Original Article With Video Illustration

Anterior Internal Impingement: An Arthroscopic Observation

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Purpose: The source of pain in patients with a stable shoulder and clinical signs of impingement is traditionally thought to be subacromial or outlet impingement, as popularized by Neer. This report introduces the concept of anterior internal impingement in patients with signs and symptoms of classic impingement syndrome and arthroscopic evidence of articular-side partial rotator cuff tear. Contact that occurs between the fragmented undersurface of the rotator cuff and the anterosuperior labrum is the apparent source of pain in these patients. **Type of Study:** Case series. **Methods:** Ten patients with a primary symptom of pain and an arthroscopic finding of a partial rotator cuff tear were reviewed. Arthroscopic visualization of the subacromial space revealed no evidence of subacromial impingement or bursitis in any patient. All patients had clinical signs and symptoms of classic impingement. The initial part of the surgical procedure consisted of a complete diagnostic arthroscopy in a low-volume gas medium using a single posterior portal. While performing the Hawkins test, the locations of any areas of abnormal soft-tissue contact and impingement were observed directly. **Results:** There was anterior internal impingement in all 10 patients with partial-thickness rotator cuff tears. The abnormal and fragmented rotator cuff tissue made contact with the anterior superior labrum when the shoulder was visualized from the posterior portal while performing the Hawkins test. Preoperative magnetic resonance imaging correctly showed a partial-thickness rotator cuff tear in 20% of the cases. **Conclusions:** Recognition of anterior internal impingement as a clinical entity is important because magnetic resonance imaging results are often misleading. This is of particular importance in young patients with isolated lesions in whom arthroscopic acromioplasty and capsular reefing procedures would be unnecessary. When anterior internal impingement is recognized as the source of unresolved shoulder pain, patient selection for surgery and procedure selection can be improved. **Key Words:** Impingement syndrome—Internal impingement—Rotator cuff tear—Acromioplasty—Shoulder—Gas arthroscopy.

Classic shoulder impingement as described by Neer[1] is caused by extrinsic compression of the subacromial bursa and rotator cuff by the coracoacromial arch structures. It is a progressive attritional process that can lead to rotator cuff tear and retraction. It presents most commonly in middle-aged, nonathletic individuals. Surgical decompression is the procedure of choice in refractory cases.

More recently, the phenomenon of internal impingement has been described as a clinical entity in younger athletes with unexplained shoulder pain.[2-5] These patients are usually throwing athletes and present with refractory posterior shoulder pain. Arthroscopic findings include fraying of the posterior aspect of the supraspinatus and posterior labrum. This posterior internal impingement occurs when the arm is in abduction and is maximally externally rotated. In this position, many authors have observed a "kissing" contact between the insertion of the posterior rotator cuff and posterior glenoid labrum. Pain is believed to

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0749-8063/02/1801-2779$35.00/0

doi:10.1053/jars.2002.29868

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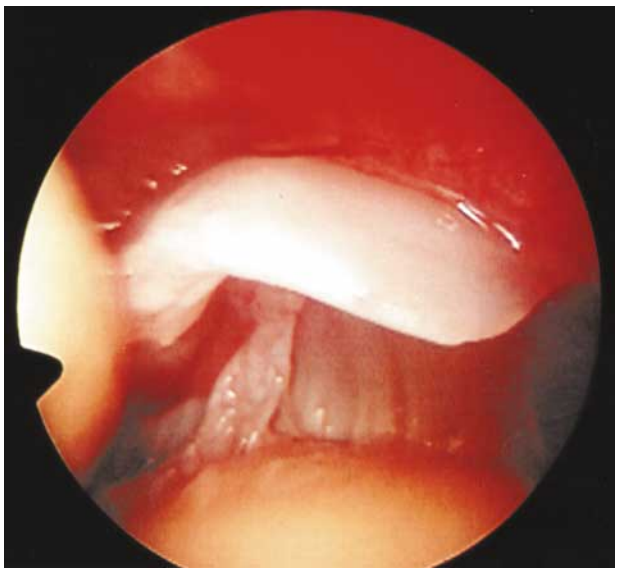

