## Abstract

**Purpose:** This study investigated the long-term results of arthroscopic Bankart repair in terms of rates and timelines of recurrence of instability, with special interest in young adult patients aged ≤20 years.

**~~Patients and m~~Methods:** Between 2000 and 2005, 186 shoulders (182 patients, 50 women, median ~~mean~~ age 2~~8~~6 [range, 15–58] years) were operated on at a university hospital using arthroscopic Bankart repair because of instability after traumatic anteroinferior shoulder dislocation. Medical records were retrospectively reviewed and patients assessed using postal questionnaires or telephone interview after a minimum of 10 years of follow-up (~~mean~~ median 12.~~5~~2 [range, 10–16] years). The primary ~~O~~outcome measure~~s~~ was ~~included~~ recurrence of instability (assessed from 167 shoulders) , other outcome measures included Oxford instability score (OIS), subjective shoulder value (SSV), and Western Ontario instability index (WOSI) (assessed from 157 shoulders).

**Results:** At the end of follow-up, 50/167 shoulders (30%) had recurrence of instability and 30/167 (18%) were subjected to re-operation due to instability symptoms. Twenty-six (52%) failures occurred within ≤2 years, 11 (22%) within 2–5 years, and 13 (26%) >5 years after surgery. Failure rate was 19/35 (54%) for patients aged ≤20 years and 31/132 (24%) for patients aged >20 years; reoperation rates were 11/35 (31%) and 19/132 (14%), respectively. Mean OIS was 20 (SD 9, range 12–50), SSV 83% (SD 21, range, 10–100), and WOSI score 80 (SD 22, range, 33–100).

**Conclusions:** Nearly one third of patients had recurrence of instability after arthroscopic Bankart repair after a minimum of 10 years follow-up. Patients aged ≤20 years did poorly with more than half of the patients having recurrence; alternative stabilization techniques should probably be considered for these patients.


Level of evidence: Level IV

Keywords: Shoulder dislocation; Shoulder instability; Surgery; Bankart operation; long-term outcome; Survival analysis

## Introduction

A rapid evolution of practice from open stabilization to arthroscopic Bankart repair has taken place in the treatment of posttraumatic shoulder instability [23]. In Britain, arthroscopic shoulder stabilization surgery has more than quadrupled (from 16 % to 71%) between the years 2002 and 2009 [23]. Using modern instruments and implants, arthroscopic Bankart repair is technically feasible in nearly all cases of instability. A recent systematic review of level IV studies with a minimum of 5 years of follow-up confirmed that open and arthroscopic Bankart repairs result in similar outcomes [17].

Previous studies have suggested that recurrences after arthroscopic Bankart repair occur mostly within two years after surgery [22]. However, some studies have reported contrasting results showing that failures do not all occur after two years, but rather continue to occur steadily during long-term follow-up [5, 35]. Only a few studies of arthroscopic Bankart repair have reported long-term failure rates. Failure rates in these studies ranged from 21% to 38% after a minimum of 10 years follow-up [8, 30, 31]. These long term-studies have not addressed the timeline of failure in detail.

Adolescents or young adults are at an especially high risk for failure after arthroscopic Bankart-repair [1, 3, 13, 25]. Previous studies have reported only short- to mid-term results in young patients, and little is known of the long-term failure or reoperation rates. Virtually all studies focusing on adolescent patients have included a mixed patient population, with skeletally mature and pediatric patients with open physes [9, 19, 27, 33]. Therefore, the results may not be applicable to skeletally mature young adults who are the most common patient group undergoing shoulder stabilization surgery.

## ~~Purpose~~

This study aimed to investigate the long-term results of arthroscopic Bankart repair in terms of the rate and timeline of recurrence of instability, with special interest in young adult patients who are aged ≤20 years old.

## Materials and methods

The study protocol and re-review of the patient records was approved by the hospital administration ( Oulu University Hospital, number 138/2015). The patients comprised a previous cohort of 182 consecutive patients (132 men, 50 women) and included 186 shoulders with instability (recurrent dislocation or subluxation) after initial traumatic anteroinferior shoulder dislocation (Table 1). The patients were operated on using arthroscopic Bankart repair between the years 2000 and 2005 at a university hospital. The median~~an~~ age of the patients at the time of surgery was 2~~8~~6 (range, 15–58) years and all patients were skeletally mature. No pediatric patients with open physes were included in the study. No open surgery was performed as the primary operation for shoulder instability during the study period at our institute. Plain radiographs were used to assess the presence of glenoid defects and Hill-Sachs lesion without trying to measure the size bone defects (Table 1). Patients with large (>25% of width in axial view) glenoid fractures and or cases with displaced greater tubercle fractures were excluded.

