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Arthroscopic Bankart repair with remplissage versus Latarjet procedure for management of engaging Hill-Sachs lesions with subcritical glenoid bone loss in traumatic anterior shoulder instability: a systematic review and meta-analysis

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Background: A large engaging Hill-Sachs lesion (HSL) with subcritical glenoid bone loss (GBL) is approached through either increasing the glenoid arc by the Latarjet procedure or converting the HSL to an extra-articular defect by arthroscopic Bankart repair with remplissage (BRR). Until now, there has been no evidence-based consensus about which of these 2 most appropriate procedures is the better surgical choice. The purpose of this study was to analyze the current literature comparing results of BRR vs. the Latarjet procedure in the treatment of engaging HSLs with subcritical GBL.

Methods: A comprehensive review of the PubMed and Cochrane databases was completed for studies that compared the clinical outcomes and complications of BRR vs. the Latarjet procedure with minimum follow-up of 2 years. The outcome measures analyzed included postoperative Rowe score, visual analog scale pain score, postoperative range of motion (ROM), and rates of recurrent instability and other complications.

Results: Overall, 4 articles (level III evidence in 3 and level II in 1) were included from an initial 804 abstracts. The study population consisted of a total of 379 patients, of whom 194 underwent BRR and 185 underwent the Latarjet procedure. There were no unacceptable differences in baseline characteristics between the 2 groups. For the rate of recurrent instability, both groups had comparable risk ratios (RRs) (N = 379; RR, 0.72; 95% confidence interval [CI], 0.37-1.41). The risk of other complications was significantly increased with the Latarjet procedure (by about 7 times) relative to the the BRR procedure (N = 379; RR, 7.37; 95% CI, 2-27). Both groups had comparable postoperative Rowe scores (n = 190; mean difference [MD], –0.9; 95% CI, –3.45 to 1.7) and visual analog scale pain scores (n = 347; MD, –0.2; 95% CI, –0.6 to 0.2). Moreover, both groups had comparable postoperative external rotation ROM (MD, –1.7°; 95% CI, –9.4° to 6°) and internal rotation ROM (MD, 1.95°; 95% CI, –5.35° to 9.25°). There was substantial heterogeneity in the effect of both procedures on postoperative pain and ROM (external rotation and internal rotation).

Conclusion: Both the BRR and Latarjet procedures are effective for the management of engaging HSLs with subcritical GBL and give comparable clinical outcomes. However, given the fewer overall postoperative complications, remplissage may be safer. The results of the included studies were adequately consistent for most analyzed outcomes. However, for the intervention effect on postoperative pain and ROM, there was a small body of evidence, limiting the strength of the reported conclusions.

Level of evidence: Level III; Meta-analysis; Systematic Review

Keywords: Shoulder instability; Hill-Sachs lesion; glenoid bone loss; remplissage; Latarjet

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

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Orthopedic surgeons have not forgotten the admonition of Hill and Sachs[18] that their eponymous compression fracture might predispose to failure of a soft-tissue capsulorrhaphy. Burkhart and De Beer[6] explained the concept of the engaging

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Hill-Sachs lesion (HSL). The orientation and size of this lesion predispose to its engagement at the corner of the glenoid in the functional position of abduction–external rotation. This articular arc deficit markedly increases the failure rate after arthroscopic Bankart repair.[6] Although HSLs are quite common and can be observed in 100% of shoulders with recurrent dislocation,[14] the prevalence of engaging HSLs has varied in the literature, ranging from 1.5% to 34%.[6,9,19,28] However, the implications of HSLs cannot be considered in isolation. Associated glenoid bone loss (GBL), even if minor, would accentuate this adverse effect of large engaging HSLs.[3]

Orthopedic surgeons have indicated several concepts in the management of large engaging HSLs. First, arthroscopic Bankart repair alone is not enough. Second, the management approach depends on the degree of GBL. If the GBL is critical (defined by consensus as $\geq$25% of the inferior glenoid diameter), the HSL is approached through increasing the glenoid arc by coracoid transfer via the Latarjet procedure.[12] If the GBL is subcritical, the HSL is approached through converting it to an extra-articular defect by the remplissage procedure with Bankart repair.[32]

However, the concept of what defines the critical amount of GBL has been challenged recently, with several studies showing inferior outcomes of arthroscopic Bankart repair with GBL as low as 13.5%.[36,37] This introduces evidence that even with the addition of remplissage, arthroscopic Bankart repair may not be sufficient for GBL as low as 10%, and a block procedure such as the Latarjet procedure may be a better option for this specific group of instability patients with engaging HSLs and <25% GBL. This debate has not been resolved yet, with no clear guidelines as to how to address patients with engaging HSLs with subcritical GBL.

Each of the 2 aforementioned procedures has its disadvantages. The remplissage procedure might result in loss of internal-external range of motion (ROM) and alteration of glenohumeral kinematics.[4,13,27] The Latarjet procedure results in significant anatomic distortion with unique multiple adverse effects, such as hardware-related complications, coracoid graft nonunion, and long-term osteoarthritis.[15]

Multiple systematic reviews have evaluated the outcomes of the remplissage procedure for the treatment of anterior instability with a substantial humeral head defect.[7,21,33] Moreover, several clinical studies have assessed the Latarjet procedure in this specific patient population.[30,40] However, to our knowledge, no systematic review and meta-analysis have directly compared the efficacy and outcomes of these 2 procedures in anterior instability patients with substantial engaging HSLs and subcritical GBL. The purpose of our review was to qualitatively and quantitatively assess the current literature to compare arthroscopic Bankart repair with remplissage (BRR) and the Latarjet procedure in terms of clinical outcomes including patient-reported outcomes (PROs) and complications including recurrence.

