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Long-term clinical outcome of arthroscopic Bankart repair with suture anchors

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Background: The most common surgical technique in traumatic anterior shoulder instability is the arthroscopic Bankart repair, which has excellent short-term results. The long-term results of the arthroscopic Bankart repair are less frequently studied, with a high recurrence rate of 23% to 35%. The aim of this study was to evaluate the medium-term to long-term results of arthroscopic Bankart repair using suture anchors and to identify specific risk factors for recurrent instability.
Methods: Included were 147 patients after traumatic anterior shoulder dislocation who underwent an arthroscopic Bankart repair. The primary outcome was recurrent instability, defined as dislocation or subluxation as perceived by the patients. The secondary outcome was subjective shoulder stability and function as well as quality of life, evaluated using the Western Ontario Shoulder Instability Index, the Simple Shoulder Test, and the 12-Item Short Form Health Survey. Prognostic factors for recurrent instability were analyzed.
Results: Recurrent instability occurred in 22% of patients with a mean follow-up of 6.3 years. Survival at 5 and 10 years without recurrent instability was 79% and 78%, respectively (95% confidence interval, 72%-85% and 71%-85%, respectively). The Western Ontario Shoulder Instability Index score, the Simple Shoulder Test score, and the 12-item Short Form Physical Component Summary improved significantly in the nonrecurrence group ($P < .001$, $P = .004$, and $P = .002$, respectively). Younger age and use of fewer than 3 anchors were associated with a higher risk of recurrent dislocation ($P = .008$ and $P = .039$, respectively).
Conclusion: We found an overall recurrent instability rate of 22% (dislocation or subluxation). Good long-term results were observed after arthroscopic Bankart repair in patients older than 20 years with 3 or more suture anchors used.
Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Shoulder; instability; arthroscopic; Bankart repair; long-term follow-up; suture anchors

Traumatic anterior instability of the glenohumeral joint affects mainly the young and active population: most patients are male and between 20 and 30 years old.[18,23] The incidence of traumatic anterior shoulder instability is between 17 and 32 per 100,000 persons per year.[5,10,12] After a first dislocation and nonsurgical therapy, the mean recurrence rate

The Regional Medical Ethical Committee Isala Hospital, Zwolle, The Netherlands, approved this study (Number 16.0590).

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is between 21% and 33%.[11,18,26] Several risk factors for persistent symptomatic instability after a traumatic anterior dislocation have been identified: male sex, young age, hyperlaxity, and participation in collision sports.[11,18] Traumatic anterior shoulder dislocation often results in detachment of the labral structures from the glenoid and stretching of the capsular ligaments. Together with bony defects of the humeral head and glenoid, these soft tissue injuries create more laxity in the glenohumeral joint and increase the risk of repeat dislocations.[20,27]

The most common surgical technique to restore shoulder stability is the arthroscopic Bankart repair. The arthroscopic Bankart repair techniques have been evolved over time from transglenoid suturing, bioabsorbable tack fixation (like the Suretac; Smith & Nephew Endoscopy, Mansfield, MA, USA) to newer techniques using suture anchors, with improving results. The short-term results of the arthroscopic Bankart repair with suture anchors are excellent and comparable with the results of the open Bankart repair, with recurrence rates of approximately 8% to 11%.[8] Few studies on long-term results of the arthroscopic Bankart repair with suture anchors are available, reporting high recurrence rates of 23% to 35%.[4,21] The aim of this study was to evaluate the medium to long-term results and the survival rate of shoulder stability after arthroscopic Bankart repair using suture anchors, and to identify prognostic risk factors for recurrent instability.

