



Treatment of recurrent post-traumatic anterior-inferior glenohumeral instabilities with the selective capsular shift technique

Travma sonrası tekrarlayan anterior-inferior glenohumeral instabilitelerin selektif kapsül kaydırma tekniği ile tamiri

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Amaç: Travma sonrası tekrarlayan anterior-inferior glenohumeral instabilite tanısıyla selektif kapsül kaydırma ameliyatı yapılan hastaların fonksiyonel sonuçları değerlendirildi.

Çalışma planı: Çalışmada, travma sonrası tekrarlayan anterior-inferior glenohumeral instabilite nedeniyle selektif kapsül kaydırma tekniği uygulanan 16 hasta (15 erkek, 1 kadın; ort. yaş 30; dağılım 25-38 yıl) incelendi. Çıkkıklar 14 hastada ciddi, ikisinde hafif travmadan sonra oluşmuştu. Ameliyattan önce ortalama çıkık sayısı 14 (dağılım 4-45) idi. Ameliyattan önce yapılan manyetik rezonans incelemelerinde tüm hastalarda Bankart lezyonu, %20'sinde ise Hill-Sachs lezyonu saptandı. Hastalar, Amerikan Omuz ve Dirsek Cerrahları standart omuz değerlendirme formuna (ASES) ve Rowe Bankart tamiri için skorlama tablosuna göre değerlendirildi. Ameliyattan önce ve sonra tüm hastalarda omuzun ön-arka ve aksiller radyografileri çekildi. Eklem hareket açıklığı gonyometre ile, kas güçleri ise manuel olarak ölçüldü. Hastalar ortalama 41 ay (dağılım 21-74 ay) süreyle izlendi. İstatistiksel değerlendirmede t-testi kullanıldı.

Sonuçlar: Ameliyat öncesi ve sonrası ortalama ASES skorları anlamlı farklılık gösterdi (63.2 ve 95.8; $p<0.05$). Ameliyattan sonra ortalama Rowe skoru 92.5 (dağılım 70-100) bulundu. İnfraspinatus, supraspinatus ve subskapularis kas güçlerinde ameliyattan sonra anlamlı artış görüldü ($p<0.05$). Sonuçlar 12 hastada (%75) mükemmel, ikisinde (%12.5) iyi, ikisinde orta olarak değerlendirildi. On beş hasta (%93.8) yapılan ameliyattan memnun kaldığını belirtti.

Çıkarımlar: Bankart lezyonuna ek olarak kapsül yaralanması veya laksitesi bulunan anterior-inferior instabiliteli olgularda Bankart lezyonu tamiri ile birlikte uygulanan selektif kapsül kaydırma tekniği stabilite sağlamak ve hareket açıklığını korumaktadır.

Anahtar sözcükler: Çıkık/cerrahi; eklem kapsülü/cerrahi; eklem instabilitesi/fizyopatoloji/cerrahi; hareket açıklığı, eklem; omuz eklemi/fizyopatoloji/cerrahi.

Objectives: We evaluated the functional results of treatment with the selective capsular shift technique in patients with recurrent post-traumatic anterior-inferior glenohumeral instability.

Methods: The study included 16 patients (15 males, 1 female; mean age 30 years; range 25 to 38 years) who underwent selective capsular shift operation for recurrent post-traumatic anterior-inferior glenohumeral instability. Dislocations occurred following severe ($n=14$) or mild ($n=2$) trauma. Preoperatively, the mean number of dislocations was 14 (range 4 to 45) and magnetic resonance imaging showed a Bankart lesion in all the patients and a Hill-Sachs lesion in 20%. The patients were evaluated according to the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES) and Rowe's scoring for Bankart repair. Preoperative and postoperative anteroposterior and axillary x-rays were obtained from all the patients. Range of motion was measured with a goniometer and manual muscle strength tests were performed. The mean follow-up was 41 months (range 21 to 74 months). Statistical analysis was made using the t-test.

Results: The mean preoperative and postoperative ASES scores differed significantly (63.2 vs 95.8; $p<0.05$). The mean Rowe score was 92.5 (range 70 to 100). Strength of the infraspinatus, supraspinatus, and subscapularis muscles increased significantly ($p<0.05$). The results were excellent in 12 patients (75%), good in two patients (12.5%), and fair in two patients. Fifteen patients (93.8%) expressed satisfaction with the operation and results.

