ARTHROSCOPIC BANKART REPAIR OF THE SHOULDER

ARTICLE BY GARY J. ALLEN, CST

Endoscopic procedures have become almost routine in many surgical specialties, providing valuable diagnostic information and allowing for therapeutic intervention with little risk to the patient. This is most evident in the field of orthopedics, where the arthroscope has all but eliminated the need for knee arthrotomy (one of the more common orthopedic procedures prior to the introduction of the arthroscope to the United States in 1975). Today, the orthopedist is able to debride and repair menisci, retrieve loose bodies, and reconstruct the ligaments of the knee effectively through arthroscopic intervention. These techniques also have been used recently to evaluate and treat other joints of the body, particularly the shoulder. Advancing rapidly since its inception, the value of shoulder arthroscopy is enhanced by the difficulty inherent in establishing an accurate diagnosis based solely on clinical examination of this joint.

This article is an overview of a recently developed orthopedic technique for repairing recurrent anterior shoulder instability: the arthroscopic Bankart repair of a torn anterior glenoid labrum. In the course of this discussion, the relevant anatomy, the patient's intraoperative experience as related to Mercy Hospital, Springfield, Massachusetts, and the complications and rehabilitative processes of this type of reconstruction will be presented. The surgical technologist's specific role will be discussed to help the surgical technologist to be aware of his/her duties during this procedure. Although an extensive comparison between the open arthrotomy and arthroscopic repairs is not presented, the immediate patient benefit derived from this approach will be demonstrated.

Anatomy of the Shoulder

Bones

The shoulder is subjected to great mechanical stress and yet has a wider range of motion than any other joint in the body. A complex ball and socket joint, the shoulder is capable of triaxial motion, that is, abduction-adduction, flexion-extension, and rotation. The bony foundation of the shoulder consists of the distal clavicle, humeral head, and the glenoid fossa and the acromial and corocoid processes of the scapula (Figure 1). These structures serve as important landmarks for the surgeon during shoulder arthroscopy. Normal shoulder function depends on separate articulations between the humeral head, the glenoid fossa, the clavicle, the acromial process, and the sternum. The focus of this paper is the glenohumeral joint.

Soft Tissue

The strength and stability of the glenohumeral joint are maintained by an encircling arrangement of deep muscles and their tendons (supraspinatus, infraspinatus, subscapularis, and terres minor) known collectively as the rotator cuff. Stability is further enhanced by thickened bands within the anterior and inferior joint capsule. Referred to as the glenohumeral ligaments, the most important of these is the inferior glenohumeral, which attachs to the glenoid rim in the structure known as the anterior glenoid labrum. These are important structures in the consideration of anterior shoulder instability. Other supportive ligaments include the coracohumeral and transverse humeral (Figure 2). Both the glenoid labrum and various associated bursae serve to lessen articular friction.

Shoulder Disorders

Impingement

A common phenomenon in shoulder disorders is impingement of the rotator cuff and biceps tendon. This occurs against the anterior acromion and coracoacromial ligament, thus leading to tendonitis. Impingement may be evidenced during clinical examination by difficulty and pain noted on abduction of the shoulder. When these problems fail to respond to conservative modalities, an open arthrotomy or arthroscopy may be employed to perform a subacromial decompression.

Rotator Cuff Tears

To date, anterior instability and rotator cuff lesions have been the focus of shoulder arthroscopy. Both surfaces of the rotator cuff can be examined via the arthroscope. Evident full-thickness tears in the rotator cuff are still best reconstructed by open arthrotomy. However, lesser degrees of cuff inflammation and wear are often amenable to repair with arthroscopic techniques.

Anterior Instability

The ligaments and muscles that give the shoulder its strength unfortunately lend themselves to instability caused by trauma or stressful usage. Dislocation of the shoulder is one of the earliest recorded medical injuries: early Egyptian

Gary J. Allen, CST, is employed by Mercy Hospital in Springfield, Massachusetts. A 5-year member of AST, he specializes in orthopedic, thoracic, and vascular surgery. Mr Allen earned his associate degree in surgical technology at Springfield Technical Community College. The figures in this article were drawn by the author.

