Arthroscopic Management of Rotator Cuff Disease

Gary M. Gartsman, MD

Abstract

Rotator cuff disease (stage 2 impingement, partial-thickness tears, complete cuff tears, and irreparable tears) is as yet only partially understood, and the role of arthroscopy in its management is still under debate. Stage 2 impingement can be managed satisfactorily with arthroscopic techniques. Arthroscopy allows a complete inspection of the glenohumeral joint, enabling the surgeon to diagnose and treat coexisting intra-articular lesions. A thorough bursectomy, coracoacromial ligament resection, and acromioplasty can be performed without the need for deltoid detachment. Arthroscopic technique appears to offer advantages over open technique in the management of partial-thickness tears by allowing accurate inspection of the articular surface of the rotator cuff. The depth and size of the tear can be determined precisely, allowing an appropriate selection of debridement, decompression, and/or tendon repair. The management of complete tears is currently under investigation, with some advocating complete arthroscopic repair and some preferring arthroscopic acromioplasty and "mini-open" repair; there are merits to both approaches. The arthroscopic management of irreparable tears appears to offer the advantages of an open decompression with decreased morbidity. However, the surgeon's ability to accurately determine reparability may be less precise with arthroscopy.

J Am Acad Orthop Surg 1998;6:259-266

This article summarizes the present state of knowledge on arthroscopic surgical management of rotator cuff disease. Four distinct stages of rotator cuff disease are reviewed: stage 2 disease (subacromial impingement syndrome), partial rotator cuff tears, complete tears, and irreparable tears.

Literature Review

A number of reports in the orthopaedic surgery literature have described the arthroscopic management of stage 2 rotator cuff disease. Several authors have reported 70% to 90% success rates with arthroscopic acromioplasty.[1-4] All stress that arthroscopic surgery is successful when impingement is due to extrinsic compression on the tendon by the structures of the coracoacromial arch but is not successful when the "impingement" is due to glenohumeral subluxation.

Other studies have compared the open and arthroscopic techniques. Lazarus et al[5] found that while the open technique produced a slightly higher success rate, the return to function was superior with arthroscopic treatment. Norlin[6] found that the arthroscopic technique produced better results and a more rapid return of function. Van Holsbeeck et al[7] reported marginally better results with the open technique but advised arthroscopic decompression for patient convenience and satisfaction.

Three options are available for the treatment of partial-cuff tears: (1) debridement of the partial-thickness tear alone, (2) debridement of the tear with arthroscopic decompression, and (3) open or arthroscopic repair of the partial-thickness tear combined with subacromial decompression. Andrews et al[8] reported 85% good or excellent results in a group of throwing athletes (average age, 22) treated with arthroscopic debridement alone without decompression. Snyder et al[9] found 47 partial tears in a group of 600 patients and advocated debridement without decompression if the tear was confined to the articular surface. Arthroscopic subacromial decompression was added if the tear was present on both the articular and the bursal surfaces. Esch et al[10] reported 85% good or excellent

Dr. Gartsman is Clinical Associate Professor, Department of Orthopaedics, University of Texas Medical School, Houston, and is in private practice with Fondren Orthopedic Group, Texas Orthopedic Hospital, Houston.

Reprint requests: Dr. Gartsman, Fondren Orthopedic Group, Texas Orthopedic Hospital, 7401 South Main Street, Houston, TX 77030.

The author or the departments with which he is affiliated have received something of value from a commercial or other party related directly or indirectly to the subject of this article.

results in 34 patients treated with arthroscopic subacromial decompression. Gartsman[3] reported good results in 80% of 40 patients with an average age of 40; decompression was performed in all cases.

There are also three options for the treatment of complete rotator cuff tears: (1) arthroscopic decompression without cuff repair, (2) arthroscopic decompression with "mini-open" repair, and (3) arthroscopic repair. A number of studies have reported on the use of arthroscopic decompression without cuff repair. Esch et al[10] reported satisfactory results in 20 of 26 (77%) patients treated with arthroscopic subacromial decompression without cuff repair. The results were excellent in all 4 patients in whom the tear was smaller than 1 cm. Levy et al[11] reported 84% excellent or good results in 25 patients. Ellman[2] reported good results in 9 of 10 patients with tears measuring 2 cm or less, but only 3 of 6 patients had good results if the tear was 2 to 4 cm. Gartsman[3] reported satisfactory results in 10 of 20 patients. In a comparison study of open repair versus arthroscopic treatment, Montgomery et al[12] found 78% good results in 50 patients treated with open repair but only 39% satisfactory results in 38 patients treated with arthroscopic decompression without repair. Burkhart et al[13] reported 90% good or excellent results in 72 patients, with follow-up ranging from 6 to 72 months. In that study, patients with good external rotation strength and good subscapularis strength had been carefully selected for arthroscopic treatment alone.

