Diagnostic Shoulder Arthroscopy

11

Antonio E.G.C. Cartucho

Introduction

Shoulder arthroscopy turned, in the last 20 years, in a fundamental diagnostic and treatment tool. Since the first description of subacromial decompression by Ellman [1], there has been a constant evolution driven by basic science, biomechanics, and engineering that turned possible that nowadays most of the instability, rotator cuff, and part of the articular degenerative problems of the shoulder girdle are treated using arthroscopy.

Arthroscopy should be looked as a tool to deal with certain problems. This means that it should be used in the right indication, with the correct technique and taking into account the "state of the art" for the treatment of the pathology. Behind the technical gesture lies the most important part of arthroscopy. The ability of the surgeon to recognize what is not normal, what is a normal variance, if the structural damage observed is the primary cause of the patient complaints, and finally the decisions of the correct way to deal with the problem, allied with a good technique, are altogether the keys of success.

In this chapter, we will explain the technical aspects together with the pathologic and clinical relevant issues.

Operating Room and Patient Positioning

The rational use of the space available at the operating room with a correct positioning of the operating table is vital. This position and the distribution of other equipment like the camera, the pump, the radiofrequency device, and the screen are dependent of the patient positioning.

The "beach chair position" (BCP) and "lateral decubitus position" (LDP) are equally used with no definitive advantage of one over the other. Nevertheless, it is consensual that BCP permits an easier turn to open surgery and that LDP permits a better access and visualization on instability procedures.

In BCP the patient is seated with a 45–80º back inclination. An operating table with a segmented back, permitting to uncover the back of the shoulder to be operated, is an important asset. If not available, the patient's arm is pulled to the extremity of the table, and a small pillow can be used under the shoulder blade in order to slightly rotate the shoulder; otherwise, the manipulation of the arthroscope will be disturbed by the operating table specially when the surgeon tries to look with the arthroscope to the lateral side of the shoulder.

When using LDP, a standard operating table can be used. The patient should lay on the side with the support of a vacuum cushion or pubic and sacrum supports. A 3 kg traction device is used in order to maintain the arm at 70º of abduction and 20º of forward flexion. This position may be changed in order to inspect the subacromial bursa.

In both operating positions, the necessary equipment is placed opposite to the surgical team with the ventilator and the anesthesiologist at the head of the patient.

Arthroscopic Instruments

For shoulder arthroscopy, the necessary basic instruments are similar to the ones used for the knee:

- A 4.5 mm arthroscopic sheath with at least one fluid entrance and ideally with another for aspiration control
- A 30º optical device
- A cold light system
- A camera
- A probe (preferably long)

A.E.G.C. Cartucho, MD
Shoulder Unit, Orthopaedic Surgery, Hospital Cuf Descobertas, Mario Botas, Lisbon 1990-018, Portugal
e-mail: a.cartucho@gmail.com

The online version of this chapter (doi:10.1007/978-1-4471-5427-3_11) contains supplementary material, which is available to authorized users.

G. Milano, A. Grasso (eds.), *Shoulder Arthroscopy,*
DOI 10.1007/978-1-4471-5427-3_11, © Springer-Verlag London 2014

- A monitor
- A fluid pump
- A digital recording system
- A mechanic cutting device (shaver)
- A radio frequency device
- An operating cannula

The recording system although not essential is important to review cases with a bad clinical outcome, to use the images for teaching purposes, and last but not least as proof in case of litigation.

Although considered unnecessary by a few surgeons, the fluid pump is the only way to know the exact pressure of fluid inside the joint. This should be kept between 40 and 50 mmHg. The pump also permits to perform short periods of hyperpressure for further distension or hemorrhagic control.

General Principles and Portals

With the patient in the chosen position, drawing of the osseous landmarks should be done. From the spine of the scapula, the external border of the acromion with its posterolateral and anterolateral corners should be carefully marked. The anterior and posterior margins of the clavicle and acromioclavicular joint must be outlined. Finally, the coracoid process is identified (Fig. 11.1). These landmarks will help the surgeon in triangulation techniques and to insert the portals in the proper position. Nevertheless, it should be kept in mind that during the procedure, the skin marks can change as far as 2 cm from the initial mark. This fact is due to soft tissue distension which is particularly evident in extra-articular procedures. A less correct surgical technique with multiple "failed" accesses to the joint also contributes to fluid extravasation turning the surgical procedure more and more difficult.

