

## **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**

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# 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

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**Background:** Glenohumeral osteoarthritis is a well-documented, long-term complication of open stabilization procedures. However, there is a lack of knowledge about long-term radiographic outcome after arthroscopic Bankart procedures.

**Hypothesis:** Glenohumeral osteoarthritis will develop less frequently in arthroscopic Bankart repair compared with open repairs reported in the literature.

**Study Design:** Case series; Level of evidence, 4.

**Methods:** The inclusion criteria for this study were (1) all-arthroscopic Bankart repair for a (2) symptomatic anteroinferior shoulder instability and (3) a minimum follow-up of 10 years. True anteroposterior and lateral radiographs were obtained to evaluate the prevalence and grade of osteoarthritis according to the Samilson classification. Patients were assessed by the Constant score and examined for passive external rotation deficits.

**Results:** Of 165 shoulders that fulfilled the inclusion criteria, 100 were available for evaluation. The median Constant score at an average  $\pm$  SD 156.2  $\pm$  18.5 months after Bankart repair was 94 (range, 46-100). Twenty-one shoulders (21%) sustained a recurrent dislocation. Overall, 31% of shoulders showed no evidence of glenohumeral osteoarthritis; 41% showed mild, 16% moderate, and 12% severe degenerative changes. Osteoarthritis did not correlate with Constant score results ( $P = .427$ ). The grade of osteoarthritis was significantly associated with the number of preoperative dislocations ( $P = .016$ ), age at initial dislocation ( $P = .005$ ) and at surgery ( $P = .002$ ), and the number of anchors used ( $P = .001$ ), whereas time from initial dislocation to surgery ( $P = .854$ ) and external rotation deficit at 0° and 90° of abduction ( $P = .104$  and  $.348$ , respectively) showed no significant correlation. Recurrent dislocation did not affect the presence or grade of osteoarthritis ( $P = .796$  and  $.665$ , respectively).

**Conclusion:** At an average 13 years after arthroscopic Bankart repair, osteoarthritic changes are a common finding and, overall, are comparable with reports in the literature regarding open procedures as well as nonoperative treatment. The extent of trauma sustained during preoperative dislocations and the age of the patient seem to be more relevant for long-term dislocation arthropathy than the kind of treatment. Accordingly, the study hypothesis must be rejected. Avoiding preoperative dislocations is more important for the prevention of osteoarthritis than short-term treatment. The number of anchors used was found to be a predictor for long-term development of osteoarthritis.

**Keywords:** dislocation arthropathy; glenohumeral osteoarthritis; arthroscopic Bankart repair; shoulder instability

Recurrent anteroinferior shoulder dislocation is common in young and active patients.<sup>23</sup> Given the high risk of redislocation after nonsurgical treatment, surgical stabilization is recommended, particularly for athletes in sports that place high demands on the shoulder.<sup>2,17,31,37</sup>

Arthroscopic suture anchor repair is now considered the standard procedure for the treatment of symptomatic

shoulder instability and has proven to be a successful procedure, with results comparable with those of open Bankart repair.<sup>†</sup>

The purpose of the stabilization procedure is to restore shoulder stability and function in the short term and to avoid long-term complications like osteoarthritis development. However, besides a reported high rate of glenohumeral osteoarthritis after nonoperative treatment, the development of degenerative changes is also a well-

documented issue after open stabilization procedures.<sup>3,11,14,25,32</sup> Varying between techniques, long-term osteoarthritis rates (>10 years of follow-up) up to 89% have been published.<sup>1,3,11,25,28,32</sup> Regarding open Bankart procedures, degenerative changes have been reported in as many as 58% of patients.<sup>3,11,25,32</sup>

Until recently, no long-term data were available regarding osteoarthritis after arthroscopic Bankart repair. In 2010, Castagna et al<sup>7</sup> reported mild to moderate degenerative changes in 12 of 30 patients (39%) after arthroscopic suture anchor Bankart repair at an average follow-up of 10.9 years. More recently, Privitera et al<sup>27</sup> and Kavaja et al<sup>19</sup> provided long-term radiographic data on arthroscopic Bankart repair using bioabsorbable tacks.

