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Diagnostic Arthroscopy of the Shoulder: Normal Anatomy and Variations

INTRODUCTION

The SCOI "15-point system" for performing a complete diagnostic arthroscopic evaluation of the shoulder was developed by the authors in 1984 and first presented at the annual meeting of the Western Orthopedic Association in 1986. The purpose for establishing a stepwise checklist for the diagnostic shoulder arthroscopic exam was to institute a standardized intuitive arthroscopic routine that would ensure the strict performance of a uniform comprehensive evaluation of all anatomical structures in the shoulder. Another equally important purpose of this formal exam is to familiarize the surgeon with the skills needed to visualize the shoulder from both anterior and posterior portals. Unless he or she is comfortable with routinely viewing from both anterior and posterior portals, it will be difficult for them to comfortably operate from both vantage points.

The steps of the 15-point exam are designed to follow a smooth, natural progression around the shoulder joint, pausing at each important anatomical area for assessment and, when necessary, palpation. The typical exam requires about 4 minutes of surgical time but ensures that no significant pathology will be missed. Once the video scope became available, we began recording every shoulder arthroscopy exam, both for our own records and also for our patient to review to help his or her understanding of their particular surgery. Having a standard, consistent video-recorded exam guaranteed that no pathology would ever be overlooked. Additionally, as our library of video cases expanded, these records became a valuble source of reference information, affording us a voluminous data bank for future studies such as that of the Buford complex, rotator cuff pathology, and the superior labral changes related to patient age.

The 15-point SCOI arthroscopic shoulder exam is ideally performed with the patient in the lateral decubitus position on the operating table and with the arm supported in 70 degrees of abduction and 15 degrees of forward flexion. The diagnostic procedure consists of visualizing and video recording all of the anatomic features in the glenohumeral joint and subacromial space from both the anterior and posterior portals. In this chapter, we will describe the techniques we use to visualize the normal glenohumeral anatomy, as well as the common and sometimes confusing normal variations that may be encountered.

PHYSICAL EXAMINATION OF THE SHOULDER

Physical Exam

A complete physical examination of the shoulder is always performed in the clinic. This always includes observation of the bony and muscular anatomy, palpation of all areas of the shoulder, both active and passive range of motion and specific tests for muscle strength and joint stability.

SURFACE ANATOMY OUTLINE

With the arm prepared for surgery and suspended in traction, outline the surface anatomy. Palpate the supraclavicular fossa, bordered anteriorly by the clavicle and the AC joint, posteriorly by the spine of the scapula and laterally by the acromion. Outline this area with a sterile skin-marking pen.

FIGURE 3-1. The skin outline of the bony shoulder anatomy should be placed along the *inferior* edge of the clavicle, acromion, and scapular spine. The orientation line begins at the posterior edge of the AC joint and extends laterally down the arm.

Next, trace the acromial and clavicular outlines. It is important to realize that when these reference lines are drawn, they should be "around the corner" and thus on the inferior surface of the bone and not on the most superficial subcutaneous bony prominence. In other words, the important anatomical reference point is the inferior margin of these bones, because that is the area from which the entry points and surgical incisions for the joint and bursa are estimated. To locate the correct position, use a "pincher"-type grasp. Place the thumb in the supraclavicular notch and use the index finger to feel for the inferior aspect of the acromion beginning at the posterior lateral angle. Once this area is located, draw an ink dot on the skin at the inferior edge of the bone. Define the remainder of the lateral border of the acromion with the index finger, placing another dot below the center point of the lateral edge and another below the anterior lateral corner. Connect the dots to define the lateral acromial border.

Next, outline the S-shaped anterior edge of the clavicle to its midpoint. Place all four fingers of the anterior hand on the clavicle, using the fingertips to determine the location and shape of the bone. Complete the outline by drawing the scapular spine again by placing the tips of three or four fingers under the edge to determine the proper location. Begin from the mark at the posterior lateral angle of the acromion and continue medially to the middle of the scapula. Mark out the AC joint beginning at its posterior edge, located at the anterior margin of the suprascapular notch. Its direction can usually be identified by palpation and typically angles approximately 60 degrees in a lateral direction.

Beginning at the posterior edge of the AC joint (the anterior edge of the supraclavicular fossa), draw a line that crosses perpendicular to the lateral border of the acromion and extends distally 5 cm down the arm. This reference line divides the acromion into an anterior two-fifths and posterior three-fifths. Beneath the defined anterior acromion lies the subacromial bursal cavity containing the biceps tendon in the rotator interval anteriorly and the supraspinatus attachment site area laterally. The posterior bursal curtain is located just posterior to this orientation line, and the AC joint is at the medial edge. The orientation line is helpful as a reference when creating the lateral subacromial-operating portal for decompression and rotator cuff repair procedures (Fig. 3-1).

▶ GLENOHUMERAL ARTHROSCOPY

Creating the Posterior Mid-Glenoid Portal

The first step in performing the 15-point evaluation of the glenohumeral joint is to create the posterior mid-glenoid portal (PMGP) by inserting an arthroscopic cannula. To choose the insertion point, palpate the posterior shoulder anatomy and ballot the humeral head, rocking it in an anterior to posterior direction to sense the location of the joint line. The position for the portal should be approximately 1 cm lateral from the joint line (to avoid injuring the labrum) and cannot be simply measured from the surface anatomy. The entry point should be determined after considering both the thickness of the soft tissues around the shoulder and the size of the bony anatomy. In the average-sized individual, the entry point is approximately 2 to 3 cm inferior and 1 to 2 cm medial from the posterolateral acromial angle. For patients with thicker tissues or larger bony structures, the point will be further inferior and medial. Make a small stab wound through the skin with a #11 knife blade following the direction of the skin lines. *Do not attempt to pierce the muscular tissues or capsule at any time with the knife for fear of injuring the articular cartilage or cutting a blood vessel.*

Insert the arthroscopic cannula fitted with a tapered-tip obturator through the posterior skin incision and through the muscle until the posterior humeral head is palpated (Fig. 3-2). With the opposite hand palpating the anterior surface of the shoulder joint, ballot the humeral head back and forth until a sense of the joint line location is appreciated. Direct the cannula to slide medially off the humeral head to feel the step-off between the head and glenoid. Work the cannula so that it punctures perpendicular through the capsule, usually feeling a definite pop. A common error making the initial PMGP is to insert the cannula at a point too lateral or proximal. Remember that the joint line is located inferior

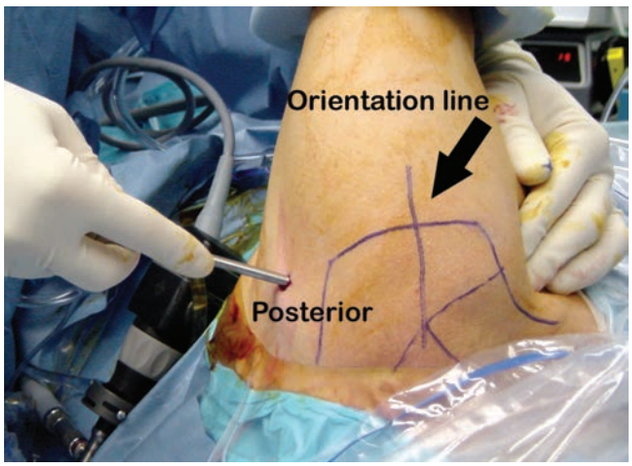

FIGURE 3-2. Insert the arthroscopic cannula into the PMGP using the taper tip of the obturator to palpate the articular surface of the humeral head.

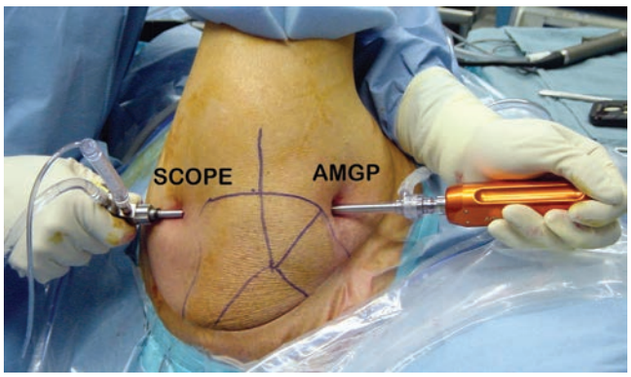

FIGURE 3-3. Insert the anterior cannula over a guide rod and scope sheath and into the joint to create the AMGP.

and medial to the posterolateral acromial corner. If difficulties are encountered, inject 30 CCS of surgical irrigant into the joint via the chosen portal site to confirm the position. Never use excessive pressure or employ a sharp trocar in the scope cannula for fear of penetrating the soft bone in the back of the humeral head, damaging the articular surface, the labrum, or the posterior rotator cuff. Once the capsule is punctured, insert the scope, turn on the fluid flow, and confirm that the portal is truly in the joint and not in the bursa.

Occasionally the initial visualization may be poor due to bleeding, and joint lavage may be necessary. Remove the scope from the arthroscopic cannula and place a thumb tightly over the outer opening. Turn on the pump to distend the joint and intermittently release and apply the thumb over the opening. Raise the pump pressure temporarily to tamponade the bleeders. Always remember to decrease the pump pressure as low as possible following the lavage and throughout the case to avoid unnecessary fluid extravasation into the soft tissues. After a few lavage cycles, the visual field is usually clear. If not, check that the patient's blood pressure is reasonably controlled (<100 mm Hg systolic in a healthy patient when in the lateral decubitus position) and that the pump pressure sensor is functioning correctly.

Anterior Mid-Glenoid Portal Creation

An anterior portal must be created before performing the glenohumeral arthroscopy in order to allow use of a probe and later to complete the second part of the diagnostic examination (steps 11 to 15). With the arthroscope inserted into the posterior cannula, distend the joint using the arthroscopic pump, orient the scope so that the glenoid is inferior (parallel with the floor), and choose the spot for the anterior portal. The choice of which location is best for the initial anterior portal is determined only after first visualizing the anterior anatomy. Pay particular attention to the condition of the superior and anterior labrum before determining where to establish the first anterior portal. For a routine shoulder evaluation, rotator cuff repair, or subacromial surgery, a single, standard anterior mid-glenoid portal (AMGP) is recommended. To establish the AMGP, pass the tip of the arthroscope into the anterior triangle between the biceps and subscapularis tendons, angle the tip of the scope 20 degrees superior and lateral, and hold it against the anterior capsule. Remove the scope from the sheath and insert a taper-tipped guide rod into the cannula. Push it through the soft tissues to puncture the anterior capsule and tent the skin. Back out the guide rod a few milimeters and make a stab incision in the area of the tip, which should be located approximately 3 cm inferior and 2 cm medial to the anterior edge of the acromion. Pass the guide rod through the joint and push the arthroscopic sheath over it until it is outside the anterior skin incision. Insert an operating cannula such as a Crystal cannula (Arthrex, Inc., Naples, FL) over the tip of the rod and scope sheath and work it into the joint (Fig. 3-3). Connect the outflow drainage tubing from the pump to the side port of the cannula. Insert the arthroscope back into the PMGP, place the arthroscopic probe into the anterior cannula, activate the video recorder, and begin the 10 steps of the 15-point glenohumeral anatomy review.

