Overview of Glenohumeral Instability

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Siriraj Med J 2009;61:113-116
E-journal: http://www.sirirajmedj.com

Shoulder instability is the common shoulder problems in the young and the contact athletes. The shoulder joint is composed of 4 articulations (glenohumeral, acromioclavicular, sternoclavicular, and scapulothoracic) but the term "instability" is mainly focused on the glenohumeral articulation. The spectrum of the instability is varying upon dislocation, subluxation and the microinstability. The glenohumeral dislocation is clearly identified by severe pain, gross deformation and disability. In contrast, the clinical presentations of glenohumeral subluxation and microinstability are obscure. Once the shoulder is dislocated, the common sequela is the recurrent dislocation. The factors that influence the recurrent dislocation are age, activities, bony defect, and immobilization technique.

Biomechanics

The glenohumeral joint is the most frequent dislocated joint in the body due to the greatest arc of motion and the unconstraint characteristic. The stabilizing mechanisms of the glenohumeral joint depends on the static and dynamic stabilizers. For the static stabilizers, the bony construct and the capsulolabral complex play the major role. The glenohumeral joint is considered a ball and socket joint; however, the glenoid bone is relatively flat when compared to the deep socket of acetabulum. The glenoid labrum is a fibrous tissue that deepens the glenoid rim and serves as the attachment for the glenohumeral ligaments and the long head of biceps tendon. The glenohumeral ligaments are lax during the mid-range of motion and become taut at the extreme position. From the anatomical study, the glenohumeral ligaments have a wide variation of the size and the attachment, so is the restraint function. The glenohumeral joint capsule is a thin tissue reinforced by the glenohumeral ligaments. The intact capsule and the labrum contribute to the stability by keeping the negative intraarticular pressure along with the suction cup effect. The capsuloligametous tissue between supraspinatus and subscapularis called "rotator interval" is another area of interest. From the cadaveric study, the tightened rotator interval contributes to the glenohumeral contracture by decreaseing the external rotation. Lastly, the adhesions/cohesions are the stabilizing mechanism of the lubricated synovial fluid. Conditions that affect the wetability of the joint surface such as arthritis or displaced intraarticular fracture would compromise this mechanism. For the dynamic stability, the rotator cuff, the prime mover, and the periscapular muscles are the main stabilizers. The dynamic stabilizing mechanism that centers the humeral head to the glenoid during the midrange of motion can be explained by the net joint reaction forces and the optimal glenoid arc. Trauma is the most common etiology that compromises the stabilizing mechanism such as the labral defect (Bankart lesion), humeral head defect (Hill-Sachs lesion), glenoid bone loss (Fig. 1), capsular avulsion, and rotator cuff tear. Other than that, the deterioration of the neuromuscular control for example stroke, cervical spondylosis, or the brachial plexus injury also affect the muscles around the shoulder[1-4] (Fig. 2).

Many classification systems have been proposed based on frequency, causes, directions, and the degree

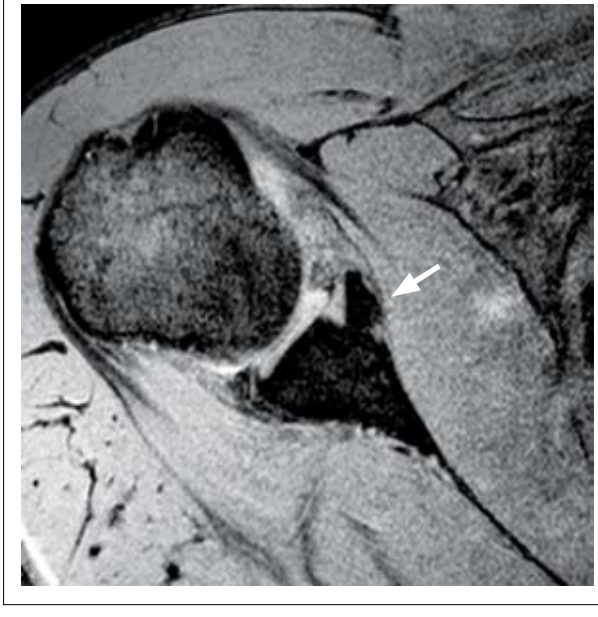

Fig. 1. The anteroinferior glenoid defect known as bony Bankart lesion (white arrow).