What still remains unknown is whether dislocation arthropathy develops due to the trauma of dislocation or the duration of instability or whether it may even be affected by the surgical procedure itself.<sup>5,6,10,14</sup>

Therefore, the purpose of this study was (1) to add data to the current knowledge on long-term radiologic outcome of arthroscopic Bankart repair, by examining a large number of patients, and (2) to define risk factors for the development of dislocation arthropathy. We hypothesized that because of the minimal invasiveness of the Bankart procedure, glenohumeral osteoarthritis would develop less frequently in arthroscopic Bankart repair compared with prior reports on open Bankart repair in the literature.

## MATERIALS AND METHODS

The inclusion criteria for the current study were (1) all arthroscopic Bankart repair for a (2) symptomatic anteroinferior shoulder instability (dislocation or subluxation) and (3) a minimum follow-up of 10 years postoperatively. Exclusion criteria were posterior or multidirectional instability, rotator cuff tears, bony Bankart defects, voluntary shoulder instability, and neurologic disorders involving the shoulder girdle. A failed previous Bankart stabilization procedure (arthroscopic or open) as well as a concomitant superior labrum anterior and posterior (SLAP) repair were not exclusion criteria.

All patients were assessed by the Constant score and clinically examined for passive external rotation deficits (0° and 90° of abduction) to correlate osteoarthritic changes and clinical outcome.<sup>9</sup> True anteroposterior view and lateral radiographs were obtained to evaluate the prevalence and grade of osteoarthritis according to the Samilson classification (Figure 1).<sup>33</sup> All radiographs were analyzed by an orthopaedic surgeon who specialized in shoulder surgery and by an experienced musculoskeletal radiologist in consensus.

The study protocol was approved by the local ethics committee, and all patients provided written informed consent to participate in this investigation.

## Risk Factors of Dislocation Arthropathy

The following potential risk factors for the development of secondary glenohumeral osteoarthritis after arthroscopic anteroinferior Bankart repair were assessed in this study: age at primary dislocation and at surgery, number of preoperative dislocations, time from initial dislocation to surgery, number and type of fixation devices used during surgery, recurrence of instability, and external rotation deficit at time of follow-up.

To reduce potential biases of retrospective data collection due to the 13-year follow-up, values for preoperative number of dislocations and time from initial dislocation to surgery were obtained from a database that was established at an average of 37 months postoperatively.

## Arthroscopic Procedure and Rehabilitation

All surgeries were either conducted or directly supervised by the senior author (A.B.I.). The patient was placed in the beach-chair position, and diagnostic arthroscopy was performed through the standard posterior portal. An elevator was introduced through an anterosuperior portal to mobilize the anteroinferior labral lesion and to partially decorticate the glenoid neck. The capsulolabral repair was performed through a deep anteroinferior portal (5:30-o'clock position) in all patients as described previously.<sup>16,35</sup> Different fixation devices were used: FASTak/Bio-FASTak (Arthrex; n = 71/5), Suretac (Smith & Nephew Endoscopy; n = 14), and Panalok (DePuy Mitek; n = 10). The number of devices used varied between patients, depending on the extent of the capsulolabral lesion.

In case of a reconstructable SLAP lesion, suture anchor repair was performed through a transtendinous lateral portal. Small bucket-handle tears or a frayed labrum were resected.

Postoperatively, patients used a sling for comfort, and progressive active and assisted range of motion exercise was initiated on the following day, limiting external rotation to -30° and abduction as well as flexion to 45°. At 4 weeks postoperatively, abduction and flexion to 90° were allowed and external rotation was limited to 0°. Free active range of motion was allowed after 6 weeks postoperatively. Patients were permitted to return to overhead activities after 6 months postoperatively. In case of concomitant SLAP repair, active biceps training was prohibited for the first 6 weeks.

