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Sex-specific differences in outcomes after anterior shoulder surgical stabilization: a meta-analysis and systematic review of literature

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Background: Anterior shoulder instability frequently occurs in young, physically active individuals and may be treated with surgical stabilization. Previous studies have shown that males more often require surgical management for anterior shoulder instability and may have a higher frequency of recurrent instability episodes after surgical management, but females have been found to have increased incidence of apprehension after surgical stabilization. The purpose of this study is to review the literature and assess anterior shoulder surgical stabilization postoperative outcomes between males and females to identify and describe sex-based differences.

Methods: A systematic search of electronic databases was conducted to identify level I-IV clinical studies on anterior shoulder instability published between 1960 and August 2020. We included studies that evaluated sex-specific outcomes in patients who underwent anterior shoulder instability procedures. A meta-analysis of the data was performed to analyze sex-specific outcomes.

Results: Thirty studies (2.1%) met inclusion criteria, representing 9829 patients. Of the studies that reported the number of male and female patients, 74% were male and 26% were female. Twenty-six studies used Bankart repair alone, two used open Latarjet procedure alone, and two had a Bankart repair group and Latarjet procedure group. Instability recurrence, return to sport, and apprehension were included in the meta-analysis. Our meta-analysis demonstrated a significantly higher rate of instability recurrence for males than for females who underwent arthroscopic Bankart repair (risk ratio [RR] = 1.25; 95% confidence interval [CI] = 1.03, 1.52; $P = .0239$). We did not identify a significant difference between males and females in rates of apprehension (RR = 0.68; 95% CI = 0.37, 1.27; $P = .2300$) or return to sport (RR = 0.98; 95% CI = 0.81, 1.18; $I^2 = 0\%$; $P = .8110$) for arthroscopic Bankart repair or open Latarjet procedure.

Conclusion: For patients who underwent arthroscopic Bankart repair for anterior shoulder stabilization, recurrent rates of instability were significantly higher for males than for females. When open Bankart and Latarjet procedures were included, there was no difference. No difference was seen between males and females after arthroscopic Bankart repair or open Latarjet procedures with regard to return to sport or apprehension.

Shoulder instability is a common problem in young, physically active individuals. Instability can be related to the shoulder's wide range of motion (ROM), requiring muscle strength and coordination for stability.[3] More than 95% of shoulder dislocations occur anteriorly, and recurrent anterior instability after the first dislocation has been estimated in up to 92% of cases with 7 years of follow-up.[6,15] Recurrent shoulder instability after conservative management can be treated surgically, most often with arthroscopic or open Bankart repair. However, in cases with significant glenoid bone loss, procedures such as the modified Bristow-Latarjet coracoid transfer, or bone block autograft or allograft augmentation, can be used.[6] When it comes to sex-specific outcomes after these shoulder stabilization procedures, previous studies have shown that males more often undergo surgical management than females.[5,10] However, male sex may also be a contributing factor for recurrence of instability after surgical management.[2] In contrast, Kaipel et al evaluated sex-related differences after arthroscopic shoulder stabilization and found females to have a lower Constant-Murley score and increased incidence of a positive apprehension test.[20]

Institutional review board approval was not required for this systematic review.

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The underlying impact of sex on outcomes of anterior shoulder instability has been postulated to be due to differences between males and females in muscle forces on the shoulder, which are critical for maintaining proper articulation.[20] The differences are believed to be the result of females having lower muscle mass than males, and therefore lacking balanced muscle forces required to maintain stability of the shoulder. Another possible cause for differences in outcomes between males and females could be the increased prevalence of hyperlaxity in females. However, other studies have shown that external factors, such as contact sports, may predispose males to instability as they may put themselves in positions that increase their risk of sustaining a shoulder dislocation compared with females.

Owing to this reported discrepancy in incidence and outcomes of shoulder instability between males and females, the purpose of this study was to review the current literature and to analyze sex-based differences in outcomes after anterior shoulder surgical stabilization.

Materials and methods

Search strategy and study selection

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used to complete this systematic review and meta-analysis, and approval from the institutional review board was not required.[27] An electronic database search was conducted using PubMed, Embase, PubMed Central, Ovid, and Cochrane Library. Search terms included "shoulder instability", "Bankart repair", "labral repair", "Remplissage technique", "Remplissage procedure", "Latarjet technique", "Latarjet procedure", "Bristow technique", "Bristow procedure", "Bristow-Latarjet technique", "Bristow-Latarjet procedure", "Capsular shift", "distal tibia allograft", "distal clavicle autograft", "iliac crest allograft", "iliac crest autograft", "male", "female", "gender", and "sex". Further references were obtained from identified review articles. Clinical studies with a level of evidence I-IV and a publication date between 1960 and August 21, 2020, were considered for inclusion.

Eligibility criteria

Studies that evaluated patients who underwent anterior shoulder instability operative repair, assessed sex-specific outcomes, and had a mean follow-up of at least one year were included. Only human clinical studies reported in the English language were considered for review. Case reports, review articles, and studies including concomitant biceps tenotomy or tenodesis or rotator cuff repair were excluded. Animal, cadaver, and laboratory-based studies were also excluded.

Data extraction and quality appraisal

Data related to sex-specific differences in outcomes were extracted from each study. The following data points were extracted from at least one study: failure/instability recurrence rate (which included rates of redislocation, subluxation, and/or requiring revision surgery, depending on the study), return-to-sport (RTS) rate, apprehension, sulcus sign, ROM, strength, maximum voluntary contraction, and validated outcome scores. In addition to evaluating instability recurrence and RTS rates, we also reviewed the definitions for instability recurrence and RTS and compared them across studies.

