Bankart Repair versus Bankart Repair with Remplissage: Meta-analysis and Comparison of the Shoulder Re-Dislocation Rate

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Abstract

Bankart repair (B) and bankart repair with remplissage (BR) are two popular arthroscopic methods to surgically address shoulder instability. A meta-analysis was conducted to assess these two arthroscopic treatment options. This study tested the hypothesis that the re-dislocation rate is statistically lower after arthroscopic BR compared with arthroscopic B alone. The weighted re-dislocation rate from all included studies was found to be 5.300% after arthroscopic BR, while the weighted re-dislocation rate from all included studies was found to be 14.800% after arthroscopic B alone. The addition of remplissage results in a statistically significant reduction in recurrence of anterior shoulder instability.

Introduction

Recurrent shoulder instability affects approximately 1.7% of the world's population. The most common type of shoulder instability is an anterior dislocation, accounting for over 90% of all shoulder dislocations. Rates are increased in men, contact athletes, and military personnel.[1] Multiple factors must be considered prior to surgical treatment. These include patient age, vocation, and desired level of activity. Surgical management should be considered in patients with recurrent unidirectional shoulder instability and in young active people, particularly those that engage in high demand and contact sports1. Consequences of recurrent shoulder instability include labral tearing, bone loss, cartilage damage, glenohumeral arthritis, persistent pain and disability.

There are currently two popular arthroscopic methods used to surgically address anterior shoulder instability in the presence of anteroinferior labral pathology: bankart repair (B) and bankart repair with remplissage (BR). The aim of this meta-analysis is to assess these two arthroscopic treatment options on the basis of post-operative re-dislocation rates. This study tested the hypothesis that the post-operative re-dislocation rate is statistically lower after arthroscopic BR compared with isolated arthroscopic B by performing a systematic review and meta-analysis of the current literature.

Materials and Methods

This meta-analysis followed guidelines published by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses).[2]

Search Strategy and Eligibility Criteria

A search was performed of the PubMed,Web of Science, Embase, and Clinicaltrials.gov databases on June 19, 2018 for studies evaluating the shoulder re-dislocation rate after arthroscopic B versus after arthroscopic BR procedure. The search syntax is provided in Table 1. After deleting all duplicates and screening through the title and abstract of all identified records, articles were assessed based on full text. The inclusion criteria were clinical studies or trials; arthroscopic B and/or arthroscopic BR treatment groups; sample sizes of five or greater;

Table 1. Search terms and findings from every database including within this meta-analysis.

Search Terms	Database
("Bankart Lesions" [Mesh] OR shoulder instabilit*[tiab] OR anterior shoulder instabilit*[tiab] OR shoulder redislocat*[tiab]) AND bankart repair*[tiab] AND remplissage*[tiab]	PubMed (NLM-search platform): 39 Results
TS=(("Bankart Lesions" OR shoulder instabilit* OR anterior shoulder instabilit* OR shoulder redislocat*) AND (bankart repair* AND remplissage*))	Web of Science (Clarivate Analutics-serarch platform): 100 Results
('bankart lesion'/exp OR 'recurrent shoulder dislocation'/exp OR 'shoulder instabilit*':ti,ab OR 'anterior shoulder instabilit*':ti,ab) AND ('bankart repair'/exp OR 'bankart repair*':ti,ab) AND remplissage*:ti,ab	Embase (Elsevier-search platform): 45 Results
Bankart repair AND remplissage	Clinicaltrials.gov: 2 Results

