Comprehensive Arthroscopic Management (CAM) Procedure for Shoulder Osteoarthritis

Daniel Rios, MD, Frank Martetschläger, MD,*† Trevor R. Gaskill, MD,**
and Peter J. Millett, MD, MSc†‡

Abstract: Shoulder osteoarthritis can lead to severe shoulder pain and dysfunction. Many patients with shoulder osteoarthritis are young, active, and regularly participate in demanding activities that place the durability of current arthroplasty options in question. Therefore, in this article, we describe the comprehensive arthroscopic management of glenohumeral osteoarthritis that combines traditional glenohumeral debridement and capsular release with inferior humeral head osteoplasty and axillary nerve decompression when needed. In our experience, this technique has shown promising early results in active patients by decreasing pain and returning them to high levels of activity and function.

Key Words: glenohumeral arthritis, shoulder arthritis, capsular release, humeral head osteoplasty, axillary nerve decompression

(*Tech Should Surg* 2012;13: 182–186)

Treatment options for shoulder arthritis are well established. Initial nonoperative measures include nonsteroid anti-inflammatory medications, physical therapy, exercise, and injections. Nonoperative treatment modalities are often effective in minimizing associated symptoms and maintaining quality of life[1]; however, when they fail, more severe cases of osteoarthritis are often treated with shoulder arthroplasty. Long-term results of shoulder arthroplasty are encouraging in older patients; however, results in younger patients are not as successful.[2,3] Younger patients have higher activity levels and place more stress on the shoulder arthroplasty, potentially leading to premature implant failure.[3] Complications such as implant loosening, fractures, and dislocation are more commonly seen in younger patients.[3]

Arthroscopic joint-preserving surgery has some advantages in that it may delay the need for total joint replacement while at the same time decreasing pain and improving function.[4] Arthroscopy of the shoulder has been used to treat young patients with glenohumeral osteoarthritis, who due to their age, demanding activity level, or their own desire for joint preservation are not good candidates for a shoulder arthroplasty.[3]

Arthroscopic treatment of glenohumeral osteoarthritis is not new, and others have shown improvement in symptoms with this treatment.[3,4] Some investigators have reported less successful outcomes when performing arthroscopy and large inferior ostophytes are present.[4] Experience in our center has shown that inferior humeral osteophytes may tension the axillary pouch and may be capable of compressing the axillary nerve.[5] In a manner similar to quadrilateral space syndrome, this compression may result in pain, weakness, and decreased range of motion, thereby potentially explaining suboptimal results in this cohort of patients. Therefore, we describe a novel procedure for comprehensive arthroscopic management (CAM) of glenohumeral osteoarthritis coupling an extensive debridement and capsular release with arthroscopic excision of the inferior osteophytes from the humeral head and transcapsular axillary nerve decompression. Axillary nerve neurolysis is done only in selected patients; compression of the axillary nerve can result in pain, weakness, and atrophy in some patients.[5,6] Our preliminary experience has shown that this alleviates pain and improves glenohumeral motion.[2]

From the *Steadamn Phillippon Research Institute; ‡The Steadman Clinic, Vail, CO; and †Clinic for Trauma Surgery, Emergency Department, University Hospital Rechts der Isar, Munich Technical University, Munich, Germany.

The authors declare no conflict of interest.This work was not directly supported by a grant. However, P.J.M. is a consultant and receives payments from Arthrex and has stock options in Game Ready.

This research was supported by the Steadman Philippon Research Institute, which is a 501(c) 3 nonprofit institution supported financially by private donations and corporate support from the following entities: Arthrex, Smith & Nephew Endoscopy, Siemens, Ossur Americas.

Reprints: Peter J. Millett, MD, MSc, The Steadman Clinic, 181 West Meadow Drive, 81657 CO (e-mail: drmillett@staedmanclinic.net).