Fig. 11.1 Drawing of the osseous landmarks

Triangulation is the technique that permits the surgeon to know where he/she is, what to do to see a certain structure, and to take the instruments to the visual field. This is accomplished combining exterior visualization of the instruments and their directions combined with the marked bony references. If the surgeon cannot see the probe or surgical instrument he/she is using than with the arthroscope standing still, the instrument should touch it and follow it to the tip of the arthroscope in order to bring the instrument to the visual field.

The initial viewing portal for shoulder arthroscopy is the posterior portal. A stab incision, just enough to permit the introduction of the arthroscopic sheath with a blunt trocar, should be performed, 2 cm inferior and 1 cm medial to the posterolateral corner of the acromion (Fig. 11.2). The arthroscope passes the skin, the posterior deltoid, and the interval between the infraspinatus (IS) and the teres minor (TM). At that point the arthroscopic sheath should be directed towards the coracoid process, penetrating the posterior capsule between the humeral head and the posterior rim of the glenoid, entering the shoulder joint. This way the surgeon will avoid the neurovascular structures of the triangular interval (radial nerve and deep brachial artery), the triangular space (circumflex scapular vessels), and the quadrangular space (posterior humeral circumflex vessels and axillary nerve).

This same posterior portal is used to access the subacromial space after the complete glenohumeral arthroscopy. In order to enter the subacromial space, the arthroscopic sheath with the blunt trocar is withdrawn through the interval between the IS and TM and is redirected more laterally and superiorly in order to pass immediately under the acromion and reach its anterior tip. At this stage the tip of the trocar should be palpated under the skin just beneath the anterior border of the acromion and lateral to the coracohumeral ligament. The common errors are to place the arthroscope either to medial or to stay too posterior not entering the bursa. In that case the surgeon will not have a distended bursa and the vision will be disturbed by soft tissues around the lens. Several attempts should be made to reach the correct position by keeping in mind that this may lead to less fluid extravasation and soft tissue distension.

The posterior portal should be inferior enough to permit a smooth passage of the arthroscopic sheath. If a resection of

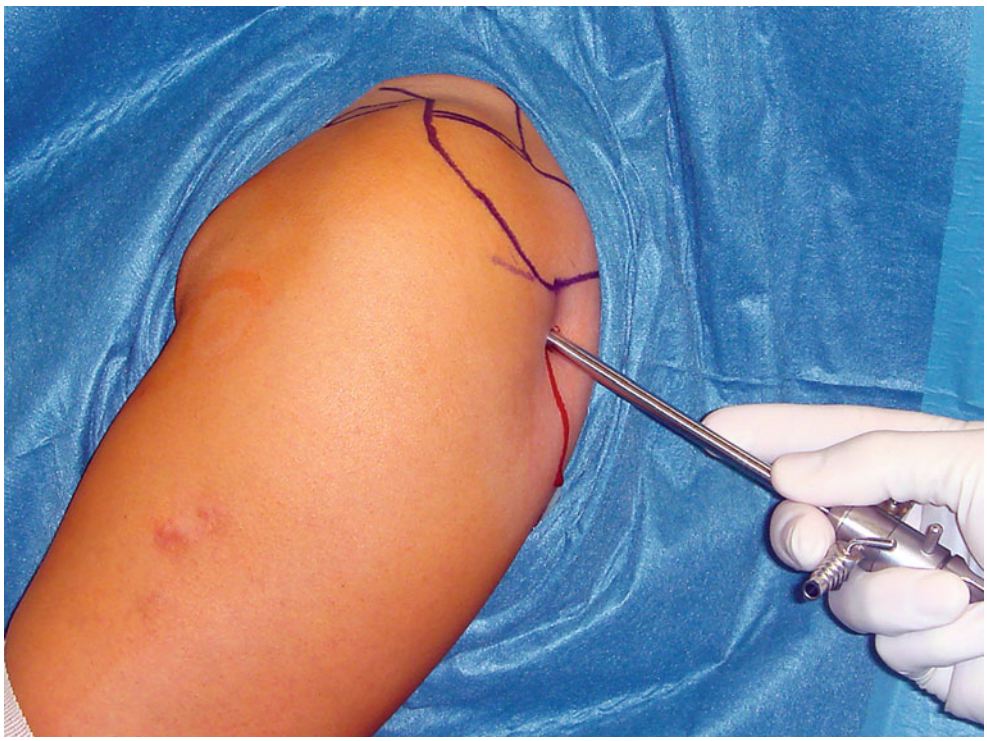

Fig. 11.2 Posterior portal

the distal clavicle is part of the procedure, the posterior portal can be made more medial, and on the contrary if a rotator cuff reconstruction is planned, a more lateral position of the portal is desirable. Nevertheless, it is important to search for balance. If a more lateral posterior portal will facilitate the view of the rotator cuff from the bursal side, a too lateral portal will make it very difficult to access the articular side of the same lesion.