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**Figure 1.** (A) Follow-up radiograph of a 37-year-old patient without any osteoarthritic changes at 153 months (12.8 years) after the index procedure. (B) Follow-up radiograph of a 39-year-old patient with moderate osteoarthritic changes at 140 months (11.7 years) after the index procedure.

### Statistics

Statistical analyses were performed by use of SPSS software v 21 for Macintosh (SPSS Inc). All data were tested for normal distribution by use of the Kolmogorov-Smirnov test. For normally distributed data, the *t* test was used. Nonnormally distributed data were analyzed by the Mann-Whitney *U* test and Kruskal-Wallis test. Spearman correlation coefficients were calculated to assess correlations between osteoarthritis and possible risk factors. Dichotomous data were computed by the chi-square test. The level of significance was set at  $P < .05$ .

### RESULTS

Between December 1996 and December 2000, 165 shoulders that fulfilled the inclusion criteria underwent arthroscopic Bankart repair at our department. When the study began, 34 patients (34 shoulders) refused radiographic imaging or participation in the study at all, 26 patients (26 shoulders) could not be reached, and 5 patients (5 shoulders) were deceased, leaving 100 shoulders available for evaluation.

A concomitant SLAP repair was performed in 19% of shoulders, and 15% of shoulders were revision cases.

The median Constant score at an average  $\pm$  SD 156.2  $\pm$  18.5 months after arthroscopic Bankart repair was 94 (range, 46-100) (Table 1). Twenty-one shoulders (21%) sustained a recurrent dislocation, and 14 shoulders (14%) underwent revision surgery for recurrent anterior instability.

Overall, 69% of shoulders showed some evidence of glenohumeral osteoarthritis. The grade of osteoarthritis according to the Samilson classification was mild in the majority of these cases and did not correlate with the

Constant score result ( $P = .427$ ) (Figure 2). Furthermore, shoulders that revealed osteoarthritic changes did not have inferior Constant scores compared with radiographically healthy shoulders ( $P = .777$ ).

When compared with the healthy contralateral shoulder joint, the operated shoulder showed a mean passive external rotation deficit of 5° (range, -30° to 80°) at 0° and of 5° (range, -25° to 40°) at 90° of abduction, respectively (Table 1).

There were no neurovascular complications, postoperative infections, or postoperative shoulder stiffness that needed surgical intervention within our patient population. Detailed patient characteristics are provided in Table 1.

### Risk Factors of Dislocation Arthropathy

Patients with osteoarthritic changes were overall older at initial dislocation ( $P = .014$ ) and at surgery ( $P = .009$ ). There was a positive correlation between the patients' age at the time of initial dislocation ( $P = .005$ ) as well as at surgery ( $P = .002$ ) and the grade of glenohumeral degeneration (Table 2).

A positive correlation with the grade of osteoarthritic changes was also found for the number of dislocations before surgical stabilization ( $P = .016$ ), while no such relationship was detected for the duration of shoulder instability ( $P = .854$ ) (Table 2). Furthermore, a higher number of fixation devices used during surgery appeared to be a risk factor for the severity ( $P = .001$ ) and presence ( $P = .013$ ) of osteoarthritic changes, while the type of anchor did not affect glenohumeral joint degeneration (severity of osteoarthritis,  $P = .327$ ; presence of osteoarthritis,  $P = .432$ ) (Table 2).

Patients who sustained a recurrent shoulder dislocation did not show osteoarthritic changes more frequently

TABLE 1  
Patient Demographics

Follow-up period, mo, average ± SD (range)	156.2 ± 18.5 (121-206)
Constant score, median (range)	94 (46-100)
No. of shoulders (No. of patients)	100 (96)
Patient sex, male:female, n	77:23
Affected side, right:left, n	54:46
Dominance on affected side, dominant:nondominant, n	88:12
Previous stabilization procedure, % of shoulders	
Arthroscopic	10
Open	5
Age at initial dislocation, y, average ± SD (range)	23.1 ± 6.7 (10-43)
Age at surgery, y, average ± SD (range)	27.7 ± 7.7 (16-57)
Time from initial dislocation to surgery, mo, median (range)	23.3 (0.6-338.5)
No. of preoperative dislocations, median (range)	5 (0-100)
No. of fixation devices used, median (range)	3 (2-7)
Type of fixation device, n	
FASTak	71
Bio-FASTak	5
Suretac	14
Panalok	10
Median external rotation deficit (range), deg	
0° of abduction	5 (-30 to 80)
90° of abduction	5 (-25 to 40)
Concomitant SLAP repair, % of shoulders	19

