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

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Abstract

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 to long-term results of arthroscopic Bankart repair using suture anchors and to identify specific risk factors for recurrent instability.

Methods: 147 patients after traumatic anterior shoulder dislocation who underwent an arthroscopic Bankart repair were included. 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, and quality of life, evaluated using the Western Ontario Shoulder Instability Index (WOSI), the Simple Shoulder Test (SST) and the Short Form-12 (SF-12). Prognostic factors for recurrent instability were analysed.

Results: 22% of the patients experienced recurrent instability with a mean follow-up of 6.3 years. 5-years and 10-years survival without recurrent instability was 79% and 78%, respectively (95% CI: 72-85% and 71-85%, respectively). The WOSI-score, the SST-score and the SF-12 physical scale improved significantly in the non-recurrence group ($p<0.001$, $p=0.004$ and $p=0.002$, respectively). Younger age and use of less than three anchors were associated with a higher risk of recurrent dislocation ($p=0.008$ and $p=0.039$, 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 above age of 20 years with 3 or more suture anchors used.

Level of evidence: Level IV; retrospective case series.

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

Introduction

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 non-surgical therapy, the mean recurrence rate is between 21 and 33%.[11,18,26] Several risk factors for persistent symptomatic instability after a traumatic anterior dislocation have been identified: male gender, 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 re-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 tack) 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 around 8-11%.[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.

Material and Methods

Design

This study was waived for ethical approval by the local medical ethics committee. The study design was a retrospective case series with all consecutive patients who underwent an arthroscopic Bankart repair between January 2005 and December 2013. All surgeries were performed by one orthopaedic shoulder surgeon [redacted] The patients were selected based on the following inclusion criteria: (1) a traumatic involuntary, recurrent, anterior instability of the shoulder, with at least one full dislocation treated with an arthroscopic Bankart repair; (2) age of 18 years or older at time of 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 re-operation 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 under general anaesthesia in the beach-chair position. The orthopaedic surgeon examined function and stability of the shoulder before starting surgery. During the study period a single standardized surgical technique was performed. Three standard portals were used (posterior, anterior, and anterosuperior). After inspection of the glenohumeral and subacromial space, the ruptured labrum was released from the glenoid and mobilised, 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 were used to fixate the labrum on the glenoid with emphasis on the capsular shift in order to re-tension the inferior and middle glenohumeral ligaments. The first anchor was placed at the 5-o'clock position. After May 2012, non-absorbable knotless anchors, 2.9 mm, made of PEEK (Biorapter Smith&Nephew, Andover, United States of America) with Ultrabraid 2.0 sutures were used. Patients were discharged from the hospital the day after surgery and immobilized for 3 weeks with an anti-rotation sling. After this period, patients were mobilized under the guidance of a physiotherapist, with daily active guided exercises during the first 6 weeks till 20 degrees of external rotation.

Outcome Measures

The primary outcome for this study was recurrent instability, defined as either 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, and quality of life. This was evaluated with three 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 a quality of life questionnaire: the Short Form-12(SF-12), containing two scores, the physical component summary (PCS) and the mental component summary (MCS) scale.[25] Patient satisfaction was assessed by asking patients if 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.

Radiological analysis

The size of a Hill Sachs lesion and a glenoid defect was measured using a Magnetic Resonance Imaging (MRI) scan or a Computer Tomography (CT) scan. The Hill Sachs lesions were measured on CT or MRI 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 were described by mean (SD) or median (Interquartile Range (IQR)). The primary outcome, recurrent instability, was expressed as 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 non-recurrence 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, gender, 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 first dislocation and surgery, number of anchors, size of 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 analyse the influence of age at surgery and number of anchors, based on literature, and gender and presence of shoulder hyperlaxity, based on clinical relevance, on recurrent instability. Multivariable logistic regression was performed with patients whose data of the selected risk factors were known (N=100).

Statistical analyses were performed using IBM SPSS Statistics (version 23) and p-values of <0.05 were considered significant.