Fig. 2. Inferior subluxation of the left shoulder in brachial plexus injury.

Fig. 4. The positive ruler sign of the right shoulder (absence of the deltoid contour).

of instability. During the 90's, Matsen et al. categorized the shoulder instability patient in to TUBS (Traumatic etiology, Unidirectional symptom, presenting of Bankart lesion, and require Surgery) and AMBRI (Atraumatic etiology, Multidirectional instability, Bilateral symptom, response well to Rehabilitation, may require Inferior capsular shift or rotator Interval closure) which is easy to understand. However, many patients do not fall in to each category such as the ligament laxity patient who presents with atraumatic anterior instability with the Bankarts lesion.[5] Gerber et al. proposed the classification to distinguish between static instabilities, dynamic instabilities, and voluntary dislocation. This classification considered the static instabilities for the patient who had the subluxated glenohumeral joint associated with the rotator cuff or degenerative joint disease.[6] In 2004, Lewis et al. proposed the Stanmore classification using the 3 polar groups. By modifying the Matsen's concept, the patients are classified into Type I (True TUBS), Type II (True AMBRI), or Type III (Muscle patterning disorders/ Habitual non-structural) with 2 subtypes for each polar (Fig. 3). This classification system offers the flexibility in patient classifying, allow the "shift in" pattern, and also the guideline of treatment.

Clinical presentations

The thoroughly history taking such as the mechanism of injury, the position of the arm, degree of severity is a key for diagnosis. For the acute glenohumeral dislocation, the clinical findings are pain, deformity, and disability from the limited range of motion. The anterior glenohumeral dislocation always presents by the lack of deltoid bulging (Ruler sign) (Fig. 4) and the arm is held in slightly abduct, external rotation and limited in internal rotation (Dugar's sign) (Fig. 5a). In contrast, the common features of the posterior dislocation are limitation of external rotation and elevation. Because of the ability to reach the opposite shoulder and the trivial deformity, the posterior shoulder dislocation is one of the most common misdiagnosed conditions (Fig. 5b). The neurovascular status especially the axillary nerve should be monitored before and after reduction. The injury of the rotator cuff is the expected condition for the patient over 40 years old who has recurrent shoulder dislocation (Fig. 6a, b).

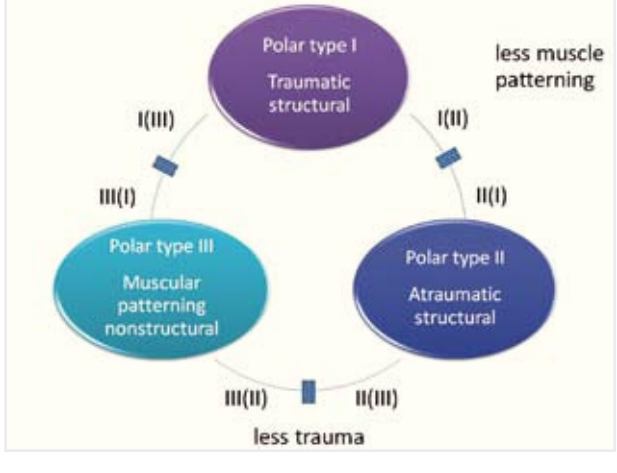

Fig 3. Stanmore classification for glenohumeral instability.

Physical examination

The physical examination for glenohumeral instability should start from the general considerations such as, adequate exposure, observing atrophy, asymmetry, winging scapular, ligamentous laxity, evaluating the active and passive ranges of motion, grading the strengths of the prime mover, rotator cuff, and scapular stabilizers.

