12 The Comprehensive Arthroscopic Management (CAM) Procedure for Young Patients with Glenohumeral Osteoarthritis

Peter J. Millett, Joshua A. Greenspoon, and Ryan J. Warth

Introduction

Glenohumeral osteoarthritis (OA) is a common condition typically associated with increasing age and often previous trauma. Patients typically present in later stages with generalized shoulder pain due to degeneration of articular cartilage with limited active and passive range of motion as a result of capsular contractures. There are many *potential* causes of glenohumeral OA (e.g., posttraumatic or iatrogenic); however, the majority of cases are idiopathic in nature.

Although glenohumeral OA is most commonly observed in the aging population, younger patients can still be afflicted with the condition. As a referral practice, we have seen a particularly large number of younger patients (e.g., <60 years of age) with glenohumeral OA who prefer to either avoid or delay arthroplasty using a joint-preserving approach.

The rationale to pursue joint preservation is based upon the limitations and risks currently associated with total shoulder arthroplasty (TSA) in young patients. Specifically, it is well known that the clinical outcomes and patient satisfaction following TSA are less favorable in patients younger than 50 years of age [1–8]. This effect is perhaps due to the fact that younger patients are more likely to engage in higher-demand activities and are generally more active. Due to limited implant longevity, TSA in younger patients may necessitate revision TSA which, in itself, is also known to produce less optimal outcomes when compared to primary TSA [9–11]. Thus, the risk for failure after TSA is particularly elevated in those who participate in higher-demand activities which may accelerate polyethylene wear and lead to implant loosening.

Arthroscopic joint preservation is considered a palliative measure designed to address known and treatable pain generators in the shoulder in order to alleviate symptoms and either delay or prevent the need for future arthroplasty. The comprehensive arthroscopic management (CAM) procedure involves glenohumeral debridement and chondroplasty, humeral head osteoplasty, capsular releases, and axillary nerve neurolysis. Microfracture, subacromial decompression with or without acromioplasty, and biceps tenodesis are also performed when necessary. Preliminary results

Research Performed at the Steadman Philippon Research Institute, Vail, CO.

P.J. Millett, MD, MSc (✉)
Vail Valley Medical Center, The Steadman Clinic, Vail, CO, USA
e-mail: drmillett@thesteadmanclinic.com

J.A. Greenspoon, BSc
Vail Valley Medical Center, Steadman Philippon Research Institute, Vail, CO, USA

R.J. Warth, MD
Department of Orthopaedic Surgery, University of Texas Health Sciences Center, Houston, TX, USA

J.D. Kelly IV (ed.), *Elite Techniques in Shoulder Arthroscopy*,
DOI 10.1007/978-3-319-25103-5_12

of this procedure have been encouraging [12]. The purpose of this chapter is to describe and illustrate the CAM procedure in detail and to review the clinical results following arthroscopic joint-preserving approaches for glenohumeral OA.

The Comprehensive Arthroscopic Management Procedure

Patient Selection

Appropriate patient selection is critical to achieve a successful outcome following the CAM procedure. The procedure is generally indicated for young, active patients with glenohumeral OA who wish to delay arthroplasty. The precise age at which the CAM procedure may be most appropriate and beneficial has not been clearly defined; however, Spiegl et al. found that arthroscopic management was the preferred treatment strategy for patients younger than 47 years who had glenohumeral OA, TSA was the preferred treatment strategy for patients older than 66 years, and either procedure was reasonable for patients between the ages of 47 and 66 years [13]. Millett et al. also noted that patients who presented with <2.0 mm of joint space preoperatively were eight times more likely to progress to arthroplasty [12]. In addition, patients with greater range of motion limitations preoperatively, particularly regarding internal rotation, were more satisfied with the procedure. Of importance, it is always necessary to ensure that patient and physician expectations coincide before undertaking operative management [14].

