Arthroscopic Posterior-Inferior Capsular Release in the Treatment of Overhead Athletes

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Abstract

In this article, we present our technique for arthroscopic posterior-inferior capsular release and report the results of applying this technique in a population of athletes with symptomatic glenohumeral internal rotation deficit (GIRD) that was unresponsive to nonoperative treatment and was preventing them from returning to sport.

Fifteen overhead athletes met the inclusion criteria. Two were lost to follow-up. Of the 13 remaining, 6 underwent isolated posterior-inferior capsular releases, and 7 had concomitant procedures. Before and after surgery, patients completed an activity questionnaire, which included the American Shoulder and Elbow Surgeons (ASES) Standardized Shoulder Assessment Form. Passive internal rotation in the scapular plane was measured with a bubble goniometer.

Mean age was 21 years (range, 16-33 years). Mean follow-up was 31.1 months (range, 24-59 months). Mean ASES score improved significantly ($P < .01$) from before surgery (71.5) to after surgery (86.9). Mean GIRD improved from 43.1° to 9.7° ($P < .05$). Three athletes (23%) did not return to their preoperative level of play; the other 10 (77%) returned to their same level of play or a higher level.

Selective arthroscopic posterior-inferior capsular release may be a reasonable solution for overhead athletes with symptomatic GIRD unresponsive to conservative management.

Glenohumeral internal rotation deficit (GIRD) can be observed in overhead athletes and is thought to play a role in generating pain and rotator cuff weakness in the dominant shoulder with sport. It is unclear what is an acceptable value of GIRD in a population of overhead athletes and whether it should be based solely on internal rotation deficit or should include total range of motion (ROM) deficit.[1,2] Acquired GIRD in the athlete's throwing shoulder has been thoroughly documented in the literature as a loss of internal rotation relative to the nonthrowing shoulder, with etiologies including bony adaptations (increased humeral retroversion), muscular tightness, and posterior capsular tightness.[1,3-11] In particular, the repetitive torsional stresses acting on the throwing shoulder of baseball players is thought to produce, over the long term, structural adaptations such as increased humeral retroversion.[5,12-14] Further, for shoulders with posterior-inferior capsular tightness, cadaveric studies have shown increased contact pressure at the coracoacromial arch during simulated follow-through.[15] Athletes of other overhead and throwing sports, such as football, softball, tennis, and volleyball, may show similar adaptations in overhead motion.[9,16,17]

GIRD has been associated with a variety of pathologic conditions, including scapular dyskinesis, internal and secondary impingement, partial articular-sided rotator cuff tears, damage to the biceps–labral complex, and ulnar collateral ligament insufficiency.[10,12,18-22]

Restriction from engaging in exacerbating activities (eg, throwing) and compliance with a specific stretching program reduces or eliminates GIRD in the majority of cases.[1,23-28] In the few cases in which conservative management fails, operative intervention may be indicated.[1,23,29,30] Few investigators have detailed an operative technique for selective arthroscopic capsular release of the posterior-inferior capsule or evaluated the ability of athletes to return to sport after such surgery.

In this article, we present our technique for arthroscopic posterior-inferior capsular release and report the results of applying this technique in a population of athletes with symptomatic GIRD that was unresponsive to nonoperative treatment and was preventing them from returning to sport.

We hypothesized that selective arthroscopic surgical release of the posterior-inferior capsule would improve symptomatic GIRD and result in a return to sport in the majority of cases unresponsive to nonoperative treatment.

Materials and Methods

Patients

After obtaining institutional review board approval, we retrospectively reviewed patient charts and collected data. Study

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inclusion criteria were arthroscopic selective posterior-inferior capsular release between 2004 and 2008; failure to resume sport after minimum 3 months of physical therapy, including use of sleeper stretch, active joint mobilization by licensed physical therapist, and sport-specific restriction from exacerbating activities (eg, throwing for baseball players); and active participation in overhead sport.[1,27] Exclusion criteria were generalized adhesive capsulitis, labral pathology producing glenohumeral joint instability (Bankart or reverse Bankart lesion), high-grade or full-thickness tearing of rotator cuff, and clinically significant partial-thickness tearing or instability of long head of biceps tendon.