In order to establish accessory portals, two methods are available. "Inside-out" method consists in placing the scope sheath in a chosen space inside the joint under direct view and to make protruding to the skin a switching stick trough the arthroscopic sheath. A skin incision is made, large enough to put a working cannula in place. This method is technically less demanding but limits the possible positions for portal placement and working field of the instruments. For instance, when dealing with an instability case, the instruments should be able to reach the anteroinferior capsule, and the placement of anchors in the anterior glenoid rim requires a 45º angulation.

The "outside-in" method consists in placing a needle inside the joint under direct visualization on a chosen place with the correct angle in order to turn possible or facilitate the procedure (Fig. 11.3). After selecting and confirming this way the correct position, a skin incision is performed and again a working cannula can be used. This is usually the method preferred by experienced shoulder surgeons but the "inside-out" method is very useful at the beginning of the learning curve.

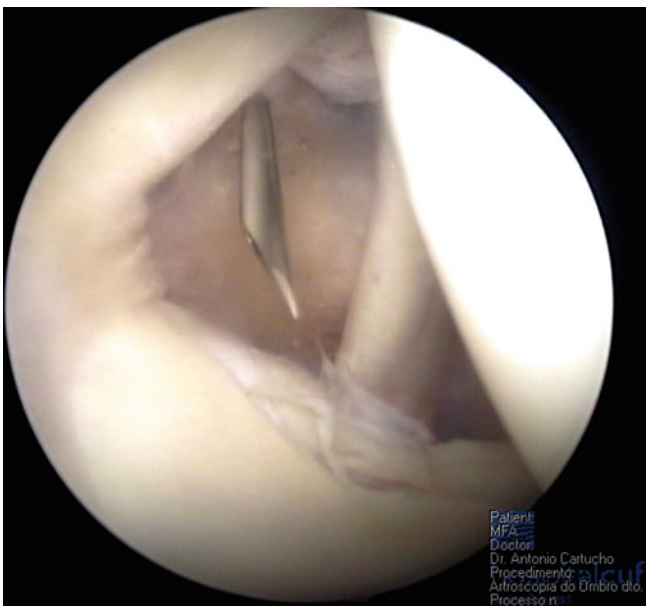

Fig. 11.3 "Outside-in" method

The anterior portal in the glenohumeral joint is created through the rotator interval. This space is limited superiorly by the long head of the biceps (LHB) and inferiorly by the superior border of the subscapularis (SbS) tendon. Again if the "outside-in" technique is used, the angulation on the superior to inferior and medial to lateral axis should be chosen according to the procedure.

The use or not of operating cannulas in this accessory portal is optional. With a cannula the inflow can be changed from the arthroscope to the cannula. These devices also permit a better fluid control and facilitate the repetitive entrance of the instruments. Nevertheless, cannulas may need longer incisions and limit the freedom of movement of the surgeon. For those reasons experienced shoulder surgeons tend not to use them specially when working outside the glenohumeral joint, namely, at the subacromial space.

In subacromial space, a lateral portal can be created in direct line with the posterior border of the clavicle and approximately 2–3 cm distal to the lateral border of the acromion. Again using the "outside-in" technique the surgeon must find the correct position in order to easily reach the undersurface of the acromion or the rotator cuff according to the planned procedure.

Glenohumeral Diagnostic Arthroscopy (Video 11.1)

After entering the joint trough the posterior portal, the surgeon should look for the LHB and the rotator interval limited superiorly by this structure and inferiorly by the SbS tendon (Fig. 11.4).

Diagnostic arthroscopy must be systematic in order to visualize all the structures. Initially the intra-articular visualization can be performed without distending the joint with fluid. This way the inflammatory signs are better quantified as the fluid pressure will alter the superficial vascularization. For didactic purposes four regions will be detailed.

