact pressures resulting in successful outcomes from labral reconstruction.

Sierra and Trousdale first reported a technique for reconstruction of segmental labral defects via a **surgical hip dislocation** using a ligamentum teres autograft [11]. Philippon first reported on an **arthroscopic technique** for labral reconstruction using an iliotibial band autograft [12, 13]. Matsuda reported on labral reconstruction using a gracilis autograft [14]. Since then, other arthroscopic and open techniques for labral reconstruction using a variety of different autograft and allograft tissues have been reported with good outcomes [15–20].

Labral reconstruction has provided patients with significant improvements in pain reduction, function, return to sports, avoidance of future hip arthroplasty and high levels of satisfaction [21–23].

Augmentation of the labrum is proposed by some as an alternative to reconstruction, and the results of this technique are also encouraging [24]. One advantage of this technique is that the labrum is not resected, and so allows direct suturing of the graft to the native labrum, with good to excellent reported outcomes [25].

The choice of graft for reconstruction or augmentation remains a subject of some debate [26, 27]. Some authors prefer autograft and others prefer allograft. There is even potentially a role for a synthetic graft (xenograft), which may be more affordable and could even come pre-prepared in predetermined diameters and lengths. A potential advantage of a xenograft is that it may improve integration and speed up the period of labralisation (that every graft undergoes), by reducing the time needed for remodelling [28]. Further research is required to establish what the ideal graft material is.

In the vast majority of cases, labral reconstruction is carried out in the revision setting [23]. Some authors have however popularised the use of primary labral reconstruction with very encouraging results [29, 30].

There have been three systematic reviews on labral reconstruction published in 2019 alone, with the most recent in October 2019 [31–33], and all of these, as well as two previous systematic reviews [34, 35], have concluded that acetabular labral reconstruction achieves clinically significant functional improvements with low complication rates, low rates of revision surgery and low progression rates for osteoarthritis.

15.4 Complications

Labral reconstruction is a complex procedure that is technically very difficult, requiring high skill levels in arthroscopic surgery.

Concerns can be raised with regard to prolonged traction time, particularly in the early stages of the learning curve. Furthermore, there can be difficulties with the introduction and fixation of the graft, as well as the risk of iatrogenic injury during the procedure.

Overall, however, the literature reports a low complication rate with this procedure.

15.5 The Author's Preferred Technique of Labral Reconstruction

15.5.1 Introduction

The author initially gained experience with segmental fascia lata **autograft** labral reconstruction, but due to issues with the handling properties of the autograft tissue then changed to fascia lata **allograft** for segmental labral reconstruction (Fig. 15.1).

An observation in common with others was that segmental reconstructions necessitated anastomoses with host labrum at each end of the graft (i.e. two anastomoses), and these can be weak points of the reconstruction. With ever-increasing length of reconstructions, the need for one or both anastomoses can be abolished, as the graft can then potentially be secured low on the acetabular clockface and close to or confluent with the transverse acetabular ligament.

Fig. 15.1 Fascia lata allograft (freeze-dried)

Circumferential acetabular labrum reconstruction is now growing in popularity and is even being proposed as a primary procedure [29, 30].

15.5.2 Pre-operative Considerations

In the vast majority of cases, the author carries out labral reconstruction in the setting of revision surgery. It is therefore essential to eliminate other causes for ongoing pain in this setting.

1. **Imaging studies** are needed to exclude dysplasia or other developmental abnormalities. Radiographs need to show a joint space of at least 2 mm and a femoral head–neck offset that is either already normal or that can be restored to normal with further surgery. If the femoral head–neck offset has been compromised by over-resection of the cam lesion, then labral reconstruction would be contraindicated.
2. If there is any doubt from the radiographs, then computed tomography (CT) would be indicated with 3D volume rendering to aid surgical planning. With CT, 3D motion simulation reports (by, for example, Clinical Graphics) can be obtained (Fig. 15.2), which further add value and can provide accurate assessments of radiographic indices.
3. The rotational profile needs to be assessed, at least clinically, and if there is any doubt, a formal CT rotational profile assessment (looking at hips, knees and ankles) is carried out (Fig. 15.3). A rotational profile within normal limits (for acetabular, femoral and tibial rotation) is required for successful labral reconstruction.
4. Magnetic resonance imaging (MRI) can provide information on the integrity of the ligamentum teres, and it is essential that the ligamentum teres is intact if reconstruction is to be successful. Otherwise, consideration might need to be given to reconstruction of both the ligamentum teres and labrum at the

