Variability of Reporting Recurrence After Arthroscopic Bankart Repair

A Call for a Standardized Study Design

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Background: High recurrence rates have been reported after anterior shoulder dislocations, regardless of the treatment utilized. However, the definition of recurrent instability has been inconsistent, making a comparison between studies difficult.

Purpose: To report on the nature with which the rate of recurrent instability is reported after arthroscopic Bankart repair, across all levels of evidence, and to analyze factors that may affect the reported rate of recurrence.

Study Design: Systematic review; Level of evidence, 4.

Methods: A systematic review of the literature was performed by searching PubMed, the Cochrane Central Register of Controlled Trials, Embase, and ClinicalTrials.gov for studies published within the dates of January 2008 and September 2018. Studies in English that reported on the recurrence of instability after arthroscopic Bankart repair for anterior shoulder instability were considered for inclusion in this review. A meta-regression was performed to test for a linear association between the reported recurrence rate and several continuous covariates, including mean age at surgery, mean length of follow-up, attrition rate (loss to follow-up percentage), and percentage of male patients.

Results: A trim-and-fill meta-analysis yielded an estimated overall recurrence rate of 17.4% (95% CI, 14.3%-20.9%). There was a significant difference in the recurrence rate depending on the level of evidence ($Q(3) = 10.98$; $P = .012$). Significant associations were found with the recurrence rate through the meta-regression, including a negative association with mean age ($P = .009$), a positive association with mean follow-up time ($P = .002$), and a positive association with attrition rate ($P = .035$).

Conclusion: A call for standardization is necessary for reporting outcomes of anterior instability after arthroscopic Bankart repair, especially with regard to the reporting of recurrence/failure rates, with careful consideration of the effects that may occur from patient demographics and study design. With no current recommendations for deeming failure, we suggest that all forms of instability be accounted for when determining a failed treatment procedure, with future studies placing an emphasis on greater control of the study design.

Keywords: arthroscopic Bankart; anterior shoulder instability; recurrence; failure; dislocation

Anterior instability is the most commonly reported form of instability in the shoulder,[49] with a reported incidence of 1.7% in the general population.[62] Patients with anterior shoulder instability undergoing nonoperative treatment have a high probability of recurrence, with reported rates between 47% and 94.5%.[5,9,26,35,37] Arthroscopic repair is more common, owing to superior patient-reported outcomes and range of motion postoperatively; however, lower recurrence rates are often reported with open approaches.[38] Although a 2018 systematic review by Adam et al[2] reported an average recurrence rate of 13.7% after arthroscopic Bankart repair and a revision rate of 7.1%, rates of recurrence are highly variable, with reported rates ranging from 2%[25,28,34] to 40%.[31,84]

Various factors have been associated with an increased risk of recurrent instability after Bankart repair. These include the total number of instability events before surgery,[2,34,45] placement of anchors,[54] and concomitant injuries present at surgery.[53] Kasik and Saper[33] found a considerable variation in the means of reported clinical outcomes after arthroscopic Bankart repair. The current definitions for recurrent shoulder instability are inconsistent, which may lead to variations in the reported rates of recurrence, contributing to misconceptions of expectations after the Bankart procedure for anterior instability. The criteria for recurrence after surgery have been defined by an assortment of indications, ranging from the exclusive occurrence of dislocations[4,16,57] to studies considering recurrence by

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additional means of instability, including dislocations or subluxations,[11,19,70] or further by the inclusion of apprehension or feelings of pain or instability.[47,61,68]

The purpose of this study was to evaluate the nature with which the rate of recurrent instability is reported after arthroscopic Bankart repair, across all levels of evidence (LOEs), and to analyze factors that may affect the reported rate of recurrence. It was hypothesized that recurrence rates would be affected by the inclusivity of criteria used for the recurrence definition, duration of follow-up, and quality of the study design.

METHODS

Search Strategy

A systematic review in accordance with the Meta-analysis of Observational Studies in Epidemiology (MOOSE) guidelines was performed.[73] Two investigators (M.I.K., C.M.) performed the search in PubMed, the Cochrane Central Register of Controlled Trials, Embase, and ClinicalTrials.gov for studies published within the dates of January 2008 and September 2018. The search terms used to identify potential studies for assessments specific to the intervention (arthroscopic Bankart) and instability (anterior shoulder instability) were individually entered to ensure that no studies were missed. Furthermore, studies demonstrating the potential for inclusion, identified from citations within text, were supplemented to the study query.

