Neer Modification of Open Bankart Procedure: What are the Rates of Recurrent Instability, Functional Outcome, and Arthritis?

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Abstract

Background Neer modified the Bankart procedure by combining a superiorinferior capsular shift with the labral reattachment. The theoretical advantages of the modification were that such a procedure would restore the patient's anatomy and also treat the repeated capsular stretching encountered in anteroinferior instability without limiting external rotation and, thereby reducing the risk of arthritis. **Questions/purposes** We therefore determined: (1) the rate of recurrent instability after this modification, (2) patient function, and (3) the incidence and stage of glenohumeral

osteoarthritis at greater than 2 years followup in patients with traumatic anteroinferior instability.

Methods We retrospectively reviewed all 64 patients (average age, 27 years) who had the modified Bankart procedure for recurrent dislocations (n = 39) or subluxation (n = 25) from 1991 to 1997. The labrum was reattached with suture anchors and a superiorinferior capsular shift was added. We determined the rate of recurrent instability, Rowe and Walch-Duplay scores and shoulder ROM, and the presence of glenohumeral osteoarthritis (modified Samilson and Prieto classification). The minimum followup was 24 months (median, 40 months; range, 24–120 months).

Results Recurrent instability occurred in seven of the 64 patients (11%) at an average of 25 months postoperatively (range, 7 days to 6 years); in six patients the recurrence was associated with trauma; five of the six patients underwent reoperation with a Latarjet procedure. Eight additional patients (13%) presented with persistent shoulder apprehension or discomfort. The average Rowe score was 83% (range, 20–100%) and average Walch-Duplay score 83% (range, 15–100%). However, only 36 of 64 (56%) patients could return to the same sport at the same level. The loss of external rotation was 13° compared with the contralateral side. Glenohumeral osteoarthritis incidence increased from 4% preoperatively to 17% postoperatively.

Conclusions The open Bankart procedure modified by Neer provided high function scores but a relatively low rate of return to sport and high rate of recurrent instability. Our rate of recurrent instability, similar to that obtained with arthroscopic Bankart procedures, has prompted us to abandon the open procedure.

Level of Evidence Level IV, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

Each author certifies that he or she has no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

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This study was conducted in France and is considered noninterventional research because it entails treatments used in the normal treatment course. As such, ethical committee approval is not required.

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Introduction

In 1938, Bankart [3] described a surgical procedure to treat traumatic anterior instability of the shoulder. The procedure is intended to restore the patient's anatomy by reattaching the detached capsulolabral complex on the anteroinferior glenoid margin and a mediolateral capsular shift. The main criticisms with the mediolateral capsular repair are potential postoperative limitation of external rotation and possible development of glenohumeral arthritis [5, 16, 24, 39, 45].

Neer and Foster [43] modified the original Bankart technique by combining the capsulolabral repair with a capsular shift in the superoinferior direction, not just mediolateral as described in the original technique. This modification of the Bankart procedure was derived from "the inferior capsular shift," which Neer and Foster [43] described for multidirectional instability. In the early 1990s, because we were disappointed by the high rate of recurrent instability obtained with arthroscopic Bankart repair using transglenoid sutures (ie, the Morgan technique), we revisited open surgery and the procedure described by Neer became our routine technique for treatment of anteroinferior traumatic instability of the shoulder [40, 61]. We presumed the theoretical advantages of the modification by Neer and Foster were that such a procedure would restore the patient's anatomy and also treat the constant plastic deformation of the capsule encountered in anteroinferior instability without limiting external rotation and, thereby decrease the risk of arthritis [7, 42].

Therefore, we determined: (1) the rate of recurrent instability, (2) functional scores, and (3) the incidence and stage of glenohumeral osteoarthritis at greater than 2 years followup in patients with traumatic anteroinferior instability.