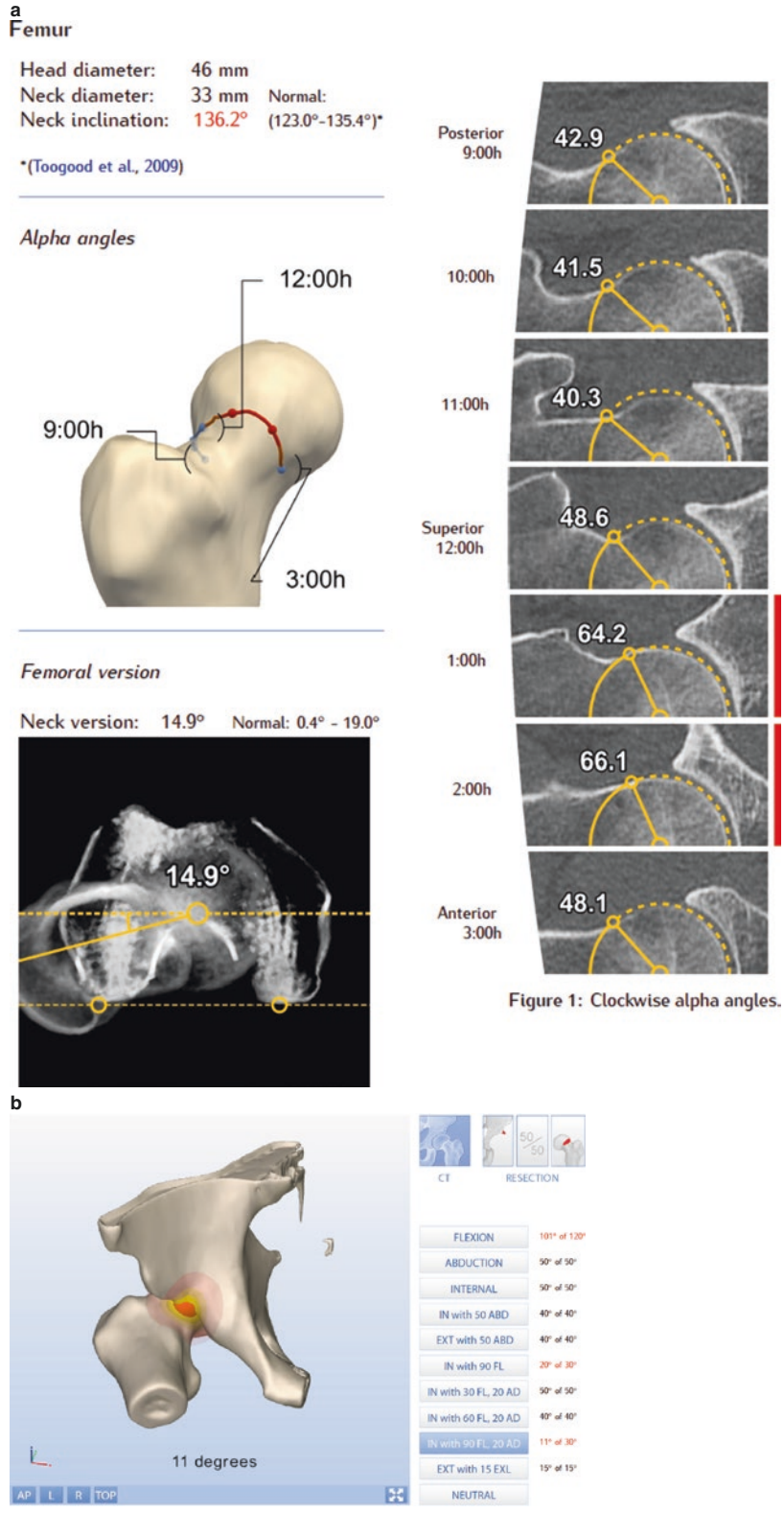
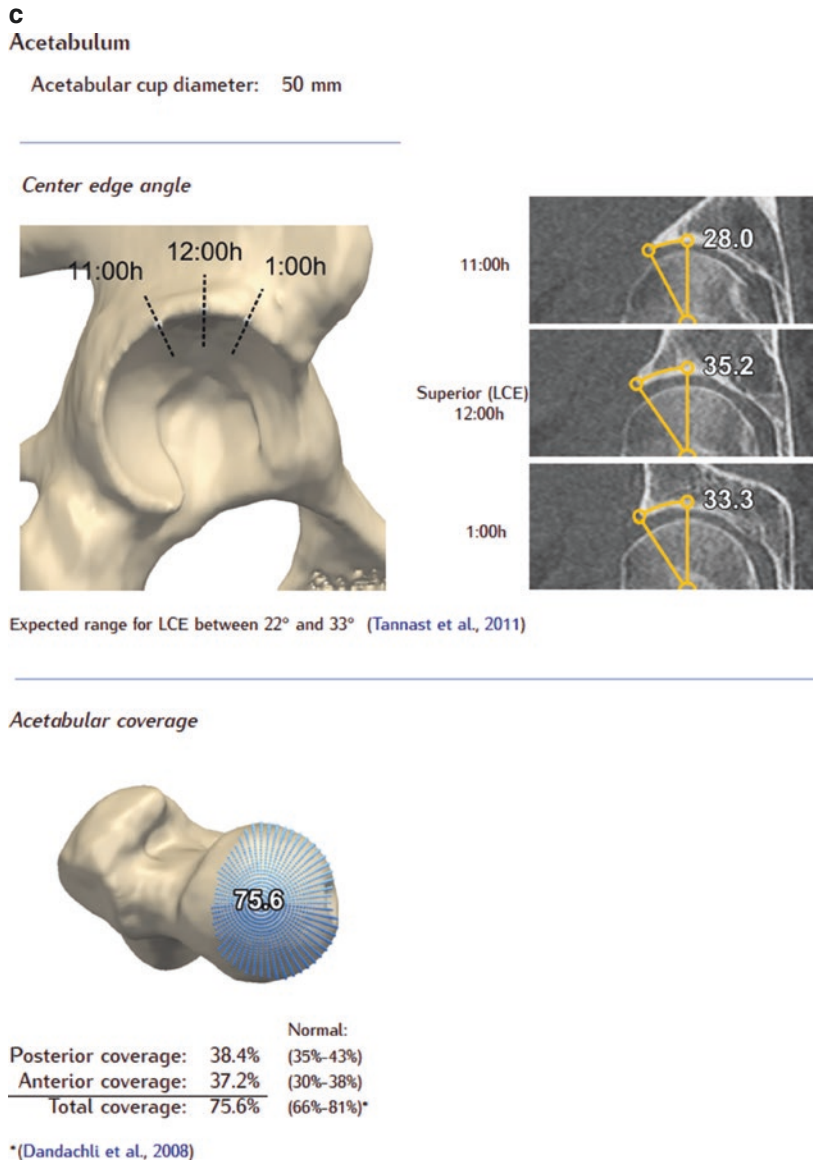


Fig. 15.2 Illustrative example of Clinical Graphics analysis: (**a**) Femoral analysis showing the clockwise alpha angles and femoral anteversion; (**b**) calculated impingement analysis in different positions; (**c**) acetabular analysis showing centre edge angles and acetabular coverage values

Fig. 15.2 (continued)



same sitting [36]. MRI will also provide information on the integrity of the articular surfaces of the acetabulum and femoral head. Any significant degenerative change would also be a contraindication to labral reconstruction.