Validated outcome scores included in this study were the Rowe score; Western Instruments score; Disabilities of the Arm, Shoulder, and Hand (DASH) score; Subjective Shoulder Value (SSV); Subjective Assessment of Shoulder Function (SASF); American Shoulder and Elbow Surgeons (ASES) evaluation form; and Constant-Murley score. The Rowe score is a rating system based on stability, motion, and function and is scored out of 100 points.[21] The Western Ontario Shoulder Instability Index (WOSI) evaluates symptoms and different domains of function—sports, recreation, work, lifestyle, and emotional well-being. The WOSI score can be presented in a raw form—0 to 2,100, with 2100 being the worst score—or converted to a percentage—0 to 100%, with 100% being the best possible score.[21] The DASH assessment is a 30-item questionnaire that evaluates symptoms and functional status.[21] The SSV is a subjective patient assessment scored as a percentage out of 100%.[16] The SASF score is determined by asking the patient "How does your shoulder function in daily living and different physical activities?" and is also rated out of 100%.[19] The ASES consists of a physician assessment (unscored) and patient evaluation and is scored out of 100 possible points.[21] The Constant-Murley assessment includes 65 points for physical examination and 35 points for subjective patient evaluation.[21] The quality of each study was assessed using the Tools to Assess Risk of Bias in Cohort Studies, Case Control Studies, and Randomized Controlled Trials by the CLARITY Group at the McMaster University.[4] This tool is used as a guide to assess studies for bias due to the selection of cohorts, assessment of prognostic and outcome variables, and length of follow-up.

Statistical analysis

The random-effects model was used to determine pooled estimates of sex-based differences for failure/instability rates and RTS rates. Meta-analysis of the previously mentioned validated outcomes scores was not performed because of heterogeneity of reported study outcomes. An odds ratio and 95% confidence interval (CI) were calculated for each outcome evaluated. Heterogeneity was examined using the I^2 statistic.[17] $P < .05$ was considered significant. R (version 4.0.2) was used for all statistical analyses.

Results

A total of 1412 studies were identified in the initial database search, of which 30 (2.1%) met inclusion criteria (Fig. 1). The characteristics of these studies are included in Table I. Of the 30 studies, 24 studies analyzed arthroscopic Bankart repair alone,[1,2,6–8,11,14,15,20,22–25,28,30–32,36–42] two studies compared arthroscopic Bankart and open Bankart repair,[3,12] one study compared arthroscopic Bankart and open Latarjet procedure,[43] one study compared open Bankart repair and open Latarjet,[19] and two studies analyzed only the open Latarjet procedure.[9,33]

Patient demographics

The 30 studies represent 9829 patients; 74% male and 26% female among the studies that reported number of male and female patients. One study did not stratify the total number of patients according to sex but stratified the recurrence rate by sex.[22] The mean age was not provided for every study but ranged from 15.7 ± 1 years to 37 ± 1 years among the 23 studies (8,777 patients) that reported mean age.[1,2,6–8,11,20,23,24,30–32,37–41]

Quality bias assessment

A quality bias analysis was completed using the Tools to Assess Risk of Bias in Cohort Studies, Case Control Studies, and Randomized Controlled Trials by the CLARITY Group at the McMaster University, and the results of these analyses are displayed in Table II. Of