Study Eligibility

Studies in English that reported the recurrence of instability after arthroscopic Bankart repair for anterior shoulder instability were considered for inclusion in this review. Studies of all LOEs (1-4) were assessed. Initial screening was performed by 2 investigators (M.I.K., C.M.) with the following exclusion criteria: duplicates, expert opinions, systematic reviews and meta-analyses, and studies not exclusive to anterior instability (posterior or multidirectional instability). If studies failed to define the recurrence of instability, an attempt was made to contact the author; failure to contact resulted in study exclusion.

Data Extraction and Processing

The extraction of data was performed by 2 investigators (M.I.K., C.M.) into separate but identically formatted spreadsheets. The data points of interest consisted of the following: age at the time of surgery (years), follow-up duration (months), sex (% male), associated lesions, study design, number of patients included, attrition rate (% lost to follow-up), definition of recurrence, recurrence rate (% failure), dislocations, and subluxations. Data points were merged after the completion of data extraction.

Initial grouping was performed by allocating studies according to their definition of recurrence/failure after arthroscopic Bankart surgery, classifying studies by the criteria of recurrence that each study was most closely associated with: dislocation (exclusively), dislocation or subluxation, or any form of instability (dislocation, subluxation, positive apprehension, pain, etc). These groups were labeled as dislocation, dislocation/subluxation, and dislocation/subluxation/other, respectively. A subgroup analysis was performed to determine if any discrepancies in the recurrence rate were present across the studies in addition to study classification. A subgroup analysis was further performed across LOEs 1 through 4.

Quantitative Synthesis

To allow for generalizability of the results beyond the set of included studies, all meta-regressions and subgroup meta-analyses utilized mixed-effects models.[30] Residual heterogeneity was estimated using the DerSimonian-Laird method, reported using the I^2 statistic and presented with 95% CIs. Meta-regression results were visualized by plotting fitted values along with 95% CIs across the range of observed covariate values. The evidence for publication bias was assessed using funnel plots, and symmetry was tested using the rank correlation test. As a sensitivity analysis, the trim-and-fill method was used to estimate the overall instability recurrence rate, adjusting for publication bias.

A meta-regression was performed to test for a linear association between the reported recurrence rate and several continuous covariates, including mean age at surgery, mean length of follow-up, attrition rate (percentage lost to follow-up), and percentage of male patients. Additionally, a subgroup meta-analysis was performed to test whether the recurrence rate differed by the definition of recurrence or by the LOE of the study. Model assumptions and fit were assessed via residual diagnostics. Statistical software R version 3.5.0 was used to produce all analyses and results figures (R Foundation for Statistical Computing, with additional packages meta, metafor, and ggplot2).[30,67,75,78,81]

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Evaluation of Study Quality

Study quality was evaluated using the Methodological Index for Non-Randomized Studies (MINORS) score.[71] The following factors were used to assess validity: clearly stated aim, inclusion of consecutive patients, prospective collection of data, endpoints appropriate to the aim of the study, unbiased assessment of the study endpoint, follow-up period appropriate to the aim of the study, loss of follow-up less than 5%, and prospective calculation of the study size. Furthermore, 4 additional items were assessed for comparative studies: adequate control group, contemporary groups, baseline equivalence of groups, and adequate statistical analyses.

RESULTS

Study Characteristics

From the original query of 2614 studies, 52 met the inclusion criteria (Table 1), yielding a total of 3952 shoulders included for analyses. The mean age was 26.8 years, and the mean proportion of male patients was 79.1%. Among the 52 studies evaluated, there were 3 with level 1 evidence, 15 with level 2 evidence, 17 with level 3 evidence, and 17 with level 4 evidence (Appendix Figure A1). Five studies reported on 2 separate cohorts specific to the Bankart procedure, which were included separately from the pooled data; the studies (separate cohorts) were as follows: Godinho et al[27] (single-loading anchors and double-loading anchors), Kim et al[34] (primary dislocation group and recurrent dislocation group), Ozbaydar et al[53] (anterior labroligamentous periosteal sleeve avulsion lesion group and Bankart lesion group), Hantes et al[28] (anterior labral lesion group and superior labral lesion group), and Marshall et al[45] (first-time dislocation group and recurrent dislocation group). The meta-analysis therefore included 57 cohorts.

Meta-analysis

An unmoderated random-effects meta-analysis demonstrated that the rate of recurrent instability was 14.2% (95% CI, 11.5%-17.5%) across all studies. The rank correlation test found significant funnel plot asymmetry (tau = –0.244; P = .007), which was evidence for possible publication bias against smaller studies with relatively high recurrent instability rates (Figure 1). A trim-and-fill meta-analysis was then performed as a sensitivity analysis that aimed to account for publication bias, finding an estimated overall recurrence rate of 17.4% (95% CI, 14.3%-20.9%).