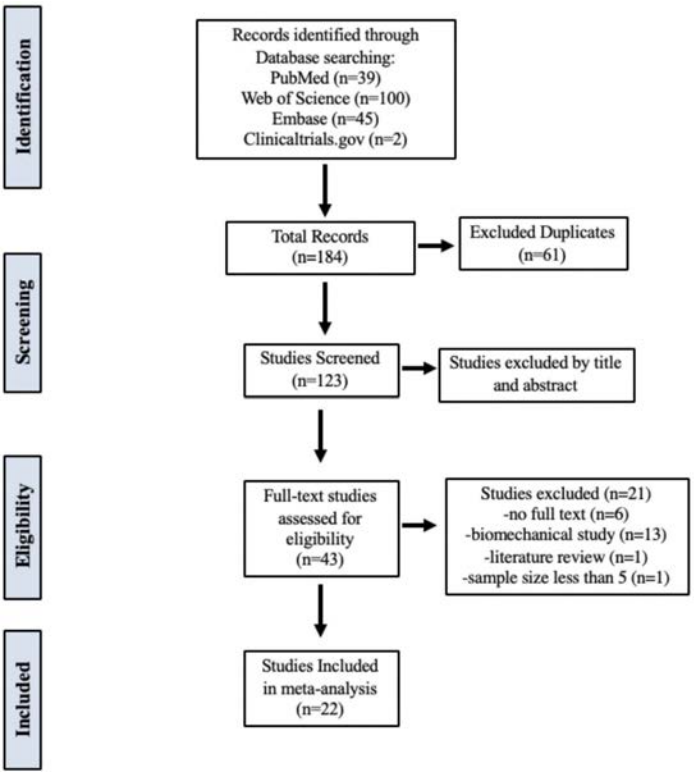


Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram representing the search and screen process of evaluating studies examining the results of arthroscopic bankart repair and arthroscopic bankart repair with remplissage

reporting of the re-dislocation rate in the study and publication in 2000 or later. The meta-analysis excluded all studies not reporting the re-dislocation rate; biomechanical studies and literature reviews; studies prior to 2000; no availability of full text; and all articles not written in English. References were organized via RefWorks citation builder (ProQuest, Ann Arbor, MI). Figure 1 shows the PRISMA flowchart of the literature search conducted.

Data Extraction

The following data was extracted from each article: title, author, publication date, methodology of the study, treatment groups, characteristics of the sample, percent of glenoid bone loss when recorded, and post-operative re-dislocation rate.

Outcome Measures

The shoulder re-dislocation rate within a treatment group was observed and recorded for each treatment group (Table 2). This was given as a percentage of patients that experienced a dislocation recurrence after the operation divided by the total sample size of that treatment group. In addition, the percent of both humeral and glenoid bone loss reported was recorded in order to determine if a correlation existed between percentage of glenoid bone loss present at the index operation and post-operative recurrence of shoulder instability.

Statistical Analysis

Comprehensive Meta-Analysis software version 3 (Biostat, Englewood, NJ) was used to pool the data and run the statistical tests. On the studies that collected the shoulder re-dislocation rate of both treatment groups, the odds ratio and 95% confidence intervals were calculated using this software. In addition, the re-dislocation data was pooled from all studies having one or two of the treatment groups, to get a single weighted re-dislocation rate for each treatment group. The variance ratio test showed that a two-sample t-test with unequal variances was required to determine statistical significance (Figure 2). A two-sample t-test with equal variances would

Table 2. Re-dislocation rates from the 22 included articles.

Study Number	Re-dislocation Rate group 1: remplissage and bankart repair	Re-dislocation Rate group 2: bankart repair
1	0	20
2	Not included	22
3	15	Not included
4	Not included	6
5	11.8	Not included
6	Not included	16.6
7	14.7	Not included
8	9	Not included
9	2.04	Not included
10	0	Not included
11	4.4	Not included
12	1.6	Not included
13	6.7	Not included
14	6.3	Not included
15	5.4	25.7
16	4.5	33
17	0	9
18	2	Not included
19	0	5.9
20	0	0
21	3.9	Not included
22	9.1	Not included

Treatment Group	Observations (number of groups)	Mean (% re-dislocation rate)	Standard Error	Standard Deviation	95% Confidence Interval
group 1: remplissage and bankart repair	19	0.052	0.010	0.045	0.034 – 0.074
Group 2: bankart repair	9	0.148	0.032	0.095	0.076 – 0.221
Combined: groups 1 and 2	28	0.083	0.015	0.078	0.053 - 0.114
Ratio = sd(x)/sd(y)		H_0 : ratio = 1	F = 0.226	Degrees of freedom = 18 , 8	
H_a : Ratio < 1		H_a : Ratio = 1		H_a : Ratio > 1	
Pr (F < f) = 0.004		2 * Pr (F < f) = 0.008		Pr (F > f) = 0.996	

Figure 2. Variance ratio test which determines which type of two sample t-test to perform.

not be statistically valid as the two treatment groups had different total sample sizes. The main quantitative assessment of significance was the "t-value". When the t-value was less than or equal to 0.050, the re-dislocation rate was considered to be statistically different between the two groups.