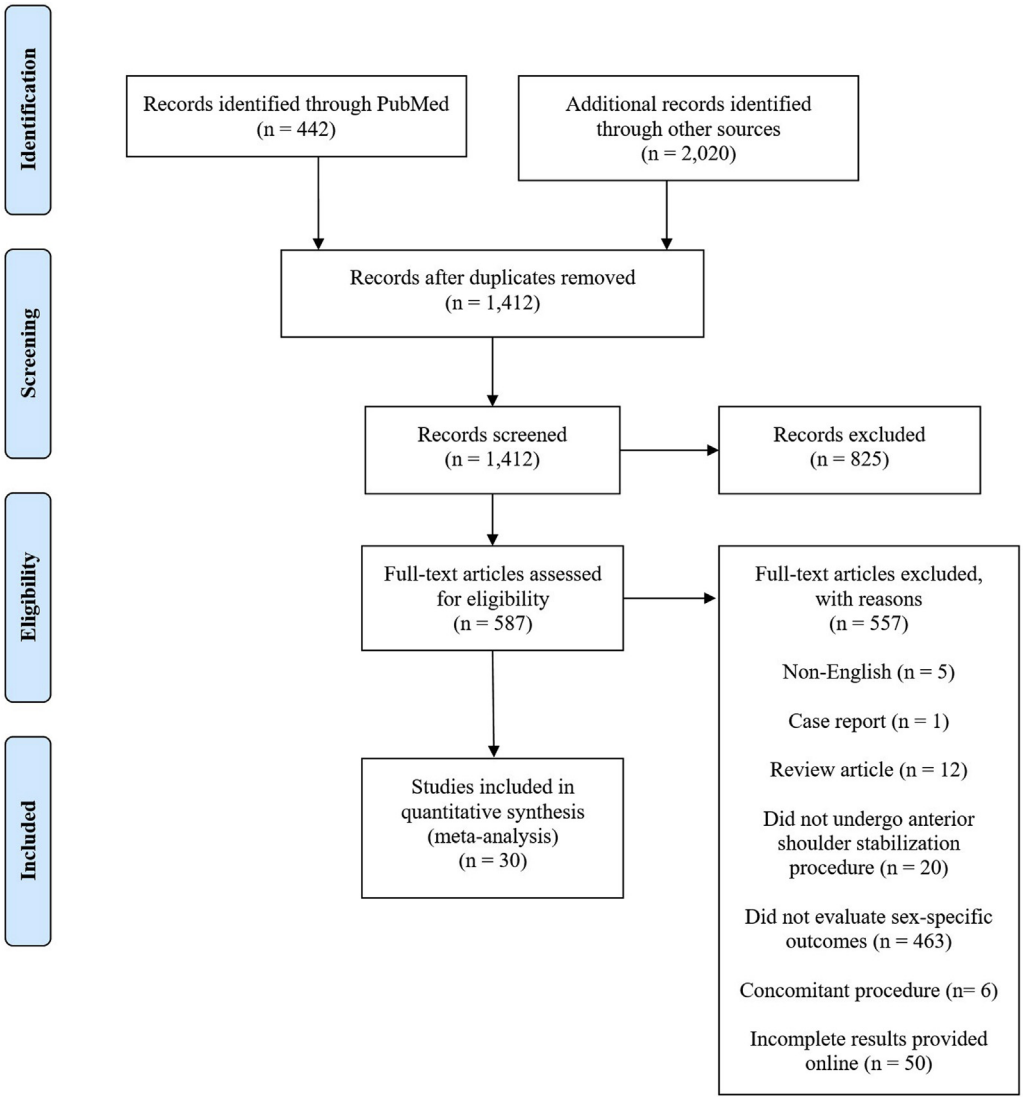

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.

the studies included in this review, the levels of evidence were two level I studies, one level II study, nine level III studies, and eighteen level IV studies. Given that many of these studies were case series, there was a high level of bias associated with matching exposed and unexposed participants, as is indicated in Table II. However, the remainder of the bias analysis table indicates low levels of bias for the other categories of bias.

Functional outcomes

Instability recurrence, RTS, and apprehension were included in the meta-analysis. The definition of instability recurrence for each study is provided in Table III. Three studies defined instability recurrence as redislocation,[1,8,15] 11 studies defined it as redislocation or subluxation,[2,6,11,12,30,31,36–40] two studies defined it as needing revision surgery for instability,[7,24] five studies defined it as "recurrent instability" (with no additional clarification),[23,25,28,32,42] one study defined it as redislocation or revision surgery,[43] and one study defined it as revisions, recurrences, and/or subluxations.[18]

Twenty-three studies were included in the instability recurrence analysis for all procedural categories (arthroscopic Bankart repair, open Bankart repair, and open Latarjet procedures), representing 6858 males and 2423 females (Fig. 2)[1,2,6–8,11,12,15,18,23–25,28,29,31,32,35,37–40,42,43] No significant difference was found in instability recurrence rate between males and females (risk ratio [RR] = 1.16; 95% CI = 0.85, 1.58; $P = .3490$). There was a significantly high level of heterogeneity among the studies ($I^2 = 71\%$).

A subgroup analysis of studies using only arthroscopic Bankart repair was performed and included 21 studies representing 6858 males and 2423 females (Fig. 3).[1,2,6–8,11,15,23–25,28,29,31,32,35,37–40,42,43] Males had a significantly higher rate of recurrence than females (RR = 1.25; 95% CI = 1.03, 1.52; $P = .0239$). Heterogeneity between studies was low and not significant ($I^2 = 18\%$).

We were unable to perform a separate analysis of instability recurrence for open Bankart repair and open Latarjet procedural groups due to insufficient data. Two studies[12,18] using open Bankart repair and one study[18] using open Latarjet procedure reported instability recurrence rates, but did not report separate instability recurrence rates for males and females. The overall recurrence rate (for males and females combined) was reported by each study; 8% and 30% in the two open Bankart repair studies[12,18] and 11% in the open Latarjet procedure study.[18]

Table I
Study characteristics.

First author	Year published	Study design	Level of evidence	Sex		Age*, y	Procedure	Length of follow-up*, mo
				Male	Female			
Aboalata[1]	2017	Case series	IV	107	107	24.8	Arthroscopic Bankart repair	—
Ahmed[2]	2012	Prospective cohort	Prognostic I	265	37	26.5	Arthroscopic Bankart repair	68.5
Chan[6]	2019	Retrospective case-control	IV	119	12	26.8	Arthroscopic Bankart repair	24
Cordasco[7]	2020	Case series	IV	48	19	17.5	Arthroscopic Bankart repair	42.72
de Almeida Filho[8]	2012	Case series	IV	42	7	30	Arthroscopic Bankart repair	42.7
Flinkkilä[11]	2010	Case series	IV	132	50	28	Arthroscopic Bankart repair	51
Gartsman[14]	2000	Case series	IV	44	9	32	Arthroscopic Bankart repair	33
Gigis[15]	2014	Prospective cohort study	II	24	14	—	Arthroscopic Bankart repair	204
Kaipel[20]	2010	Case series	IV	24	12	30.8	Arthroscopic Bankart repair	58.65
Locher[22]	2016	Case series	IV	—	—	—	Arthroscopic Bankart repair	22.4
Loppini[23]	2019	Retrospective case-control	III	572	98	27	Arthroscopic Bankart repair	100.8
Mahure[24]	2018	Case series	IV	4013	1706	24.9	Arthroscopic Bankart repair	—
Martel[25]	2016	Case series	IV	43	4	—	Arthroscopic Bankart repair	33
Nakagawa[28]	2017	Retrospective cohort	III	214	43	—	Arthroscopic Bankart repair	55
Nakagawa[29]	2017	Retrospective case-control	III	110	13	18.3	Arthroscopic Bankart repair	—
Ozturk[31]	2013	Case series	IV	42	11	19.5	Arthroscopic Bankart repair	27
Panzram[32]	2020	Case series	IV	76	24	37	Arthroscopic Bankart repair	99.6
Robinson[36]	2008	Randomized controlled trial	Therapeutic I	82	6	—	Arthroscopic Bankart repair	—
Sommaire[37]	2012	Retrospective cohort	III	54	23	27.48	Arthroscopic Bankart repair	44.4
Szyluk[38]	2015	Case series	IV	74	18	25.6	Arthroscopic Bankart repair	98.4
Thal[39]	2007	Case series	IV	57	15	26.7	Arthroscopic Bankart repair	—
Vermeulen[40]	2019	Case series	IV	112	35	30	Arthroscopic Bankart repair	75.6
Yamamoto[41]	2019	Retrospective cohort	III	30	13	26	Arthroscopic Bankart repair	32
Yian[42]	2020	Retrospective cohort	III	281	56	—	Arthroscopic Bankart repair	74.4
Augustsson[3]	2012	Prospective cohort	III	24	7	—	Arthroscopic Bankart repair Open Bankart repair	84
Flint[12]	2018	Case series	IV	56	3	19	Arthoscopic Bankart repair Open Bankart repair	—
Zimmerman[43]	2016	Retrospective cohort	Therapeutic III	184	87	28.2	Arthroscopic Bankart repair	—
				82	11	30.8	Open Latarjet procedure	
Hovelius[19]	2011	Retrospective case-control	III	68	20	21.8	Open Bankart repair	—
				82	15	22.7	Open Latarjet procedure	
Domos[9]	2020	Case series	IV	26	19	15.7	Open Latarjet procedure	79.2
Privitera[33]	2018	Case series	IV	64	9	25.8	Open Latarjet procedure	52

