Evoluci{	extquoteleft}n of arthroscopic shoulder stabilization: do we still need open techniques?

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Abstract

Introduction

Traumatic anterior instability of the shoulder is a common condition associated with a high recurrence rate in young adults. Clinicians, therefore, have been trying to find a technically simple, highly effective, reproducible procedure for recurrent anterior shoulder instability. The arthroscopic treatment of glenohumeral instability is becoming increasingly accepted as a viable treatment option. The purpose of this paper is to evaluate the accuracy of arthroscopic techniques comparing them with the open surgical procedures, and to find out whether there are absolute contraindications for arthroscopic techniques.

We conducted a critical review of recently published relevant literature.

Discussion

Arthroscopic stabilization has become the panacea for traumatic shoulder instability due to the escalating advances in surgical techniques and technology. In comparison with open techniques, arthroscopic procedures have the advantages of decreased morbidity rate, early functional rehabilitation and improved range of motion.

Conclusion

The absolute contraindications to arthroscopic shoulder stabilization are decreasing every day. We believe that significant humeral head defects and sizable glenoid bone loss remain the only definitive indications for open surgery.

Introduction

The glenohumeral joint is inherently unstable because the large humeral head articulates with the small shadow glenoid fossa. Stability of the shoulder joint is based on both static and dynamic stabilizers. Static stabilizers include the glenoid labrum, the joint capsule and the rotator interval.

The labrum is a fibrocartilaginous ring that circumferentially attaches to the glenoid rim. The function of the glenoid labrum in maintaining the stability of the glenohumeral joint has been well-described. Labral resection will reduce resistance to translation by 20%-4. The labrum doubles the anteroposterior deepness of the glenoid fossa and serves as a bumper preventing the head from rolling over the anterior edge of the glenoid. The antero-inferior labrum also serves as the anchor point for the inferior glenohumeral ligament. Above the glenoid equator, the labrum is relatively mobile, whilst below the glenoid equator the labrum is more securely attached to the glenoid articular surface.

The inferior glenohumeral ligament complex is the primary check against anterior, posterior and inferior translation between 45° and 90° of glenohumeral elevations. The superior and middle glenohumeral ligaments limit anteroposterior and inferior translation in the middle and lower levels of elevation as the arm approaches the adducted positions.

The rotator interval region between supraspinatus and subscapularis provides stability against inferior and posterior translation, particularly when the arm is adducted and externally rotated.

Dynamic control is conferred by the rotator musculature, biceps brachii and scapular muscle function. The rotator cuff and the long head of biceps brachii enhance stability by increasing compression across the glenohumeral joint, thereby increasing the loads required to translate the humeral head. The task of joint compression on shoulder stability was elucidated by Lippitt and Matsen and termed ‘concavity compression’. It referred to the stability obtained by compressing the humeral head into the concave glenoid fossa.

The articular surface also plays a key role in stability. Likewise, negative intra-articular pressure and adhesion-cohesion enhance shoulder stability. The aim of this critical review is to discuss the evolution of arthroscopic shoulder stabilization techniques.

Discussion

The authors have referenced some of their own studies in this paper. These referenced studies have been conducted in accordance with the Declaration of Helsinki (1964), and the protocols of these studies have been approved by the relevant ethics committees related to the institution in which they were performed. All human subjects, in these referenced studies, gave informed consent to participate in these studies.

Pathoanatomy

An avulsion of the labrum from the glenoid rim below the equator is known as Bankart lesion, which is considered the essential pathoana-
tomic lesion. It is present in about 90% of all traumatic anterior shoulder dislocations. Nonetheless, sectioning and stress testing have also shown that, despite being considered the essential lesion, a Bankart lesion alone is not enough to permit recurrent instability. Associated plastic deformation of the glenohumeral ligaments is a necessary factor in recurrent instability and must be addressed if successful stabilization is to be achieved arthroscopically.

Classification of shoulder instability
The classification of instability has historically been based on direction (anterior, posterior, inferior or multidirectional), degree of instability (subluxation or dislocation) and the number of episodes of instability (primary vs. recurrent) 1.