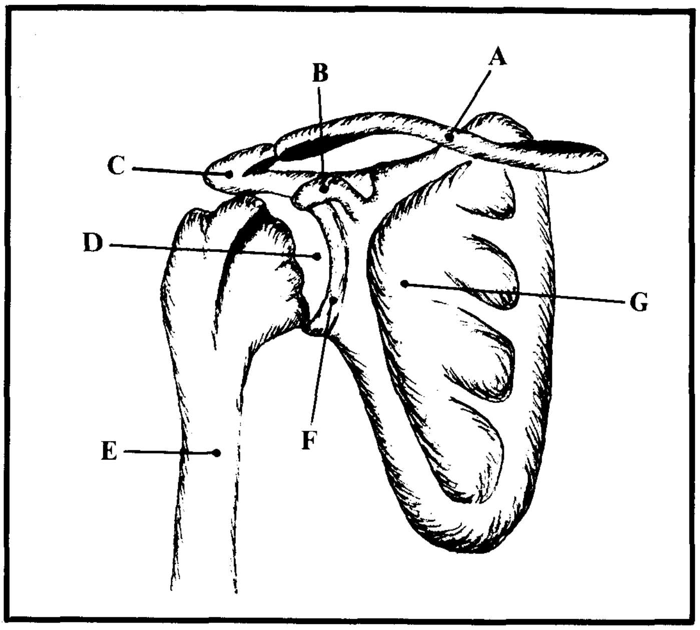

Figure 1. Anterior view of the shoulder joint showing articulations. **A,** Clavicle; **B,** Corocoid process; **C,** Acromial process; **D,** Humeral head; **E,** Humerus; **F,** Glenoid rim; and **G,** Scapula.

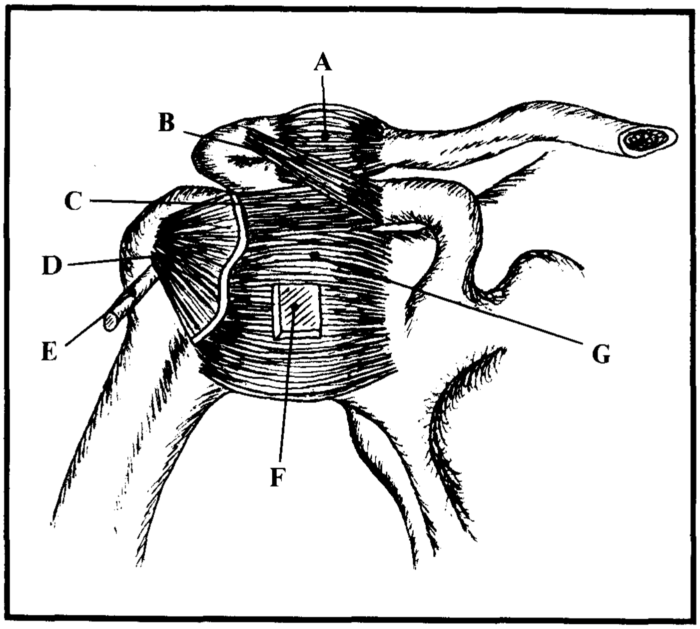

Figure 2. Anterior view of the shoulder. **A,** Acromioclavicular ligament; **B,** Coracoacromial ligament; **C,** Coracohumeral ligaular **D,** Transverse humeral ligament (divided); **E,** Biceps tendon; **F,** Articular capsule (inferior); and **G,** Glenohumeral ligament complex.

paintings demonstrate manipulation to reduce dislocated shoulder instability.

The posterior portion of the shoulder is strongly supported by broad muscles and tendons, and the posterior rim of the glenoid and the acromial process serve somewhat as a wall. Therefore, posterior instability is not a common problem. However, the shallow glenoid fossa has one-half the contour and one-third the area of the humeral head's articular surface, although its depth is augmented by the fibrocartilagenous glenoid labrum.

The shoulder then is very dependent on its supportive soft tissue structures for anterior stability. Soft tissue injury therefore can result in an unstable joint. This may be apparent to the physician upon clinical examination when stressful extension and flexion of the shoulder produces pain. The glenoid labrum and the closely associated glenohumeral ligaments are very prone to injury, particularly when the arm is in an extended or overhead position, as often occurs in athletics.