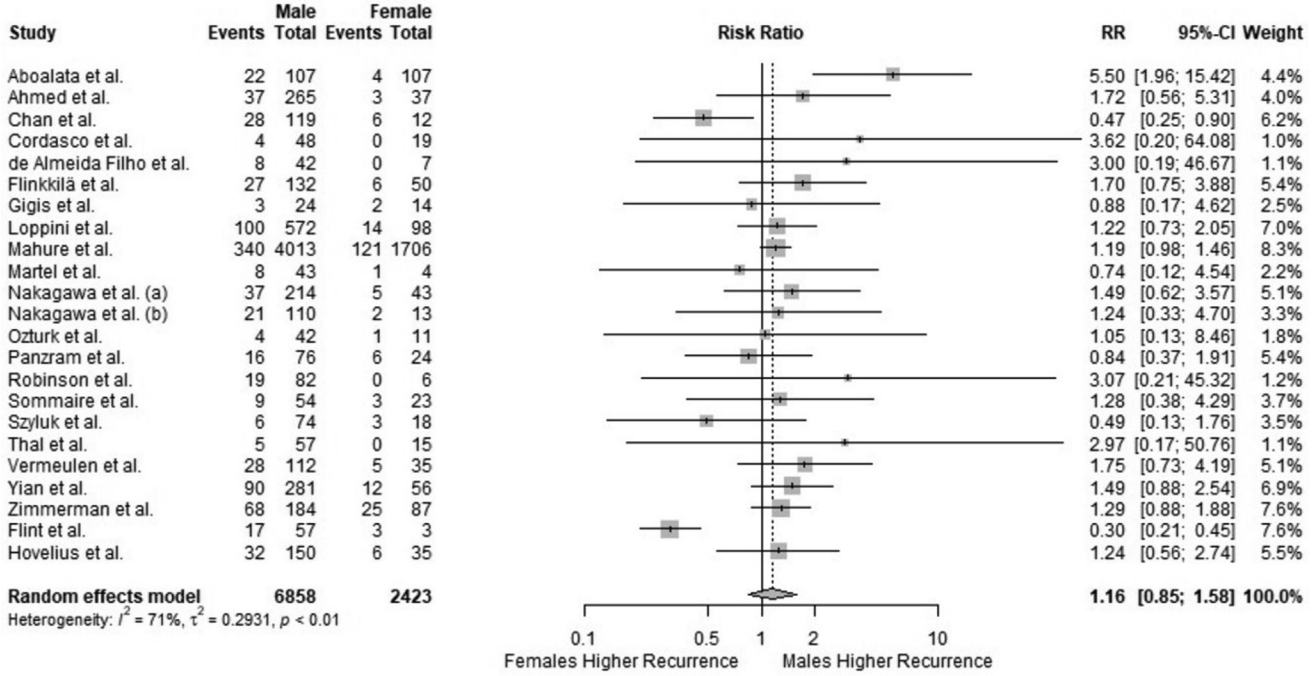

Figure 2 Instability recurrence for males and females for arthroscopic Bankart repair, open Bankart repair, and open Latarjet procedure.

Table II
Tools to assess risk of bias cohort studies.