Patients and Methods

We retrospectively reviewed all 77 patients treated using the Neer modification of the open Bankart procedure for traumatic anteroinferior instability of the shoulder between 1991 and 1997. The indication for use of the modified procedure was all patients with recurrent anteroinferior instability of the shoulder. The contraindications were patients with atraumatic or voluntary instability. During that same time, we treated no patients with traumatic anteroinferior instability using other approaches but we excluded 13 patients with (1) a first-time dislocation and (2) no Bankart lesion at the time of the surgery. This left 64 patients for study. The average age of the patients at surgery was 27 years (range, 16–48 years) (Fig. 1). There were 46 males (72%) and 18 females. The dominant shoulder was

Fig. 1 The number of patients according to their age at the time of the intervention is shown.

involved in 30 cases (47%) and there was bilateral instability in 11 cases. The average time from the onset of symptoms to surgery was 57 months (range, 5–420 months). Thirty-nine patients presented with recurrent dislocations and 25 with recurrent subluxations. Ten patients presented with an associated anterior hyperlaxity, defined by external rotation greater than 85° with the arm at the side [59]. Three patients had a previous failed Latarjet procedure. Sixty patients (89%) were involved in athletics and 20 participated in competitive sports. This involved low-risk activities in nine, contact activities in 21, overhead activities in nine, and resisted overhead activities in 21. The preoperative radiographic assessment identified an osseous lesion of the glenoid in 41 cases (64%) and a Hill-Sachs lesion in 44 cases (69%). Osteoarthritis was evaluated preoperatively according to the modified Samilson and Prieto classification [53], and this identified a 3% incidence of osteoarthritis (one Stage I and one Stage II). No patients were lost to followup. The minimum followup was 24 months (median, 40 months; range, 24–120 months). Fifty-four patients returned for reexamination and radiography and 10 patients were questioned by telephone.

All patients were operated on by one surgeon (PB). The patient was placed in the beach-chair position and a deltopectoral approach was used with the cephalic vein taken medially. We identified the axillary nerve. The subscapularis tendon then was detached with either a complete tenotomy (11 cases) or an L-shaped partial tenotomy with the lower 1 cm left attached to its insertion to protect the anterior axillary vessels. The deep surface of the subscapularis was dissected from the anterior glenohumeral capsule. We performed a humeral-based T-capsulotomy, thus forming two flaps: one superior and one inferior. A humeral head retractor was inserted in the glenohumeral joint and assessment of the lesions then was performed. After abrasion of the anterior glenoid margin and neck, the labrum was reinserted using nonabsorbable polyethylene anchors (TAG; Acufex; Smith & Nephew, Memphis, TN, USA) placed on the glenoid rim. The number of anchors used was one in two cases, two in 34 cases, three in 24 cases, and four in two cases. We then reinserted the inferior

capsular flap on the humerus, effectively performing a superoinferior capsular shift and then reinserted the superior flap over the inferior flap, performing capsular reinforcement [37, 38]. These reinsertions were with the arm in 30° abduction and 30° external rotation to avoid overtensioning of the capsule. The subscapularis tendon was repaired in an anatomic position without any advancement using side-to-side repair. We closed the rotator interval with a simple stitch. Two patients also had an associated partial deep supraspinatus tear (less than 50% of tendon thickness) that was not repaired at the time of surgery.

Immediately postoperative, the patients were immobilized in adduction and internal rotation with a sling for 3 weeks. Supervised physiotherapy began at 3 weeks with passive motion until 6 weeks, after which full active mobility was allowed with avoidance of on abducted and externally rotated position for the first 3 months. Physiotherapy occurred biweekly for 6 weeks, along with daily home exercises. Return to full sports activities was allowed at 6 months.

All patients were followed up at 6 weeks, 3 months, and then yearly thereafter. At last followup all patients were reviewed by one observer (EF) not involved in the treatment. This observer was a surgeon with experience in shoulder surgery. Evaluation included clinical assessment of ROM, functional assessment with the Rowe [51] and Walch-Duplay scores [59], and a radiographic assessment. The Rowe score consists of three individual scores for function (30 points), stability (50 points), and mobility (20 points). The Walch-Duplay score consists of four individual scores for sport (25 points), stability (25 points), pain (25 points), and mobility (25 points).