For the instability examination, the patients should be asked whether they can demonstrate the instability or not. Frequently, the posterior instability patients show the pops out shoulder similar to the jerk test. The laxity tests such as anterior drawer, posterior drawer, sulcus should be performed on both shoulders. By estimating the amount of the translated humeral head over the glenoid, the laxity test is used to detect the excessive laxity among both shoulders. For the instability tests, the

Fig. 5. a) Anterior dislocation of the right shoulder showing the internal rotation deficit (positive Dugar's sign) b) Posterior dislocation of the right shoulder showing the external rotation deficit.

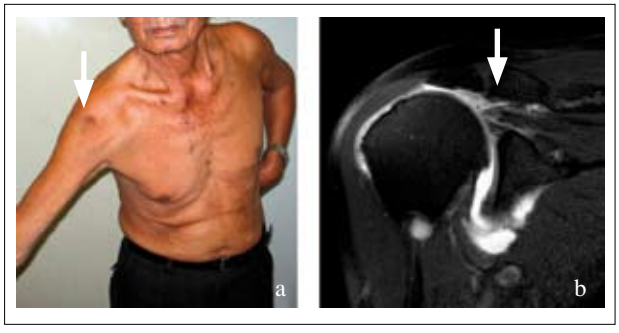

Fig. 6. a) Anteroinferior glenohumeral dislocation of the right shoulder, the patient's shoulder was locked in abducted position (arrow). MRI of this patient showing the retracted supraspinatus tear (arrow).

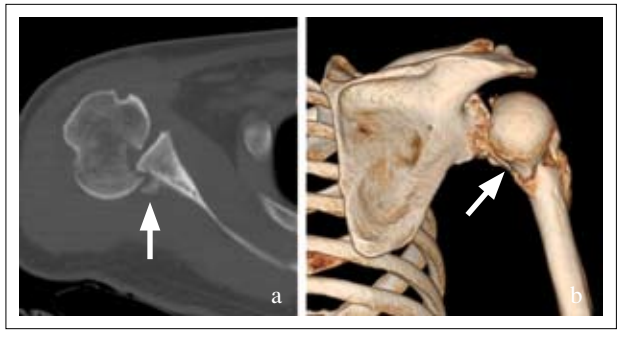

Fig. 8. a) CT scan of the right shoulder showing locked posterior glenohumeral dislocation (arrow) b) 3D reconstructed CT of the right shoulder demonstrating posterior glenohumeral dislocation, disclosing the whole humeral head (arrow).

patient shoulder is positioned in to the extreme range of motion. The positive test is reported when the patient feels the apprehension while the pain during the test is less specific. The instability test should be performed in the anterior, posterior, and inferior directions for estimating the multidirectional instability.[8]

Examination under anesthesia

The examination under anesthesia is usually performed just before the surgery. After the patient is anesthesized, the laxity test in all directions should be performed. The finding of two grades different from the normal side is usually interpreted as significant.

Investigation

The plain films for the shoulder study include AP view, transcapular view, and transaxillary view. For the acute dislocation, positioning the patient in the abducted position (transaxillary view) should be avoided (Fig. 7a). Thus, the Velpeau axillary view is recommended due to the less invasive and provides enough information (Fig. 7b). The plain films of the dislocated shoulder provide the best evidence of glenohumeral instability; however, only a small number of patient visits the hospital with the dislocated shoulder. Therefore, additional views such as Stryker notch, West point, and apical oblique view should be used to identify any bony defects.[5]

The advance imaging techniques such as CT scan or MRI play important roles for the glenohumeral instability. The CT scan is an excellent tool for demonstrating the bony abnormalities adjunct to the plain film (Fig. 8). In case a large bony defect is suspected, the CT scan is the investigation of choice. Although the cost of MRI is the highest among imaging techniques, the MRI could provide most of the information needed such as the bony and soft tissue defect. There is controversial regarding the use of arthrogram adjunct to the MRI, however, the injected dye is helpful when the defect is filled (Fig 9).

