Inferior capsular shift operation for multidirectional instability of the shoulder in players of contact sports

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Objectives: To assess the results of inferior capsular shift for multidirectional instability of the shoulder in athletes.

Methods: Multidirectional instability was surgically corrected in 53 shoulders in 47 athletes who engaged in contact sports. A history of major trauma was found in eight patients, the others having had minor episodes. Before surgery, all patients had complex combinations of instabilities. The surgical approach was selected according to the predominant direction of instability.

Results: Anterior inferior capsular shift was carried out in 37 shoulders, and anterior dislocation recurred in three. In one of these, it was anterior alone, one was anterior and inferior, and one was unstable in all three directions. After posterior inferior capsular shift in 16 shoulders, one dislocation occurred anteriorly and one posteriorly. With the anterior approach, four athletes could not return to sport. Two patients treated with the posterior approach could not return to sport. Of these six failures, five patients had had bilateral repairs. Successful repair based on the criteria of the American Shoulder and Elbow Association was achieved in 92% of anterior repairs and 81% of posterior repairs. Successful return to sport was noted in 82% of patients with anterior repairs, 75% with posterior repairs, and 17% with bilateral repairs. Overall, there were five subsequent dislocations, three in the anterior repair group (8%), and two in the posterior repair group (12%).

Conclusions: Inferior capsular shift can successfully correct multidirectional instability in most players of contact sports, but the results in bilateral cases are poor.

Although multidirectional instability is clearly defined as symptomatic glenohumeral instability in more than one direction, the pathomechanics and treatment have been controversial. Several operations had been advocated,¹⁻³ but there has been no general agreement as to the best approach. Physiotherapy has been suggested to improve symptoms,⁴ but it probably has limited value in the treatment of symptomatic multidirectional instability.

Static stability of the joint is provided by the capsule and ligaments. The shoulder capsule, which is reinforced by ligamentous thickening,⁵ plays an important role in constraint of the humeral head in the glenoid and prevents excessive translation and rotation of the joint.⁶⁻⁸ The inferior glenohumeral ligament complex provides reciprocal tightening of the anterior and posterior portions when the arm moves from external to internal rotation in the abducted position.⁹ It has been shown that repetitive loading of the inferior glenohumeral ligament at increasing levels of subfailure strain causes dramatic decreases in resistance to peak force with unrecoverable elongation.¹⁰ Repetitive minor trauma may therefore be a factor in producing instability.

In 1980, Neer and Foster¹¹ introduced the concept of multidirectional instability and designed the inferior capsular shift operation to reduce the redundancy of the inferior part of the capsule. This has become a standard operation, and the basic concept of focusing on the inferior capsule has not changed despite some modifications of the procedure.

There are difficulties associated with the diagnosis of multidirectional instability. Firstly, an accurate assessment of instability is required, as it is difficult to distinguish "instability" from "laxity". Secondly, the differentiation of unidirectional instability from multidirectional instability is not easy. The latter is instability in more than one direction, often associated with laxity in a specific direction instead of instability. Use of the inferior capsular shift operation for unidirectional instability can cause excessive tightening of the capsule,

which leads to a restriction of motion without correction of the instability. The converse also applies; an operation for unidirectional instability will not correct multidirectional instability. Neer¹² has stated that the time honoured terms "traumatic" and "atraumatic" are great oversimplifications. Bigliani et al¹³ found that athletes with anterior instability constituted a spectrum from unidirectional anterior instability to frank multidirectional instability with pronounced inferior capsular laxity, rather than simple discrete groups. In our group of athletes, we found various combinations of instability mixed with laxity, even when they complained of only unidirectional dislocation. Psychological problems should be excluded in the case of voluntary dislocation.

The possible surgical approaches are controversial. Matsen et al¹⁴ preferred the anterior approach to obtain anterior and inferior capsular tightening in forward flexion of the shoulder. He postulated that inferior capsular redundancy existed after posterior capsular tightening in flexion. On the other hand, Neer and Foster¹¹ prescribed anterior and posterior approaches according to the major components of the instability. We followed the latter, approaching posteriorly if patients had major posterior instability and anteriorly if they had major anterior or inferior instability. We investigated the results of anterior inferior capsular shift and posterior inferior capsular shift in the athletic population, selecting the operation on the basis of the major instability.