The physician then may choose to examine the shoulder under anesthesia to help confirm the diagnosis of instability. In addition, with the advent of arthroscopy, the surgeon is now able to visualize directly the soft tissue injuries that have led to the instability, as well as signs (for example, Hill-Sachs lesion of the humeral head) that may also confirm the diagnosis. This arthroscopic examination will preclude any attempted arthroscopic repair and may well be performed in conjunction with it.

Most instabilities manifest anteriorly, and through the years many open repairs have been developed: the Bristow, Magnuson, Putti-Platt, and Bankart procedures to name a few. Although proven to be reliable, all of these techniques require significant soft tissue dissection, are technically demanding, and are associated with varying degrees of morbidity and rehabilitation. Arthroscopic procedures have been developed in the hope of achieving similar degrees of stability. To demonstrate this, one such technique will be discussed here: the arthroscopic Bankart repair of a torn anterior glenoid labrum.

Intraoperative Procedure

Preoperative Preparation

At Mercy Hospital, same-day admit patients arrive 2 hours prior to surgery. Charting, identification, operative site preparation, and anesthesia evaluation are performed, and the patient is then transferred to the operating room. Here the surgeon sees the patient prior to anesthesia. Patient identification is checked and the procedure verified with the chart. The patient is transferred supinely to the OR table, and after appropriate monitor and intravenous lines are secured, the patient is inducted and intubated for general anesthesia. Muscle relaxants also are administered to facilitate arthroscopy.

The patient next is positioned laterally with the affected side up, using a vacuum-type bean bag positioner to stabilize the body. The patient's trunk is tilted 30 degrees posteriorly to align anatomy. All bony prominences are padded and pillows are placed between the legs. An upper extremity positioner is secured to the foot of the OR table and a telescoping drape is passed over its arm. At Mercy Hospital, we use the Zimmer Arthrobot™ Upper Limb Positioner. The patient's hand is placed into a specially provided holder and its cuff is inflated. The Arthrobot arm now is positioned to provide for 30 degrees of both abduction and flexion of the joint. Two drapes (for example, 3M Steri-Drape brand surgical drapes) are used to outline the operative area and to protect the patient from fluids. Then the upper arm, axilla, shoulder, neck, and chest are scrubbed and painted with povidone-iodine. The telescoping drape's unsterile cover is removed by the circulator, and the scrub person slides the inner sterile portion down to the base of

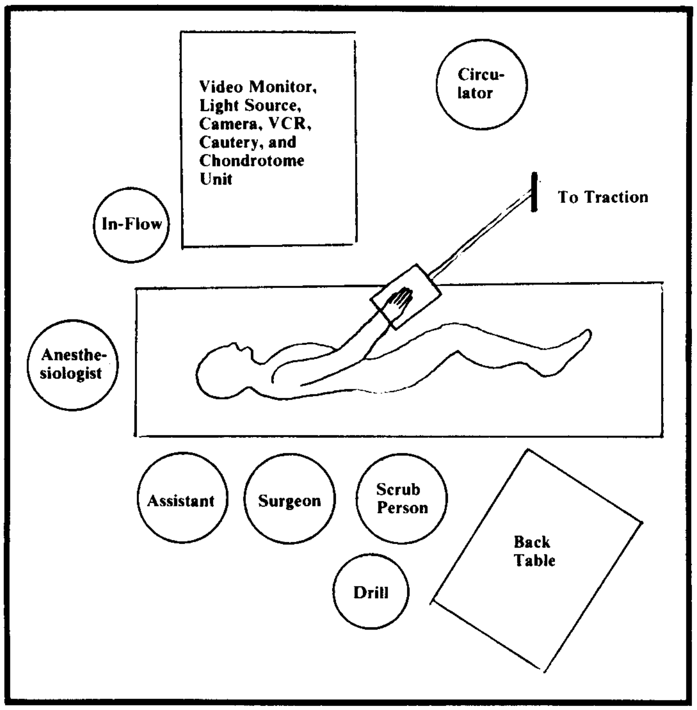

Figure 3. Room setup showing patient in lateral position with hand in cuff of Arthrobot (traction).