The Bankart lesion was repaired using standard arthroscopic techniques with suture anchors, and the patient positioned in a beach chair position. The details of the operative technique, postoperative care, and the short- to mid-term (median follow up, 4.3 years) results have been published previously [13].

The recurrence of instability (dislocation, subluxation) verified by radiographs or typical history (feeling of apprehension, subluxation or dislocation) was defined as a treatment failure, and was the primary outcome measure of the study. Electronic medical records and radiographs were re-reviewed during 2015 to assess possible further visits due to shoulder problems, failures, and possible reoperations. The reason for a new referral, new injuries, the time (month and year) of recurrence, and the type and date of reoperations were recorded. Functional results were assessed by means of the Oxford score, subjective shoulder value (SSV), and Western Ontario shoulder instability (WOSI) score (0 to 100%) [10, 16, 21]. Questionnaires including these outcome measures, in addition to inquiries about new injuries, recurrence of dislocation, subluxations or instability symptoms and possible new operations, were delivered to the patients by postal mail. Those patients who did not respond were contacted by telephone and the same forms were completed during an interview. In case patients had moved outside our hospital's catchment area and had undergone

new operations, the patients were contacted for the details of the failure and surgery. The interviewer was not involved in patient care.

~~A total of 153 patients (157 shoulders) completed the questionnaires. Three patients had died, seven patients were not interested in participating in the study, and 19 patients were lost to follow-up. They did not respond to repeated letters, and their telephone numbers were unknown. The data from the medical records of 10 of these 29 patients allowed assessment of shoulder stability or reoperations, and these data were combined with the questionnaires. Thus, the stability could be assessed from 167 (90%) shoulders and functional scores from 157 (84%) shoulders after a mean follow-up of 12.5 (10–16) years.~~

The results of the Oxford score and SSV were compared with those of ~~our~~ the earlier study [13]. The timeline of failure was assessed after combining data from both the medical records and the questionnaires. The functional scores were compared between patients who had only the index operation and those who had reoperations.

*Statistical methods*

Summary data are presented as the mean, standard deviation (SD), and range unless otherwise stated. Kaplan–Meier survival analysis was performed to assess time to failure and time to reoperation. Log-rank test was used to compare survival times. Independent samples t-test was used for comparison of means, and paired samples t-test was used for repeated measurements for continuous variables. A value of $P<0.05$ was considered significant. All analyses were performed using SPSS for Windows (IBM Corp, Released 2013, IBM Statistics for Windows, Version 22.0, Armonk, NY).

## Results

A total of 153 patients (157 shoulders) completed the questionnaires. Three patients had died, seven patients were not interested in participating in the study, and 19 patients were lost to follow-up. They did not respond to repeated letters, and their telephone numbers were unknown. The data from the medical records of 10 of these 29 patients allowed assessment of shoulder stability or reoperations, and these data were combined with the questionnaires. Thus, the stability could be assessed from 167 (90%) shoulders and functional scores from 157 (84%) shoulders after a ~~mean~~ median follow-up of 12.~~5~~2 (10-16) years.

At the end of follow-up, 50 of 167 shoulders had recurrence of instability (30%) and 30/167 (18%) were re-operated on due to instability symptoms. Twenty six (52%) failures occurred within ≤2 years, 11 (22%) between 2 to 5 years, and 13 (26%) >5 years after surgery (Fig. 1). Mean time from the operation to failure was 3.4 (SD 3.5, range 0.1–14.0) years, mean time to reoperation from primary operation was 3.8 (SD 3.2, range 0.7–12.4) years. Mean interval from failure to reoperation was on average 1.1 (SD 1.1, range 0.1–7.5) years. The failure rate was 19/35 (54%) for patients aged ≤20 years (Fig. 2) and 31/132 (24%) for patients aged>20 years (Fig. 3); reoperation rates were 11/35 (31%) and 19/132 (14%), respectively.