Materials and methods

Design

The study design was a retrospective case series with all consecutive patients who underwent an arthroscopic Bankart repair between January 2005 and December 2013. One orthopedic surgeon (C.K.) performed all operations. The patients were selected based on the following inclusion criteria: (1) a traumatic involuntary, recurrent, anterior instability of the shoulder with at least 1 full dislocation treated with an arthroscopic Bankart repair and (2) age 18 years or older at time of the study. Exclusion criteria were (1) previous shoulder surgery; (2) additional shoulder injury; (3) glenoid defect of more than 25%; (4) engaging Hill-Sachs lesion; (5) unable to complete questionnaires because of language or cognitive impairment; (6) a reoperation of the shoulder not related to an instability problem, for example, a shoulder prosthesis. If an arthroscopic Bankart repair was performed on both shoulders, only the first operation was included to prevent bias in the identification of prognostic factors.

Surgical procedure

According to the local arthroscopic Bankart repair protocol, all patients received an interscalene block of the brachial plexus for postoperative pain reduction. Surgery was performed with the patient under general anesthesia in the beach chair position. The orthopedic surgeon examined function and stability of the shoulder before starting the operation.

During the study period, a single standardized surgical technique was performed. Three standard portals (posterior, anterior, and anterosuperior) were used. After inspection of the glenohumeral and subacromial space, the ruptured labrum was released from the glenoid and mobilized, with excision of scar tissue. The anterior glenoid rim was prepared to obtain a clean and bleeding surface by decorticating the bone.

Absorbable knotless anchors, 3.5 mm, made of poly (L-lactide) acid (Bio-PushLock; Arthrex, Munich, Germany) with FiberWire 2.0 sutures (Arthrex) were used to fixate the labrum on the glenoid with emphasis on the capsular shift to retension the inferior and middle glenohumeral ligaments. The first anchor was placed at the 5-o'clock position. After May 2012, nonabsorbable knotless anchors, 2.9 mm, made of polyether ether ketone (Biorapter; Smith & Nephew, Andover, MA, USA) with Ultrabraid 2.0 sutures (Smith & Nephew) were used.

Patients were discharged from the hospital the day after surgery and immobilized for 3 weeks with an antirotation sling. After this period, patients were mobilized under the guidance of a physiotherapist, with daily active guided exercises during the first 6 weeks until 20° of external rotation.

Outcome measures

The primary outcome for this study was recurrent instability, defined as a dislocation or a subluxation, experienced by the patient. Subluxation is a subjective perception of instability and is generally described as clicking of the shoulder. The secondary outcomes were subjective shoulder stability and function as well as quality of life. This was evaluated with 3 validated patient-reported outcome measures: the Western Ontario Shoulder Instability Index (WOSI),[22] a shoulder stability questionnaire; the Dutch version of the Simple Shoulder Test (SST),[13] a functional shoulder questionnaire; and the 12-Item Short Form Health Survey (SF-12), a quality-of-life questionnaire containing 2 scores, the Physical Component Summary and the Mental Component Summary scale.[25]

Patient satisfaction was assessed by asking patients whether they would choose to undergo surgery again, if they would have to make the decision again. Patients who underwent a second stabilizing operation after the arthroscopic Bankart repair were only included in this study for the primary outcome. A web-based questionnaire was built, and patients were asked by email to fill in this questionnaire. An informed consent was obtained before patients could continue to the questionnaire.

Radiologic analysis

The size of a Hill-Sachs lesion and a glenoid defect was measured using a magnetic resonance imaging (MRI) or a computed tomography (CT) scan. The Hill-Sachs lesions were measured on MRI or CT scan, as described by van der Linde et al.[21] Measurements of the glenoid defect were performed in a sagittal oblique slice, as described by Sugaya et al.[19] The best fit circle surface area was drawn in the inferior part of the glenoid. The bone loss was expressed as the missing area of the circle as a percentage of the total surface area. All measurements were done by an experienced musculoskeletal radiologist.

Statistical analysis

Patient characteristics are described as mean and standard deviation (SD) or range, or median and interquartile range (IQR). The primary outcome, recurrent instability, was expressed as the percentage of patients who experienced recurrent instability after the arthroscopic Bankart repair. For the secondary outcomes, a Mann-Whitney *U* test was performed to assess the differences in WOSI, SST, and SF-12 scores between the recurrence and nonrecurrence group.