One of us (EF) not involved in treatment of the patients independently assessed an AP radiograph of the shoulder and a glenoid profile view. Glenohumeral osteoarthritis was classified according to the four stages of the modified Samilson and Prieto classification [53]: Stage 1, humeral osteophyte measuring less than 3 mm; Stage 2, humeral osteophyte measuring at least 3 mm but less than 8 mm; Stage 3, humeral osteophyte measuring at least 8 mm; and Stage 4, complete narrowing of the glenohumeral joint space. Any complications or reoperations also were noted.

Results

Recurrent instability occurred in 11% of the cases, at an average of 25 months postoperatively (range, 6 days to 6 years). This was dislocation in two cases and subluxation in five cases. One case of subluxation occurred early (at 6 days postoperatively) in a patient with hyperlaxity and did not recur. The six other cases occurred after trauma

(forced abduction and external rotation in four cases, a fall in one case, and a motor vehicle accident in one case). Eight patients (13%) had persistent apprehension or apprehension when the arm was placed in the throwing position (ie, anterior apprehension test). Five of the seven patients with recurrent instability underwent revision with a Latarjet procedure and had a subsequent stable shoulder.

The mean Rowe score was 83 (range, 20–100) and mean Walch-Duplay score 84 (range, 15–100) (Table 1). The average active anterior elevation was 165° (range, 150°–180°), external rotation with the arm at the side was 64° (range, 30°–90°) with a deficit compared with the contralateral side of –13° (range, –50° to 10°), and external rotation in 90° abduction was 88° (range, 20°–120°) with a deficit compared with the contralateral side of –17° (range, –50° to 10°). Patients returned to work at an average of 4 months (range, 1–12 months) and returned to sport at an average of 7 months (range, 3–24 months) after surgery. Thirty-six patients (56%) returned to sport at the same level, 19 at a lower level, six changed sport, and three did not return to sport. Forty-three patients had no pain (67%), 20 had pain with resisted internal rotation, and one had pain with activities of daily living.

Preoperatively, there were signs of osteoarthritis in 4% (two of 52) of the patients (one Stage I and one Stage II), compared with 17% (nine of 52) at the last followup (five Stage I, three Stage II, and one Stage III). In eight patients (15%) there was worsening of osteoarthritis. We did not observe any case of Stage IV osteoarthritis (Fig. 2).

Table 1. Functional results according to the Walch-Duplay and Rowe scoring systems

Walch-Duplay score		Rowe score	
Sport or activity	20/25	Function	23/30
Stability	19/25	Stability	43/50
Pain	22/25		
Mobility	24/25	Mobility	18/20
Total	84/100	Total	83/100

Fig. 2 The incidences of preoperative and postoperative osteoarthritis are shown according to Samilson and Prieto stages [52].

Radiologic assessment revealed no osseous reaction related to the polyethylene anchors.

Postoperative complications included reflex sympathetic dystrophy in eight patients (13%), all of whom had prolonged rehabilitation (greater than 6 months). Two patients had temporary axillary nerve hypoesthesia, one patient had a hematoma in the sheath of the long head of the biceps that resolved spontaneously, and one had heterotopic ossification with no effect on mobility.

Discussion

The theoretical advantages of Neer's modification of the Bankart procedure, by combining a superoinferior capsular shift with the labral reattachment, were to restore the patient's anatomy and treat the constant plastic deformation of the capsule without limiting external rotation and, therefore, may be less likely to lead to arthritis [7, 42, 43]. Our purpose for this study was to address the: (1) rate of recurrent instability, (2) functional scores and (3) incidence and stage of glenohumeral osteoarthritis at greater than 2 years followup in patients with traumatic anteroinferior instability who have undergone this procedure.

We recognize several limitations to our study. First, this is a retrospective case series and thus, is prone to selection bias. However, we believe that the findings are important and relevant. Second, we did not have a comparison group. This was our preferred treatment for this patient population during the specified time and therefore we had no other group for comparison. Third, the patients reviewed were relatively young and active, so our results may not be generalizable to the entire population. Fourth, our patients did not undergo any advanced imaging (CT or MRI), which would have allowed better assessment of bone loss and potentially improved treatment. However, this was not our practice during the period of treatment of this patient population.

