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Open Bankart Repair Versus Arthroscopic Repair With Transglenoid Sutures or Bioabsorbable Tacks for Recurrent Anterior Instability of the Shoulder

A Meta-analysis

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Background: In published comparative studies, it remains unknown if arthroscopic techniques for performing Bankart repair for anterior shoulder instability equal the success of open repair.

Hypothesis: The current literature supports a lower rate of recurrent instability after open Bankart repair compared to arthroscopic repair with bioabsorbable tacks or transglenoid sutures.

Study Design: Meta-analysis.

Methods: A Medline search identified all randomized controlled trials or cohort studies that directly compared open repair to arthroscopic techniques of Bankart repair for traumatic, unilateral, recurrent anterior instability. Data collected from each study included patient demographics, surgical technique, rehabilitation, outcome, and complications.

Results: Six studies met all inclusion criteria. There were 172 patients in the arthroscopic group (90 patients with transglenoid sutures, 77 patients with arthroscopic tacks, and 5 patients with suture anchors) and 156 patients in the open group. The groups were similar in demographic characteristics. When comparing the arthroscopic to the open group, there was a significantly higher rate of recurrent dislocation (12.6% vs 3.4%; $P = .01$) and total recurrence (recurrent dislocation or subluxation) (20.3% vs 10.3%; $P = .01$). In addition, there was a higher proportion of patients with an excellent or good postoperative Rowe score in the open group (88%) than in the arthroscopic group (71%) ($P = .01$).

Conclusions: Arthroscopic Bankart repair using transglenoid sutures or bioabsorbable tacks results in a higher rate of recurrence of instability compared to open techniques. Studies comparing open repair to newer arthroscopic techniques using suture anchor fixation and capsular plication are necessary.

Keywords: Bankart; instability; shoulder; arthroscopic; repair

Anterior instability of the shoulder is common after traumatic injuries. Bankart is generally credited with the first description of the essential lesion in anterior shoulder instability: detachment of the anterior inferior labrum from the glenoid rim.[4] The results of open repair of the Bankart lesion, as performed by Bankart, were initially published by Dickson and Devas in 1957, with a 4% failure rate (2/50 patients).[12] Rowe et al later published their results with open Bankart repair, with a rate of recurrent instability of 3.5% (5/145 patients).[51] There have been several series documenting low recurrence rates from open Bankart stabilization, ranging from 0% to 11%,[§] establishing open stabilization as the gold standard for operative repair.

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The development of arthroscopic stabilization for recurrent anterior instability has undergone significant evolution over the past 2 decades. Potential benefits of arthroscopic stabilization include decreased postoperative pain, improved range of motion, and increased return to throwing activities. Initial fixation was performed by staple capsulorrhaphy, which resulted in recurrent instability in 16% to 33% of patients.[9,23,25,35,40] Additional methods of arthroscopic stabilization have included transglenoid suturing, with a failure rate ranging from 0% to 49%,[‖] and bioabsorbable tack fixation, with a published failure rate ranging from 9% to 23%.[14,30,36,48,54] Newer techniques for arthroscopic stabilization have been developed, including suture anchor fixation with capsular plication, with failure rates ranging from 7.5% to 11%.[3,7,17,27] However, only short-term data are available on suture anchor fixation. It remains controversial whether arthroscopic techniques equal the success of open stabilization when recurrent instability is considered.

Meta-analysis is a technique to statistically combine or integrate the results of several independent clinical trials to increase statistical power.[11] Meta-analysis is an attractive alternative for answering clinically important questions when a large, expensive, and logistically difficult trial would be necessary. In addition, meta-analysis is valuable in study questions where sample sizes in individual studies are too small to detect clinically important effects and label them as "statistically significant." This effect can be demonstrated when examining the literature on arthroscopic versus open shoulder stabilization. In 5 different independent clinical trials that directly compared open and arthroscopic treatment for anterior shoulder instability, open stabilization was found to have a lower rate of recurrent instability.[18,24,31,55,56] Although a potentially clinically important difference was found in each study, because of small sample sizes, none of these differences was declared statistically significant. Meta-analysis allows the combination of several smaller clinical trials to determine if statistically significant differences exist.