Reoperations included arthroscopic revision Bankart in 18 cases, open Latarjet procedure in 10 cases, open Bankart in one patient, and debridement in one patient. Arthroscopic or open revision Bankart failed in 8/19 (42%) cases and re-revision surgery was needed (Fig. 4). Thirty eight patients regarded a new injury as the reason for the failure, but 12 patients did not recall any new injury before recurrence of symptoms.

Functional scores did not change between 5 and 12 years (mean Oxford score at 5 years was 21 [SD 10, range 12–54] vs 20 [SD 9, range 12–50], ~~*P*=~~n.s~~0.3~~ at 12 years; SSV was 84% [SD 17, range 10–100] vs. 83% [SD 21, range 10–100], ~~*P*=~~n.s~~0.2~~, respectively, paired samples t-test; mean WOSI score was 80 [SD 22, range 33–100] at 12 years).

Patients who underwent only the index operation had substantially better functional scores at the end of follow-up compared to those who needed reoperations (Oxford score 19 vs. 24, *P*=0.03; SSV 85 vs. 73, *P*=0.005; WOSI 83 vs. 67, *P*=0.001, independent samples t-tests).

**Formatted:** Tab stops: 2 cm, Left

## Discussion

~~Our~~ This study showed that in terms of recurrence of instability, the results of arthroscopic Bankart repair in unselected patient material deteriorate during long-term follow-up. The probability of a stable shoulder after a mean follow-up of 12.5 years was 72% and nearly half of the recurrences occurred 2 years after surgery. Patients aged ≤20 years did especially poorly, with only an estimated 48% having a stable shoulder. The functional scores did not change between 5 and 12 years, but patients who needed reoperations had substantially lower scores compared to others. The results of ~~open or~~ arthroscopic revision Bankart repair were unpredictable. Open Latarjet procedure was the most reliable revision surgery.

A recent systematic review of open and arthroscopic Bankart repair, with a minimum of 5 years follow-up, concluded that the recurrence rate of instability was 11% and 8% for arthroscopic and open surgeries, respectively [17]. As shown by our study and those of Privitera *et al.*, Castagna *et al.*, and Plath *et al.* with a minimum 10 years of follow-up, the true recurrence rate is much higher, ranging from 21% to 35% [8, 30, 31]. The reported long-term failure rates of arthroscopic Bankart repair are substantially higher than those from open Bankart and Latarjet procedures, with a minimum of 10 years follow-up. The recurrence rates ranged from 7% to 18% and from 1% to 13%, respectively [2, 4, 7, 12, 24, 26, 29].

An interesting finding was that half of the recurrences occurred after 2 years of follow-up, and about one fourth after 5 years of follow-up. Bessiere *et al.* and van der Linde *et al.* reported a similar trend in their studies after 6 and 8 years of follow-up, respectively [5, 35]. Most studies report results after only 2 years of follow-up. Clearly, a longer, minimum of 5 years follow-up is needed to assess the actual effectiveness of arthroscopic Bankart-repair.

Many studies have identified young age as an independent risk factor for failure after arthroscopic Bankart repair [1, 3, 13, 25]. Previous studies focusing on young patients have also included pediatric patients, and the results of those studies may not be directly comparable to ours. Shymon *et al.* reported a 49% 5-year survival rate of both open and arthroscopic Bankart repairs in an adolescent population, with a mean age of 17 years [33]. Nixon *et al*. reported a 31% failure rate in a cohort of patients with a mean age of 17 years, but their mean follow-up was only 22 months [27]. Castagna *et al*. found a 21% failure rate in

patients aged <18 years, with a mean follow-up of 5 years [9]. The patients participated in overhead or contact sports, making it a population at risk. Khan *et al.* reported on skeletally immature patients (aged <16 years), with a 7% recurrence of dislocation after open Latarjet operation, with a mean follow-up of 10 years [20].