Traditional classification systems attempt to define two distinct types of instability: traumatic instability, unidirectional, Bankart lesion, treated with surgery (TUBS); and atraumatic instability, multidirectional, bilateral, initially treated with rehabilitation, inferior capsular shift if open management fails (AMBRI) 2.

Nevertheless, this classification scheme represents a remarkable oversimplification of the problem. Many patients fall outside or between these two groups and require treatment directed at their specific anatomic pathology 1.

Gerber and Nyffeler 3 described a classification system that distinguishes between static, dynamic and voluntary instabilities. The static instabilities (Class A) are defined by the absence of classic symptoms of instability and are associated with rotator cuff tears and degenerative joint diseases. The diagnosis is radiological, not clinical. Dynamic instabilities (Class B) are always initiated by trauma, and patients present symptoms of instability. The last group, Class C, includes patients who can dislocate their shoulders voluntarily.

Evolution of arthroscopic repairs
Over the past few decades, arthroscopic techniques have evolved and are currently widely used in Bankart repair for recurrent shoulder instability. Arthroscopic repairs have been developed in an attempt to reduce common criticisms associated with open techniques, including wide dissection, loss of external rotation and the presence of post-operative pain.

Historically, the literature has defined the failures of instability repairs as those that develop recurrent instability with shoulders that are too loose. Yet, there is inadequate declaration in the literature of failure of instability repairs that are too tight, resulting in stiffness, loss of motion and late degenerative changes. It is crucial to emphasize that stiffness does not equal stability as there is a significant danger in soft tissue overconstraint.

Additionally, a review of early literature regarding the results of open repair shows that there are large retrospective series with relatively poor results in terms of returning athletes to their original level of play.

In 1982, Detrisac and Johnson 4 performed the first arthroscopic shoulder stabilization procedure using a capsular stapling technique. However, this method was quickly abandoned because of hardware problems and an inability to address capsular laxity. Lane et al. 5 reported on 54 patients who underwent arthroscopic staple capsulorrhaphy with an average follow-up of 39 months. There was a 33% recurrence rate, with 18.5% requiring a subsequent open reconstructive procedure. Follow-up radiographs revealed that 15% developed loose staples. Only 43% of athletes were able to return to their pre-injury level of activity.

Morgan and Bodenstab introduced transglenoid sutures in 1987 6. Many authors have reported variable results. In 1988, Caspari 7 described a technique that allowed him to advance and adjust tension in the capsuloligamentous structures. He reported a 4% failure rate with a 2- to 6-year follow-up. An advantage of the transglenoid technique was the multiple points of fixation for the labrum. In addition, it allows the surgeon to address the capsular laxity by shifting the capsule superiorly and medially on the glenoid rim. The drawbacks of this technique are that it is technically demanding; the trans-scapular drilling places the supraspinatus nerve in jeopardy, and it fails to restore the ‘bumper effect’ of the glenoid labrum.

The use of metallic hardware has been consistently shown to have complications, such as loosening, migration and breakage, which lead to pain and arthrosis. These problems led to the development of biodegradable anchors for the shoulder. Speer et al. 8 introduced a biodegradable single-point transfixing implants for intra-articular labral repair. Warner and Warren 9 reported on 20 patients treated with arthroscopic Bankart repair using a biodegradable implant. The patients were immobilized for 4 weeks. The authors found a 20% recurrence rate after 32 months. Common errors that were encountered when using the biodegradable implants included inadequate abrision of the glenoid rim, inadequate superior shift of the inferior glenohumeral ligament, medial placement of the anchor relative to the articular margin and insufficient capture and compression of the capsular tissue.

Repair techniques that use suture anchors have become the most commonly used arthroscopic repair methods. This is also the authors’ preferred technique of repair. The use of suture anchors was initially described by Weber et al. 10. The technique was modified later with the use of both absorbable and non-absorbable sutures.