Results

22 studies met the inclusion criteria. There were 6 case series[3-8], 15 retrospective studies[9-24], and 1 prospective study[25]. The 22 studies provided 1039 patients for meta-analysis: 380 treated with arthroscopic bankart repair and 659 with arthroscopic bankart repair in combination with remplissage. The mean patient age was 28 years and 54% of the patients were male. Follow up ranged from 1 to 6 years. There were 6 studies with both treatment groups[9,18,19,20,22,23]. However, one of these studies could not be used for the paired statistical testing due to the fact that no recurrent dislocations were observed in that study for either treatment group. Therefore, only five studies are shown in Figure 3A. A subsequent paired statistical test was conducted modifying this study to have the same lowest nonzero dislocation rates to determine if this study would impact the pooled result. This test is shown in Figure 3B.

The weighted re-dislocation rate from all included studies was found to be 5.300% after arthroscopic BR, and the weighted re-dislocation rate from all included studies was found to be 14.8% after arthroscopic B alone. This was found to be a statistically significant difference as calculated by the result of the two-sample t test with unequal variances; the results of this statistical analysis show the difference between the two groups to be statistically significant with a p-value of 0.017 (Figure 4).

Figure 3 shows the results of the Meta-Analysis. The pooled odds ratio and 95% confidence interval (CI) were calculated, and because the 95% CI of both Figure 3A and Figure 3B of the paired studies does not cross over 1.0, the odds ratio test shows the difference in re-dislocation rates observed between the two treatment groups to be statistically significant, regardless of whether study 20 was included or not.

Regarding glenoid bone loss, none of the studies identified in this review included data on the glenoid bone loss of individual patients, they only reported the range of bone loss in each sample. The reported bone loss ranged from 0-40% in the different studies. For example, in a study which reported a 25% bone loss or less, there may be some patients in that study with 10% bone loss and some patients with 20% bone loss. This would skew the results when comparing data to another study with inclusion criteria of 10% bone loss or less. Therefore, no valid statistical conclusions on glenoid bone loss as it related to post-operative re-dislocation could be drawn due to the overlap of the sample groups.

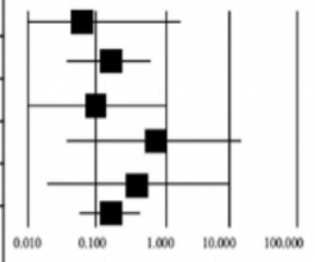
Discussion

The re-dislocation rate for arthroscopic BR in this review was significantly lower than the re-dislocation rate for arthroscopic B alone. This applies to the analysis performed on the paired studies containing both groups as well as the analysis executed with the weighted recurrence rate from all the studies pooled together.

This meta-analysis supports the growing consensus of literature in the field that arthroscopic BR significantly decreases the re-dislocation rate. The consistent result of BR resulting in a lower recurrence rate compared to arthroscopic B alone may prompt more surgeons to consider adding remplissage to their arthroscopic bankart repairs. The addition of remplissage has been shown to help avert a second surgery for a large number of patients with anterior shoulder instability who undergo arthroscopic treatment. Further studies are needed to determine which patients would benefit most from the addition of the remplissage procedure.