If it is determined that a SLAP repair, labral repair, or subscapularis repair procedure is necessary, an anterior-superior portal (ASP) is recommended as the initial anterior portal, prior to creation of the AMGP. The ideal location is in the superolateral rotator interval, where the scope can be placed for visualization of the anatomy and/or a drill guide can be placed for SLAP repairs, while leaving enough room in the rotator interval for an additional AMGP.

Creating the Anterior-Superior Portal

If it is determined that an ASP is needed, insert a spinal needle into the skin 1 cm off the anterior lateral corner of the acromion into the joint through the rotator cuff interval so that it enters just anterior to the biceps tendon. Angle the needle to approach the anchor point of the biceps anchor area by passing on the *posterior* side (Fig. 3-4). Create a skin incision in the Langer skin lines at the needle puncture site and insert a Crystal cannula fitted with a tapered-tip obturator. While viewing with the scope in the posterior portal, palpate the anterior edge of the rotator cuff tendon with the tip and feel the "soft spot" of the rotator interval just anterior to the cuff tendon. Direct the tip of the obturator to enter the joint posterior to the biceps tendon taking care *not to pass through the supraspinatus tendon.* The cannula will enter just anterior to the rotator cuff but be aimed to pass posterior to the biceps so that it is

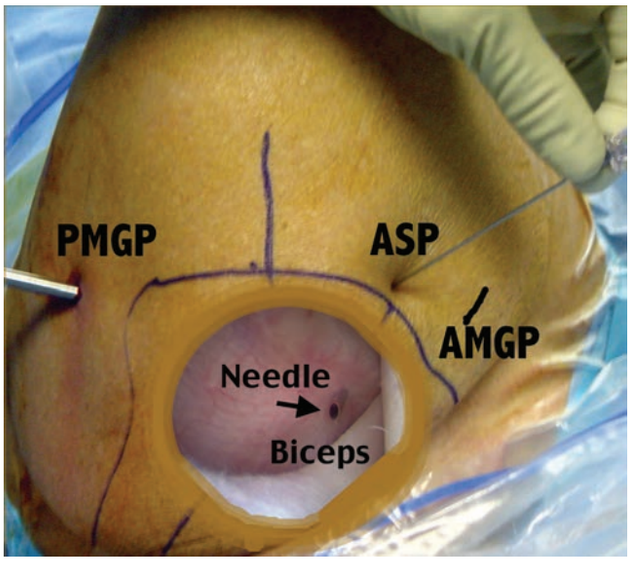

FIGURE 3-4. A spinal needle is inserted 1 cm away from the anterior lateral corner of the acromion and enters the joint just anterior to the biceps tendon to locate the ASP.

directed at the biceps anchor and toward the center of the glenoid (Fig. 3-5).

Glenohumeral Joint Evaluation, 15-Point Anatomy Review

The arthroscopic evaluation is performed with the video image oriented so that the glenoid surface is horizontal (parallel with the floor) on the lower half of the video monitor. Keeping the scope orientation this way throughout the diagnostic exam makes it easier for the entire surgical team to understand and follow the anatomy and participate in the subsequent surgery. The first 10 points of anatomy are visualized in a sequential manner with the scope in the posterior portal (Table 3-1, Fig. 3-6).

TABLE 3-1 15-Point Anatomy Review

Steps 1–10: Visualizing from the Posterior Portal

1. Biceps tendon and superior labrum
2. Posterior labrum and posterior capsule recess
3. Inferior axillary recess and inferior capsular insertion to the humeral head
4. Inferior labrum and glenoid articular surface
5. Supraspinatus tendon of rotator cuff
6. Posterior rotator cuff insertion and bare area of the humeral head
7. Articular surface of humeral head
8. Anterior-superior labrum, superior and middle glenohumeral ligaments, and subscapularis tendon
9. Anterior-inferior labrum
10. Anterior-inferior ligament

Steps 11–15: Viewing from the Anterior Portal

11. Posterior glenoid labrum and capsule insertion into the humeral head
12. Posterior rotator cuff including infraspinatus and the supraspinatus tendons
13. Anterior glenoid labrum and inferior glenohumeral ligament attachments to the humeral head
14. Subscapularis tendon and recess and middle glenohumeral ligament attachment to the labrum
15. Anterior surface of humeral head with subscapularis attachment and biceps tendon passage through the rotator interval

FIGURE 3-5. Insert the anterior-superior Crystal cannula fitted with an obturator along the path of the spinal needle.

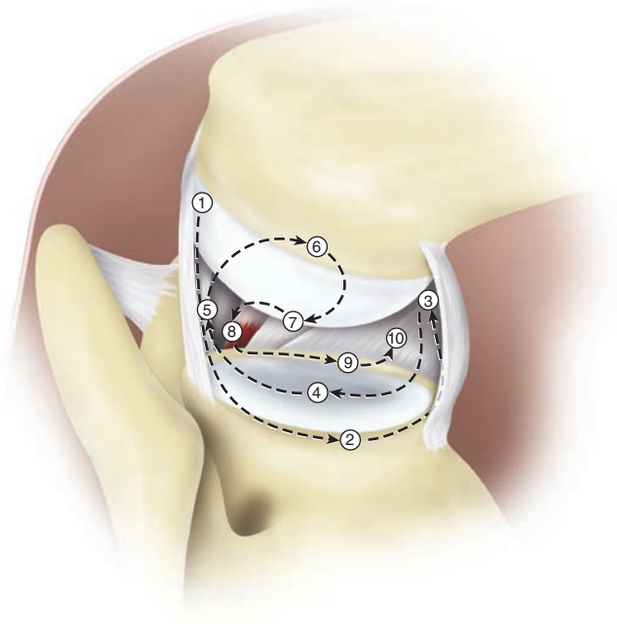

FIGURE 3-6. Steps 1 to 10 for the diagnostic arthroscopic evaluation of the shoulder are performed while viewing with the scope in the posterior portal.

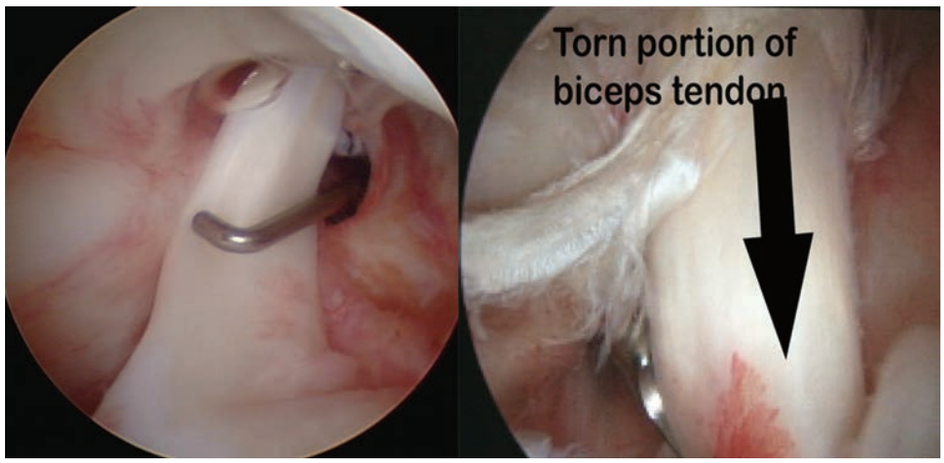

FIGURE 3-7. The biceps tendon is visualized and palpated using a probe in the ASP. Pulling the tendon into the joint reveals a torn segment.

Position 1—The Biceps Tendon and Its Superior Labral (SLAP) Anchor

Visualize the biceps tendon and carefully evaluate both surfaces of the intra-articular segment. Rotate the bevel of the scope to follow the tendon up to the entry into the intertubercular groove on the humeral neck. The normal synovial covering of the tendon has a delicate vascular pattern and there should be no visible fraying. Use a grasping tool via the AMGP to evaluate the biceps tendon, and pull it a few additional centimeters into the joint. This important maneuver scan reveal unsuspected areas of damage to the biceps located just outside the joint in the groove (Fig. 3-7).

Also evaluate the anterior and posterior pulleys, located on either side of the biceps tendon at the opening of the biceps groove. They should be well-formed and function to stabilize the biceps tendon in the groove when the arm is rotated, and the tendon is forced anteriorly with the probe (Fig. 3-8).

The "vinculae biceps" are small strands of mesentery-like synovium that pass from the biceps tendon to the surrounding synovium and capsule. These should not be mistaken for scar tissue or tears of the biceps tendon. In rare situations, the biceps tendon may be partially or completely encased by capsule and synovial tissue, causing it to appear torn or absent (Fig. 3-9). An extremely rare but important variation is a longitudinal benign split in the biceps tendon. Although this may be mistaken for a tear, close inspection will reveal that there are no signs of fraying, and it is simply a congential variation of normal (Fig. 3-10). Another unusual variation is the bifid biceps tendon, having one portion attaching to the normal supraglenoid tubercle and the other attached to the rotator cuff cable or ridge (Fig. 3-11). On very rare occasions, the biceps tendon may completely attach to the rotator cuff and not to the glenoid. One uncommon final variation is the complete absence of the biceps tendon from the joint. With no history or signs of trauma and a biceps muscle having normal function and contour, this condition is likely a congenital variation.

Inspect the superior labrum and palpate the attachment to the glenoid (Fig. 3-12). If the superior labrum is damaged or loosely attached, pull on the biceps tendon with a probe to determine whether the labrum will arch away from

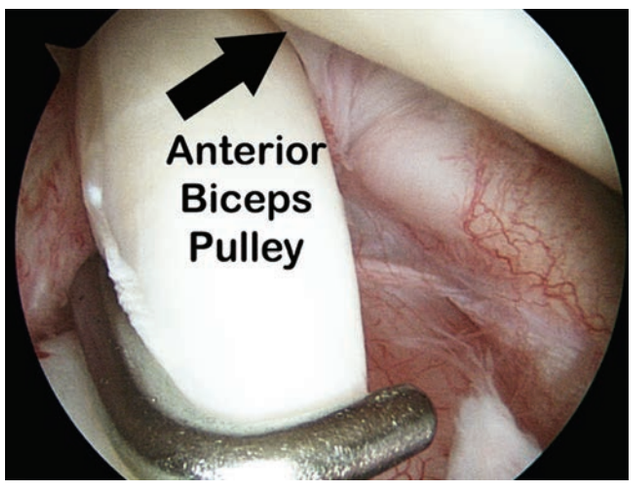

FIGURE 3-8. The probe is used to push the biceps tendon anterior against the pulley to evaluate its stability in the biceps groove.