MATERIALS AND METHODS

Over a period of five years, 52 athletes were seen and operated on for multidirectional instability. Five were lost to follow up. Forty seven athletes, who participated in contact sports, underwent capsular shift operations at a university hospital. Six patients had bilateral procedures, making 53 shoulder operations. The patients had been referred to a sports clinic. One author (DJOH) operated on all the patients. There were 18

Table 1 Evaluation of pain in 53 shoulders

	Before surgery	After surgery
None	0	19
Slight	3	23
After usual activity	29	7
Moderate	15	1
Considerable	6	3

men and 29 women. The average follow up was 42 months (range 24–73). The left shoulder was the problem in 23 and the right in 18. Six patients had bilateral symptomatic multidirectional instability. All of the patients were athletes and played on either a professional or highly competitive basis (university, high school, college, or club). Twenty patients were involved in ice hockey, 14 rugby, two soccer, nine football, and two basketball. The youngest was 17 years old and the oldest 37. Thirty one patients were aged 20–30 years, and nine were under 20 years old. Only eight patients had a traumatic dislocation of the shoulder during sports activity. Seventeen patients experienced several episodes of minor injury that caused pain and improved spontaneously after rest. Twenty two patients could not remember any major injury to the shoulders.

Initially, all dislocations were reduced in the emergency room and immobilised for about three weeks with sling or velpeau bandage. Seven shoulders dislocated 3 times or less, 17 shoulders dislocated 4–10 times, and 29 shoulders dislocated more than 10 times. Pain was a major symptom associated with the multidirectional instability. Twenty nine patients felt pain after activities of daily living, and 15 patients had a moderate degree of pain regardless of the activity. Six patients had severe pain that interfered with activities of daily living (table 1).

We assessed instability initially in the clinic and then in the operating room under general anaesthesia. The history was the prime determinant for the direction of instability. In other words, the symptomatic direction of instability was regarded as the predominant direction of instability. Where the instability was in more than one direction, we chose the direction with the most severe symptoms.

Examination under anaesthesia was the principal confirming diagnostic test. If the humeral head could be completely removed from the glenoid, this was classified as a "dislocation". If the humeral head was abnormally mobile, but did not completely disengage, we classified this as "subluxation". If less than half the humeral head came out of the glenoid socket, we considered this "stable". To meet the criteria for multidirectional instability, there had to be dislocation in at least one direction and subluxation or dislocation in another. Surgical repair was carried out as described by Neer.¹² Arthroscopy was not carried out. We felt that it added little information, as the primary surgical approach was to be open repair.

In 37 shoulders, we found the major instability was anterior. In this group, there was always an associated inferior instability. There was posterior instability in 32 of these shoulders, four with subluxation and 28 with dislocation. We found four of the shoulders to be very unstable in all directions (table 2). Shoulders with anterior instability were repaired through an anterior approach to correct the anterior inferior capsular redundancy. A deltopectoral incision was used. The conjoint tendon was retracted medially but not detached. The subscapularis tendon was split obliquely. A capsular flap in the shape of a T was developed. The inferior capsule was carefully mobilised and advanced to be sutured superiorly. The superior capsule was pulled down and sewn inferiorly. The stability was tested in the neutral position and with the arm abducted to a right angle. The subscapularis tendon was reattached without shortening. In these patients no significant Bankart lesions were found.

Posterior instability was determined to be the major pathology in 16 shoulders. In all of these, we also found anterior and inferior instability in the form of subluxation (table 2). The posterior inferior capsular shift was performed in these 16 shoulders. The posterior incision was along the line of the infraspinatus. The infraspinatus tendon was divided and retracted. A T shaped capsular incision was made. Plication was then carried out as for the anterior approach. The posterior capsule tended to be thinner than the anterior. The infraspinatus tendon was therefore shortened by about 1 cm for extra security.

After surgery, the shoulder was immobilised for three to six weeks, with a sling for patients who had had the anterior inferior capsular shift operation and an abduction brace for those who had had the posterior inferior capsular shift operation. The time interval for immobilisation was titrated against the degree of stiffness of the shoulder. If the shoulder felt quite stiff after three weeks, it was mobilised. The criteria for stiffness were the ability to abduct the arm to 90° and externally rotate to neutral. Otherwise, immobilisation was continued for up to a maximum of six weeks. Then range of motion and isometric exercises were started. Patients who reached almost a full range of motion were permitted to start isotonic exercises, with the emphasis on muscle strengthening. The final rehabilitation programme included sports specific exercises with plyometrics, proprioceptive training, and isokinetic exercises.