A

Study Name	Odds Ratio	Upper Limit	Lower Limit	Z-value	P-value	Odds Ratio and 95% CI
9	0.073	0.004	1.400	-1.736	0.082	
18	0.165	0.033	0.829	-2.187	0.029	
19	0.096	0.010	0.901	-2.051	0.040	
20	0.606	0.029	12.481	-0.325	0.746	
22	0.354	0.013	9.351	-0.622	0.534	
Total	0.167	0.058	0.480	-3.326	0.001	



B

Study Name	Odds Ratio	Upper Limit	Lower Limit	Z-value	P-value	Odds Ratio and 95% CI
9	0.073	0.004	1.400	-1.736	0.082	
18	0.165	0.033	0.829	-2.187	0.029	
19	0.096	0.010	0.901	-2.051	0.040	
20	0.606	0.029	12.481	-0.325	0.746	
22	0.354	0.013	9.351	-0.622	0.534	
23	1.000	0.058	17.325	0.000	1.000	
Total	0.207	0.077	0.557	-3.119	0.002	

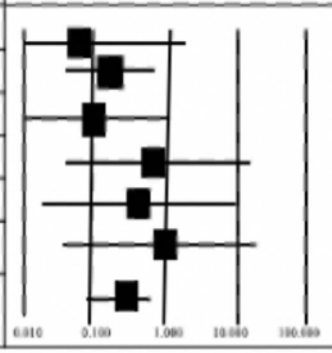


Figure 3. Results of statistical analysis performed by Comprehensive Meta-Analysis Software for Paired studies. **(A)** Statistical Meta-Analysis on Paired Studies excluding study 23. Dislocation rates were 0% for both treatment groups and because one cannot divide by zero (calculation required for odds ratio), that study was excluded from this particular paired statistical test. **(B)** Statistical Meta-Analysis on Paired Studies including modified study 23. Dislocation rate for both treatment groups in study 23 were altered from 0/18 to 1/18 (5.56%) to determine the effect on the pooled odds ratio of the study.

Treatment Group	Observations (number of groups)	Mean (% re-dislocation rate)	Standard Error	Standard Deviation	95% Confidence Interval
group 1: remplissage and bankart repair	19	0.052	0.010	0.045	0.034 – 0.074
Group 2: bankart repair	9	0.148	0.032	0.095	0.076 – 0.221
Combined: groups 1 and 2	28	0.083	0.015	0.078	0.053 - 0.114
Diff = mean (group 1) – mean (group 2) =		H_0 : diff = 0	t = -2.883	Satterthwaite's Degrees of freedom = 9.751	
H_a : Ratio < 0		H_a : Ratio != 0		H_a : Ratio > 0	
Pr (T < t) = 0.008		Pr (| T | > | t |) = 0.017		Pr (T > t) = 0.992	

Figure 4. Two sample t test with unequal variances showing the weighted average recurrence rate for all studies in either treatment group to be statistically different from one another.

The results of this systematic review must be interpreted in light of several limitations. The 22 studies identified each had different lengths of follow-up. This may have impacted the recurrence rate because groups with a longer follow up period clearly had more opportunity for re-dislocation to occur, which would negatively impact the results for either procedure. There were other limitations in some of the individual studies identified including industry funding and small sample sizes.

Recurrence of shoulder instability may be linked to the percent of both humeral and glenoid bone loss, but due to the ambiguity of bone loss measurement in the studies currently published, a correlation was unable to be derived here. In addition, insufficient data was present in the studies to comment on the presence of 'on track' vs 'off track' humeral head lesions.[27] However, future reviews or studies should explore this connection and help determine a possible specific threshold of bone loss where the addition of the remplissage procedure to the arthroscopic bankart repair becomes necessary. Similarly, the threshold percent of excessive humeral and glenoid bone loss for which even the addition of arthroscopic remplissage may be rendered inadequate, must be calculated.

For patients with only modest glenoid bone loss, the addition of remplissage to arthroscopic bankart repair can significantly reduce the re-dislocation rate.The added benefits of reducing the re-dislocation rate must be weighed against the reported (albeit inconsistent) risk of possible stiffness[26] and the burden of additional surgery. However, the results of this meta-analysis support the addition of remplissage to the treatment algorithm of arthroscopic shoulder stabilization.

Conclusion

The current available literature supports that the addition of remplissage to arthroscopic bankart repair results in a statistically significant reduction in recurrence of anterior glenohumeral instability and may be a useful adjunct in select cases.

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