Inferior Capsular Shift for Involuntary Inferior and Multidirectional Instability of the Shoulder

A PRELIMINARY REPORT

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ABSTRACT: In thirty-six patients (forty shoulders) with involuntary inferior and multidirectional subluxation and dislocation, there had been failure of standard operations or uncertainty regarding diagnosis or treatment. Clinical evaluation of these patients stressed meticulous psychiatric appraisal, conservative treatment, and repeated examination of the shoulder. All patients were treated by an inferior capsular shift, a procedure in which a flap of the capsule reinforced by overlying tendon is shifted to reduce capsular and ligamentous redundancy on all three sides. This technique offers the advantage of correcting multidirectional instability through one incision without damage to the articular surface. One shoulder began subluxating again within seven months after operation, but there have been no other unsatisfactory results to date. Seventeen shoulders were followed for more than two years.

Although little has been written about symptomatic involuntary (unintentional) inferior and multidirectional instability of the shoulder, authorities[2,5,25,27] have agreed that it is important to recognize the disorder and to distinguish it from routine unidirectional dislocation. The standard procedures done for the surgical correction of unidirectional anterior or posterior dislocation are not adequate for this problem because they do not reduce excessive redundancy of the inferior part of the capsule and failure may occur because of residual inferior instability. Furthermore, an operation that creates excessive tightness on one side of a hypermobile shoulder may cause a fixed subluxation or dislocation in the opposite direction, possibly leading to severe glenohumeral arthritis[20].

Very few articles have considered the treatment of inferior or multidirectional instability of the shoulder. Authors[2,5] have agreed, however, that shoulder-muscle strengthening exercises should be given a thorough trial before considering surgery. Rowe et al. and others[2,5] have emphasized the importance of recognizing those patients whose dislocations are intentional, as psychological prob-

lems render them unsuited for an operation. Several authors[5,25,27] have advocated combinations of procedures. Rowe et al. treated one patient who had inferior and multidirectional instability with a modified Bankart procedure[1,23] and a Nicola procedure[21], as was recommended by Thompson et al. Bateman recommended a modified Gallie-LeMesurier[9] fascial repair. Endo recently advised transfer of a part of the pectoralis major to the scapula in selected patients with this problem.

This paper considers the methods of clinical evaluation of involuntary inferior and multidirectional instability of the shoulder and describes the indications, technique, and preliminary results of inferior capsular shift, a procedure that has been performed in our center since 1974.

Material

Our series consisted of forty shoulders in thirty-six patients that were operated on between the years 1974 and 1979 by the method to be described (Table I). All had been referred to one of us (C. S. N.) by other orthopaedic surgeons either because of failure of standard operative procedures for recurrent dislocation or because of uncertainty regarding the anatomical problem and treatment. All of the patients had uncontrollable and involuntary inferior subluxation or dislocation secondary to redundancy of the ligaments and inferior part of the capsule of the glenohumeral joint. This ligament laxity was evident on physical examination (Figs. 1-A and 3) and traction roentgenograms (Figs. 1-B, 2-A, and 2-B) and was associated with both anterior and posterior dislocation or subluxation. Patients with bone abnormalities (of the glenoid or humerus), neural disorders, instability in only one direction, or voluntary dislocation were excluded from this study. Those with Bankart lesions[1,23] (detachment of the anterior portion of the glenoid labrum) were also excluded, with the exception of five patients whose shoulders dislocated three ways (anteriorly, posteriorly, and inferiorly) and in whom this lesion was discovered during repair of a capsular redundancy through a posterior approach. Patients treated non-operatively and those treated by total shoulder replacement were not included in this study of inferior capsular shift.

Twenty-nine shoulders had not had prior surgery. All

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TABLE I

	Follow-up (No. of Shoulders)						
	< 1 Yr.	1 to < 2 Yrs.	2 to < 3 Yrs.	3 to < 4 Yrs.	4 to < 5 Yrs.	5 to 6 Yrs.	Total
No prior surgery (29 shoulders)							
Anterior approach	4	5	2	1	1	1	14
Posterior approach*	3	6	3	3			15
Reoperation (11 shoulders)							
Anterior approach		1		3			4
Posterior approach†	1	3	1	1		1	7

* Five patients had a concomitant anterior approach.
† Two patients had a concomitant anterior approach.

twenty-nine dislocated in more than one direction: anteriorly and inferiorly with subluxation posteriorly in fourteen shoulders, posteriorly and inferiorly with subluxation anteriorly in ten, and dislocation in all three directions in five. Eleven shoulders had been operated on previously, of which one had been operated on twice (Fig. 2-B) and four had been operated on three times. Residual instability in these shoulders was primarily anteroinferior in four and posteroinferior in seven, two of which had fixed posterior displacement of the humeral head because of tightness caused by a previous anterior repair. Of the forty shoulders studied, the procedure to be described was performed through an anterior approach in eighteen, a posterior approach in fifteen, and both an anterior and a posterior approach in seven (Table I).

Thirty-two shoulders were examined by one of us from one to five years postoperatively. Eight shoulders had a follow-up of less than one year; fifteen shoulders, one to two years; and seventeen shoulders, more than two years.

Clinical Findings

The ages of the patients ranged from fifteen to fifty-five years and averaged twenty-four years. Only one patient was younger than seventeen years and seven were older than thirty years. Eighteen patients were male and eighteen were female. Twenty-two right shoulders were involved and eighteen left shoulders. The dominant side was operated on in twenty-six of the thirty-six patients. Four had the inferior capsular shift performed bilaterally.