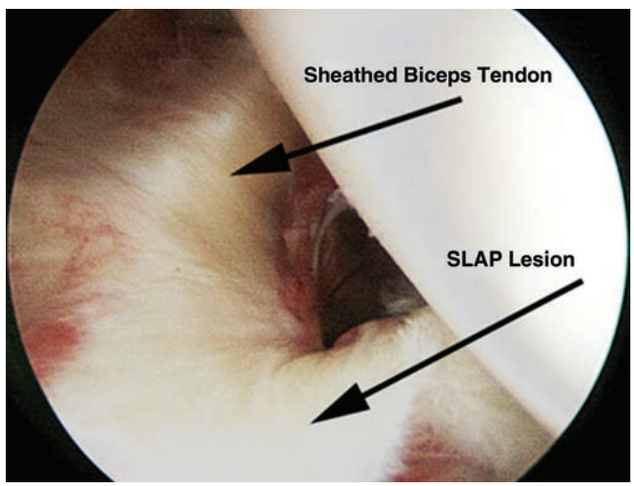

FIGURE 3-9. The normal biceps tendon may be completely covered by synovium and not be seen in the joint.

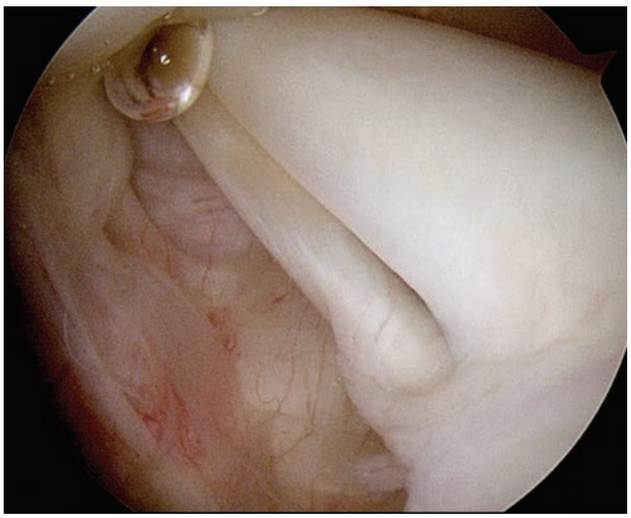

FIGURE 3-10. The biceps tendon can sometimes be bifid and should not be confused with a torn tendon.

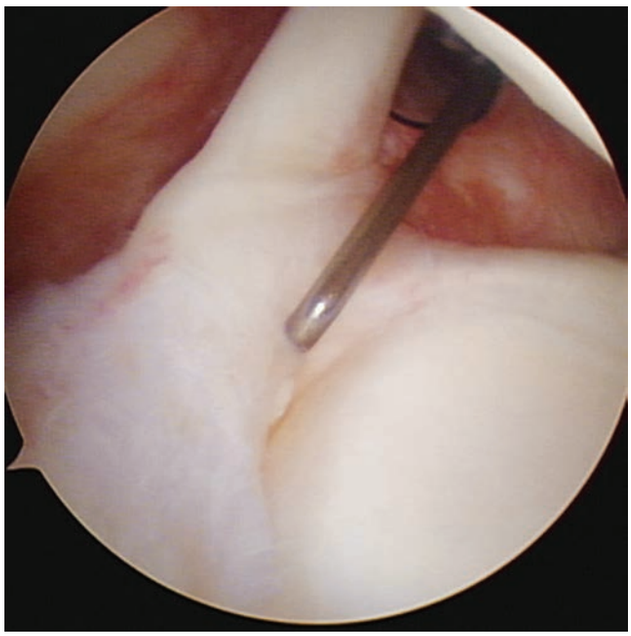

FIGURE 3-12. Use the probe to palpate the attachment of the superior labrum to the glenoid.

the glenoid. Undue laxity may be a sign of an unstable biceps anchor, indicating that a SLAP 2 lesion is present (see Chapter 8 for SLAP lesions). Always remember that the attachment of the free edge of a normal labrum will be variable depending on a person's age. In young patients, the edge of the labrum is usually intimately attached to the glenoid cartilage. As patients mature, the free edge of the labrum often separates from the cartilage so that by age 40 to 50 most people have a prominent cleft under the superior labrum (Fig. 3-13).

It is important to evaluate the solidity of the root of the biceps tendon at its anchor point on the biceps tubercle, which is usually located 5 mm medial to the edge of the glenoid. If traction is applied to the biceps and the biceps anchor lifts away from the bone, it is likely pathologic. In older patients, however, this may simply be a sign of age-related degeneration and not necessarily a cause of symptoms. In a young patient with no other obvious pathology, this sign is more likely pathologic.

Acute trauma in a younger individual (15 to 30 years of age) can result in avulsion of the superior labrum and biceps anchor. The tissue below the superior labrum will be frayed, torn, and irregular. A blood clot or reactive granulation tissue will often be seen in the area of the trauma (Fig. 3-14).

Another important sign of pathology to the biceps anchor occurs when an anatomical variation in the middle glenohumeral ligament attaches directly to the anterior-superior labrum. If traction on the tendon causes it to displace and generate tension in the attached middle glenohumeral ligament (MGHL) or anterior-superior labrum, then there is likely true pathology.

Finally, we must always be aware that chronic degenerative conditions of the glenohumeral joint or biceps tendon will cause the superior labrum to appear damaged. In an arthritic joint when the articular cartilage thins and subsides,

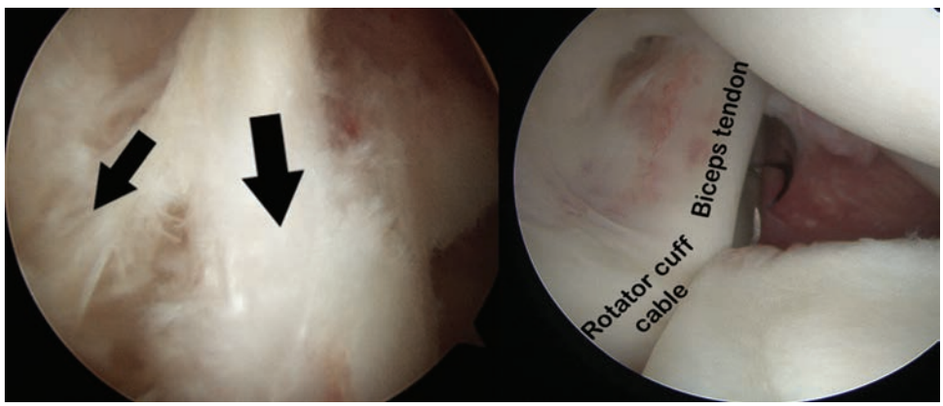

FIGURE 3-11. The biceps tendon may have a dual insertion both on the superior glenoid tubercle and labrum and the rotator cuff tendon or it may completely insert on the rotator cuff cable.

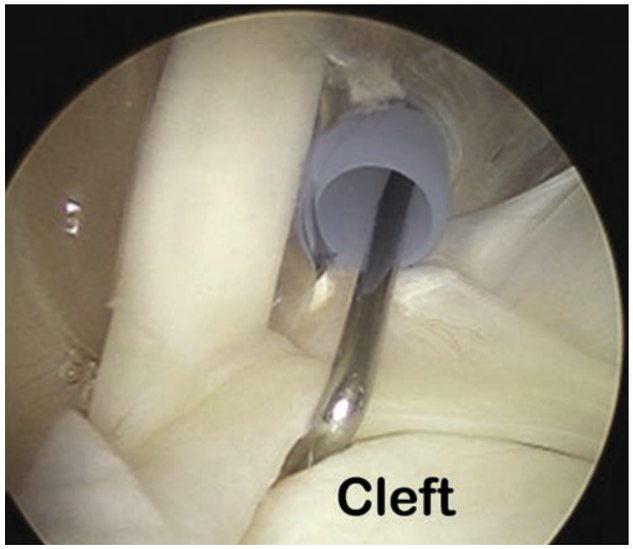

FIGURE 3-13. The superior labrum in a middle-aged patient may have a cleft below the edge and appear meniscoid but the biceps anchor will be tightly attached.

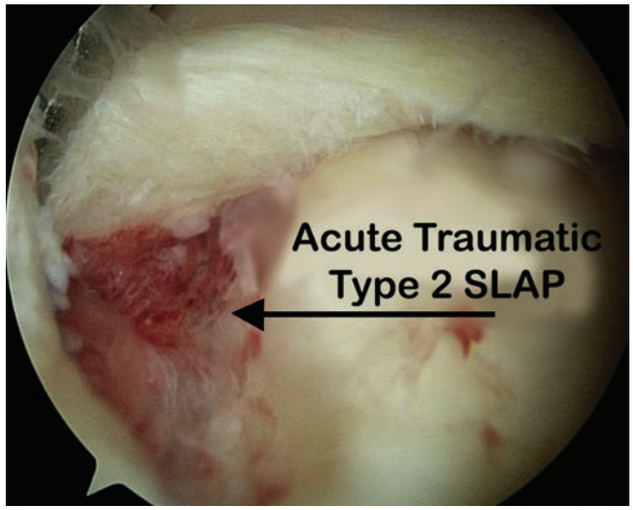

FIGURE 3-14. Following an acute SLAP lesion, the superior labrum will be torn from the glenoid at the biceps anchor and show signs of bleeding and fraying.

the superior labrum appears to be separated, suggesting a type 2 SLAP lesion. It is important to recognize that this is not a sign of pathologic labral damage, but merely a part of the degenerative state of the shoulder. If one is not aware that this is a normal condition that is often seen with advancing age, it may lead to unnecessary surgery and subsequent postoperative problems such as stiffness and pain (Fig. 3-15).

Position 2—The Posterior Labrum and Posterior Capsular Reflection or Recess

Retract the tip of the scope while rotating the bevel toward the floor. Visualize the posterior-superior labrum from the posterior edge of the biceps, around and down to the inferior recess and back to the posterior capsule. Lifting the tip of the scope to elevate it a few millimeters away from the labrum allows visualization of the labral edge. The posterior labrum should be smooth and is usually tightly fused to the glenoid surface. The outer edge of the healthy labrum is higher than the cartilage edge, creating a chock block–like border. The tip of the scope is rotated in a posterior medial direction, away from the labral edge to visualize the posterior capsular recess. It is normal to have a fairly deep recess, but when the shoulder is unduly lax, the recess will be more patulous. Loose bodies can be located in the posterior capsular folds and can be overlooked if this area is not evaluated (Fig. 3-16).

When there is significant capsular laxity, such as with multidirectional instability, the labrum can be hypoplastic and low, or even appear nonexistent, and the capsule will be thin and extremely patulous (Fig. 3-17).