Subgroup Analysis

The subgroup meta-analysis found no significant difference in the recurrence rate depending on the recurrence definition. The following recurrence rates divided by group were reported: dislocation only (10.8% [95% CI, 8.1%-14.2%]; n = 15 cohorts); dislocation or subluxation (15.6% [95% CI, 11.8%-20.3%]; n = 28 cohorts); and dislocation, subluxation, apprehension, or other (16.5% [95% CI, 10.3%-25.4%]; n = 14 cohorts) ($Q(2) = 4.29$; P = .117) (Appendix Figure A2).

There was a significant difference in the recurrence rate depending on the LOE between groups: level 1 (10.0% [95% CI, 6.3%-15.5%]; n = 3 cohorts), level 2 (9.5% [95% CI, 6.6%-13.3%]; n = 17 cohorts), level 3 (17.1% [95% CI, 11.6%-24.5%]; n = 19 cohorts), and level 4 (17.5% [95% CI, 13.4%-22.5%]; n = 18 cohorts) ($Q(3) = 10.98$; P = .012).

Meta-regression

Significant associations were found with the recurrence rate through a meta-regression, including a negative association with mean age (estimate = –0.087 [95% CI, –0.153 to –0.022]; P = .009) (Figure 2), a positive association with mean follow-up time (estimate = 0.0084 [95% CI, 0.0030 to 0.0139]; P = .002) (Figure 3), and a positive association with attrition rate (estimate = 0.0280 [95% CI, 0.002 to 0.054]; P = .035) (Figure 4).

DISCUSSION

The most important finding of this review was that aspects of the study design of reviewed articles significantly altered the reported rates of recurrence after arthroscopic Bankart repair for anterior shoulder instability. After accounting for publication bias, an overall recurrence rate was estimated at 17.4%. This was higher than that reported in the 2018 meta-analysis performed by Adam et al,[2] which reported an average failure rate of 13.7%. Recurrence rates were reported inconsistently depending on the definition of recurrence and were shown to be influenced by the factors of study quality and design. Decreased age, longer follow-up time, attrition rate, and LOE were all correlated with the rate of recurrence.

Patient age has been identified by previous studies to be a potential factor for an elevated risk of recurrence.[26,44,48,59] More specifically, 20 years of age has been deemed the critical point associated with an elevated risk of recurrence because patients younger than this age have a doubled chance of failure.[15,52,57,60,64,77] Although our data do not represent a significant age group to validate this claim, using a meta-regression, significance was observed from the various pooled age ranges, resulting in a trend of elevated recurrence in accordance with younger age at the time of surgery (P = .009). Furthermore, both follow-up duration (P = .002) and attrition rate (P = .035) were positively correlated with elevated recurrence rates.

A significant variation and lack of consistency were observed in the reporting of postoperative outcomes. This was evident in disparities of reported recurrence rates across features of the study design, with the effects being multifactorial. The subgroup analyses found a significant difference between the various LOEs, with rates reported as 10.0% (level 1), 9.5% (level 2), 17.1% (level 3), and 17.5% (level 4) (P = .012). The higher rates of recurrence in studies of lower LOEs suggest an embellished reporting of recurrence rates in lower quality study designs.

Fifteen studies defined recurrence exclusively as dislocations and reported a 10.8% recurrence rate, 28 cohorts

TABLE 1
Variable Reporting of the Definition of Instability[a]