Levy et al[14] described 80% excellent or good results with arthroscopic decompression followed by a mini-open repair. Liu and Baker[15] reported 84% good or excellent results in 44 patients with an average 4.2-year follow-up. Paulos and Kody[16] reported 89% good or excellent results in 18 patients treated with a similar technique.

Another possible approach for the patient with a complete tear is arthroscopic repair. This technique is the most recent and necessarily the one with the least documentation in the literature. Snyder and Bachner[17] recently reported on a preliminary series of 47 patients. Forty-one patients (83%) had excellent or good results. Gartsman et al[18] reported that 66 of their 73 patients (90%) had excellent or good results with a minimum 2-year follow-up.

Little has been written about the treatment of patients with irreparable tears. Ellman and Gartsman[19] have achieved good pain relief with arthroscopic treatment in a limited number of patients, with reasonable pain relief documented in most patients followed up for as long as 5 years. They emphasize that thorough debridement and synovectomy accompanied by removal of any downward-protruding acromial or acromioclavicular joint spurs is necessary. Burkhart et al[13] reported that 25 patients with massive irreparable tears had 88% good or excellent results after arthroscopic repair; those results have not deteriorated with the passage of time.

Indications

The indications for arthroscopic treatment and open surgery are identical. These include pain or weakness that interferes with work, sports, or activities of daily living and that is unresponsive to an appropriate nonoperative treatment. The usual nonoperative regimen consists of a number of elements, including oral anti-inflammatory medication, cortisone injections into the subacromial space (two or three spaced 2 months apart), activity modification, selective rest, and a rehabilitation program. That program is designed to restore or maintain movement and to improve strength in the deltoid, the scapular stabilizers, and the rotator cuff. The recommended duration for this nonoperative approach varies in different publications, but it seems reasonable to consider surgery if the patient's pain continues for a period of 12 months or is increasing in severity after 6 months.

Diagnosis

The classic history of stage 2 impingement is one of shoulder pain with activities that place the shoulder in the painful arc of 70 to 100 degrees of elevation or abduction. The pain is localized to the subacromial region and radiates to the area of the deltoid insertion and often anteriorly into the biceps. Night pain is regularly noted. The role of trauma is variable; some patients present with symptoms after a major injury, but in the majority the pain occurs after repetitive activities without trauma or antecedent injury.

Physical examination demonstrates a full or nearly normal range of passive motion. Localized tenderness in the area of the supraspinatus insertion is infrequent. Acromioclavicular joint tenderness should alert the examiner that this joint may be the primary source of pathology. Acromioclavicular joint arthritis may mimic stage 2 impingement or may exist in addition to the primary impingement process.

The physician should carefully examine younger patients (less than 40 years old) for the presence of glenohumeral instability. In these patients, subacromial pain may be the result of traction ten-

dinitis rather than true stage 2 impingement.

Three impingement signs consistent with stage 2 impingement have been described. The primary sign involves the examiner placing the shoulder in maximum elevation.[20] With the secondary sign, the shoulder is elevated 80 degrees and then maximally internally rotated.[21] The tertiary sign is subacromial pain with the shoulder in 90 degrees of abduction. The signs are recorded as positive when subacromial pain is produced. The location of the pain during these maneuvers should be carefully noted. A patient with soft-tissue pain from rhomboid-trapezius spasm may have increased pain when each of these maneuvers is performed, but the pain will not be localized to the subacromial region.

After the physical examination, an impingement test may be performed. The test consists of the subacromial injection of a local anesthetic into the subacromial space and repetition of the maneuvers that produced the impingement signs. If the pain is eliminated or substantially reduced, the test is recorded as positive. The physician must remain aware that a positive test only confirms that the structures producing pain lie within the subacromial space and is not, in and of itself, diagnostic of impingement syndrome.

Glenohumeral instability may result in secondary traction tendinitis and a positive impingement test. Successful surgical management does not involve shoulder decompression, but rather the treatment of the underlying glenohumeral instability. The diagnosis of impingement syndrome is clinical, and arthroscopy does not routinely play a role.