Surgical Technique

Following the decision to pursue arthroscopic joint preservation, the patient is brought to the surgical suite and placed supine on the operating table. An interscalene catheter is placed which provides analgesia during the initial phases of postoperative rehabilitation. General anesthesia is then administered, and the patient is placed in the modified beach chair position. This positioning allows for intraoperative manipulation of the arm which improves visualization of the inferior "goat's beard" osteophyte both fluoroscopically and arthroscopically. This technique is also helpful to ensure the lack of axillary nerve impingement. A fluoroscopic C-arm is also draped into the surgical field using sterile techniques to assist with visualization and resection of the inferior osteophyte (Fig. 12.1).

Examination under anesthesia is then performed bilaterally, specifically evaluating any

Fig. 12.1 Preoperative photograph of the surgical setup in a patient who eventually underwent the CAM procedure. Note that the C-arm is draped into the surgical field to allow for dynamic fluoroscopic examination intraoperatively

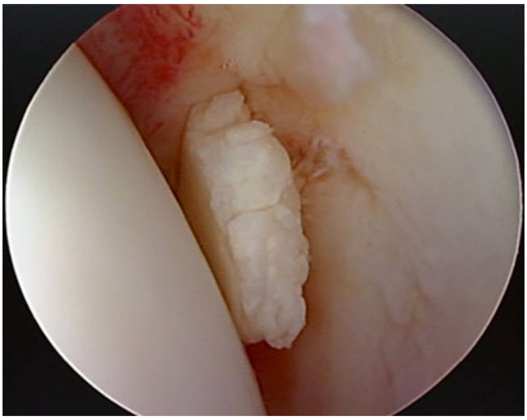

Fig. 12.2 Arthroscopic image of a loose body found upon diagnostic arthroscopy in a young patient with glenohumeral OA

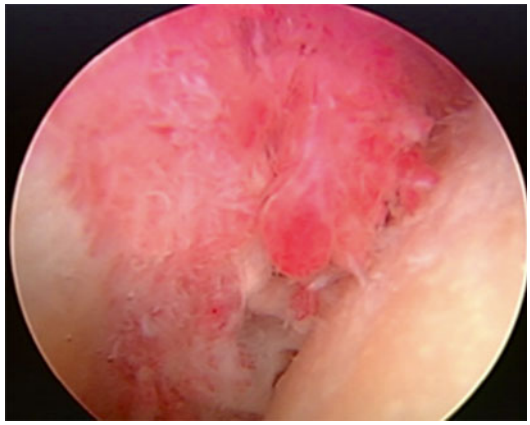

Fig. 12.3 Arthroscopic image demonstrating the typical appearance of significant synovitis that ultimately underwent debridement and resection

range of motion limitations. In general, range of motion loss of >15° in any plane is consistent with capsular contracture. The affected motion planes are noted to aid in the planning of arthroscopic contracture releases.

The glenohumeral joint is localized with a spinal needle, and a standard posterior portal is established approximately 2 cm medial and 2 cm inferior to the posterolateral corner of the acromion. An anterosuperior portal is then created through the rotator interval and a 5-mm cannula is inserted. Diagnostic arthroscopy is then performed using a combination of 30° and 70° arthroscopes.

Glenohumeral Debridement and Chondroplasty

Following an evaluation of both the glenoid and humeral joint surfaces, an arthroscopic shaver is used for the debridement of unstable articular cartilage and degenerative labral tissues to stable borders to prevent the production of a stress riser which may lead to mechanical irritation and acceleration of joint degeneration. Microfracture is performed for focal, full-thickness chondral defects with stable borders. Loose bodies are removed using standard methods (Fig. 12.2). Particular attention is paid to the subscapularis recess, where loose bodies tend to localize. This area is best accessed with an anterior superior viewing portal and straight anterior working portal. Areas of synovial hypertrophy (Fig. 12.3) are resected using radiofrequency ablation or an arthroscopic shaver. In addition, scar tissue is removed from the rotator interval to restore the coracohumeral motion interface. The capsule is otherwise preserved at this time.