Author (Year)	LOE	Definition of Instability	Lesions	Attrition[b]	Recurrence[c]
Recurrent Instability as Dislocation					
Archetti Netto et al[4] (2012)	2	Recurrent dislocation	B	26.1	11.8
Ee et al[16] (2011)	2	Recurrence of shoulder instability by dislocation	B, HSL	7.6	8.2
Mahirogullari et al[41] (2010)	2	Recurrent dislocation	na	na	5.9
Porcellini et al[57] (2009)	2	Subjective sense of subluxation or objective documentation of dislocation	B, ALPSA	8.8	8.1
Blonna et al[8] (2016)	3	Recurrent dislocation	na	na	10.0
Kraus et al[36] (2015)	3	Shoulder dislocation	na	10.8	10.6
Saier et al[65] (2017)	3	Traumatic shoulder dislocation with consecutive apprehensiveness and time interval from initial dislocation to surgery of <6 wk	na	8.3	11.4
Szyluk et al[74] (2015)	3	Complications if they had occurred spontaneously after surgery; high-energy trauma regarded as sequela of a new injury	B, HSL, SLAP, HAGL	na	9.8
Aydin et al[6] (2017)	4	Recurrent dislocation	na	7.3	7.9
Gerometta et al[25] (2016)	4	Recurrent dislocation	na	6.1	2.2
Plath et al[55] (2015)	4	Recurrence of dislocation	SLAP	39.4	21.0
Saper et al[66] (2017)	4	Instability event requiring manual reduction	SLAP, HSL	na	10.3
Stein et al[72] (2011)	4	Recurrent dislocation	B	12.2	11.6
Yamamoto et al[82] (2015)	4	Repeated anterior shoulder dislocations after an initial episode	B, ALPSA, GLAD	0.0	6.8
Zhu et al[83] (2015)	4	Recurrence of dislocation	na	28.0	33.3
Recurrent Instability as Dislocation and Subluxation					
Elmlund et al[19] (2009)	1	Patients with signs of subluxation who reported ≤1 dislocations or a minimum of 1 episode of "dead arm syndrome"	B	12.5	14.3
Shibata et al[70] (2014)	1	Experience of redislocation	HSL, SLAP, G	0.0	8.8
Bouliane et al[11] (2014)	2	Surgical: dislocation or significant subluxation requiring medical treatment; functional: failure to return to preinjury activity	B, HSL, SLAP	9.1	6.0
Elmlund et al[17] (2008)	2	Dislocation; "experienced or had signs of subluxation" (ie, pain)	B	9.5	18.4
Flinkkila et al[20] (2010)	2	Recurrence defined as redislocation or subluxation (sense of dislocation, followed by immediate reduction)	B, HSL, SLAP	4.4	19.0
Hantes et al[28] (2009)	2	Redislocation or subluxation episode	B	na	2.6
			B, SLAP	na	4.0
Kalkar et al[32] (2017)	2	Subjective feeling of subluxation or documented full dislocation	na	na	4.6
Kim et al[34] (2011)	2	Redislocation or subluxation episode	B, SLAP	na	2.4
			B, SLAP	na	2.9
Memon et al[46] (2018)	2	Dislocation or subluxation	SLAP, HSL	15.9	10.0
Owens et al[50] (2015)	2	Recurrence of dislocation or subluxation	B, SLAP	43.8	33.3
Uchiyama et al[76] (2017)	2	Redislocation and subluxation	B, SLAP, HSL	0.0	26.7
Antunes et al[3] (2016)	3	At least 1 episode of anterior subluxation or dislocation of shoulder	B, HSL, SLAP	10.4	7.0
Bessiere et al[7] (2014)	3	At least 1 episode of anterior dislocation or subluxation	B, HSL	5.1	21.5
Chechik et al[13] (2010)	3	Dislocation or subluxation	B	16.4	21.7
Elmlund et al[18] (2012)	3	Dislocation or subluxation ("dead arm syndrome")	na	0.0	17.7
Lutzner et al[40] (2009)	3	Dislocation for any cause or subluxation	SLAP	2.5	23.1
Marshall et al[45] (2017)	3	Dislocation, subluxation, or feeling of apprehension/ instability	B, HSL	32.8	29.4
			B, HSL	26.4	62.3
Shah et al[69] (2018)	3	Subluxation or dislocation	B, HSL, SLAP, PASTA	na	3.8
Aboalata et al[1] (2017)	4	Dislocation that required reduction as well as subluxation when associated with clinical signs of instability	SLAP	20.6	18.2
Boughebri et al[10] (2015)	4	Recurrence of anterior dislocation or subluxation	B, HSL, SLAP	23.7	8.9

(continued)

TABLE 1 (continued)