Study	Year	1. Was selection of exposed and nonexposed cohorts drawn from the same population?	2. Can we be confident in the assessment of exposure?	3. Can we be confident that the outcome of interest was not present at the start of study?	4. Did the study match exposed and unexposed for all variables that are associated with the outcome of interest or did the statistical analysis adjust for these prognostic variables?	5. Can we be confident in the assessment of the presence or absence of prognostic factors?	6. Can we be confident in the assessment of outcome?	7. Was the follow-up of cohorts adequate?	8. Were co-interventions similar between groups?
Aboalata et al[1]	2016	N/A	Definitely yes	Definitely yes	Definitely no	Probably yes	Probably yes	Definitely yes	Probably yes
Ahmed et al[2]	2012	N/A	Definitely yes	Definitely yes	Definitely no	Definitely yes	Probably yes	Definitely yes	Probably yes
Augustsson et al[3]	2012	N/A	Definitely yes	Definitely yes	Definitely no	Probably yes	Probably yes	Definitely yes	Probably no
Cordasco et al[7]	2020	N/A	Definitely yes	Definitely yes	Definitely no	Probably yes	Probably yes	Probably yes	Probably yes
de Almeida Filho et al[8]	2012	N/A	Definitely yes	Definitely yes	Definitely no	Probably yes	Probably yes	Probably yes	Probably yes
Domos et al[9]	2020	N/A	Definitely yes	Definitely yes	Definitely no	Definitely yes	Definitely yes	Probably yes	Definitely yes
Flinkkilä et al[11]	2010	N/A	Definitely yes	Definitely yes	Definitely no	Definitely yes	Probably no	Probably yes	Probably no
Flint et al[12]	2018	N/A	Definitely yes	Definitely yes	Definitely no	Definitely yes	Definitely yes	Probably yes	Definitely no
Gartsman et al[14]	2000	N/A	Definitely yes	Definitely yes	Definitely no	Definitely yes	Probably yes	Probably yes	Definitely no
Gigis et al[15]	2014	Probably yes	Definitely yes	Definitely yes	Probably no	Definitely yes	Probably yes	Probably yes	Probably yes
Kaipel et al[20]	2010	N/A	Definitely yes	Definitely yes	Definitely no	Probably no	Probably yes	Probably yes	Definitely yes
Locher et al[22]	2016	N/A	Definitely yes	Definitely yes	Definitely no	Definitely yes	Definitely yes	Probably no	Probably no
Mahure et al[24]	2018	N/A	Definitely yes	Definitely yes	Definitely no	Definitely yes	Probably yes	Probably yes	Definitely yes
Martel et al[25]	2016	N/A	Definitely yes	Definitely yes	Definitely no	Definitely yes	Probably yes	Probably no	Probably no
Nakagawa et al[28]	2017	Probably yes	Definitely yes	Definitely yes	Probably yes	Probably yes	Probably no	Probably yes	Probably no
Ozturk et al[31]	2013	N/A	Definitely yes	Definitely yes	Definitely no	Definitely yes	Definitely yes	Probably yes	Probably no
Panzram et al[32]	2020	N/A	Definitely yes	Definitely yes	Definitely no	Probably yes	Probably yes	Definitely yes	Probably yes
Privitera et al[33]	2018	N/A	Definitely yes	Definitely yes	Definitely no	Probably yes	Probably no	Probably yes	Probably yes
Sommaire et al[37]	2012	N/A	Definitely yes	Definitely yes	Definitely no	Probably no	Probably yes	Probably yes	Definitely yes
Szyluk et al[38]	2015	N/A	Definitely yes	Definitely yes	Definitely no	Definitely yes	Definitely yes	Definitely yes	Definitely yes
Open Bankart & Open Latarjet		N/A	Definitely yes	Definitely yes	Definitely no	Probably yes	Definitely yes	Probably yes	Defininitely yes
Vermeulen et al[40]	2019	N/A	Definitely yes	Definitely yes	Definitely no	Definitely yes	Probably yes	Definitely yes	Probably yes
Yamamoto et al[41]	2019	Open Latarjet procedure	Definitely yes	Definitely yes	Definitely no	Probably yes	Definitely yes	Probably yes	Probably yes
Yian et al[42]	2020	N/A	Definitely yes	Definitely yes	Definitely no	Definitely yes	Probably yes	Definitely yes	Probably yes
Zimmerman et al[43]	2016	N/A	Definitely yes	Definitely yes	Definitely no	Probably no	Probably yes	Definitely yes	Probably yes

Case-control studies

Study	Year	1. Can we be confident in the assessment of exposure?	2. Can we be confident that cases had developed the outcome of interest and controls had not?	3. Were the cases (those who were exposed and developed the outcome of interest) properly selected?	4. Were the controls (those who were exposed and did not develop the outcome of interest) properly selected?	5. Were cases and controls matched according to important prognostic variables or was statistical adjustment carried out for those variables?
Chan et al.[6]	2019	Definitely yes	Definitely yes	Definitely yes	Definitely yes	Definitely no
Hovelius et al.[19]	2011	Definitely yes	Probably yes	Probably yes	Probably yes	Definitely no
Loppini et al.[23]	2019	Definitely yes	Definitely yes	Definitely yes	Definitely yes	Definitely no
Nakagawa et al.[29]	2017	Definitely yes	Definitely yes	Definitely yes	Definitely yes	Definitely no

Randomized controlled trials

Study	Year	1. Was the allocation sequence adequately generated?	2. Was the allocation adequately concealed?	3. Blinding: Was knowledge of the allocated interventions adequately prevented?	4. Was loss to follow-up (missing outcome data) infrequent?	5. Are reports of the study free of selective outcome reporting?	6. Was the study apparently free of other problems that could put it at risk of bias?
Robinson et al.[36]	2008	Definitely yes	Definitely yes	Definitely yes	Definitely yes	Definitely yes	Probably yes

Three studies were included for the RTS analysis, representing 130 males and 34 females (Table IV, Fig. 4). Gigis et al did not state how RTS was determined for their study.[15] Privitera et al defined RTS as returning to original sport at preinjury level or decreased level of competition.[33] Ozturk et al reported RTS as return to preinjury level of sports activity or return to less competitive activities.[31] The number of individuals who participated in contact and noncontact or limited-contact sports is also listed in Table IV. The classification of contact and noncontact or limited-contact sports comes from The American Academy of Pediatrics.[34] No significant difference in RTS rate was found between males and females (RR = 0.98; 95% CI = 0.81, 1.18; $I^2 = 0\%$; $P = .8110$).