~~Our~~ The patient cohort in this study consisted of consecutive patients with several dislocations. They probably had bony erosions of the glenoid and engaging or bipolar off-track Hill-Sachs-lesions, which nowadays are considered by many as contraindications for arthroscopic Bankart repair [11]. This could partly explain the high recurrence rate, and patient selection could probably improve the results [26, 34]. Also, early surgery after primary dislocation could lower the recurrence rate. Long-term results after primary stabilization were substantially better than our results. Owens *et al.* reported a 36% recurrence rate after a minimum of 9 years follow-up in young (17–23 years) adult patients.[28]~~28~~ Kirkley *et al.* found a 25% recurrence rate after a minimum of 6.5 years follow-up in patients aged <30 years undergoing primary stabilization [22]. Less severe pathology after the primary dislocation compared to recurrent dislocation could better explain these stabilization results after primary dislocation. Also newer techniques, including remplissage, could possibly improve results, but no long-term studies have been published so far.

Several techniques have been used for revision stabilization after failed Bankart repair [15]. Our experience is similar to that of Blackman *et al.*, who concluded that arthroscopic and open revision Bankart repair is unpredictable, especially in adolescents, with failure rates of about 33% after mid-term (5-year) follow-up [6]. Latarjet procedure may be the best choice for revision surgery, with about a 14% failure rate regardless of bony pathology [14, 32].

The strengths of the study include a large number of patients, with a very ~~good~~ high follow-up rate for a long-term study. The technique was similar in all patients. The criteria for failure was ~~We~~ subjective ~~had very strict criteria for failure~~ because the goal of stabilization surgery is to eliminate instability symptoms, as pointed out by van der Linde *et al* [36]. Therefore, subjective feeling of instability is probably the best measure of failure.

~~Our~~ This study has also certain weaknesses. The design of the study was retrospective and sports- and non-sports related recurrences could not be separated.~~-~~ The long period between assessments may have caused recall bias. However, we combined the information from our previous report with medical records and therefore believe that we could reliably determine the timeline of failure. The primary outcome was based on radiologically verified redislocation or typical history alone, and we did not perform clinical examinations to assess apprehension and no follow-up radiographs were available.~~-~~ ~~-~~Additionally, functional scores were not available for all patients.

In the future, randomized clinical trials (RCT) should be done focused on comparing different stabilization techniques, especially in young patients. According to clinicaltrials.gov (www.clinicaltrials.gov), such an investigation comparing arthroscopic Bankart repair with open Latarjet procedure in young male patients is currently recruiting patients. Two years of follow-up, which is commonly used in RCTs, is clearly too short a period to determine the true effectiveness of these interventions, and a minimum of 5 years follow-up is needed, which poses a challenge for RCTs.

**Conclusions**

In this study nearly one third of patients had recurrences of instability after arthroscopic Bankart repair after a minimum of 10 years follow-up. Patients aged ≤20 years did especially poorly with more than half of the patients having recurrence, and alternative stabilization techniques should probably be considered for these patients.

TF analyzed the data and drafted the manuscript. RK reviewed the patient records, posted the questionnaires and interviewed the patients, KS critically revised the manuscript, PO helped in statistics, JL critically revised the manuscript. All authors read and approved the final manuscript.

## References

1. Ahmed I, Ashton F, Robinson CM. (2012) Arthroscopic Bankart repair and capsular shift for recurrent anterior shoulder instability. J Bone Joint Surg ~~(am)~~ 94-A: 1308-1315.

2. Allain J, Goutallier D, Glorion C, Creteil C. (1998) Long-term results of the Latarjet procedure for the treatment of anterior instability of the shoulder. J Bone Joint Surg 80-A; 841-852.

3. Balg F, Boileau P. (2007) The instability severity index score. A simple pre-operative score to select patients for arthroscopic or open shoulder stabilization. J Bone Joint Surg ~~(br)~~ 89-B: 1470-1477.

4. Berendes TD, Wolterbeek R, Pilot P, Verburg H, te Slaa RL. (2007) The open modified Bankart procedure: outcome at follow-up of 10 to 15 years. J Bone Joint Surg (Br) 89-B: 1064-1068.

5. Bessiere C, Trojani C, Carles M, Mehta SS, Boileau P. (2014) The open Latarjet procedure is more reliable in terms of shoulder stability than arthroscopic Bankart repair. Clin Orthop Rel Res 472: 2345-2351.

6. Blackman AJ, Krych AJ, Kuzma SA, Chow RM, Camp C, Dahm DL. et al. (2014) Results of revision anterior shoulder stabilization surgery in adolescent athletes. Arthroscopy 30:1400-1405.