Materials and methods

Search methods

We performed a comprehensive literature search of the following databases from their inception dates to February 2019: PubMed and Cochrane Library (Cochrane Central Register of Controlled Trials [CENTRAL]). Searches in these databases were carried out in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) and Meta-analysis of Observational Studies in Epidemiology recommendations.[24] Before the literature search, the research protocol for this review was registered with the PROSPERO international prospective register of systematic reviews and published online under registration number CRD42019127977

The search strategy for PubMed used the following Medical Subject Headings (MeSH) terms and key phrases: (((shoulder instability) AND Hill Sachs))) OR ((shoulder instability) AND remplissage))) OR ((shoulder instability) AND Latarjet))) OR ((Hill Sachs) AND remplissage))) OR ((Hill Sachs) AND Latarjet))) OR ((remplissage) AND Latarjet)))). The search strategy for CENTRAL was as follows: [(shoulder instability):ti,ab,kw AND (Hill Sachs):ti,ab,kw] OR [(shoulder instability):ti,ab,kw AND (remplissage):ti,ab,kw] OR [(shoulder instability):ti,ab,kw AND (Latarjet):ti,ab,kw] OR [(Hill Sachs):ti,ab,kw AND (remplissage):ti,ab,kw] OR [(Hill Sachs):ti,ab,kw AND (Latarjet):ti,ab,kw] OR [(remplissage):ti,ab,kw AND (Latarjet):ti,ab,kw]. Three independent reviewers (H.K.H., A.A.A., and M.H.S.) conducted the search separately. We also searched the reference lists of the included studies for additional eligible articles.

Eligibility criteria

The eligibility criteria for studies were as follows: studies directly comparing BRR vs. the Latarjet procedure that reported the rate of instability recurrence and $\geq$1 PRO measure with a mean follow-up period $\geq$24 months. Level V evidence (expert opinion), abstracts, case reports, conference presentations, editorials, and nonclinical studies were excluded. Only articles in English were included.

The eligibility criteria for participants were as follows: patients with traumatic anterior shoulder instability and significant HSLs on preoperative imaging (computed tomography or magnetic resonance imaging) defined as either a size >20%-30% of humeral head size or a Hill-Sachs interval that is wider than the glenoid track and/or engagement during arthroscopy. Patients had no significant GBL, defined as involving <20% of the joint surface.

Data collection and analysis

Study selection

The selection of studies was performed by 2 independent investigators (H.K.H. and A.A.A.) separately. Any disagreement was resolved by an arbiter (most senior, third author [M.H.S.]). The 3 investigators separately reviewed the title and abstract of each publication and then performed a thorough reading of all potentially relevant articles to minimize selection bias and errors.

Data extraction and management

Data from included studies were independently extracted into spreadsheets by the 3 investigators, including study population characteristics; intervention characteristics; and outcomes of interest including ROM, PROs, and rates of recurrence and other complications. Further missing data were obtained after correspondence with the senior author of one study.[2]

Assessment of risk of bias

Because quality scoring is controversial in meta-analyses of observational studies, 2 reviewers (H.K.H. and A.A.A.) independently appraised each article. Any disagreement was resolved by the arbiter. The revised and validated version of the Methodological Index for Non-randomized Studies (MINORS) scoring system was used.[38] In brief, the MINORS scoring system provides a method to assess bias, with a higher score indicative of less bias. The optimum scores for noncomparative and comparative studies are 16 and 24, respectively. Scores were reported as the absolute value and as the percentage of the total possible score.

Statistical analysis

Continuous independent variable data were described, as applicable, as mean and standard deviation. For analysis of categorical outcomes (eg, recurrence), the effect of treatment was quantified by calculating the risk ratio (RR) and its associated 95% confidence interval (CI). In case of continuous outcomes (eg, Rowe score), the difference in mean values was used. A qualitative synthesis of findings from included studies was provided. If enough comparative studies were provided ($\geq$2) using the same measurement tool, a meta-analysis was performed. A fixed-effects meta-analysis was used for combining data where it was reasonable to assume that studies were estimating the same underlying treatment effect. If substantial statistical heterogeneity (I^2 statistic $\geq$50% or $P < .1$) was detected, the possible clinical and methodologic reasons for this were explored qualitatively and a random-effects meta-analysis was used. The random-effects estimate was presented with its 95% CI, as well as the estimates of T^2 and I^2. Sensitivity analyses were performed to assess the effects of including studies at risk of baseline nonequivalence of intervention groups. We restricted this to PROs (Rowe score), external rotation in abduction (ERab) and internal rotation in abduction (IRab) ROM, and instability recurrence. Statistical significance was defined as $P < .05$. We performed these analyses using RevMan software (version 5.3.5; Nordic Cochrane Centre, Copenhagen, Denmark).

Results

Search results

The literature search produced 1200 studies. After the duplicates were removed, there were a total of 803 articles. Among 803 screened titles and abstracts, 7 full texts were assessed for eligibility after a thorough reading, resulting in 3 included studies. Two studies were excluded because they were systematic reviews assessing outcomes of remplissage.[21,23] One study was a cadaveric study.[11] Another study had not assessed any PRO, and the group managed by the Latarjet procedure had significant GBL.[17] Finally, 1 ongoing pilot randomized controlled trial was excluded.[25] Hand searching of the reference lists of relevant articles resulted in 1 additional study whose full text was reviewed for eligibility; this study was accepted for inclusion in the review.[2] Thus, 4 studies ultimately remained for further analysis[2,5,8,41] (Fig. 1).

Study and patient characteristics

The demographic characteristics of each included study are summarized in Table I.

Participants

From a total of 379 patients, 194 underwent BRR whereas 185 received the Latarjet procedure. The mean age of patients undergoing BRR and the Latarjet procedure was 26.7 and 28 years, respectively. The percentage of male patients who had undergone BRR and the Latarjet procedure was 91.7% and 91.8%, respectively. In each study, no significant difference was found between the BRR and Latarjet groups regarding age or sex.