Conclusion: Addition of the selective capsular shift technique to the Bankart repair procedure improves stability and preserves the range of motion of the glenohumeral joint in patients with anterior-inferior glenohumeral instability accompanied by a Bankart lesion and capsular injury or laxity.

Key words: Dislocations/surgery; joint capsule/surgery; joint instability/physiopathology/surgery; range of motion, articular; shoulder joint/physiopathology/surgery.

The shoulder is the most mobile joint in the body. The main stabilizers of the joint are the soft tissues surrounding the capsule, the glenohumeral ligaments and the rotator cuff muscles. Bony anatomy has the least role in the stability. The construction of the shoulder joint allows a great range of motion, however this facilitates the clinical instability.⁽¹⁾ Dislocations mostly occur at the shoulder joint and most of them are at an anterior-inferior direction. The Bankart lesion, the anterior-inferior capsulolabral avulsion, is seen in 86-97% of young patients.⁽²⁾ Clinical and experimental studies show some capsular laxity in patients with Bankart lesion and evident inferior instability in patients with recurrent post-traumatic anterior instability.⁽³⁻⁶⁾ Operative treatment is indicated in patients at whom conservative treatment fails. The purpose of the treatment is to gain the stability and to protect the motion. Several operative techniques are described for the treatment of this pathology. Most of them don't restore the damaged anatomy and decrease external rotation.⁽⁷⁾ Recently, Bankart procedure is the most preferred method in the treatment of anterior instabilities (8). Many successful results are reported with this technique.⁽⁹⁻¹²⁾ However, repairing only the Bankart lesion in patients with accompanying Bankart lesion and evident capsular laxity leads to unsuccessful results. Some surgeons, in such cases, advise performing Bankart repair and capsular shift simultaneously.⁽¹³⁻¹⁵⁾ Warner et al.⁽¹⁶⁾, modified Neer's capsular shift technique and improved the selective capsular shift technique.

We evaluated the functional results of treatment with the selective capsular shift technique in patients with recurrent post-traumatic anterior-inferior glenohumeral instability.

Patients and methods

26 patients with recurrent post-traumatic anterior-inferior glenohumeral instability were treated with selective capsular shift technique at our institute between 1997 and 2002. The study included 16 patients (15 males, 1 female; mean age 30 years; range 25 to 38 years) who came to the latest follow-up. 12 of them were operated from the right and four from the left shoulder; 81% were at the dominant side. They were operated by the same surgeon (MUO). Preoperative and postoperative anteroposterior (AP) and axillary x-rays and magnetic reso-

nance images were from all the patients. Postoperatively and at the latest follow-up AP and axillary x-rays were obtained. Range of motion was measured with a goniometer and manual muscle strength tests were performed. The patients were evaluated according to the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form (ASES) and Rowe's scoring for Bankart repair.^(10,17)

Operative technique

Under general anesthesia and in beach-chair position, the patients were examined for the degree and the direction of the instability. First the range of motion was measured and compared with the contralateral side. Afterwards, anterior, posterior and inferior drawer tests (sulcus sign) described by Altchek et al. were performed⁽¹³⁾ (Figure 1a). After the bony anatomic landmarks are identified and marked, entrance via posterior portal, diagnostic arthroscopy is performed in order to find out the capsular laxity and plasticity and other intraarticular pathologies. Open selective capsular shift procedure, first described by Warner et al.⁽¹⁶⁾, was performed to patients at whom anterior instability was diagnosed during the examination under general anesthesia; inferior sulcus sign at least 2+ while the arm is at adduction and external rotation; and obvious Bankart lesion, capsular laxity and injury (Figure 1b).