The initial shoulder dislocation occurred with a mild

FIG. 1-A   FIG. 1-B

Figs. 1-A and 1-B: A thirty-year-old woman with symptomatic inferior and multidirectional instability.
Fig. 1-A: Inferior subluxation is produced by downward traction on the arm.
Fig. 1-B: Traction roentgenogram of the same shoulder, showing marked inferior subluxation.
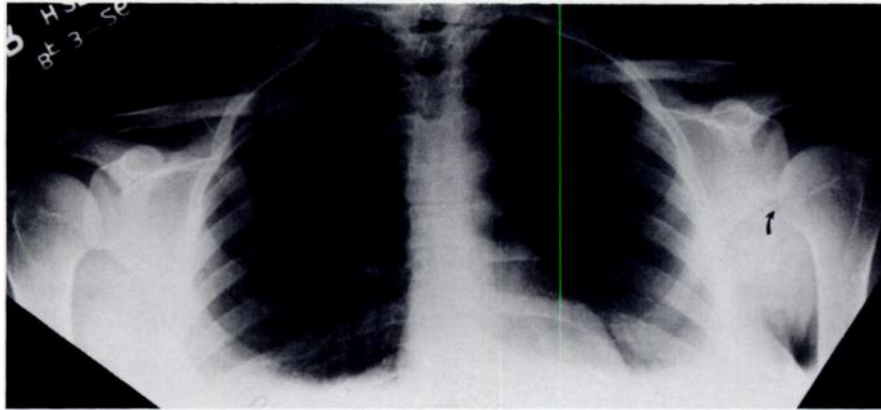
FIG. 2-A

Figs. 2-A and 2-B: The technique of traction roentgenography.
Fig. 2-A: Traction roentgenogram of a patient with hypermobility of the left shoulder. The patient was erect, held a 11.25-kilogram (twenty-five-pound) weight attached to each wrist, and was instructed to relax the shoulder muscles.
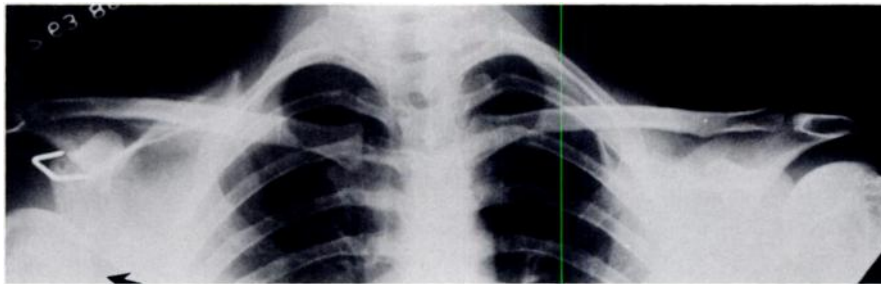

FIG. 2-B

Traction roentgenogram of a patient whose shoulder dislocated anteriorly, posteriorly, and inferiorly eight years after a failed Putti-Platt procedure and one and one-half years after a failed Boyd-Sisk procedure. (The symptomatic shoulder usually subluxated more than the opposite shoulder unless pain caused too much muscle-guarding.)

force (as in lifting a child or swinging a baseball bat) in seven patients, with a moderate injury (as in gymnastics, volleyball, or basketball) in twenty-one, and with a severe injury (as in football, wrestling, or a hard fall while skiing) in eight. Only two of these initial dislocations had been reduced by a physician but twenty-eight had been treated initially by immobilization of the shoulder for three to six weeks. Generalized hyperlaxity of joints (as shown by hypermobility of the fingers, thumb, elbow, and knees) was found in seventeen patients, all of whom had had trivial or moderate initial injuries. At least two patients had been voluntary dislocators in their adolescence and had become truly disabled with involuntary inferior and multidirectional instability in their adult years. Nineteen patients had no evidence of generalized hyperlaxity but many of them had clinical evidence of some laxity of the opposite shoulder. With few exceptions these patients were very active and athletic. Twenty-eight had been on high-school or college athletic teams and two others did heavy work with the arms overhead. Seven college-level competitive swimmers had clinical hypermobility of both shoulders without evidence of laxity of other joints and thought that the butterfly and back strokes had caused their shoulder instability. Eight patients who had no evidence of hypermobility in other joints had sustained repeated severe injuries of the shoulder with the arm overhead.

Symptoms included discomfort and fatigue when carrying loads that pulled downward on the inferior part of the capsule or when performing movements that produced subluxation. Inability to carry books, throw, swim, or work with the arms overhead were typical complaints. Two patients whose shoulders dislocated anteriorly and inferiorly and subluxated posteriorly had lingering numbness and weakness of the whole arm that lasted one or two days after such episodes (Fig. 3).

The majority of these patients had presented a diagnostic dilemma to their original physicians. The most common mistaken diagnoses were: unidirectional dislocation (either posterior or anterior), voluntary dislocation, impingement, biceps tendinitis, rotator cuff tear, and glenoid deficiency. One patient with multidirectional dislocations had been erroneously treated by anterior acromioplasty[19] and another, by biceps tenodesis.

The interval from the onset of shoulder disability to operation was from one to twenty-one years and averaged three years. Nineteen patients were referred by us to a psychiatrist prior to surgery. Many were classified as competitive, aggressive, or overachievers but none had significant emotional problems.

Indications for Surgery

Surgery was advised only to patients who had sig-

FIG. 3

A twenty-one-year-old woman whose shoulder could be dislocated inferiorly and anteriorly, and subluxated posteriorly. She was unable to carry books, reach overhead, or use the arm for activities such as tennis or swimming. There were associated episodes of numbness and weakness of the whole upper extremity which at times lasted for one or two days.

nificant chronic pain and disability from inferior and multidirectional instability that could not be controlled by conservative means. Conservative treatment included changing the style of use of the shoulder and exercises. The objective of the exercise program was to improve the strength and tone of the rotator cuff and deltoid muscles without causing mechanical irritation of the capsule and ligaments. No patient was treated surgically who had not had disability for at least one year. Patients with emotional problems were carefully excluded. We sought psychiatric consultation if there was any doubt about the maturity or motivation of the patient.