15.5.3 Operative Set-Up and Procedure

1. The patient is **supine** on a **specialist distractor (Smith & Nephew),** under general anaesthesia with muscle paralysis. Antibiotic prophylaxis is given, and the patient is risk assessed for venous thromboembolic prophylaxis.
2. **Hip arthroscopy is started with** the normal two-portal technique (anterolateral and anterior portals) to visualise the joint and carry out the central compartment diagnostic round to identify the full extent of the pathology within the joint (Fig. 15.4).
3. The diagnostic round of the central compartment has to establish the following **triad for**

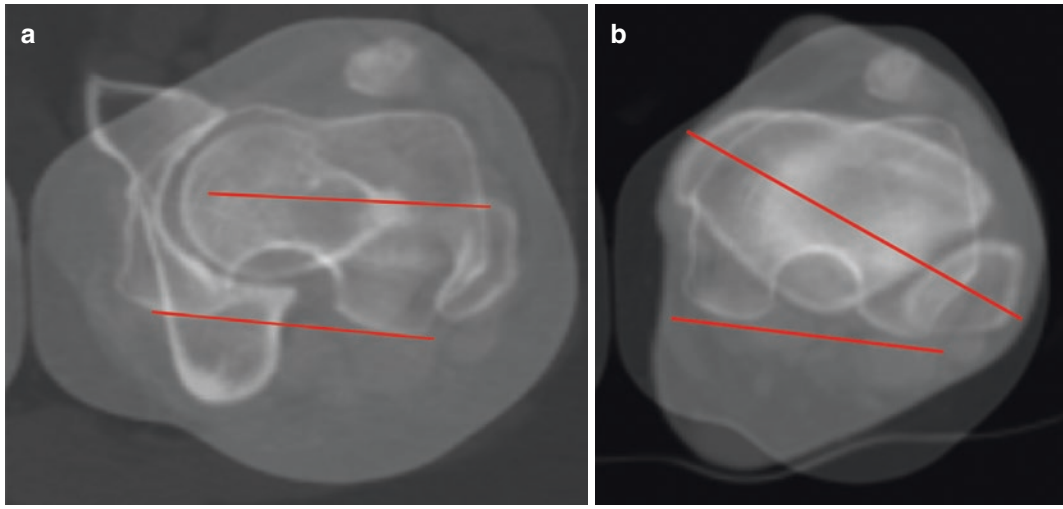


Fig. 15.3 Illustrative example of CT rotational profile assessment: (**a**) femoral version of −1° showing that femoral anteverting derotation osteotomy is indicated prior to considering labral reconstruction; (**b**) tibial torsion of 27° which is within the normal range

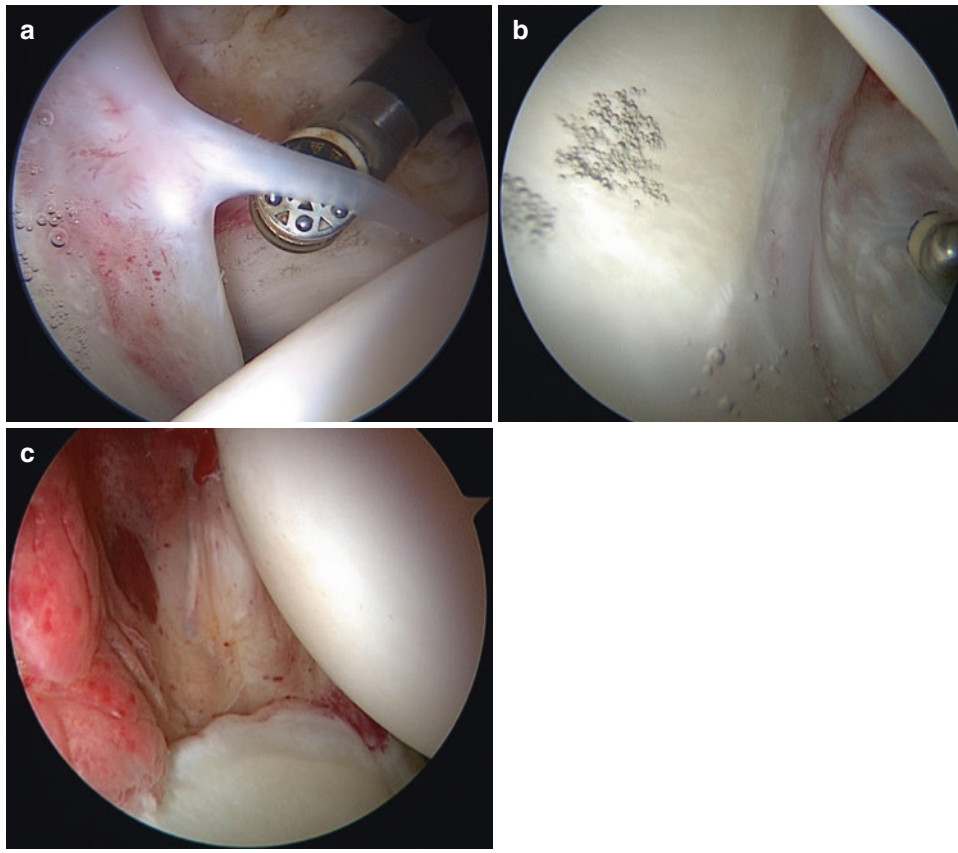


Fig. 15.4 Arthroscopic images obtained during the diagnostic round of central compartment: (**a**) anterior capsulolabral adhesion with inflammation of chondrolabral junction viewed from anterolateral portal in a right hip; (**b**) normal acetabular articular cartilage viewed from anterior portal in a right hip; (**c**) intact posterior bundle of ligamentum teres with leg in external rotation and viewed from anterolateral portal in a right hip

labral reconstruction to be appropriate:

(a) **Labral damage** is too severe to allow for successful labral repair.