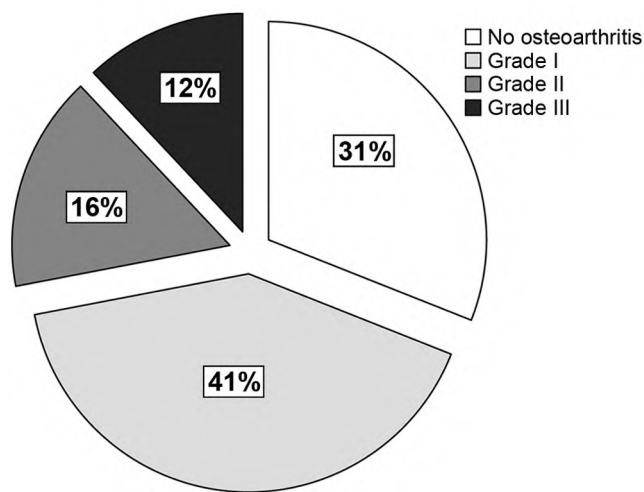


Figure 2. Prevalence and grade of osteoarthritis in study patients according to the Samilson classification.<sup>33</sup>

( $P = .796$ ) or at a higher grade ( $P = .665$ ) compared with patients who did not have a recurrence; neither did a concomitant SLAP repair or a prior stabilization procedure influence the presence ( $P = .298$  and  $.832$ , respectively) or severity ( $P = .365$  and  $.895$ , respectively) of long-term osteoarthritic changes.

DISCUSSION

At an average of 13 years after arthroscopic Bankart repair, radiologic glenohumeral osteoarthritis was found in 69% of the patients in this study. However, most of

the degenerative changes were mild, and considering the excellent Constant score outcome with no correlation between osteoarthritis and score results, these degenerative changes were well tolerated by our patients.

Our osteoarthritis rate is comparable with previous reports on long-term dislocation arthropathy after arthroscopic Bankart repair in the literature. Kavaja et al<sup>19</sup> published the largest long-term case series to date, presenting the results of 74 shoulders (72 patients) that underwent Bankart repair using Suretac fixation tacks. At an average 13 years of follow-up, the investigators found an osteoarthritis rate of 68%, with 80% of these cases rated as mild according to the Samilson classification.<sup>33</sup>

Even higher osteoarthritis rates were reported by Privitera et al.<sup>27</sup> At an average 13.5 years after the index procedure, the authors found degenerative changes in 16 of 20 patients (80%), and osteoarthritis was rated as mild in 50% of patients according to the classification of Rosenberg et al.<sup>32</sup> While both studies provided outcomes of Bankart repair using Suretac anchors, Castagna et al<sup>7</sup> published the only long-term (>10 years of follow-up) radiographic outcome study to date after arthroscopic suture anchor repair, reporting mild to moderate osteoarthritic changes in 12 of 30 patients (39%) at 10.9 years of follow-up.

Overall, when compared with reports on open Bankart repair in the literature, the rate and extent of osteoarthritic changes within our patient population were comparable or even slightly higher.<sup>3,11,25,32</sup> Accordingly, the hypothesis that dislocation arthropathy will develop less frequently in arthroscopic Bankart repair because of the minimal invasiveness of the procedure must be rejected.