The purpose of this study was to compare open versus arthroscopic stabilization for recurrent, traumatic, anterior shoulder instability by performing a meta-analysis of the published literature.

METHODS

Literature Search

Using Medline,[41] we performed a search of the published literature from January 1966 to May 2002 of all articles using the keywords *shoulder*, *instability*, *bankart*, *open*, *arthroscopic*, *dislocation*, and *anterior*. There were 892 articles found, and the abstracts were reviewed for relevance to the study. In addition, review articles and manual review of references cited in papers were used to identify any additional articles for inclusion. Articles presented in abstract form only were not considered.[33]

Inclusion Criteria

The inclusion and exclusion criteria were established before study collection. We included studies that directly compared open and arthroscopic techniques for the treatment of traumatic, unidirectional, recurrent anterior instability of the shoulder. Case series that evaluated only 1 technique of treatment, open or arthroscopic, were excluded. Any studies that included patients with multidirectional instability or initial dislocators were excluded so that the population evaluated would be homogeneous. In addition, all studies required the documentation of a Bankart lesion by arthroscopy. Any studies that combined treatment with thermal shrinkage, capsular shift alone, or nonanatomic open reconstruction (ie, Bristow, Latarjet, or Putti-Platt reconstruction) were excluded. Studies that outlined an obvious bias for selection criteria for open or arthroscopic stabilization were also excluded from the study.

Data Extraction

All data were abstracted by 1 author (KBF) from the studies that met all inclusion criteria. Demographic information was collected, including the number of patients enrolled in the study, the number of patients at final follow-up, and demographic information on the patient populations (age, sex, mean final follow-up time). Information on the surgical technique and findings (including the documentation of a Bankart lesion) and fixation technique was recorded. In addition, outcome information was collected, including the number of patients with recurrence of dislocation or subluxation, number of total failures (dislocation or subluxation), Rowe score at final follow-up, range of motion, and complications of surgery (infection, nerve injury, hardware breakage, or implant breakage).

Appropriateness of Pooling

Within each treatment group—arthroscopic or open stabilization—the studies were reviewed to determine if they could be combined. The combination of trials in each treatment arm is based on the premise that the treatment groups are clinically homogeneous in composition. The similarity among treatment groups was determined by patient inclusion and exclusion criteria, patient age and gender, and follow-up interval. For each outcome event (ie, recurrent dislocation), we constructed a contingency table of study by outcome. The purpose of this table was to test whether the proportion of patients experiencing an outcome event varied significantly across studies (test of heterogeneity). For 2-level outcomes, the Fisher-Freeman-Halton exact test was used.

[‖]References 10, 20-22, 26, 34, 38, 43, 45-47, 49, 52, 59, 63, 65.

TABLE 1
Studies Included in Meta-analysis

Study	Study Type	Choice of Procedure	Surgical Technique	Number of Patients
Sperber et al[55]	Randomized controlled trial	Random	Open	26
			Bioabsorbable tack	30
Jorgensen et al[28]	Randomized controlled trial	Random	Open	20
			Transglenoid sutures	21
Geiger et al[18]	Prospective cohort	Patient choice	Open	18
			Transglenoid sutures	16
Karlsson et al[31]	Prospective cohort	Surgeon or patient choice	Open	48
			Bioabsorbable tack	60
Steinbeck and Jerosch[56]	Prospective cohort	Quality of tissue	Open	32
			Transglenoid sutures	30
Guanche et al[24]	Retrospective cohort	Patient choice	Open	12
			Transglenoid sutures	10
			Suture anchors	5