Position 3—The Inferior Axillary Recess, the Inferior Border of the Humeral Articular Cartilage, and the Capsular Attachment to the Humeral Head

With the scope tip positioned in the axillary pouch, the bevel is rotated in an arc from inferior to superior to see the inferior capsule hammock up to its insertion into the humeral head. Normally the tissue is smooth with a delicate synovial covering. There may be small normal fenestrations near the attachment to the head (Fig. 3-18). Sometimes,

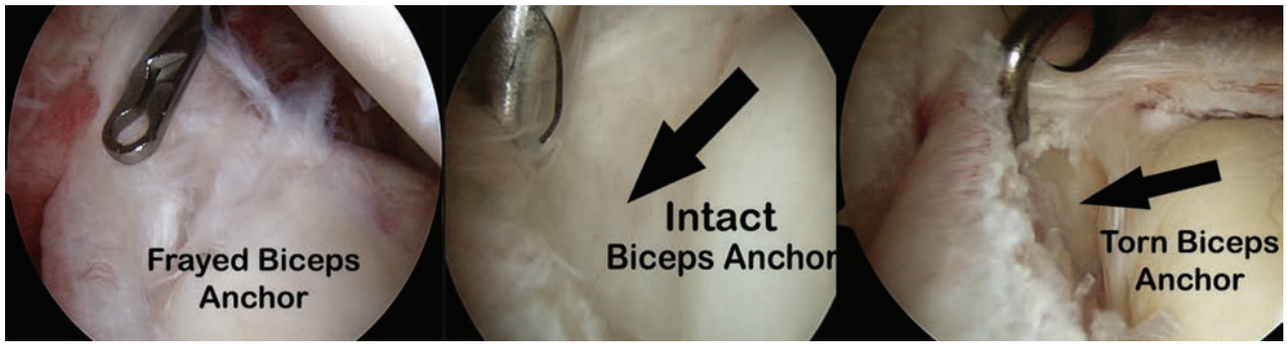

FIGURE 3-15. The superior labrum is often frayed and degenerative when the shoulder has degenerative arthritis; after debridement, it is important to evaluate the biceps anchor.

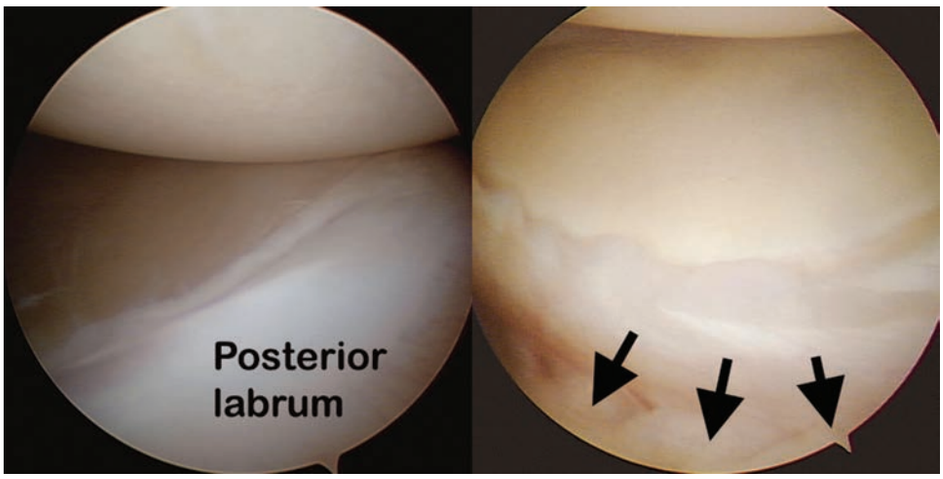

FIGURE 3-16. The posterior labrum is visualized from the posterior portal by retracting the tip of the scope and rotating it in the 6 o'clock direction. The posterior capsule has a deep fold posterior to the labrum.

early chondromalacic lesions or osteophytes are seen in this position on the neck of the humerus adjacent to the articular cartilage. When a patient has adhesive capsulitis, the inferior recess will be contracted, closing off the pouch. On rare occasions, there may be a capsular tear at the inferior capsular attachment to the humeral neck following a traumatic dislocation, especially with luxation erecta.

Position 4—The Inferior Labrum and the Glenoid Articular Surface

The inferior portion of the labrum is first evaluated and the scope is rotated in a superior direction to view the rest of the glenoid fossa. The normal inferior labrum is smoothly fused with the cartilage, and the capsular border of the labrum is elevated a few millimeters higher than the cartilage edge. In cases of congenital laxity, the labrum may appear deficient or flat with no discernable prominence of the capsular edge. A torn inferior labrum associated with anterior instability may extend to include the entire inferior and a portion of the posterior labrum. There is a normal "thin spot" in the center of the inferior half of the glenoid where the articular cartilage has a relatively thin appearance (Fig. 3-19). This finding can be confused with chondromalacia but is found in virtually all shoulders to some degree. Along the anterior edge of the glenoid, there is often an indentation or dimple, which demarcates the superior two-fifths from the inferior three-fifths of the glenoid (Fig. 3-20). This normal anatomical feature marks the point of fusion of the two ossific centers of the glenoid and can sometimes appear very deep, to resemble an old fracture.

The cartilage of the superior pole of the glenoid may also become thinner with aging, leading to a separation of the edge of the labrum from the articular cartilage. This is a normal condition of aging and should not be construed as a labral detachment.

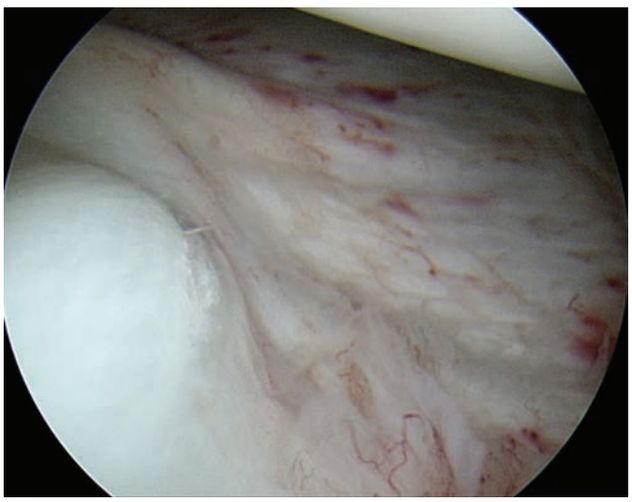

FIGURE 3-17. A hypoplastic posterior-inferior labrum and a patulous capsule can be seen in patients with multidirectional instability.

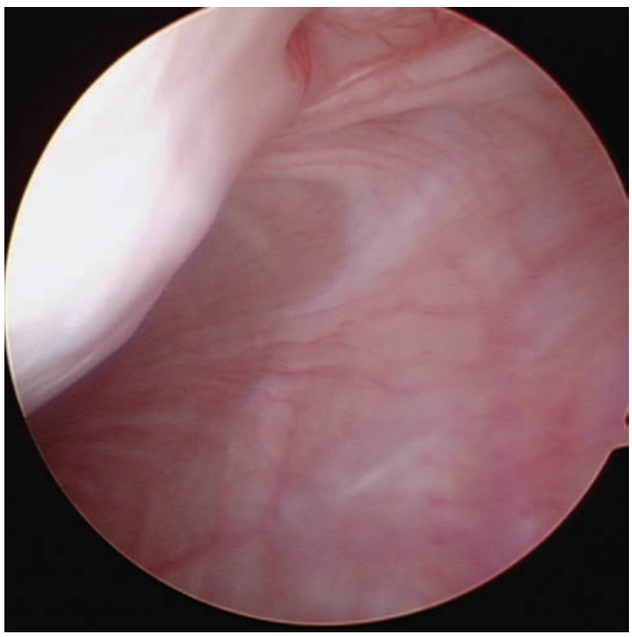

FIGURE 3-18. The axillary pouch is evaluated by rotating the scope inferior and then superior to see the attachment into the humerus.

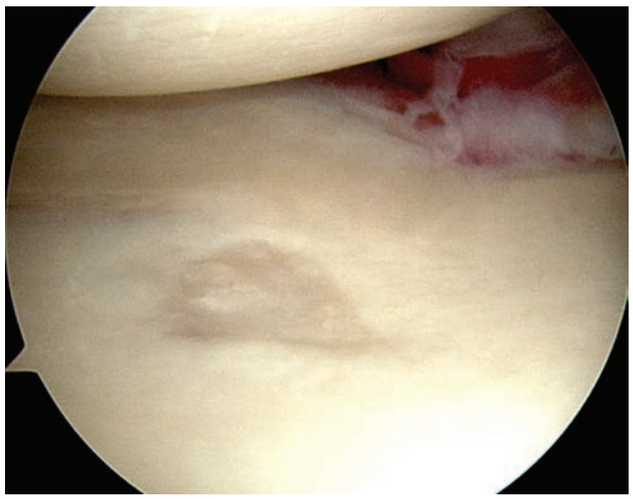

FIGURE 3-19. The articular surface of the glenoid is slightly concaved with a thin area in the center.

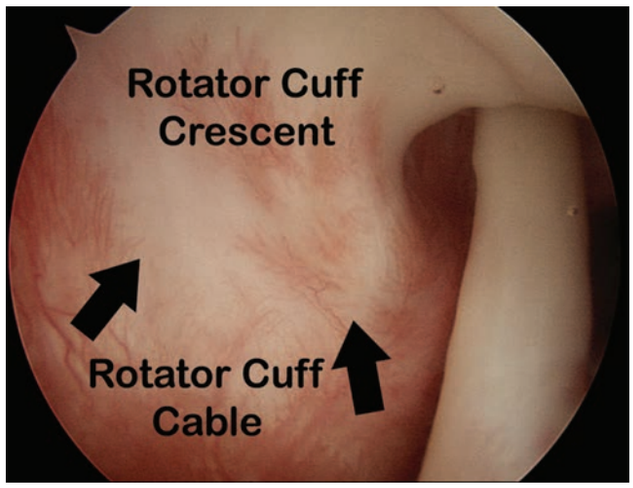

FIGURE 3-21. The supraspinatus tendon attaches to the humeral head adjacent to the articular cartilage. The rotator ridge or cable is a capsular band extending from the anterior edge of the cuff to the posterior humeral head enclosing the area called the crescent.

Position 5—The Articular Surface of the Supraspinatus Tendon of the Rotator Cuff and Its Attachment to the Humeral Head Adjacent to the Articular Cartilage

Rotate the bevel of the arthroscope upward to the 11, 12, and 1 o'clock positions to visualize the undersurface of the supraspintatus tendon as it attaches into the humeral head. This portion of the rotator cuff has a firm connection to the humeral head adjacent to the articular cartilage with no fraying or synovial reaction. The rotator cuff tendon is covered on the articular surface with a layer of capsule and synovium. These two layers can show some variations and may be confusing. If the arthroscopic fluid pressure is low, the vascular pattern in the synovium covering the cuff can appear to be inflamed. The usual vascularity is quite rich on the proximal portion of the cuff, extending from the superior glenoid area and diminishing as it approaches the humeral head attachment.

There is a thickening in the capsular tissue present on the undersurface of the cuff that is oriented perpendicular to the biceps tendon, called the "rotator cuff ridge" or "cable." This band is *not* a portion of the supraspinatus tendon, but is actually a portion of the capsule and coracohumeral ligament that extends perpendicular from the main body of the ligament as it courses from the coracoid to the humerus (Fig. 3-21). There is seldom a rich vascular supply above the lateral border of the rotator cuff ridge in the concave portion known as the rotator cuff crescent.