7. Bouju Y, Gadea F, Stanovici J, Moubarak H, Favard L. (2014) Shoulder stabilization by modified Latarjet-Patte procedure: results at a minimum 10 years' follow-up, and role in the prevention of osteoarthritis. Orthop Traumatol Surg Res 100 (4 suppl): S 213-218.

8. Castagna A, Markopoulos N, Conti M, Delle Rose G, Papadakou E, Garofalo R. (2010) Arthroscopic Bankart suture anchor repair: radiological and clinical outcome at minimum 10 years of follow-up. Am J Sports Med 38: 2012-2016.

9. Castagna A, Delle Rose G, Borroni M, Cillis BD, Conti M, Garofalo R (2012) Arthroscopic stabilization of the shoulder in adolescent athletes participating in overhead or contact sports. Arthroscopy 28: 309-315.

10. Dawson J, Fitzpatrick R, Carr A. (1999) The assessment of shoulder instability. The development and validation of a questionnaire. J Bone Joint Surg ~~(br)~~ 81-B: 420-426.

11. Di Giacomo G, Itoi E, Burkhart SS. (2014) Evolving concept of bipolar bone loss and the Hill-Sachs lesion: from "engaging/non-engaging" lesion to "on-track/off-track" lesion. Arthroscopy. 30: 90-98..

12. Fabre T, Abi-Chahla ML, Billaud A, Geneste M, Durandeau A. (2010) Long-term results with Bankart procedure: A 26-year follow-up study of 50 cases. J Shoulder Elbow Surg 19: 318-323.

13. Flinkkilä T, Hyvönen P, Ohtonen P, Leppilahti J. (2010) Arthroscopic Bankart repair: results and risk factors of recurrence of instability. Knee Surg Sports Traumatol Arthrosc ~~2010~~; 18: 1752-1758.

14. Flinkkilä T, Sirniö K. (2015) Open Latarjet procedure for failed arthroscopic Bankart repair. Orthop Traumatol Surg Res ~~2015~~; 101; 35-38.

15. Friedman LG, Griesser MJ, Miniaci AA, Jones MH. (2014) Recurrent instability after revision anterior shoulder stabilization surgery. Arthroscopy 30: 372-381.

16. Gilbart MK, Gerber C. (2007) Comparison of the subjective shoulder value and the Constant score. J Shoulder Elbow Surg 16: 717-721.

17. Harris JD, Gupta AK, Mall NA, Abrams GD, McCormick FM, Cole BJ et al. (2013) Long-Term outcomes after Bankart stabilization. Arthroscopy 29: 920-933.

18. Hovelius L, Vikerfors O, Olofsson A, Svensson O, Rahme H. (2011) Bristow-Latarjet and Bankart: a comparative study of shoulder stabilization in 185 shoulders during a seventeen year follow-up. J Shoulder Elbow Surg 20: 1095-1101.

19. Jones KJ, Wiesel B, Ganley TJ, Wells L. (2007) Functional outcomes of early arthroscopic Bankart repair in Adolescents aged 11 to 18 years. J Pediatr Orthop 27: 209- 213

20. Khan A, Samba A, Preira B, Canavese F. (2014) Anterior dislocation of the shoulder in skeletally immature patients. Comparison between non-operative treatment versus open Latarjet's procedure. Bone Joint J 96-B; 354-359.

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

Formatted: Not Highlight

240 21. Kirkley A, Griffin S, McLintock H, Ng L. (1998) The Development and evaluation of a disease specific
241 quality of life measurement tool for shoulder instability. The Western Ontario Shoulder Instability Index
242 (WOSI). Am J Sports Med 26: 764-72.

243 22. Kirkley A, Werstine R, Ratjek A, Griffin S. (2005) Prospective randomized clinical trial comparing the
244 effectiveness of immediate arthroscopic stabilization versus immobilization and rehabilitation in first
245 traumatic anterior dislocations of the shoulder: long-term evaluation. Arthroscopy 21: 55-63.

246 23. Malhotra A, Freudmann MS, Hay SM. (2012) Management of traumatic anterior shoulder dislocation in
247 the 17- to 25-year age group: a dramatic evolution of practice. J Shoulder Elbow Surg 21: 545-553.

