Anterior Portals in Shoulder Arthroscopy

Eugene M. Wolf, M.D.

Summary: The anterior portal has been the major operative portal through which hand and motorized instrumentation have been introduced into the glenohumeral joint. This portal has been limited with respect to its access to structures in the anteroinferior aspect of the joint. Anatomical and clinical studies were undertaken to evaluate the safety and effectiveness of the use of an anterior inferior, as well as an anterior superior portal. Seventy-eight unembalmed cadaver specimens and 34 operative cases were used in the studies. Only an "inside out" technique using blunt instrumentation is recommended in creating the anterior inferior portal. The margin of safety with respect to the musculocutaneous nerve is increased with adduction. The use of these two anterior portals greatly enhanced our ability to visualize and work directly on lesions of the glenohumeral ligament labral complex. These anterior portals can be safely created if guidelines are carefully followed by surgeons with considerable experience in shoulder arthroscopy. Key Words: Anterior inferior portal—Anterior superior portal—Musculocutaneous nerve.

Since the inception of shoulder arthroscopy, the anterior portal has played an important role in providing an approach to the anterior aspect of the glenohumeral joint. This portal has served as the primary operative portal, used basically for the introduction of different types of arthroscopic surgical instrumentation into the joint. Early experience in the development of an anterior portal resulted in a report of damage to neurovascular structures (1). Since major neurovascular structures lie medial to the coracoid, a dictum was established stating that the anterior portal must be created lateral to the coracoid. Although this anterior portal, lateral to the coracoid, clearly avoids any elements of the neurovascular bundle and gives us an anterior portal that can be easily created with impunity, it does not provide us with a portal that allows access to the inferior aspect of the glenohumeral joint, the inferior glenohumeral ligament labral complex, or the anterior inferior aspect of the glenoid rim and scapular neck.

Matthews et al (1) defined this anterior portal and recommended using the boundaries of an intraarticular anatomic triangle as an operative guideline. This triangle is bordered by the humeral head, the glenoid rim, and the biceps tendon. To develop this anterior portal, a spinal needle is inserted through the skin from a point lateral to the tip of the coracoid and introduced into this triangle, always remaining above the superior border of the subscapularis tendon. The portal is then created by an "outside in" approach with an incision made at the needle puncture site and a sharp trocar is used to enter the joint. These authors recognized the limitations of this anterior portal with respect to access to the inferior third of the glenoid and labrum. This approach has provided us with a good diagnostic and operative portal, but has been a limiting factor with respect to lesions of the inferior glenohumeral ligament labral complex (IGLLC).

It has been through an anterior portal that arthroscopic surgeons (2–5) have attempted to remedy lesions that are responsible for anterior instability.
Figure 1 demonstrates the relative orientation of an instrument placed through an anterior portal located lateral to the coracoid. Any attempt to penetrate or traverse the scapular neck at such an acute angle with a drill, Kirschner (K) wire, staple, or any fixation device would appear extremely difficult.

Johnson first described a technique for staple capsulorrhaphy (4) for anterior instability. Matthews et al (3) and Johnson (6) presented their results and complications. Small (7) reported on the relatively high complication rate of staple capsulorrhaphy in his overview of complications in arthroscopy.

The problems of inadequate or partial staple insertion, bending, loosening, impingement, or tissue amputation by overdriving the staple have been due in part to a technique using the anterior portal described above, and to the relatively extensive use of this procedure in an orthopedic community that was, and still is, in the early phases of the learning curve in shoulder arthroscopy. Many staples that were thought to be solidly inserted had only one tine in bone. Others skived off medially, coming to rest in the soft tissues. Most staples that were believed to have loosened in a short period were probably never properly inserted with both tines firmly fixed in bone.

Early experience with staple capsulorrhaphy led to the development of a new anterior inferior portal, an anterior superior portal, and an alternative system of fixation using a cannulated screw and ligament washer (8). Two new anterior portals were used and defined: An anterior superior portal that is located between the coracoid and the acromion, and an anterior inferior portal located immediately inferior to the tip of the coracoid (Figs. 2 and 3). The anterior superior portal is similar to the standard anterior portal described by Andrews (9), but is slightly more medial and superior.