Results

Arthroscopic Bankart repair was performed in 220 patients, between January 2005 and December 2013. Figure 1 presents the study enrolment and follow-up. Of the 220 patients, 175 patients met the inclusion criteria. Of the 175 patients, 28 patients could not be reached (18%). Medical records of these 28 patients in our hospital and in general practice were checked for signs of recurrent instability: no full dislocations or subluxations after surgery were noted. The study population consisted of 147 patients, 112 (76%) men and 35 (24%) women, 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 first traumatic dislocation was 26 years (SD, 9.9) and mean age at time of surgery was 30 years (SD, 11.1). The median time between first dislocation and surgery was 31 months (IQR 10-73 months). Median number of preoperative dislocations was 3 times (IQR 1-5). The glenoid defect was less than 25% in all patients. During surgery, a median of three anchors was used (range 1-7). Of the included 147 patients, 15 (10%) patients underwent a second operation because of recurrent glenohumeral instability: in 3 patients a re-arthroscopic Bankart repair was performed, in 4 patients an open Bankart repair and in 8 patients a Latarjet's procedure.

Table I presents baseline characteristics of the study population, stratified for recurrent and non-recurrent instability after arthroscopic Bankart repair. Patients in the recurrent instability group were younger ($p < 0.001$), the dominant arm was more frequently affected ($p = 0.026$) and time between first dislocation and surgery was shorter ($p < 0.001$). All patients had a glenoid defect 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

156 At follow-up, a total of 33 patients (22%) experienced recurrent instability after surgery: 21
157 patients (14%) had one or more full dislocations after surgery, while 12 patients (8%) had no
158 full dislocation but experienced subluxations. Of the 21 patients with a full dislocation, 9
159 patients (43%) had one single episode of full dislocation postoperatively, 8 patients (38%) had
160 between 2 and 5 postoperative dislocations and 4 patients (19%) had more than 5 dislocations.
161 In nine cases the recurrent instability occurred after a new, clinically relevant, trauma, such as
162 an accident or fall.
163
164 Of the patients who experienced postoperative instability (N=33), defined as dislocation and
165 subluxation, 64% developed recurrent instability within the first two years postoperatively. In
166 this study all recurrent instability developed within the first 5 years after surgery. In 10
167 patients (30%) the recurrent instability developed within two to five years after surgery. One
168 patient (3%) developed recurrent instability at five years after surgery. The survival curve is
169 shown in Figure 2. The 5-years survival without recurrent instability was 79% and the 10-
170 years survival was 78% (95% CI: 72-85% and 71-85%, respectively).
171
172 *Subjective shoulder function*
173 The results of the WOSI, SST and SF-12 questionnaires are shown in table II. The non-
174 recurrence group scored significantly lower on the WOSI questionnaire than the recurrence
175 group, (39 (IQR 14-56) and 95 (IQR 61-124) respectively, $p< 0.001$), indicating a
176 subjectively more stable shoulder. Also the subjective functional score (SST) was
177 significantly better in the non-recurrence group ($p = 0.004$). Outcome of the physical score
178 (PCS) of the SF-12 was significantly better in the non-recurrence group compared to the
179 recurrence group (51 (IQR 49-56) and 47 (IQR 42-53) respectively, $p=0.002$). No difference
180 in mental health scores between the recurrence and non-recurrence group was found.

110 of 124 patients (89%) would choose to undergo surgery again, if they would have to make the decision again. 84% of patients could return to pre-injury level of work and 61% could return to the pre-injury level of sport.

Prognostic factors

The logistic regression analysis (Table III) showed that a younger age at time of surgery significantly affects the occurrence of recurrent instability ($p = 0.008$). The highest recurrence rate was found in patients younger than 20 years (recurrence rate of 52%) (Figure 3). Also a significantly higher risk for the occurrence of recurrent instability was observed if less than three anchors were inserted during surgery ($p = 0.039$). 32 patients were treated with less than three 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 two types of anchors. No significant relation in the logistic regression analysis was found between gender or shoulder hyperlaxity and recurrent instability.