Among the studies, there was variable recording of other independent risk factors such as involvement of the dominant side, number of instability episodes before surgery, and preoperative Instability Severity Index score. However, in each study, there was no significant difference between the BRR and Latarjet groups regarding any of these risk factors (Table I).

Patients with previous instability surgery were included in 2 studies: 33 of 135 patients in the BRR group and 61 of 126 patients in the Latarjet group.[8,41] In both studies, there were significantly more revision patients in the Latarjet group.

Study duration

The mean follow-up for patients undergoing BRR and the Latarjet procedure was 37.1 and 38.3 months, respectively. In each study, there was no statistical difference between the BRR and Latarjet groups regarding the mean follow-up period, with the exception of 1 study in which the follow-up period was significantly longer in the Latarjet group.[8]

Evaluation of glenoid and humeral lesions

The methods and results of GBL and HSL evaluation are shown in Tables II and III, respectively.[31]

HSL size relative to published evidence

In the study of Yang et al,[41] although the HSL was narrower than the reported width of the engaging HSL,[9] HSL depth and HSL angle were significant. In the study of Cho et al,[8] HSL depth was moderate. In the study of Bah et al,[5] HSL depth was moderate and the HSL depth–to–humeral head radius ratio was poor (>15%).[35]

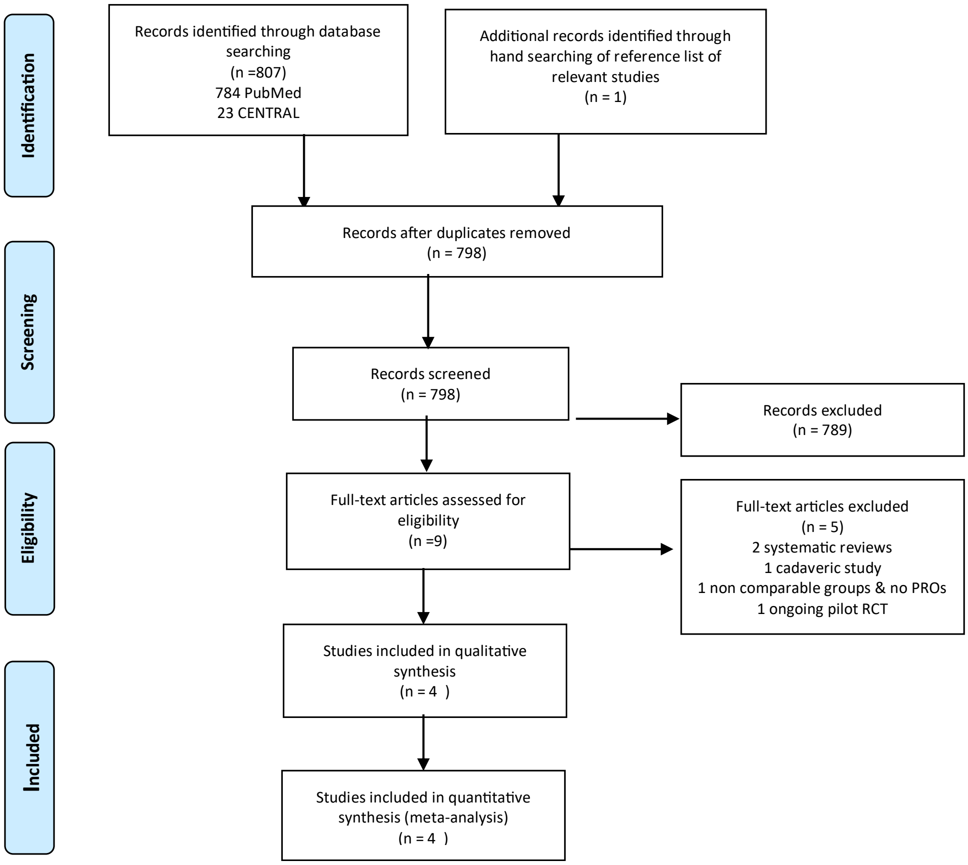

Figure 1 Flowchart of methodology used for inclusion and exclusion of articles comparing remplissage and Latarjet procedure for systematic review and meta-analysis. *CENTRAL*, Cochrane Central Register of Controlled Trials; *PRO*, patient-reported outcome; *RCT*, randomized controlled trial.

Surgical techniques

Remplissage procedure

In 2 studies, the remplissage procedure included posterior capsulodesis and infraspinatus tenodesis,[2,5] as originally described by Purchase et al.[32] In the study of Cho et al,[8] isolated posterior capsulodesis was performed. In the study of Yang et al,[41] the surgical technique was not reported. The number of anchors used for the procedure was 2 single-loaded anchors in the study of Cho et al and 1 double-loaded anchor in the study of Abouelsoud and Abdelrahman[2]; this was not reported in the other 2 studies.[5]

Latarjet procedure

Coracoid transfer was performed as described by Latarjet[20] and modified by Patte et al[29] in 2 studies.[5,8] In the study of Abouelsoud and Abdelrahman,[2] the Latarjet procedure was performed by the congruent-arc modified technique described by de Beer et al.[10] The fourth study, by Yang et al,[41] reported a modified Latarjet procedure without clarifying which modification.