INDICATION FOR THE PROCEDURE

Typically, young patients (age younger than 60) with glenohumeral osteoarthritis who have failed nonoperative treatment, those with capsular contractures, and with or without large inferior humeral spurs should be included (Fig. 1). The technique is technically easier in those with inferior osteophytes <2 cm and without excessive scarring. In chronic cases, deltoid atrophy and weakness may be present on examination and those are the cases we select to decompress the axillary nerve.

EVALUATION

Physical and radiographic examination should be performed in each patient. Radiographs should include a true anteroposterior, scapular lateral, and axillary lateral view.[7] A radiographic shoulder classification for osteoarthritis has been described by Weinstein and colleagues, as follows: stage I with normal radiographs, stage II changes include minimal joint space narrowing with a concentric head and glenoid. Stage III includes moderate space narrowing with early inferior osteophyte formation. Stage IV changes include severe loss of joint space with osteophyte formation and loss of concentricity between the humeral head and the glenoid.[4] Younger patients participating in high demand shoulder activities in stage III are ideal candidates for CAM procedure, although many patients in stage IV may also be good candidates. Magnetic resonance imaging can be useful to confirm the axillary nerve compression by showing neurogenic edema or fatty infiltration of the deltoid or teres minor.[8–10]

TECHNIQUE

We recommend performing the procedure in a beach chair position. We have performed this procedure in the lateral position but find inferior capsular access and the ability to manipulate the arm in the beach chair position to be superior. The surgeon should be able to freely move the arm, as the complete osteophyte can only be well appreciated with arm rotation. An examination under anesthesia is performed, and an ordinary preparation and draping

FIGURE 1. Anteroposterior image of patient with large inferior humeral spur (arrow).

is completed. A C-arm is draped into the field (Fig. 2). Fluoroscopy is always used to assess resection of bone. A standard posterior viewing portal is made approximately 1 cm medial and 2 cm inferior to the posterolateral corner of the acromion. A 30-degree arthroscope is then introduced into the glenohumeral joint and a complete diagnostic arthroscopy is performed. Anterior portal is placed through the rotator interval, and a 5-mm instrumentation working cannula is inserted through it.

Debridement

Labral tissue and unstable cartilage flaps are debrided using an oscillating shaver (Fig. 3). Loose bodies should be removed as encountered. Stabilization of chondral margins is performed to prevent cartilage delamination and mechanical symptoms inside the joint. A radiofrequency device and shaver

FIGURE 2. Beach chair position with C-arm draped and arm positioner to freely manipulate the arm.

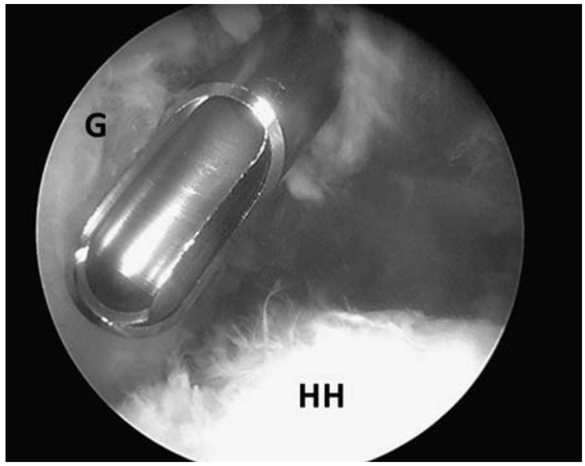

FIGURE 3. Unstable cartilage flaps are debrided as encountered using an oscillating shaver.

are used next to perform a synovectomy in areas where there is relevant hypertrophy. A radiofrequency device is used to release rotator interval scar tissue, allowing us to increase external rotation and restore the normal subcoracoid motion.