Discussion

Recent studies on long-term results after arthroscopic Bankart repair which 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 opinion, subluxation is also 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. and lower than the recurrence rate found by van der Linde et al.[4,21]

In this study all recurrent instability developed within the first 5 years after surgery. In our experience, patients are frequently feeling apprehensive about using their shoulder during the first one or two 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 two years after surgery. Within five years after surgery most patients have used and tested their shoulder extensively and that is probably an explanation 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 22-45% of patients the recurrence of instability occurred after more than 5 years postoperatively.[7,21] The development of new instability five years after surgery might be the result of a new trauma. In our study population 9 out of 33 patients with recurrent instability reported a trauma prior to the new dislocation or subluxation after surgery. We have no reliable data if 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.

Secondary outcome

89% of our patients was 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 to the non-recurrent 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] Return to level of work and return to level of sports rates were similar to or higher than scores found in other studies.[1,7,16]

Prognostic factors

Two significant prognostic factors were identified in this study: younger age at time of surgery and 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, young patients' non-compliance 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 under the age of

20 years with traumatic anterior shoulder instability. Khan et al. compared the results after non-operative treatment and Latarjet's procedure in skeletally immature patients (age < 16 years).[9] In patients after Latarjet's procedure, good clinical outcome was observed with a re-dislocation rate of 8% and a positive apprehension test in 27% of patients after a mean follow-up of 9.7 years. Deitch et al. 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.[6] 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, when three or more anchors were used, the risk of recurrent instability decreased significantly, 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 by one orthopaedic surgeon specialized in shoulder surgery in one hospital, and one type of anchor was used in our study period to assess the 5-years and 10-years survival. This study also has some limitations. The study design was retrospective, with incomplete preoperative PROM's. 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 two 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 above the age of 20 years and in patients with 3 or more suture anchors used.

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Tables and Figures

Table I. Patient characteristics.

SD, standard deviation; IQR, interquartile range

Figure 1. Kaplan-Meier survival curve of recurrence rate.

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

IQR, interquartile range

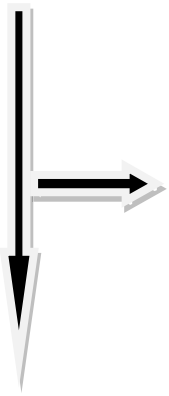
Table III. Analysis of prognostic factors for recurrent instability.

SD, standard deviation; OR, odds ratio; CI, confidence interval

Figure 2. Recurrent instability per age category.

Figure (No.1)

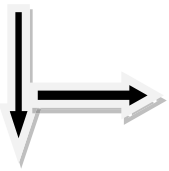
All consecutive arthroscopic Bankart procedures in study period (n = 220).



Reasons for ineligibly (n = 45):

Previous surgery	n = 18
Instability, no full dislocation	n = 24
Subsequent surgery on same shoulder, not related to instability problem	n = 2
Unable to complete questionnaires	n = 1

Eligible patients (n = 175)



Excluded (n = 28):

Lost to follow-up	n = 28

Study population (n = 147)

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

Figure (No.2)