The procedure under consideration was used in pa-

tients who had hyperlaxity of the ligaments and the inferior part of the capsule. These structures were carefully evaluated preoperatively. It is generally recognized that the capsule is normally loose enough to allow some inferior subluxation of the humeral head when the rotator cuff muscles and deltoid have lost tone, as has been seen with some humeral fractures[8]. Abnormal inferior instability was determined clinically by stress and apprehension tests (Figs. 1-A and 3) and by traction roentgenograms (Figs. 1-B, 2-A, and 2-B). The shoulder was examined for instability in all three directions each time the patient was seen, to determine all of the directions of dislocation and subluxation. The most accurate evaluation of instability, however,

FIG. 4

Photograph of a left shoulder made through a posterior approach in the operating room, showing the pathological characteristic of posterior and inferior dislocation with anterior subluxation. The redundant capsular pouch posteriorly and inferiorly is being held open by three clamps. The posterior part of the glenoid labrum (arrow) is frayed and cracked.
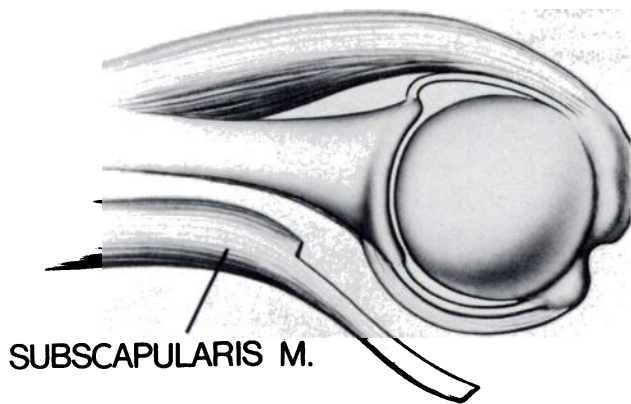
SUBSCAPULARIS M.

FIG. 5-A

Figs. 5-A through 5-D: The technique of inferior capsular shift through an anterior approach.

Fig. 5-A: Reinforcement of the capsular flaps. About 50 per cent of the thickness of the subscapularis tendon is left attached to reinforce the capsule.

head[11] or subperiosteal bone reaction at the inferior rim of the glenoid[24], which would provide further evidence of the directions of instability. Axillary roentgenograms made with force applied in various directions (anteriorly, posteriorly, and inferiorly), fluoroscopy, and cineradiography were helpful at times. Arthrograms did not add useful information. Arthroscopy of the shoulder was performed occasionally in a search for fraying or fibrillation of the glenoid labrum which would confirm an organic pathological process or determine whether the major pathological process was anterior or posterior.

Bankart lesions (detachment of the anterior part of the glenoid labrum) require a special explanation. Authorities[2,10,15,18] have agreed that the anterior part of the glenoid labrum is in fact the medial portion of the inferior glenohumeral ligament, and it has been thought important that this structure be reattached to the scapula. Bankart lesions that were repaired while treating anterior and inferior
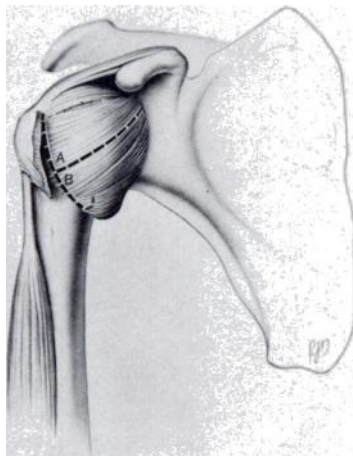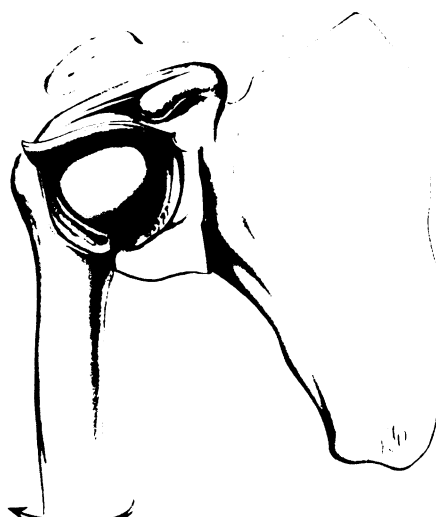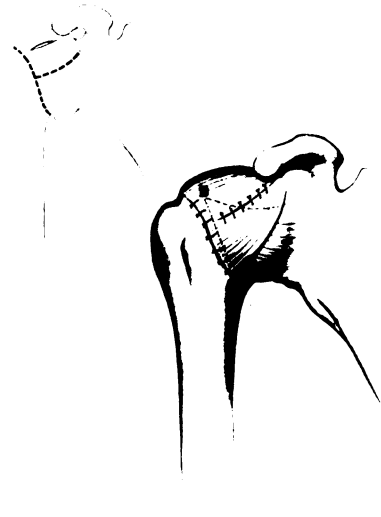

| FIG. 5-B | FIG. 5-C | FIG. 5-D |

Fig. 5-B: Capsular incisions. The opening between the superior and middle glenohumeral ligaments (which is almost constant) is closed with non-absorbable sutures. A T-shaped opening is made by incising longitudinally between the middle and inferior glenohumeral ligaments and detaching the capsule and ligaments from the neck of the humerus anteriorly, inferiorly, and to the posterior part of the neck.

Fig. 5-C: Preparation of flaps and slot. The arm is externally rotated as the inferior flap is detached from the inferior part of the neck of the humerus all the way back to the posterior aspect of the neck. During this step a flat elevator is used to protect the axillary nerve. A shallow slot is made in the neck of the humerus anteriorly and inferiorly.