Assessment

One of 3 authors (Dr. Buss, Dr. Codding, or Dr. Dahm) used a bubble goniometer to measure passive internal rotation. Patients were positioned supine with 90° of thoracohumeral abduction and 90° of elbow flexion. The examiner's hand stabilized the scapula against the examination table, in accordance with published techniques.[1,26] Active internal rotation was measured at 0° of thoracohumeral abduction by noting the most superior spinal segment reached. Before and after surgery, passive internal rotation measurements were taken on both arms. GIRD was determined by the difference between dominant and nondominant arm measurements; segmental differences were obtained by subtracting segments achieved between the dominant and nondominant arms.

Before surgery and at minimum 2-year follow-up after surgery, patients completed a subjective questionnaire, which included the American Shoulder and Elbow Surgeons (ASES) Standardized Shoulder Assessment Form, for assessment of both arms. ASES scores are reliable, valid, and responsive in evaluating shoulder pain and function.[15,31] Patients also answered questions about their ability to return to play, their level of play after surgery, and whether they would undergo the procedure again.

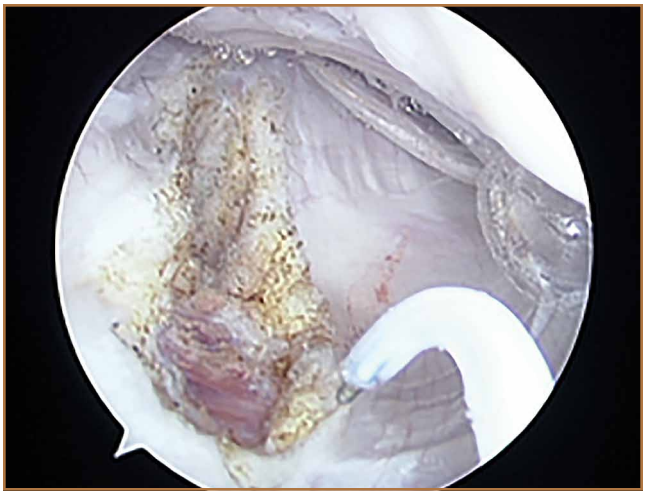

Figure. Intraoperative arthroscopic image of posterior-inferior capsular release.

Surgical Technique

After induction of general anesthesia and standard preparation and draping, the patient is placed in a standard beach-chair position and examined. Diagnostic arthroscopy is then performed. In all patients, intra-articular evaluation revealed a thickened, contracted posterior band of the inferior glenohumeral ligament. This finding is consistent with other studies of patients with significant GIRD.[1,14,22,30]

On completion of the diagnostic portion of the arthroscopy, attention is turned to the selective posterior-inferior capsular release. Key to proper execution of the release is establishing a posterior-inferior accessory portal. This is accomplished while viewing from a standard posterior ("soft spot") portal and determining the appropriate location and angle of entry by spinal needle localization. Typically, an entry point is selected about 4 cm distal and 1 cm lateral to the standard posterior portal. An 18-gauge spinal needle introduced at this location is angled about 15° superiorly and about 20° medially. Once the appropriate vector is determined, a skin incision is made, and a Wissinger rod is introduced, over which a small-diameter cannula is passed. A hooked-tip electrocautery device is used to divide the posterior capsule from the glenoid labrum between the 8- and 6-o'clock positions in the right shoulder (**Figure**). Care is taken to perform the release immediately adjacent to the glenoid labrum and using short bursts of cautery in order to minimize risk of injury to the teres minor branch of the axillary nerve. Adequate release is confirmed by reassessing passive internal rotation under anesthesia. Additional procedures are performed, if necessary, after completion of the capsular release.

Postoperative rehabilitation consists initially of pendulum exercises and scapular retraction starting on postoperative day 1. Once the swelling from the surgical procedure subsides, typically within 1 week, passive and active-assisted ROM and gentle posterior capsular mobilization are initiated under the direction of a licensed physical therapist. Active ROM is allowed once the patient regains normal scapulothoracic rhythm. Strengthening consists initially of isometrics followed by light resistance strengthening for the rotator cuff and scapular stabilizers once active ROM and scapulothoracic rhythm return to normal. Passive internal rotation stretching, including use of the sleeper stretch, is implemented as soon as tolerated and continues throughout the rehabilitation process.[32]

Statistical Analysis

Statistical analysis was performed with Stata Release 11 (StataCorp, College Station, Texas). Paired *t* tests were used to assess preoperative and postoperative mean differences in ASES scores, in passive glenohumeral internal rotation, and in active glenohumeral internal rotation; independent-samples *t* tests were used to assess side-to-side differences. Significance was set at $P < .05$.