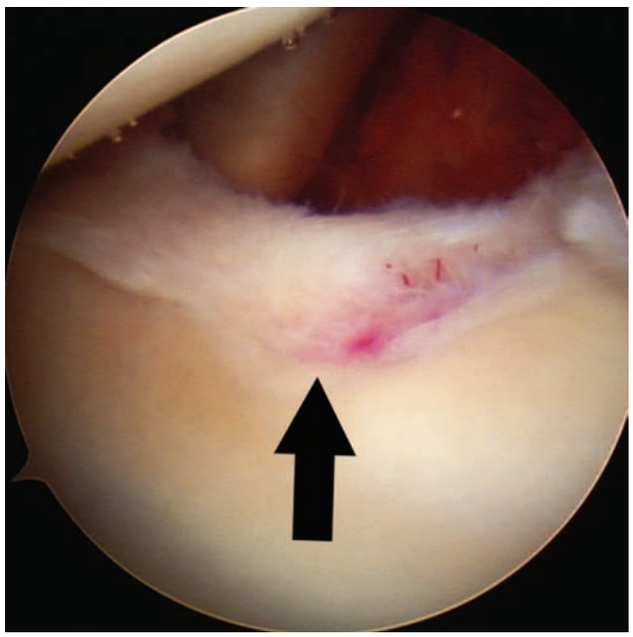

FIGURE 3-20. The anterior glenoid edge usually has an indentation or notch that demarcates the inferior and superior portions.

Position 6—The Posterior Section of the Rotator Cuff at Its Attachment Adjacent to the "Bare Area" of the Humeral Head

Evaluate position 6 by following the rotator cuff insertion along the anatomical neck of the humerus in a posterior and superior direction. The arthroscope is carefully withdrawn while the bevel is rotated to the 11 or 1 o'clock position, keeping the cuff attachment in view. Take care not to withdraw the scope completely from the joint since there are only a few millimeters of space available in this location for viewing. The insertion of the rotator cuff in this posterior area frequently appears fenestrated with openings in the superficial layers. The "bare area" of the humeral is a portion of the head that is devoid of articular cartilage. It is located adjacent to the posterior lateral rotator cuff attachment. A normal bare area can encompass a few millimeters of humeral head or be very extensive, up to 2 to 3 cm in size. It is recognized by the absence of the normal, glistening white articular cartilage that covers the rest of the humeral head. The margin of the bare area is usually smooth as it blends with the articular cartilage more medially.

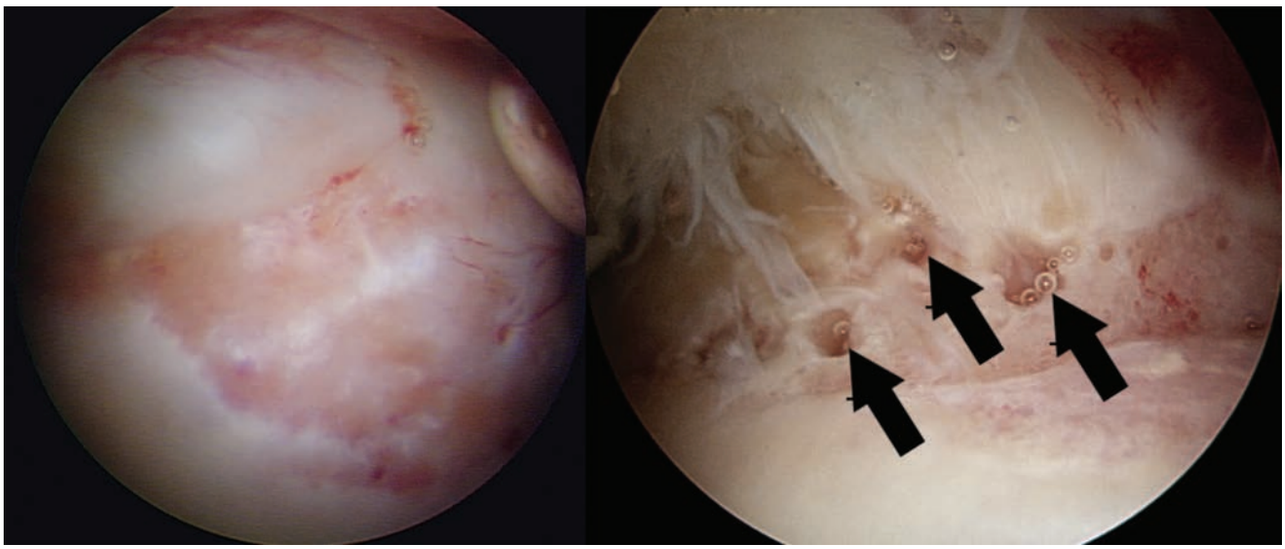

FIGURE 3-22. The bare area of the humeral head is located adjacent to the infraspinatus attachment to the humeral head and may have multiple blood vessel channels.

Within this area there can be deep pits representing vascular channels into the bone. Sometimes these will have a very rough appearance under the arthroscopic magnification. Do not confuse this bare area with a post-dislocation osteochondral fracture known as the Hill-Sachs lesion. The Hill-Sachs lesion is found in a more medial location of the humeral head and is deeper with irregular edges and surrounded by otherwise normal articular cartilage (Fig. 3-22).

Position 7—The Remainder of the Articular Surface of the Humeral Head That Can Be Viewed from Posteriorly

Maneuver the arthroscope more medial from its position near the bare area, and rotate the bevel of the scope both clockwise and counterclockwise to visualize the horizon of the globe of the humeral head. Rotate the shoulder in various directions while viewing the weight-bearing articular contact surface. The center of the humeral head is the area where the articular cartilage often begins to break down in chondrolysis, osteochondritis, or degenerative arthritis. It is helpful to palpate the cartilage to evaluate for early chondromalacia or subchondral bony deficiency. Blistering of the cartilage is a sign of impending chondral breakdown (Fig. 3-23).

Position 8—The Anterior-Superior Triangle of the Shoulder Including the Anterior-Superior Labrum, the Superior Glenohumeral Ligament, the Superior Edge of the Subscapularis Tendon, and the MGHL

Begin visualizing this position by viewing and palpating the portion of the labrum located anterior-inferior to the biceps tendon. The anterior-superior labrum is that portion below the biceps attachment and above the mid-glenoid notch. It is a confusing anatomical area having several common normal variations. In the usual situation, the anterior-superior labrum attaches firmly to the glenoid rim (approximately 70%) (Fig. 3-24). There is often a delicate synovial overgrowth or tuft just above the mid-glenoid notch (Fig. 3-25). In 14% of normal patients, there will be an opening or sublabral foramen beneath the labral attachment (Fig. 3-26). The size of this hole can vary from a few millimeters to the entire anterior-superior quadrant. It is important to differentiate the normal sublabral hole from a Bankart-type traumatic labral detachment, or a SLAP lesion. A Bankart lesion always involves the labrum *below* the anterior glenoid notch but can extend more proximally and has the appearance of damaged tissue with either fraying or scarring. A SLAP lesion, or injury to the *superior labrum* from *anterior* to *posterior*, always includes the biceps anchor and extends posteriorly to it. The designation as a type 2 SLAP lesion requires that

FIGURE 3-23. The globe of the normal humeral head is smooth with firm articular cartilage.

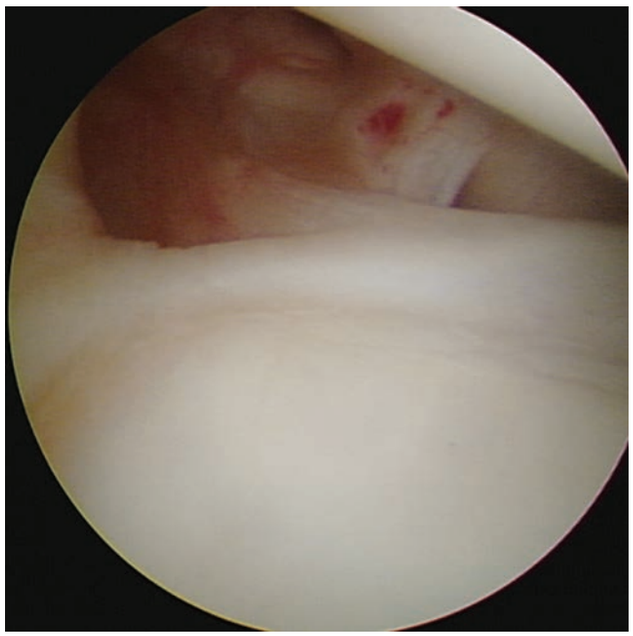

FIGURE 3-24. The anterior-superior labrum is normally firmly attached to the anterior-superior glenoid.

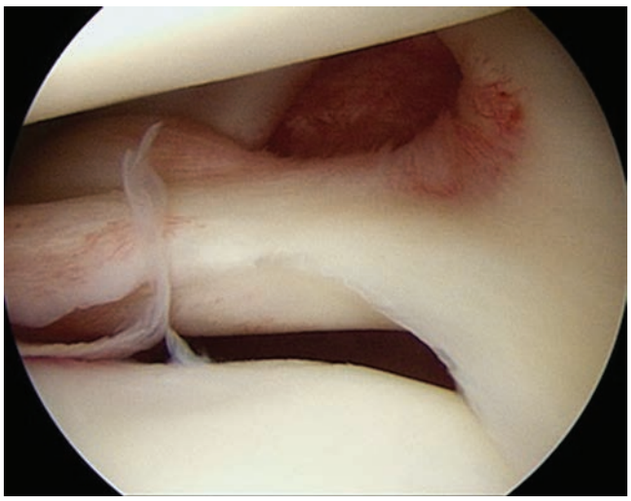

FIGURE 3-26. The sublabral hole or foramen often has a cord-like MGHL attached and is a normal anatomical variation that may resemble a labral detachment.

the injury is located on the superior labrum and include the biceps anchor. In a type 2 SLAP, the involved tissues are frayed and detached and the traumatic or degenerative etiology should be obvious.

A very interesting albeit infrequent variation easily confused with a pathologic anterior-superior labral detachment is the so-called Buford complex. This normal variant occurs in approximately 2.5% of shoulders. There are three features included in the complex: (1) there is a thick cord-like MGHL; (2) the MGHL attaches to the superior labrum just anterior at the base of the biceps anchor; and (3) there is *no* labral tissue on the anterior-superior glenoid edge (Fig. 3-27). The appearance of this normal anatomical complex is quite striking since it appears as if there has been an avulsion of the anterior-superior labrum and MGHL away from the glenoid. On further inspection, it will be observed that there is no fraying or signs of trauma to the labral or capsular tissues, and the edge of the cord-like middle ligament is smooth, indicating that the anatomy is more likely a congenital variation.

The superior glenohumeral ligament is also seen in position 8 crossing between the biceps and subscapularis tendon. Its course extends from the labrum at the superior glenoid tubercle to the upper portion of the lesser tuberosity. Often the superior glenohumeral ligament will have a common insertion with the superior edge of the subscapularis tendon. It frequently has a normal tuft of fluffy synovium at the humeral attachment (Fig. 3-28).