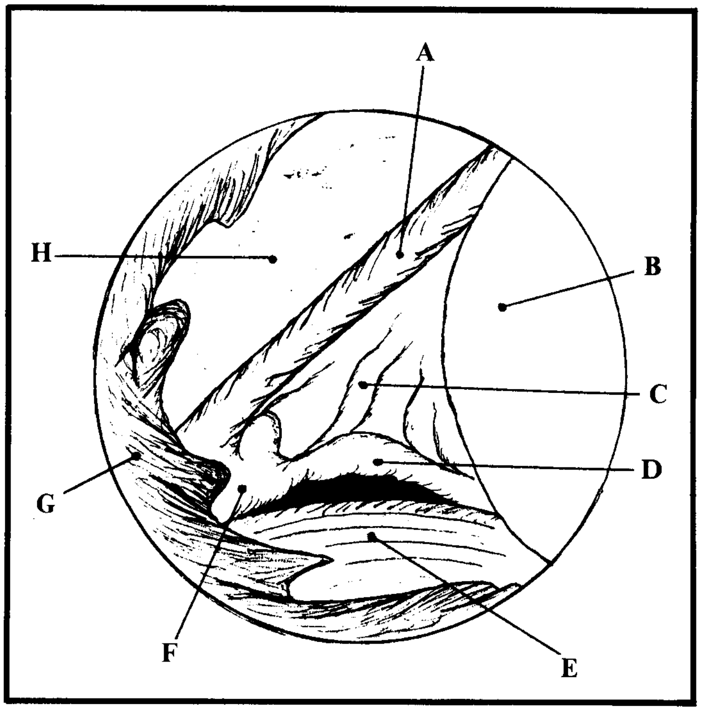

Figure 4. Arthroscopic posterior view of the glenohumeral joint. **A,** Biceps tendon; **B,** Humeral head; **C,** Inferior glenohumeral ligament; **D,** Torn labrum (Bankart lesion) on anterior glenoid rim; **E,** Glenoid fossa; **F,** Intact labrum; **G,** Synovium (foreground); and **H,** Joint capsule.

the Arthrobot in one direction and over the patient's hand to the elbow in the other, thus enclosing the positioner in a sterile field. The drape is secured about the patient's forearm with adhesive strips. The patient is now completely draped using four towels to encircle the shoulder, and four large sheets serve to cover the head, remaining body, and the base of the Arthrobot. All equipment is rolled into place near the sterile field (Figure 3). At this point, 15 lbs of traction is applied to the joint and the time is noted, as this arm is not to be suspended for longer than 90 minutes.

Arthroscopic Portal Establishment

The surgeon now palpates the shoulder to locate the bony landmarks. He/she draws their outlines and marks the locations of the selected portal sites (posterior, anterior, and superior). During this time, the scrub person secures the in-flow and suction tubings, light cord, cautery, and camera to the field and checks the operation of the air-powered drill (for example, the 3M Maxi-Driver II brand air-powered instrumentation for large bone orthopedic surgery) and the electrodriven chondrotome. The surgeon injects each portal site with 0.5% bupivacaine hydrochloride (Marcaine) with epinephrine 1:200,000. He/she then makes an initial stab wound incision into the posterior aspect of the shoulder and introduces the arthroscopic sheath into the joint.

The sheath's trocar is withdrawn and a 30-degree arthroscope is inserted with the camera and light cord attached. Suction and in-flow tubings are now connected to the sheath. A 3,000-cc bag of sterile glycine solution with 1 cc of epinephrine 1:1,000 added is allowed to infuse and is used throughout the procedure. A preliminary arthroscopic examination is performed, and the biceps tendon, humeral head, glenoid fossa, inferior glenohumeral ligaments, capsule, and labrum are readily identified (Figure 4). With anterior instability, the labral detachment will be evident on the anterior aspect of the glenoid rim.