A number of conditions that mimic the clinical presentation of impingement are best diagnosed with arthroscopic techniques. Glenohumeral instability, articular-surface partial rotator cuff tears, labrum tears, small areas of degenerative arthritis, posterior glenoid-cuff impingement, and lesions of the rotator interval are examples. Other conditions that may mimic stage 2 impingement syndrome but that cannot be diagnosed with arthroscopic technique include acromioclavicular joint arthritis, cervical spine disease, and suprascapular neuropathy.

Arthroscopy is particularly valuable in the diagnosis and management of partial-thickness tears of the rotator cuff (Fig. 1). The vast majority of partial-thickness tears are on the articular surface[22] and are not visible during inspection of the bursal surface of the cuff, such as occurs during an open procedure. It would seem, therefore, that the incidence of partial tears has been underestimated in the literature dealing with open surgery.

Techniques proposed to deal with this issue during open procedures include saline injection, methylene blue injection, and division of the tendon and visual inspection. The techniques that involve injection of fluid into the glenohumeral joint depend on the surgeon's ability to appreciate fluid egress from the cuff (saline injection) or staining of the cuff tissues with blue dye (methylene blue injection). These events signal a partial tear and should prompt the surgeon to split the cuff longitudinally to find the defect. Some surgeons will incise the rotator cuff longitudinally if no defect is found but a tear is suspected on the basis of the clinical or radiologic evaluation. However, exposure is limited, and the articular surface of the cuff is not well visualized. Inspection of the articular surface is better performed with arthroscopic technique, as the entire cuff can be easily inspected and the location, size, and depth of the tear can be appreciated. The tear can be marked with a suture, so that the precise area can be found on subacromial inspection and repair.

For patients with complete tears, the findings from the clinical examination are most commonly compared with those from radiologic studies (arthrography or magnetic resonance [MR] imaging [Fig. 2]) to make the diagnosis. The arthroscope can be used as well to diagnose the presence and size of a complete rotator cuff tear[23] (Fig. 3), although no authors have suggested that this be used routinely. The arthroscope is most useful in diag-

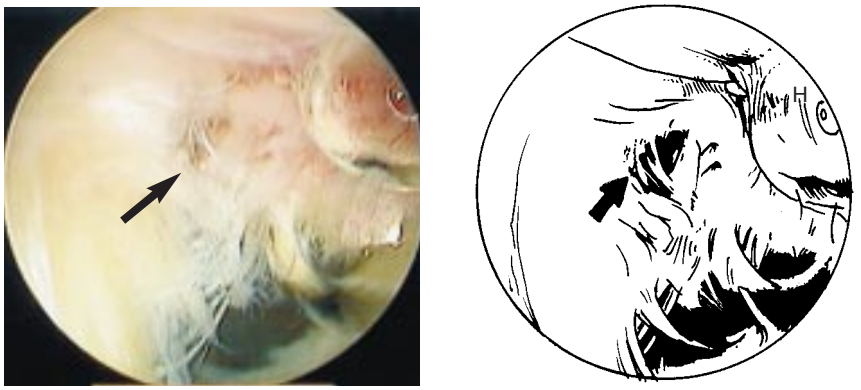

Fig. 1 Arthroscopic image and accompanying line drawing of a partial-thickness rotator cuff tear (arrow) viewed from the articular surface (glenohumeral joint). H = humeral head.

Fig. 2 Coronal T2-weighted spin-echo MR image demonstrating a full-thickness rotator cuff tear (arrow).

nosing complete tears in patients who have false-negative imaging studies. False-negative results occur most frequently with arthrography, particularly if the synovial lining remains intact, or with MR imaging if the tear is smaller than 1 cm.

It is difficult for surgeons to determine whether a large, retracted rotator cuff tear is reparable. This is as true for arthroscopic technique as it is for conventional open technique. If the tendon is mobile and can be advanced to its anatomic location, the tear is reparable. However, if the tendon does not meet these criteria, it is not necessarily irreparable. Subacromial, subdeltoid, and intra-articular adhesions may limit cuff excursion. The ability to release these adhesions and determine definitively whether the tear can be repaired is, for most surgeons, better in an open procedure than in an arthroscopic setting.