Considering the natural course of dislocation arthropathy as published by Hovelius and Saeboe,<sup>14</sup> with an osteoarthritis rate of 60% after nonoperative treatment,

TABLE 2  
Risk Factors for the Development of Glenohumeral Osteoarthritis in Shoulder Instability<sup>a</sup>

	Presence of Osteoarthritis			Correlation With Grade of Glenohumeral Degeneration	
	Radiographic Signs (n = 69)	No Radiographic Signs (n = 31)	P	P	Spearman ρ
Age at initial dislocation, y, average ± SD (range)	24.2 ± 7.3 (10-43)	20.7 ± 4.3 (12-29)	<b>.014</b>	<b>.005</b>	<b>0.279</b>
Age at surgery, y, average ± SD (range)	29.1 ± 8.2 (15-57)	24.7 ± 5.8 (17-40)	<b>.009</b>	<b>.002</b>	<b>0.312</b>
No. of preoperative dislocations, median (range)	6 (0-99)	2 (0-100)	.084	<b>.016</b>	<b>0.241</b>
Time from initial dislocation to surgery, mo, median (range)	13.3 (0.6-339)	30.1 (1-244)	.734	.854	0.019
External rotation deficit, deg, median (range)					
0° of abduction	5 (-30 to 80)	0 (-30 to 25)	.190	.104	0.163
90° of abduction	5 (-25 to 40)	5 (-20 to 20)	.344	.348	0.095
No. of fixation devices used, median (range)	4 (2-7)	3 (2-4)	<b>.013</b>	<b>.001</b>	<b>0.341</b>

<sup>a</sup>Bolded text indicates statistical significance.

Bankart repair seems neither to considerably expose patients to an increased risk of osteoarthritis nor to protect against long-term joint degeneration.

The number of dislocations before Bankart repair correlated with the grade of dislocation arthropathy, which is consistent with previous reports in the literature.<sup>5,12</sup> This implies that regardless of the surgical procedure, the extent of preoperative trauma may decide the fate of long-term joint degeneration. This fact has been stressed by other authors.<sup>5,14,22</sup>

In contrast, the time interval from primary dislocation to surgery was not a risk factor for long-term joint degeneration in this study. Thus, avoiding a recurrent dislocation seems to be more important for osteoarthritis prevention than early surgery per se.

Older age at initial dislocation and at surgery appeared to be a predictor of shoulder osteoarthritis development. In fact, age at time of surgery is the most consistent risk factor in the literature to date.<sup>5,6,10,12,14,19</sup> This finding may be related to the normal aging process, because older patients have a higher incidence of arthritis than younger patients. However, primary glenohumeral osteoarthritis is a rare condition, and given the strong correlation of osteoarthritis and age within this study, it is evident that an older joint is more susceptible to secondary dislocation arthropathy.

Summarizing, our data suggest that long-term dislocation arthropathy is affected by preoperative risk factors like sustained trauma and patient's age rather than by the surgical procedure itself. However, this may only be true if the selected surgical procedure is done correctly and aims to restore the native anatomy of the shoulder. In previous studies, protruding hardware into the joint, excessive anterior soft tissue tightening, an overhanging bone block, and extra-anatomic stabilization procedures were identified as major arthrogenic factors.<sup>1,5,12,28,29,32,36,39</sup>

In the current study, we found a significant positive correlation between number of anchors used and the grade of osteoarthritis. This finding is in accordance with a report by Franceschi et al,<sup>12</sup> and Hovelius and Saeboe<sup>14</sup> referred

to this as *anchor arthritis*. However, in the current study we did not detect any obvious anchor interference with joint motion as far as could be seen on conventional radiography.

The degree of labral lesion was previously reported to be a risk factor for long-term joint degeneration.<sup>12</sup> The higher number of anchors may also indicate a more severe trauma to the anteroinferior capsulolabral complex. This would be consistent with our findings on the effect of preoperative trauma on long-term degeneration. A concomitant SLAP repair, however, as a possible indicator for a more severely damaged labrum, did not influence shoulder osteoarthritis in the current study.