This technique has the benefit of allowing the capsuloligamentous structures to be shifted supe-
riorly and be properly tensioned. Compared with transglenoid repair techniques, suture anchor methods allow for the knots to be tied in the joint arthroscopically without the need for posterior incision. Recent arthroscopic techniques involve modern suture anchors that enable capsular plication. Such techniques have been shown to decrease the recurrence rates of post-arthroscopic instability.

**Arthroscopic stabilization versus open stabilization**

According to Burkhart and De Beer, the debate over the supremacy of open versus arthroscopic surgical repair for traumatic anterior shoulder instability has finally crystallized into a classic conflict between ‘lumpers’ (the open proponents) and ‘splitters’ (the arthroscopic proponents).

Nevertheless, Green and Christiansen reported that arthroscopic stabilization procedures decreased operation-room time, blood loss, necrotic tissue, hospital stay, time for return to work and complications when compared with open procedures.

Generally, though recurrent anterior shoulder instability is one of the most widespread shoulder problems treated by orthopaedic surgeons, there have been few rigorous trial studies and meta-analyses comparing the new arthroscopic methods with the traditional open procedures.

Mothadi et al. demonstrated better outcomes with the open technique with respect to recurrence and the patient’s return to activity. On the other hand, Kim and Ha demonstrated a similar rate of recurrent instability between open repair and arthroscopic repair by suture anchors, where there were two recurrences in each group. Nevertheless, the arthroscopic group showed better functional results.

In a recent meta-analysis reported by Pettera et al., the arthroscopic repair using suture anchors resulted in similar redislocation and reoperation rates. It concluded that the redislocation and reoperation rates are improving in arthroscopic cases.

**Technical reasons for improved arthroscopic results**

Arthroscopic results have improved to the point of being equivalent to those of open procedures. This is for several reasons, including improvements in arthroscopic technique, recognition of pathology during diagnostic arthroscopy, glenoid neck preparation, soft tissue tensioning and the experience of arthroscopic surgeons. Additionally, adjusted rehabilitation, based on each patient’s pathology and arthroscopic procedure, has improved the results.

**Personal clinical and surgical experiences in arthroscopic Bankart repair**

We reported recurrence rates of 7.5% in two consequent studies of arthroscopic Bankart repair. The former study included 40 shoulders with a minimum of 2 years follow-up. The latter study had 79 shoulders in 74 patients who were followed up for more than 2 years. The patients underwent arthroscopic Bankart repair using bioabsorbable suture anchors for their shoulder instability.

The surgical technique is listed below:

- **The beach chair position** is used as it is efficient, and conversion to open repair is easier compared with the patient being in the lateral decubitus position.
- **Dual anterior portal technique** is recommended. The low portal is just above the superior border of subscapularis tendon as well as a high anterior border behind the biceps tendon.
- **After the joint is entered**, all pathology is carefully evaluated. The condition of the Bankart lesion should be assessed, including tissue integrity, presence of a bony component and suspected capsular redundancy.
- **The Bankart lesion must** be completely freed from the neck of the glenoid. This dissection could be tedious; however, every attempt should be made to avoid thinning or harming the glenohumeral ligament during the dissection. At the completion of this step, the subscapularis muscle can be clearly visible through the tear site. The goal is to mobilize the labrum so that it can be shifted superiorly and laterally.
- **The first anchor is placed** at the 5.30 clock position on the glenoid articular surface, 3 mm from the articular edge (Figure 1). We believe that this is essential in recreating the labral bumper, re-establishing the concavity compression effect and tensioning the inferior glenohumeral ligament. The most inferior placement would ideally be placed at the 6 o’clock position; however, this is often not possible due to the limitations in the placement angle.
- **A suture passer is passed under the Bankart lesion**. The suture strand of the suture anchor near the labrum is brought out through the anterosuperior portal, and, in turn, through the labrum in a retrograde fashion using a suture passer and is retrieved from the midglenoidal portal. This suture limb remains as the post during suture tying, and this ensures that the knot rests on the capsular side of the glenoid labrum and not on the articular side (Figure 2). This technique effectively pushes the labrum up towards the glenoid socket, restoring labral height.
- **The second and third suture anchors are done** at the 4.30 and 3.30 clock positions in the same manner. The sutures are tied using the Tennessee slider knot, which is easy to tie, has a low profile and possesses good holding strength.
- **In cases with anteroinferior capsular laxity**, the suture passer would be passed through the peri-
Critical review