Data Analysis

The absolute risk for each outcome event was determined for the open and arthroscopic stabilization group. The point estimate of absolute risk was determined by adding the number of events that occurred throughout all studies and dividing by the number of patients at risk. In any study, if 1 of the outcomes was not specifically defined, the patients were not considered at risk for that particular outcome and were therefore eliminated from the denominator. A pooled analysis was then performed. To create the 95% confidence interval (CI) for each agent, a generalized linear model was run to adjust for clustering within study. This approach allows for variability in outcome rates among studies. The practical effect of this approach is generally to increase the width of the estimated CI as compared with a standard approach ignoring the correlation between observations within a study.[13]

In addition, a logistic regression model was performed to calculate the odds ratio for each outcome, adjusted for clustering of study. Because of the number of comparisons performed, the significance level was set at $P = .05/2$ or $P = .025$.

RESULTS

Literature Search

There were 892 abstracts reviewed for relevance to the study. Of these, 59 studies evaluated the clinical results of Bankart repair for recurrent instability. There were 10 studies that directly compared open and arthroscopic Bankart repair. Of these 10 studies, 4 were excluded for not meeting all inclusion criteria. One study included initial dislocators.[50] Two studies had biased selection criteria for open versus arthroscopic repair: Sisto and Cook[53] performed open surgery only in cases of failed arthroscopic repair, and Cole et al[8] performed open repair for patients with inferior instability. The study by Kartus et al[32] was excluded because of duplicate data.

Six studies met all inclusion criteria; they are listed in Table 1. There were 2 randomized controlled trials, 3 prospective cohort studies, and 1 retrospective cohort study.

Study Heterogeneity

When we looked at the cross tabulations of study by outcome, the only evidence of heterogeneity among studies was within the arthroscopic group for the Rowe score outcome ($P = .0048$). However, because no correlation could be observed to explain the heterogeneity between groups, all studies were retained in the analysis. No other outcomes expressed significant heterogeneity between study groups.

Patient Characteristics

The patient demographics for the 6 studies included in the analysis are listed in Table 2, including the number of patients, mean age, mean follow-up, and gender. Because of differences in the method of reporting, no meaningful summary of data could be performed on certain patient characteristics, such as the number of dislocations before surgery and the amount of time from injury to surgery. All patients had an arthroscopically documented Bankart lesion at the time of surgery.

For each study, the type of study, method of choice of the surgical procedure (open versus arthroscopic), surgical technique, and number of patients at final follow-up are listed in Table 1. The summary of the surgical technique used for each procedure is presented in Table 3. Guanche et al[24] performed 2 different surgical techniques in the arthroscopic group, using transglenoid sutures in 10 patients and suture anchors in 5 patients. The postoperative regimen for each group was similar, with a mean time in a sling of 3.3 weeks and an average return to sports of 5.4 months for both the open and arthroscopic groups.

TABLE 2
Patient Demographics

Technique	Number of Studies	Number of Patients	Mean Age, y	Mean Follow-up, mo	Mean %, Male
Open	6	156	27.7	33.8	83
Arthroscopic	6	172	26.5	29.1	77

TABLE 3
Surgical Technique for Bankart Repair

Technique	Surgical Procedure	Number of Studies	Number of Patients
Open	Bone tunnels	2	22
	Suture anchors	5	134
Arthroscopic	Transglenoid sutures	4	77
	Bioabsorbable tack	2	90
	Suture anchors[a]	1	5

[a]Guanche et al[24] performed 2 different surgical techniques in the arthroscopic group, using transglenoid sutures in 10 patients and suture anchors for 5 patients.

Rate of Recurrent Instability

The rates of recurrent dislocation were significantly different between the open and arthroscopic group, with a rate of dislocation of 3% (95% CI, 2%-6%) in the open group compared to 13% (95% CI, 9%-17%) in the arthroscopic group ($P < .0001$) (Table 4). In addition, the rate of total recurrence (dislocation + subluxation) was significantly higher in the arthroscopic group (20%; 95% CI, 14%-28%) than in the open group (10%; 95% CI, 8%-13%) ($P < .0001$).