Fig. 5-D: Relocating the flaps. The arm is held in slight flexion and 10 degrees of external rotation on the arm board. The inferior flap (B) is relocated first. It is pulled forward to tighten the posterior part of the capsule until posterior subluxation no longer occurs and it is pulled upward until the inferior capsular pouch is eliminated. The flap then is sutured to the stump of subscapularis tendon and to the part of the capsule remaining on the humerus to hold it against the slot. The surplus portion of the flap is usually folded over to further reinforce the capsule. The superior flap (A), which contains the middle glenohumeral ligament, then is brought down over the inferior flap so that it acts to suspend the humerus and reinforces anteriorly as well. Note the sutures used to close the cleft between the middle and inferior glenohumeral ligaments prior to making the capsular incision. Finally, the subscapularis tendon is brought to its normal position and secured with non-absorbable sutures so that it will remain a strong internal rotator.

is that done under general anesthesia prior to surgical repair. Traction roentgenograms usually showed that the symptomatic shoulder subluxated inferiorly farther than the opposite shoulder, unless the test was too painful to allow relaxation of the muscles. True anteroposterior and axillary roentgenograms of the scapula and rotational roentgenograms of the humeral head were also used. These were studied for evidence of wear on the humeral

dislocations through an anterior approach were not included in this study, as a concomitant inferior capsular shift was rarely performed in these patients. However, five patients whose shoulders dislocated posteriorly, inferiorly, and anteriorly and who had Bankart lesions anteriorly were included in the series. It was thought that these five patients required an inferior capsular shift through the posterior approach and concomitant reattachment of the anterior
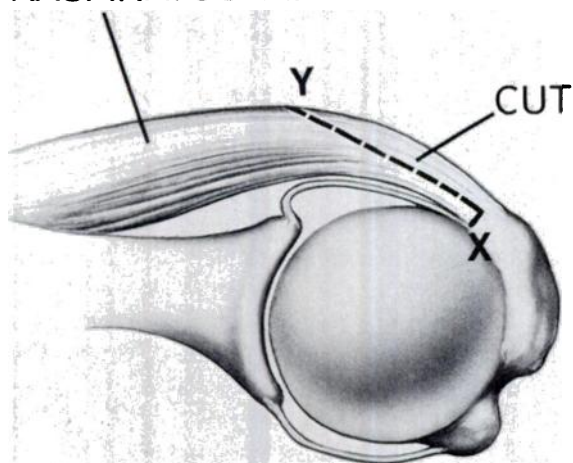
INFRASPINATUS M.

FIG. 6-A

Figs. 6-A through 6-D: The technique of inferior capsular shift through a posterior approach.

Fig. 6-A: Detachment of the infraspinatus tendon. The tendon is divided obliquely so that the superficial portion can be attached to the scapula to reinforce the posterior part of the capsule (Fig. 6-D). This technique is thought to offer the advantages of less likelihood of injury to the suprascapular nerve and less prominence on the greater tuberosity.

aspect of the glenoid labrum to the scapula through an anterior approach. Because the anterior aspect of the glenoid labrum was considered, as Grant showed, to be the same as the medial attachment of the inferior glenohumeral ligament, it was thought essential for this important ligament to be attached to the scapula for the inferior capsular shift to be effective.

A special indication for inferior capsular shift was residual inferior instability after previous surgical repairs.

Standard procedures (such as the Magnuson[16], Bankart[1,23], Putti-Platt[22], and Bristow[17] operations anteriorly, and glenoid osteotomy[13,26], Boyd-Sisk[4], and bone block[6,12] operations posteriorly) had not solved the problem of inferior capsular laxity and inferior instability, as illustrated in Figure 2-B. Previous skin incisions were used. The procedure included lengthening of tight structures and anatomical restoration as much as possible prior to the inferior capsular shift.

Operative Technique and Postoperative Regimen

The principle of this procedure is to detach the capsule from the neck of the humerus and shift it to the opposite side of the calcar (inferior portion of the neck of the humerus) not only to obliterate the inferior pouch and capsular redundancy on the side of the surgical approach but also to reduce laxity on the opposite side (Figs. 5-A through 6-C). A portion of the overlying tendon is used to reinforce the capsule. The procedure is performed through one surgical approach, either anterior or posterior, depending on the direction in which the shoulder is most unstable. A second approach is used if a Bankart lesion is found while doing an inferior capsular shift through a posterior approach. In this situation a second approach is made anteriorly to reattach the glenoid labrum. It is important when operating on these hypermobile joints to take special care to avoid injury to the axillary nerve and to select a new location for the capsular flap that balances stability in all directions. A second approach can be made to ensure stability on the opposite side (not done in the patients in this series). Postoperatively, stress on the newly formed ligaments is avoided until they mature and the muscles regain strength.

FIG. 6-B

FIG. 6-C

Fig. 6-B: A T-shaped opening is made in the posterior pouch to form a superior flap (A) and an inferior flap (B). The inferior flap is completed by detaching the capsule from the neck of the humerus to its anterior aspect. During this step the arm is internally rotated. The axillary nerve is carefully protected with a flat elevator and by leaving the teres minor intact. The proximity of the suprascapular and axillary nerves is illustrated. If at operation the anterior part of the glenoid labrum is found to be detached, a second approach is made anteriorly to reattach it to the scapula before proceeding with the inferior capsular shift.

Fig. 6-C: Relocation of the flaps. After a shallow slot has been made in the neck of the humerus, the arm is held in moderate external rotation and extension as the flaps are reattached. The superior flap (B) is pulled downward and reattached. The inferior flap (A) is then pulled backward and upward over it, reducing the redundancy of the capsule anteriorly, inferiorly, and posteriorly and reinforcing it posteriorly.
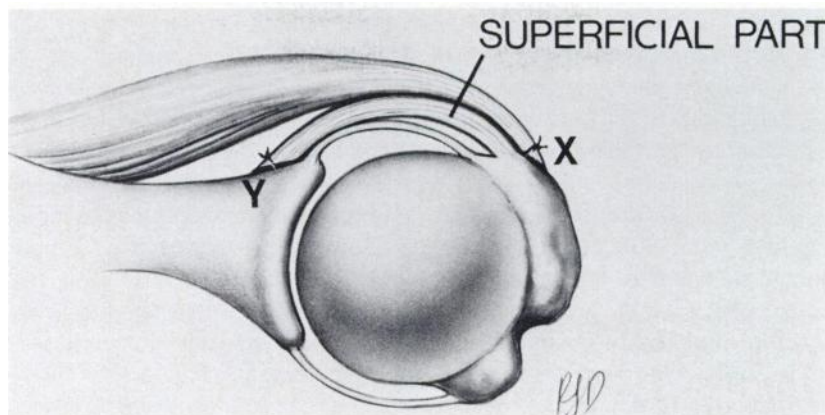
FIG. 6-D

Reinforcement of the capsular flaps. The superficial part of the infraspinatus tendon (Y) is brought down and sutured against raw bone on the scapular neck. The deep portion of the infraspinatus tendon (X) is sutured over this so that it will remain a strong external rotator.