(b) **Ligamentum teres** must be intact.

(c) **Articular surfaces** of acetabulum and femoral head must be well preserved.

4. Excise the abnormal labrum and size the defect to determine whether a segmental graft is appropriate or whether a circumferential graft would be preferable. Historically, segmental grafts were the norm, but this technique relies on two graft-host anastomoses. It has, therefore, become preferable to carry out an increasingly circumferential reconstruction, where anastomoses are not needed.
5. At this stage consider whether a **three- or four-portal** technique (distal anterolateral accessory (DALA) +/− posterolateral portals) is required, depending on how extensive a reconstruction is being carried out. For smaller segmental reconstructions can even manage with a two-portal technique, but for a full circumferential reconstruction, a four-portal technique is recommended. Establish the accessory portals as required and consider the use of an appropriate portal saver to facilitate the use of the portals (Fig. 15.5).
6. Carry out a labral resection/debridement and an appropriate acetabular rim trim back to the normal chondrolabral junction as seen from the articular side (Fig. 15.6). In so doing be careful not to create an iatrogenic dysplasia.
7. **Pre-drill anchors** from the appropriate portal. The most anterior and anteroinferior anchors will be drilled and placed through the anterior portal (Fig. 15.7a). The DALA will be used for the more superior anchors (Fig. 15.7b), and then the anterolateral and posterolateral portals for the more posterior anchors (Fig. 15.7c). Consider the need for **all-suture** anchors for the most anteroinferior and most posteroinferior sites, and **Knotless** for majority of clockface (**Speedlock—Smith & Nephew**).
8. An all-suture anchor (Q-Fix) is used at the most anteroinferior (inferior to psoas notch and adjacent to anterior end of transverse acetabular ligament) and most posteroinferior limits of the reconstruction, and the sutures are brought out of the anterior and most posterior portals accordingly.
9. **Prepare the appropriate graft** on back table (the author's preference is to use an allograft fascia lata graft).

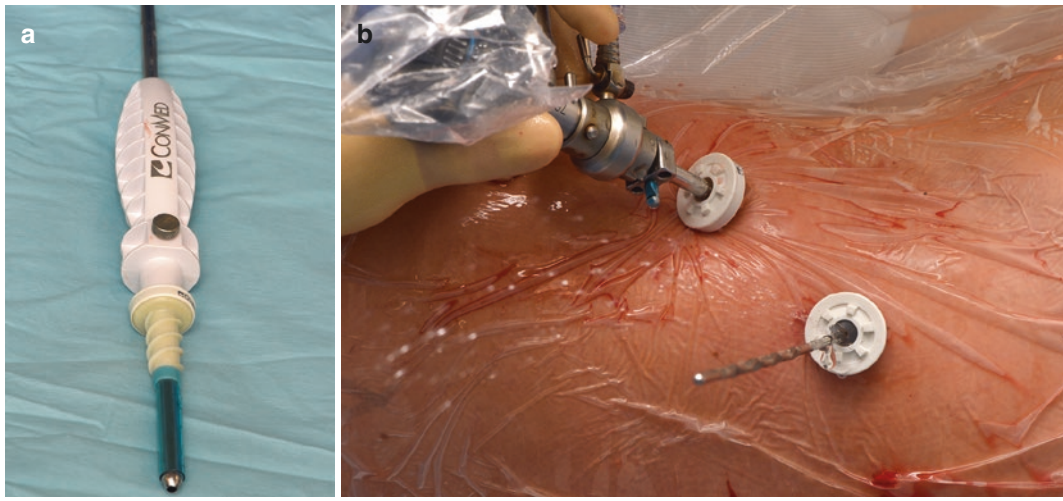


Fig. 15.5 Portal saver (EZ switch, Conmed): (**a**) EZ switch portal saver cut to size and mounted on introducer; (**b**) two EZ switch portal savers in use during a left hip arthroscopy

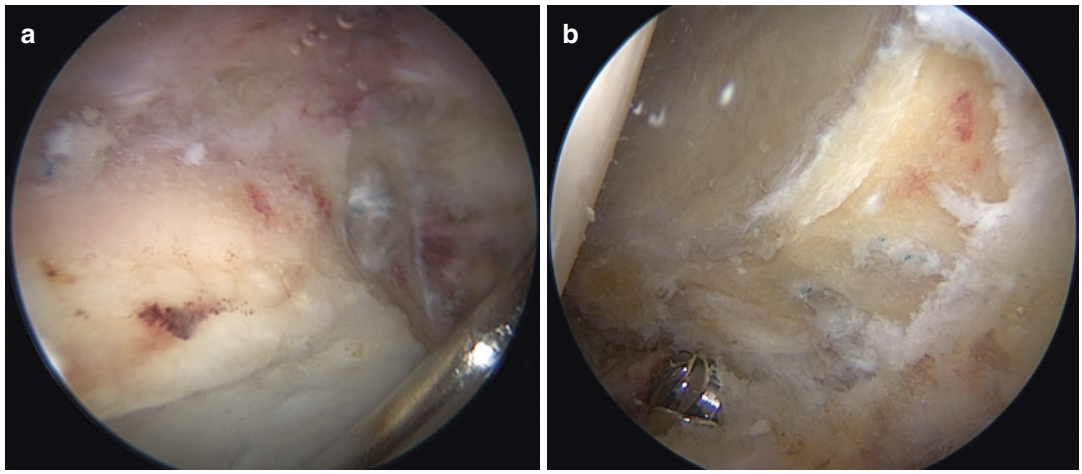


Fig. 15.6 Labral debridement and acetabular rim trim in preparation for labral reconstruction: (**a**) anterosuperior acetabular rim trim and labral debridement viewed from anterolateral portal in a right hip; (**b**) posterior acetabular rim viewed from anterior portal

(a) Tubularise and whipstitch with an absorbable suture (2/0 vicryl undyed) (Fig. 15.8).
(b) Mark each end with a different colour suture (to aid identification in joint).