The skin is injected with 1% lidocain with epinephrine, and then incised with a scalpel down to the subcutaneous tissue through an incision that begins 2-3 cm inferior to the coracoid extending inferiorly into the axilla kept low in the anterior axillary line for improved cosmesis (Figure 1c). The cephalic vein is retracted laterally after being fully exposed. A selfretaining retractor is placed in the deltopectoral interval to expose the underlying clavipectoral fascia. Once the fascia is incised and cleared, the conjoint tendon, coracoid, coracoacromial ligament, lesser tuberosity and bicipital groove are clearly visualized. After the biceps tendon is identified, the proximal 1 cm of tendon of the pectoralis major insertion on the humerus is released and tagged for later repair. A portion of the lateral aspect of the coracoacromial ligament is resected to allow better visualization of the superior capsule. A small transverse incision is made in the lateral portion of the

conjoint tendon just distal to the coracoid tip to allow for greater medial exposure. The conjoint tendon is gently retracted to avoid injury to the musculocutaneous nerve, and the position of the axillary nerve deep to the conjoint tendon and superficial to

the subscapularis is identified by palpation. The arm is externally rotated to expose the subscapularis. At its inferior border, the anterior humeral circumflex vessels are identified and ligated or coagulated in a controlled fashion. The superior and inferior borders