Humeral Osteoplasty

If inferior osteophytes are present radiographically and posterior or lateral shoulder pain corresponding to the axillary nerve distribution is present on preoperative examination, axillary nerve decompression and osteophyte removal are performed (Fig. 4). In such cases, both 30- and 70-degree scopes may be used for visualization of the inferior capsular recess. We first visualize the axillary pouch from the standard posterior portal. Humeral osteophytes are typically located intra-articular within the capsule. The C-arm is used at this point to determine and confirm the magnitude of resection. To minimize fluid extravasation and for protection of the axillary nerve, it is preferable to maintain the inferior glenohumeral capsule while the osteoplasty is performed. The capsular release should be delayed until the bone resection is completed.

An accessory posteroinferior portal must be created (Fig. 5). A spinal needle is used to localize a posteroinferior arthroscopic portal. The axillary nerve runs from anteromedial to posterolateral as it traverses the inferior capsular recess. In consideration of this, it is safest for the spinal needle to enter the inferior recess of the glenohumeral joint near the junction of the medial and central thirds of the inferior capsule just anterior to the posterior band of the inferior glenohumeral ligament. Once the needle is placed for orientation, all cannulae are inserted bluntly to avoid nerve injury. Only the skin is incised and a blunt switching stick is inserted into the axillary pouch. Dilators are then used before placing a cannula. We prefer to use an 8.25-mm cannula that has special tabs so that it will not dislodge (Gemini; Arthrex, Naples, FL). The portal should be placed approximately 5 cm inferior to and low in line with the posterolateral aspect of the acromion at 7 o'clock.

Once the inferior humeral osteophyte is identified from this posteroinferior portal, then the osteophyte is resected using a 4.0- or 5.0-mm shielded arthroscopic burr. A curved curette can be useful to help in the resection of the spur, and a rasp can be used to contour the humerus (Fig. 6). The inferior joint capsule should be respected while the osteoplasty is performed; this will provide the axillary nerve additional protection from iatrogenic injury. The capsule will protect the

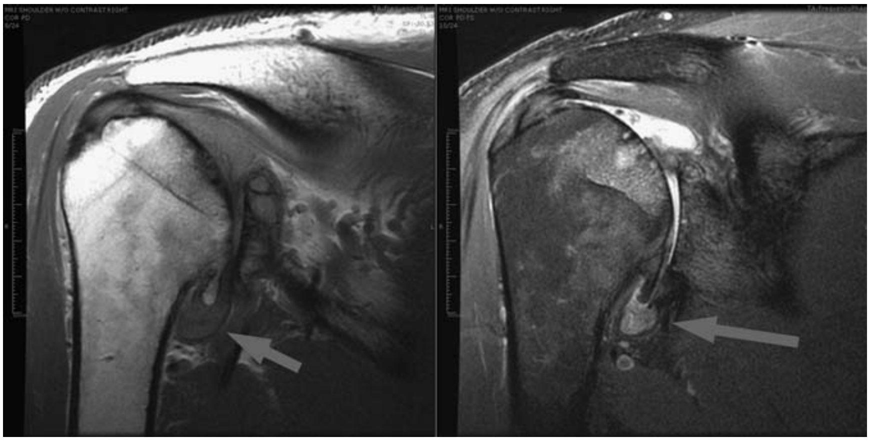

FIGURE 4. Inferior osteophyte present in the axillary nerve distribution (black arrow).

neurovascular bundle and also prevents bone debris from accumulating around the axillary nerve. Next C-arm is used to confirm complete osteophyte removal. Extension and internal rotation of the arm are helpful when performing the resection of the inferior osteophyte. Some of the massive inferior spurs can be technically challenging, and it may be more prudent if the surgeon is not comfortable to excise these through an open approach to better protect the axillary nerve. Some of the more anteroinferior spurs are difficult to visualize and approach and may require partial arthroscopic excision or open excision.

