Review Article

# Glenohumeral Dislocation Arthropathy: Etiology, Diagnosis, and Management

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## Abstract

Dislocation arthropathy describes the development of progressive degenerative changes of the glenohumeral joint in the setting of instability. Although the specific etiology remains unclear, the trauma of a single dislocation, repetitive injury associated with recurrent dislocations, changes in shoulder biomechanics, and complications associated with instability surgery have all been implicated in its development. Pain and restricted range of motion are the most common patient complaints. Conservative management, consisting of pain control, activity modification, and physical therapy, is the first-line treatment after the development of arthropathy. If conservative management fails, multiple surgical options exist. Arthroscopic débridement can be attempted in young, active patients and in those patients with mild-to-moderate arthropathy. Open subscapularis lengthening and capsular release can be done in patients with prior instability repairs that are overly tight. In young patients with minimal bone loss and glenoid wear, surface replacement arthroplasty and hemiarthroplasty are surgical options. In older patients with moderate-to-severe arthropathy, total shoulder or reverse shoulder arthroplasty is the preferred treatment option. Further study is needed to better predict which patients will develop dislocation arthropathy and will thus benefit from early surgical intervention.

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In 1982, Neer et al[1] identified a subset of patients with glenohumeral arthritis who had a history of shoulder instability or had surgical stabilization for instability. This condition was formally described in 1983 by Samilson and Prieto[2] who coined the term dislocation arthropathy when they noted glenohumeral arthritis in patients with a history of even a single dislocation. Subsequently, changes in shoulder biomechanics secondary to many previously popular nonanatomic surgical procedures used to address instability have been associated with the development of premature arthrosis, also referred to as capsulorrhaphy arthropathy.

Currently, dislocation arthropathy describes degenerative changes of the glenohumeral joint after at least one dislocation with or without surgical intervention for instability. In this article, we will present a review of the literature, the relevant anatomy, clinical presentation, and the diagnosis and management options for dislocation arthropathy.

## Anatomy and Biomechanics

The glenohumeral joint is unique in its wide arc of motion and low level of osseous constraint. The price of this

**Figure 1**


A B C

**A**, Left shoulder AP radiograph demonstrating severe dislocation arthropathy with joint space narrowing and large inferior osteophytes. This patient is a 61-year-old man who had a single glenohumeral dislocation at age 25 years. **B**, Left shoulder axial CT image demonstrating severe dislocation arthropathy in the same patient. **C**, Left shoulder CT 3D reconstruction image showing severe dislocation arthropathy in the same patient.

freedom of movement is a high degree of instability. This joint relies on a complex interplay of static and dynamic stabilizers to maintain the head of the humerus reduced on the surface of the glenoid.[3] The static stabilizers include the glenohumeral articulation, the labrum, the glenohumeral ligaments and rotator cuff interval, and the negative intra-articular pressure. The dynamic stabilizers consist of the rotator cuff, the deltoid, and the scapular stabilizers. Damage or dysfunction of any part of these stabilizers can result in clinically notable instability.

Instability can be the result of multiple factors, with the mechanism of initial injury being anterior dislocation through a combination of abduction and external rotation in most patients. Specific pathology that commonly contributes to recurrent instability includes Bankart and bony Bankart lesions, excessive capsular laxity, Hill-Sachs lesions, rotator cuff and subscapularis injuries, capsular injury, glenoid fractures, or dysplasia.[4]

Several anatomic and nonanatomic procedures have been developed to address glenohumeral instability. Overtightening the anterior capsule may result in biomechanical changes and restrictions in motion, leading to progressive capsulorrhaphy arthropathy. Excessive anterior tightening can result in increased posterior subluxation of the humeral head, shearing forces on the posterior glenoid, and eventual arthrosis. In addition, mispositioned implants or bone grafts, such as screws, anchors, or bone block, can also lead to premature arthrosis.[5]