Postoperative Rowe Score

There was a significant difference in the postoperative Rowe score between the 2 groups: 88% (95% CI, 84%-91%) of patients had an excellent or good Rowe score in the open group compared to 71% (95% CI, 52%-84%) in the arthroscopic group ($P < .0001$) (Table 4). Also, the risk of having a poor Rowe score was higher in the arthroscopic group (22%; 95% CI, 12%-37%) compared to the open group (5%; 95% CI, 3%-9%) ($P < .0001$).

Transglenoid Sutures Versus Bioabsorbable Tacks

When analyzed separately, the rate of recurrent dislocation was significantly higher in both the bioabsorbable tack group (12%; 95% CI, 6%-29%) and the transglenoid suture group (13%; 95% CI, 8%-21%) when compared to the open group (3%; 95% CI, 2%-6%) ($P = .046$). In addition, the rate of total recurrence (dislocation + subluxation) was significantly higher in both the bioabsorbable tack group (18%; 95% CI, 13%-23%) and the transglenoid suture group (23%; 95% CI, 13%-37%) when compared to the open group (10%; 95% CI, 8%-13%) ($P < .0001$). There were no significant differences between the bioabsorbable tack or transglenoid suture group for recurrent dislocation or total recurrence.

Range of Motion

Because of differences in reporting, there was no meaningful way to combine the results for postoperative range of motion in the 2 groups. Each study reported the results by a different technique and in different arm positions. When looking at loss of external rotation, only 1 study found a significant difference between open and arthroscopic techniques. Karlsson et al[31] found that the mean external rotation in abduction was 90° in the arthroscopic group and 80° in the open group, which was significant ($P = .001$). Sperber et al[55] reported that the mean loss of external rotation was 9° in the arthroscopic group and 10° in the open group (not significant). Steinbeck and Jerosch[56] found that 12 patients (38%) in the open group had a loss of 5° in the abducted position, whereas 8 patients (27%) in the arthroscopic group had a loss of 5° (not significant). Jorgensen et al[28] reported that 5 of 20 patients lost 25% of external rotation in the open group compared to 1 of 21 patients in the arthroscopic group (not significant). Guanche et al[24] reported an average loss of 3° of external rotation in the arthroscopic group versus 1.7° in the open group with the arm at the side ($P = .70$) and an average loss of 0.8° in the open group versus 7° in the arthroscopic group in the abducted position ($P = .29$). Geiger et al[18] reported that the average range of motion was 85% of normal in the open group versus 91% in the arthroscopic group with the arm at the side and 85% of normal in the open group versus 88% of normal in the arthroscopic group with the arm abducted. Neither of these results was significant.

Although the results could not be combined, 5 of the 6 studies found better external rotation in the arthroscopic group than in the open group, although these differences were not significant.

Return to Sports or Activity

Because of differences in reporting and insufficient information, no meaningful comparisons could be made with regard to return to sports after instability repair. No study found significant differences in the ability to return to sports or activity after open or arthroscopic repairs. Sperber et al[55] and Karlsson et al[31] provided no information with regard to return to sports. Steinbeck and Jerosch[56] reported the return to highly demanding overhead sports, with 3 of 8 returning in the arthroscopic group compared to 3 of 5 returning in the open group. They commented that 30 of 32 in the open group and 25 of 30 in the arthroscopic group had little or no restriction in activity. Jorgensen et al[28] found that 11 of 21 patients had unrestricted activity in the arthroscopic group compared to 12 of 20 in the open group. Guanche et al[24] reported that 11 of 15 in the arthroscopic group and 9 of 12 in the open

TABLE 4
Risk of Recurrent Instability After Open or Arthroscopic Bankart Repair

Outcome	Open Repair (95% confidence interval)	Arthroscopic Repair (95% confidence interval)	Odds Ratio[a]	P
Recurrent dislocation	3% (2%-6%)	13% (9%-17%)	0.24	<.0001
Total recurrence (dislocation + subluxation)	10% (8%-13%)	20% (14%-28%)	0.44	<.0001
Excellent/good Rowe score	88% (84%-91%)	71% (52%-84%)	2.95	<.0001
Poor Rowe score	5% (3%-9%)	22% (12%-37%)	0.34	<.0001

[a]Odds ratio of open versus arthroscopic repair.