Because the intraoperative status of the anteroinferior labrum was not documented in detail during surgery, the association between number of anchors and long-term joint degeneration cannot not be clarified conclusively based on our data. Nonetheless, while performing stabilization procedures, surgeons should keep in mind that a higher number of fixation devices used during arthroscopy results in a higher amount of potentially conflicting foreign material (sutures and anchors). In particular, a recent publication showed that a successful repair can be achieved with fewer than 3 anchors and that a single anchor is sufficient for most patients.<sup>38</sup>

Excessive anterior soft tissue tightening was previously associated with glenohumeral osteoarthritis.<sup>5,12,28,32</sup> In our population, a deficit of external rotation at follow-up examination was not found to be a risk factor for secondary joint degeneration. However, severe movement restrictions after arthroscopic Bankart repair are rare, which can be explained by the anatomic repair obtained with the arthroscopic procedure.<sup>7,16,18</sup> With a median deficit of only 5°, the effect of a restricted external rotation may not be judged conclusively based on our data. Furthermore, a major limitation of range of motion assessment at follow-up examination is that it is impossible to retrospectively differentiate between a primary and a secondary phenomenon.

The reported recurrence rate in long-term studies (>10 years of follow-up) after arthroscopic Bankart repair is

high, ranging from 14.3% to 25%.<sup>7,19,24,27</sup> In our series, 21 of the 100 shoulders sustained a recurrent dislocation, giving a comparable recurrence rate of 21%. Recurrence did not affect osteoarthritis development, which is in accordance with previous reports in the literature.<sup>12,27</sup> At first, this seems to be conflicting considering the effect of preoperative trauma on long-term joint degeneration. However, the interval between recurrence and follow-up examination may be too short to have a significant effect on the radiographic outcome.

There are several limitations of the present study that need to be considered. First, 34 patients refused to participate in the study, 26 patients could not be reached, and 5 patients were deceased, raising the possibility of a selection bias. Second, values for preoperative number of dislocations and time from initial dislocation to surgery were obtained from a database that was established at an average of 37 months postoperatively. Retrospective data acquisition may have biased our results. Third, different fixation devices were used in this study, making the study cohort heterogeneous in this respect. Fourth, preoperative radiographs were no longer available because of storing policies and had been destroyed. Hence we were unable to compare glenohumeral osteoarthritis between pre- and postoperative imaging. However, we present data on dislocation arthropathy of 100 shoulders at 13 years after arthroscopic Bankart repair. To our knowledge, this study is the largest series to date focusing on radiographic long-term outcome after arthroscopic Bankart repair.

## CONCLUSION

At an average of 13 years after arthroscopic Bankart repair, osteoarthritic changes are a common finding and are comparable with reports in the literature regarding open procedures as well as nonoperative treatment. The extent of trauma sustained during preoperative dislocations and the age of the patient seem to be more relevant for long-term dislocation arthropathy than the kind of treatment. Accordingly, our hypothesis must be rejected.

Avoiding preoperative dislocations is more important for the prevention of osteoarthritis than short-term treatment. The number of anchors used was found to be a predictor for long-term development of osteoarthritis.