Caspari's anterior portal described for his suture technique (2) is “located just lateral to and parallel with or slightly inferior to the coracoid process.”

The additional anterior inferior portal provides the surgeon with an increased capacity to evaluate the glenohumeral joint, and with new methods, strategies, and techniques in arthroscopic anterior shoulder capsulorrhaphy regardless of the type of fixation used. These new portals allow anterior triangulation and direct visualization of work performed on the scapular neck and IGLLC.

Anatomical studies, clinical experience, the technique of placement of an anterior superior and an anterior inferior portal, and their specific use are discussed.

MATERIALS AND METHODS

I have performed or personally supervised the dissection of 78 fresh, unembalmed cadaver shoul-
Anterior portals in shoulder arthroscopy

The four major portals are represented with their anatomical relationships.

Arthroscopy had been performed on 31 of the specimens prior to the dissections. A specialized shoulder specimen holder was developed to maintain firm position in traction and in different degrees of abduction. Anterior superior and anterior inferior portals were created and different types of anterior capsulorrhaphies were performed using staples (3, 4, 6), sutures (2, 5), and cannulated screws (8).

The coracoid was the pivotal structure, around which these two anterior portals were made. A posterior portal was made approximately 3 cm distal and 2 cm medial to the posterolateral tip of the acromion. This was used as a viewing portal only. A superior portal was established for fluid outflow and pressure transduction.

Clinical Study

The anterior inferior and anterior superior portals have been used in 34 cases of arthroscopic anterior shoulder capsulorrhaphy. This is a technically demanding procedure and should be undertaken by an experienced arthroscopic shoulder surgeon. A dedicated, well-equipped arthroscopic surgical suite with specialized personnel is needed to prevent these cases from becoming frustrating ordeals. Careful attention was paid to both intraarticular and extraarticular landmarks, the latter clearly delineated with a marking pen.

Operative technique

After induction of general endotracheal anesthesia, the patient is positioned in a lateral decubitus position. The operating table is then rotated so that the anesthesiologist is positioned in front of the patient but away from the head of the table, thereby giving the surgeon and the surgical assistant 180° of access to the shoulder (Fig. 4).

Distal traction of 10–15 lb, depending on the size of the patient, is applied so that the arm is abducted approximately 30°. This is the initial traction configuration, but is modified later in the procedure to include a second traction device that will pull on an underarm sling (Fig. 5). This is a modification of the traction technique described by Gross and Fitzgibbons (10). But with twin traction devices, the relative weight on each sling, as well as the position of the arm can be modified during the procedure.
Different degrees of adduction, abduction, flexion, and extension with different weight configurations can modify intraarticular anatomy to meet the needs of different operative situations.

The posterior portal

The position of the posterior portal is vital to accurate anterior portal placement and to successful visualization of the entire glenohumeral joint. It is created at the level of the posterior joint line and at the midpoint of the glenoid. Careful palpation of the posterior bony contours and identification of the joint line is aided by rotation of the arm by an assistant. Grasping the rotating humeral head between the thumb and fingers will give the surgeon an excellent perception of where the joint line is located. This obviates the need for attempts to fill and distend the shoulder joint by injection of saline solution via a spinal needle prior to scope insertion. Such attempts are often misdirected and result in inadvertent soft tissue distention that does not facilitate posterior portal entry into the joint. Sharp trocars are unnecessary and can cause damage to the glenoid and humeral head. The blunt trocar and sheath easily pass through the muscular and capsular layers and are used to palpate the bony contours and the joint line.

It is important that the arthroscope is inserted at the level of the posterior joint line so it can traverse the joint parallel to the glenoid surface (Fig. 6). Generally, this means that this posterior portal will be more medial and inferior than the usual posterior portal. This will vary from 1 to 2 cm medial and 2 to 3 cm distal to the posterolateral tip of the acromion, varying with patient size. When the posterior portal is properly placed, the anterior inferior portal will be more easily and safely created.