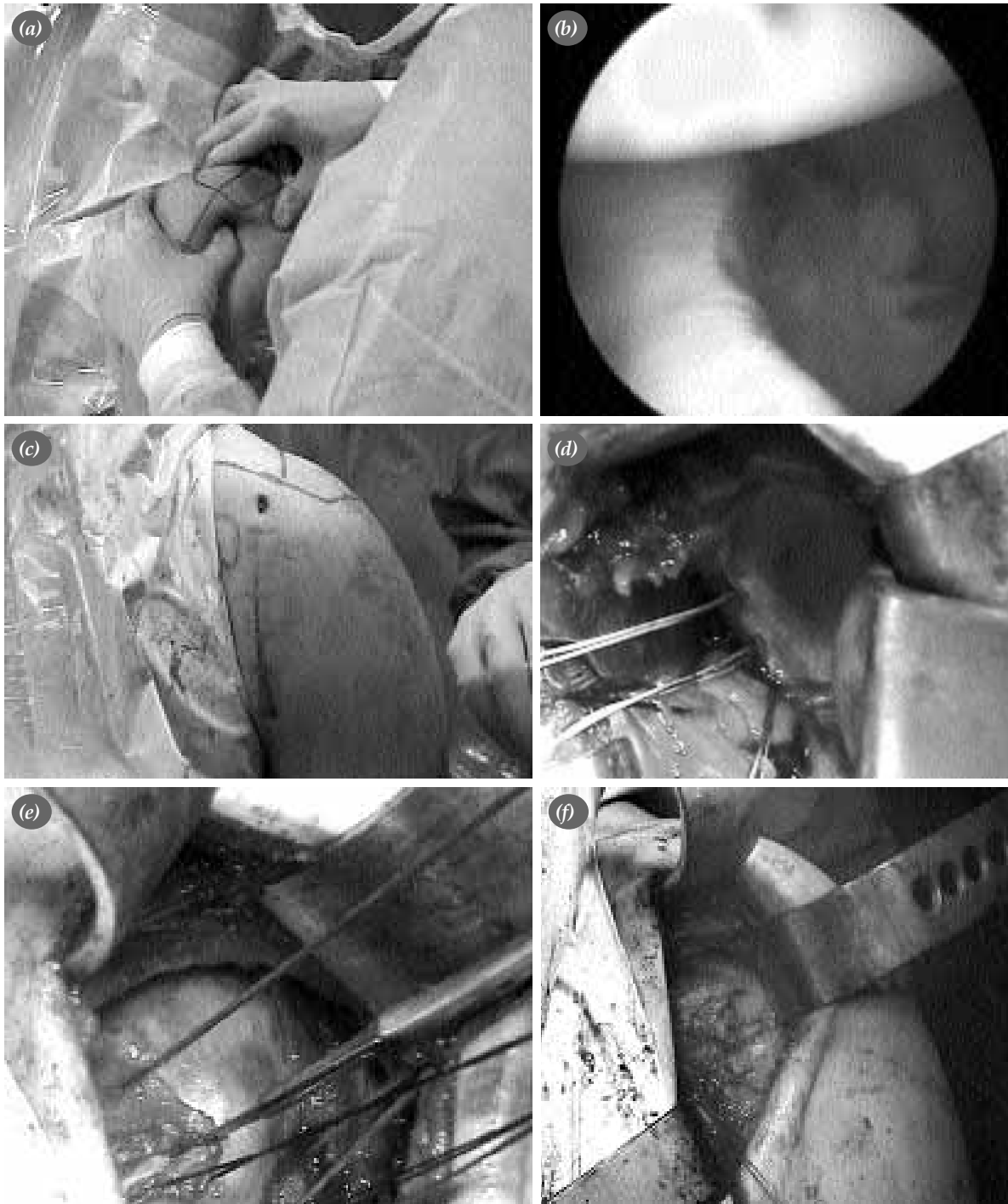


Figure 1. a) Examination under general anesthesia. b) Arthroscopic view of the Bankart lesion and the capsular laxity. c) Anterior incision. d) Suture anchors placed to the glenoid for Bankart repair. e) Capsular incision. f) View after capsular shift procedure.

of the subscapularis are identified. The subscapularis is incised approximately 1 cm medial to its insertion on the lesser tuberosity and reflected in the coronal plane with the use of an electrocautery. Four or five braided nonabsorbable no. 2 sutures are placed in the subscapularis tendon for retraction. The rotator interval is identified, and sutures are placed at its superior margin for later repair. As the dissection is carried inferiorly, the arm is externally rotated for exposure while a safe distance is maintained from the axillary nerve. A blunt retractor or finger can be used for further protection of the axillary nerve. The capsule is cut along the inferior neck that extends to 6 o'clock for the right shoulder. A humeral head retractor, such as a Fukuda retractor (George Tiemann & Co., Hauppauge, New York, USA), is inserted behind the posterior labrum to expose the glenoid surface and the anteroinferior labral attachment of the capsule. The Bankart lesion is encountered, it is slightly enlarged medially by stripping the capsulolabral attachments from the scapular neck. The anteroinferior portion of the scapular neck and glenoid rim are decorticated with a small osteotome. 5 mm suture anchors, loaded with two braided nonabsorbable no. 1 sutures, are secured into the bone at the prepared edge of the glenoid rim at locations just above the equator to 1, 3, 5 o'clock positions (Figure 1d). By using free needle ends and inside-out sutures the Bankart lesion is repaired anatomically. Care is taken not to shorten the capsule in a medial direction.

At this point, and in cases where there is no significant rotator interval capsular defect, the horizontal portion of the T-shaped capsulotomy is directed toward the glenoid, usually between the middle and inferior glenohumeral ligaments. Prior to the repair, the sulcus lateral to the articular margin is decorticated. As the rim of capsular tissue that will be used for repair tends to be deficient along the anteroinferior part of the humeral neck, one or two suture anchors are placed to ensure a secure repair (Figure 1e).

The shoulder is placed in a position of 50-80° of abduction, 45-60° of external rotation and 10° of forward flexion. With the arm in this position, the capsule is repaired in an inferior to superior direction under tension by pulling on the stay sutures. Once this is completed, the arm is repositioned in 0°

abduction, approximately 45° of external rotation, and 10° of flexion to prepare for repair of the superior capsular flap. First, the rotator interval is closed with the previously placed sutures. The superior flap is then directed inferiorly and laterally over the inferior flap and sutured to the rim of capsular tissue. Sutures placed along the horizontal edge of the inferior flap are brought under the horizontal edge of the superior flap to close this space in a mattress fashion and reinforce the capsule, completing the repair (Figure 1f).

When the capsular repair is complete, range of motion and laxity of the shoulder are gently retested. The subscapularis then is repaired anatomically to its stump at the lesser tuberosity with the use of braided nonabsorbable no. 2 sutures with the modified Mason-Allen suture technique.⁽¹⁸⁾ The tendinous portion of the pectoralis major and conjoint tendon are repaired. The skin is closed in a subcuticular fashion.

Postoperative rehabilitation

Postoperatively, abduction arm slings and cryocuffs are applied to the patients for the first 48 hours. The patients were discharged at the second day. Home exercise programme consisting of pendulum, passive and assisted-active elevation, is taught to each patient and asked to perform them for two weeks. At the end of the second week the sutures are removed and the patients were sent to the physiotherapy department so as to perform the exercises under the control of a physiotherapist. They performed tensile exercises to improve range of motion for one month. After the end of the sixth week they started strengthening exercises. They started active resisted exercises at the tenth week and they were allowed to return to daily living activities and to work. Return to sports were allowed after the fourth-sixth months. The mean follow-up was 41 months (range 21 to 74 months). Statistical analysis was made using the t-test.