Findings

Most authors include an examination of the glenohumeral joint before an arthroscopic subacromial decompression to examine for any unsuspected lesion or to determine the status of the intra-articular structures. This clearly is an advantage to the arthroscopic approach. The knowledge gained may alter the postoperative management and may serve to explain why some patients do better than others. "Impingement syndrome" is a clinical diagnosis and is therefore somewhat imprecise. The increased knowledge gained by arthroscopic joint examination will likely serve to further subdivide and clarify this syndrome and allow more effective treatment.

The subacromial findings in stage 2 impingement are variable. The space may be clear, or a dense fibrous reaction may exist. The dense fibrous tissue is reactive bursitis. Impingement syndrome may exist even in the presence of a clear, well-defined subacromial space. In some individuals, the contact between the rotator cuff and the acromion produces pain but does not incite an inflammatory bursitis reaction. Tendon erosion, fraying, or partial-thickness tears may be found on the superior or bursal surface of the cuff.

Erosions on the acromial undersurface near the anterior edge are frequently noted, as are small areas of inflammation. Interestingly, the literature does not document consistent abnormalities of the coracoacromial ligament. While these findings are suggestive of subacromial impingement, they are not necessarily diagnostic.

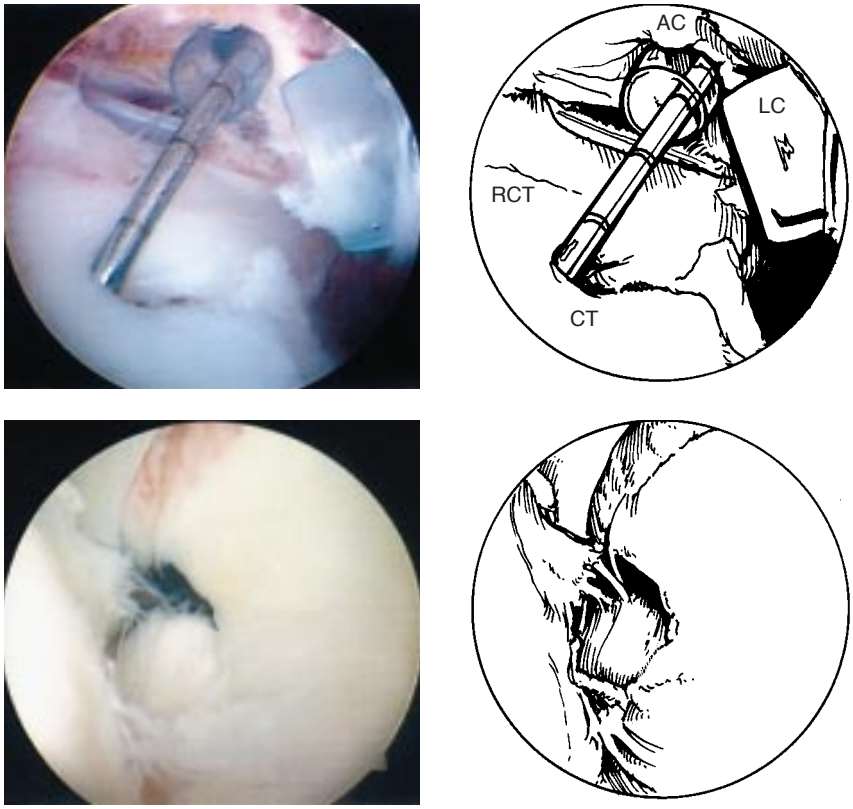

Fig. 3 Arthroscopic images and accompanying line drawings of full-thickness rotator cuff tears viewed from the subacromial space **(top)** and from the glenohumeral joint **(bottom)**. AC = anterior capsule; CT = cuff tear; LC = lateral cannula; RCT = rotator cuff tendon.

The diagnosis of subacromial impingement is made clinically on the basis of the history and the findings from the physical examination, impingement testing, and imaging studies.

The clinical findings in patients with partial tears are related both to delineation of the tear and to the characteristics of other areas of the joint. Most tears are located on the articular surface; approximately 75% are in the supraspinatus, 20% in the infraspinatus, and 5% in the teres minor.[19] The depth or severity is grade 1 (less than one fourth of the tendon thickness) in 45% of cases, grade 2 (less than one half of tendon thickness) in 40%, and grade 3 (more than one half of tendon thickness) in 15%.[19] The finding of chondral defects in the humeral head or glenoid, labrum tears, or separations is suggestive of glenohumeral instability and should prompt the surgeon to consider whether the partial rotator cuff tear is coexistent with other clinical diagnoses.