Next, a superior (in-flow) portal is established by introducing a 4.5-mm cannula into the joint via the suprascapular fossa. The in-flow tubing is disconnected from the arthroscopic sheath and reattached to this cannula. While allowing for excellent distention of the joint, the cannula's position should not interfere with the manipulation of the arthroscopic instruments. Under arthroscopic observation, an 18-gauge spinal needle is carefully inserted into the joint anteriorly to obtain the proper angle of approach to the glenoid neck and the labral defect. This entry is made just lateral or slightly inferior to the corocoid process. Once positioned, the needle is replaced with a 5.5-mm cannula with a rubber dam within to prevent any backflow of liquids, and the anterior (operative) portal is now established.

The Repair

Initially the surgeon will probe the tear with a nerve hook to determine the extent of the labral detachment. During this time the scrub person loads the chondrotome with a 4.5-mm full radius-type tip, which the surgeon inserts into the operative cannula and uses to debride the repair area of any useless soft tissue. Any bleeding is easily controlled by electrocauterization. The chondrotome's debriding tip is then replaced with a 4.0-mm round burr that is employed to abrade the bony surface of the anterior glenoid neck to facilitate healing of the forthcoming labral repair. The scrub person loads the drill with a 0.25-in. Steinman pin on the Jacob's chuck.

The surgeon now introduces the Steinman pin into the

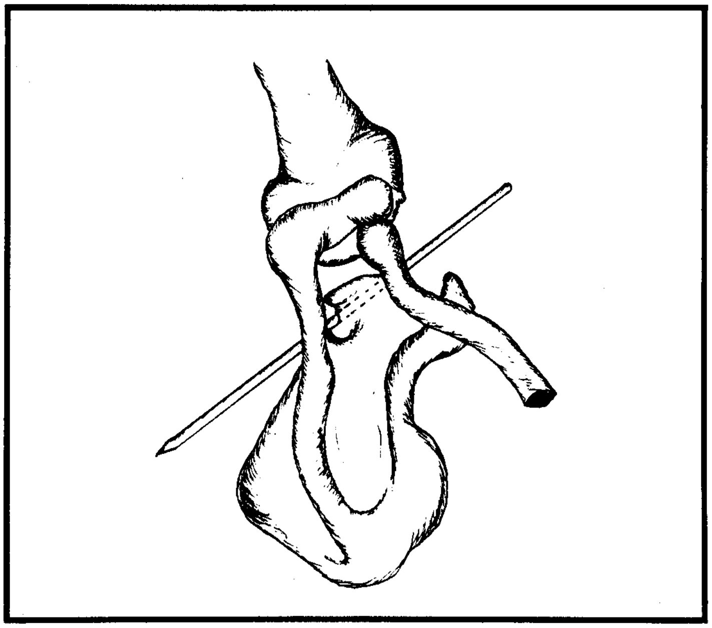

Figure 5. Oblique superior view of shoulder joint showing 0.25-in. Steinman pin driven through glenoid neck and exiting the infraspinatus fossa.

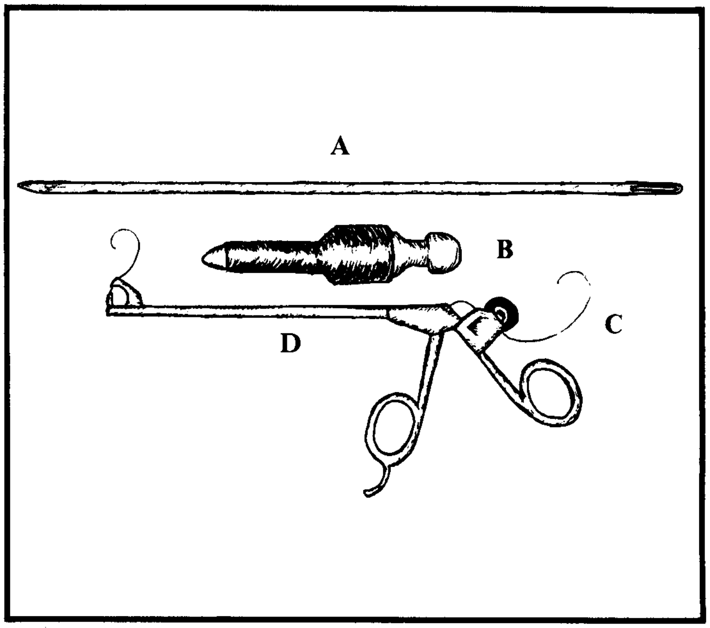

Figure 6. The suture punch set. **A,** Suture passer; **B,** Oblong cannula with plastic trocar; and **C,** 0 polypropylene suture threaded through shaft of **D,** the suture punch.