We conducted a subanalysis assessing the influence of several possible risk factors on recurrent instability after arthroscopic Bankart repair, extracted from the patients' medical records. Possible risk factors were age at surgery, age at first dislocation, sex, whether the affected shoulder is the dominant arm, hyperlaxity of the shoulder (defined as external rotation >85° in both shoulders), number of preoperative dislocations, time between the first dislocation and surgery, number of anchors, size of the Hill-Sachs lesion, and size of the glenoid defect.

To be able to predict the risk of recurrent instability, we explored the associations between key patient characteristics and recurrent instability. Multivariable logistic regression was performed to analyze the influence of age at surgery and number of anchors, based on literature, and sex and presence of shoulder hyperlaxity, based on clinical relevance, on recurrent instability. Multivariable logistic regression was performed with 100 patients whose data for the selected risk factors were known. Statistical analyses were performed using SPSS Statistics 23 software (IBM, Armonk, NY, USA), and *P* values of <.05 were considered significant.

Results

Arthroscopic Bankart repair was performed in 220 patients between January 2005 and December 2013. Fig. 1 presents the study enrollment and follow-up. Of the 220 patients, 175 patients met the inclusion criteria. We were unable to reach 28 patients (18%). Their medical records in our hospital and in general practice were checked for signs of recurrent instability, and no full dislocations or subluxations after surgery were noted. The study population thus consisted of 147 patients,

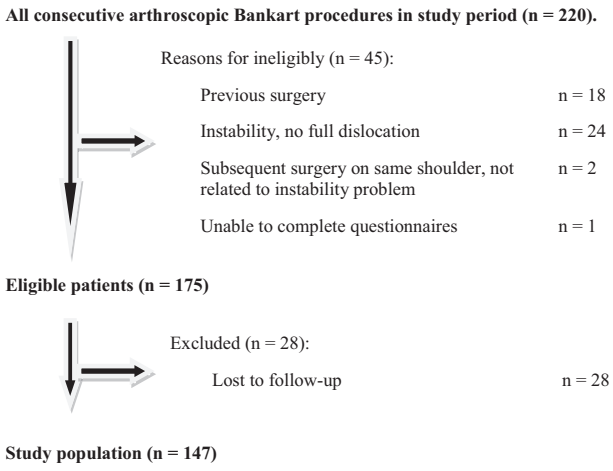

Figure 1 Flow diagram with study enrollment and follow-up.

112 men (76%) and 35 women (24%), with a mean follow-up of 6.3 years (range, 3-12 years). All patients signed informed consent when the postoperative questionnaire was filled in. The mean age at the first traumatic dislocation was 26 (SD, 9.9) years, and mean age at the time of surgery was 30 (SD, 11.1) years. The median time between the first dislocation and surgery was 31 months (IQR, 10-73 months). Median number of preoperative dislocations was 3 times (IQR, 1-5 times). The glenoid defect was less than 25% in all patients.

During surgery, a median of 3 anchors was used (IQR, 1-7 anchors). Of the included 147 patients, 15 (10%) underwent a second operation because of recurrent glenohumeral instability: a repeat arthroscopic Bankart repair was performed in 3 patients, an open Bankart repair in 4, and a Latarjet procedure in 8.

Table I presents baseline characteristics of the study population, stratified for recurrent and nonrecurrent instability after arthroscopic Bankart repair. Patients in the recurrent instability group were younger ($P < .001$), the dominant arm was more frequently affected ($P = .026$), and the time between the first dislocation and surgery was shorter ($P < .001$). All patients had a glenoid defect of less than 25%. Humeral head and glenoid bony defects were not associated with recurrent instability. No infections or other complications occurred in the study period.

Recurrent instability

At follow-up, 33 patients (22%) experienced recurrent instability after surgery: 21 (14%) had 1 or more full dislocations, and 12 (8%) had no full dislocation but experienced subluxations. Of the 21 patients with a full dislocation, 9 (43%) had 1 episode of full dislocation postoperatively, 8 (38%) had between 2 and 5 postoperative dislocations, and 4 (19%) had more than 5 dislocations. The recurrent instability in 9 patients occurred after a new, clinically relevant, trauma, such as an accident or fall.