Humeral Head Osteoplasty

Using an 18-gauge spinal needle, an accessory posteroinferior portal (i.e., low 7-o'clock portal) is established under direct visualization to allow access to the inferior axillary recess, humeral neck, and axillary nerve. The spinal needle should always enter the inferior recess near the junction of the medial and central thirds of the inferior capsule just anterior to the margin of the posterior band of the inferior glenohumeral ligament (IGHL). A small skin incision is made, and a switching stick is placed into the axillary pouch following the path of the previously placed spinal needle. Tissue dilators are inserted over the switching stick and a 5- or 6-mm cannula is inserted bluntly to avoid iatrogenic injury to the axillary nerve which runs from anteromedial to posterolateral through the inferior recess. The capsule of the axillary pouch is preserved at this point to protect the axillary nerve. When present, the intra-articular inferior osteophyte (Fig. 12.4) is then removed using a shielded, high-speed 4- or 5-mm arthroscopic bur, arthroscopic shavers, and handheld curettes. The arm is extended and internally and externally rotated during the procedure

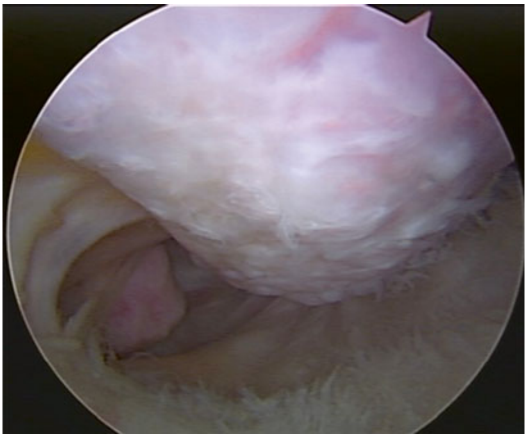

Fig. 12.4 Arthroscopic image showing a large osteophyte located on the inferior aspect of the humeral head

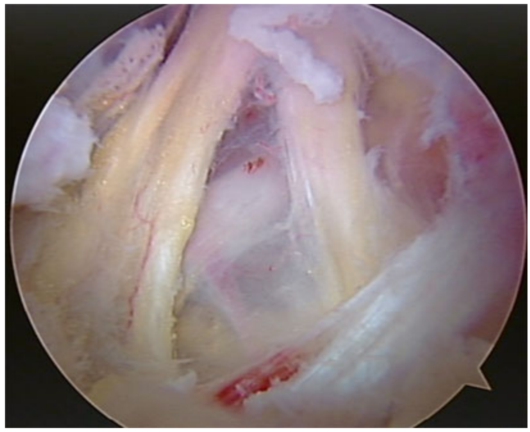

Fig. 12.5 Arthroscopic image showing the bifurcation of the axillary nerve. Neurolysis should always be performed from proximal to distal in order to mitigate the risk of iatrogenic injury to small, distal branches of the axillary nerve

to bring all areas of the osteophyte into view or within the plane of the fluoroscope to ensure adequate bony resection. Curettes can also be used to remove hypertrophic bone from the anteroinferior areas that are more difficult to access with motorized instruments. While complete removal of hypertrophic bone is desired, this may not be possible in some cases. It is always the goal to remove enough bone to decompress the axillary nerve throughout the range of shoulder motion.