All of the patients were followed by clinical examination. The results were evaluated using the criteria of the American Shoulder and Elbow Association (ASEA)¹⁵ and were graded using the criteria of Neer and Foster.¹¹

RESULTS

Overall, the capsular shift procedures resulted in substantial pain improvement. In 19 shoulders, there was no pain at the time of the final follow up. In 23 shoulders, there was pain but it did not cause any limitation of activity. In seven shoulders, there was pain after activities of daily living. Pain that limited sports activities was found in four shoulders: in one the pain was moderate and in three it was considerable (table 1).

Active elevation of the arm averaged 166° (range 125–180°) in the anterior repair group and 168° (range 145–180°) in the

Table 2 Preoperative components of multidirectional instability

Stability	Anterior inferior capsular shift (n=37)			Posterior inferior capsular shift (n=16)		
	Anterior	Posterior	Inferior	Anterior	Posterior	Inferior
Normal	0	5	0	0	0	0
Subluxation	0	28	26	12	0	16
Dislocation	37	4	11	4	16	0

Table 3 Average range of motion (°) at final follow up

Motion	Anterior inferior capsular shift	Posterior inferior capsular shift
Sitting position		
Active total elevation	166 (125–180)	168 (145–180)
Passive internal rotation*	L4 (Trochanter–T6)	L2 (L4–T7)
Active external rotation arm at side	75 (55–95)	81 (61–95)
Active external rotation at 90° abduction	71 (45–95)	82 (65–95)
Supine position		
Passive total elevation	171 (120–180)	179 (145–180)
Passive external rotation at 90° abduction	69 (50–95)	82 (60–95)

*Segment of posterior anatomy reached by thumb.

Table 4 Muscle strength at final follow up (n=53)

Muscle	Normal	Good	Fair	Poor	Trace	Paralysis
Anterior deltoid	47	2	4	–	–	–
Middle deltoid	51	2	–	–	–	–
External rotators	37	13	3	–	–	–
Internal rotators	34	12	7	–	–	–

Table 5 Postoperative stability in each direction

Stability	Anterior inferior capsular shift (n=37)			Posterior inferior capsular shift (n=16)		
	Anterior	Posterior	Inferior	Anterior	Posterior	Inferior
Normal	24 (65)	28 (76)	29 (78)	12 (75)	11 (69)	9 (56)
Subluxation	10 (27)	8 (22)	6 (16)	3 (19)	4 (25)	6 (38)
Dislocation	3 (8)*	1 (3)	2 (5)	1 (6)†	1 (6)	1 (6)

Values are number of shoulders (%).

*One patient had dislocation in all three directions, one patient in two directions (anterior and inferior); †one patient dislocated anterior and inferior, one patient dislocated posterior.

posterior repair group. Passive internal rotation was evaluated by checking the segment of posterior anatomy that could be reached by the thumb. In the anterior repair, the average internal rotation was to the 4th lumbar spinal segment, and in the posterior repair to the 2nd lumbar spinal segment. Active external rotation with the arm at the side was similar in both repair groups. In the anterior repair group, average external rotation was 75° and in the posterior repair group it was 81°. The average active external rotation at 90° abduction was 71° in the anterior repair group and 82° in the posterior repair group. We also examined the passive motion in the supine position. Passive total elevation was an average of 171° in the anterior repair group and 179° in the posterior repair group. Passive external rotation with the arm at the side was an average of 69° in the anterior repair group and 82° in the posterior repair group (table 3).

The strengths of the anterior deltoid, middle deltoid, external rotator, and internal rotator muscle were evaluated. The anterior deltoid muscle in 47 shoulders had normal strength, in two it had good strength, and in four it was fair. Fifty one shoulders had normal strength and two had good strength in the middle deltoid muscle. External rotator strength was normal in 37, good in 13, and fair in three. The strength of internal rotation was measured as normal in 34, good in 12, and fair in seven. No muscle of trace or poor strength was found (table 4).

After the anterior inferior capsular shift, complete anterior stability was achieved in only 24 shoulders (65%). Posterior stability was found in 28 (76%), and inferior stability in 29 (78%). Three patients experienced anterior recurrent dislocation. One of these patients had an anterior dislocation alone, also an associated inferior dislocation, and the third had

recurrent dislocations in all directions. The patient who had multidirectional dislocation was treated successfully with a subsequent posterior capsular shift. One patient with anterior recurrent dislocation rejected re-operation, and the remaining patient had a successful secondary revision procedure with a repeat capsular shift (table 5).