Of the 33 patients who experienced postoperative instability, defined as dislocation and subluxation, 64% developed recurrent instability within the first 2 years postoperatively. In this study, all recurrent instability developed within the first 5 years after surgery. The recurrent instability developed within 2 to 5 years after surgery in 10 patients (30%) and at 5 years after surgery in 1 patient (3%). The survival curve is shown in Fig. 2. The 5-year survival without recurrent instability was 79% (95% confidence interval, 72%-85%), and the 10-year survival was 78% (95% confidence interval, 71%-85%).

Subjective shoulder function

The results of the WOSI, SST, and SF-12 questionnaires are summarized in Table II. The nonrecurrence group scored significantly lower on the WOSI questionnaire than the recurrence group (39 [IQR, 14-56] and 95 [IQR, 61-124], respectively; $P < .001$), indicating a subjectively more stable shoulder. The

Table I Patient characteristics

Variables	Nonrecurrence group	Recurrence group	*P* value
Follow-up, mean (SD), yr	6.0 (2.6)	6.9 (2.5)	
Age at surgery, mean (SD), yr	32 (10.7)	23 (9.4)	**<.001**
Age at first dislocation, mean (SD), yr	28 (9.9)	20 (7.7)	**<.001**
Male sex, No. (%)	84 (74)	28 (85)	.185
Dominant arm affected, No. (%)	51 (55)	6 (29)	**.026**
Shoulder hyperlaxity , No. (%)	14 (18)	8 (33)	.116
Preoperative dislocations, median (IQR), No.	3 (1-5)	2 (1-5)	.660
Time to surgery			**.032**
Median (IQR), mo	36 (12-84)	14 (9-21)	
≥24 mo, No. (%)	60 (65)	5 (21)	**<.001**
Hill-Sachs lesion, median (IQR), %	3 (0-6)	3 (0-5)	.190
Glenoid lesion, median (IQR), %	0 (0–0)	0 (0–0)	.243
Anchors			
Median (IQR), No.	3 (3-3)	3 (2-3)	.061
≥3, No. (%)	89 (81)	20 (65)	.054

SD, standard deviation; *IQR*, interquartile range.
Bold *P* values are statistically significant ($P < .05$).

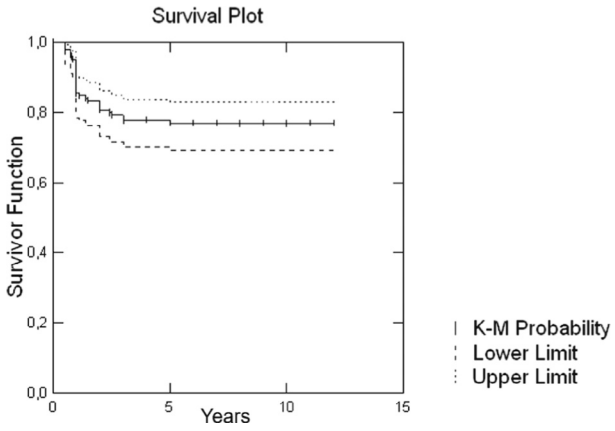

Figure 2 Kaplan-Meier (*K-M*) survival curve of recurrence rate.

Subjective Functional Score (SST) was also significantly better in the nonrecurrence group ($P = .004$). Outcome of the Physical Component Summary of the SF-12 was significantly better in the nonrecurrence group compared with the recurrence group (51 [IQR, 49-56] and 47 [IQR, 42-53] respectively, $P = .002$). No difference in Mental Health Component Summary between the recurrence and nonrecurrence group was found.

There were 110 of 124 patients (89%) who would choose to undergo surgery again, were they to have to make the decision again. Most patients (84%) could return to preinjury level of work, and 61% could return to the preinjury level of sport.