Patients are advised to clean the shoulder and axilla daily with bactericidal soap for several days prior to admission. Prophylactic antibiotics are used. Under general anesthesia, prior to preparation of the skin, the instability of the shoulder is again evaluated. Although it is difficult and demands great care in interpretation, this method of evaluation is thought to be the most reliable procedure for determining whether the initial incision should be anterior or posterior. Similar examinations of shoulder instability done without anesthesia were often found to be misleading because of muscle-guarding by the patient. Anterior instability is tested with the arm in external rotation and extension at various levels of abduction. Inferior instability is tested with the arm directly overhead. Posterior instability is tested with the arm in internal rotation at various levels of forward elevation. The acromion and coracoid process are palpated to confirm that the humeral head is moving from a reduced position to a displaced position rather than from a displaced position to a reduced position. The direction in which the head is displaced and caught most prominently is used to indicate the site of approach. All patients are placed in a high-tilt position with both the front and the back of the shoulder exposed so that either the anterior or the posterior approach can be used. The arm is draped free.

When the anterior approach is used, the skin creases are marked prior to applying adherent plastic drapes and an arm board is attached to the side of the table. A 9.0-centimeter incision is made in the skin creases from the anterior border of the axilla toward the coracoid process, and the subcutaneous tissue is mobilized to just beyond the coracoid process[14]. The deltopectoral interval is developed medial to the cephalic vein and the deltoid is retracted laterally. The clavipectoral fascia is divided and the muscles attached to the coracoid process are retracted medially. With the arm in external rotation, the superficial half of the thickness of the subscapularis tendon is divided transversely 1.0 centimeter medial to the biceps groove (Fig. 5-A). The deep half of the subscapularis tendon is left attached to reinforce the anterior aspect of the capsule,

while the superficial half of the tendon is tagged with stay sutures and retracted medially. It is considered important that this superficial portion of the subscapularis tendon be free so that the action of the subscapularis muscle is not tethered. Originally the reinforced part of the capsule was opened by enlarging the cleft between the middle and superior glenohumeral ligaments and detaching the capsule from the neck of the humerus inferior to this point. Now, however, in order to make more efficient use of the middle glenohumeral ligament, the cleft between the middle and superior glenohumeral ligaments is closed with non-absorbable sutures and a T-shaped opening is made by incising between the middle and inferior glenohumeral ligaments, as shown in Figure 5-B. With a flat elevator to protect the axillary nerve and with the arm in external rotation, the capsular flap is developed by detaching the reinforced part of the capsule containing the inferior glenohumeral ligament from the inferior aspect of the neck of the humerus around to the posterior aspect of the neck (Fig. 5-C). The interior of the joint is inspected and any osteochondral bodies or tags of labrum are removed. Posterior instability is tested both with and without forward traction on the inferior capsular flap in order to estimate the new location for the flap. Using curets and a small gouge, a shallow slot is made in the bone at the anterior and inferior sulcus of the neck of the humerus, as shown in Figure 5-C. The capsular flap is then sutured to the stump of the subscapularis tendon and to the part of the capsule that remains on the humerus, so that the capsular flap is held against the slot of raw bone. The tension on the capsular flap that is selected must eliminate the inferior pouch and reduce posterior capsular redundancy (Fig. 5-D). The inferior flap is sutured first and then the superior flap is drawn down over it and sutured so as to cause the middle glenohumeral ligament to reinforce the capsule anteriorly and also act as a sling against inferior subluxation. The arm is held in slight flexion and about 10 degrees of external rotation on the arm board while the anterior portion of the capsule is being reattached with non-absorbable sutures. The subscapularis tendon is then brought over this

and reattached at its normal location. After closure of the deltopectoral interval with resorbable sutures and of the skin with continuous subcuticular nylon, the arm is maintained at the side in neutral flexion-extension and in about 20 degrees of internal rotation by light plastic splints (Fig. 7).

For the posterior approach, a 10.0-centimeter incision is made either horizontally or vertically over the posterior aspect of the acromion and the spine of the scapula. The deltoid is detached from the posterolateral aspect of the acromion and the lateral 9.0 centimeters of the spine of the scapula, and is split 3.0 centimeters from above downward. The infraspinatus is detached obliquely, as shown in Figure 6-A, so that the superficial piece of tendon can be used later to reinforce the posterior part of the capsule. A T-shaped opening is made in the posterior pouch and the posterior part of the capsule (Fig. 6-B). A superior capsular flap is formed by detaching 1.5 centimeters of capsule above the initial longitudinal capsular incision. Using a flat elevator to protect the axillary nerve and with the arm in progressive internal rotation, the inferior capsular flap is formed by detaching the capsule from the neck of the humerus around to the anterior part of the calcar. The teres minor is elevated from the capsule and left intact. The joint is then distracted (with the addition of muscle relaxants as necessary) so that the glenoid labrum can be inspected anteriorly. When the anterior portion of the glenoid labrum is detached a second approach is made anteriorly, as described, through which the labrum is sutured to the bone of the glenoid (Bankart repair). When the anterior part of the labrum is intact, or after it has been reattached, the posterior part of the capsule is drawn backward to eliminate the inferior pouch and to reduce anterior capsular laxity (Fig. 6-C). With curets and a small gouge, a shallow slot is