Inferior Capsular Release and Axillary Neurolysis

Large inferior humeral head osteophytes almost always occur in the presence of a thickened, contracted inferior capsule which limits both active and passive glenohumeral abduction capacity. Release of the inferior capsule is always performed after humeral head osteoplasty, as the intact capsular tissue can help protect the axillary nerve from iatrogenic injury [15]. Arthroscopic scissors, an arthroscopic punch, and a monopolar radiofrequency probe are used to complete this portion of the procedure. The inferior capsular release is begun posteriorly near the insertion site of the posteroinferior cannula, and the capsule is transected from proximal to distal. A blunt trocar is also helpful to establish tissue planes between the capsule and surrounding soft tissues. Once the axillary nerve is identified, dissection is carried out from proximal to distal to avoid damage to any branches of the axillary nerve. While the nerve classically has two main branches, it is not uncommon to find multiple arborations. Working from proximal to distal helps prevent damage to small distal branches of the axillary nerve as they course beneath the axillary pouch.

Axillary neurolysis is performed in patients who present with posterior or lateral shoulder pain (following the distribution of the axillary nerve) or those with evidence of nerve impingement on diagnostic images or direct arthroscopic visualization [16]. Isolated atrophy of the teres minor, best seen on T1 sagittal MRI images, suggests axillary nerve compression.

Following the inferior capsular release, the axillary nerve is identified just inferior to the junction between the middle and anterior thirds of the axillary pouch. Release of adherent tissues around the axillary nerve is performed from proximal to distal and from medial to lateral using blunt dissection to avoid inadvertent injury or irritation of the small distal branches of the axillary nerve (Fig. 12.5). It is important to maintain hemostasis during neurolysis in order to improve visualization, prevent postoperative hematoma formation, and reduce the risk of scar tissue postoperatively. Neurolysis is complete when the axillary nerve is clearly visible along its entire course between the subscapularis and teres

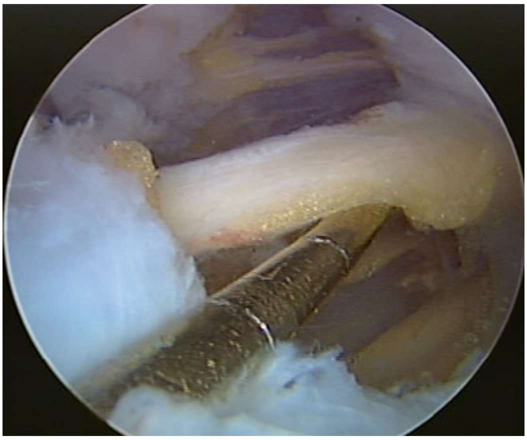

Fig. 12.6 Arthroscopic image of the axillary nerve following neurolysis

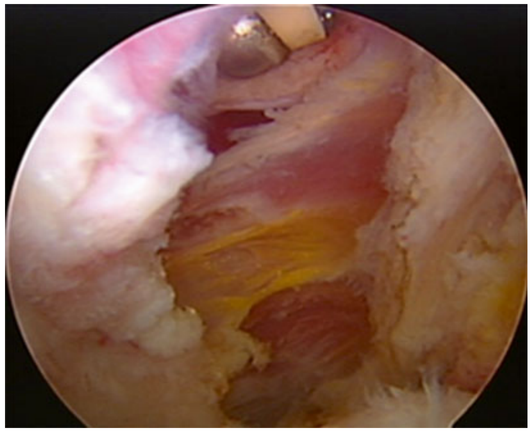

Fig. 12.7 Arthroscopic image showing the fibers of the subscapularis muscle following anterior capsular release

minor muscles without soft tissue adherence or osseous impingement (Fig. 12.6). Adequate clearance is directly visualized arthroscopically during dynamic examination.

Anterior and Posterior Capsular Releases

Anterior and posterior capsular releases should always be performed after osteophyte resection and axillary neurolysis to prevent fluid extravasation into the axillary space, which may limit visualization during these delicate procedures. Soft tissue releases are first performed within the rotator interval (medial to the biceps reflection pulley and inferior to the superior glenohumeral ligament) using electrocautery and a motorized shaver. The anterior capsule is released medially from superiorly to approximately the 5-o'clock position (in a right shoulder) along the capsulolabral junction. The fibers of the subscapularis muscle are then visualized. Care should be taken to avoid injury to the fibers of the subscapularis muscle (Fig. 12.7). Anterior capsular tissue is also released through the rotator interval from superior to inferior until the coracoid and coracoacromial (CA) ligament are clearly visible from within the joint.