TABLE 5
Risk of Complications After Open or Arthroscopic Bankart Repair

Outcome	Open Repair (95% confidence interval)	Arthroscopic Repair (95% confidence interval)	Odds Ratio[a]	P
Infection	1% (0%-3%)	1% (0%-4%)	1.09	.95
Hardware failure	1% (0%-4%)	1% (0%-3%)	0.97	.13
Motion loss requiring surgery	3% (1%-13%)	2% (0%-7%)	1.87	.39
Nerve injury	3% (0%-16%)	2% (1%-5%)	1.10	.91

[a]Odds ratio of open versus arthroscopic repair.

group returned to sports, although the level was not defined. Geiger et al[18] found that 16 of 18 in the open group and 8 of 15 in the arthroscopic group returned to their primary work or sport, although the level was not defined.

Complications

There were no significant differences when comparing open and arthroscopic stabilization with regard to infection, hardware failure, motion loss requiring surgery, or nerve injury (Table 5).

DISCUSSION

The optimal surgical technique for the treatment of recurrent instability of the shoulder remains a controversial topic, with both open repair and arthroscopic repair demonstrating good results. Open stabilization has been considered the gold standard for comparison because of the low rate of recurrent instability after open repair.[¶] Arthroscopic techniques for anterior stabilization have gained increasing popularity, with attempts to equal the success of open Bankart repair. This study demonstrates that the current literature supports a lower risk of recurrent instability after open Bankart repair compared to arthroscopic techniques using transglenoid sutures or bioabsorbable tacks. Open Bankart repair led to a lower rate of recurrent dislocation, total recurrence (dislocation or subluxation), and a higher percentage of patients with a good or excellent Rowe score.

There are several possible reasons for failure with arthroscopic treatment of recurrent instability. Burkhart and De Beer[7] reviewed a series of arthroscopic Bankart repairs to identify specific factors related to recurrence of instability. They found that failure of arthroscopic stabilization was due to a lack of recognition of significant bony lesions, including engaging Hill-Sachs lesions and anteroinferior glenoid bone loss ("inverted pear glenoid"). When patients with these lesions were excluded, the recurrent instability rate was 4%. Another reason cited for failure of arthroscopic techniques has been the failure to address capsular laxity at the time of surgery.[44,54] Mologne et al[44] reported the findings at the time of open surgery after a failed arthroscopic Bankart repair and found the most common reasons for failure to be a persistent Bankart lesion and capsular laxity. In addition, there is a significant learning curve involved in the techniques of arthroscopic stabilization, and this can contribute to a higher rate of recurrent instability as well.

It is important to recognize that the surgeons in the literature reviewed for this meta-analysis performed arthroscopic stabilization with transglenoid sutures or bioabsorbable tacks. These are the only techniques used in the current literature that directly compare open to arthroscopic Bankart repair. Many surgeons have currently adopted the technique of suture anchor repair of the glenoid labrum, combined with suture plication of the capsule. This newer technique was not used in the studies included in this meta-analysis. The rate of recurrent instability after arthroscopic repair using suture anchors and capsular plication may be lower than the results reported in this article. Kandziora et al[29] found that the transglenoid suture technique led to a higher rate of recurrent instability (35/108, 32%) compared to suture anchor fixation (9/55, 16%), which was significant ($P < .05$). However, a 16% failure rate with suture anchor fixation would still appear higher than the open technique. Although many of

[¶]References 1, 5, 15, 16, 19, 37, 39, 42, 57, 58, 60-62, 64.

us believe that the current technique has a failure rate equal to open repair, it will be necessary to directly compare this technique with open repair to evaluate its efficacy.