Risk of bias

Of the 4 included clinical studies, 3 had level III evidence and 1 had level II evidence (Table I). In all studies, the groups were comparable with no confounding factors. However, in 2 studies, there were concerns that were perceived to be acceptable. In the study of Yang et al,[41] the deeper HSL in the Latarjet group does not negate that it was off track in both groups as the effects of bone loss, either humeral sided or glenoid sided, are complementing each other. In addition, the greater number of previous instability surgical procedures in the Latarjet group could not be considered a confounding factor toward the BRR group. Subgroup univariate analysis of revision patients was performed and showed that the BRR group had significantly higher visual analog scale (VAS) pain scores, higher recurrence rates, and higher revision rates. In the study of Cho et al,[8] although the mean follow-up period was shorter in the BRR group, it was >2 years, which is considered long enough for assessment of outcomes. Furthermore, most of the postoperative recurrence episodes would happen within the early follow-up period if they

Table I Summary of study characteristics and patient demographic details

Study	Country	Study design (LOE)	Patients, n	Age, yr	Follow-up, mo*	Male/ female, n	Arm dominance, n (%)	Instability episodes*	ISI score	Revision patients
Abouelsoud and Abdelrahman[2] (2015)	Egypt	Prospective comparative (II)					NR	NR	NR	NI
BRR			16	28.2†	31 (24-40)	15/1				
LAT			16	28.2†	31 (24-40)	14/2				
Cho et al[8] (2016)	Republic of Korea	Retrospective comparative (III)								
BRR			37	24.8 (±7.9)	24.7 (±9.5)	34/3	32 (86)	7.7 (2-20)	4.2 (±1.0)	10
LAT			35	27.8 (±9.0)	30.4 (±11.2)	32/3	31 (89)	9.9 (2-100)	4.5 (±1.4)	22
Bah et al[5] (2018)	France	Retrospective comparative (III)								NI
BRR			43	24.25 (±4.3)	47.3 (24-67)	35/8	25 (58.1)	8 (±2.1)	4.2 (±1.8)	
LAT			43	24.25 (±6.45)	47.3 (24-67)	36/7	23 (53.4)	10 (±3.5)	4.6 (±1.2)	
Yang et al[41] (2018)	United States	Retrospective comparative (III)					NR	NR		
BRR			98	28.3 (±10)	38.4 (24-144)	94/4			4.8 (±1.9)	23
LAT			91	30 (±2.1)	38.4 (24-144)	86/5			4.9 (±1.3)	39
Overall										
BRR			194	26.7	37.1	178/16	57 (71.25)	7.86	4.5 (±1.6)	33/135
LAT			185	28	38.3	168/17	54 (69.2)	9.95	4.7 (±1.3)	61/126

LOE, level of evidence; *ISI*, Instability Severity Index; *BRR*, Bankart repair with remplissage; *LAT*, Latarjet procedure; *NR*, not reported; *NI*, not included.
Data are presented as mean (±standard deviation) unless otherwise indicated.
* Data are presented with standard deviations or ranges according to the data recorded.
† Standard deviations were not reported.

Table II Methods and results of GBL evaluation

Study	GBL evaluation		BRR	LAT	*P* value
	Imaging	Method			
Abouelsoud and Abdelrahman[2] (2015)	MRI	NR	NR*	NR*	—
Cho et al[8] (2016)	CT	Bare area method, %[33]	8.5 ± 5.8	9.8 ± 6.1	NS
Bah et al[5] (2018)	CT	Surface area method, %[33]	NR*	NR*	—
Yang et al[41] (2018)	CT	Surface area method, %	10.4 ± 6.8	12.3 ± 8.79	NS

GBL, glenoid bone loss; *BRR*, Bankart repair with remplissage; *LAT*, Latarjet procedure; *MRI*, magnetic resonance imaging; *NR*, not reported; *CT*, computed tomography; *NS*, not significant.
Data are presented as mean ± standard deviation.
* The inclusion criteria included <30% of the joint surface.

Table III Methods and results of HSL evaluation

Study	HSL evaluation		BRR	LAT	*P* value
	Imaging	Method			
Abouelsoud and Abdelrahman[2] (2015)	MRI	NR	NR*	NR*	—
Cho et al[8] (2016)	CT axial image	Depth, mm	6.8 ± 1.7	6.4 ± 2.4	NS
Bah et al[5] (2018)	Radiography in IR and CT axial image	Depth, mm	7.7 ± 1.2	7.9 ± 1.5	NS
		D/R index, %	0.23 ± 0.03	0.21 ± 0.04	NS
Yang et al[41] (2018)	CT axial image	Width, % (of HH diameter)	28.4 ± 12	30 ± 17.7	NS
		Depth, % (of HH diameter)	14.9 ± 7.14	18.3 ± 3.24	S
		HSL angle, °	19 ± 7.5	19.9 ± 13.6	NS
		Glenoid tracking	NR†	NR†	—

HSL, Hill-Sachs lesion; *BRR*, Bankart repair with remplissage; *LAT*, Latarjet procedure; *MRI*, magnetic resonance imaging; *NR*, not reported; *CT*, computed tomography; *NS*, not significant; *IR*, internal rotation; *D/R*, Hill-Sachs lesion depth to humeral head radius; *S*, significant ($P < .05$); *HH*, humeral head.
* The inclusion criteria included 20%-30% of HH size.
† The inclusion criteria included off tracking.

were to be attributed to the surgical technique. Regarding the significantly increased number of patients with previous instability surgery in the Latarjet group, the small sample size may account for the appearance of clinically minor differences. The MINORS scoring system deemed studies as acceptable quality with low bias. The mean MINORS score for all included studies was 15.5 (65.5% of total possible points; range, 50%-79%) (Table IV). (Detailed risk-of-bias assessment is given in Supplementary Appendix S1.) No statistically significant difference was found between the mean MINORS scores calculated by the 3 examiners.

Qualitative synthesis and meta-analysis: effects of interventions

Patient-reported outcomes

Rowe score

Three studies fulfilled the criteria for review of postoperative Rowe scores. The difference in mean postoperative scores between the 2 groups was –0.9 (95% CI, –3.45 to 1.7), in favor of the BRR group. However, this difference was statistically insignificant ($P = .5$). There was moderate heterogeneity ($I^2 = 45\%$) (Fig. 2).

VAS pain score

Three studies fulfilled the criteria for review of the postoperative VAS pain score. The difference in mean postoperative scores between the 2 groups was –0.2 (95% CI, –0.6 to 0.2), in favor of the BRR group. However, this difference was statistically insignificant ($P = .3$). There was moderate heterogeneity ($I^2 = 53\%$) (Fig. 3).