The intra-articular lesions in patients with complete tears found during open rotator cuff repair are poorly documented, precluding adequate comparison with the arthroscopic findings. Most arthroscopic studies report abnormalities that may include areas of synovitis, partial biceps-tendon tears, arthritic changes in the humeral head or glenoid, labrum tears, and loose bodies.[24] More complete documentation of glenohumeral findings may promote better understanding of the postoperative performance of patients and further delineate the category "rotator cuff tear." It is uncertain whether these changes are brought about by the cuff tear or merely accompany the cuff tear and occur as a natural consequence of aging.

As irreparable tears generally occur in older patients, the arthroscopic findings include arthritic changes, synovitis, and biceps tendon tears. Not surprisingly, these findings occur with a higher frequency than is noted in patients with partial or complete rotator cuff tears.

Treatment

Arthroscopic treatment of stage 2 impingement involves examination under anesthesia to document range of motion and instability, followed by an inspection of the glenohumeral joint and treatment, if indicated, of any coexisting intra-articular lesions. Subacromial treatment includes excision of the pathologic bursa to (1) inspect the surface of the tendons, (2) remove the space-occupying lesion, and (3) remove an inflamed, pain-producing structure. In most cases, treatment of the coracoacromial ligament involves resection from the lateral border to the medial acromial border. Some surgeons prefer to divide, rather than resect, the ligament.

An inferior acromioplasty is performed, with the goal being to convert the acromion to a flat (type 1) structure (Fig. 4). This may be accomplished with a power burr placed in either the lateral or the posterior portal, depending on the surgeon's preference. Anterior acromial recession is more controversial. This step involves removing the anterior acromial osteophyte or protuberance (i.e., all of the anterior acromion that projects anterior to the anterior border of the acromioclavicular joint). This part of the procedure is performed by some but not by others.

The acromioclavicular joint contributes to the impingement syndrome by two mechanisms: formation of inferior acromioclavicular joint osteophytes and acromioclavicular joint arthritis. Inferior osteophytes may project downward into the rotator cuff tendons and cause or exacerbate impingement. Determination of the presence of these osteophytes is made radiologically on plain films or an MR imaging study. The osteophytes can be removed arthroscopically.

Acromioclavicular joint arthritis may also coexist with subacromial impingement. If the patient is symptomatic from acromioclavicular joint arthritis as determined on the preoperative clinical examination, acromioclavicular joint resection is performed. Acromioclavicular resection may be performed through the subacromial approach, although some surgeons prefer a direct approach into the acromioclavicular joint itself.

Three factors must be considered in the arthroscopic management of partial-thickness rotator cuff tears: (1) size and depth of the tear, (2) patient activity level, and (3) bone structure. No one factor

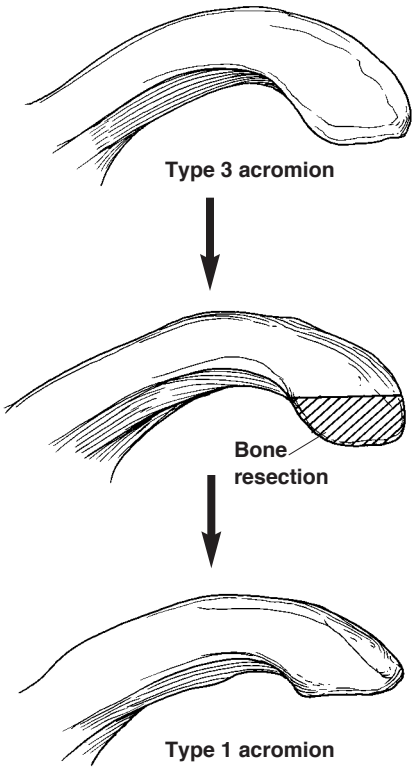

Fig. 4 Steps in inferior acromioplasty.

solely determines treatment; it is the clinician's ability to analyze the effects of all the factors involved that leads to appropriate management.

The most critical determination that must be made is whether the tear can be treated by arthroscopic decompression alone or whether the decompression must be accompanied by tendon repair. There is no general agreement on how the area of the tear should influence the surgeon. There is some agreement on the role of tendon depth, with most authors recommending repair if 50% or more of the tendon substance is involved. Sedentary patients with partial tears are more likely to do well with decompression alone; active patients are more likely to benefit from tendon repair. Patients with structural bone abnormalities (e.g., hooked acromion, inferior acromioclavicular joint osteophytes, anterior acromial spurs) are more likely to benefit from decompression. However, patients with partial tears and no extrinsic structural bone abnormalities are more likely to benefit from repair if the lesion is more than 50% of the tendon thickness and from debridement alone if the lesion is less than 50% of the tendon thickness.