Superior Region

The LHB is attached to the superior labrum. This structure with a triangular shape at its basis may have a meniscal-type insertion and may present several degrees of fraying or detachment as described by Snyder [2]. In order to evaluate the attachment site of this structure, a probe should be introduced from an anterior portal. Fraying and the presence of bare bone are not normal. Nevertheless, a careful inspection, the clinical history, examination, and the presence or not of biceps instability will determine the need for repair or tenodesis.

The coracohumeral ligament (CHL) encircles the biceps, sending fibers to the supraspinatus (SS) and SbS, contributing to form the bicipital groove, whose floor is formed by the superior glenohumeral ligament (SGHL) that runs from the anterosuperior part of the glenoid towards the lesser tuberosity.

The stability of the LHB can be assessed by moving the arm in flexion and abduction with internal/external rotation. At this point a probe from the anterior portal can pull inside the joint the extra-articular part of biceps to search for fraying, partial ruptures, or inflammatory signs.

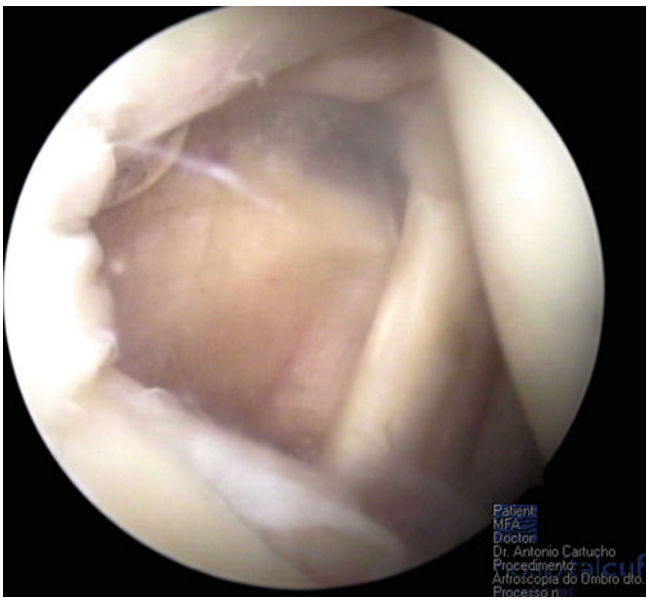

Fig. 11.4 Rotator interval

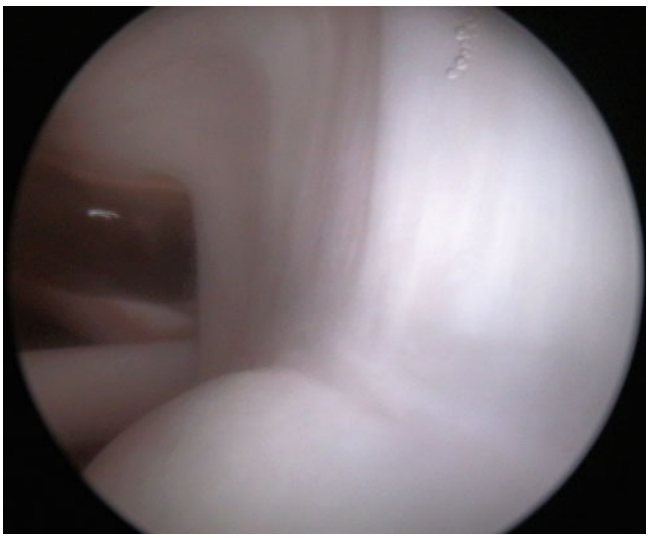

Fig. 11.5 Supraspinatus insertion

The arthroscope should be slightly withdrawn, and lowering the hand with a simultaneous rotation of the optical system, the SS insertion is inspected (Fig. 11.5). Partial degenerative articular-side tears present with a fraying, and usually traumatic partial ruptures have a flap of tissue protruding inside the joint. Any fraying of the SS should be debrided, and a marking suture should be put in place through a spinal needle in order to access the same segment of cuff from the subacromial space during bursoscopy. It is important, for treatment choice, to quantify the depth of the tear. This can be done using an instrument of known size between the cuff and the articular margin.