## Natural History

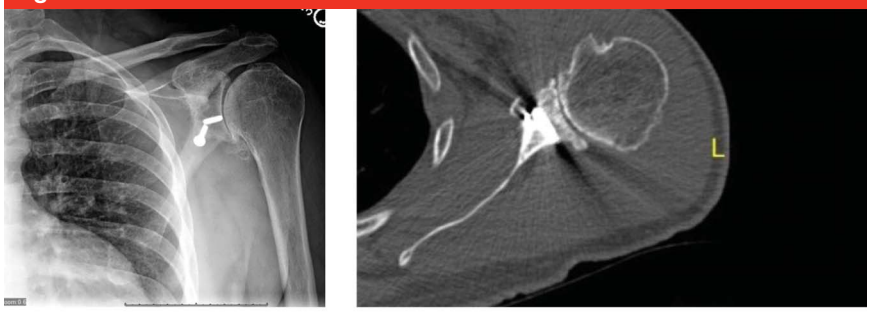
Shoulder instability is common, with an incidence of 1.7% in the general population.[6] The recurrence rate is high, especially among the young and those participating in contact sports. The trauma of a single dislocation event, repetitive injury of multiple dislocations and changes in biomechanics, and intra-articular device placed during surgical repair have all been implicated in the development of dislocation arthropathy. Norlin[7] reported on 24 patients with an acute, primary anterior dislocation who were assessed arthroscopically 1 to 3 days after the injury. Of the 24 shoulders assessed, 18 had chondral lesions—with the remaining six demonstrating osteochondral lesions, after a single dislocation event. Hovelius and Rahme[8] conducted a prospective study of 257 primary anterior shoulder dislocations in 255 patients. At 25-year follow-up, 27% had mild glenohumeral arthritis and 34% had moderate to severe arthrosis. Several of the patients found to have arthritic changes experienced only a single dislocation event (Figure 1). This may suggest the trauma associated with the primary dislocation event or the resulting changes in glenohumeral biomechanics play an important role in the development of arthropathy, although the role of recurrent dislocation remains unclear.

## Historical Management

The ideal management for first-time glenohumeral dislocation remains controversial, with most of the patients being managed nonsurgically. The high rate of re-dislocation, especially in certain populations, such as contact athletes and young men,[10] has prompted the study of more aggressive treatment for primary dislocations. Crall et al[11] conducted a cost-effective analysis and found that primary arthroscopic

stabilization is effective at preventing re-dislocation and is more cost-effective than nonsurgical treatment. In a systematic review, Brophy and Marx[12] found that surgical management in young patients was associated with a markedly lower rate of recurrence at both 2-year and longer term follow-up. Many historical surgical treatments have been associated with the development of arthropathy, leading to the suspicion that instability surgery may contribute to arthropathy, rather than prevent it.

Figure 2




A B

**A**, Left shoulder AP radiograph of patient status post–Bristow procedure. **B**, Left shoulder CT image of a patient status post–Bristow procedure.

## Putti-Platt Repair and Magnuson-Stack Procedure

The Putti-Platt repair involves overlapping the medial and lateral aspects of the tenotomized subscapularis, effectively shortening it, and tightening and reinforcing the anterior capsule, thereby increasing shoulder stability and reducing external rotation. The Magnuson-Stack procedure transfers the subscapularis insertion site from the lesser tuberosity to just lateral to the bicipital groove.

At a mean follow-up of 22 years, van der Zwaag et al[13] found arthritic changes in 61% (40/66) after Putti-Platt repair. Hawkins and Angelo[14] reported 11 shoulders that developed painful arthrosis at 13.2 years after Putti-Platt surgery. Matsen et al[15] coined the term capsulorrhaphy arthropathy to describe glenohumeral arthritis developed because of excessive soft-tissue tightening. Hawkins and Angelo[14] speculated that an extremely tight repair would cause limitations in external rotation. Once this limit was surpassed, the humeral head would exert abnormally high forces on the glenoid, leading to cartilage wear. Kiss et al[16] reported pain and limited external rotation in 90% of patients at 9-year follow-up after Putti-Platt repair. They concluded that both the incidence and severity of osteoarthritis were markedly increased after Putti-Platt repair.

The Manguson-Stack procedure was designed to restore shoulder stability by transferring the subscapularis attachment site. However, this surgery does not address the pathologic lesion created by the instability event. Moreover, recurrence rates range from 2 to 17%,[17,18] and similar to the Putti-Platt repair, this procedure is associated with premature arthrosis.[4]

## Bristow-Latarjet

The Bristow-Latarjet procedure involves transferring the coracoid tip or body along with its muscular attachments to the anterior-inferior glenoid, creating an anterior-inferior musculotendinous sling (Figure 2).