Although the study of Abouelsoud and Abdelrahman[2] recorded the postoperative VAS pain score, their findings could not be pooled with those of the other studies because they only assessed VAS scores at 1 week postoperatively. In addition, the study of Bah et al[5] recorded a number of patients with postoperative residual pain, which was twice as common in the BRR group. Moreover, the study of Cho et al[8] recorded VAS pain scores with motion, with no significant difference between the 2 groups.

Other scores

The study of Bah et al[5] used the Walch-Duplay score, and the study of Yang et al[41] used the Western Ontario Shoulder Instability index. Moreover, a simple 1-question functional

Table IV Critical appraisal of selected studies using MINORS criteria

	Abouelsoud and Abdelrahman[2]	Cho et al[8]	Bah et al[5]	Yang et al[41]
Item				
1. Clearly stated aim	1	1	1	2
2. Inclusion of consecutive patients	1	1	2	2
3. Prospective collection of data	2	1	1	1
4. Endpoints appropriate to aim of study	1	1	2	2
5. Unbiased assessment of study endpoint	1	0	2	0
6. Follow-up period appropriate to aim of study	2	2	2	2
7. Loss to follow-up <5%	0	0	1	1
8. Prospective calculation of study size	0	1	0	2
9. Adequate control group	2	2	2	2
10. Contemporary groups	2	1	2	2
11. Baseline equivalence of groups	0	1	2	1
12. Adequate statistical analysis	0	2	2	2
Total score				
Absolute value	12	13	18	19
% of total possible score	50	54	75	79

MINORS, Methodological Index for Non-randomized Studies.
A score of 0 indicates not reported; 1, reported but inadequate; and 2, reported and adequate.

shoulder assessment tool was used in 2 studies (Single Assessment Numeric Evaluation in the study of Yang et al and Subjective Shoulder Value in the study of Bah et al). All these scores could not be included in the meta-analysis because they were not used in >1 study. However, in both studies, no significant differences in scores between the 2 groups were found.

Outcome in active patients

Only 2 studies reported the outcome in active athletes. However, they differed in the methodology used and the way the results were reported. Cho et al[8] recorded the rate and grade of return to play in active patients in each group, with no significant difference detected. Yang et al[41] performed subgroup analysis of the collision and

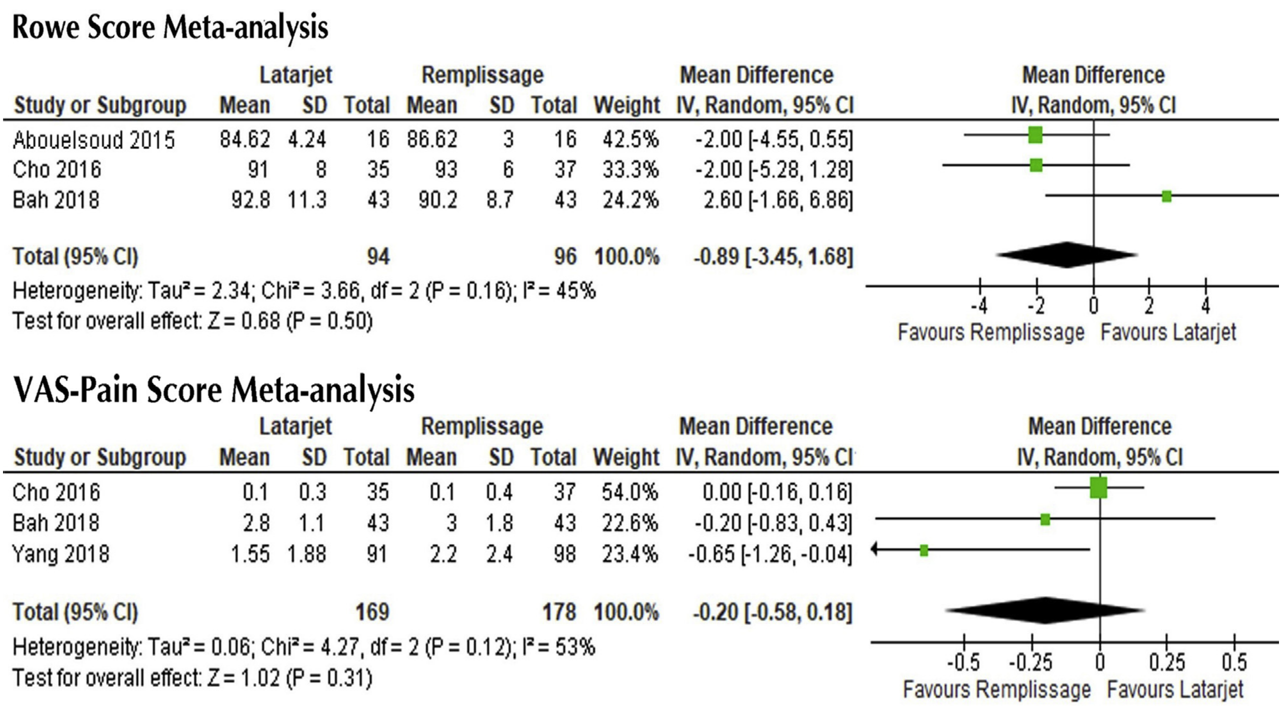

Figure 2 Meta-analysis of patient-reported outcomes after Latarjet vs. remplissage procedure: Rowe score and visual analog scale *(VAS)* pain score. *SD*, standard deviation; *CI*, confidence interval; *IV*, inverse-variance method.