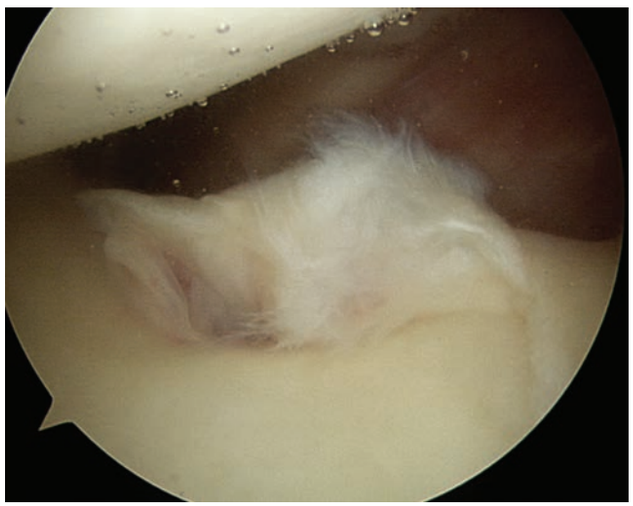

FIGURE 3-25. There is often a normal synovial tuft on the labrum just above the mid-glenoid notch.

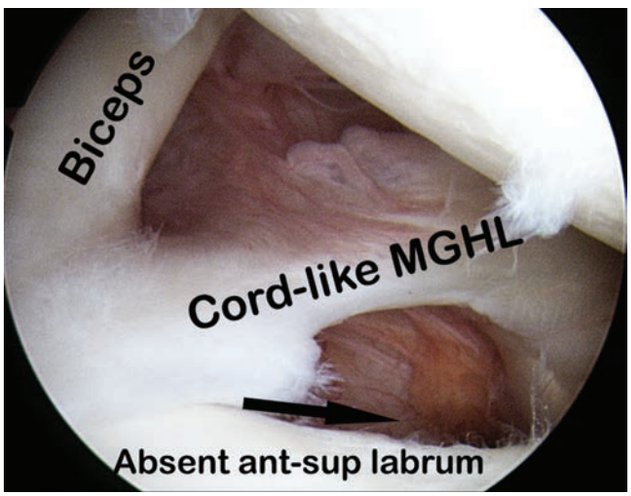

FIGURE 3-27. The Buford complex is easily confused with anterior-superior labral detachment.

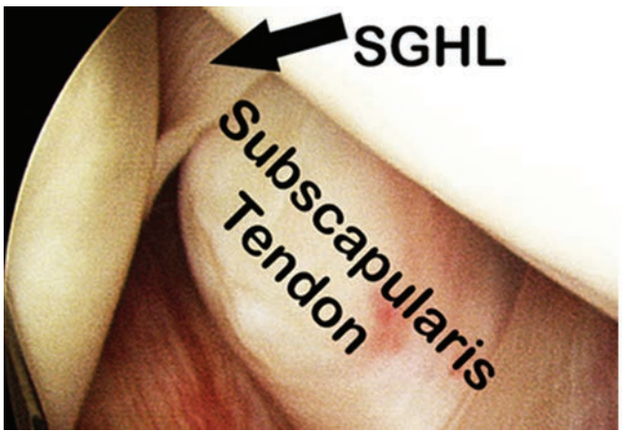

FIGURE 3-28. The superior glenohumeral ligament attaches to the lateral edge of the subscapularis tendon.

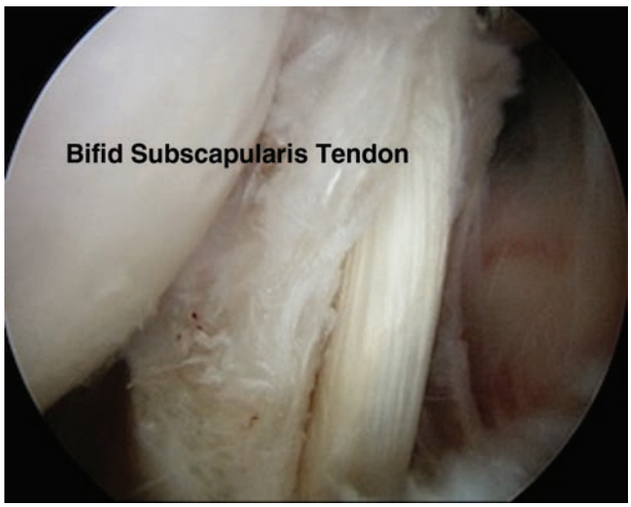

FIGURE 3-29. The normal subscapularis tendon may have a bifid appearance.

The subscapularis tendon is a very prominent landmark demarcating the inferior boundary of the anterior-superior triangle. In most situations, it has a smoothly rolled edge and passes vertically from its humeral head attachment at the lesser tuberosity to disappear below the glenoid rim. The MGHL in the usual situation crosses between the midpoint and the lower third of the subscapularis tendon at an angle of approximately 45 degrees. There are several variations in the subscapularis tendon. The leading edge of the tendon may have a split or bifid appearance (Fig. 3-29). Although rare, when this situation does occur, it appears as a smooth separation in the tendon with no obvious fraying or synovial reaction around the tissues. In addition, there is no detachment of the tendon insertion. This unusual but normal variation is found in approximately 3% of shoulders. The MGHL has the most variable appearance of all the anterior shoulder ligaments. In the usual situation (approximately 70%), it appears as a fold or thickening in the anterior capsule that crosses the subscapularis tendon at a 45-degree angle to insert on the anterior-superior neck of the glenoid, either on or just medial to the labrum. In this situation, there is only one opening into the subscapularis recess located anterior to the leading edge of the middle ligament.

The most common variation in the middle ligament anatomy is the "cord-like" appearance. This pattern is present in 20% of normal shoulders. A "cord-like" middle ligament has a smooth rope-like structure rather than as the more common sheet-like ligament. The cord may attach to the normal position of the middle ligament at the neck of the anterior-superior glenoid or it may attach to the anterior-superior labrum sometimes in association with a sublabral hole (see Fig. 3-27). In either of these normal situations, access to the subscapularis recess is possible either above or below the cord-like MGHL.

A third variation of the middle ligament is that of a "thin veil" or complete absence of ligament tissue (Fig. 3-30).

This pattern is present in approximately 10% of shoulders. The middle ligament structure appears as a translucent fibrous sheet or a few flimsy fibrous bands. When present, this variation is usually accompanied by a very hypertrophic inferior glenohumeral ligament.

Position 9—Includes the Anterior-Inferior Labrum

Retract the scope to the center of the glenoid and rotate the bevel inferiorly to visualize the entire anterior-inferior labral attachment to the glenoid. There are two normal patterns of anterior labral attachments. In approximately 95% of cases, the labrum has a smooth attachment to the glenoid cartilage (Fig. 3-31). This firm attachment occurs from the mid-glenoid notch around the entire anterior and inferior portions of the glenoid. The second type of labral attachment is a

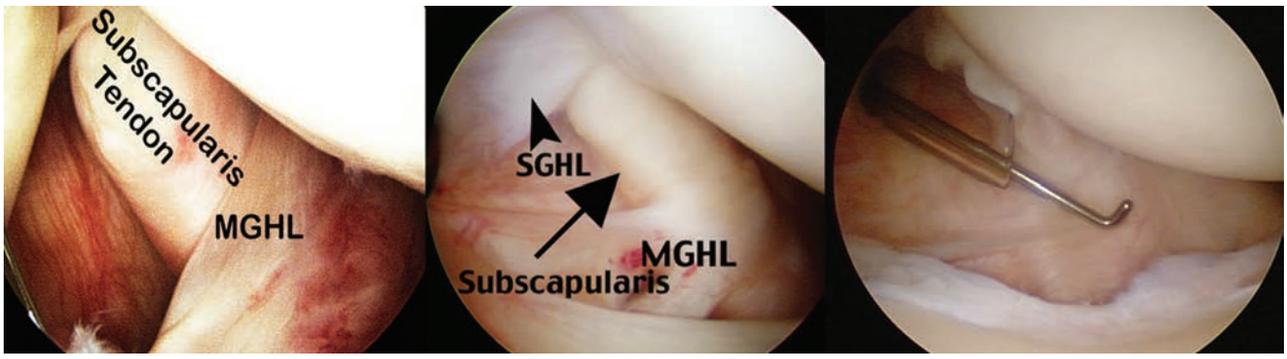

FIGURE 3-30. The MGHL may appear as a thick sheet, a very thin or "gossamer" film, or it may be completely absent.

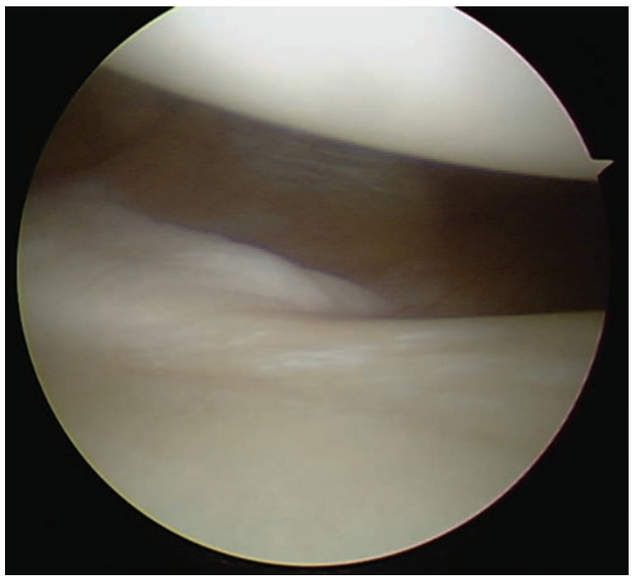

FIGURE 3-31. The anterior-inferior labrum is normally tightly fused with the articular cartilage below the mid-glenoid notch.

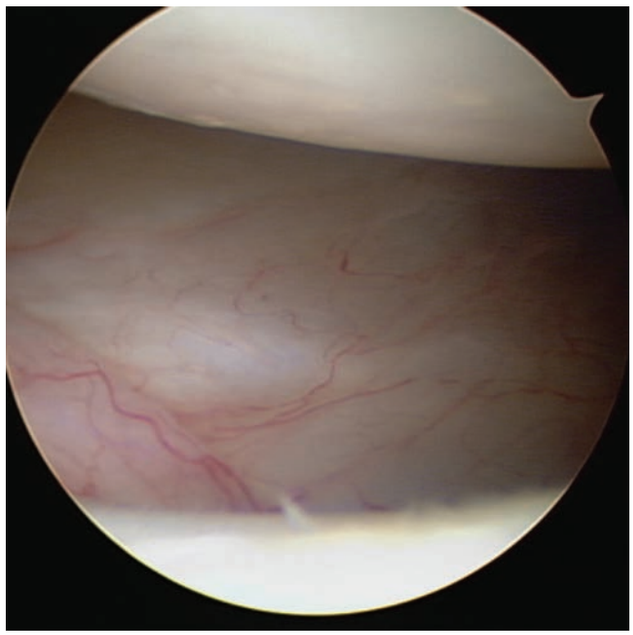

FIGURE 3-32. The inferior glenohumeral ligament usually has a thickening called the anterior-superior band that inserts on the anterior labrum but may not be apparent when the joint is distended.