Results

Dislocations occurred following severe trauma in 14 (87.5%) and mild trauma in 2 (12.5%) patients. Preoperatively, the mean number of dislocations was 14 (range, 4-45) and all of them occurred in an anterior-inferior direction. Preoperatively the main symptom in all of the patients was instability. The

Table 1. Functional and statistical results pre and postoperatively.

	Preoperatively		Postoperatively		<i>p</i>
	Mean	Range	Mean	Range	
Range of Motion					
Forward flexion					
Active	154.0	90-170	163.8	150-180	<0.05
Passive	163.8	160-170	168.8	160-180	<0.05
Adduction-Ext rot.	54.1	35-80	50.0	35-70	>0.05
Abduction-int rot.	56.3	40-70	65.6	40-90	<0.05
Abduction-ext rot.	58.1	40-80	55.9	35-90	>0.05
Muscle strength (manuel-max 5)					
Infraspinatus	4.5	4-5	4.9	4-5	<0.05
Supraspinatus	4.4	4-5	4.9	4-5	<0.05
Subscapularis	4.5	4-5	4.9	4-5	<0.05
ASES scores (max 100)	63.2	14-81	95.8	72-100	<0.05
Rowe's scores (max 100)			92.5	70-100	
Stability (max 50)			45.0	30-50	
Range of motion (max 20)			18.8	15-20	
Function (max 30)			28.8	25-30	

patients underwent an operation at a mean of 53.2 (range, 6-168) months after the first dislocation. Two patients had had an arthroscopic and one an open Bankart repair previously.

During the operation in all the patients a Bankart lesion and in 20% a Hill-Sachs lesion was diagnosed. Furthermore, in one patient type 1 SLAP lesion was diagnosed and debrided; in one patient underwent a repair for inferior glenohumeral ligament rupture. For Bankart repair, three suture anchors in five patients; four in three and two in eight patients were used.

Patients used arm slings postoperatively for a mean of 1.16 (range, three days-two months) months. In addition to the home programme, 11 patients had had a physical therapy programme under the control of a physiotherapist for a mean of 1.4 (15 days-three months) months. One patient didn't carry-out the programme.

Functional results obtained pre and postoperatively are given at table 1. Postoperatively, All range of motions, except abduction-external rotation improved. Improvement in active and passive anterior flexion and abduction-internal rotation were statistically significant ($p < 0.05$; table 1).

In 12 (75%) patients, adduction-external rotation degrees were same as the other side. In four (25%)

patients, adduction-external rotation decreased for a mean of 16.3° (range, 10-20°).

Preoperatively, active adduction-internal rotation in four (25%) patients were noted at a level of T4; in four at T7; in seven (43.8%) at T12 and in one (6.3%) at L5. These levels improved to T4 in six (37.5%); T7 in eight (50%); T12 in one and L1 in one patient.

Strength of the infraspinatus, supraspinatus and subscapularis muscles increased significantly ($p < 0.05$; table 1).

The mean preoperative and postoperative ASES scores differed significantly (63.2 vs 95.8; $p < 0.05$; table 1).

Postoperatively, the mean Rowe score was 92.5 (range 70-100). The results were excellent in 12 patients (75%), good in two patients (12.5%) and fair in two patients (table 1). Stability, range of motion and functional scores were noted at a mean of 45, 18.8, and 28.8, respectively.

Return to their work took three months (range, one week- seven months) for an average.

Magnetic resonance imaging showed a Bankart lesion in all the patients and Hill-Sachs lesion in 20%. In anteroposterior and axillary x-rays, pre and postoperatively, the were noted to be secured.

Fifteen patients (93.8%) expressed satisfaction with the operation and results. One patient, at whom the apprehension test was positive, was unsatisfied.