Postoperative rates of apprehension for males and females were reported in three studies and represented 74 males and 45 females

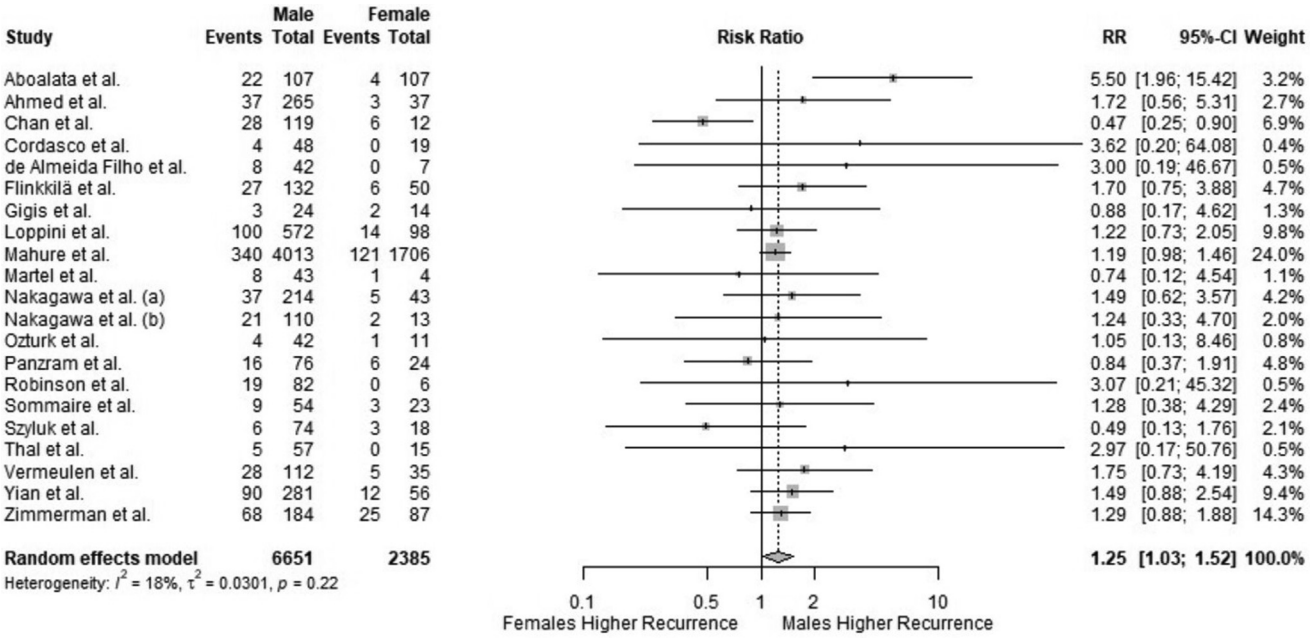

Figure 3 Instability recurrence analysis for males and females for arthroscopic Bankart repair.

(Fig. 5).[9,15,20] Analysis of reported apprehension revealed no significant difference in the rate of apprehension between males and females (RR = 0.68; 95% CI = 0.37, 1.27; P = .2300). Significant heterogeneity was found between the studies (I^2 = 79%).

Outcome scores and physical examination findings were not included in the statistical meta-analysis because of significant heterogeneity in the results reported in each study, but outcomes scores are included in Table V. Table V contains male and female outcome scores for the shoulder functional assessment tools: Rowe, WOSI, DASH, SSV, SASF, ASES, and Constant-Murley. Only one study reported sex-stratified physical examination findings (maximum voluntary contraction, strength, and ROM), and as such, we have not included the data in this analysis.[3]

Discussion

In this systematic review and meta-analysis of anterior shoulder surgical stabilization postoperative outcomes between males and females, we analyzed instability recurrence, RTS, and apprehension. We found males to have a higher rate of instability recurrence than females after arthroscopic Bankart repair, which is consistent with what was previously reported in the literature.[2] Arthroscopic Bankart repair was the only procedural category that could be analyzed individually for instability recurrence in the meta-analysis because of the limited availability of studies and sex-specific data for open Bankart repair and open Latarjet procedure. An analysis of instability recurrence for all procedural categories grouped together was able to be performed, and there was no significant difference between males and females when including the open Bankart repair and open Latarjet procedure. We did not find a significant difference between males and females in terms of apprehension or RTS rates for arthroscopic Bankart repair and open Latarjet procedure studies. One possible explanation for the lack of significant difference when all procedural categories were grouped together is the inclusion of the open Latarjet procedure, which has been found to have better outcomes for contact athletes.[26] Although none of the studies of contact vs. noncontact athletes reported the percentage of males and females within each category (contact vs. noncontact), if more males were included in the contact sports category, it would follow that they would have better outcomes when undergoing the open Latarjet procedure.

Instability recurrence was defined differently across the 23 studies that reported this outcome, making interstudy analysis less reliable and generalizable. Three studies defined instability recurrence as redislocation,[1,8,15] 11 studies defined it as redislocation or subluxation,[2,6,11,12,30,31,36–40] two studies defined it as needing revision surgery for instability,[7,24] five studies defined it as "recurrent instability",[23,25,28,32,42] one study defined it as redislocation or revision surgery,[43] and one study defined it as revisions, recurrences, and/or subluxations.[18] These varying definitions of recurrent instability create a wide umbrella under which we include various types of failure after surgery and make it difficult to determine the true success and failure rates of procedures. These definitions of recurrence also do not address failure of the procedure in terms beyond instability—such as return to activity—which raises questions about the value of the definition of recurrence or failure. In order to better assess failure/instability recurrence in future studies, a standard definition for failure/instability recurrence should be established and used when assessing patients during the follow-up period. It would also add to the strength of these studies to subcategorize surgical procedures based on intraoperative variations to ensure equivalent procedures are being compared.