The arthroscope is then placed into the anterosuperior portal to allow visualization of the posterior capsule and capsulolabral junction. Using the posterior portal for instrumentation, the posterior capsule is released from inferior (approximately 7-o'clock position in a right shoulder) to superior (approximately 11-o'clock in a right shoulder) medially along the capsulolabral junction to avoid damaging the posterior cuff tendons which are situated more laterally. The posterior release is typically connected to the inferior release which was performed earlier in the procedure. Dynamic examination is then performed under both arthroscopic and fluoroscopic visualization to evaluate shoulder range of motion following capsular releases. Range of motion capacity is then compared to the contralateral shoulder. Manipulation of the shoulder can be performed at this point in the procedure to maximize functional range of motion of the shoulder.

Additional Procedures

1. Subacromial Decompression/Acromioplasty

   The arthroscope is then placed back into the posterior portal to access the subacromial space. Bursectomy is always performed to allow for visualization of the rotator cuff tendons and to restore the scapulohumeral motion interface. Acromioplasty is performed using an arthroscopic bur through the lateral portal for cases in which visible fraying or scuffing of the CA ligament (i.e., impingement lesion), a Bigliani type III acromion, or a large anterolateral acromial spur is present

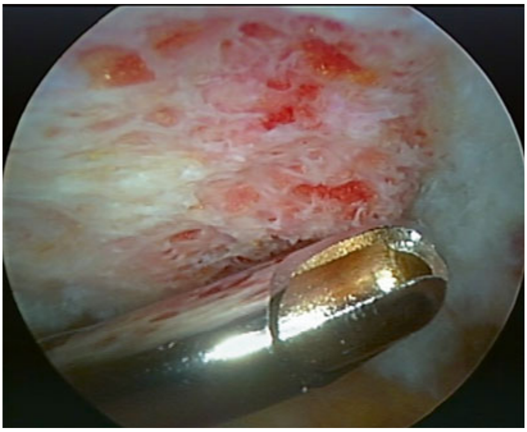

Fig. 12.8 Arthroscopic image of the inferior acromion following subacromial decompression and acromioplasty

(Fig. 12.8). Otherwise, acromioplasty is not routinely performed.

2. Long Head of the Biceps Tenodesis

   When injured or inflamed, the long head of the biceps (LHB) tendon can be a significant pain generator. The LHB tendon may also restrict forward elevation in some cases (e.g., hourglass deformity) [17]. Therefore, arthroscopic release of the LHB tendon with subsequent open subpectoral tenodesis is commonly performed in patients with a degenerative shoulder. LHB tendon release and tenodesis are typically indicated for patients with LHB tendonitis, bicipital groove tenderness, degenerative SLAP tears, or any condition that may compromise the ability of the LHB tendon to glide freely and painlessly within the bicipital groove. The procedural details for open subpectoral LHB tenodesis have been described elsewhere [18, 19].

Postoperative Rehabilitation

The primary goals of postoperative rehabilitation are to maintain joint motion and to improve overall shoulder kinematics. Nonsteroidal anti-inflammatory drugs (NSAID) are used liberally to help decrease inflammation and pain during the postoperative period. Postoperative rehabilitation follows a phasic approach where individual customization may be necessary depending on concomitant pathologies and procedures. The first phase of rehabilitation begins immediately postoperatively and focuses on passive range of motion, active-assisted range of motion, and cautious stretching (to avoid further pain and inflammation). At approximately 6 weeks postoperatively, functional strengthening is begun, particularly implementing elastic resistance bands. At approximately 3 months postoperatively, more advanced strengthening exercises are begun followed by a return to normal activities and sports between 4 and 6 months postoperatively.