Hovelius et al[19] found mild arthropathy in 35% and moderate to severe arthropathy in 14% of shoulders treated with the Bristow-Latarjet procedure at 15-year follow-up. Suboptimal (lateral) positioning of the coracoid transfer and/or prominent screws used in the Bristow-Latarjet procedure is thought cause impingement against the humeral head during abduction and external rotation.[19,20]

## Bankart Procedure

The Bankart procedure involves reattachment and tightening of the anterior-inferior labrum and inferior glenohumeral ligament complex.

A 2001 study found arthropathy in 16 of 26 shoulders after Bankart repair (14 mild, 2 moderate).[20] Another study found arthritic changes in 41% at 8-year follow-up; 8 of 34 (24%) had minor changes and 6 of 34 (17%) had moderate changes.[21] None had severe changes. Franceschi et al[22] had similar findings after arthroscopic Bankart repair, with 12 of 55 shoulders (21.8%) showing arthritic changes at 8-year follow-up. The number of anchors used and labral damage were the most important factors associated with a higher risk of radiographic arthritic changes.

Plath et al[23] found 69 of 100 shoulders with some evidence of arthrosis 13 years after Bankart repair, although most changes were mild according to the Samilson classification.[2] Patients with arthritic changes were generally older at initial dislocation and at the time of surgery, and there was a positive correlation between the grade of arthritic changes and the number of dislocations before surgical stabilization. Constant scores did not correlate with the degree of radiographic changes. Whereas the type of anchor or fixation device used during the repair did not affect either the presence or the severity of osteoarthritis, a higher number of fixation devices used during surgery had a positive correlation with the presence and severity of arthritis. Recurrent

dislocation after surgery did not appear to affect the presence or severity of arthritic changes.

## Eden-Hybinette

The Eden-Hybinette operation is an augmentation of the anterior glenoid rim with an iliac crest bone graft.

Several groups have reported very high rates of arthropathy after the Eden-Hybinette operation. Brox et al[24] found mild or moderate arthrosis in 24 of 45 patients (53%) on the operative side compared with 9 of 45 patients (20%) on the nonoperative side at 14-year follow-up. Konig et al[25] reported that 8 of 9 patients (88.9%) had arthritic changes at 26.9-year follow-up (versus 15 of 26 patients (57.6%) who underwent Putti-Platt). Changes were mild in three, moderate in two, and severe in three patients. Although the numbers were small, these results support the view that arthrosis rates are extremely high after Eden-Hybinette operation. Rachbauer et al[26] reported similar numbers, with arthritic changes in 88.9% of 36 shoulders.

## Risk Factors

Prior surgery is perhaps the most important risk factor for the development of dislocation or capsulorrhaphy arthropathy. In addition, several other risk factors have been associated with arthropathy. Hovelius and Saeboe[27] found that history of dislocation (both solitary and recurrent), age at primary dislocation, contact sports, and alcohol abuse were all associated with the later development of glenohumeral arthropathy. Buscayret et al[28] found the most predictive preoperative risk factors to be older age at initial dislocation or surgery, increased length of time between initial dislocation event and surgery, and concomitant rotator cuff tear, glenoid lesion, or humeral head lesion. Postoperative risk factors included older age at initial dislocation and surgery, increased number of dislocation events, and longer follow-up.

The extent of trauma occurring during the initial dislocation can play a large role in the development of arthropathy, with bony injuries of the glenoid and humeral head impaction fractures being known contributing factors of future arthrosis.[28]

Older age at the time of initial dislocation and/or surgery is one of the most consistent risk factors for the development of arthropathy.[23,28] Plath et al[23] suggested that although this may be related in part to the normal aging process, primary glenohumeral arthritis is a less common condition. They conclude that older individuals may be more susceptible to secondary dislocation arthropathy.