10. The author's preference is to use an all-suture knotted anchor (Q-Fix) for the anterior and anteroinferior zones where the bone is at a premium, and then a knotless anchor (Speedlock) for the superior zones where the bone is more plentiful. Posteriorly again the all-suture knotted anchor (Q-Fix) is used.
11. Bring one end of the suture from the most anterior Q-Fix suture out through the DALA portal and pass this through the anterior end of the graft. This will allow it to be shuttled into the joint. Pass the graft into the joint through the DALA portal (Fig. 15.9) and position the posterior end posteriorly in the acetabulum and pull the posterior stay suture out through the most posterior portal. This allows tension to be applied on the graft for better visualisation of the graft.
12. Take the front end of the graft anteroinferiorly and gather the Q-Fix suture (that had previously been pulled out through the DALA portal) and pull it back out of the anterior portal. This then allows the most anteroinferior anchor to be tied down securing the anterior end of the graft (Fig. 15.10).
13. Then in sequence, secure the graft from anterior to posterior using each anchor that had been pre-drilled (Fig. 15.11). Once the most posterior limit is reached, then secure the posterior end with the most posteroinferior Q-Fix anchor (Fig. 15.12) and cut off any excess length of graft using either a blade or an Eflex ligament chisel.
14. Test the stability of the reconstruction with a hook, and also test that the fluid seal is restored by letting off traction and inspecting the seal throughout (Fig. 15.13).

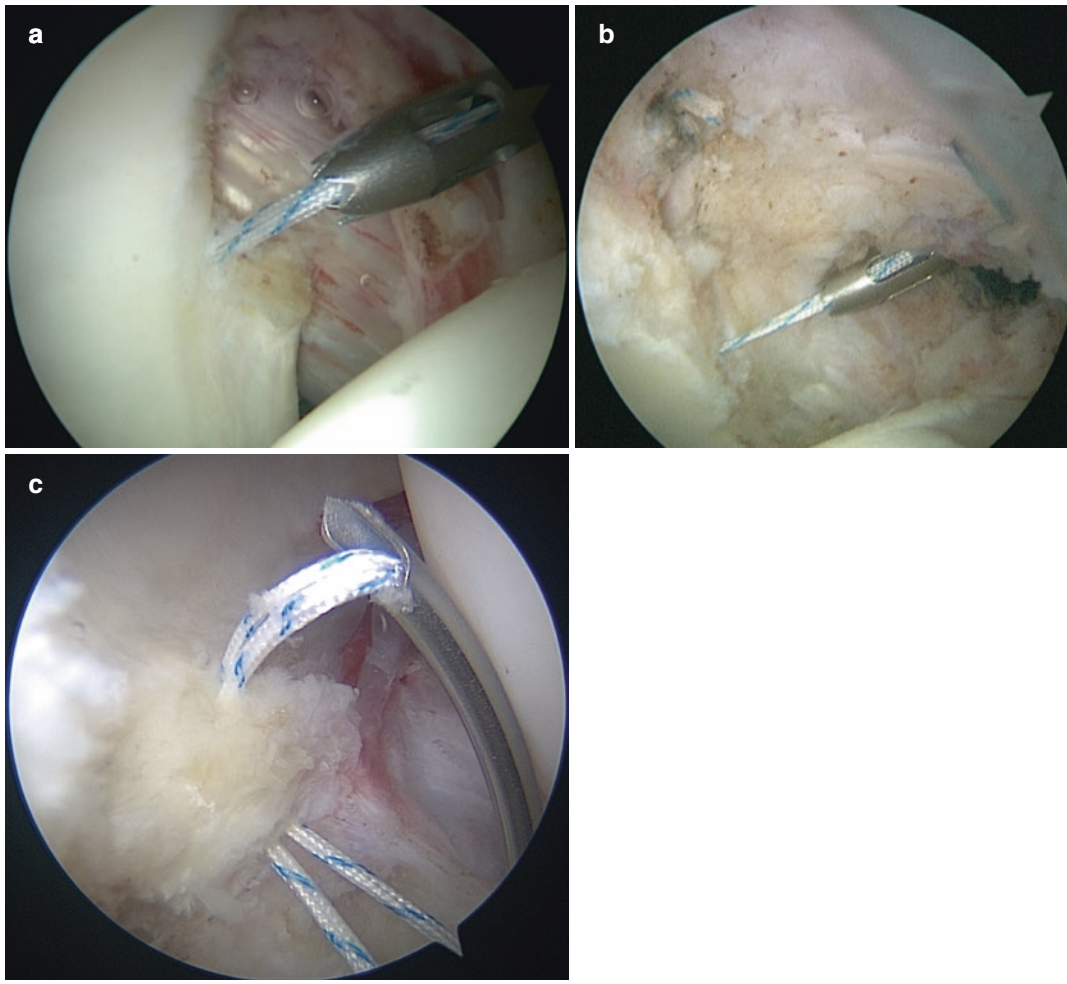


Fig. 15.7 (**a**) Anterior all-suture anchor drilled through anterior portal, at the level of the psoas notch (notice the psoas tendon just behind) as viewed from anterolateral portal in a right hip. (**b**) Superior anchors drilled through distal anterolateral accessory (DALA) portal—note an all-suture anchor in place and to its left the drill hole for a Speedlock anchor (knotless peak anchor). (**c**) Ultrabraid suture being passed around the stump of the native labrum posteriorly in preparation for a Speedlock anchor (as viewed from anterior portal in a right hip)

15. Carry out a dynamic impingement test to ensure satisfactory femoral head–neck offset and contour. Carry out a femoral osteoplasty as necessary to optimise both the contour and the offset (Fig. 15.14).