Table II Outcome subjective shoulder function and stability scores and quality-of-life scores

Questionnaire	Non-recurrence	Recurrence	*P*-value
	Mean (IQR) score	Mean (IQR) score	
WOSI (0-210)	39 (14-56)	95 (61-124)	**<.001**
SST (0-12)	11 (10-12)	10 (8-12)	**.004**
SF-12 PCS	51 (49-56)	47 (42-53)	**.002**
SF-12 MCS	55 (53-60)	55 (51-61)	.534

IQR, interquartile range; *WOSI*, Western Ontario Shoulder Instability Index; *SST*, Simple Shoulder Test; *SF-12*, 12-Item Short Form Health Survey; *PCS*, Physical Component Summary; *MCS*, Mental Component Summary.
Bold *P* values are statistically significant ($P < .05$).

Prognostic factors

The logistic regression analysis (Table III) showed that a younger age at the time of surgery significantly affects the occurrence of recurrent instability ($P = .008$). The highest recurrence rate (52%) was found in patients younger than 20 years (Fig. 3). A significantly higher risk for the occurrence of recurrent instability was also observed if fewer than 3 anchors were inserted during surgery ($P = .039$). Thirty-two patients were treated with fewer than 3 anchors, and 11 of these patients experienced a recurrent instability. From 2012, a different type of anchor was used. We compared the short-term results (3 to 4 years) of both anchors and could not find a difference in recurrent instability between the 2 types of anchors. No significant relation in the logistic regression analysis was found between sex or shoulder hyperlaxity and recurrent instability.

Discussion

Recent studies on long-term results after arthroscopic Bankart repair that used suture anchors showed high recurrence rates of 23% and 35%.[3,21] Both of these studies defined recurrent instability as recurrent dislocations and subluxations. In our

Table III Analysis of prognostic factors for recurrent instability

Prognostic factor	Mean (SD)	OR	95% CI	*P* value
Age at time of surgery, yr	30 (11.1)	0.908	0.845-0.975	**.008**
Male sex		2.567	0.557-11.838	.227
Shoulder hyperlaxity		2.375	0.604-9.340	.216
<3 anchors		3.628	1.065-12.359	**.039**

SD, standard deviation; *OR*, odds ratio; *CI*, confidence interval.
Bold *P* values are statistically significant (*P* < .05).

opinion, subluxation is also a failure of surgery. That is why recurrent instability in our study was defined as recurrent dislocations and recurrent subluxations. We found a recurrence rate of 22% at a mean follow-up of 6.3 years, which is comparable to the study by Castagna et al[4] and lower than the recurrence rate found by van der Linde et al.[21]

All recurrent instability in this study developed within the first 5 years after surgery. In our experience, patients are frequently feeling apprehensive about using their shoulder during the first 1 or 2 years after stabilizing surgery. After this period, most patients try to use their shoulders in all sorts of activities, resulting in recurrent dislocations or subluxations mainly in the first 2 years after surgery. Within 5 years after surgery, most patients have used and tested their shoulder extensively, and that probably explains why we did not find a new dislocation or subluxation event more than 5 years after surgery.

Other studies on the long-term outcome of the arthroscopic Bankart repair reported a different recurrence pattern: in 22% to 45% of patients, the recurrence of instability occurred after more than 5 years postoperatively.[7,21] The development of new instability 5 years after surgery might be the result of a new trauma. In our study population, 9 of 33 patients with recurrent instability reported a trauma before the new dislocation or subluxation after surgery. We have no reliable data whether this was a trauma that was able to dislocate a stable shoulder or a minor trauma that dislocated a shoulder that remained unstable after surgery.

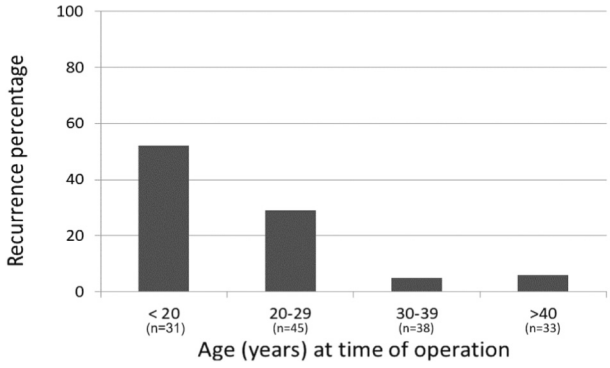

Figure 3 Recurrent instability per age category.