These factors are then considered in light of patient preference. Some patients will prefer an open approach if it can more reliably effect a cure; others may chose arthroscopic surgery because that approach offers fewer lifestyle inconveniences. At each end of the decision-making spectrum, treatment is less controversial. Active individuals with normal bone shape and tears involving more than 50% of the tendon thickness are best treated with surgical repair. Sedentary patients with a hooked acromion and tears involving less than 50% of the tendon thickness can be treated successfully with arthroscopic decompression alone. It is in the middle area that treatment is less well defined; surgeon experience and patient preference, rather than scientific data, appear to dictate treatment.

There are three options for arthroscopic management of complete rotator cuff tears: (1) arthroscopic decompression without repair, (2) arthroscopic decompression and mini-open repair, and (3) arthroscopic decompression and repair of the torn tendon with the use of arthroscopic techniques alone. The surgeon may elect to perform an arthroscopic subacromial decompression without any attempt to repair the torn tendon. Debridement of tendon flap tears, synovectomy, and leveling of a prominent greater tuberosity may accompany this procedure. A second option is to perform the arthroscopic decompression and then make a small lateral incision and repair the tendon tear with conventional open technique; the advantage is that the incision is smaller and deltoid detachment is not needed, as the acromioplasty is performed arthroscopically. The third option is to perform the decompression and tendon repair entirely with the use of arthroscopic techniques.

Arthroscopic technique allows intra-articular inspection and loose-body removal, synovectomy, labrum debridement, and repair of partial biceps lesions if necessary. The advantages of decreased pain from smaller incisions and improved cosmesis are important to patients.

The greatest difficulty with arthroscopic treatment of the seemingly irreparable cuff tear is the possibility of misdiagnosis. Often a massive cuff tear is retracted and appears irreparable, but after release of adhesions on both its bursal and articular surfaces, the defect is reparable. In many instances, arthroscopic inspection will lead to an inaccurate assessment of irreparability. Magnetic resonance imaging, which some surgeons do not use routinely in the older patient, is often of great value in this clinical setting. The amount of tendon retraction is more clearly defined than on arthrography and, perhaps more important, the degree of atrophy in the rotator cuff muscles can be appreciated. If a patient has grade 3 rotator cuff strength or less and the MR study demonstrates retraction of the tendon to the glenoid rim with severe muscular atrophy, the cuff defect is almost certainly irreparable. The arthroscopic approach is then the technique of choice, as it combines the thorough decompression afforded by open debridement with the advantages of arthroscopic surgery.

The technique of subacromial decompression is altered if the tendons are irreparable. As Nirschl[25] and Flatow et al[26] have reported, removal of the coracoacromial arch in patients without any functioning rotator cuff can result in the devastating complication of superomedial humeral head dislocation. The coracoacromial ligament is not resected, and a minimal acromioplasty is performed. The goal is to shape or sculpt the acromion, rather than flattening its inferior surface. Interposed soft-tissue fragments of tendon are removed. If the greater tuberosity is prominent, it can be contoured and smoothed.

Comparison of Open and Arthroscopic Approaches

Arthroscopy appears to have certain theoretical advantages over conventional open surgery. The skin incisions are smaller, and the cosmetic result is better. The procedure can be performed on an outpatient basis, which is more convenient for the patient and less expensive for the third-party payer. Most patients can perform activi-

ties of daily living and return to a sedentary job within days. Since the deltoid is not detached from the acromion, active range-of-motion exercises can be started as soon as tolerated.

Perhaps more important is the fact that the glenohumeral joint can be inspected. Although clinically important intra-articular lesions are not common, glenohumeral instability, labrum tears, partial-thickness articular-surface rotator cuff tears, biceps lesions, and arthritic changes in the glenoid and/or humeral head can be identified. These might well be overlooked with a conventional open approach; their accurate diagnosis and eventual treatment can clearly be of benefit in achieving the most optimal functional result for the patient.

Arthroscopic subacromial decompression can be a difficult skill for many individuals to master, and it is certainly harder to teach than open acromioplasty. Better hand-eye coordination is required. The ability to triangulate and manipulate power instruments within millimeters of each other can be challenging.