Risks and Complications

There are several surgical risks and potential complications that can be avoided when the procedure is performed systematically using meticulous surgical technique. Small branches of the axillary nerve are particularly susceptible to iatrogenic injury during inferior capsular release and axillary neurolysis because they are typically difficult to appreciate arthroscopically. In all cases, it is important to work from proximal to distal during axillary neurolysis to help visualize distal arborization. Anterior and posterior capsular releases should always be performed after addressing the axillary nerve to prevent fluid excursion or leakage into the axillary space. This fluid egress may decrease visualization during the delicate neurolysis procedure and may produce increased postoperative pain as a result of increased compartment pressure. Expeditious inferior capsular release and neurolysis while also using lower fluid pump pressures may help decrease the risk for this complication. Although uncommon, the inferior capsular scar tissue that often develops postoperatively may involve the axillary nerve, potentially resulting in recurrent posterior and lateral shoulder pain. Recurrent positional symptoms may also be caused by incomplete humeral osteoplasty. While concern about postoperative instability exists due to the extent of the capsular release, we have not seen this complication likely due to the overall stiff soft tissue envelope associated with the underlying glenohumeral OA.

Clinical Results

For patients with glenohumeral OA, the goals of arthroscopic management are to relieve symptoms related to mechanical impingement (through stabilization of chondral defects and labral tears), to improve functional range of motion (through capsular releases), and to delay the need for joint arthroplasty. Several studies have evaluated the results of arthroscopic management for glenohumeral OA (Table 12.1). Most of these studies reported significant pain relief where improved postoperative range of motion was demonstrated in those patients who underwent capsular releases.

Recent evidence suggests that axillary nerve impingement may be produced by the large

Table 12.1 Summary of studies that evaluated the clinical outcomes following arthroscopic management for glenohumeral OA in young patients

Authors	Year	*N*	Mean age	Technique	Revisions and complications	Preoperative status	Postoperative outcomes
Weinstein et al. [19]	2000	25	46	Debridement	None	NR	Improved pain in all
Cameron et al. [20]	2002	70	50	Debridement ± capsular releases	NR	Functional score (0–60): 24 Satisfaction: 0.67 FE: 119° IR: L2	Functional score (0–60): 38.7 Satisfaction: 6/10 FE: 157° IR: T11
Richards and Burkhart [21]	2007	8	55	Debridement ± capsular releases	NR	FE: 131.9° IR: 17.2° ER: 42.8°	FE: 153.3° IR: 48.3° ER: 59.4°
Kerr and McCarty [22]	2008	20	38	Debridement ± tenotomy, microfracture	NR	NR	ASES: 75.3 Marx: 12.6 SANE: 63 % WOOS: 0.64
de Beer et al. [23]	2010	31	Median 57.5	Debridement, glenoid resurfacing, tenotomy	Axillary paresis (1) Material failure (2) Synovitis (1) Contusion from MUA (1)	Median constant: 40	Median constant: 64.5
Van Thiel et al. [24]	2010	81	47	Debridement ± capsular releases, tenotomy, microfracture, acromioplasty	Arthroplasty (16) at mean 10.1 months	ASES: 51.8 SST: 6.1 VAS: 4.8 SF-12: 35.9	ASES: 72.7 SST: 9.0 VAS: 2.7 SF-12: 36.1 Constant: 72.0 UCLA: 28.3 SANE: 71.1 FE: 137° Abduction: 129° ER: 48°
Millett et al. [25]	2013	30	52	Debridement ± capsular releases, humeral osteoplasty, axillary neurolysis, acromioplasty	Arthroplasty (6) at mean 1.9 years	ASES: 58 SF-12 PCS: 42.8 FE: 98.2° ER: 13.4° ER at 90° abduction: 27.3° IR: 23.8°	ASES: 83 SF-12 PCS: 49.4 FE: 152.9° ER: 62.2° ER at 90° abduction: 75.4° IR: 60.8°