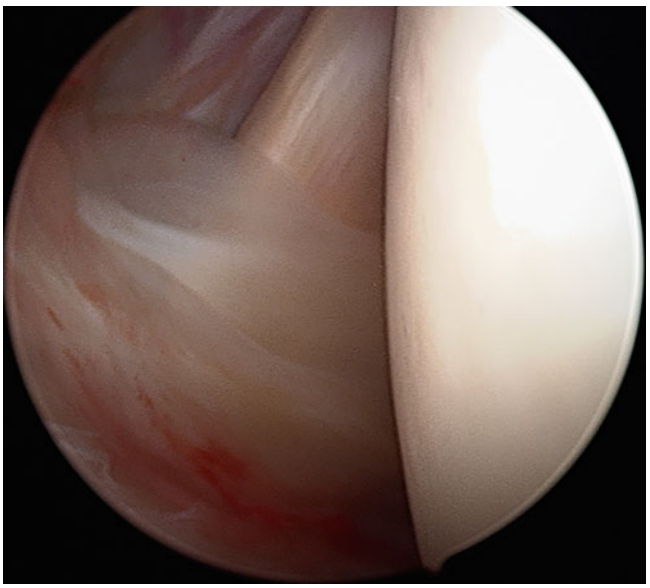

Fig. 11.6 Middle glenohumeral ligament

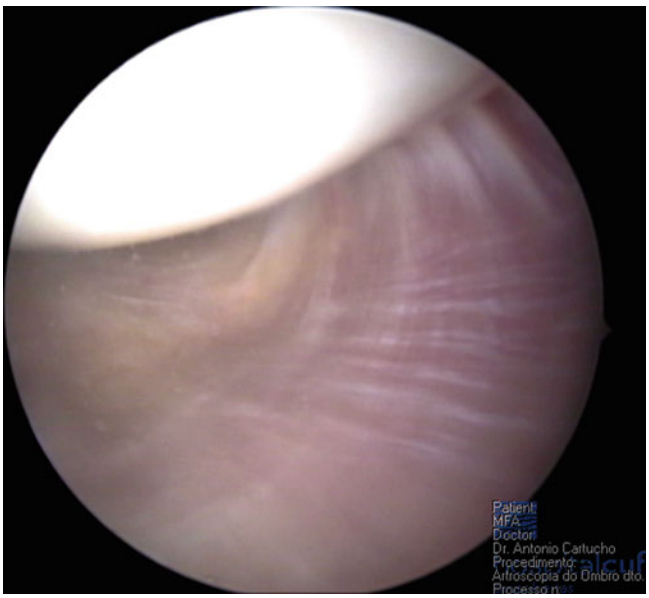

Fig. 11.7 Insertion of the capsule on the humerus

Continuing to go posterior after the bare area on the humeral head (HH) (no cartilage and nutritive holes with a pink aspect), the insertion of the IS is observed for the presence of tears or fraying. In this case the diagnosis of posterosuperior impingement should be kept in mind and confirmed by the clinical evaluation and by the contact of the IS with the posterosuperior labrum with the arm in abduction and external rotation [3].

Anterior Region

The articular cartilage of the HH and of the glenoid should be carefully inspected. An anterior entail of the glenoid rim at the "3 o'clock" position is normal constituting the glenoid notch. Inferiorly to it any detachment of the labrum is considered pathologic. On the other hand, superiorly to the glenoid notch the labrum can present a labral hole or be absent like in the Buford-type insertion of the medial glenohumeral ligament (MGHL) [4]. These variants are normal. Also a central depression of the cartilage is normal.

The SbS tendon should be inspected for intra-articular tears. The MGHL crosses the SbS at a 60° angle and varies from a firm structure to a transparent veil (Fig. 11.6). It runs from the humeral neck near the lesser tuberosity to the anterosuperior glenoid rim. At this stage the SbS recess should be inspect for loose bodies that would be missed otherwise.

Inferior Region

With gentle traction at 45º of abduction, the arthroscope is turned anteroinferiorly. The anterior band of the inferior glenohumeral ligament (IGHL) runs from the humerus to the anteroinferior glenoid rim. Continuing to look down the axillary pouch should be inspected and the presence of loose bodies noted. It should be remembered that the axillary nerve lies just beneath the capsule and can be damaged during surgical procedures for instability (capsular plication) or stiffness (capsulotomy) in this area. Slightly withdrawing the arthroscope, the posterior band of the IGHL can be accessed. In order to see the insertion of the capsule on the humerus with the arthroscope turned to the axillary pouch, the view should be turned up (Fig. 11.7). This way humeral avulsions of the glenohumeral ligament (HAGL) can be diagnosed.