## History and Physical Examination

During history and physical examination, attention should be paid to the number of prior dislocations, age at the time of first dislocation, and any prior surgical procedures. Shoulder pain and motion restriction are the most common presenting complaints. Assessing both active and passive range of motion, and rotator cuff strength, especially subscapularis integrity after any prior open procedures, is important. Motion loss may be related to osteophyte impingement, capsular contracture, posterior humeral head subluxation, and excessive tightening of the anterior capsule or subscapularis shortening during a stabilization procedure.[9] Severe internal rotation contracture may indicate posterior glenoid wear, retroversion, and posterior bone loss.

## Imaging

Radiographs of post-dislocation arthropathy typically demonstrate joint space narrowing, osteophyte and cyst formation, subchondral sclerosis, and posterior glenoid wear. In 1983, Samilson and Prieto[2] proposed a radiographic system of staging post-dislocation glenohumeral arthropathy, which was later expanded by Buscayret et al[28] in 2004, by further differentiating stage 3 into two stages.

Although not specific to post-dislocation arthropathy, Walch et al[29] classified glenoid morphology into subtypes, and recently expanded this classification based on three-dimensional imaging.[30] Type A1 glenoids have a humeral head centered on the glenoid with minor central erosion and A2 glenoids have major central erosion. Type B1 glenoids have posterior humeral head subluxation with glenoid retroversion. B2 glenoids have a biconcave deformity. B3 glenoids are monoconcave and posteriorly worn, with at least 15° retroversion or at least 70% posterior humeral head subluxation, or both. Type C glenoids have a premorbid retroversion of >25°. A type D glenoid has anteversion or humeral head subluxation of less than 40%. Noteworthy is that in many cases of post-dislocation arthropathy, tightening of the anterior capsule can result in posterior displacement of the head, resulting in severe B2 and B3 deformities.

The fact that the presence of radiographic changes does not necessarily correlate with symptoms or subjective assessment of function should be emphasized.[8] This aspect may be particularly true in the case of mild radiographic changes in which patients often exhibit no clinical symptoms.

CT may be more effective at detecting arthritic changes after dislocation. Ogawa et al[31] examined 282 young patients with unilateral instability without previous surgery. Arthritic changes were found in 32 shoulders (11.3%) on the plain radiographs. Conversely, CT pneumoarthrography revealed arthritic changes in 88 shoulders (31.2%), including all 32

of the arthritic shoulders found on plain radiographs. Furthermore, CT evaluation, particularly with 3D reconstruction (Figure 1, C), details the osseous anatomy of the glenohumeral joint and allows for the quantification of any glenoid bone loss and version abnormalities more reliably than radiographs.

In our practice, plain radiographs and occasionally non-contrast MRI are used in cases of minimal to moderate arthropathy to determine the extent of disease and the presence of cartilage loss on both the humeral and glenoid surfaces. The presence of full thickness cuff tears, loose bodies, or biceps pathology that may be contributing to symptoms can be delineated with MRI and may guide the physician in determining whether arthroscopy has a role in management. Three-dimensional imaging, such as CT, is generally reserved for advanced arthropathy to determine the degree of glenoid deformity, retroversion, and the adequacy of the glenoid vault in preparation for anatomic shoulder arthroplasty or reverse total shoulder arthroplasty.

## Management

There are many treatment options for dislocation arthropathy. Considering both patient-specific and shoulder-specific factors when determining the appropriate course of management is essential. Patient-specific factors include current age and activity level. Shoulder-specific factors include prior surgery, severity of motion loss or contracture, severity of the bony glenoid deformity, and the presence of humeral head subluxation.

### Nonsurgical Management

Nonsurgical management continues to be the initial treatment for most patients with dislocation arthropathy, which includes activity modification and anti-inflammatory medications. Physical therapy and a comprehensive strengthening program of the rotator cuff and surrounding musculature can be particularly helpful. Educating patients to avoid movements or activities that promote subluxation or dislocation is helpful in preventing future dislocation and improving pain relief and function. Corticosteroid and viscosupplementation injections may also provide relief in certain patients; however, data supporting this postulation are limited.

### Arthroscopic Débridement/Capsular Release

In patients with mild to moderate arthritis who have continued pain despite prolonged nonsurgical management, arthroscopic débridement may be appropriate to provide symptomatic relief. This approach is effective especially in less active patients with lower demands or in young, active patients who may want to avoid arthroplasty or other open procedures.[32] Arthroscopic or open capsular release and subscapularis lengthening may be indicated when limited range of motion is the chief complaint.[33] Arthroscopic débridement is contraindicated in patients with severe arthritic changes and/or complete loss of joint space, notable bone loss, or loss of articular congruency.