"meniscoid type" in which the articular edge of the labrum is separated from the glenoid cartilage. This pattern is present in approximately 5% of patients, and a probe can be inserted between the articular surface of the glenoid and the overlying labrum. The capsular attachment to the labrum is still intact and will not separate from the glenoid when traction is applied.

Position 10—Includes the Inferior Glenohumeral Ligament and Anterior-Inferior Capsule

Normally, with the arm in traction, the scope can be maneuvered into the anterior recess with relative ease. If the ligaments are overly loose, the scope passes without any difficulty, a condition known as a "drive-through sign" exists. Conversely, if the ligaments are overly tight, as with adhesive capsulitis, the space between the head and glenoid is constricted and the scope can be passed only with difficulty, or not at all. The anterior capsular ligaments insert into the labrum and are firmly attached with it to the neck of the glenoid. The usually prominent superior band of the inferior ligament marks the uppermost extent and can attach as high as the anterior-superior labrum. Other than the fold of the superior band of the inferior ligament, the capsular tissues are smooth and covered with a thin synovial investment (Fig. 3-32).

This completes the first 10 steps of the arthroscopic anatomy review that is performed with the scope in the posterior portal. The next five anatomical areas are reviewed after changing the arthroscope to the anterior portal and connecting the outflow tubing to the cannula in the posterior portal (Fig. 3-33).

Position 11—Includes Visualization of the Posterior Labrum and the Posterior Capsule Viewing Across the Joint from Anterior to Posterior

The arthroscope is inserted into the anterior portal, and the bevel is rotated inferiorly to evaluate the posterior-inferior labrum. Use a probe through the posterior cannula to palpate the tissues during evaluation. The most common type of attachment of the posterior labrum is directly to the glenoid rim with no separation between its attachment and articular cartilage (Fig. 3-34). In a small percentage of shoulders (<5%), the normal posterior labrum, like the anterior labrum, is meniscoid in appearance with a cleft below the labral edge

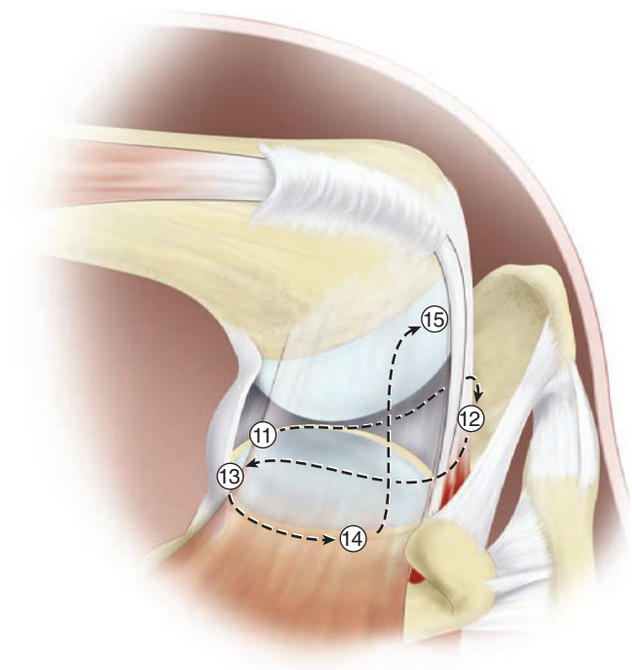

FIGURE 3-33. Glenohumeral anatomy review steps 11 to 15 viewing from the anterior portal.

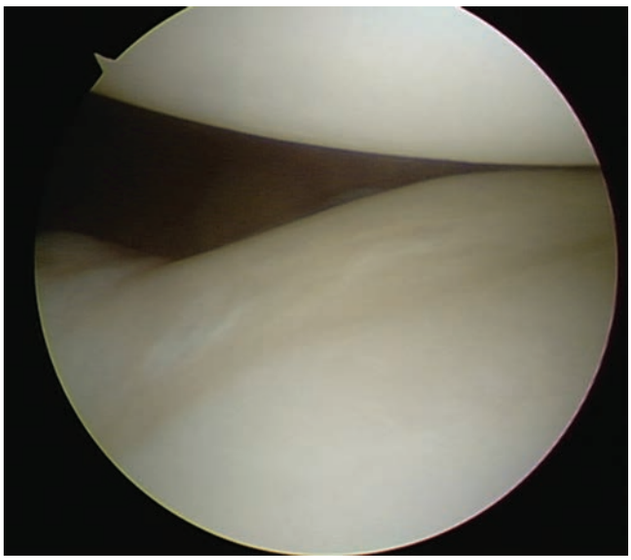

FIGURE 3-34. The posterior labrum is usually firmly fused to the articular cartilage of the glenoid.

(Fig. 3-35). Beneath the meniscus-like labrum, the articular cartilage may appear smooth but is sometimes thin and soft. The normal posterior labral margin should be firmly attached at the periphery. The posterior capsular tissue is usually quite smooth except for the presence of a thickening, the posterior-superior band of the inferior glenohumeral ligament. This fold of capsule attaches to the midportion of the posterior labrum and extends at a 45-degree angle inferiorly and laterally to fuse with the inferior capusle. The posterior capsular recess cannot be well-visualized from the anterior portals but capsular laxity can be assessed by pinching a fold of capsule with a pincer clamp and testing the integrity by pulling on the tissue (Fig. 3-36). Rotate the scope to visualize the posterior lateral capsule attachment to the humeral head. There can be a tear in the capsule in this area called an "RHAGL" lesion, an acronym for reverse humeral avulsion of the glenohumeral ligament (Fig. 3-37).

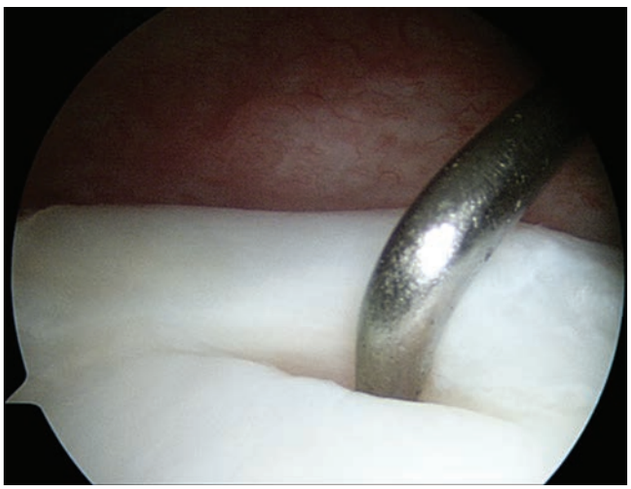

FIGURE 3-35. In a small number of patients, the posterior labrum has a cleft between the edge and the cartilage but it is still well-attached to the glenoid.

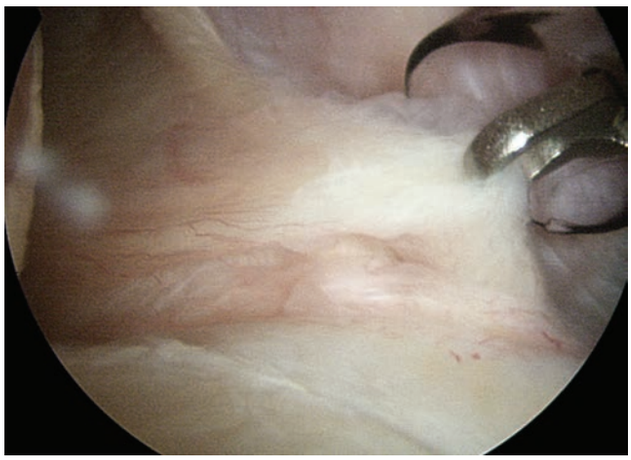

FIGURE 3-36. Test the laxity of the posterior-inferior capsule by pinching a fold of tissue and moving it to the edge of the labrum.

Position 12—Includes the Posterior-Superior Capsule and the Posterior Aspect of the Rotator Cuff

Visualize this area by rotating the arthroscope bevel superior to see the posterior aspect of the cuff insertion into the humeral head. Move the scope tip back out and around anterior to the biceps tendon to completely visualize the cuff. The normal surface of the rotator cuff is smooth, with regular vascularity. The posterior attachment of the rotator cuff ridge or cable arches across the posterior cuff to attach to the humeral head (Fig. 3-38). Maneuver the arthroscope around the superior part of the glenoid and rotate the bevel so that it views medially into the superior glenoid recess. Move past the root of the biceps tendon and back into the glenoid fossa.

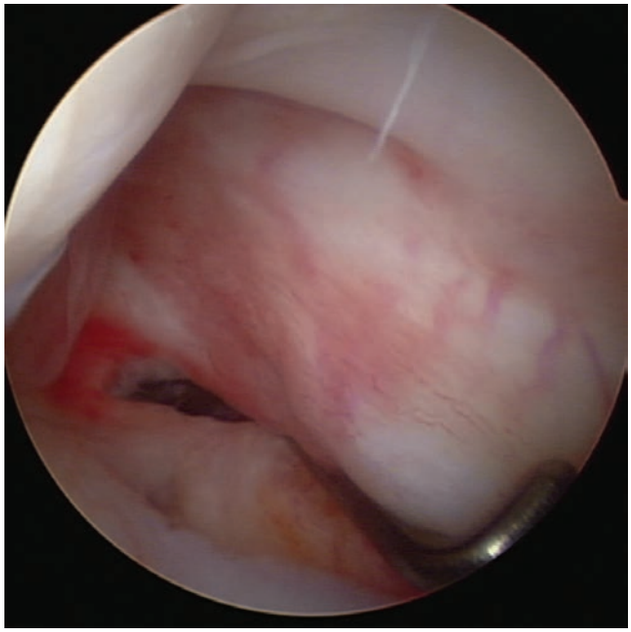

FIGURE 3-37. The posterior capsule can be seen attaching to the posterior aspect of the humeral head.

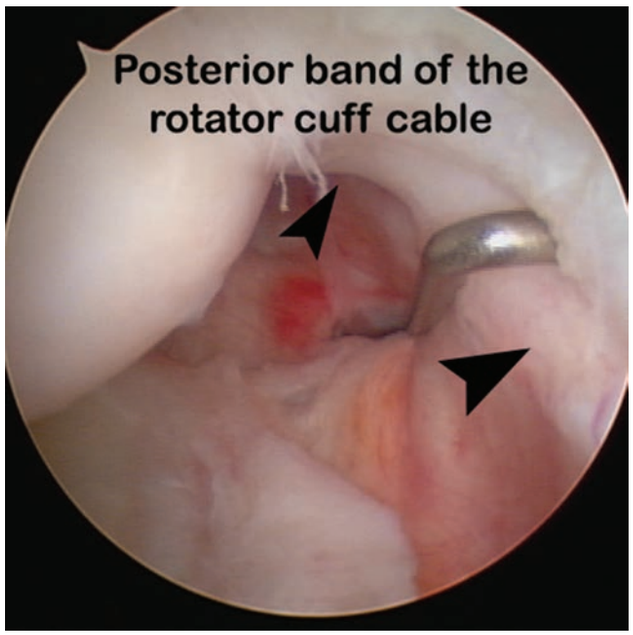

FIGURE 3-38. The posterior extension of the rotator cuff cable is seen attaching with the cuff to the back of the humeral head.