15.6 Further Considerations

Techniques of labral reconstruction continue to be refined. Continuing developments in instrumentation will inevitably turn what is currently a

Fig. 15.8 Fascia lata allograft: (**a**) being prepared for use; (**b**) allograft tubularised and ready for use

highly challenging procedure into an easier and more reproducible procedure.

There are logistical issues, not to mention financial ones, involved with having allografts available for labral reconstruction, particularly if primary reconstruction is to be considered. This currently inevitably means that the procedure is not as widely available as it would ideally be.

The role of stem cells in labral reconstruction is yet to be established. Furthermore, the role of a composite chondrolabral (labral and articular cartilage) graft is yet to be explored.

The next decade is likely to witness a steep increase in the adoption of labral reconstruction, particularly as improved instrumentation is developed and released. Ongoing research will establish definitively the role of labral

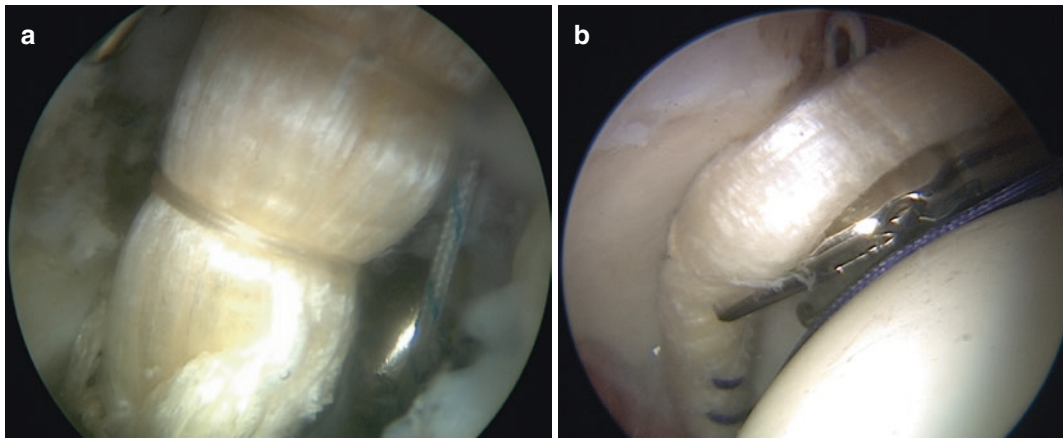


Fig. 15.9 (**a**) Allograft is passed into hip joint through the DALA portal. (**b**) Allograft being manipulated into position

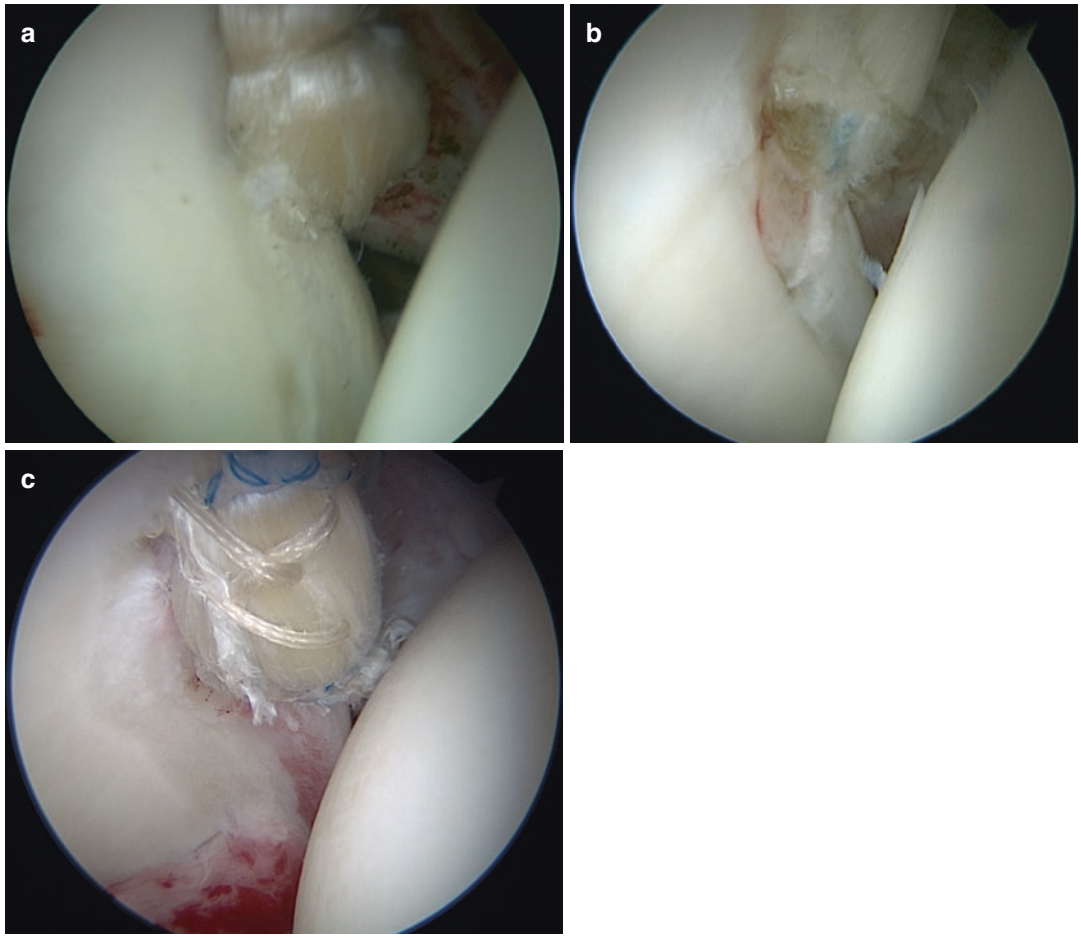


Fig. 15.10 Anterior end of allograft secured with Q-Fix suture anchor in three different cases: (**a**–**c**)