Results

Fifteen overhead athletes met the study inclusion criteria. Two were lost to follow-up. Of the remaining 13 patients, 6 under-

went isolated arthroscopic posterior-inferior capsular release, and 7 had concomitant procedures (6 subacromial decompressions, 1 superior labrum anterior-posterior [SLAP] repair). There were 11 male athletes and 2 female athletes. Twelve of the 13 patients were right-hand–dominant. Mean age at time of surgery was 21 years (range, 16-33 years). There were 10 baseball players (6 pitchers, 4 position players); the other 3 patients played softball (1), volleyball (1), or tennis (1). Six patients played at high school level, 5 at college level, 1 at professional level, and 1 at amateur level. All 13 patients underwent a minimum of 3 months of comprehensive rehabilitation, which included use of the sleeper stretch, active joint mobilization by a licensed physical therapist, and sport-specific restriction from exacerbating activities. Mean duration of symptoms before surgery was 18 months (range, 4-48 months). Mean postoperative follow-up was 31 months (range, 24-59 months). Mean ASES score was 71.5 (range, 33-95) before surgery and 86.9 (range, 60-100) after surgery ($P < .001$). Mean GIRD improved from 43.1° (range, 30°-60°) before surgery to 9.7° (range, −7° to 40°) after surgery ($P < .001$). Mean active internal rotation difference improved from 3.8 vertebral segments before surgery to 2.6 vertebral segments after surgery; this difference was not statistically significant ($P = .459$). Ten (77%) of the 13 patients returned to their preoperative level of play or a higher level; the other 3 (23%) did not return to their preoperative level of play but continued to compete in a different position (**Table**). Eleven patients (85%) stated they would repeat the procedure. One of the 2 patients who would not repeat the procedure was in the isolated posterior-inferior capsular release group; the other was in the concomitant-procedure group (subacromial decompression). Total glenohumeral ROM of dominant arm was 122° before surgery and 136° after surgery ($P = .04$). There was no significant difference in total ROM between dominant and nondominant arms after surgery (136° and 141°; $P = .12$), but the preoperative difference was significant (122° vs 141°; $P = .022$).

Discussion

GIRD has been associated with various pathologic conditions of the upper extremity. In 1991, Verna[28] found that a majority of 39 professional baseball pitchers with significant GIRD had shoulder problems that affected playing time. More recently, GIRD has been associated with a progression of injuries, including scapular dyskinesia, internal and secondary impingement, articular-sided partial rotator cuff tears, rotator cuff weakness, damage to the biceps–labral complex, and ulnar collateral ligament insufficiency.[12,18-22] In a cadaveric study of humeral head translation, Harryman and colleagues[33] noted an anterosuperior migration of the humeral head during flexion and concluded it resulted from a loose anterior and tight posterior glenohumeral capsule, leading to loss of glenohumeral internal rotation. More recently, posterosuperior migration of the humeral head has been postulated, with GIRD secondary to an essential posterior capsular contracture.[1] Tyler and colleagues[34] clinically linked posterior capsular tightness with GIRD, and both cadaveric and magnetic resonance imaging studies have supported the finding that posterior capsular contracture leads to posterosuperior humeral head migration in association with GIRD.[14,20] Such a disruption in normal glenohumeral joint mechanics could produce phenomena of internal or secondary acromiohumeral impingement and pain.

More recently, in a large cohort of professional baseball pitchers, a significant correlation was found between the incidence of rotator cuff strength deficits and GIRD.[35] More than 40% of the pitchers with GIRD of at least 35° had a measureable rotator cuff strength deficit in the throwing shoulder.

Burkhart and colleagues[23] concluded that the shoulder most at risk for developing "dead arm" has GIRD and an advanced form of scapular dyskinesia known as SICK scapula (the phenomenon involves Scapula malposition, Inferior medial border prominence, Coracoid pain and malposition, and dysKinesis of scapular movement).