made in the sulcus of the humeral neck so that the capsular flap will be approximated to raw bone. The arm is held in slight extension and moderate external rotation as the capsule is reattached, as shown in Figure 6-C. The superior flap is reattached first, being drawn downward to eliminate the posterior pouch. The longer, inferior flap is then drawn over it and the excess part of the capsule is turned back for reinforcement posteriorly. The superficial portion of the infraspinatus is used to further reinforce the posterior portion of the capsule (Fig. 6-D). The deep part of the infraspinatus is reattached superficially to preserve active external rotation (Fig. 6-D). The deltoid is carefully reattached, and the wound is closed. The arm is immobilized at the side in neutral flexion-extension and 10 degrees of external rotation by means of a light plastic splint extending from the wrist to the middle part of the arm and around the waist, with the elbow bent 90 degrees (Fig. 7). Rigid external immobilization is needed to ensure that 10 degrees of external rotation is maintained. Plaster is no longer used because the weight causes discomfort and threatens to cause downward subluxation of the shoulder.

Immobilization is continued in the cast (or splint) for five or six weeks, at which time heat and gentle assisted exercises are begun. The rehabilitation goal for motion is set at 20 degrees less than that of the opposite shoulder. The shoulders tend to recover motion rapidly. Isometric exercises to strengthen the deltoid and rotator-cuff muscles are started eight weeks postoperatively. At twelve weeks postoperatively, progressive resistive exercises are added, done in such a way as to avoid stress on the repaired capsule and ligaments. It is important to remember that the internal and external rotators curb anterior and posterior displacement and the supraspinatus and middle part of the deltoid curb inferior displacement. It is thought that com-
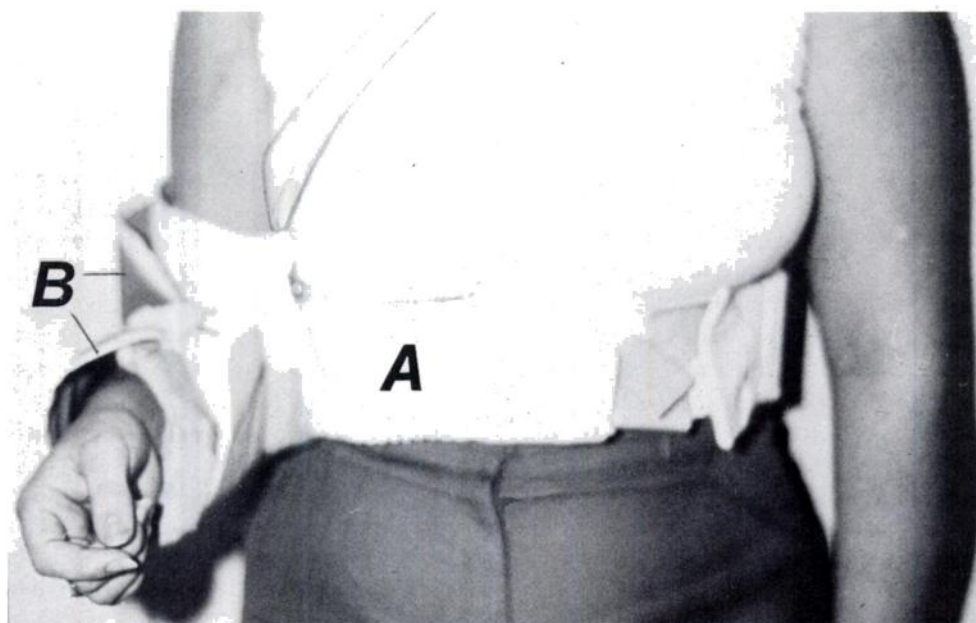

FIG. 7

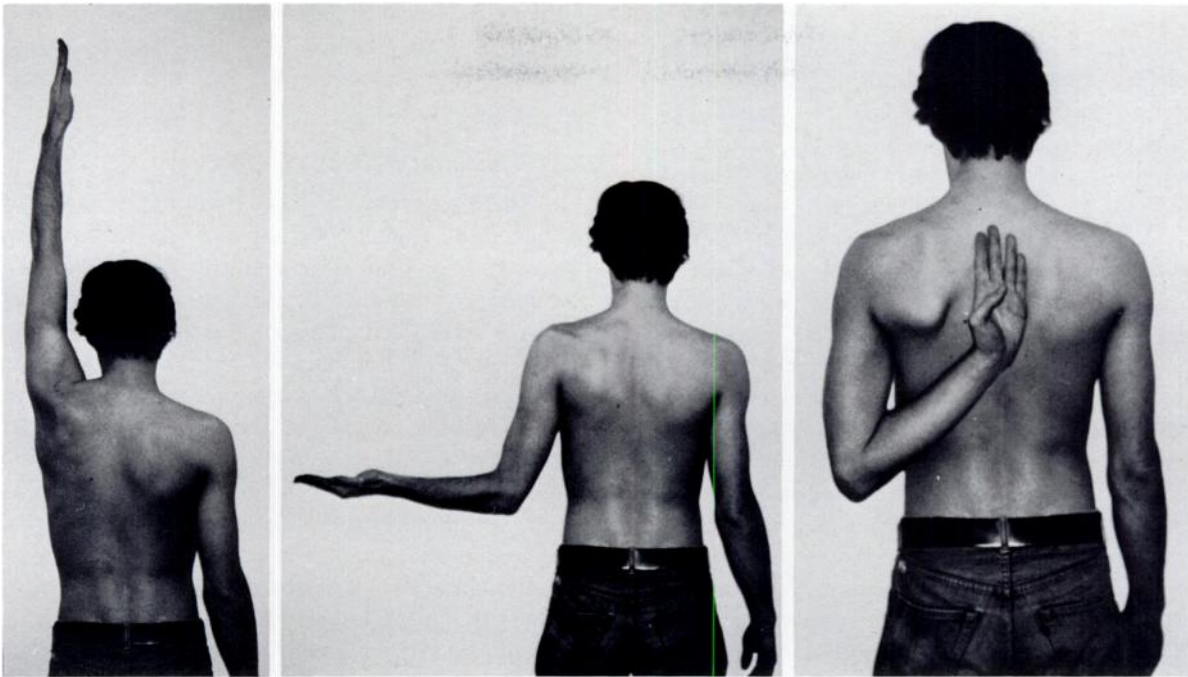The plastic splint (B) and sling (A) used postoperatively.