Author (Year)	LOE	Definition of Instability	Lesions	Attrition[b]	Recurrence[c]
Flinkkila et al[21] (2018)	4	Dislocation or subluxation (verified by radiographs or typical history; ie, feeling of apprehension, subluxation, or dislocation)	G, HSL, SLAP	10.2	19.0
Franceschi et al[22] (2011)	4	Patients with signs of subluxation who reported ≤1 frank dislocations or a minimum of 1 episode of "dead arm syndrome"	B	16.7	16.7
Owens et al[51] (2009)	4	Recurrent dislocation (requiring manual reduction), subluxation, or revision surgery	na	18.4	37.5
Ozbaydar et al[53] (2008)	4	Dislocation; "subjective sense of subluxation"	B, SLAP, RCT, GBL, HSL	7.0	7.5
			SLAP, RCT, GBL, HSL, ALPSA	7.0	19.2
Recurrent Instability as Dislocation, Subluxation, Positive Apprehension, or Other					
Robinson et al[61] (2008)	1	Dislocation; symptoms of slipping or apprehension with positive apprehension and load-and-shift test results	B, SLAP, HSL, GBL	14.0	8.1
Mishra et al[47] (2012)	2	Recurrent shoulder dislocation; any sensation of subluxation or instability preventing a return to full activity or requiring a further stabilizing procedure	na	23.1	6.0
Sedeek et al[68] (2008)	2	Recurrent dislocation, symptomatic subluxation, or instability preventing a return to full activities	B, HSL	na	7.5
Cho et al[14] (2016)	3	Positive apprehension sign, subluxation, or dislocation	HSL	na	25.7
Godinho et al[27] (2015)	3	Symptom of instability (insecurity, subluxation, dislocation)	G, HSL, SLAP	14.8	5.8
			G, HSL, SLAP	14.8	7.7
Jeon et al[31] (2018)	3	Presence of dislocation or subluxation or subjective instability with a positive apprehension test result	B	na	39.7
Park et al[54] (2018)	3	Recurrent anterior dislocation or subluxation or positive apprehension test result	B, SLAP	0.0	12.2
Virk et al[79] (2016)	3	Recurrence of dislocation, subluxation by history, or positive apprehension	B	10.8	12.1
Zimmermann et al[84] (2016)	3	Recurrence of instability by anterior apprehension, subluxation, or redislocation	na	9.4	41.7
Chapus et al[12] (2015)	4	Dislocation; sensation of subluxation	B, HAGL	4.8	35.0
Pogorzelski et al[56] (2018)	4	Clinical failure from recurrent instability defined by dislocation, subluxation, or positive apprehension	GLAD, SLAP	18.1	13.9
Privitera et al[58] (2012)	4	Dislocation, revision surgery, positive apprehension, and relocation sign with or without history of subluxation	B	37.5	35.0
Voos et al[80] (2010)	4	Recurrence of subluxation, dislocation, or significant apprehension	na	12.1	17.8

[a]ALPSA, anterior labroligamentous periosteal sleeve avulsion; B, Bankart lesion; G, glenoid lesion; GBL, glenoid bone loss; GLAD, glenolabral articular disruption; HAGL, humeral avulsion of the glenohumeral ligament; HSL, Hill-Sachs lesion; LOE, level of evidence; na, not available; PASTA, partial articular supraspinatus tendon avulsion; RCT, rotator cuff tear; SLAP, superior labral tear from anterior to posterior.

[b]Percentage of patients who failed to complete the study.

[c]Percentage of patients relative to the study population.

further included subluxations within the definition and reported a 15.6% recurrence rate, and 14 cohorts considered all forms of postoperative instability as failure and reported a 16.5% recurrence rate. Although a difference of at least 4.8% was observed between studies defining recurrence as dislocations and those including additional criteria, a statistical significance was not found across the various definitions used for recurrent instability ($P = .117$).

Our results highlight an issue within outcomes research in the current literature, raising concerns for a comparison of results across differing modalities and the resultant effect of pooling data for systematic reviews and meta-analyses.[23,24,29,39,42,63] Lukenchuk et al[39] reported on the extensive variability in preferred outcome measures, in which 28 different tools are currently being used for tracking the postoperative phase of anterior shoulder instability. Kasik and Saper[33] likewise reported an inconsistency in outcome measurements in the adolescent population after arthroscopic Bankart repair. In our meta-analyses, we showed that multiple aspects of the study design and patient demographics can influence reported recurrence rates after arthroscopic Bankart repair for anterior shoulder instability. Because of the potential for the

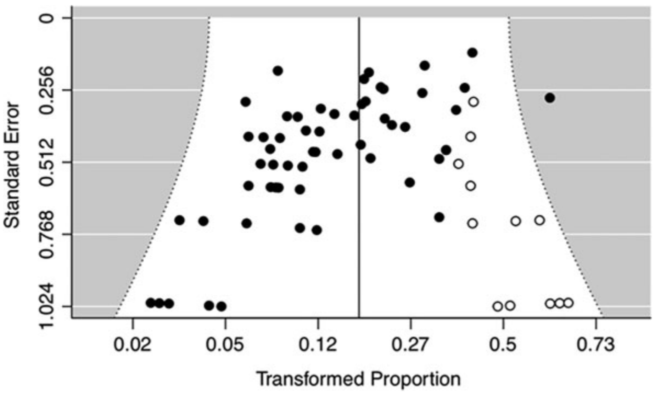

Figure 1. Funnel plot for all studies (black circles), with additional imputed studies generated through the trim-and-fill method (white circles). Significant evidence for funnel plot asymmetry was found ($P = .007$), indicating possible publication bias.