The RTS and apprehension analyses only included three studies, representing a small sample of patients. The limited number of studies and participants increases the risk for bias. In addition, the definition of RTS was only reported in two of these studies, and the definition varied between the two.[31,33] Privitera et al[33] considered RTS as patients returning to their original sport, while Ozturk et al[31] considered RTS as returning to any sports activity. These studies also did not clearly differentiate levels of activity (contact vs. noncontact) for males and females, making it difficult to compare males and females in terms of RTS. An additional consideration with the apprehension analysis is the lack of explicit definition for apprehension as well as the variability in apprehension determination based on the examiner. All these factors combined elucidate

Table III
Instability recurrence rate and definition of instability recurrence for arthroscopic Bankart repair, open Bankart repair, and open Latarjet procedure.

	Author	Procedure	Instability recurrence rate, n (%)		Definition of failure/instability recurrence
			Male	Female	
Arthroscopic Bankart	Aboalata et al[1]	Arthroscopic Bankart repair	22/107 (21)	4/107 (11)	Redislocation
	Ahmed et al[2]	Arthroscopic Bankart repair	37/265 (14)	3/37 (8)	Redislocation or subluxation
	Chan et al[6]	Arthroscopic Bankart repair	28/119 (24)	6/12 (50)	Redislocation or subluxation
	Cordasco et al[7]	Arthroscopic Bankart repair	4/48 (8)	0/19 (0)	Revision surgery for instability
	de Almeida Filho et al[8]	Arthroscopic Bankart repair	8/42 (19)	0/7 (0)	Redislocation
	Flinkkilä et al[11]	Arthroscopic Bankart repair	27/132 (20)	6/50 (12)	Redislocation or subluxation
	Gigis et al[15]	Arthroscopic Bankart repair	3/24 (13)	2/14 (14)	Redislocation
	Loppini et al[23]	Arthroscopic Bankart repair	100/572 (17)	14/98 (14)	Recurrent instability
	Mahure et al[24]	Arthroscopic Bankart repair	340/4013 (9)	121/1706 (7)	Revision surgery for instability
	Martel et al[25]	Arthroscopic Bankart repair	8/43 (19)	1/4 (25)	Recurrent instability
	Nakagawa et al[29]	Arthroscopic Bankart repair	37/214 (17)	5/43 (12)	Recurrent instability
	Nakagawa et al[30]	Arthroscopic Bankart repair	21/110 (19)	2/13 (15)	Redislocation or subluxation
	Ozturk et al[31]	Arthroscopic Bankart repair	4/42 (10)	1/11 (9)	Redislocation or subluxation
	Panzram et al[32]	Arthroscopic Bankart repair	16/76 (21)	6/24 (25)	Recurrent instability
	Robinson et al[36]	Arthroscopic Bankart repair	19/82 (23)	0/6 (0)	Redislocation or subluxation
	Sommaire et al[37]	Arthroscopic Bankart repair	9/54 (17)	3/23 (13)	Redislocation or subluxation
	Szyluk et al[38]	Arthroscopic Bankart repair	6/74 (8)	3/18 (17)	Redislocation or subluxation
	Thal et al[39]	Arthroscopic Bankart repair	5/57 (9)	0/15 (0)	Redislocation or subluxation
	Vermeulen et al[40]	Arthroscopic Bankart repair	28/112 (25)	5/35 (14)	Redislocation or subluxation
	Yian et al[42]	Arthroscopic Bankart repair	90/281 (32)	12/56 (21)	Recurrent instability
	Zimmerman et al[43]	Arthroscopic Bankart repair	68/184 (37)	25/87 (29)	Redislocation or revision surgery
Arthroscopic and open Bankart	Flint et al[12]	Arthoscopic Bankart repair Open Bankart repair	17/57 (30)	3/3 (100)	Redislocation or subluxation
Open Bankart and open Latarjet	Hovelius et al[18]	Open Bankart repair Open Latarjet procedure	32/150 (21)	6/35 (17)	Revisions, recurrences, and/or subluxations

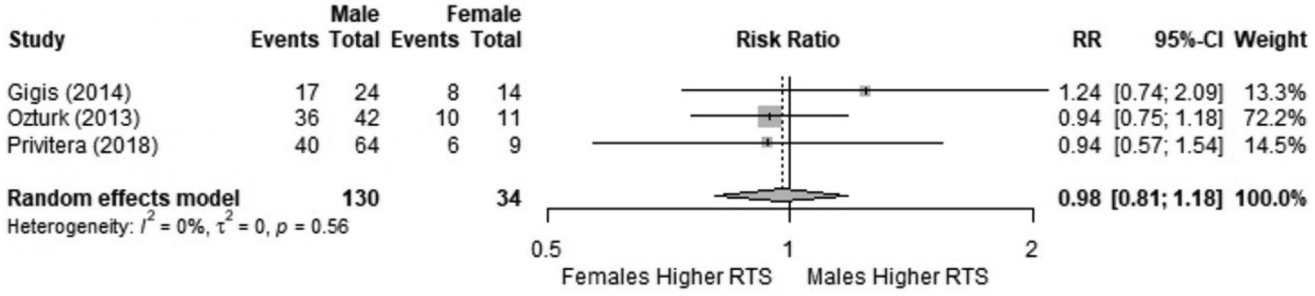

Figure 4 Return-to-sport (RTS) analysis for males and females.

Table IV
Return to sport according to sex, contact level, participation level, and definition of RTS.