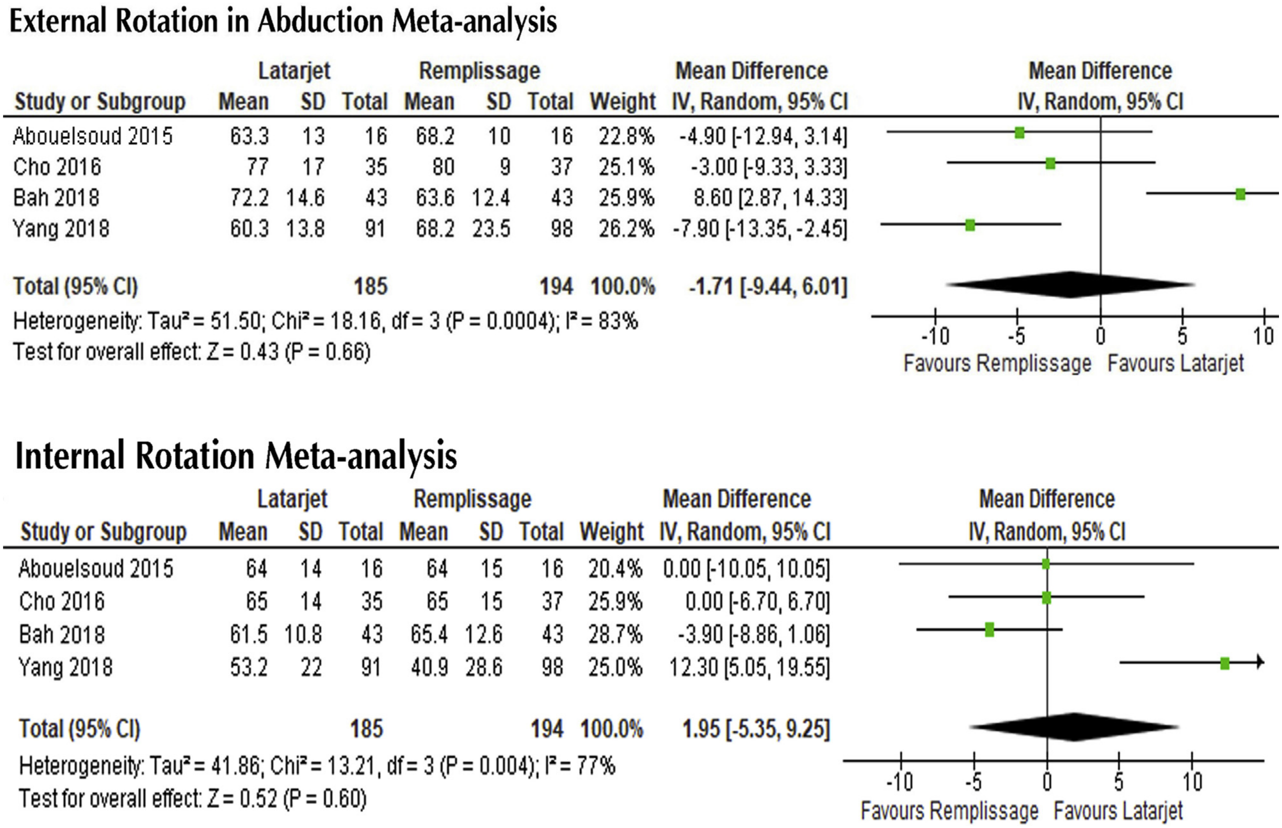

Figure 3 Meta-analysis of postoperative range of motion after Latarjet vs. remplissage procedure: external and internal rotation. *SD*, standard deviation; *CI*, confidence interval; *IV*, inverse-variance method.

contact athlete population in each group. The results showed significantly better Western Ontario Shoulder Instability index scores and a significantly lower recurrence rate in the Latarjet group and no statistically significant differences in Single Assessment Numeric Evaluation scores, VAS pain scores, revision rates, and complication rates.

Objective outcomes

Range of motion

The 4 studies investigated mean postoperative ROM as an outcome. The difference in mean postoperative ERab between the 2 groups was 1.7° (95% CI, –9.4° to 6°), in favor of the BRR group. There was substantial heterogeneity ($I^2 = 83\%$) (Fig. 3). The difference in mean postoperative IRab between the 2 groups was 1.95° (95% CI, –5.35° to 9.25°), in favor of the Latarjet group. There was substantial heterogeneity ($I^2 = 77\%$) (Fig. 3). The difference in mean postoperative forward flexion between the 2 groups was 2.9° (95% CI, –6.5° to 0.5°), in favor of the BRR group. There was low heterogeneity ($I^2 = 21\%$). However, all these differences in postoperative ROM were statistically insignificant, with $P = .6$, $P = .6$, and $P = .1$ for ERab, IRab, and forward flexion, respectively.

Recurrence

Recurrent instability

The 4 studies reported recurrence as an outcome. It was defined as subluxation or dislocation in 2 studies[5,41] and was not defined in the other 2.[2,8] For convenience, both subluxation and dislocation are referred to as recurrent instability in this article. Recurrent instability occurred in 9.8% of BRR procedures (n = 19) and 7% of Latarjet procedures (n = 13). The Latarjet procedure reduced the risk of recurrence by 28% relative to the BRR procedure (RR, 0.72; 95% CI, 0.37-1.41). However, this effect was statistically insignificant ($P = .35$). There was also no significant heterogeneity ($I^2 = 0\%$) (Fig. 4).

Revision surgery owing to recurrent instability

Two studies recorded revision surgery and could be analyzed.[5,41] Within these studies, 141 BRR and 134 Latarjet procedures were performed. Revision surgery occurred in 2.8% of BRR procedures (n = 4) and 2.2% of Latarjet procedures (n = 3). The Latarjet procedure reduced the risk of revision stabilization surgery by 21% relative to the BRR procedure (RR, 0.79; 95% CI, 0.18-3.47). However, this effect was statistically insignificant ($P = .76$).