Most athletes with symptoms attributed to GIRD respond to conservative management. A posterior-inferior capsular stretching program focused on regaining internal rotation in the throwing arm has been shown to return about 90% of athletes to play.[1] Numerous studies have indicated that enrollment in a compliant stretching program reduces GIRD.[1,23-27] However, nonoperative treatment fails in a reported 10% of patients with GIRD; these patients may respond to operative treatment.[1]

More specifically, for patients who do not respond to conservative treatment, a posterior-inferior capsular release may be

Table. Level of Play, Sport, Position, and Return to Sport for Athletes Before and After Surgery

Before Surgery			After Surgery		
Level of Play	Sport	Position	Return to Sport	Level of Play	Position
High school	Baseball	Pitcher	Different position	High school	Catcher
High school	Baseball	Pitcher	Different position	High school	Utility
High school	Baseball	Pitcher	Different position	College	1st base
High school	Baseball	2nd base	Yes	College	2nd base
College	Baseball	Pitcher	Yes	College	Pitcher
College	Baseball	Pitcher	Yes	College	Pitcher
College	Baseball	Pitcher	Yes	College	Pitcher
College	Baseball	Catcher	Yes	College	Catcher
Amateur	Baseball	2nd base	Yes	Amateur	2nd base
Professional	Baseball	Shortstop	Yes	Professional	Shortstop
High school	Tennis	—	Yes	College	—
High school	Volleyball	—	Yes	High school	—
College	Softball	Pitcher	Yes	College	Pitcher

indicated.[1,29] Ticker and colleagues[22] identified 9 patients who had lost internal rotation and had a posterior capsular contracture at arthroscopy. That study, however, was not performed on overhead or throwing athletes. Yoneda and colleagues[30] followed 16 overhead throwing athletes after arthroscopic posterior-inferior capsular release and found favorable preliminary clinical results. Eleven of the 16 patients returned to their preinjury level of performance; the other 5 returned to a lower level. In addition, all 4 patients who underwent isolated arthroscopic capsular release had throwing power restored to between 90% and 100%.

Selective arthroscopic posterior-inferior capsular release can be recommended as a reasonable operative solution for overhead athletes with symptomatic GIRD that has not responded to conservative management.

In the present study, 10 of 13 patients who underwent arthroscopic posterior-inferior capsular release returned to their preoperative level of play or a higher level. Mean passive GIRD improved significantly from before surgery to after surgery. ASES scores likewise were significantly improved from before surgery to after surgery. The active internal rotation difference as measured by vertebral segment level was not significantly changed after surgery. This lack of improvement may stem from the more complex musculoligamentous interactions governing active internal rotation versus isolated, passive internal rotation. Another possible explanation for lack of improvement is that the interobserver and intraobserver reliability of this method is lower.[36]

At 2-year follow-up, the patient who had undergone concomitant SLAP repair demonstrated a 23% improvement in ASES score and more internal rotation on the dominant arm relative to the nondominant arm. This patient returned to a level of play at least as good as his preoperative level. Although we could not determine its statistical significance, this patient's improvement suggests that the SLAP repair did not reduce the efficacy of the posterior-inferior capsular release.

Limitations of this study include its relatively small cohort (precluded statistical comparisons between groups), the proportion of patients (7/13) who had concomitant surgeries, and the limited options for patient outcome scores. Although the ASES score is a validated outcome score, the Kerlan-Jobe Orthopaedic Clinic Shoulder and Elbow (KJOC) score or the Disabilities of the Arm, Shoulder, and Hand (DASH) score may be more appropriate in an athletic population. In addition, although all study patients had GIRD that was unresponsive to a concerted trial of nonoperative management, we did not have a control group (nonoperatively treated patients) for comparison. Finally, we did not obtain computed tomography scans or account for the potential contribution of humeral retroversion to GIRD in this group of patients.

Conclusion

Selective arthroscopic posterior-inferior capsular release can be recommended as a reasonable operative solution for overhead athletes with symptomatic GIRD that has not responded to conservative management. In the present study, ASES scores improved significantly, and 77% of our athlete-patients returned to sport at their preoperative level of play or a higher level.

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