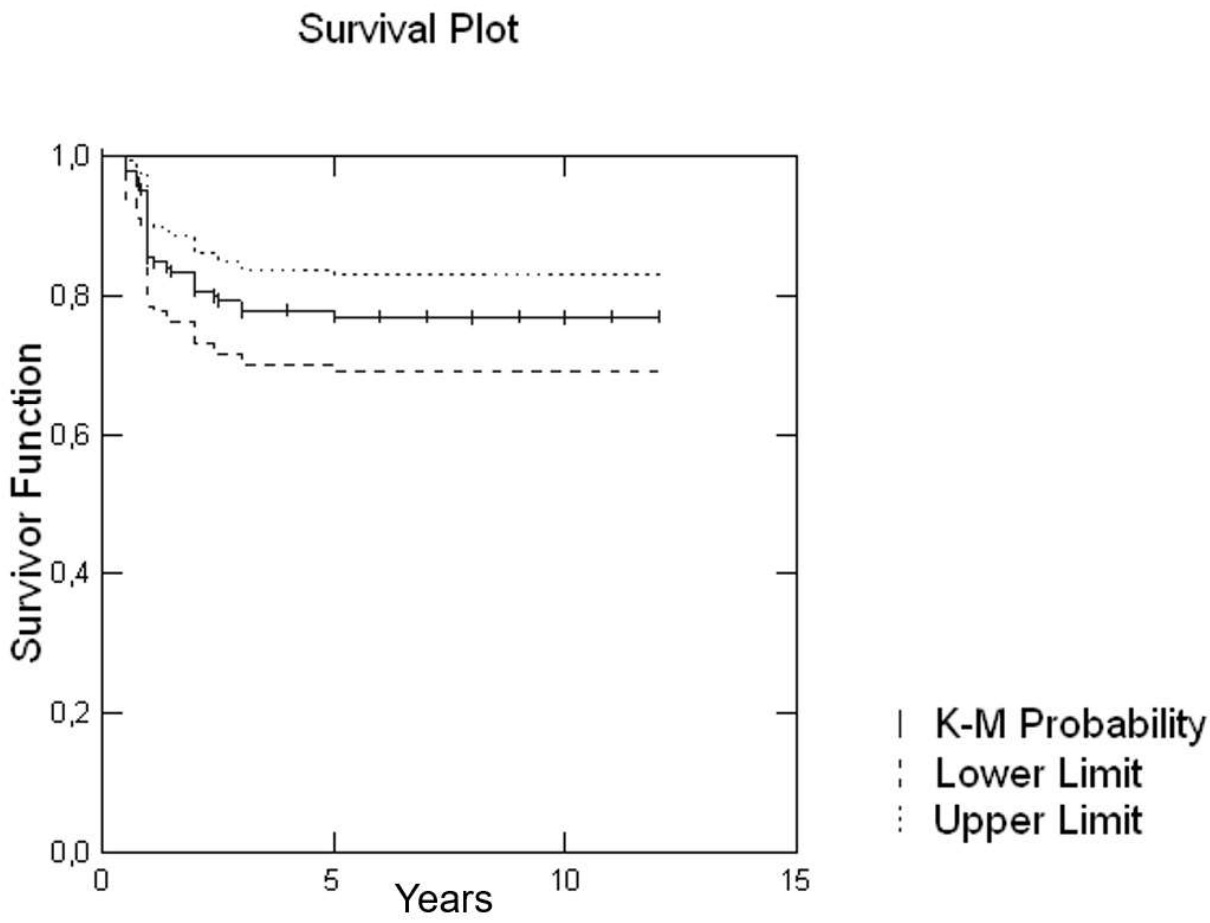


Figure 2. Kaplan-Meier survival curve of recurrence rate.

Figure (No.3)