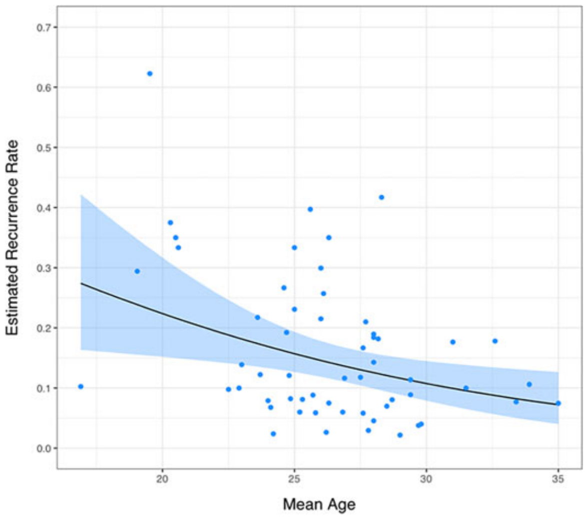

Figure 2. A significant negative association was seen in a meta-regression analysis of the mean age of the study cohort and the reported recurrence rate (estimate = –0.087 [95% CI, –0.153 to –0.022]; $P = .009$).

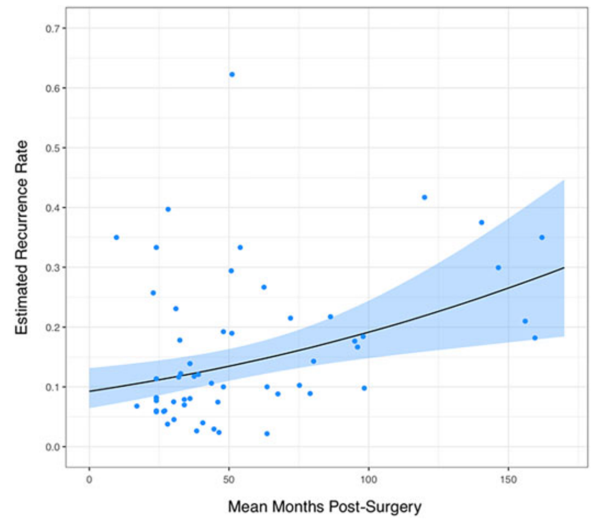

Figure 3. A meta-regression identified that the study's mean follow-up time was significantly positively associated with the reported recurrence rate (estimate = 0.0084 [95% CI, 0.0030-0.0139]; $P = .002$).

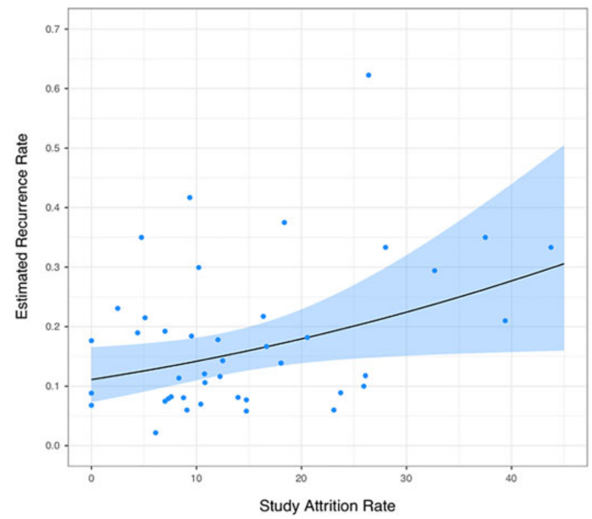

Figure 4. A meta-regression identified that the study's attrition rate (percentage lost to follow-up) was significantly positively associated with the reported recurrence rate (estimate = 0.0280 [95% CI, 0.002-0.054]; $P = .035$).

manipulation of reporting, we believe that the definition of recurrence should be consistently reported as any means of failure, including dislocations, subluxations, feelings of apprehension, or unstable painful shoulders. This will not only clarify reporting across the literature by consistent means for recurrent failure, but it will also provide patients with consistent information as to the progression or potential classification of failure regarding the treatment of anterior shoulder instability after an injury.