FIGURE 1. Partial-thickness rotator cuff tear as seen from the posterior portal in a right shoulder.

be the result of the 2 abnormal surfaces being crushed together while the arm is in the pathologic position. Most believe that occult instability is an important component of this entity.[3,5,6]

This report describes a variation of internal impingement entirely separate from that of athletic patients with posterior internal impingement. Patients in this group are from the general population, are younger than typical impingement patients, and are not elite throwing athletes. They present with normal stability and classic signs of subacromial impingement. The consistent arthroscopic finding in this group of patients is an undersurface partial rotator cuff tear (Figs 1-3). Internal impingement is observed between the fragmented rotator cuff and the superior labrum, just anterior to the biceps anchor (Figs 4 and 5). Resultant fragmentation and fraying of superior labral tissue as a result of this impingement can also be seen (Fig 6). This can be visualized arthroscopically from the posterior portal in a low-volume gas medium while performing the Hawkins maneuver (Videos 1 and 2).

PATIENTS AND METHODS

Ten patients who had clinical signs of classic impingement and who had an arthroscopically confirmed undersurface rotator cuff tear in association with a normal subacromial space are reported herein. Table 1 summarizes the clinical information on all 10 cases.

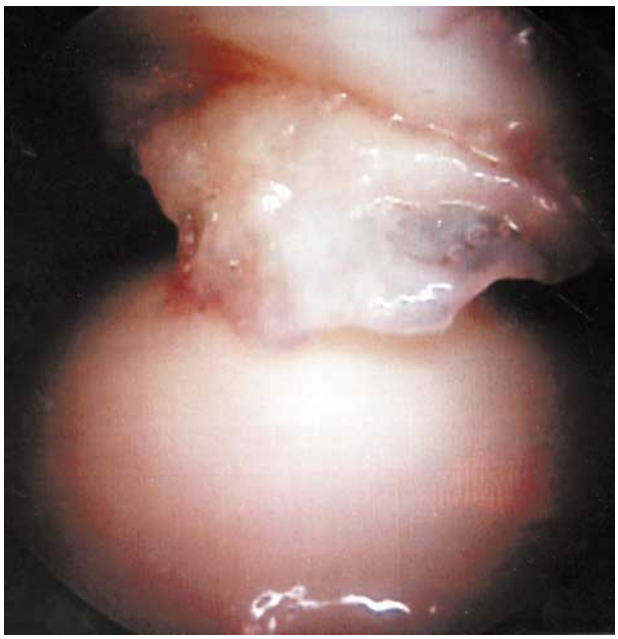

FIGURE 2. Partial-thickness rotator cuff tear in a right shoulder viewed from the posterior portal.

These cases were identified from a consecutive series of 127 shoulder arthroscopies performed by a single surgeon over a 2-year period. Arthroscopic surgery was carried out using either interscalene regional block or general anesthesia, and patients were positioned in a semi-sitting position on a beanbag. The technique for utilizing low-volume gas arthroscopy has been described previously.[7]

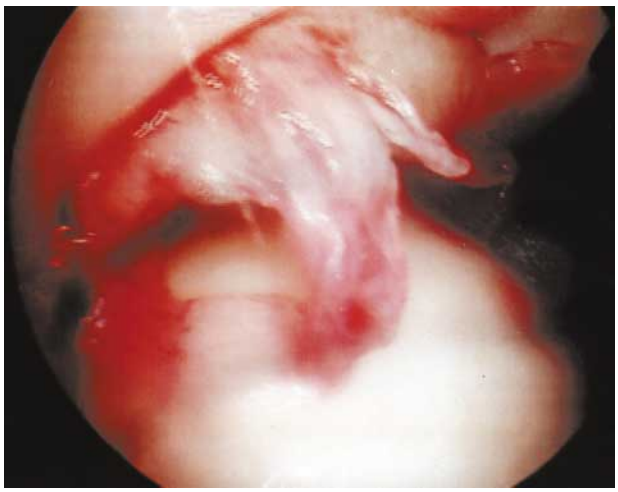

FIGURE 3. Partial-thickness rotator cuff tear in a left shoulder viewed from the posterior portal.