Secondary outcome

Most of our patients (89%) were satisfied with the outcome of the surgery. The group with recurrent instability after arthroscopic Bankart repair also scored significantly lower at subjective stability (WOSI score) compared with the nonrecurrent group. Similar results were found in other studies.[14,21] Not only was the subjective stability significantly worse in the recurrent instability group, but the functional status of the shoulder and quality of life, measured by the SST and SF-12 was also worse. The negative influence of recurrent shoulder instability on the functional status of the shoulder and quality of life was not reported in previous studies.[3,17,21] Rates of return to level of work and return to level of sports were similar to or higher than rates reported in other studies.[1,7,16]

Prognostic factors

Two significant prognostic factors were identified in this study: younger age at time of surgery and the number of anchors. In our study population, we found no association between the glenoid and Hills-Sachs defect and recurrent instability, most likely because our study population was a selected group with no or only small glenoid defects and Hill-Sachs lesions that did not engage. Patient with larger defects underwent other surgical procedures in the study period.

Patients younger than 20 years had a significantly higher risk of recurrent instability, as observed in other studies.[11,15,18,26] In the group of patients younger than 20 years we found a recurrence rate of 52%. We hypothesize that younger patients often use their shoulder more intensively in daily life and participate more often in high-risk sports, such as overhead or contact sports. Also, noncompliance of young patients to the postoperative rehabilitation protocol might explain the high recurrence rate. A glenoid defect could not explain the higher recurrence rate: in all patients the glenoid defect was less than 25%.

Our results indicate that arthroscopic Bankart repair might not be the optimal treatment for patients aged younger than 20 years with traumatic anterior shoulder instability. Khan et al[9] compared the results after nonoperative treatment and a Latarjet procedure in skeletally immature patients (age <16 years). In patients after the Latarjet procedure, good clinical

outcome was observed, with a redislocation rate of 8% and a positive apprehension test in 27% of patients after a mean follow-up of 9.7 years. Deitch et al[6] reported a recurrence instability rate of 31% after different surgical stabilizing procedures in patients younger than 18 years and a mean follow-up of 4 years. No subgroup analysis between the results of the different surgical techniques were presented.

A subsequent study of this young population and possible causes for this high recurrence rate would be a useful continuation of our study. A study comparing other surgical treatment options with arthroscopic Bankart repair for patients in this age category would be a next step to find the optimal surgical technique to treat traumatic anterior instability of the shoulder in young patients. In our study, the risk of recurrent instability decreased significantly when 3 or more anchors were used, confirming results of earlier research.[2,16,21,24]

Strength and limitations

One of the strengths of our study is the large patient population with a follow-up rate of 82% and mean follow-up of 6.3 years. All patients were operated on by 1 orthopedic surgeon specialized in shoulder surgery in 1 hospital, and 1 type of anchor was used in our study period to assess the 5-year and 10-year survival.

This study also has some limitations. The study design was retrospective, with incomplete preoperative patient-reported outcome measures. Therefore, we decided not to include these preoperative data.

Only a relatively small group of patients had a minimum follow-up of 10 years. From 2012, a different type of anchor was used. The long-term results of this new type of anchor could differ from the results of previously used anchors. We compared the short-term results (3 to 4 years) of both anchors and did not find a difference in recurrent instability between the 2 types of anchors.

Conclusion

This study showed a recurrent instability rate of 22% (dislocation or subluxation) in 147 patients who had an arthroscopic Bankart repair with the suture anchor technique, with a follow-up of 6.3 years. The best results were observed in patients older than age 20 years and in patients in whom 3 or more suture anchors were used.

Disclaimer

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