Limitations

This meta-analysis was not absent of potential limitations. Meta-regression is susceptible to confounding among moderator variables, and significant correlation was observed among several of the continuous variables we assessed, including percentage of male patients and mean age as well as percentage of male patients and attrition rate. The possibility of aggregation bias (also known as Simpson's paradox), which can occur when covariates are inferred from study means rather than individual-level data, is also a limitation of our meta-regression analysis. An assessment of study quality by the MINORS tool found that only 8 studies were viable in scoring adequately in the category of attrition (being $<5\%$); 12 failed to report attrition.

CONCLUSION

A call for standardization is necessary for reporting outcomes of anterior instability after arthroscopic Bankart repair, with careful consideration of reporting recurrence/failure rates from effects that may occur from patient demographics and aspects of the study design, including attrition rate and duration of follow-up. With no current recommendations for deeming failure, we suggest that all forms of instability be accounted for when determining a failed treatment procedure, with future studies placing an emphasis on greater control of the study design.

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APPENDIX

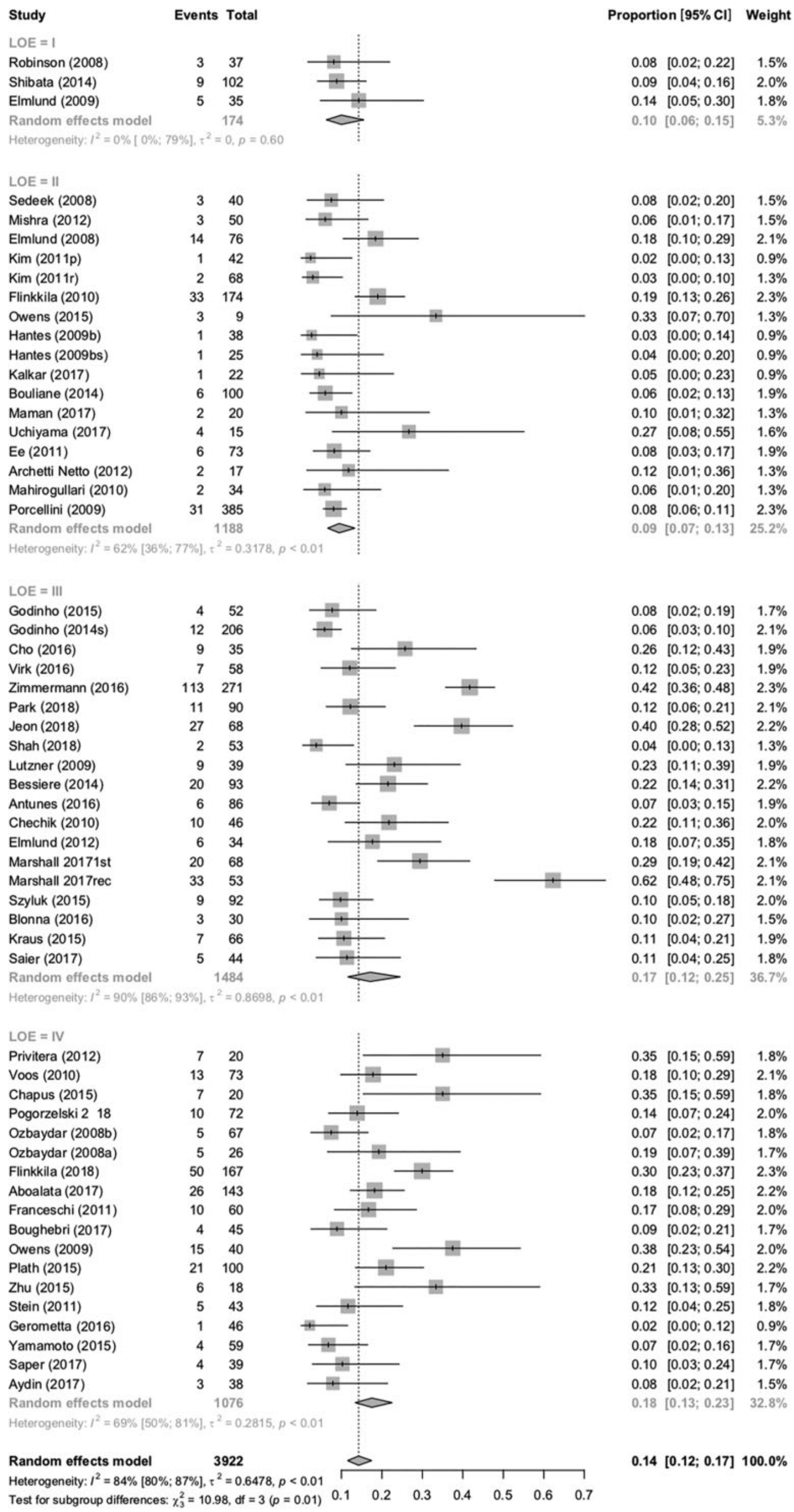

Figure A1. Forest plot of the subgroup meta-analysis comparing the recurrent instability rate among levels of evidence.