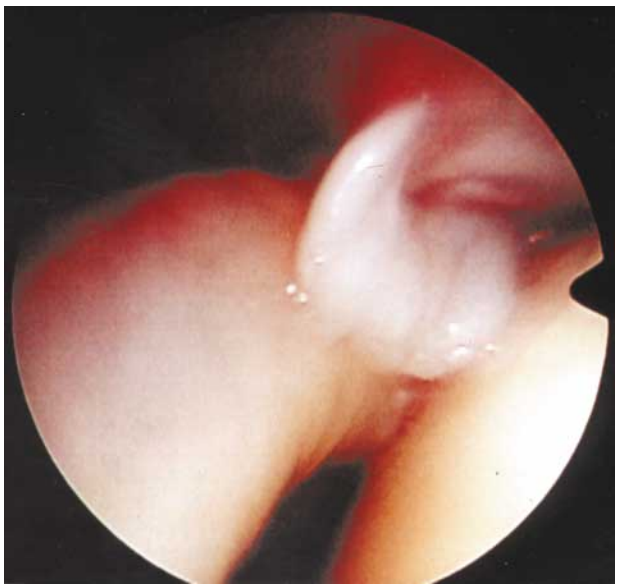

FIGURE 4. Same view as in Fig 1 with the arm now forward flexed and internally rotated. The partial rotator cuff tear is now seen impinging between the humeral head and superior glenoid labrum.

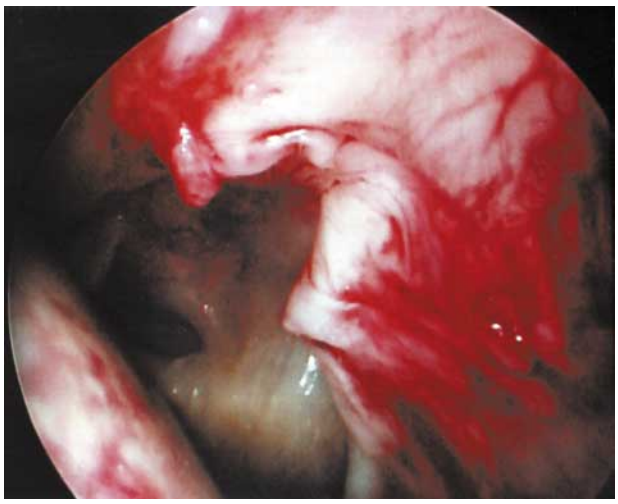

FIGURE 6. Same view as in Fig 3 with emphasis now on the shredded tissue along the glenoid from the 12 o'clock to 3 o'clock position indicating areas of damaged tissue possibly resulting from the shear and compression forces of anterior internal impingement.

Illustrative Case

A 35-year-old man presented with a 6-week history of right shoulder pain. The pain became progressively worse and the patient had pain with forward elevation. Night pain became more prominent. In addition, he experienced painful popping and clicking with overhead use of the arm. He was an avid golfer and was unable to play because of his symptoms.

Clinical evaluation revealed active forward flexion to 100° and passive forward flexion to 150°, associated with pain. The patient had a positive Hawkins test that reproduced his symptoms and he had tenderness over the anterior rotator cuff area. He had no other areas of tenderness and shoulder stability was normal. Magnetic resonance imaging (MRI) was negative for rotator cuff tear.

Arthroscopy revealed a partial-thickness rotator cuff tear involving the supraspinatus tendon (Fig 2). When the Hawkins maneuver was performed under direct vision from the posterior portal in a low-volume gas medium, the torn flap of rotator cuff tissue was caught between the humeral head and the superior labrum, as seen in Fig 5. The area was debrided (Fig 7). When the Hawkins maneuver was repeated, contact was seen between the rotator cuff and superior labrum (Fig 8); however, the area of soft-tissue impingement was now absent. Inspection of the superior labrum in the area of soft-tissue impingement showed a very small area of lifting off of the superior labrum from the underlying labrum (Fig 9). A small area of labral fraying in the anterior glenoid was noted and debrided. One month postoperatively, the patient had full range of motion and was free of pain. He was fully active in golf.