joint through the operative cannula. The angle of entry is checked, and the pin is driven into the anterior aspect of the glenoid neck, just below the glenoid rim, through the scapula, exiting posteriorly to the infraspintus fossa (Figure 5), and out through the skin. The drill is released and then refastened to the Steinman pin's point and the pin is pulled out until the blunt end is viewed within the joint to be flush with the glenoid neck. During pin placement, the scrub person prepares the suture punch from the punch set (Figure 6) by passing a 0 polypropylene suture (for example, Ethicon Prolene™ suture) into the rear hole and advancing it through the punch shaft by using the feeder wheel above. This is done until the end of the suture is flush with the jaw point. Several more 0 polypropylene sutures are also prepared for use in the punch.

The anterior cannula is now removed and replaced with the larger oblong cannula from the punch set. Its plastic trocar is removed and the punch is advanced through the cannula to the labral tear. By grasping the detached labrum and clamping the jaws shut, the suture can be passed through the jaws to suture the labrum, using the feeder wheel. The suture is now advanced until one-half of its length is within the joint. The punch jaw is opened releasing the labrum, and the punch is withdrawn out the cannula pulling the two free ends of the suture with it. This step is repeated until ample sutures have been placed through the labrum to effect repair (Figure 7).

At this point, four to six sutures will have been applied and all suture ends will exit the joint via the operative cannula. The suture ends are now placed through the eye of the passer and the tip of the passer is inserted into the operative cannula. It is observed entering the joint and is directed to the end of the Steinman pin. The Steinman pin is now extracted slowly as the passer follows the drilled hole through the scapula and out the skin, pulling the suture ends with it. These sutures are divided into two equal groups and threaded onto a free Mayo needle. Each group of sutures is then passed through 1 cm of infraspinatus fascia. Traction on the joint is released as tension is maintained on the sutures. The closed defect is observed arthroscopically as the sutures are tied together with a double square knot.

The surgeon now observes the repair and utilizing a nerve hook probe checks its integrity. Once satisfied, he/she closes the posterior puncture wound with a 4-0 nylon suture. The surgeon next withdraws the operative cannula from the anterior portal and closes the incision with the same suture. The joint is flushed of any residual debris, the superior cannula is removed, and this portal also is closed in a like manner. Finally, the joint is drained through the arthroscopic sheath, 20 cc of 0.5% bupivacaine with epinephrine 1:200,000 is infused, and the scope and sheath are withdrawn. The final (posterior) portal is now closed with a 4-0 nylon suture, a petroleum gauze is applied to the wounds, and dry sterile dressings are taped in place. All lines are now handed off from the field, the patient's arm is released from the positioner, and all drapes are removed. The patient is now repositioned supinely with care taken to keep the affected arm adducted.

Postoperative Care

At this point, anesthesia maintenance has been discontinued and the patient is extubated. After the arm is placed in a sling, the patient is transferred to a stretcher and taken to the postanesthesia care unit. Here the patient will remain for about an hour. Most patients report very little immediate postoperative pain, which is a result not only of the local anesthetic administered at the end of the surgical procedure, but of the limited surgical intervention itself. The patient may then be admitted to a room for the night and released the next day. In many cases, the patient recovers rapidly enough to be allowed to leave the hospital within hours after surgery. This in itself is a substantial reduction in the length of hospital stay as compared with a Bankart