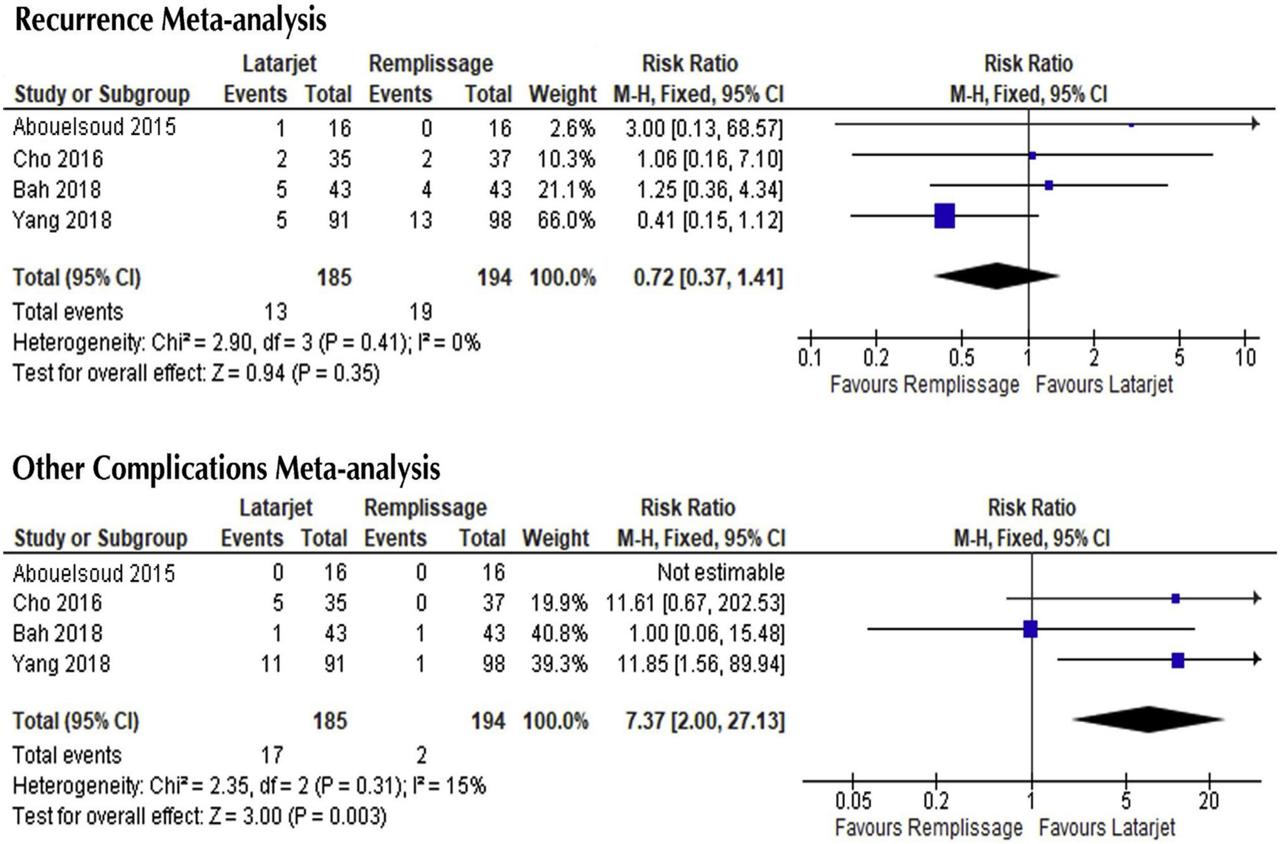

Figure 4 Meta-analysis of recurrence and other complications after Latarjet vs. remplissage procedure. *CI*, confidence interval; *M-H*, Mantel-Haenszel method.

Complications other than recurrence

The 4 studies reported other complications. Overall, the rate of other complications was 1% of BRR procedures (n = 2) and 9% of Latarjet procedures (n = 17). The Latarjet procedure increased the risk of other complications by about 7 times relative to the BRR procedure (RR, 7.37; 95% CI, 2-27). This effect was statistically significant ($P = .003$). There was low heterogeneity ($I^2 = 15\%$) (Fig. 4).

In the study of Yang et al,[41] subsequent nonstabilization procedures were recorded. Significantly more patients in the BRR group underwent revision for nonstabilization procedures such as subacromial decompression and glenohumeral débridement.

Sensitivity analyses

We found that PROs (Rowe score), ERab ROM, IRab ROM, and recurrent instability at the end of follow-up (≥2 years) did not differ between the intervention groups in the primary analysis (ie, including all studies) (mean difference [MD], –0.9 [95% CI, –3.45 to 1.7]; MD, –1.7° [95% CI, –9.4° to 6°]; MD, 1.95° [95% CI, –5.35° to 9.25°]; and RR, 0.72 [95% CI, 0.37-1.41], respectively) or in the sensitivity analysis, in which we excluded studies with unbalanced inclusion of participants with previous instability surgery across intervention groups (MD, –0.03 [95% CI, –4.49 to 4.43]; MD, 2.16° [95% CI, –11.06° to 15.37°]; MD, –3.14° [95% CI, –7.85° to 1.31°]; and RR, 1.44 [95% CI, 0.46-4.54], respectively). (Data are given in Supplementary Figure S1.)

Discussion

To our knowledge, this is the first systematic review and meta-analysis of comparative studies investigating BRR vs. the Latarjet procedure in the management of traumatic anterior shoulder instability with engaging HSLs and subcritical GBL. Our review found that there was no statistically significant difference between BRR and the Latarjet procedure in terms of recurrence and PROs (including VAS pain score). This review also demonstrated that there was no statistically significant difference between BRR and the Latarjet procedure in terms of postoperative ROM (including external rotation). Aside from recurrence, the overall complications were significantly more associated with the Latarjet procedure.