After the posterior inferior capsular shift, complete anterior stability was achieved in 12 shoulders (75%), posterior stability in 11 (69%), and inferior stability in nine (56%). Only one patient experienced a recurrent posterior dislocation. Anterior dislocation was found in one patient, combined with inferior dislocation. The latter patient was treated with the anterior inferior capsular shift operation by an anterior approach with good results (table 5).

Functional improvements after surgery are as important an indicator of a successful result as is stability. We considered an activity level of mild compromise as a satisfactory result (grade 3 out of 4 on the ASEA score). There was no limitation in usual daily activities in our patients (using back pocket, perineal care, washing opposite axilla, eating with utensil, combing hair, and dressing). One or two patients had difficulty in using the hand with the arm at shoulder level, carrying 4.5 kg with the arm at the side, sleeping on the affected side, and lifting after surgery. For three shoulders after the anterior repair and two after the posterior repair, there was difficulty in pulling. For four shoulders after anterior repair and three after posterior repair, there was difficulty in using the hand above the head. Even though the patients could throw a ball, five felt some difficulties after the anterior repair, and six after the posterior repair. Four patients could not return to their previous jobs, two in each group. Four patients (seven shoulders) could not return to the previous level of sport after the anterior inferior capsular shift. This included three bilateral cases

Table 6 Functional results according to the American Shoulder and Elbow Association (ASEA)

Function	Anterior inferior capsular shift (n=37)					Posterior inferior capsular shift (n=16)				
	N	MC	D	WA	U	N	MC	D	WA	U
Use back pocket	34	3				14	2			
Perineal care	37					16				
Wash opposite axilla	37					16				
Eat with utensil	37					16				
Comb hair	37					16				
Use hand with arm at shoulder level	32	4	1			14	2			
Carry 4.5 kg with arm at side	32	3	2			13	2	1		
Dress	37					16				
Sleep on affected side	32	3	2			14	1	1		
Pulling	31	3	3			12	2	2		
Use hand overhead	29	4	4			11	2	3		
Throwing	27	5	5			7	3	6		
Lifting	29	7	1			13	2	1		
Do usual work	29	3	3		2	11	2	1		2
Do usual sports	25	3	2		7	9	2	1		4

N, Normal; MC, mild compromise; D, difficulty; WA, with aid; U, unable.

(six shoulders). After the posterior inferior capsular shift, two patients (four shoulders; bilateral cases) could not return to previous sports (table 6).

Complications occurred in a few patients. Two superficial infections were found after surgery but resolved with short term antibiotic treatment. In one patient, partial musculocutaneous nerve damage recovered spontaneously. One patient experienced a psychotic episode. Two keloid scars developed but these did not affect the final result.

In subjective evaluation of the shoulder, patients were satisfied with their results in 34 cases (92%) after the anterior inferior capsular shift operation and in 13 (80%) after the posterior inferior capsular shift.

DISCUSSION

In athletes engaged in contact sports, the shoulder joint is subjected to many repetitive stresses. In this study, we found that most cases of multidirectional instability were associated with minor repetitive trauma. The number of patients who had a single traumatic episode was low. In our series, the contact athletes probably have an underlying laxity of their shoulders that becomes manifest after repetitive trauma with stretching of the capsular ligamentous structures. Most of our patients did not have a Bankart lesion, pointing to the underlying laxity and the lack of importance of significant trauma. Many had non-symptomatic laxity or instability of the opposite shoulder.

Neer and Foster¹¹ described the principle of inferior capsular shift, not only to obliterate the inferior pouch and capsular redundancy in the direction of instability but also to reduce laxity on the opposite side. They used one surgical approach, either anterior or posterior, depending on the direction in which the shoulder was most unstable. We followed the same guidelines. Most authors^{11 13 16 17} have followed this principle. Cooper and Brems¹⁸ used only the anterior approach regardless of the major instability, and they reported an excellent range of motion with no major limitations. Although the inferior capsular shift operation has the advantage of reducing laxity in the opposite direction to the surgical approach, complete correction of the component of posterior capsular laxity is difficult.