Inferior Capsular Release

Experience has shown that a thickened inferior capsule is always present with large inferior humeral osteophytes, and this limits shoulder motion. Once the osteophyte is safely removed, a radiofrequency device or hand-held punch is used to transect the inferior glenohumeral joint thickened capsule (Figs. 7A, B). The capsulotomy should be performed starting posterior, near the cannula insertion site. A blunt trocar can be used for dissecting the capsular tissue from the underlying soft tissues; this will prevent inadvertent damage to the axillary nerve as it branches underneath the axillary pouch. The axillary nerve is typically located near the junction of the middle and anterior thirds of the inferior capsular pouch. The decompression is considered complete when the axillary nerve is visualized from the subscapularis to the teres major with no soft tissue tethering the nerve and no bone impinging upon it throughout this course (Fig. 8). Before completion of this portion of the procedure, hemostasis should be ensured.

Anterior and Posterior Capsular Releases

Anterior and posterior capsular releases should be performed once the axillary nerve decompression is completed. First, the anterior capsule is released medially along the anterior glenoid at the capsulolabral junction, allowing visualization of the subscapularis muscle fibers. Care must be taken

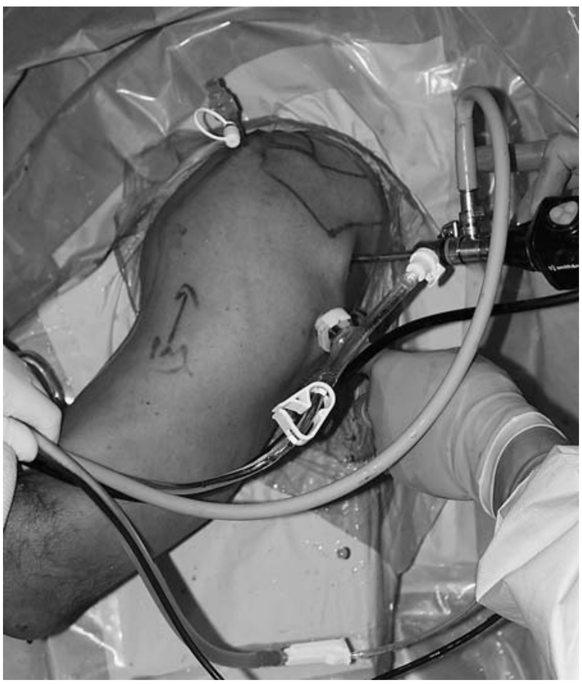

FIGURE 5. Accessory posteroinferior portal with 8.25-mm working cannula.

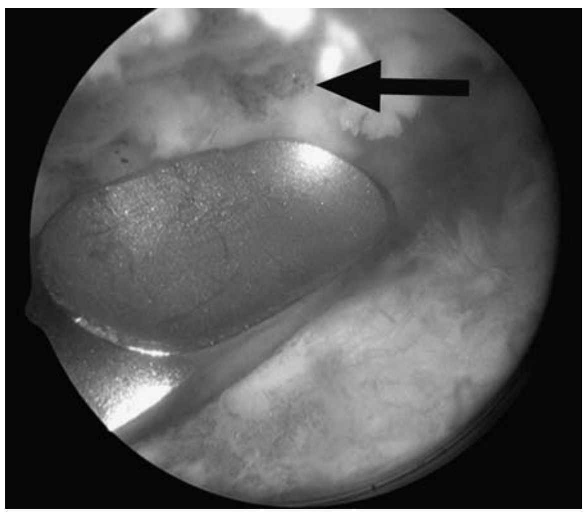

FIGURE 6. Curved curette helpful in the osteophyte resection (black arrow).