A recent systematic review of 212 patients who underwent arthroscopic débridement for glenohumeral arthritis found that most patients noted a notable improvement in motion and functional outcomes at 34.8-month follow-up, with 13% requiring conversion to shoulder arthroplasty.[34] A further study by the same group found that although arthroscopic débridement combined with capsular release did provide pain relief and improvements in motion, these results were often only temporary. They concluded that isolated arthroscopic débridement and capsular release may not provide enough benefit to justify its use in most patients.[35]

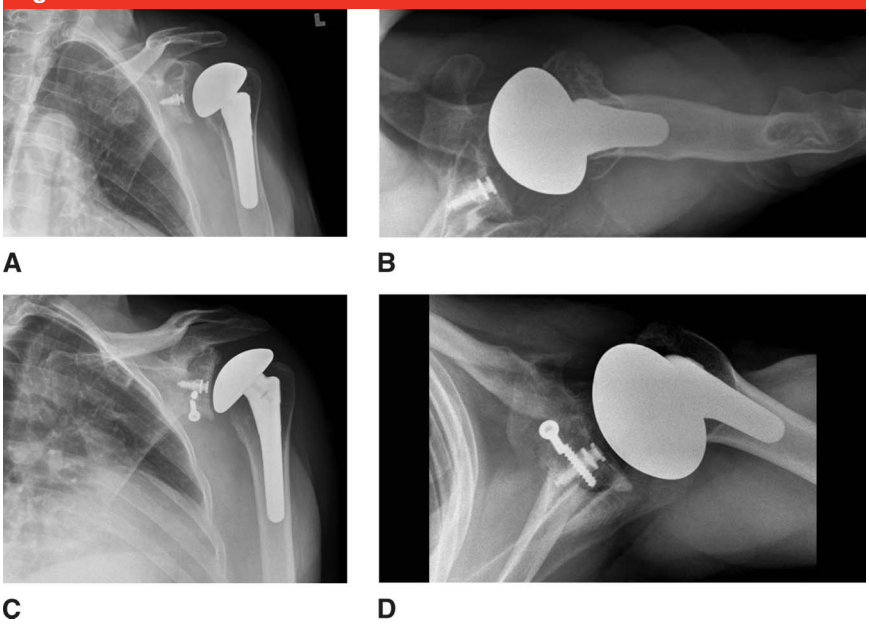
Expanding on these procedures, Millett et al[36] developed the comprehensive arthroscopic management (CAM) procedure as an alternative to arthroplasty, especially for young or active patients who may wish to delay progression to arthroplasty as much as possible. The procedure involves arthroscopic débridement, humeral osteoplasty and osteophyte excision, extensive capsular release, axillary nerve neurolysis (if compression or scarring present), and biceps tenodesis. In their series of 29 patients (30 shoulders), they noted improvements in function and reductions in pain in patients treated with the CAM procedure. They found that in patients with less than 2 mm of glenohumeral joint space preoperatively, their condition was nearly 8 times more likely to progress to an arthroplasty.[36]

Arthroscopic débridement and the CAM procedure may improve function, reduce pain, and delay arthroplasty in young, active patients and those with preserved joint space. Although an arthroscopic débridement procedure has the advantages that are inherent with an arthroscopic surgery, we typically reserve this treatment strategy for a highly selective subset of patients.

### Surface Replacement Arthroplasty

Young patients with humeral head articular cartilage loss and minimal bone loss, along with minor glenoid wear, may benefit from surface replacement arthroplasty.[37] In this procedure, only the damaged humeral surface is replaced, whereas the glenoid is not resurfaced. Preserving the glenoid bone stock and native anatomy increases surgical options for future revisions if necessary. Levy and Copeland[38] noted improvements in active elevation for patients who underwent surface replacement

**Figure 3**




**A**, Left shoulder AP radiograph of the same patient in Figure 1, now status-post left total shoulder arthroplasty. **B**, Left shoulder axillary radiograph of the same patient in Figure 1, now status-post left total shoulder arthroplasty. **C**, Left shoulder AP radiograph of the same patient in Figure 2, now status-post left total shoulder arthroplasty. **D**, Left shoulder axillary radiograph of the same patient in Figure 2, now status-post left total shoulder arthroplasty.

arthroplasty for instability arthropathy. Long-term data are lacking, and some data suggest that it may lead to progressive glenoid erosion and pain, and may limit the surgical approach to the glenoid for future revision procedures.[37] Despite these limitations, surface replacement arthroplasty remains an option for young patients with minimal osseous deformity of the humeral head and well-maintained glenoid articular cartilage.