The classic concept of multidirectional instability has been changed. Multidirectional instability has been defined as instability in all directions. This is true if the joint is congenitally unstable, but, in athletes exposed to continuous stress, the unstable shoulder shows various components of excessive laxity or instability. Flatow and Warner¹⁰ described how repetitive injuries from athletic activities often stretch many

different parts of the capsule, each episode stressing only that portion of the capsule that was taut in the particular position in which the arm was injured. The reason why acquired instability is often multidirectional may be that the cumulative effect of multiple minor injuries with the arm in various positions is a globally lax capsule. Bigliani et al¹⁶ described a spectrum of injury from less laxity of the inferior capsule in unidirectional instability to more laxity in multidirectional instability. They have used the term bidirectional to describe instability in only two directions, which could be placed between unidirectional and multidirectional instability. They found that only six patients out of 34 who had been treated with a posterior inferior capsular shift had isolated instability. Seven had bidirectional instability, and 22 had multidirectional instability. They recommended correcting as much inferior laxity as is actually present in each case. We agree with these concepts. In our study, all but five of the patients with major anterior instability also had posterior and inferior instability. Instability in all directions was found in all whom had symptomatic posterior instability. The variety and combination of laxity and instability in this series would be explained by the cumulative effect of repetitive stress on the different parts of the capsule, probably superimposed on a generally lax joint.

The range of forward flexion after surgery was similar in both groups. The range of active and passive external rotation, which was found to be decreased by about 10° in anterior inferior capsular shift, compared to that in posterior inferior capsular shift. There was a difference of two spinal segment levels in the range of passive internal rotation of both groups.

It is our policy to immobilise the shoulder for three to six weeks after surgery to allow maturation of the scar, and then to start aggressive rehabilitation. Most authors recommend immobilisation for three to six weeks. Nixon and Lindenfeld¹⁹ reported the advantage of early rehabilitation after modified inferior capsular shift. They permitted 90° elevation during the first three weeks, isometric exercise by the third week, and resistance exercises by six weeks. No subluxation or dislocation was found in 14 patients. At final examination, most of their patients had good or normal muscle strength. The shoulder motion was satisfactory. Recovery of strength in the shoulder muscles is important for recovery from the surgical trauma and prevention of recurrence. We included strength exercises in a step by step progression with a combination of proprioceptive exercises. Sports specific exercises, including plyometrics, were the final step of rehabilitation before return to high level sports.

All parameters in the evaluation criteria showed improvement after surgery. There were no limitations in the basic

Take home message

Multidirectional instability in contact athletes can be corrected surgically by inferior capsular shift repair. The outcome for patients with bilateral instability is poor.

functions of daily living. In functions requiring shoulder motion and strength, such as lifting, pulling, and carrying, one or two patients in each repair group had some difficulty, but all of the patients could perform these activities in spite of the difficulty. More patients had problems with actions above the head, including use of the hand above the head and throwing. It was surprising to find that, for six shoulders (37%) in the posterior inferior capsular shift group, there was difficulty with throwing, compared with five (14%) in the anterior repair group. The percentage of those who had difficulty with overhead use was also higher in the posterior repair group: 19% v 11%. Limitation of external rotation is a well known problem after anterior repair of anterior instability; in our study, the slight limitation of external rotation did not have any effect on function.

In the initial report of Neer and Foster¹¹ of a series of 32 patients, only one unsatisfactory result was noted. After posterior shift, Bigliani et al¹⁶ reported 80% success after five years of follow up. In a separate article, they also reported that 58 (92%) of 63 patients treated with anterior inferior shift could return to their sports.¹³ In the study of Cooper and Brems,¹⁸ 39 (91%) of 43 shoulders were satisfactory two years after the operation. Yamaguchi and Flatow¹⁷ also reported that 94% of 54 patients who were treated with inferior capsular shift were rated as satisfactory after five years. In an active duty population, Lebar and Alexander²⁰ experienced only one failure after inferior capsular shift performed in 14 patients. They felt that a history of an acute traumatic event was predictive of greater improvement in pain and stability. Hawkins et al²¹ reported less favourable results. They found satisfactory results in 19 (41%) of 31. We considered that it was an unsatisfactory result if a patient could not return to their sport, because all patients in this study were athletes. After anterior inferior capsular shift, four patients out of 32 with an anterior repair and two of 15 patients with a posterior repair could not return to their sport. Of these six patients, five had had bilateral repairs. Hence, the prognosis for return to athletic activities must be guarded in the presence of bilateral symptomatic instability. The outcome for 92% of the patients would be classified as good or excellent from the point of view of their daily activities, but only 82% successfully returned to sport after anterior repair, 75% after a posterior repair, and 17% after bilateral repairs.

We found that the capsular shift procedure worked well for multidirectional instability in the athletic population. The repair was successfully carried out by approaching the shoulder from the major symptomatic direction of instability. Overall, our results were better for anterior repairs than for posterior repairs. The prognosis for return to high level sport is poor for bilateral instability.

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