Position 13—The Anterior Labrum and the Attached Anterior-Inferior Ligament to the Humeral Head

Maneuver the scope down the anterior edge of the glenoid and lift the humeral head away from the socket and rotate the scope to evaluate the anterior-inferior labrum. This position is extremely important for the surgeon to precisely assess the status and quality of the supporting ligaments, labrum, and capsular tissue when evaluating for instability (Fig. 3-39).

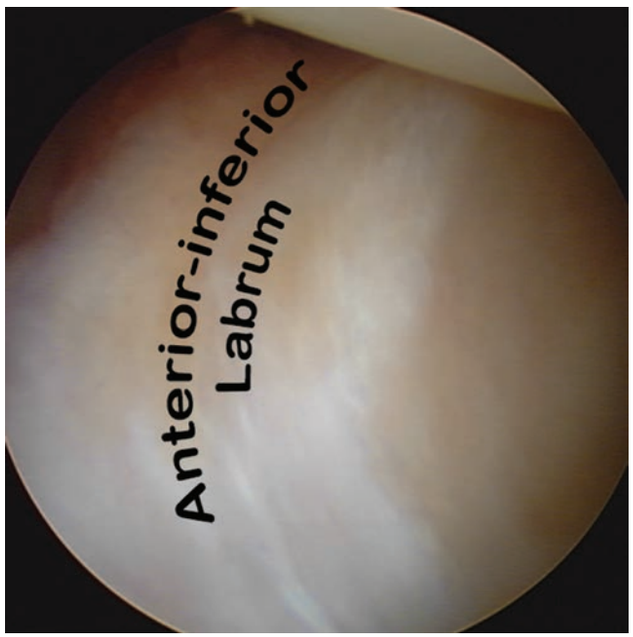

FIGURE 3-39. The anterior-inferior labrum and the attachment of the anterior-inferior ligaments are best seen when viewing from the anterior portal.

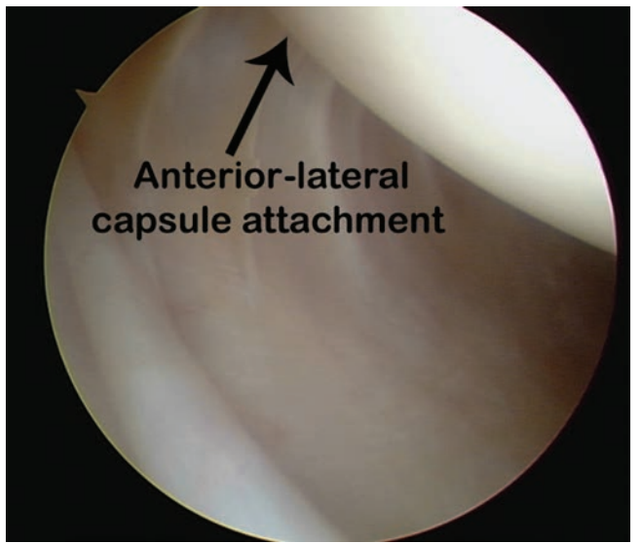

FIGURE 3-40. The lateral humeral attachment of the anterior capsule must be evaluated by turning the scope bevel to view in a lateral direction.

The labrum can be palpated with a probe passed through a posterior portal to assess the security of the attachment to the glenoid. The important superior band of the inferior ligament appears as a thickened fold of capsule blending with the inferior capsular pouch distally and attaching to the labrum near or slightly above the mid-glenoid notch.

A rare but normal situation is seen in which a distinct superior band is not visualized. This occurs in an atraumatic setting where the capsular ligaments are formed into a single solid sheet. Although it does not confirm that instability is present, it seems to be associated with congenital laxity and may be a predisposing factor of congenital loose shoulders. By rotating the scope lateral, the humeral attachment of the anterior capsule can be evaluated (Fig. 3-40).

This step is commonly overlooked and will result in diagnostic errors when the capsule is avulsed with an HAGL lesion (see Chapter 11 for HAGL lesions).

Position 14—Includes the Anterior Attachment of the MGHL and the Subscapularis Recess

Locate the MGHL (if it is present) by retracting the arthroscope and rotating the tip anterior until the subscapularis tendon is found. The anterior attachment of the MGHL crosses the tendon to insert into the labrum or glenoid neck (Fig. 3-41). The superior edge of the subscapularis tendon should be followed medial into the subscapularis recess. Rotate the scope anterior and posterior to evaluate the depths of the subscapularis recess (Fig. 3-42). The recess is variable in size but most often can be entered and followed across the anterior aspect of the glenoid neck. Commonly, if loose bodies are present in the shoulder, they will be located in the subscapularis recess. Also, the superior edge of the subscapularis tendon must be carefully evaluated for fraying below the level of the glenoid rim, the so-called FUSSI lesion. The tip of the arthroscope is then oriented so that the superior edge of the subscapularis tendon is in view. The edge is followed back out past the attachment of the MGHL and up to the humeral head.

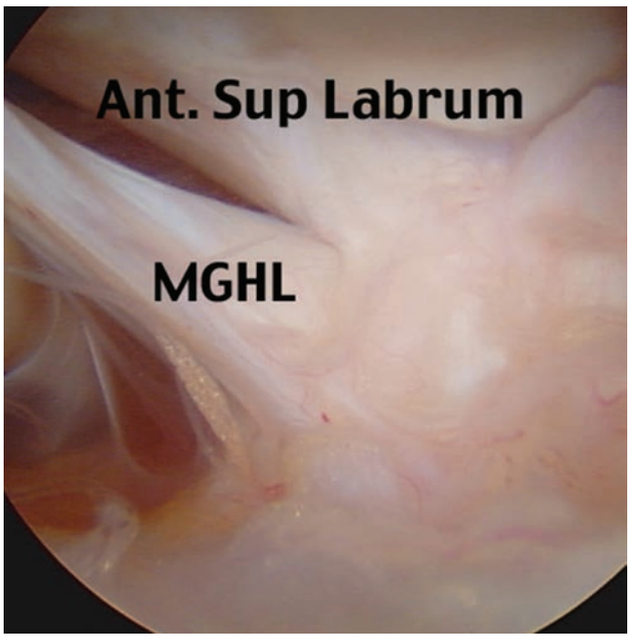

FIGURE 3-41. The attachment of the MGHL into the labrum or glenoid neck is seen crossing the subscapularis tendon.

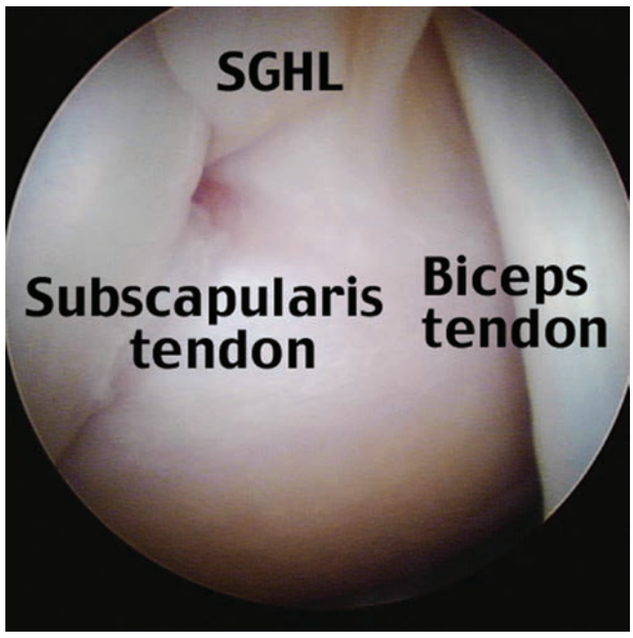

FIGURE 3-43. The anterior surface of the humeral head is an important area to evaluate the subscapularis attachment.

Position 15—Includes the Attachment of the Subscapularis Tendon to the Humeral Head, the Anterior Surface of the Humeral Head, and the Adjacent Biceps Tendon

The tip of the arthroscope follows the leading edge of the subscapularis tendon up to its attachment into the humerus at the lesser tuberosity. The superior glenohumeral ligament inserts into this area as well, and there is often a little irregularity of the synovium. Visualize the anterior articular surface of the humeral head. There is sometimes a normal "bare area" similar to that found on the posterior humeral head. This appears as a thin area of anterior humeral head cartilage and is located superior to the attachment of the subscapularis tendon. This area should not be confused with an anterior humeral head defect found in conjunction with posterior instability. Rotating the humeral head and visualizing the anterior humerus affords the best view of the subscapularis attachment (Fig. 3-43).

This completes the video-recorded 15-point glenohumeral anatomy evaluation. The surgeon is now familiar with the condition of all visible anatomic structures in the joint and can develop a comprehensive surgical plan with complete understanding of the needs of the patient.

15 PT Evaluation

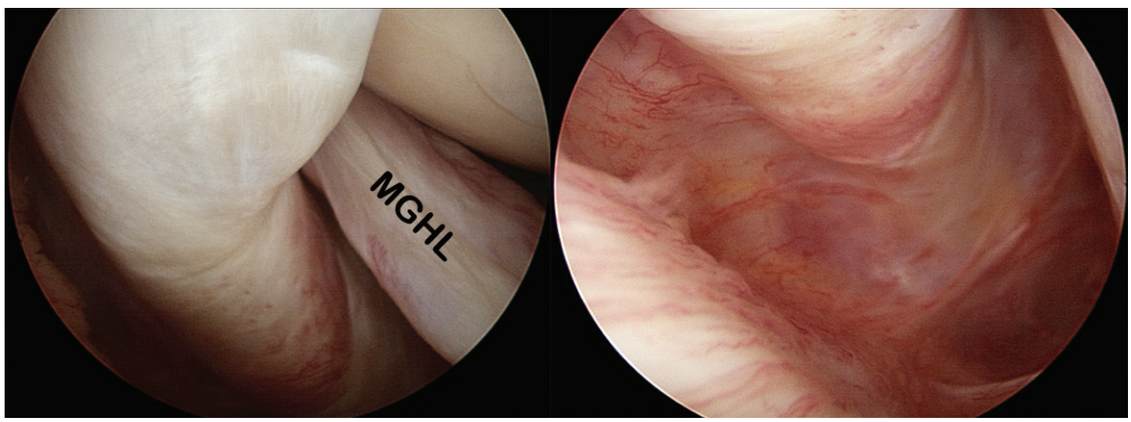

FIGURE 3-42. The subscapularis recess may have several compartments that can hide loose bodies.