## Hemiarthroplasty/Ream and Run

In younger patients (less than age 50 years) and patients with minimal concentric glenoid wear, hemiarthroplasty is a surgical option.[39] The benefit is that it poses no risk of loosening or glenoid component failure that could occur with total or reverse total shoulder arthroplasty. Werner and Gohlke[40] noted Constant score improvements from 16.8 to 78.1 in 29 patients treated with humeral head arthroplasty, with a mean follow-up of 39 months. Five patients required revision, and two required conversion to total shoulder arthroplasty after developing painful glenoid erosion. Hemiarthroplasty is relatively contraindicated in shoulders with eccentric glenoid wear.[41]

The ream and run procedure is ideally indicated for younger or very active patients, in which a conventional humeral prosthesis is combined with concentric reaming of the glenoid. The goal of concentric reaming is to "re-center" the posteriorly subluxated humeral head. Matsen et al[42] highlighted the increased failure risk of total shoulder arthroplasty in patients with the "arthritic triad" of posterior humeral head displacement, glenoid biconcavity, and retroversion. They reported the ream and run procedure resulted in improved centering of the humeral head and increases in patient-reported outcomes while avoiding the risk of glenoid component failure.

## Anatomic Total Shoulder Arthroplasty

Total shoulder arthroplasty should be considered in older patients with post-dislocation arthropathy with an intact rotator cuff and sufficient bone stock to support the glenoid component.[39] In a series of 17 patients with post-dislocation arthropathy, Bigliani et al[43] found total shoulder arthroplasty to be a satisfactory treatment, with 16 of 17 patients experiencing pain relief and increases in elevation and external rotation. The complexity of the operation was increased because of bony and soft-tissue deformity after prior instability surgery. Extensive scarring, distorted anatomy, soft-tissue contractures, and posterior glenoid wear associated with capsulorrhaphy arthropathy provide notable challenges.[43] Green and Norris[44] also reported reduced pain and improved function after total shoulder arthroplasty after surgical intervention for anterior instability. Their results were inferior to those typically reported for total shoulder arthroplasty for primary osteoarthritis and they attributed this to internal rotation contracture and scarring. Matsoukis et al[45] compared shoulder arthroplasty outcomes for patients with arthropathy after nonsurgical management of anterior shoulder instability to shoulder arthroplasty in patients with a history of instability surgery. The authors found no notable differences in functional outcome, complication rate, reoperation rate, or radiographic findings. Their results were similar to previous studies that reported good outcomes, however not as good as those reported for arthroplasty performed for primary osteoarthritis.

Overall, anatomic total shoulder arthroplasty is a suitable treatment

for advanced dislocation arthropathy (Figure 3). Although outcomes are generally good, symptomatic improvement is not as substantial as compared with outcomes of total shoulder arthroplasty for primary osteoarthritis.[43-45] More severe posterior glenoid wear secondary to capsular overtightening during the index procedure is expected at the time of arthroplasty. Consequently, eccentric reaming, bone grafting, and the use of a stepped or augmented glenoid prosthesis may all be used to correct excessive retroversion or concomitant bone loss. Furthermore, circumferential subscapularis release may be used for proper soft-tissue balancing.

## Reverse Total Shoulder Arthroplasty

Reverse total shoulder arthroplasty is most commonly considered for patients with rotator cuff tear arthropathy. Medialization of the shoulder's center of rotation recruits additional deltoid muscle fibers to flex and abduct the shoulder, thereby compensating for the loss of rotator cuff function.[44,46] Furthermore, reverse shoulder arthroplasty also provides a fixed fulcrum that keeps the humerus centered. Raiss et al[47] evaluated outcomes after reverse shoulder arthroplasty in patients with a prior surgery for recurrent anterior instability. At 3.5-year follow-up, patients experienced notable improvements in shoulder flexion, Constant score, and internal rotation. Twelve of 13 patients were satisfied with the outcome, similar to outcomes for reverse shoulder arthroplasty for cuff tear arthropathy.