This study has several strengths. Only studies that directly compared open and arthroscopic Bankart repair were included. There are several reasons for using this strict inclusion criterion. Most important, this criterion attempts to limit the introduction of confounding factors into the analysis. The combination of study groups in a meta-analysis is based on the premise of homogeneity—that the groups are similar in composition. Including studies that directly compared open and arthroscopic techniques attempts to limit confounding factors between groups that can be present when combining a group of case series. Other strict inclusion criteria were also enforced, eliminating population characteristics that could affect the outcome, such as the lack of a Bankart lesion, multidirectional instability, or first-time dislocators. When the literature on open and arthroscopic stabilization is examined, there are many studies that combine a variety of treatment groups in their analysis. This study attempts to limit this possible heterogeneity by including only studies that compared patients with recurrent, traumatic, unidirectional anterior instability with a documented Bankart lesion. Although the meta-analysis could have included several case series that examined only 1 technique of repair (open or arthroscopic stabilization), this technique of meta-analysis can introduce into the results additional sources of heterogeneity that cannot be controlled. In addition, using studies that directly compare the 2 techniques in each study allows the data to be combined in the form of an odds ratio, which preserves the relationship between groups within each study. For these reasons, only studies that directly compared open and arthroscopic stabilization were included.

There were 2 studies that directly compared open and arthroscopic techniques for anterior instability that were excluded from the study. Sisto and Cook[53] performed open stabilization only after a failed arthroscopic procedure. This method of selection introduces bias between the 2 populations because the more difficult patients were likely to be placed in the open group. The study showed a failure rate of 13% for the arthroscopic group (bioabsorbable tack) and 0% for the open group, despite a bias toward failure of the open group. In addition, Cole et al[8] included patients with a significant inferior component of instability in their study, with all of these patients being treated with open stabilization. This study showed a failure rate of 24% for arthroscopic stabilization and 18% for open stabilization, despite a bias toward failure of the open group. The exclusion of these 2 studies from the analysis strengthens the conclusions of the study.

Because the inclusion criteria were strict, there are many study questions that remain unanswered by this analysis. For example, the role of arthroscopic stabilization in the first-time dislocator was not addressed. There are several studies that have examined arthroscopic techniques for stabilization of the first-time dislocator, with relatively low rates of recurrent instability. Arciero et al[2] found a recurrence rate of 14% (3/21) using transglenoid sutures and a 12% recurrence rate using a bioabsorbable tack for stabilization. Boszotta and Helperstorfer[6] found a recurrence rate of 7.5% using transglenoid sutures for the initial dislocator. Another issue that was not specifically addressed was the role of arthroscopic stabilization in the contact athlete.

There are several potential weaknesses of the study. Like all meta-analyses, the study is based on the strength of the literature it incorporates. There are some limitations to the studies that were included. Although they all directly compared open and arthroscopic techniques, they were not all randomized controlled trials. Therefore, there is potential for confounders between the 2 groups. In addition, the combination of studies allows for a variety of surgeons and a variety of surgical techniques, all of which can affect the results. Finally, some important results, such as range of motion and return to activity, could not be compared because of differences in reporting throughout the studies. Finally, only published studies were included in the meta-analysis, which can introduce publication bias. This effect can occur because, in general, studies that show differences are more likely to be published than studies that show no differences. This effect is unlikely in this meta-analysis, however, because nearly all studies included did not have enough statistical power to show meaningful differences, although trends existed.

In conclusion, the current literature supports that open stabilization leads to a lower rate of recurrent instability than arthroscopic stabilization using transglenoid sutures or bioabsorbable tacks. One of the major roles of meta-analysis is to clarify or quantify weaknesses in the existing literature and encourage better quality studies in the future. Newer techniques, using suture anchor fixation and capsular plication, need to be studied in direct comparison to open stabilization to demonstrate its efficacy before widespread adoption of the technique. A clinical trial designed with appropriate power to detect a difference in recurrent instability of 5% between open and arthroscopic stabilization would need to enroll 474 patients in each group. To attain this number of patients, a multicenter clinical trial will be necessary. An appropriately designed clinical trial to address this issue will be the best way to ensure optimal results for patients.

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