FIG. 8-A   FIG. 8-B   FIG. 8-C

Figs. 8-A, 8-B, and 8-C: Photographs of a twenty-four-year-old basketball player seen three years after an inferior capsular shift that had been done through a posterior approach with concomitant reattachment of the anterior aspect of the glenoid labrum through an anterior approach. The patient had normal motion and strength of the shoulder and was continuing to play competitive basketball without symptoms.

plete recovery of the muscles is necessary to protect the repair, as the capsule and ligaments normally function only as a checkrein. Lifting more than 9.0 kilograms (twenty pounds) and participation in sports are prohibited for nine months and until muscle strength is normal on manual testing when compared with the contralateral side. The patients are cautioned that ligament healing will be more mature at one year postoperatively and they are advised against swimming with the back and butterfly strokes, heavy overhead use of the involved arm, and participation in impact sports (including skiing) during this period.

Results

The results were graded as satisfactory or unsatisfactory. A satisfactory result meant that there was no recurrence of dislocation or subluxation, no significant pain, full activities, normal strength on manual testing compared with the contralateral shoulder, and within 10 degrees of full elevation and 40 degrees of rotation compared with the contralateral shoulder. In an unsatisfactory result these criteria were not met. Since the contralateral shoulder was usually hypermobile, 20 degrees' less rotation was considered ideal for the repaired shoulder.

Over-All Results

The average postoperative hospital stay was seven days. There were no wound infections. Since these patients tended to have hypermobile shoulders, those who had not had previous surgery usually recovered motion quite rapidly (Figs. 8-A, 8-B, and 8-C). A few patients

were given more aggressive stretching exercises for specific deficiencies in motion that persisted beyond four months after operation. Recovery of motion was, in general, more difficult for those who had had previous surgery.

Neurapraxia of the axillary nerve occurred in three patients, a stern reminder that this procedure places the axillary nerve in jeopardy.

Thirty-two shoulders were followed for more than one year, seventeen of them for more than two years (Table I). Only one of these shoulders received an unsatisfactory rating. The shoulder began to resubluxate anteriorly seven months after an inferior capsular shift through a posterior approach. The patient had not had a previous operation and will be discussed later with this group. Failure was thought to be due to a Bankart lesion of the anterior glenoid labrum that was not repaired. One other patient who had been followed for four years had two bouts of disabling pain, two years apart. No redislocation occurred and the pain abated with rest followed by exercises.

It must be emphasized that this is a preliminary report and a longer follow-up is needed to determine the long-term effectiveness of the inferior capsular shift.

Anterior and Inferior Dislocation with Posterior Subluxation

Of the shoulders that had not been previously operated on, inferior capsular shift was performed through the anterior approach in fourteen (Table I). All had fraying and cracks at the anterior and inferior aspects of the glenoid labrum but without detachment of the labrum. The

posterior aspect of the glenoid labrum usually was similarly involved and the humeral head could be subluxated posteroinferiorly as well as dislocated anteroinferiorly. The inferior capsule was redundant. Two patients in this group had transitory neurapraxia of the axillary nerve postoperatively which cleared spontaneously. There were no redislocations and no resubluxations.

The functional results of the shoulders in ten patients with more than one year of follow-up, five of whom had been followed for more than two years, were evaluated. All were rated satisfactory. Motion was regained spontaneously. One fifty-five-year-old patient who had been suffering from recurrent dislocations for twenty-one years recovered strength more slowly than the others. A twenty-two-year-old woman with generalized joint laxity complained of pain at the shoulder two years and eight months after surgery; the pain was found to be due to a subluxating acromioclavicular joint. She had no evidence of glenohumeral subluxation or dislocation on examination or on traction roentgenograms. Four patients returned to competitive athletics: two swimmers, one basketball player, and one football player.

Posterior and Inferior Dislocation with Anterior Subluxation

Inferior capsular shift was performed through a posterior approach in fifteen shoulders that had not had previous surgery (Table I). Five of these also had a second approach anteriorly. All had a redundant pouch of capsule posteriorly that was large enough to hold the humeral head. The posterior part of the glenoid labrum was frayed and cracked (Fig. 4). The inferior portion of the capsule was also redundant and the head could be subluxated or dislocated anteriorly as well as posteriorly. The anterior part of the glenoid labrum was detached in six patients, five of whom had a second approach anteriorly to reattach it.

One patient in this group had neurapraxia of the axillary nerve postoperatively which cleared within six weeks. Widening of posterior incisional scars occurred routinely and preoperatively patients were warned to expect this. In one of the patients who had bilateral shoulder repair by this technique the left shoulder subluxated with discomfort and spontaneous reduction seven months after operation. This was thought to be due to an error in surgical judgment. At operation a Bankart lesion of the anterior portion of the glenoid labrum had been found in both shoulders. The Bankart lesion in the right shoulder had been repaired through a second anterior approach but the less extensive lesion in the left shoulder was not repaired. We would now repair all such lesions through a second approach anteriorly. To date there have been no additional redislocations, resubluxations, or other complications in this group.

The functional results of the shoulders in the twelve patients with one year of follow-up were evaluated; six of them had been followed for more than two years. Four of these patients had anterior Bankart lesions reattached

through a second approach anteriorly. All were given satisfactory ratings (Figs. 8-A, 8-B, and 8-C). Five patients had resumed competitive sports: four swimmers and one basketball player.

Reoperation for Failed Surgery

There were eleven shoulders in this group (Table I). At operation, an attempt was made first to convert the tissue back to its original anatomical position before doing the inferior capsular shift. This initial anatomical restoration was considered an essential step.