Glenoid morphology has an effect on the outcomes after shoulder arthroplasty. The B2 glenoid has been associated with poor outcomes after anatomic shoulder arthroplasty.[48] Mizuno et al[49] reported notable improvements in Constant score, active forward flexion, external rotation, and internal rotation in patients with a biconcave glenoid and an intact rotator cuff treated with reverse total shoulder arthroplasty. Further investigation is necessary to determine whether these positive outcomes are comparable in patients with a B2 glenoid as a result of dislocation arthropathy versus primary glenohumeral arthritis.

## Authors' Preferred Treatment Approach

In young, active patients with early radiographic arthropathy, we initially pursue conservative management. This approach includes activity modification, NSAIDs, corticosteroid injection, and, in select cases, a course of viscosupplementation in combination with an intra-articular NSAID. Should these patients fail nonsurgical management, then surgical intervention is considered.

Arthroscopic débridement may be considered in those with greater than 2 to 3 mm of preserved joint space, with concomitant biceps tenotomy or tenodesis based on physical examination findings and response to diagnostic injection. For young, active patients with moderate to severe arthropathy who have failed nonsurgical management, we consider hemiarthroplasty versus total shoulder arthroplasty depending on their weight-bearing and activity requirements. Noteworthy is that in cases of a previous stabilization procedure, the subscapularis may be shortened or attenuated. A meticulous dissection is required to identify the borders of the subscapularis, especially in cases of a previous Bristow/Latarjet procedure in which the conjoined tendon may be adherent to the muscle belly. In cases where passive glenohumeral external rotation is less than 0° with the arm in adduction, we prefer to perform a subscapularis peel with subsequent medialization of the repair through bone tunnels to improve external rotation. In other cases, a lesser tuberosity osteotomy is performed with care to maintain the anterior capsule as we think this adds structural bulk to the subscapularis which may be compromised in this setting. If an implant from the previous surgery is encountered, it is generally removed. However, if the hardware cannot be removed safely, and it will not interfere with placement of the glenoid component, then it is left in situ. In older patients with advanced arthropathy, severe glenoid pathology (eg, B3 or C), or rotator cuff insufficiency, we recommend reverse total shoulder arthroplasty for the most predictable outcome.

If there is any suspicion of occult infection before arthroplasty, serum cell count and inflammatory makers are obtained, as well as intra-articular fluid for cell count, culture, and a qualitative α-defensin assay (Synovasure; Zimmer-Biomet). Noteworthy is that *Propionibacterium acnes* may present with pain or mild transient erythema and negative inflammatory markers. Consequently, a high level of suspicion should be maintained for any patient with persistent pain from the time of index surgery, and open biopsy may be considered in these cases before arthroplasty.

## Summary

Dislocation arthropathy represents a treatment challenge for shoulder surgeons. Discussing prevention strategies and treating shoulder instability appropriately from the time of a first dislocation, years before arthropathy develops, are essential. Shoulder instability is common, and the number of dislocations, older age at primary dislocation or surgery, historical procedures that shorten the subscapularis, number of anchors used during repair, and increased time between initial dislocation and

surgery have all been associated with the development of arthropathy. Once arthropathy develops, management is based largely on patient age, activity level, and severity of arthropathy and/or bone loss. Surgical management options include arthroscopic débridement, surface arthroplasty, hemiarthroplasty, total shoulder arthroplasty, and reverse shoulder arthroplasty. Further investigation is required to better predict which patients will develop dislocation arthropathy and which patients may benefit from early surgical intervention.

## References

*Evidence-based Medicine:* Levels of evidence are described in the table of contents. In this article, reference 10 is a level I study. References 11, 27, 29 and 48 are level II studies. References 21 and 41 are level III studies. References 19, 20, 22, 23, 24, 28, 34-36, 38, 42, 45, 47 and 49 are level IV studies. Reference 1 is a level V study.

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