248 24. Mizuno N, Denard PJ, Raiss P, Melis B, Walch G. (2014) Long-Term results of the Latarjet procedure
249 for anterior instability of the shoulder. J Shoulder Elbow Surgery 23: 1691-1699.

250 25. Mohtadi NGH, Chan DS, Hollingshead RM, Boorman RS, Hiemstra LA, Lo IKY (2014). A randomized
251 clinical trial comparing open and arthroscopic stabilization for recurrent traumatic anterior shoulder
252 instability. J Bone Joint Surg ~~(am)~~ 96-A; 353-360.

253 26. Moroder P, Odorizzi M, Pizzinini S, Demetz E, Resch H, Moroder P. et al. (2015) Open Bankart repair
254 for the treatment of anterior shoulder instability without substantial osseus glenoid defects: results after a
255 minimum follow-up of twenty years. J Bone Joint Surg ~~(am)~~ 97-A: 1398-1405.

256 27. Nixon MF, Keenan O, Funk L. (2015) High recurrence of instability in adolescents playing contact sports
257 after arthroscopic shoulder stabilization. J Pediatric Orthop 24: 173-177.

258 28. Owens BD, DeBernandino TM, Nelson BJ, Thurman J, Cameron KL, Taylor DC et al. (2009). Long-
259 term follow-up of acute arthroscopic repair for initial anterior shoulder dislocations in young athletes.
260 Am J Spors Med 37: 669-673.

261 29. Pelet S, Jolles BM, Farron A.(2006) Bankart repair for recurrent anterior glenohumeral instability:
262 results at twenty-nine years' follow-up. J Shoulder Elbow Surg 15: 203-207.

30. Plath JE, Aboalata M, Seppel G, Juretzko J, Waldt S, Vogt S, Imhoff AB. (2015) Prevalence of and risk factors for dislocation arthropathy: radiological long-term outcome of arthroscopic Bankart repair in 100 shoulders at an average 13-year follow-up. Am J Sports Med 43: 1084-1090.

31. Privitera DM, Bisson LJ, Marzo JM. (2012) Minimum 10-year follow-up of arthroscopic intra-articular Bankart repair using bioabsorbable tacks. Am J Sports Med 40: 100-107.

32. Schmid SL, Farshad M, Catanzaro S, Gerber C. (2012) The Latarjet procedure for the treatment of recurrence of anterior instability of the shoulder after operative repair. A retrospective case series of forty-nine consecutive patients. J Bone Joint Surg ~~(am)~~ 94-A: e75(1-7).

33. Shymon SJ, Roocroft, J, Edmonds EW. (2015) Traumatic anterior instability of the pediatric shoulder: A comparison of arthroscopic and open Bankart repairs. J Pediatric Orthop 35: 1-6.

34. Szyluk K, Jasiński A, Widuchowski W, Mielnik M, Koczy B. (2015) Results of arthroscopic Bankart lesion repair in patients with post-traumatic anterior instability of the shoulder and a non-engaging Hill-Sachs lesion with a suture anchor after a minimum of 6-year follow-Up. Med Sci Monit 21:2331-2338.

35. van der Linde JA, van Kampen DA, Terwee CB, Dijksman LM, Kleinjan G, Willems WJ. (2011) Long-term results after arthroscopic shoulder stabilization using suture anchors: an 8- to 10-year follow-up. Am J Sports Med 39: 2396-2403.

36. van den Linde JA, van Kampen DA, Willems JW. (2013) How should we define failure after surgical shoulder stabilization? Arthroscopy 29: 1602.

**Figure 1** Kaplan-Meier survival analysis of the time to recurrence of instability. The estimate for the cumulative proportion of stable shoulders after a mean follow-up of 12.5 years was 0.72.

**Figure 2** Kaplan-Meier survival analysis of time to recurrence of instability in patients aged ≤20 years and >20 years. The estimates for the cumulative proportion of stable shoulders at a mean follow-up of 12.5 years were and 0.48 for patients aged ≤20 years and 0.78 for patients aged >20 years. Log-rank test, $P<0.001$.

**Figure 3** Kaplan-Meier estimate of the time to reoperation after arthroscopic Bankart repair. The estimate of the cumulative proportion of shoulders with revision surgery after a mean follow-up of 12.5 years was 0.18.

**Figure 4** Reoperations after failure.

Table 1. Baseline variables of the patients