This location of the posterior portal also allows a unique view of the IGLLC, and the inferior pole of the glenoid (Fig. 7).
FIG. 7. An inferior arthroscopic view of a Bankart lesion in a right shoulder. The arthroscope is in the posterior portal, placed in the axillary pouch, with the angle of a 70° scope directed superiorly. The inferior pole of the glenoid (G) and the detached inferior glenohumeral ligament labral complex (C) are visualized.

The superior portal

This portal is used primarily for fluid management. Once the arthroscope cannula and blunt trocar are in the joint, the combination transduction and outflow cannula of an arthroscopic pump (3M Medical Products Div., St. Paul, MN) is inserted in the interval between the distal clavicle and the scapular spine. It passes through the muscular portion of the supraspinatus, to lie posterior to the humeral head. Its insertion is facilitated by the scope cannula already in the joint that is palpated by the advancing combination cannula. Once again only blunt trocars are used.

The anterior superior portal

This portal is located between the coracoid and the acromion, but slightly more superior and medial than the traditional anterior portal. It is at the level of the joint line and enters the joint just anterior to the biceps tendon (Fig. 2). This keeps it at a distance from the anterior inferior portal and allows for better visualization and triangulation anteriorly. An 18-gauge spinal needle is used for localization. Its proper placement into the joint is observed with the arthroscope in the posterior portal.

The anterior inferior portal

This portal is safely created by intraarticular palpation of the coracoid with the arthroscope and allowing it to slide off the inferior edge of the coracoid tip. The arthroscope is then withdrawn from its sheath, and the Wissinger rod passed through the capsule. A cannula is then inserted over the rod thus creating this portal that is immediately adjacent to the coracoid tip (Figs. 2 and 3). If larger cannulas are inserted over switching sticks, they should have a cannulated obturator that fits snugly over the stick.

This portal allows us to have better access to the inferior pole of the glenoid and scapular neck at a more workable angle. The combined use of the anterior superior and anterior inferior portals permits operative triangulation in the anterior aspect of the glenohumeral joint.

As is the case with all portals in shoulder arthroscopy, it is important to keep them snug and to use switching sticks and cannulas so as not to lose them during the procedure. It is important to avoid repeated capsular punctures that can produce rather dramatic extravasation of fluid into soft tissues. If a portal is lost at any point during the case, a switching stick should be used to carefully recannulate the portal. Sharp trocars or other sharp instruments are never used.

RESULTS

Anatomical Study

The shoulders were dissected by first removing all skin and subcutaneous tissue. The deltoid was then freed from its acromial and clavicular origins and reflected distally. The brachial plexus and its branches were identified and the relative positions of the anterior portals noted. Since the need for an anterior portal that was more inferior and medial was envisioned, the dissections were specifically directed at the most laterally situated of the branches of the brachial plexus, the musculocutaneous nerve (Fig. 8). The position of the nerve relative to the coracoid and its point of entry into the coracobrachialis muscle was recorded. Other authors (11,12) have also reported on this anatomical relationship, and their results are essentially the same as those found in this series of dissections. The musculocutaneous nerve was found to enter the coracobrachialis muscle anywhere from 2 to 8 cm from the tip of the coracoid, with an average of 5 cm. This measurement and its variability are of considerable importance when one is contemplating a portal inferior and just medial to the coracoid tip, but of more significance is the shortest distance between the co-
racoid and the nerve at any point in its course. This was measured with the arm at 30° of abduction and ranged from 2 to 4.5 cm. It was noted that this distance increased slightly with adduction and decreased with abduction. Considering these anatomical findings, the optimal operating position for anterior inferior portal placement was determined to be with the arm in ≈30° of abduction.

The dissections did not demonstrate any evidence of damage or even contact made with the musculocutaneous nerve or any other vital structure by instruments placed through the anterior inferior portal. This portal was found to be 1.5–4.0 cm from the musculocutaneous nerve, with an average of 2.9 cm (Fig. 8). The portal was located at the inferior border of the coracoid and at the apex of the angle formed by the conjoined tendon and the pectoralis minor (Fig. 9). Occasionally, the portal passed through the conjoined tendon at its origin.