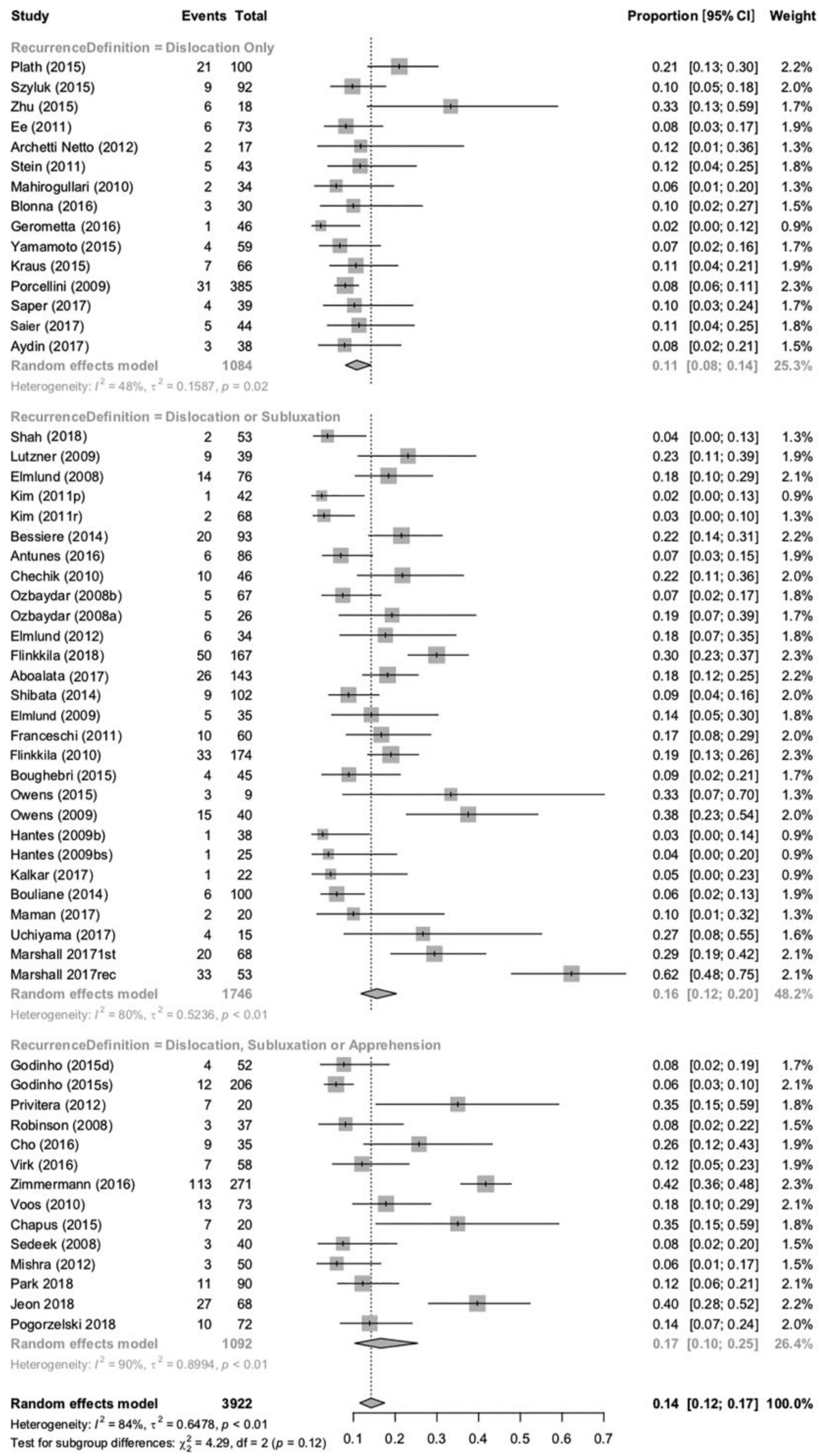

Figure A2. Forest plot of the subgroup meta-analysis comparing the recurrent instability rate among recurrence definitions.