We observed an 11% rate of recurrent instability (seven of 64 patients) and five patients (8%) have undergone revision surgery with a Latarjet procedure. In addition, eight patients (13%) had persistent apprehension or pain with an anterior apprehension test. Several poor prognostic factors for recurrent instability after an open Bankart repair have been described [8, 10, 12, 22, 26, 37, 39, 58]. In our series, patients younger than 25 years showed a trend for a higher risk of recurrence. This is similar to previous studies that have reported that younger patients are at higher risk for recurrent instability after instability surgery [8, 26, 58]. Although our rate of recurrent shoulder instability is disappointing, its interpretation and those reported in the literature depends on the definition of failure. In the classic paper of Rowe [50], the reported rate of failure for stability was 2% in 145 patients reexamined 6 years after surgery.

However, on careful inspection, only dislocations were included in the failure rate; when subluxations are added, the failure rate increases to 8%. This is similar to the 11% rate of recurrent instability in our study. Similarly, in the series with the longest followup, Pelet et al. [44] reported a recurrence rate of 10%, but this also included only dislocations. Using the same technique as described by Neer [42] and used here, Bigliani et al. [7] reported a 13% recurrence rate, whereas Mansat [37] reported a 5% recurrence rate and 6% rate of persistent apprehension. Voos et al. [58] reported a 10% rate of recurrent dislocation and an additional 8% rate of recurrent subluxation or apprehension. Rahme et al. [45] reported a 6% rate and Fabre et al. [16] reported a 16% rate of recurrent dislocation, but neither reported the rate of recurrent subluxation. Interpretation of our results would be incomplete without comparison to arthroscopic procedures. Although the reported recurrence rates after arthroscopic Bankart procedures were initially high, ranging from 7.5% to 49% [18, 20, 23, 61], more recent studies have found improved recurrence rates, ranging from zero to 12.5% [4, 15, 17, 29, 32, 46, 56, 58, 62]. Our rate of recurrent instability after arthroscopic Bankart repair, using sutures and anchors, was 15% in 91 patients at 36 months followup [8]. This rate is similar to the 11% rate of failure reported here.

The function in our patients is comparable with that reported in the literature. Functional outcome scores of other series have ranged between 73% and 98% (Table 2). However, one must be cautious when comparing the results with those reported in the literature (Table 2). Many series often include various procedures (ie, capsular reattachment, capsular reattachment with subscapularis advancement, capsular reattachment with plication, capsular reattachment with labrum). In addition, comparison between series often involves patients with different types of lesions (ie, capsular distension, multidirectional laxity, bony defects), because the exact physiopathology of recurrent anterior instability of the shoulder is not completely understood. One of the main complications of any capsulolabral repair technique is loss of external rotation [16, 34, 45]. In previous series, loss of external rotation has ranged from 0° to 24° [16, 27, 44, 45, 47]. Early techniques of shoulder stabilization (ie, Bankart, Putti-Platt) used mediolateral retensioning, thus limiting external rotation. However, the Neer modification of the open Bankart procedure does not include mediolateral retensioning, but rather superoinferior retensioning without shortening the capsule in the horizontal plane. We found an acceptable loss of external rotation of 14° with the arm at the side compared with the contralateral side and a loss of 17° with the arm in abduction. Other factors potentially avoiding loss of external rotation with Neer's technique are reattachment of the subscapularis tendon in an anatomic position (ie, without advancement) and performing the capsulolabral