Abbreviations: *ASES* American Shoulder and Elbow Surgeons' score, *ER* external rotation, *FE* forward elevation, *IR* internal rotation, *MUA* manipulation under anesthesia, *NR* not reported, *SANE* Single Assessment Numeric Evaluation score, *SF-12* short form-12, *SF-12 PCS* short form-12 physical component summary, *SST* simple shoulder test, *UCLA* University of California Los Angeles shoulder score, *VAS* Visual Analog Scale for pain, *WOOS* Western Ontario Osteoarthritis score inferior humeral head osteophyte that is common in patients with glenohumeral OA [20]. As noted, Millett et al. found that larger humeral head osteophytes were significantly correlated with increased fatty infiltration of the teres minor muscle. Impingement of the axillary nerve may also serve as a stimulus for scar tissue formation which can further entrap the axillary nerve. As a result of this research, the senior surgeon began to perform humeral osteoplasty and axillary neurolysis in patients with evidence of axillary nerve impingement to enhance pain relief and further delay the need for arthroplasty. In a series of 30 shoulders, Millett et al. performed debridement and capsular releases with additional humeral osteoplasty and axillary neurolysis (CAM procedure) [12]. In that study, 6 of 30 patients underwent TSA at a mean of 1.9 years following this arthroscopic treatment regimen. In the remaining shoulders, American Shoulder and Elbow Surgeons' (ASES) scores improved from 58 preoperatively to 83 postoperatively after a mean 2.6-year follow-up period. In an unpublished study from our institution with over 100 patients, predictors of a poor outcome after the CAM procedure included a narrowed joint space and a Walch types B2 or C glenoid (biconcave). Although further study is needed to define the longevity of this joint-preserving technique, preliminary data suggests that the CAM procedure can be an effective treatment option to help decrease pain, improve function, and delay arthroplasty in younger patients with glenohumeral OA.

Conclusion

Arthroscopic joint preservation strategies can reduce pain and improve function while also helping to delay the need for future shoulder arthroplasty in young patients with glenohumeral OA. The CAM procedure is a safe technique that utilizes additional humeral osteoplasty and axillary neurolysis to further reduce pain and enhance postoperative function in these patients.

References

1. Bartelt R, Sperling JW, Schleck CD, Cofield RH. Shoulder arthroplasty in patients aged fifty-five years or younger with osteoarthritis. J Shoulder Elbow Surg. 2011;20(1):123–30.
2. Cheung EV, Sperling JW, Cofield RH. Revision shoulder arthroplasty for glenoid component loosening. J Shoulder Elbow Surg. 2008;17(3):371–5.
3. Denard PJ, Raiss P, Sowa B, Walch G. Mid- to long-term follow-up of total shoulder arthroplasty using a keeled glenoid in young adults with primary glenohumeral arthritis. J Shoulder Elbow Surg. 2013;22(7): 894–900.
4. Deutsch A, Abboud JA, Kelly J, Mody M, Norris T, Ramsey ML, Iannotti JP, Williams GR. Clinical results of revision shoulder arthroplasty for glenoid component loosening. J Shoulder Elbow Surg. 2007;16(6):706–16.
5. Papadonikolakis A, Neradilek MB, Matsen III FA. Failure of the glenoid component in anatomic total shoulder arthroplasty: a systematic review of the English-language literature between 2006 and 2012. J Bone Joint Surg Am. 2013;95(24):2205–12.
6. Raiss P, Aldinger PR, Kasten P, Rickert M, Loew M. Total shoulder replacement in young and middle-aged patients with glenohumeral osteoarthritis. J Bone Joint Surg Br. 2008;90(6):764–9.
7. Rasmussen JV. Outcome and risk of revision following shoulder replacement in patients with glenohumeral osteoarthritis. Acta Orthop Suppl. 2014;85(355):1–23.
8. 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(6):604–13.
9. Em B, Roberts SM, Siegel E, Yannopoulos P, Higgins LD, Warner JJ. Reverse shoulder arthroplasty as salvage for failed prior arthroplasty in patients 65 years of age or younger. J Shoulder Elbow Surg. 2014;23(7):1036–42.
10. Dines JS, Fealy S, Strauss EJ, Allen A, Craig EV, Warren RF, Dines DM. Outcomes analysis of revision total shoulder replacement. J Bone Joint Surg Am. 2006;88(7):1494–500.
11. Walker M, Willis MP, Brooks JP, Pupello D, Mulieri PJ, Frankle MA. The use of the reverse shoulder arthroplasty for treatment of failed total shoulder arthroplasty. J Shoulder Elbow Surg. 2012;21(4): 514–22.
12. Millett PJ, Horan MP, Pennock AT, Rios D. Comprehensive Arthroscopic Management (CAM) procedure: clinical results of a joint-preserving arthroscopic treatment for young, active patients with advanced shoulder osteoarthritis. Arthroscopy. 2013; 29(3):440–8.
13. Spiegl UJ, Faucett SC, Horan MP, Warth RJ, Millett PJ. The role of arthroscopy in the management of