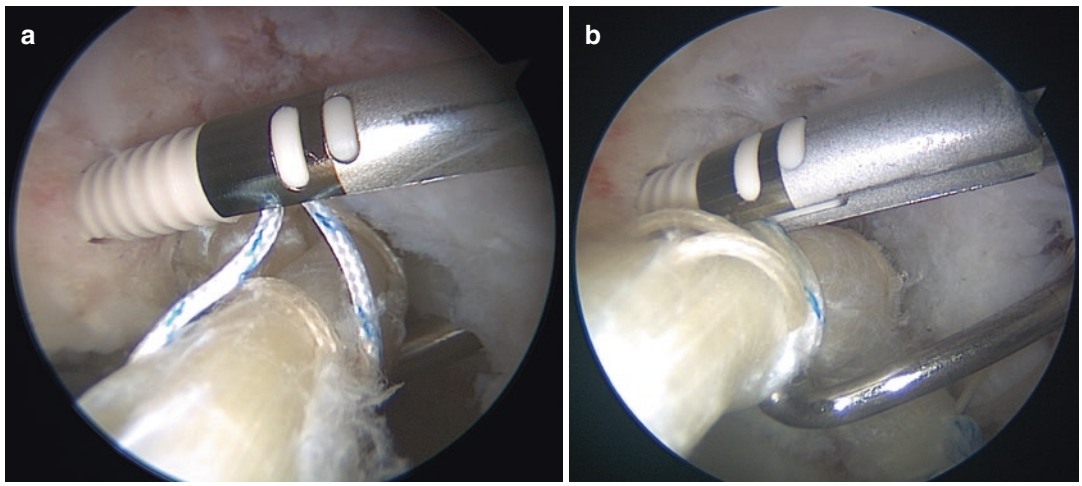


Fig. 15.11 Speedlock suture anchor securing allograft superiorly: (**a**) anchor is placed into the pre-drilled hole; (**b**) partial tensioning allows accurate placement of suture relative to anchor, and anchor is then tapped into position and final tensioning achieved

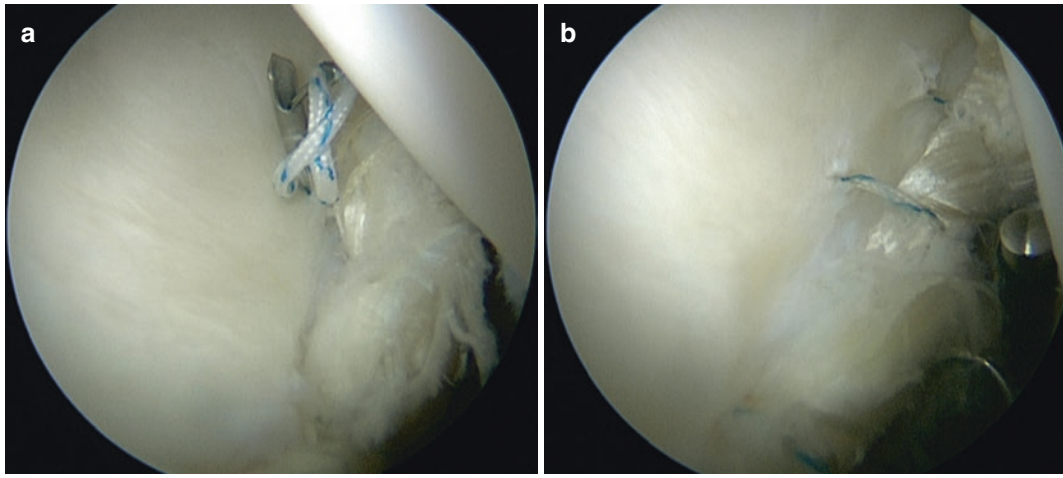


Fig. 15.12 Posterior end of graft secured with Q-Fix suture anchor: (**a**) suture passed through native labral stump; (**b**) Q-Fix all-suture anchors posteriorly secure the graft to the native stump with an overlap