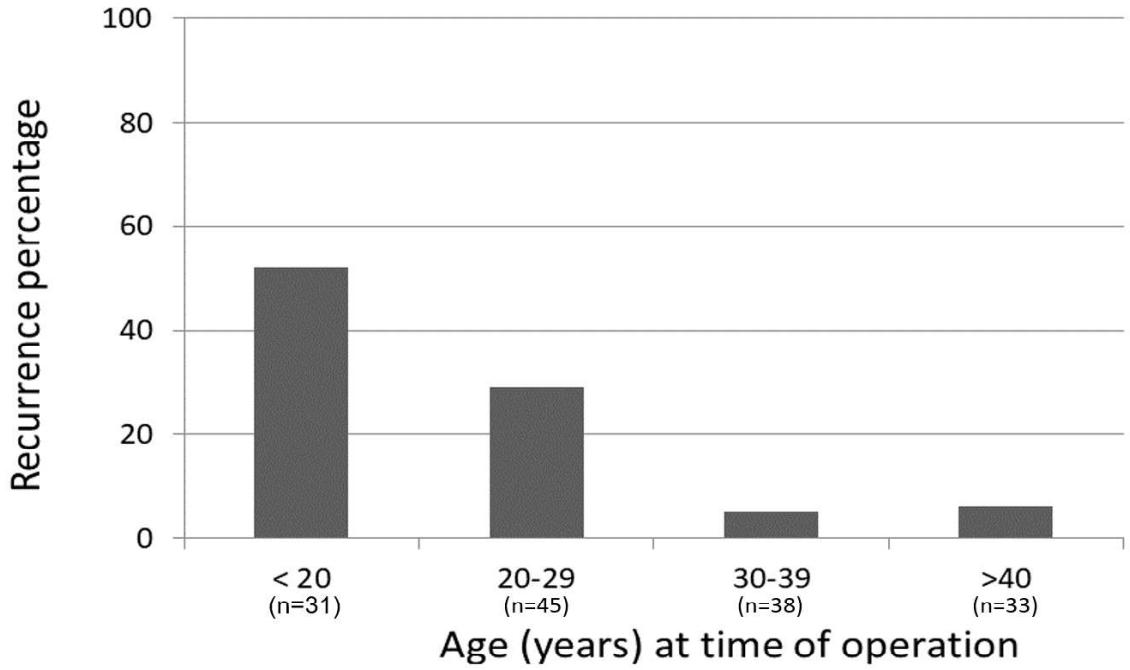


Figure 3. Recurrent instability per age category.

Table I. Patient characteristics.

Variables	**Non-recurrence group**	**Recurrence group**	**P-value**
Mean follow-up (years) (SD)	6.0 (2.6)	6.9 (2.5)	
Age at surgery (years) Mean (SD)	32 (10.7)	23 (9.4)	**< 0.001**
Age at first dislocation (years) Mean (SD)	28 (9.9)	20 (7.7)	**<0.001**
Gender N (%) Male	84 (74%)	28 (85%)	0.185
Dominant arm affected N (%)	51 (55%)	6 (29%)	**0.026**
Shoulder hyperlaxity N (%)	14 (18%)	8 (33%)	0.116
Preoperative dislocations Median (IQR)	3 (1–5)	2 (1–5)	0.660
Time to surgery Median months (IQR)	36 (12-84)	14 (9-21)	**0.032**
≥ 24 months N (%)	60 (65%)	5 (21%)	**< 0.001**
Hill Sachs lesion Median percentage (IQR)	3 (0–6)	3 (0–5)	0.190
Glenoid lesion Median percentage (IQR)	0 (0–0)	0 (0–0)	0.243
Anchors Median number (IQR)	3 (3-3)	3 (2-3)	0.061

≥ 3 N (%)	89 (81%)	20 (65%)	0.054

SD, standard deviation; IQR, interquartile range

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

Questionnaire		**Non-recurrence**	**Recurrence**	**P-value**
WOSI (0 - 210)	Mean Score (IQR)	39 (14-56)	95 (61-124)	**< 0.001**
SST (0 - 12)	Mean Score (IQR)	11 (10-12)	10 (8-12)	**0.004**
SF-12 PCS	Mean Score (IQR)	51 (49-56)	47 (42-53)	**0.002**
SF-12 MCS	Mean Score (IQR)	55 (53-60)	55 (51-61)	0.534

IQR, interquartile range

Table III. Analysis of prognostic factors for recurrent instability.

Prognostic factor	**Mean (SD)**	**OR***	**95% CI[a]**	**P-value**
Age at time of surgery				
	30 (11.1)	0.908	(0.845 – 0.975)	**0.008**
Male gender				
		2.567	(0.557 – 11.838)	0.227
Shoulder hyperlaxity				
		2.375	(0.604 – 9.340)	0.216
Number of Anchors				
< 3		3.628	(1.065 – 12.359)	**0.039**

SD, standard deviation; OR, odds ratio; CI, confidence interval