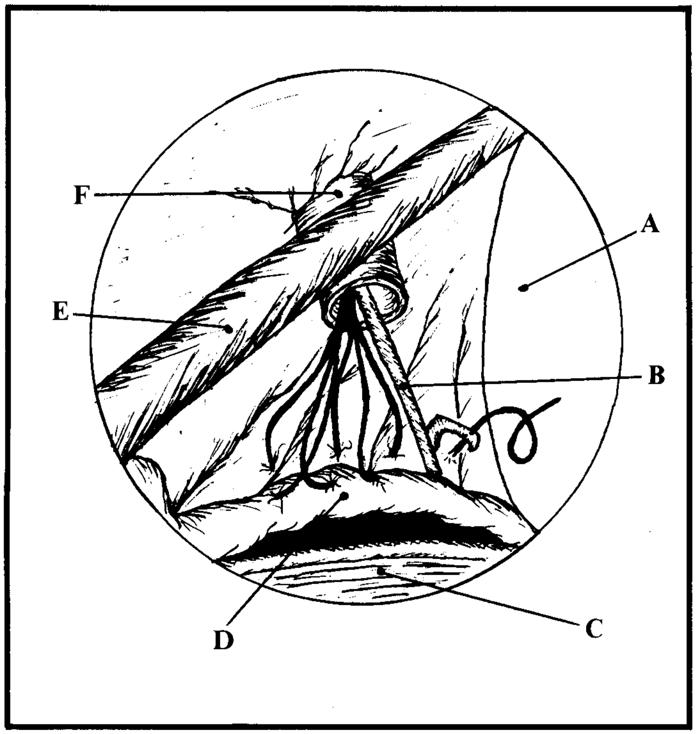

Figure 7. Arthroscopic posterior view of glenohumeral joint. **A,** Humeral head; **B,** Suture passer and partially passed 0 polypropylene suture; **C,** Glenoid fossa; **D,** Detached labrum with three previously passed sutures; **E,** Biceps tendon; and **F,** Oblong cannula. Note: All suture ends of the three previously passed sutures exit the joint via the oblong cannula (anteriorly).

repair performed through an open arthrotomy, which normally requires 24 to 36 hours of hospitalization and nursing care (Table 1).

Complications

The general complications of arthroscopy are articular damage, usually caused by the introduction or use of instrumentation; infection, which is quite uncommon and mainly attributed to improperly sterilized equipment; burns caused by light cords or solutions; and neurovascular injury, found to be the result of injudicious portal selection. Complications that are specific to arthroscopy of the shoulder include nerve palsy, the result of an extended length of extremity stress upon the brachial plexus; and extensive tissue extravasation, which may be due to existing rotator cuff tears or an overly high in-flow pressure.

Another potential complication is rotator cuff tears induced during arthroscope insertion (as this is done "blind"), which may well require further surgery to correct. The incidents of complications overall, however, appear to be very low. Olgivie-Harris and Wiley[1] noted a 3% complication rate. Of the 439 shoulder arthroscopies performed, they reported eight cases of massive fluid dissection that cleared within 7 days, five cases of minor articular damage, and one case each of sepsis and nerve palsy, both of which resolved themselves in 6 weeks.

Rehabilitation

Although it is clear that the arthroscopic approach described here is considerably less intrusive than an open arthrotomy, the tissues involved heal at a given rate. Therefore, rehabilitative measures are essentially comparable with either method of repair. The most notable difference, however, is the period of time that passes before the patient begins to feel better. When open arthrotomy is employed, with its extensive tissue dissection, the patient may not feel well for 2 weeks. With arthroscopy, the patient generally begins to experience postoperative relief in 2 days (see Table 1). This is important for emotional well-being, but without strictly followed rehabilitative measures this rapid postoperative relief can lead to the premature notion that the repair is healed and the ruination of the surgeon's careful work.

It is important then that the patient follow the regimen set by the physician. In the first postoperative week, the arm is kept in a sling at all times. After 7 days, the patient sees the physician, the stitches are removed, and the wound is checked for sepsis. For the next few weeks, up to 1 month, the patient must sleep with the sling on but is allowed to let the arm dangle at the side, and the patient can begin simple, light movement, such as very limited, gentle swinging and small pendulous circles.

In the second and third months of rehabilitation, the patient is allowed light activity and gentle rotation of the arm, with elbow flexion, always keeping the upper arm close to the side and below the shoulder. During this time, tissue healing has taken hold (about the sixth week) and continues for 6 months, up to a full year. For the next 3 months, the patient will slowly increase activity and begin raising the arm above the shoulder. All phases of the rehabilitation are monitored by the physician and strictly reinforced.