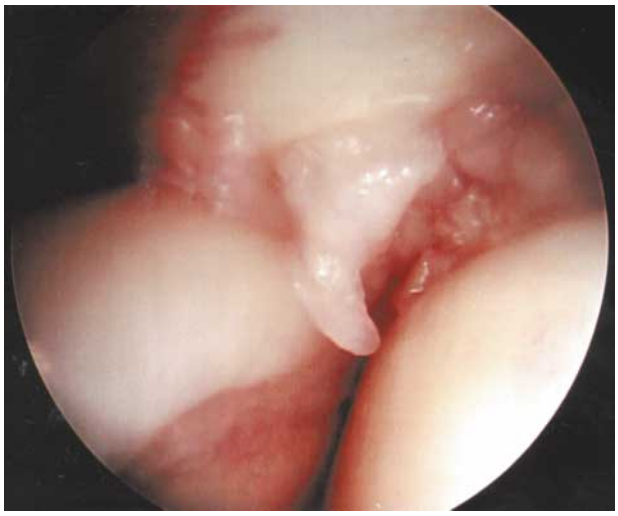

FIGURE 5. Same view as in Fig 2 with the arm now forward flexed and internally rotated. Anterior internal impingement of the partial cuff tear against the superior glenoid is evident.

TABLE 1. *Patient Clinical Information*

Pt No.	Age	Sex	Neer[8]	Hawkins[9]	Duration of Symptoms	MRI	Additional Surgical Findings	Surgical Treatment
1	41	F	+	+	3 mo	—	—	Debridement
2	24	M	+	+	4 mo	—	Partial subscapularis tear	Debridement
3	38	M	+	+	2 yr	—	Labral detachment	Debridement and labral repair
4	45	M	+	+	8 mo	—	Labral fraying Chondral lesion glenoid	Debridement
5	32	M	−	+	2 mo	Partial rotator cuff tear	Labral detachment Partial biceps tear	Debridement and labral repair
6	31	M	+	+	3 mo	—	Partial subscapularis tear	Debridement
7	36	F	+	+	3 mo	—	—	Debridement
8	35	F	+	+	3 mo	Complete rotator cuff tear	Labral fraying	Debridement
9	36	M	+	+	2 mo	—	Labral fraying	Debridement
10	48	F	+	+	4 mo	Partial rotator cuff tear	Labral detachment Capsular laxity	Debridement Labral repair Thermal capsulorrhaphy

RESULTS

Nine of the 10 patients in this series were seen on short-term follow-up (between 3 and 6 months). Six of the 9 patients were pain free and had a full range of motion. Two patients had pain only with extreme activities and 1 patient had little improvement from the surgery. This patient was the only patient in the series who had radiographic evidence of osteoarthritis and was found to have significant chondral damage on both the humeral head and glenoid surfaces at the time of surgery.

DISCUSSION

Jobe et al.[8] have shown the anatomic basis for anterior internal impingement in vitro. By simulating the Neer[9] and Hawkins[10] tests on cadaver shoulders,

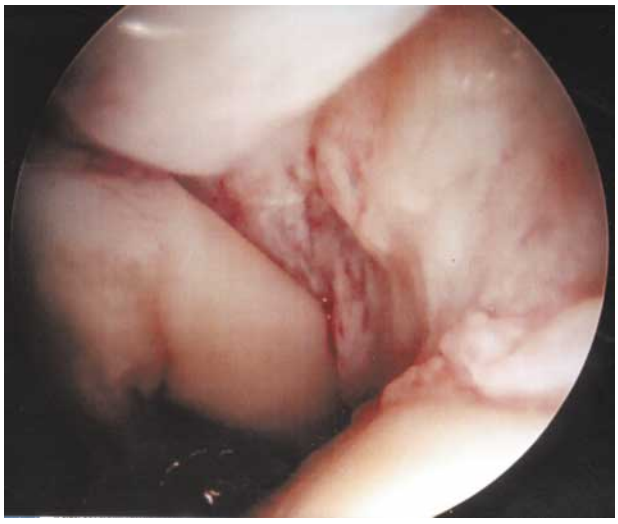

FIGURE 7. Same view as in Figs 2 and 5 after debridement. The arm is forward flexed.