The anterior superior portal passed anterior to or through the coracoacromial ligament, and through the rotator cuff interval and anterior superior capsule near the superior glenohumeral ligament.

Attention was also directed to the intraarticular safe triangle and the relative position of these anterior portals to this triangle. The anterior inferior portal was always within this safe triangle and located at the angle formed by the subscapularis tendon and the middle glenohumeral ligament (Fig. 2).

Skeletal specimens were also studied to determine the anatomical and spatial relationships of the coracoid to the glenoid. The coracoid always curved anterior and lateral to the glenoid surface and constitutes a palpable landmark within the safe triangle (Fig. 2).

Clinical study

Thirty-four patients underwent arthroscopic anterior capsulorrhaphy using the above-described portals.

The anterior superior portal, when used as a viewing portal, enhanced our ability to directly observe and diagnose the lesions of the IGLLC, and offered a different perspective of the entire gleno-humeral joint. It also allowed direct visualization of work being performed on the scapular neck and IGLLC by instrumentation inserted through the anterior inferior portal (Fig. 10). As a working portal it was used to insert a grasper that was used to retention and reposition a deficient or avulsed IGLLC. This portal was created without complications.

The anterior inferior portal permitted access to the entire anterior aspect of the joint. The scapular neck was attained at a workable angle, and instrument skiving was essentially eliminated. This portal was created without complications.

The combined use of anterior inferior and anterior superior portals increased our capacity and proficiency in diagnosis and treatment of lesions of the IGLLC.
The coracoid origins of the conjoined tendon (CT) and pectoralis minor (PM) form an acute angle. It is at the apex of this angle that the anterior inferior portal (P) is located. The brachial plexus is apparent and the musculocutaneous nerve is marked.

An arthroscopic view of a Bankart lesion in a left shoulder form the anterior superior portal. The view from this portal permits direct visualization of the abrasion of the scapular neck. The detached labrum (L) and the anterior glenoid rim (G) are best visualized from this portal.

DISCUSSION

The development of shoulder arthroscopy has paralleled the development of knee arthroscopy in that we have gone from relatively simple diagnostic arthroscopies to more difficult excisional and complex reconstructive procedures. Advanced arthroscopic procedures in the knee, shoulder, elbow, wrist, hip, and ankle have been paralleled by the development of new portals that allow us to perform more complex procedures. With increasing complexity and demanding techniques, with portals in proximity to neurovascular structures, the arthroscopic surgeon must have a three-dimensional perspective of the involved anatomy.

It is my belief that the anterior portals previously described (1,9,13) are inadequate to gain access to the inferior aspect of the glenohumeral joint and, in particular, the IGLLC. The need for an additional anterior portal more inferior and medial than previously described became obvious. The new portal also had to provide better access to the scapular neck. Triangulation in the anterior aspect of the glenohumeral joint required two separate portals.

The anatomical portion of this study was per-
formed to identify the relationships of anatomical structures to these new anterior portals. The relationship of the musculocutaneous nerve to the anterior inferior portal was particularly addressed. The margin of safety with respect to the musculocutaneous nerve is increased with adduction of the arm. The anterior inferior portal should only be created with an “inside out” technique using blunt instrumentation. The portal is maintained at all times with switching sticks. Sharp trocars should never be used.

The clinical experience demonstrated an increased diagnostic and surgical ability with no increased morbidity or complications. It expanded our arthroscopic anatomical perspective and has led to a much improved surgical approach to the lesions of the inferior glenohumeral ligament labral complex.

CONCLUSION

The anatomical study and clinical experience presented here has demonstrated that these new anterior shoulder portals can be safely created if the guidelines outlined above are followed. The new anterior inferior and anterior superior portals remain within the safe triangle that has been previously described for anterior portal placement. The combined use of these portals is recommended for experienced shoulder arthroscopic surgeons.

The addition of the anterior inferior and anterior superior portals expands our capacities to remedy the pathology found in the anterior and inferior aspects of the glenohumeral joint.

REFERENCES