Discussion

Both Bankart and Perthes noted that capsule and the glenohumeral ligaments play an important role in shoulder stability.^(19,20) At mid 20th century, by the improvement of nonanatomic repair procedures, caused to deny the pathologic path mentioned before. Putting bony graft to the glenoid, transfer of tendon and bone and shortening of the subscapularis muscle procedures had become favourable because of the relatively difficult Bankart procedure. The purpose of those operations was to restrict external rotation and to prevent anterior dislocations. These procedures are not about the joint itself and don't restore the pathologic anatomy. They destroy the normal joint kinematics and cause abnormal motion; and the end result is increased compression in the joint.⁽⁷⁾ Turkel et al.⁽²¹⁾ in their classical study at 1981, rementioned the pathologic anatomy causing instability. They highlighted the role of the glenohumeral ligaments in the shoulder joint stability. Recently, the Bankart operation, is the widely accepted procedure in especially traumatic shoulder dislocations and successful results can be obtained by this procedure.⁽⁹⁻¹²⁾ However, some clinical and experimental studies showed that capsular injury or laxity can also be seen in addition to the Bankart lesion.^(3,5,6) For this reason, some surgeons advise to add a capsular shift to the Bankart repair in cases at which anterior-inferior capsular laxity is diagnosed.⁽¹³⁻¹⁵⁾ However, during this kind of procedure, distinguishing the normal and the pathologic joint laxity is difficult. Furthermore, the amount of capsular shift, in order to minimize the external rotation loss, is under debate.⁽¹⁶⁾

In anatomic and biomechanical studies it is found that, the role of the capsuloligamentous structures in anterior and inferior stability is related to the position of the arm; and in abduction-external rotation, the anterior and inferior stability is provided by the inferior glenohumeral ligament.⁽²²⁻²⁶⁾ Superior and middle glenohumeral ligaments prevent anterior and inferior translation when the arm is at adduction-external rotation. Thus, the position of the arm during the capsuloraphy, determines the postoperative range of motion, as well as the stability. At the tech-

nique of selective capsular shift, at which the capsular incision is made at the humeral side, if the superior and inferior capsular flaps are repaired at their optimal tensile position (superior flap at abduction-external rotation, inferior flap at adduction-external rotation), the capsule is prevented from less or more tensile repair. Thus, it is possible to prevent the range of motion while restoring the stability.⁽¹⁶⁾

Warner et al.⁽¹⁶⁾, evaluated the results of their 18 patients for a mean follow-up of 27 (range, 24-39) months. They reported that in 61% of their patients they were able to obtain symmetric range of motion compared to the other side and in the others slight external rotation loss were noted.

The mean preoperative and postoperative ASES scores differed significantly (63.2 vs 95.8; $p < 0.05$). Postoperatively, the mean Rowe score was 92.5. The results were excellent in 12 patients (75%), good in two patients (12.5%) and fair in two patients. Return to their work took three months for an average. In 12 (75%) patients, adduction-external rotation degrees were same as the other side. In four (25%) patients, adduction-external rotation decreased for a mean of 16.3°.

Arthroscopic anterior stabilization procedures are being improved for the last 20 years. Although, successful results of open repair for shoulder instability have been reported, successful results of arthroscopic Bankart repair are sufficient yet. Unsuccessful results after arthroscopic Bankart repair differ from 5% to 40%.⁽²⁷⁾

Labral detachment may not be the only cause of the increased anterior glenohumeral translation leading to shoulder instability. This theory has been tested by Speer et al.⁽²⁸⁾ in a biomechanical study and has been concluded that some additional abnormalities are required for glenohumeral dislocation. The Bankart lesion is not enough by itself for humeral head dislocation. Simply, procedures putting the labrum on the glenoid but, not restoring the inferior glenohumeral ligament tension or capsular laxity are candidates for insufficiency. This may be the cause of the unsuccessful results of the prior arthroscopic repairs.⁽⁷⁾

For this reason, it is mandatory to choose the appropriate cases before deciding to perform an open or arthroscopic repair. In cases at which evi-

dent capsular laxity is diagnosed in addition to Bankart lesion, performing a selective capsular shift may decrease the rate of unsuccessful results. Examination under general anesthesia and diagnostic arthroscopy may be helpful in case selection.

Addition of selective capsular shift technique to the Bankart repair procedure improves stability and preserves the range of motion of the glenohumeral joint in patients with anterior-inferior glenohumeral instability accompanied by a Bankart lesion and capsular injury or laxity.

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