Posterior Region

With the arthroscope nearly out of the joint, the posterior part of the HH should be inspected. Osteochondral lesions (Hill-Sachs lesions) are often seen in instability cases (Fig. 11.8), and engaging of the lesion over the anterior glenoid rim should be tested with the arm in abduction and external rotation. The posterior labrum must be inspected for detachments and fraying. Particularly, fraying of posterosuperior labrum associated with articular-side tear of the IS raises the suspicion of posterosuperior impingement [3].

This region should be inspected also looking from the anterior portal. This allows a better visualization of the posterior labrum and capsule and also an "over-the-top" view (Fig. 11.9) of the anterior structures. This is crucial in instability cases.

Fig. 11.8 Posterior part of the humeral head

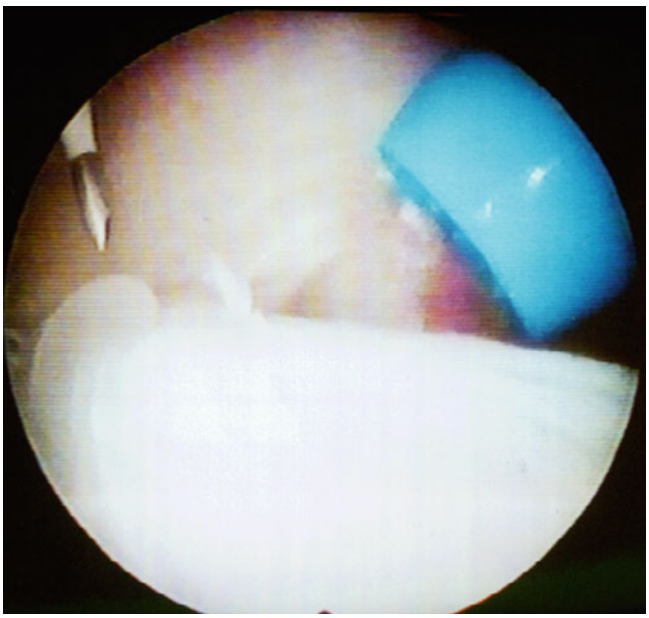

Fig. 11.10 Subacromial bursa

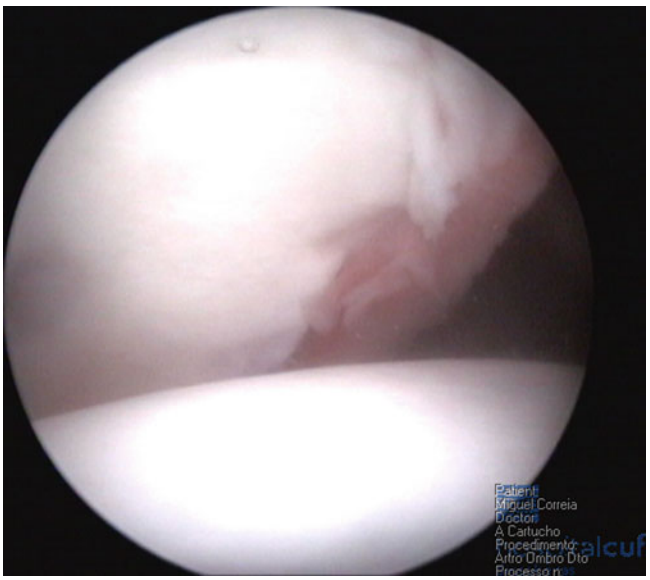

Fig. 11.9 View of posterior labrum and capsule from the anterior portal

Bursal Diagnostic Arthroscopy (Video 11.1)

The scope is introduced from the posterior portal and the lateral portal is placed according to the previously described technique. The surgeon must be aware that distending the bursa makes a view of the tendons possible from the beginning and that the need for extensive soft tissue debridement to have visualization is not frequent (Fig. 11.10). When bursectomy is necessary to improve visualization, after confirmation that the arthroscope is in the correct position, we prefer to use a shaver device that is kept close to the camera and facing up in order to not damage the rotator cuff. It is important to know that a functional rotator cuff tendon is not easy to damage even with a mechanic cutting device. Nevertheless, the surgeon should take all the necessary measures to avoid any iatrogenic damage.