Fig. 7. a) Positioning for the transaxillary view b) positioning for the Velpeau axillary view

Non-operative treatment

The glenohumeral dislocation is considered the emergency conditions in orthopaedic. Up to now, the popular reduction techniques are traction-based such as traction-counter traction, modified Milch, Spaso's etc. Due to the high risk of fracture, the leverage techniques should be avoided.[5,9] For the first time anterior glenohumeral dislocation, the 3 week of internally rotated immobilization is recommended after reduction is achieved. In contrast, Itoi et al. mentioned that the externally rotated position better reduces the detached labrum and lowers the recurrent dislocation rate.[10] However, the same outcome could not be reproduced in the other series.

The management guideline for the recurrent glenohumeral instability is varied upon the type of the instability. However, the non-operative treatment should have been tried, especially the multidirectional instability, voluntary instability, and posterior instability. Restoring the dynamic stabilizers is the key element in non-operative treatment. Once the full range of motion is achieved, the closed chain exercise and the core strengthening should be started.[11] After the coordination is improved, the open chain exercise is followed for strengthening the prime mover and the rotator cuff.

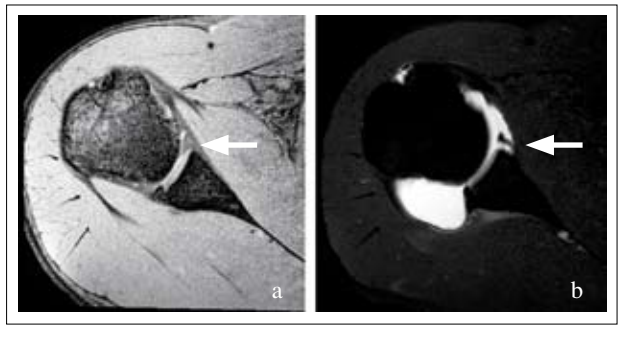

Fig. 9. a) Axial view MRI of the right shoulder showing the signal change of the anterior labrum with minimal displacement (arrow) b) Axial view MR arthrogram of the same patient showing the filled dye at the Bankart lesion (arrow).

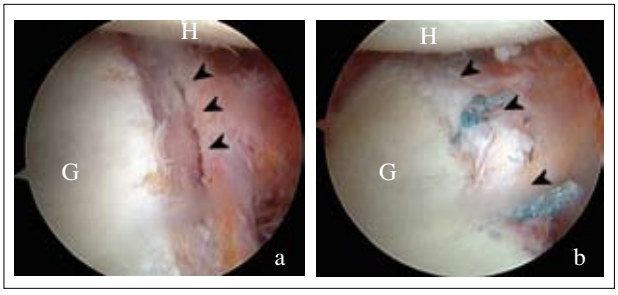

Fig 10. Anteroinferior compartment of the left shoulder viewing from posterior portal; H = humeral head, G = glenoid. a) Tear of anteroinferior labrum from the glenoid rim known as Bankart lesion (arrow head) b) Repaired Bankart lesion using 3 suture anchors (arrow head).

Fig. 11. An adolescent patient after the arthroscopic Bankart repair. a) Only 2 small hyperpigmented surgical scars are noted at the anterior aspect of the shoulder (arrows) b & c) full range of motion was achieved after 5 months of operation.

Operative treatment

Even though the dynamic stabilizer is restored, the remaining static stabilizers should provide enough stability for the construction. There are many shoulder stabilizing procedures have been described to treat the recurrent glenohumeral dislocation. These procedures could be catagorized in to non-anatomical repairs and anatomical repairs. Long-term studies for the non-anatomical repair have demonstrated the satisfactory result; however, these procedures have limitation in restricted motion and progressive arthritis. Currently, the anatomical repairs either by open or closed techniques are the procedures of choice. The most common procedure for the anterior glenohumeral dislocation is Bankart repair. This technique can be performed by approximating the labroligamentous complex back to the prepared glenoid rim (Fig. 10). The results of the Bankart repair have been reported successful in more than 90% of the patients either by open or arthroscopic techniques (Fig. 11). For the instability that caused by the large defect of humeral head or glenoid, the reconstructive surgical procedures should be considered. The humeral head defect that exceeds 40% in the young patient should have been restored by osteochondral allograft fixation, rotational osteotomy, or tendon/bone transfer, contrary to the older patient that the humeral head replacement is the procedure of choice.[12,13] The glenoid rim defect that exceeds 20% is considered the pathology that lead to the failure after Bankart repair so the bone block fixation to the anterior glenoid rim using the coracoid process or the iliac crest graft are recommended adjunct to the capsulolabral repair.[14]