glenohumeral osteoarthritis: a Markov decision model. Arthroscopy. 2014;30(11):1392–9.
14. Warth RJ, Briggs KK, Dornan GJ, Horan MP, Millett PJ. Patient expectations before arthroscopic shoulder surgery: correlation with patients' reasons for seeking treatment. J Shoulder Elbow Surg. 2013;22(12): 1676–81.
15. de Beer JF, Bhatia DN, van Rooyen KS, Du Toit DF. Arthroscopic debridement and biological resurfacing of the glenoid in glenohumeral arthritis. Knee Surg Sports Traumatol Arthrosc. 2010;18(12):1767–73.
16. Elser F, Dewing CB, Millett PJ. Chondral and osteochondral lesions of the humerus: diagnosis and management. Oper Tech Sports Med. 2008;16(4):178–86.
17. 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(3):249–57.
18. Mazzocca AD, Rios CG, Romeo AA, Arciero RA. Subpectoral biceps tenodesis with interference screw fixation. Arthroscopy. 2005;21(7):896.
19. Millett PJ, Sanders B, Gobezie R, Braun S, Warner JJ. Interference screw vs. suture anchor fixation for open subpectoral biceps tenodesis: does it matter? BMC Musculoskelet Disord. 2008;9:121.
20. Millett PJ, Schoenahl JY, Allen MJ, Motta T, Gaskill TR. An association between the inferior humeral head osteophyte and teres minor fatty infiltration: evidence for axillary nerve entrapment in glenohumeral osteoarthritis. J Shoulder Elbow Surg. 2013;22(2):215–21.
21. Weinstein DM, Bucchieri JS, Pollock RG, Flatow EL, Bigliani LU. Arthroscopic debridement of the shoulder for osteoarthritis. Arthroscopy. 2000;16(5): 471–6.
22. Cameron BD, Galatz LM, Ramsey ML, Williams GR, Iannotti JP. Non-prosthetic management of grade IV osteochondral lesions of the glenohumeral joint. J Shoulder Elbow Surg. 2002;11(1):25–32.
23. Richards DP, Burkhart SS. Arthroscopic debridement and capsular release for glenohumeral osteoarthritis. Arthroscopy. 2007;23(9):1019–22.
24. Kerr BJ, McCarty EC. Outcome of arthroscopic debridement is worse for patients with glenohumeral arthritis of both sides of the joint. Clin Orthop Relat Res. 2008;466(3):634–8.
25. Van Thiel GS, Sheehan S, Frank RM, Slabaugh M, Cole BJ, Nicholson GP, Romeo AA, Verma NN. Retrospective analysis of arthroscopic management of glenohumeral degenerative disease. Arthroscopy. 2010;26(11):1451–5.