In this compartment, outflow control is crucial. If excessive, the distended bursa will collapse. This causes bleeding, turning visualization very difficult. The acromial branch of the coracoacromial artery that lies near the coracoacromial ligament (CAL) is responsible for important bleeding when this ligament is resected. In this case aspiration should be stopped; if possible, the fluid pressure controlled by the pump is augmented to 70 mmHg, and with the tip off the arthroscope, the bleeding vessel is searched and identified. This way the incoming fluid from the arthroscope will wash away the blood, making it possible to coagulate the vessel with the help of a radiofrequency device. If in spite of these measures outflow control is not obtained, the surgeon must limit all losses of fluid with coverage of all portals with the finger and eventually check with the anesthesiologist the blood pressure of the patient. According to Morrison et al. there should be a difference of around 50 mmHg between the systolic pressure of the patient and the pressure at the subacromial space [5].

With the arthroscope facing down and rotating the arm, the quality of the tendons must be evaluated, and a tear must be characterized in location, shape, retraction, and mobility. At this stage changing the viewing portal to the lateral portal to have a frontal view of the tear can be useful (Fig. 11.11). This also permits to easily debride the posterior bursa with a shaver coming from the posterior portal and to determine the status of the muscle-tendon junction.

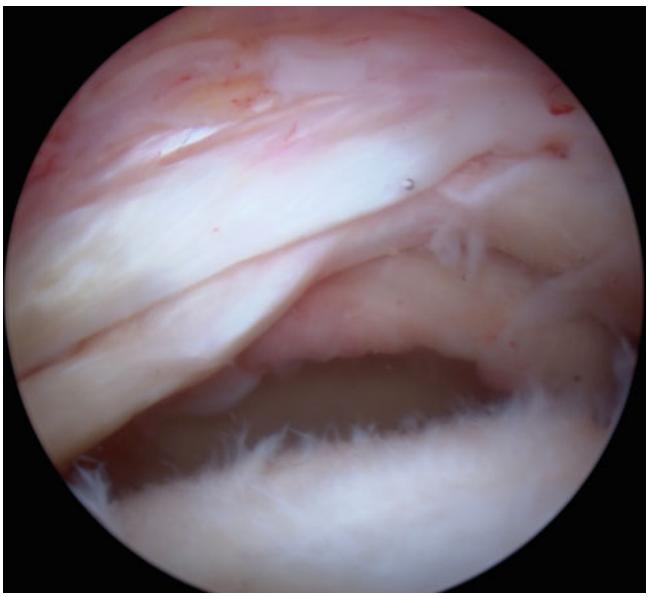

Fig. 11.11 Full-thickness rotator cuff tear (frontal view from the lateral portal)

With the arthroscope facing up, fraying of the undersurface of the acromion and CAL might be associated with subacromial impingement.

Summary

Arthroscopy is a precious diagnostic and surgical tool. Its practice has a long learning curve. Supported by a sound theoretical knowledge, one must practice first technical skills on plastic models and then move to practice in cadaver lab. A fellowship in shoulder surgery and visits to experienced surgeons are of great value. The first procedures should ideally be performed with the cooperation of an experienced shoulder arthroscopic surgeon.

Complications are rare in spite of anecdotic neurological, vascular, infectious, and pulmonary edema reports.

Arthroscopy permits the evaluation of shoulder structures with great detail, and the risk of overestimating the structural findings is a concern. There should be a clear relationship between the arthroscopic findings and the clinical history and examination before considering the proper treatment.

References

1. Ellman H. Arthroscopic subacromial decompression: analysis of one- to three-year results. Arthroscopy. 1987;3:173–81.
2. Snyder SJ. Shoulder arthroscopy. Philadelphia: Lippincott Williams & Wilkins; 2003.
3. Walch G, Boileau P, Noel E, Donell ST. Impingement of the deep surface of the supraspinatus tendon on the posterosuperior glenoid rim: an arthroscopic study. J Shoulder Elbow Surg. 1992;1:238–45.
4. Williams MM, Snyder SJ, Buford Jr D. The Buford complex – the "cord-like" middle glenohumeral ligament and absent anterosuperior labrum complex: a normal anatomic capsulolabral variant. Arthroscopy. 1994;10:241–7.
5. Morrison DS, Schaefer RK, Friedman RL. The relationship between subacromial space pressure, blood pressure, and visual clarity during arthroscopic subacromial decompression. Arthroscopy. 1995;11:557–60.