Because of the improvement in basic knowledge, advance imaging, and surgical instruments, the management of glenohumeral instability is now evolving. However, the satisfactory outcome depends on the patient selection among the variety of treatment. Therefore, the thoroughly history taking, physical examination, and the proper investigation are crucial as well.

REFERENCES

1. Dugas JR, Cooper DE, O'Brien SJ. Gross and microscopic anatomy of the shoulder. In: Warren RF, Craig EV, Altchek DW, editors. The unstable shoulder. Philadelphia: Lippincott-Raven; 1999. p. 27-50.
2. Hunt SA, Kwon YW, Zuckerman JD. The rotator interval: anatomy, pathology, and strategies for treatment. J Am Acad Orthop Surg. 2007 Apr;15(4):218-27.
3. Veeger HE, van der Helm FC. Shoulder function: the perfect compromise between mobility and stability. J Biomech. 2007;40(10):2119-29.
4. Warner JJP, Boardman III ND. Anatomy, biomechanics, and pathophysiology of glenohumeral instability. In: Warren RF, Craig EV, Altchek DW, editors. The unstable shoulder. Philadelphia: Lippincott-Raven; 1999. p. 51-76.
5. Matsen III FA, Titelman RM, Lippitt SB, Rockwood Jr CA, Wirth MA. Glenohumeral instability. In: Rockwood Jr CA, Matsen III FA, Wirth MA, Lippitt SB, editors. The shoulder. 3rd ed. Philadelphia: Saunders; 2004. p. 655-790.
6. Gerber C, Nyffeler RW. Classification of glenohumeral joint instability. Clin Orthop Relat Res. 2002 Jul(400):65-76.
7. Lewis A, Kitamura T, Bayley JIL. The classification of shoulder instability: new light through old windows! Curr Orthop. 2004 April;18(2): 97-108.
8. McFarland EG. Instability and laxity. In: Kim TK, Park HB, El Rassi G, Gill H, Keyurapan E, editors. Examination of the shoulder: The complete guide. 1st ed. New York: Thieme; 2005. p. 162-212.
9. Harnroongroj T. A simple procedure for reducing anterior shoulder dislocation without anesthesia: traction, abduction and external rotation. Siriraj Med J. 1999 March 1999;51(3):153-7.
10. Itoi E, Hatakeyama Y, Sato T, Kido T, Minagawa H, Yamamoto N, et al. Immobilization in external rotation after shoulder dislocation reduces the risk of recurrence. A randomized controlled trial. J Bone Joint Surg Am. 2007 Oct;89(10):2124-31.
11. Kibler WB, Livingston B. Closed-chain rehabilitation for upper and lower extremities. J Am Acad Orthop Surg. 2001 Nov-Dec;9(6):412-21.
12. Green A. Chronic posterior dislocation; open reduction and tendon-bone transfer. In: Zuckerman JD, editor. Advanced Reconstruction Shoulder. Rosemont: The American Academy of Orthopaedic Surgeons; 2007. p. 111-20.
13. Sahajpal DT, Hawkins RJ. Chronic anterior dislocation: prosthetic replacement. In: Zuckerman JD, editor. Advanced Reconstruction Shoulder. Rosemont: The American Academy of Orthopaedic Surgeons; 2007. p. 103-10.
14. Burkhart SS, De Beer JF. Traumatic glenohumeral bone defects and their relationship to failure of arthroscopic Bankart repairs: significance of the inverted-pear glenoid and the humeral engaging Hill-Sachs lesion. Arthroscopy. 2000 Oct;16(7):677-94.