Table 2. Review of the literature

Study	Followup (years)	Functional outcome scores (%)	Recurrence (%)	Osteoarthritis (%)	Loss of external rotation (degrees)
Bankart [3]	NA	NA	0	NA	NA
Bost and Inman [9]	1.9	NA	11	NA	NA
Robertson and Stark [48]	0.6–1.5	NA	0	NA	10–15
Adams [1]	> 2	NA	5.6	NA	51
Eyre-Brook [14]	2.1	NA	0	NA	NA
Dickson and Devas [13]	NA	NA	3.8	NA	NA
Rowe [50]	> 10	NA	3.3	NA	NA
Werner and Reimers [63]	7.8	NA	6.5	NA	15–20
Morrey and Janes [41]	10.2	NA	11	NA	NA
Rowe et al. [51]	6	97	3.5	0	NA
Hovelius et al. [25]	1.5–10	NA	2.2	NA	16
Rowe and Zarins [52]	4.1	94	8	NA	NA
Loomer and Fraser [34]	3.2	83	13.3	NA	4
Thomas and Matsen [55]	5.5	97	2.6	NA	NA
Varmarken and Jensen [57]	4	NA	13	NA	20
Berg and Ellison [6]	6	90	8.7	NA	5
Altchek et al. [2]	3	98	10	NA	5
Jobe et al. [27]	3.3	92	0	NA	0
Richmond et al. [47]	1.25	94	5.9	NA	0
Rosenberg et al. [49]	15	73	9.1	NA	18
Wirth et al. [64]	5	93	6.8	NA	6
Gill et al. [19]	11	93	5	NA	12
Steinbeck and Jerosch [54]	3	89	10	NA	NA
Chapnikof et al. [11]	16	73	9.5 (dislocation)	Stage II = 13 Stage III = 3.7 Stage IV = 7.4	9.4
Hamada et al. [21]	8.3	74	26	NA	15
Mansat [37]	3.5	89	4	0	NA
Magnusson et al. [36]	5.8	NA	17	NA	7.5
Jolles et al. [28]	3	91	0 (dislocation)	0	8
Lai et al. [30]	4.6	93	1.2	NA	10
Pelet et al. [44]	29	75	10 (dislocation)	40	24
Berendes et al. [5]	11	84	23	29	
Rahme et al. [45]	5	76	6%	NA	12
Fabre et al. [16]	28	92	16	69	9
Current study	3.8	75	11	Stage I = 9.3 Stage II = 5.6 Stage III = 1.9	13

NA = information not available.

reattachment and rotator interval closure with the arm in 30° external rotation and 30° abduction [63]. We also encountered several complications, most frequently reflex sympathetic dystrophy (13%). This is a relatively high rate and was diagnosed and treated by an experienced physical rehabilitation physician. All patients had prolonged rehabilitation and the reflex sympathetic dystrophy resolved

by a year postoperatively. Owing to the small number (eight patients), it was not possible to identify a difference in outcomes between this group and other patients.

This study shows similarities with other series regarding the low incidence of glenohumeral osteoarthritis after an open Bankart procedure [26, 28, 44, 51]. In our study, at an average followup of 47 months, 17% of the patients

showed some osteoarthritis, but only one patient had Samilson and Prieto Stage III (inferior osteophyte greater than 7 mm) and none had true osteoarthritis with joint space narrowing (ie, Samilson and Prieto Stage IV). In the literature, the rate of true osteoarthritis (ie, Samilson and Prieto Stage IV) after open Bankart repair varies from 0% reported by Rowe et al. [51] and Jolles et al. [28] (with 6- and 3-year followups, respectively) to 40% for Pelet et al. [44] (at 29 years followup) and 61% for Hovelius et al. [26] (at 18 years followup). Therefore, the incidence of osteoarthritis seems to increase with time. However, intraobserver and interobserver reliabilities of the Samilson and Prieto classification have been shown to vary between fair and poor (kappa coefficients 0.07–0.33), therefore these findings must be interpreted with caution [33].

We found the Neer modification of the open Bankart procedure had a somewhat high rate of recurrent instability but similar function and low rate of glenohumeral osteoarthritis at a median of 40 months in comparison to previous studies. Because open and arthroscopic techniques seem to give similar results, the choice of surgical technique is becoming more of an academic or individual question [32]. Owing to our findings we abandoned the use of an open Bankart procedure for traumatic anterior shoulder stabilization and arthroscopic stabilization is now our preferred procedure. In the case of severe bony lesions, our preference is to perform a Latarjet procedure [8, 31, 60].

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