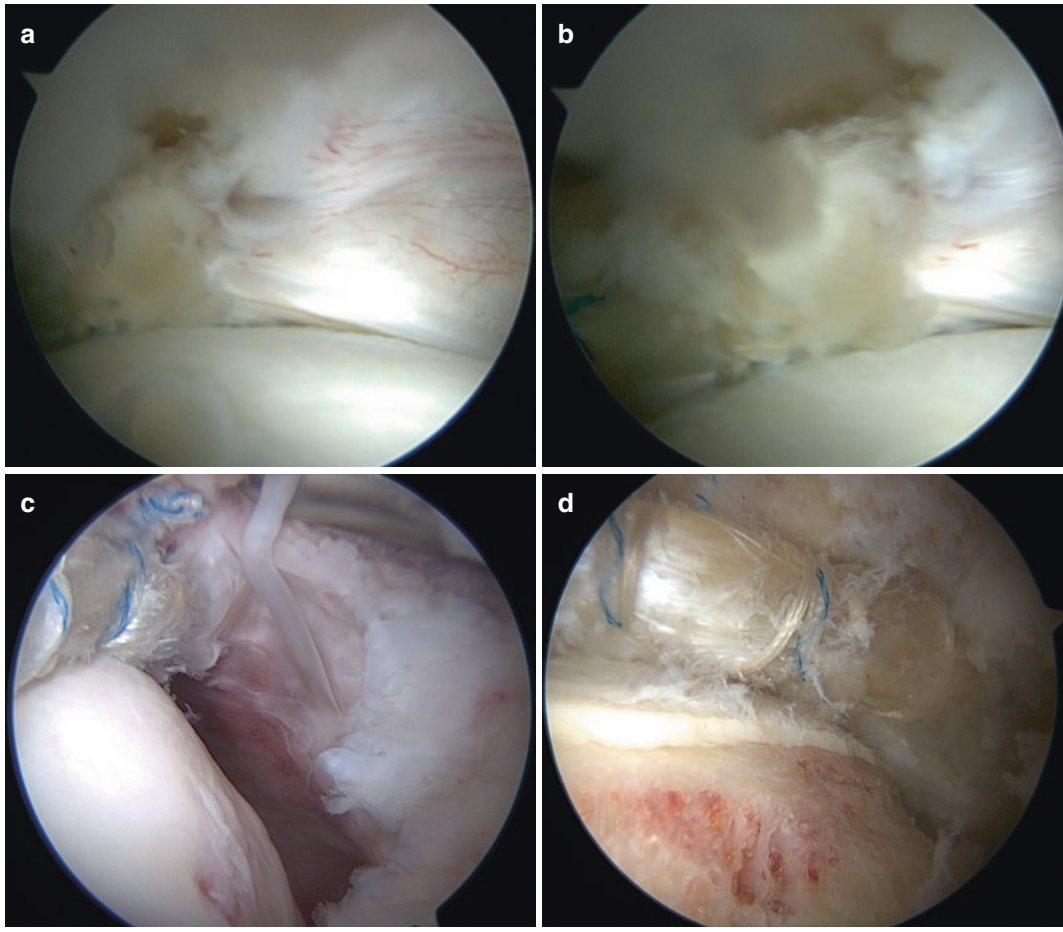


Fig. 15.13 Inspecting the labral seal with traction released: (**a**, **b**) viewing the anterior anastomosis of allograft and native labrum at level of psoas notch; (**c**) view of allograft over anterior hip confirming labral seal; (**d**) a different case where femoral osteoplasty was required, still confirming labral seal

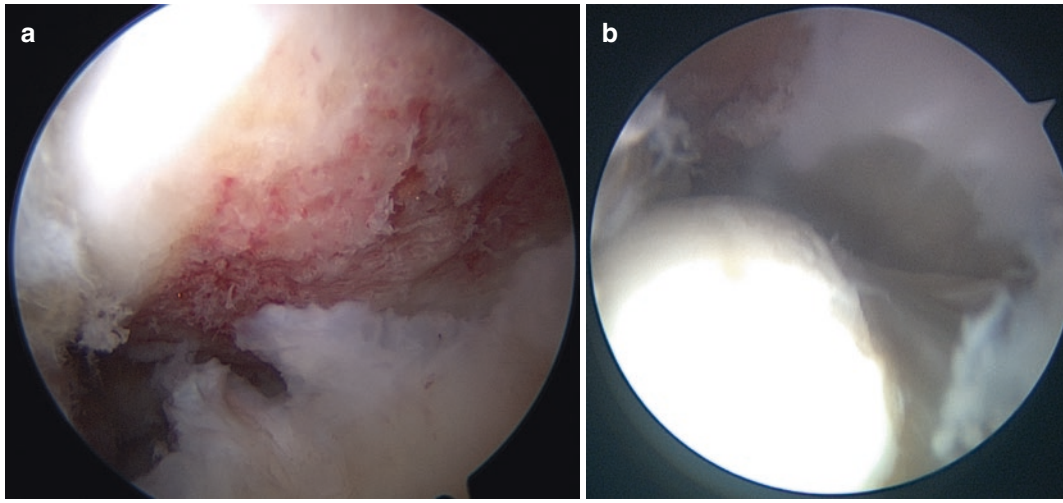


Fig. 15.14 Ensure appropriate femoral head–neck offset and femoral neck contour: (**a**) femoral neck in a right hip viewed from anterior portal looking posteriorly; (**b**) femoral head–neck junction in a different case confirming appropriate offset

reconstruction and will determine whether reconstruction can deliver superior outcomes to labral repair.

Tips and Tricks in Labral Reconstruction

Pre-operative Planning

1. Labral reconstruction is technically a highly demanding procedure, and so before considering carrying out your first case, ensure that you have been appropriately trained in the techniques of labral reconstruction. Preferably go on an approved cadaveric course and spend some time with an experienced surgeon who carries out these procedures regularly.
2. When considering reconstruction for cases where arthroscopic surgery has already been carried out previously, ensure that there is no other persisting structural cause for ongoing symptoms. If there is, this would need addressing prior to carrying out a labral reconstruction.
3. Plan to use allograft for your first case as the tissue handling properties are more favourable than autograft.
4. Be familiar with the different graft materials (for the reconstruction) and practice graft preparation before undertaking your first case. Ensure the allograft is tubularised and tightly packed to avoid it becoming engorged once in the joint.

At Operation

5. Consider using fluoroscopy, before starting the arthroscopy, to check the femoral head–neck offset and femoral neck contour. Plan to carry out a femoral osteoplasty as necessary to restore appropriate head–neck offset.
6. At arthroscopy always carry out a diagnostic round first to ensure that the ligamentum teres is intact and that the articular surface is well preserved. Both of these are pre-requisites for a successful outcome from labral reconstruction.
7. Do not be afraid to use four portals, as this will increase efficiency and reduce operative time.
8. Use appropriate portal savers (for example, the EZ switch from Conmed) to increase operative efficiency.

9. Plan to use an allograft that is longer than needed, so that it can be secured front to back and then cut off the excess. Prepare it as described in step 4.
10. Use the better end of the prepared graft as the anterior end, and do not use a stay suture in this end of the graft.
11. Use a long stay suture in the posterior end of the graft, so that once the graft is introduced into the joint through the DALA portal, this stay suture can be brought out of the joint through the most posteriorly placed portal and be used to keep the graft under appropriate tension when then securing the front end of the graft.
12. Carry out an appropriate labrectomy and acetabular rim trim, and then predrill all anchors. Ensure that the anchors are as close to acetabular rim as possible, as otherwise they will tend to evert the labral graft and compromise the labral seal. Use of the DALA portal for drilling (all but the most anterior and most posterior) anchors will facilitate this.
13. Use a pre-sited (all-suture) Q-Fix anchor suture to tie down the anterior end of the graft (close to or inferior to the psoas notch).

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