Author	Procedure	Athlete type, n (%)		Participation level	Definition of RTS	RTS, n (%)	
		Contact	Non-contact/Limited contact			Male	Female
Gigis et al[15]	Arthroscopic Bankart repair	9 (33)	18 (67)	Competitive level	–	17/24 (71)	8/14 (57)
Ozturk et al[31]	Arthroscopic Bankart repair	22 (42)	31 (58)	- Professional: 6 - Collegiate: 15 - High school: 10 - Recreational: 22	Return to preinjury level of sports activity or return to less competitive activities	36/42 (86)	10/11 (89)
Privitera et al[33]	Open Latarjet procedure	64 (88)	9 (12)	- Professional or semiprofessional level: 3 (4) - Collegiate varsity level: 20 (27) - High school varsity or junior varsity level: 19 (26) - Recreational level: 29 (40)	Return to original sport at preinjury level or decreased level of competition	40/64 (63)	6/9 (67)

RTS, return to sport.

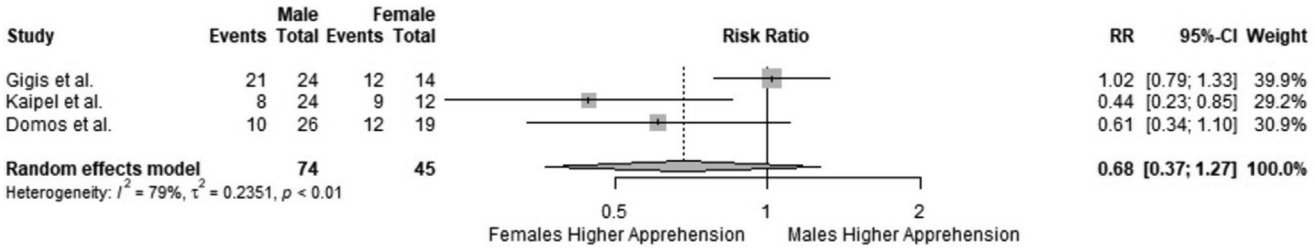

Figure 5 Apprehension analysis for males and females.

Table V
Postoperative functional assessment scores.

First author	Procedure	Rowe		WOSI (%)		WOSI (Raw)		ASES		Constant-Murley	
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Gartsman et al[14]	Arthroscopic Bankart repair	92	91	—	—	—	—	—	—	—	—
Kaipel et al[20]	Arthroscopic Bankart repair	—	—	—	—	—	—	—	—	88 ± 2	79 ± 6
Thal et al[39]	Arthroscopic Bankart repair	92.8	95.7	—	—	—	—	96	96	—	—
Yamamoto et al[41]	Arthroscopic Bankart repair	—	—	70.9 ± 18.5	81 ± 20.4	—	—	—	—	—	—
Augustsson et al[3]	Arthroscopic Bankart repair	—	—	—	—	231 ± 403.5	191 ± 103.25	—	—	89 ± 18.5	80 ± 3.75
Augustsson et al[3]	Open Bankart repair										

All averages are means.
WOSI, Western Ontario Shoulder Instability Index; *DASH*, Disabilities of the Arm, Shoulder, and Hand; *SSV*, Subjective Shoulder Value; *SASF*, Subjective Assessment of Shoulder Function; *ASES*, American Shoulder and Elbow Surgeons.

a need for more accurate and consistent reporting of RTS and apprehension for the sake of future studies.

This review contributes to the literature in several ways. Our analysis suggests that males have higher rates of recurrent instability after arthroscopic Bankart repair, but it is unknown whether open Bankart repair has better outcomes for males because there are currently not enough studies available for sex-specific analysis of this procedure. This calls attention to the need for more studies of open Bankart repair that take patient sex into consideration when assessing outcomes; however, open Bankart repair has recently been shown to have less favorable outcomes overall than arthroscopic Bankart repair and may fall out of favor as a result.[13] Our study also highlights the need for consistent definitions of failure/recurrence and RTS. The studies included in our analysis defined these two outcomes in a variety of ways, making it difficult to compare these outcomes across studies. Our proposed definition of failure is more nuanced than the current definition. Rather than defining failure as an overarching category, we propose classifying every patient during the follow-up period in terms of laxity and apprehension assessed on physical examination, along with patient report of the number of episodes of redislocation and subluxation (reported separately). If all studies reported each of these outcomes separately, we could analyze them across studies to better identify which procedures produce better outcomes. In addition, for studies with patients who participated in sports before surgery, we propose categorizing every athlete as participating in either a contact or noncontact sport before surgery and documenting if or when the patient RTS, and whether they returned to contact or noncontact sports. Using our proposed definitions for failure/recurrence and RTS would allow for more reliable and generalizable analyses of these outcomes after shoulder stabilization procedures. The greatest limitation to this study was the inclusion of mostly level IV studies (18 out of 30 studies), which increased the risk of inherent bias. In addition, females represented approximately 24% of the patients in the analysis, which incorporated bias and decreased the generalizability of the studies. This trend is present in many sports medicine–related studies but becomes more noticeable and problematic in sex-specific studies that would benefit from more equal ratios of males and females. Finally, this study was limited by the lack of sex-stratified outcomes within studies and resultant inability to compare these data between studies. Furthermore, outcomes within these studies were heterogeneous. Seven different functional assessment tools were used, and many studies did not use the same tools, resulting in data that could not be analyzed between studies.

Conclusion

For patients who underwent arthroscopic Bankart repair for anterior shoulder stabilization, recurrent rates of instability were significantly higher for males than for females. When open Bankart and Latarjet procedures were included, there was no difference. No difference was seen between males and females after arthroscopic Bankart repair or open Latarjet procedures with regard to RTS or apprehension.

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