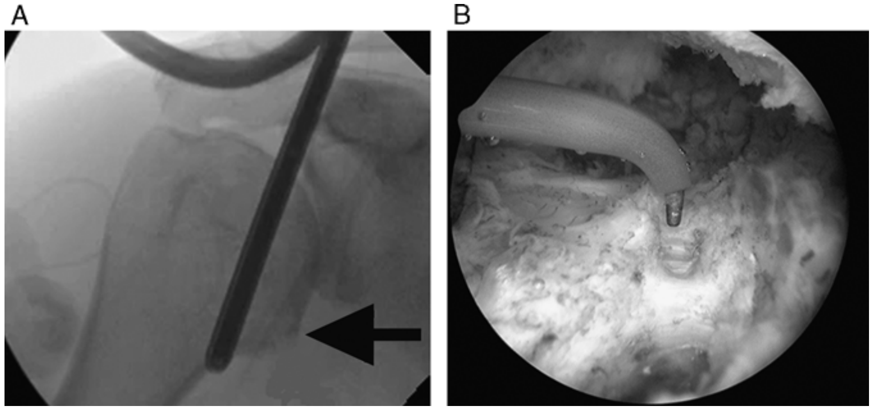

FIGURE 7. A, Osteophyte removal (black arrow) assessment with fluoroscopy. B, Radiofrequency device used to transect inferior glenohumeral joint thickened capsule.

to avoid inadvertent injury to the subscapularis tendon. Then, the rotator interval is also released until the underlying coracoid and coracoacromial ligaments are demonstrated. The arthroscope is then placed through the anterior portal so that the posterior glenohumeral joint is visualized. A capsular release and similar debridement procedure is performed posteriorly, working from inferior to superior. The capsular release is extended to the inferior release that was safely completed during the axillary nerve decompression. Using a radiofrequency device, the inferior release is extended posterosuperiorly. Similar to the anterior release, this capsulotomy is performed medially at the capsulolabral junction to protect from inadvertently damaging the laterally based posterior rotator cuff tendons.

Additional Procedures

On the basis of individual patient pathology, a subacromial decompression and subpectoral biceps tenodesis are performed in most cases. A liberal bursectomy is performed at the subacromial space, reestablishing the normal scapulohumeral motion interface. An acromioplasty is not routinely performed unless there is a significant anterolateral acromial spur. The subcoracoid space is also liberated, as it is frequently scarred. The long head biceps is frequently degenerative and can contribute to postoperative motion loss and pain. An arthroscopic tenotomy is performed, if the biceps tendon does not slide properly in its groove.[11] Because the patients undergoing the CAM procedure are typically active and desire to return to high levels of activity, a standard subpectoral long head biceps tenodesis using interference screw fixation is performed.[12]

The portals are then closed in a standard manner; the glenohumeral joint is manipulated to maximize glenohumeral motion and when appropriate is compared with the contralateral shoulder. It is critical to maintain motion gains achieved after capsular release and manipulation. The patient is placed in a shoulder immobilizer, and rehabilitation includes immediate active and passive range of motion. Operative regional interscalene anesthesia is frequently helpful to facilitate early therapy, and nonsteroidals are used liberally to decrease inflammation during rehabilitation. Strengthening typically begins around 4 to 6 weeks based on their postoperative clinical presentation. Full recovery is typically seen 4 to 6 months after surgery with a good physical therapy program.

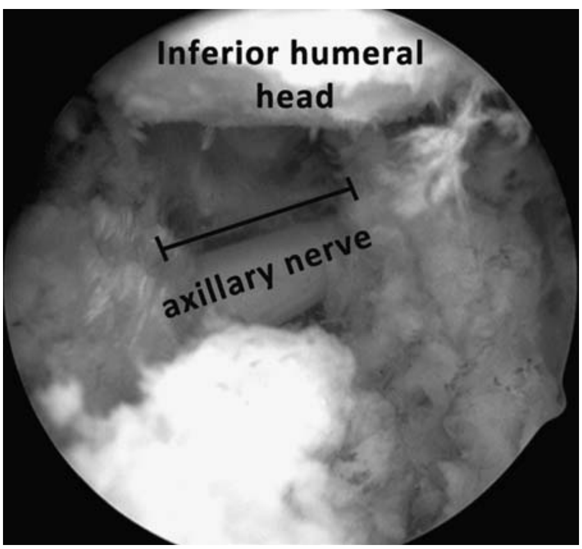

FIGURE 8. Axillary nerve decompressed.