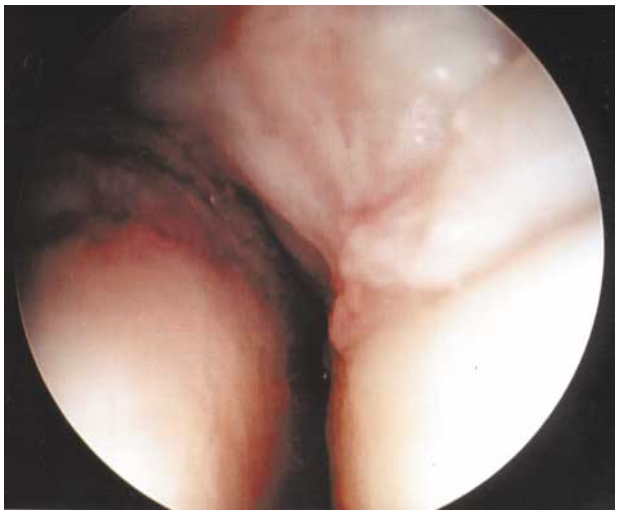

FIGURE 8. Same view as Figs 2 and 5 with the arm now forward flexed and internally rotated. The normal contact that occurs between the rotator cuff and glenoid labrum is seen in this position; however, the anterior internal impingement is now absent.

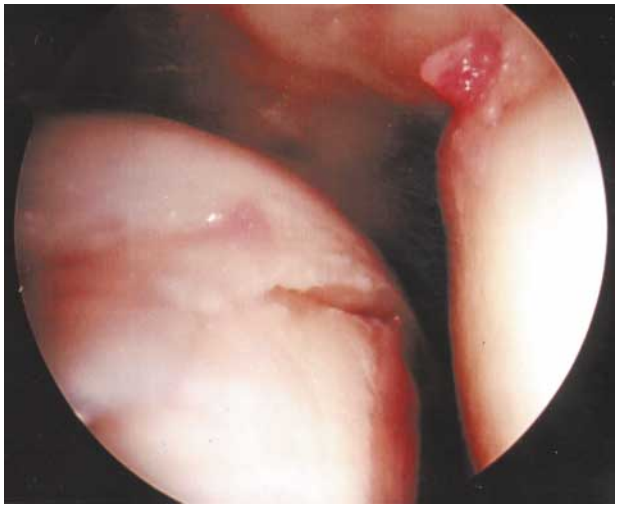

FIGURE 9. Same view as in Figs 2 and 5 with emphasis now on the cleavage between the superior labrum from the glenoid, possibly a result of compression and shear forces.

contact between the rotator cuff insertion and the anterior superior labral area was demonstrated on all specimens.[11] Similar cadaver studies have shown the same anatomic basis for posterior internal impingement when shoulders placed in the abducted externally rotated position were sectioned and photographed.[8,11] For both posterior and anterior internal impingement, the cadaver studies strongly suggest that contact between the rotator cuff and superior glenoid is normal. In posterior internal impingement, MRI studies as well as arthroscopic observations have further supported the notion that contact between the rotator cuff and glenoid labrum is both normal and physiologic.[4,5,12]

The etiology of symptomatic posterior internal impingement has not been established. Glenohumeral instability, attritional wear, and intrinsic fiber failure have all been suggested and implicated, yet remain unproven. Nevertheless, the soft-tissue impingement contact between pathologic rotator cuff tissue and the posterior labrum is currently acknowledged as the source of pain in these patients. Debridement has been shown to eliminate symptoms in these patients.[2,3,5]

To date, there are no clinical reports on anterior internal impingement. In establishing an in-vitro basis for this phenomenon, Jobe suggested that this type of internal impingement might explain the presence of a positive Neer or Hawkins test on clinical examination.[11] Jobe hypothesized that shoulder pain seen in swimmers may be the result of anterior internal impingement because the pain is frequently found at the point of hand entry. In this position, the humeral position is between that of the Neer and the Hawkins test.