The cost difference between outpatient arthroscopic surgery and inpatient open procedures may not be as great as perceived by patients, surgeons, and insurance carriers. Certainly the cost of a hospital stay is avoided with arthroscopic surgery, but this is at least partially offset by the increased cost of the arthroscopic setup. The price of disposable instruments, tubing, and saline is an important consideration. The operating room, recovery room, surgeon's, and anesthesiologist's fees constitute the largest portion of the hospital cost. These charges are similar for both arthroscopic and open acromioplasty.

It would seem logical that the arthroscopic approach allows patients to more rapidly return to a job that does not require heavy labor. This should have a substantial impact in cost analyses that take into account days lost from work; however, studies that systematically address that issue have not been performed. Furthermore, it appears that even in this area, the differences are slight. Many patients do not have manual-labor jobs and can return to work when pain is adequately controlled. The ability to return to work seems to be less heavily influenced by the lesions found at the time of surgery; more important are social, emotional, and economic concerns, which are not influenced by the surgical technique.

Deltoid management differs between the open and arthroscopic approaches. The open approach requires a small amount of deltoid detachment and reattachment, and the deltoid must be protected and allowed to heal in order to avoid the debilitating complication of deltoid dehiscence. In contrast, the arthroscopic technique allows immediate active motion. Advocates of open techniques state that very little deltoid removal from the acromion is required and that reliable techniques exist for the secure reattachment of the deltoid. Advocates of the arthroscopic approach argue that deltoid detachment is avoided with the arthroscopic approach; however, the arthroscopic technique also has the potential for deltoid injury. The deltoid fascial origin can be disrupted if an overly aggressive anterior or anterolateral acromioplasty is performed.

The rehabilitation programs after arthroscopic and open repair of the rotator cuff are identical, with most authors recommending 6 weeks of passive motion while the tendon-bone junction is uniting, followed by a similar period of time for active motion. Strengthening of the repaired tendon may begin about 3 months after surgery. Arthroscopic treatment cannot overcome the principles of tendon biology. Postoperative management after decompression for stage 2 impingement and irreparable tears progresses more rapidly after arthroscopic surgery because active motion can be started immediately without fear of deltoid detachment.

Current Status

In cases of stage 2 impingement, arthroscopic and open techniques produce equivalent results. Therefore, the selection of the appropriate technique depends on surgeon and patient preference.

In patients with partial tears, arthroscopy appears to offer the advantages of open technique in allowing the surgeon to evaluate the size, location, and depth of the tear. The decision to perform debridement, debridement and decompression, or debridement, decompression, and repair should be based on tear depth, patient activity level, and the existence of correctable structural bone abnormalities. There is no evidence to document the superiority of the open, arthroscopic, or combined technique.

The current data support tendon repair over arthroscopic debridement alone as the treatment of choice for complete tears. The results of mini-open repair after arthroscopic debridement are promising. Total arthroscopic management of the complete rotator cuff tear is currently in a state of rapid development, and it is difficult to draw firm conclusions. It has not yet been established whether arthroscopic decompression and tendon repair is a successful procedure with long-lasting results, and whether the technical complexity of the procedure limits its usefulness. Further clinical

investigation should be directed at critically analyzing the efficacy of the various treatment options. Currently, surgeons treat a patient with a full-thickness tear on the basis of their personal experience with open and arthroscopic techniques.

For irreparable tears, arthroscopic debridement appears to combine the completeness of open debridement with the advantages of arthroscopic treatment. However, further documentation is needed.

Summary

The best treatment for rotator cuff disease continues to be controversial. Rotator cuff disease and its management are only partially understood, and decisions are currently made on the basis of the individual surgeon's clinical experience rather than firm scientific data and experiential analysis.

Central to this debate on the best treatment for rotator cuff disease is the lack of prospective, controlled clinical studies that clearly define the patient population, surgical technique, and evaluation method. Patient outcome studies are vital. Until these are performed, the orthopaedic surgeon must base treatment decisions on personal experience and suggestions from the literature.