PRELIMINARY RESULTS

We recently reported on a series of 27 CAM procedures in 26 patients.[2] In this series, we reported improved American Shoulder and Elbow Surgeons Scores, a high patient satisfaction rate, decreased pain, and increased range of motion. Only 1 patient elected to undergo total shoulder arthroplasty, and there were no complications in this series of patients.

DISCUSSION

Shoulder arthritis in the young patient has become a challenging problem for the orthopedic surgeon. Glenohumeral arthritis is frequently seen concurrently with other pathologies of the shoulder such as tendonopathy of the long head of the biceps tendon, adhesive capsulitis, and subacromial bursitis. Axillary nerve compression may be another cause of shoulder pain in these patients, particularly in those with large inferior humeral head osteophytes. Therefore, we present the CAM technique as a comprehensive arthroscopic approach that addresses all the pathoanatomy typically encountered in arthritic patients. To date, we have seen promising results in a carefully selected cohort of active, young, motivated patients who desire to avoid total joint arthroplasty and meet the criteria for this procedure.

We theorize that the axillary nerve is susceptible to a static compressive or dynamic traction injury when inferior humeral osteophytes are of sufficient size. In our clinical experience with this procedure, we have found that the axillary nerve is indeed directly beneath the inferior osteophyte and that once it is removed and the nerve is released, the course of the nerve moves more superiorly. Considering this, we believe that axillary nerve compression from large inferior osteophytes may manifest symptoms that are similar to axillary nerve compression in quadrilateral space syndrome. Our unpublished research data have also shown that the size of the inferior spur correlates with the degree of teres minor atrophy, again consistent with this hypothesis.

Several authors have reported satisfactory early results after an extensive arthroscopic glenohumeral debridement and capsular release.[4,13,14] Weinstein et al[4] reported satisfactory results from arthroscopic debridement alone in patients with mild or minimal arthritic change. As would be expected, their results were less favorable in patients with advanced glenohumeral degeneration. Richards et al[14] combined glenohumeral debridement with capsular release in young patients and reported improved glenohumeral motion and an average symptom-free period of 9 months in a small series of patients. Van Thiel et al[13] recently reported substantial pain relief in 55 of 71 patients undergoing arthroscopic debridement at a mean of 27 months. Therefore, arthroscopic management of glenohumeral arthritis may not prevent the arthritic progression but may provide a window of improved pain and function delaying a larger operation in those with physically demanding occupations or lifestyles.

Some authors have suggested that large humeral osteophytes may predict less favorable outcomes from arthroscopic debridement.[4,13] All patients in those published studies exhibited inferior humeral osteophytes and by all measures met the radiographic and clinical indications for total shoulder arthroplasty. Unique to this procedure, therefore, is performing a humeral osteoplasty and axillary nerve decompression as routine portions of an arthroscopic joint preservation procedure. We hypothesize that osteophyte removal and transcapsular axillary nerve decompression may provide symptomatic relief that is greater than simple debridement and capsular release alone. Failure to address this potentially compressive lesion may partially explain the less favorable outcomes reported by some authors when large osteophytes are present. Surgeons should be aware that a technically demanding procedure should only be undertaken by experienced arthroscopic shoulder surgeons with a detailed understanding of arthroscopic neuroanatomy.

SURGICAL RISKS

The procedure is performed in close proximity to the axillary neurovascular bundle, which could be injured during the procedure. To this end, the axillary nerve frequently arborizes as it traverses inferior to the glenohumeral joint. As any number of branches can be encountered in this location, smaller branches may be easily damaged if not appropriately identified. Another concern is fluid extravasation into the axillary space or arm that could result in elevated upper extremity compartment pressures or neurovascular compression. Expeditious axillary nerve decompression and moderate arthroscopic pump pressures can minimize this risk.