Clinical descriptions of the posterior internal impingement phenomenon have always been limited to elite athletes. In many cases, these shoulders are lax or unstable, bringing into question the role of occult instability in the evolution of lesions that create posterior internal impingement pain. However, the patients in this review are from the general population and did not complain of instability. The 1 patient who did have a thermal shrinkage procedure had excessive capsular laxity, but did not complain of instability.

The data from this review indicate that anterior internal impingement is a common clinical problem in patients with shoulder pain. The clinical presentation of patients with anterior internal impingement is often identical to that of patients with subacromial impingement, making preoperative identification impossible. Indeed, many patients with subacromial impingement also have undersurface partial rotator cuff tears. In these cases, it is likely that the cause of impingement pain may be both intra-articular as well as subacromial. Snyder et al.[13] found in their series of 31 patients with partial rotator cuff tears that 18 of the patients also had subacromial impingement. The presence of anterior internal impingement in patients without any signs of subacromial abnormalities, however, is critically important because these patients are difficult to identify clinically. In this review, the average patient age was 37 years, well below the usual age for patients with subacromial impingement. While these patients have signs and symptoms similar to those with subacromial impingement, their relatively young age lowers the index of suspicion for that diagnosis. Impingement based on intra-articular pathology has not previously been considered for these patients. In addition, MRI cannot be relied on to correctly identify many of these patients. In this review, the majority of patients (7 of 10) had a false-negative MRI. The failure of imaging studies (both MRI and arthrography) to diagnose partial rotator cuff tears has been observed by other investigators as well, with a false-negative rate of 42% to 86% reported.[14,15] These are similar to the findings in the present report in which only 20% of patients had a partial rotator cuff tear correctly identified on preoperative MRI. Identifying the undersurface rotator cuff tear as the source of clinical impingement in this particular patient group is important because they may not only fail to improve with prolonged nonsurgical care but their tears may progress to full-thickness during the treatment period.[16] In one study on the progression of partial cuff tears, the authors concluded that in the

majority of cases, partial rotator cuff tears frequently progress to full-thickness tears in the course of 1 year.[16]

Although identifying underlying instability or laxity in younger patients with shoulder pain is often the primary concern, many of these younger patients have neither, underscoring the need for particular vigilance in identifying anterior internal impingement as the possible cause for unresolved shoulder pain. The review by Gartsman and Milne[17] of partial rotator cuff tear divided a total of 106 patients into 3 distinct groups: patients with primary instability, patients with a partial rotator cuff tear coexistent with subacromial impingement, and patients with an isolated partial rotator cuff tear in a stable shoulder. This latter group of 12 patients is similar to the patients in this review in both age range (22 to 51 years) and average age (44 years).

Identifying anterior internal impingement as the source of pain can allow more directed surgical treatment. While some authors have argued that all partial rotator cuff tears should be treated with debridement and acromioplasty,[15,18] others have taken the more selective position of treating only the partial cuff tear and omitting the acromioplasty.[13,14,17,19] By correctly identifying the partial rotator cuff tear as the source of pain and correlating that with the preoperative clinical findings, the surgeon has an objective reason to avoid the added morbidity of acromioplasty in patients who have no evidence of subacromial bursitis or impingement, thereby optimizing treatment and reducing morbidity. This may have greater significance in the throwing athlete where results from procedures that included acromioplasty have been disappointing.[20]

SUMMARY

Contact between the rotator cuff and the superior labrum is physiologic when the shoulder is rotated in the forward flexed position (Video 1). When the rotator cuff is torn in this area, contact becomes abnormal as the fragmented tissue is sheared and compressed between the superior humeral head and glenoid. This phenomenon is easily visualized arthroscopically and causes impingement-type pain (Video 2). Physical examination is similar to that of patients with subacromial impingement. Whereas anterior internal impingement may occur as an isolated pathologic entity, it can also present with subacromial impingement. The diagnosis of an isolated lesion in a young patient with normal shoulder stability can easily be missed because of the high false-negative rate of MRI. When anterior internal impingement is correctly diagnosed, surgical treatment can be streamlined to the removal of the mechanical irritant, avoiding acromioplasty. While partial undersurface rotator cuff tears are a multifactorial problem, anterior internal impingement is a consistent cause of pain in these patients.

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