## REFERENCES

- Allain J, Goutallier D, Glorion C. Long-term results of the Latarjet procedure for the treatment of anterior instability of the shoulder. *J Bone Joint Surg Am*. 1998;80(6):841-852.
- Arciero RA, Wheeler JH, Ryan JB, McBride JT. Arthroscopic Bankart repair versus nonoperative treatment for acute, initial anterior shoulder dislocations. *Am J Sports Med*. 1994;22(5):589-594.
- Berendes TD, Wolterbeek R, Pilot P, Verburg H, te Slaa RL. The open modified Bankart procedure: outcome at follow-up of 10 to 15 years. *J Bone Joint Surg Br*. 2007;89(8):1064-1068.
- Bottoni LCR, Smith MEL, Berkowitz MMJ, Towle CRB, Moore CJH. Arthroscopic versus open shoulder stabilization for recurrent anterior instability: a prospective randomized clinical trial. *Am J Sports Med*. 2006;34(11):1730-1737.
- Buscayret F, Edwards TB, Szabó I, Adeleine P, Coudane H, Walch G. Glenohumeral arthrosis in anterior instability before and after surgical treatment: incidence and contributing factors. *Am J Sports Med*. 2004;32(5):1165-1172.
- Cameron ML, Kocher MS, Briggs KK, Horan MP, Hawkins RJ. The prevalence of glenohumeral osteoarthritis in unstable shoulders. *Am J Sports Med*. 2003;31(1):53-55.
- Castagna A, Markopoulos N, Conti M, Rose GD, Papadakou E, Garofalo R. Arthroscopic Bankart suture-anchor repair: radiological and clinical outcome at minimum 10 years of follow-up. *Am J Sports Med*. 2010;38(10):2012-2016.
- Cole BJ, L'Insalata J, Irrgang J, Warner JJ. Comparison of arthroscopic and open anterior shoulder stabilization: a two to six-year follow-up study. *J Bone Joint Surg Am*. 2000;82(8):1108-1114.
- Constant CR, Murley AH. A clinical method of functional assessment of the shoulder. *Clin Orthop Relat Res*. 1987;214:160-164.
- Elmlund AO, Ejerhed L, Sernert N, Rostgård LC, Kartus J. Dislocation arthropathy and drill hole appearance in a mid- to long-term follow-up study after arthroscopic Bankart repair. *Knee Surg Sports Traumatol Arthrosc*. 2012;20(11):2156-2162.
- Fabre T, Abi-Chahla ML, Billaud A, Geneste M, Durandea A. Long-term results with Bankart procedure: a 26-year follow-up study of 50 cases. *J Shoulder Elbow Surg*. 2010;19(2):318-323.
- Franceschi F, Papalia R, Del Buono A, Vasta S, Maffulli N, Denaro V. Glenohumeral osteoarthritis after arthroscopic Bankart repair for anterior instability. *Am J Sports Med*. 2011;39(8):1653-1659.
- Harris JD, Gupta AK, Mall NA, et al. Long-term outcomes after Bankart shoulder stabilization. *Arthroscopy*. 2013;29(5):920-933.
- Hovelius L, Saeboe M. Arthropathy after primary anterior shoulder dislocation—223 shoulders prospectively followed up for twenty-five years. *J Shoulder Elbow Surg*. 2009;18(3):339-347.
- Ide J, Maeda S, Takagi K. Arthroscopic Bankart repair using suture anchors in athletes: patient selection and postoperative sports activity. *Am J Sports Med*. 2004;32(8):1899-1905.
- Imhoff AB, Ansah P, Tischer T, et al. Arthroscopic repair of anterior-inferior glenohumeral instability using a portal at the 5:30-o'clock position: analysis of the effects of age, fixation method, and concomitant shoulder injury on surgical outcomes. *Am J Sports Med*. 2010;38(9):1795-1803.
- Jakobsen BW, Johannsen HV, Suder P, Søjbjerg JO. Primary repair versus conservative treatment of first-time traumatic anterior dislocation of the shoulder: a randomized study with 10-year follow-up. *Arthroscopy*. 2007;23(2):118-123.
- Kartus C, Kartus J, Matis N, Forstner R, Resch H. Long-term independent evaluation after arthroscopic extra-articular Bankart repair with absorbable tacks: a clinical and radiographic study with a seven to ten-year follow-up. *J Bone Joint Surg Am*. 2007;89(7):1442-1448.
- Kavaja L, Pajarinen J, Sinisaari I, et al. Arthrosis of glenohumeral joint after arthroscopic Bankart repair: a long-term follow-up of 13 years. *J Shoulder Elbow Surg*. 2012;21(3):350-355.
- Marquardt B, Witt KA, Gotze C, Liem D, Steinbeck J, Potzl W. Long-term results of arthroscopic Bankart repair with a bioabsorbable tack. *Am J Sports Med*. 2006;34(12):1906-1910.
- Martetschläger F, Imhoff AB. [Shoulder dislocation in athletes: current therapy concepts]. *Orthopäde*. 2014;43(3):236-243.
- Ogawa K, Yoshida A, Matsumoto H, Takeda T. Outcome of the open Bankart procedure for shoulder instability and development of osteoarthritis: a 5- to 20-year follow-up study. *Am J Sports Med*. 2010;38(8):1549-1557.
- Owens BD, Agel J, Mountcastle SB, Cameron KL, Nelson BJ. Incidence of glenohumeral instability in collegiate athletics. *Am J Sports Med*. 2009;37(9):1750-1754.
- Owens BD, DeBerardino TM, Nelson BJ, et al. Long-term follow-up of acute arthroscopic Bankart repair for initial anterior shoulder dislocations in young athletes. *Am J Sports Med*. 2009;37(4):669-673.
- Pelet S, Jolles BM, Farron A. Bankart repair for recurrent anterior glenohumeral instability: results at twenty-nine years' follow-up. *J Shoulder Elbow Surg*. 2006;15(2):203-207.