Glenohumeral bone defect
Osseous lesions of the humeral head or glenoid commonly occur during shoulder dislocation. Arthroscopic techniques to address bone defects continue to evolve. Nonetheless, the size and orientation of the glenoid and humeral head defects can be enormously variable, making it difficult to determine pre-operatively exactly which lesions are significant or sizable enough to warrant surgical repair. We consider glenoid bone deficiency of more than 25% or Hill–Sachs lesions of more than 25% to be of critical size, and open surgical reconstruction needs to be considered.

Glenoid deficiency
Bigliani et al. developed a classification scheme for glenoid defects. Type I lesions represent an avulsion fracture with an attached capsule. Type II lesions symbolize a medially displaced fragment malunited to the glenoid rim. Type III lesions involve erosion of the glenoid rim and are additionally subdivided into <25% bone loss and more than 25% bone loss. The concept of dividing patients into groups with less than or more than 25% bone loss has been validated in a cadaveric study by Ito et al. where a glenoid defect >21% reduced the translation force required for glenohumeral dislocation.

Burkhart and DeBeer showed high rates of recurrent instability when the anterior to posterior glenoid diameter below the midglenoid is less than the anterior to posterior glenoid diameter above the midglenoid, the so-called inverted pear glenoid.

The amount of bone loss can be quantified by arthroscopic means. Burkhart et al. suggest that the bare spot can be used as a constant reference point from which to determine glenoid bone loss because it is located at the centre of a circle of the articular margin below the midglenoid notch level. By this technique they recommend bone grafting for defects >25%.

Figure 1: The suture anchor is placed on the glenoid articular surface, 3 mm from the articular edge.

Figure 2: The knot rests on the capsular side of the glenoid labrum creating a good bumper.

labral capsule, 1 cm anterior and 1 cm inferior to the Bankart lesion to plicate the redundant capsule. The drive-through sign is considered to be diagnostic of shoulder laxity. Cases of capsular laxity should be managed meticulously as unaddressed anteroinferior capsular laxity could lead to the failure of the arthroscopic stabilization.

Humeral head defects

Compression fractures of the posterolateral humeral head often occur during traumatic anterior shoulder instability, and they have been linked to high figures of recurrent instability after capsulolabral reconstruction. However, there is a considerable debate regarding the size of the humeral head defect that increases risk for recurrent dislocation.

Many authors define significant lesions as >20%-40%. Nevertheless, a recent laboratory study suggests that defects as small as 12.5% of the humeral head and certainly 25% may affect joint stability.

Additionally, it is crucial to assess the orientation of the defect. Bukhart and De Beer noted that Hill–Sachs lesions, with a long axis parallel to the anterior glenoid with the shoulder in the functional position of external rotation and abduction, were more likely to result in symptomatic subluxation or dislocation. These defects were called ‘engaging Hill–Sachs lesions’. In contrast, lesions with a long axis non-parallel to the anterior glenoid in the functional position are unlikely to engage the glenoid rim and were termed the ‘non-engaging Hill–Sachs lesions’. They do not contribute to shoulder pathology resulting in instability. Patients with non-engaging lesions are candidates for arthroscopic Bankart repair because they do not have a functional articular arc defect.

Conclusion

The continuous technical advancements and escalating surgical experiences have widened the application of arthroscopic shoulder stabilization procedures, which have become rather effective alternatives. Therefore, strict, absolute, contraindications to arthroscopic stabilization are declining. We believe that significant humeral head defects and sizable glenoid bone loss remain the only definitive indications for open surgery.

References


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