Although releasing the inferior capsule may result in a higher risk of glenohumeral instability, our experience is that encompassing soft tissues are often contracted and minimize any risk of instability. In addition, the axillary nerve decompression is optimally performed between the anterior and posterior bands of the inferior glenohumeral ligament. By preserving these structures, the risk of glenohumeral instability is further reduced. We believe that early and aggressive rehabilitation protocols and meticulous surgical hemostasis are important to avoid recurrent scar formation after axillary nerve decompression that could result in recurrent symptoms in some patients with longer-term follow-up.

CONCLUSIONS

The optimal treatment of glenohumeral arthritis in young patients is not firmly established. Although arthroplasty options provide reliable relief in older, lower-demand patients, the long-term longevity of these implants in a young, high-demand population has not been as successful.[3] Arthroscopic debridement and capsular release is reported to provide satisfactory results in young, active patients with mild or moderate arthritis.[4] When indicated, the addition of a humeral osteoplasty and axillary nerve decompression as described in our CAM procedure may provide better results and the return to higher levels of activity in these patients.

REFERENCES

1. Sperling JW, Cofield RH, Rowland CM. Minimum fifteen-year follow-up of Neer hemiarthroplasty and total shoulder arthroplasty in patients aged fifty years or younger. *J Shoulder Elbow Surg*. 2004;13: 604–613.
2. Millett PJ, Gaskill TR. Arthroscopic management of glenohumeral arthrosis: humeral osteoplasty, capsular release, and arthroscopic axillary nerve release as a joint-preserving approach. *Arthroscopy*. 2011;27:1296–1303.
3. George MS. Arthroscopic management of shoulder osteoarthritis. *Open Orthop J*. 2008;2:23–26.
4. Weinstein DM, Bucchieri JS, Pollock RG, et al. Arthroscopic debridement of the shoulder for osteoarthritis. *Arthroscopy*. 2000;16:471–476.
5. Cahill BR, Palmer RE. Quadrilateral space syndrome. *J Hand Surg Am*. 1983;8:65–69.
6. Francel TJ, Dellon AL, Campbell JN. Quadrilateral space syndrome: diagnosis and operative decompression technique. *Plast Reconstr Surg*. 1991;87:911–916.
7. McCarty LP III, Cole BJ. Nonarthroplasty treatment of glenohumeral cartilage lesions. *Arthroscopy*. 2005;21:1131–1142.
8. Elsayes KM, Shariff A, Staveterg PT, et al. Value of magnetic resonance imaging for muscle denervation syndromes of the shoulder girdle. *J Comput Assist Tomogr*. 2005;29:326–329.
9. Linker CS, Helms CA, Fritz RC. Quadrilateral space syndrome: findings at MR imaging. *Radiology*. 1993;188:675–676.
10. Sanders TG, Tirman PF. Paralabral cyst: an unusual cause of quadrilateral space syndrome. *Arthroscopy*. 1999;15:632–637.
11. Boileau P, Ahrens PM, Hatzidakis AM. Entrapment of the long head of the biceps tendon: the hourglass biceps—a cause of pain and locking of the shoulder. *J Shoulder Elbow Surg*. 2004;13:249–257.
12. Millett PJ, Sanders B, Gobezie R, et al. Interference screw vs. suture anchor fixation for open subpectoral biceps tenodesis: does it matter? *BMC Musculoskelet Disord*. 2008;9:121–127.
13. Van Thiel GS, Sheehan S, Frank RM, et al. Retrospective analysis of arthroscopic management of glenohumeral degenerative disease. *Arthroscopy*. 2010;26:1451–1455.
14. Richards DP, Burkhart SS. Arthroscopic debridement and capsular release for glenohumeral osteoarthritis. *Arthroscopy*. 2007;23: 1019–1022.