26. Petrera M, Patella V, Patella S, Theodoropoulos J. A meta-analysis of open versus arthroscopic Bankart repair using suture anchors. *Knee Surg Sports Traumatol Arthrosc.* 2010;18(12):1742-1747.
27. Privitera DM, Bisson LJ, Marzo JM. Minimum 10-year follow-up of arthroscopic intra-articular Bankart repair using bioabsorbable tacks. *Am J Sports Med.* 2012;40(1):100-107.
28. Rachbauer F, Ogon M, Wimmer C, Sterzinger W, Huter B. Glenohumeral osteoarthritis after the Eden-Hybbinette procedure. *Clin Orthop Relat Res.* 2000;373:135-140.
29. Rhee YG, Lee D-H, Chun IH, Bae SC. Glenohumeral arthropathy after arthroscopic anterior shoulder stabilization. *Arthroscopy.* 2004;20(4):402-406.
30. Rhee YG, Lim CT, Cho NS. Muscle strength after anterior shoulder stabilization: arthroscopic versus open Bankart repair. *Am J Sports Med.* 2007;35(11):1859-1864.
31. Robinson CM, Howes J, Murdoch H, Will E, Graham C. Functional outcome and risk of recurrent instability after primary traumatic anterior shoulder dislocation in young patients. *J Bone Joint Surg Am.* 2006;88(11):2326-2336.
32. Rosenberg BN, Richmond JC, Levine WN. Long-term followup of Bankart reconstruction: incidence of late degenerative glenohumeral arthropathy. *Am J Sports Med.* 1995;23(5):538-544.
33. Samilson RL, Prieto V. Dislocation arthropathy of the shoulder. *J Bone Joint Surg Am.* 1983;65(4):456-460.
34. Sperber A, Hamberg P, Karlsson J, Swärd L, Wredmark T. Comparison of an arthroscopic and an open procedure for posttraumatic instability of the shoulder: a prospective, randomized multicenter study. *J Shoulder Elbow Surg.* 2001;10(2):105-108.
35. Tischer T, Vogt S, Imhoff AB. Arthroscopic stabilization of the shoulder with suture anchors with special reference to the deep anterior-inferior portal (5.30 o'clock). *Oper Orthop Traumatol.* 2007;19(2):133-154.
36. van der Zwaag HM, Brand R, Obermann WR, Rozing PM. Glenohumeral osteoarthritis after Putti-Platt repair. *J Shoulder Elbow Surg.* 1999;8(3):252-258.
37. Wheeler JH, Ryan JB, Arciero RA, Molinari RN. Arthroscopic versus nonoperative treatment of acute shoulder dislocations in young athletes. *Arthroscopy.* 1989;5(3):213-217.
38. Witney-Lagen C, Perera N, Rubin S, Venkateswaran B. Fewer anchors achieves successful arthroscopic shoulder stabilization surgery: 114 patients with 4 years of follow-up. *J Shoulder Elbow Surg.* 2014;23(3):382-387.
39. Zuckerman JD, Matsen FA. Complications about the glenohumeral joint related to the use of screws and staples. *J Bone Joint Surg Am.* 1984;66(2):175-180.