By the time 6 months have passed, most patients are back to normal activity and healing is complete. Renewed stabil-

Table 1. Comparison Between Arthroscopic Approach and Open Arthrotomy for Bankart Repair of a Torn Labrum

	Arthroscopy	Arthrotomy
Procedure length	1.5 hours (maximum)	2 hours (average)
Blood loss	Minimal	200 cc (approximate)
Scarring	Four 0.75-in. punctures	5-in. wound with deep tissue division
Hospital stay	8-12 hours (average)	24-36 hours (average)
Postoperative relief	2 days	2 weeks
Rehabilitation period	6 months	6 months

ity should be evident and the patient may go back to work. The exception to this is the throwing athlete. This type of patient, particularly those who are career-minded, will be encouraged to work up to normal activity much more slowly and may require a full year to reach maximum effort. This is due to the unusual stress applied to the shoulder joint with throwing as the rapid acceleration and deceleration can easily tear a repair that is not completely healed.

Conclusion

After 15 years of successful application, many studies have shown arthroscopy to be an excellent alternative to open arthrotomy of the knee and, now it seems, the shoulder as well. As the field of shoulder arthroscopy broadens, other procedures similar in the complexity and apparent value of the arthroscopic Bankart repair will be developed. With arthroscopy, patient morbidity has been noticeably reduced as there is less tissue scarring, decreased overall patient discomfort, and a lesser degree of loss of motion and strength. Early success rates have also appeared to be quite comparable with those of open repair techniques.

The arthroscopic approach reproduces the goal of the open arthrotomy technique in that the torn labrum and resultant weakened inferior glenohumeral ligament are reattached in such a way as to reestablish the integrity of the anterior shoulder. The eventual acceptance or abandonment of such techniques depends, of course, upon the success rates of greater numbers of clinical applications. Therefore, shoulder arthroscopy should become a more commonly scheduled procedure. The surgical technologist involved with orthopedics may be encouraged to know that with such applications as these, the future of arthroscopy is proving to be as exciting and challenging as it is rewarding. □

Acknowledgments

The author would like to acknowledge Dr Sumner Karas of New England Orthopedic Surgeons, whose guidance and encouragement helped to make this paper possible.

The author also would like to acknowledge Patricia Lake, RN, CNOR, for her constant input and the assistance of Zimmer Arthroscopy Systems, Ethicon, and 3M in providing information on their products.

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President's Message — *continued*

Dorothy Corrigan, CST, an instructor in the Chicago area, wrote a letter last fall in which I think she expressed the essence of what I am trying to say.

> We all must realize that today's surgical technology student is what we, AST and the profession, will become tomorrow. Before we can become instructors or circulators or surgical assistants or managers or whatever else we want to become, we must first be surgical technology students. . . . If one of AST's purposes is to promote a high standard of surgical technology performance in the community for quality care, then AST must involve itself with our student population. . . . It seems to me that the organization that nurtures and supports its young, involves them and makes them important, is an organization that will grow and develop forever.

I urge you all to get involved. □

Now for some fun with numbers for our column . . .

Did You Know That . . .

The average adult brain weighs about 1,400 gm (3 lbs) and contains 20% to 25% of the body's total blood volume. It requires a blood flow rate of 800 ml/min and uses 20% of the body's total oxygen and nutrients around the clock. Over 100,000 chemical reactions occur in the brain each second. The number of possible interconnections among the neurons in a single human brain is estimated to be 2 to the 10 billionth power; to write out that number at the rate of one digit per second would take 90 years nonstop. In the fetal brain, nerve cells develop at an average rate of more than 250,000 per minute. After age 20, we start to lose about 100,000 neurons per day.

In an average lifespan, the human heart pumps enough blood to fill the Rosebowl Stadium to overflowing.

The average adult body contains 62,000 miles of blood vessels, enough to encircle the earth almost two and one-half times. There are 10 billion capillaries in the human body.

If the one million nephrons contained in just one kidney were stretched out, they would have a combined length of more than 140 miles.

The average adult has about 20 square feet of skin, which weighs about 10 pounds. The skin renews itself completely every 3 to 4 weeks, so you are not wearing the same skin you had last month.

The cells of the stomach and the entire intestinal lining are replaced every 3 days. The lifespan of a tastebud cell is about 10.5 days.

Fingernails grow about four times faster than toenails, about 0.02 in. per week. □