The anterior approach was used in four shoulders, of which two previously had been treated by Putti-Platt procedures and two, by Magnuson procedures. One had been revised twice and one, once. In all of these patients we found that after releasing the subscapularis tendon and anterior part of the capsule, the problem was fixed posterior subluxation and residual inferior instability. An inferior capsular shift (Figs. 5-A and 5-B) was performed through an anterior approach to correct this. A scarred and adherent long head of the biceps was used to reinforce the inferior portion of the capsule in one patient who had had three previous procedures. The anterior structures were reattached with the arm held in about 10 degrees of external rotation. Three of these patients were followed for more than three years and one, for more than one year. The shoulders were given satisfactory ratings.

The posterior approach was used in five shoulders in which the anterior structures were not excessively tight and residual posteroinferior instability was apparent. Three of them had been operated on three times previously and had healed scars both anteriorly and posteriorly. The failed operations were: three Magnuson, one Bankart, and one Putti-Platt procedure; two posterior bone blocks; one posterior soft-tissue procedure; and one posterior glenoid osteotomy. After freeing the infraspinatus tendon and the capsule, an inferior capsular shift was done to eliminate the inferior pouch and residual anterior laxity and to reinforce the posterior part of the capsule (Figs. 6-A, 6-B, and 6-C). Three of these patients were followed for more than two years and one, for more than one year, with the shoulders receiving satisfactory ratings.

Both anterior and posterior approaches were used in two patients who had had previous operations. One of these patients had tight anterior structures after a combined Bristow and Magnuson procedure performed four years previously. This caused the humeral head to be held in a posteriorly subluxated position and allowed it to dislocate inferiorly. In this patient the subscapularis tendon and the anterior part of the capsule were released and reattached in a near-normal position through the anterior approach, after which, through a posterior approach, the posterior pouch and the redundant inferior part of the capsule were eliminated by the inferior capsular shift. The patient was followed for more than one year, with a satisfactory result, although at operation he had been noted to have sufficient post-traumatic arthritis to make the long-term prognosis

guarded. The other patient, a twenty-two-year-old man, had had a failed Putti-Platt procedure eight years previously, followed by a failed Boyd-Sisk procedure six and one-half years later (Fig. 2-B). He had an extremely unstable shoulder that dislocated completely three ways (anteriorly, posteriorly, and inferiorly). Both anterior and posterior approaches were used to convert the shoulder anatomy to as nearly normal as possible. An inferior capsular shift then was performed through both incisions and the long head of the biceps was used to reinforce the posteroinferior portion of the capsule.

Discussion

The literature on inferior and multidirectional instability is very limited, and few surgeons have reported experience with its surgical correction. This study has shown that evaluation of the disorder is difficult and at least four aspects should be considered. First, it is important to exclude voluntary (intentional) dislocators from this group, as they may willfully cause the procedure to fail. The patients in our study differed from the series of voluntary dislocators described by Rowe et al. Our patients were somewhat older, were psychologically normal, usually had a history of trauma or repetitive mechanical stress, and had a demonstrable pathological disorder of the glenoid labrum seen at operation or arthroscopy. A psychiatric consultation should be obtained if there is any doubt. Secondly, inferior instability is not always symptomatic and it may be that another local lesion is the cause of the discomfort. For example, a symptomatic patient with an unstable shoulder was completely relieved of pain after an injection of Xylocaine (lidocaine) into the acromioclavicular joint, proving that the pain was due to an old fracture of the distal articular surface of the clavicle rather than to instability. Thirdly, mildly symptomatic inferior instability can at times be controlled by altering the activity of the patient and with specific muscle exercises. Surgery should not be considered until efforts to strengthen the rotator-cuff muscles and deltoid have failed. Finally, accurate assessment of the direction of instability is essential in planning the repair. This can be surprisingly difficult. It is easy to mistake a humeral head that is going from a dislocated to a reduced position for one going from a reduced to a dislocated position.

It is important that this condition initially be distinguished from the much more frequent unidirectional anterior or posterior dislocation. A surgical procedure based on an incorrect diagnosis poses the threat not only of surgical failure but also of damage to the joint. In our series, three types of surgical errors were seen. First, the wrong procedure was performed, such as a biceps tenodesis or an anterior acromioplasty. This made later evaluation of the unsolved instability problem especially difficult. Secondly, there was failure after standard procedures for anterior and posterior dislocations, because the operation did not eliminate redundancy of the inferior part of the capsule. Thirdly, surgery created excessive tightness on one side of a hypermobile glenohumeral joint, causing a fixed subluxation or dislocation of the humeral head in the opposite direction. This can lead to extensive traumatic arthritis. During the course of this study, seven shoulders (not in the series) were treated by total shoulder replacement because of this problem.

Study of the patients in our series suggests that the etiology of symptomatic inferior and multidirectional instability is based on two factors in varying proportions: (1) the inherent laxity of the shoulder capsule, and (2) the activities of the patient. Extremely hypermobile shoulders can become symptomatic without unusual stress, merely from the activities of daily living. The most common combination of factors associated with this disorder seemed to be an individual with a relatively loose shoulder who stressed it repetitively in work or sports. Least frequent was the patient who had no predisposition to laxity of the joints but appeared to have acquired multidirectional instability of the shoulder as a result of repeated violent injuries such as those sustained in contact sports or wrestling. To classify all multidirectional dislocations as atraumatic seems to be an oversimplification that would cause misunderstanding of this condition.

The inferior capsular shift offers the advantage of stabilizing this type of shoulder, usually through one incision and without damage to the articular surfaces. Since the capsule and ligaments form the only inelastic barrier against dislocation and since hyperlaxity of the capsule with excessive joint volume appears to be the cause of the problem, it is logical to use a direct repair with reinforcement of these structures rather than some less anatomical method. It is unfortunately true, however, that this procedure is more difficult than the standard repairs for unidirectional dislocations.

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