References

1. Altchek DW, Warren RF, Wickiewicz TL, Skyhar MJ, Ortiz G, Schwartz E: Arthroscopic acromioplasty: Technique and results. *J Bone Joint Surg Am* 1990;72:1198-1207.
2. Ellman H: Arthroscopic subacromial decompression: Analysis of one- to three-year results. *Arthroscopy* 1987;3: 173-181.
3. Gartsman GM: Arthroscopic acromioplasty for lesions of the rotator cuff. *J Bone Joint Surg Am* 1990;72:169-180.
4. Ryu RK: Arthroscopic subacromial decompression: A clinical review. *Arthroscopy* 1992;8:141-147.
5. Lazarus MD, Chansky HA, Misra S, Williams GR, Iannotti JP: Comparison of open and arthroscopic subacromial decompression. *J Shoulder Elbow Surg* 1994;3:1-11.
6. Norlin R: Arthroscopic subacromial decompression versus open acromioplasty. *Arthroscopy* 1989;5:321-323.
7. Van Holsbeeck E, DeRycke J, Declercq G, Martens M, Verstreken J, Fabry G: Subacromial impingement: Open versus arthroscopic decompression. *Arthroscopy* 1992;8:173-178.
8. Andrews JR, Broussard TS, Carson WG: Arthroscopy of the shoulder in the management of partial tears of the rotator cuff: A preliminary report. *Arthroscopy* 1985;1:117-122.
9. Snyder SJ, Pachelli AF, Del Pizzo W, Friedman MJ, Ferkel RD, Pattee G: Partial thickness rotator cuff tears: Results of arthroscopic treatment. *Arthroscopy* 1991;7:1-7.
10. Esch JC, Ozerkis LR, Helgager JA, Kane N, Lilliott N: Arthroscopic subacromial decompression: Results according to the degree of rotator cuff tear. *Arthroscopy* 1988;4:241-249.
11. Levy HJ, Gardner RD, Lemak LJ: Arthroscopic subacromial decompression in the treatment of full-thickness rotator cuff tears. *Arthroscopy* 1991;7:8-13.
12. Montgomery TJ, Yerger B, Savoie FH III: Management of rotator cuff tears: A comparison of arthroscopic debridement and surgical repair. *J Shoulder Elbow Surg* 1994;3:70-78.
13. Burkhart SS, Nottage WM, Ogilvie-Harris DJ, Kohn HS, Pachelli A: Partial repair of irreparable rotator cuff tears. *Arthroscopy* 1994;10:363-370.
14. Levy HJ, Uribe JW, Delaney LG: Arthroscopic assisted rotator cuff repair: Preliminary results. *Arthroscopy* 1990; 6:55-60.
15. Liu SH, Baker CL: Arthroscopically assisted rotator cuff repair: Correlation of functional results with integrity of the cuff. *Arthroscopy* 1994;10:54-60.
16. Paulos LE, Kody MH: Arthroscopically enhanced "miniapproach" to rotator cuff repair. *Am J Sports Med* 1994;22:19-25.
17. Snyder SJ, Bachner EJ: Arthroscopic fixation of rotator cuff tears with miniature screw anchors and permanent mattress sutures: A preliminary report. Presented at the American Shoulder and Elbow Surgeons Annual Meeting, Williamsburg, Va, October 30, 1993.
18. Gartsman GM, Brinker MR, Khan M: Early effectiveness of arthroscopic repair for full-thickness tears of the rotator cuff: An outcome analsis. *J Bone Joint Surg Am* 1998;80:33-40.
19. Ellman H, Gartsman GM: *Arthroscopic Shoulder Surgery and Related Procedures*. Philadelphia: Lea & Febiger, 1993, pp 203-218.
20. Neer CS II: Impingement lesions. *Clin Orthop* 1983;173:70-77.
21. Hawkins RJ, Abrams JS: Impingement syndrome in the absence of rotator cuff tear (stages 1 and 2). *Orthop Clin North Am* 1987;18:373-382.
22. Gartsman GM, Milne JC: Articular surface partial-thickness rotator cuff tears. *J Shoulder Elbow Surg* 1995;4: 409-415.
23. Gartsman GM: Arthroscopic assessment of rotator cuff tear reparability. *Arthroscopy* 1996;12:546-549.
24. Gartsman GM, Taverna E: The incidence of glenohumeral joint abnormalities associated with full-thickness, reparable rotator cuff tears. *Arthroscopy* 1997:13:450-455.
25. Nirschl R: Rotator cuff surgery. *Instr Course Lect* 1989;38:447-462.
26. Flatow EL, Connor PM, Levine WN, Arroyo JS, Pollock RG, Bigliani LU: Coracoacromial arch reconstruction for anterosuperior subluxation after failed rotator cuff surgery: A preliminary report. Presented at the 13th Annual Meeting of the American Shoulder and Elbow Surgeons, Amelia Island, Fla, October 20, 1996.