The results of the included studies were adequately consistent for most analyzed outcomes. However, the intervention effect on ROM in our review had a small body of evidence. This limited the strength of the reported conclusions. The demonstrated substantial heterogeneity in the effect of both the BRR and Latarjet procedures on external rotation and internal rotation ROM may be explained by between-study variations in surgical technique within each group. Variations in the surgical technique of the Latarjet procedure were evident, including the orientation of the coracoid graft and technique of dealing with the lateral capsular flap, whether it was attached to the coracoacromial ligament stump[5,8] or repaired to the anterior glenoid rim.[2] In addition, variations in the surgical technique of the remplissage procedure were evident, including the number and position of anchors and whether capsulodesis alone[8] or capsulo-tenodesis was performed. Moreover, selection bias was present especially in the retrospective studies. The preferences of the surgeon[41] and even the patient[5] determined which procedure was performed. Detection bias was evident even in the only prospective study included, with no blind evaluation of objective endpoints such as ROM.[2]

Although our review demonstrated no statistically significant difference between the 2 interventions in terms of postoperative pain, this finding had a small body of evidence. This resulted from the small number of included studies (only 3) and moderate heterogeneity of intervention effect. This heterogeneity could be explained by between-study variability in surgical technique especially in the remplissage group, in which capsulodesis alone or capsulo-tenodesis was performed. This small amount of evidence cannot allow a robust conclusion against what other evidence concluded. A long-term prospective study comparing Bankart repair alone and Bankart repair with remplissage demonstrated persistence of posterior shoulder pain in one-third of remplissage patients.[26] The authors proposed that the pain may be due to inflammation associated with partial tendon healing or impingement between the posterior labrum and footprint of the infraspinatus after tenodesis, which may also explain the demonstrated increased rates of subacromial decompression and glenohumeral débridement in the BRR group in one of the studies in our review.[41] In addition, in another study in this review, residual pain was twice as common in the BRR group.[5]

The indication for management by either BRR or the Latarjet procedure in our studies included mainly 2 HSL features[6,34]: either large size or engagement assessed by preoperative imaging or arthroscopy. However, both of these indications have recently been debated.[12,19] The concept of engaging vs. non-engaging described by Burkhart and De Beer[6] has recently been replaced by the concept of the glenoid track of Di Giacomo et al,[12] which has been validated both in vitro and in vivo.[39] This validated and applicable method of quantifying HSLs has not been used in the selection of HSLs in the studies included in our review, except partially in 1 study.[41] Therefore, further comparative clinical studies of BRR vs. the Latarjet procedure using off tracking of HSLs as a uniform indication of management should be performed to confirm our findings.

This review cannot be applied to athletes participating in contact and overhead sports, who are high-risk instability patients.[16] Only 2 studies[8,41] assessed the outcome in active athlete groups, and their findings could not be pooled because each used a different assessment method. In addition, their findings were not consistent. Therefore, further comparative studies of BRR vs. the Latarjet procedure in that specific population should be performed.

Given that the number of preoperative instability episodes was variably reported by the included studies, we could not perform a subgroup analysis using this possible effect modifier. A simple questionnaire of multiple instability episodes is an indirect predictor of superadded associated anterior soft-tissue pathologic injuries that could affect the decision making in the management of anterior shoulder instability.[1,16,22]

As mentioned earlier, this is the first systematic review and meta-analysis comparing BRR and the Latarjet procedure in this specific patient population. However, after comparing our highest-evidence findings with the most relevant literature, we noted the following: Our review demonstrated that there was no statistically significant difference between BRR and the Latarjet procedure in terms of recurrence. This finding is consistent with what Degen et al[11] demonstrated in a biomechanical study on shoulder specimens with 25% Hill-Sachs defects, in which there was no difference in dislocation frequency between the 2 procedures. In addition, Plath et al[30] showed the efficiency of the Latarjet procedure in the treatment of off-track HSLs. They demonstrated the persistence of 14% mean enlargement of the glenoid beyond the native dimensions at 2 years postoperatively, thus avoiding the recurrence of off-track lesions. Yang et al[40] demonstrated a recurrence rate of 15% (relatively higher than our result) after a modified Latarjet procedure performed in patients with engaging HSLs with concomitant GBL $< 25\%$. However, all recurrences occurred in patients with failed previous stabilization procedures. After reviewing systematic reviews assessing recurrence after the BRR procedure in similar patient populations, we found that the recurrence rate ranged from 3.2% to 5.8%,[7,21,23,33] which was similar to the rate in our study.

Our review demonstrated that both the BRR and Latarjet procedures improved the postoperative PROs with no statistically significant difference. This finding is in accordance with what Yang et al[41] demonstrated in a clinical study assessing the outcomes of the Latarjet procedure in a patient group with engaging HSLs and $<25\%$ GBL. The overall rate of satisfaction with surgery was 87.8%, and 95% of patients stated that they would undergo the operation again.[41] Moreover, after reviewing systematic reviews assessing the outcomes of BRR in similar patient populations, we found that good to excellent postoperative shoulder-specific outcome scores were demonstrated.[7,23,33]

Our review showed that the overall complications (other than recurrence) were more associated with the Latarjet procedure. This finding is in accordance with what was demonstrated in a systematic review quantifying the complications after the Latarjet procedure: Aside from recurrence, the overall complication rate was 21.3%.[15] In addition, the assessment of complications, aside from recurrence, after BRR in multiple systematic reviews showed a rare prevalence of complications, ranging from 0.4% to 0.6%.[7,21,33]

With respect to internal validity, there are several limitations to this study: First, only a small number of studies were identified, and all were of limited quality. However, we found that higher-quality clinical trials are not available for the time being. In time, as such reviews are updated, the limited-quality studies may be dropped when higher-quality clinical trials become available. Second, each study was further limited by a small sample size. Owing to the small sample sizes, the studies may have been underpowered to determine a possible statistical difference between the 2 groups in terms of recurrence and PROs. Third, a source of measurement bias was an unclear definition of recurrence in 2 studies.[2,8] However, although the definitions of recurrence may confound the results across the studies, it would be expected to bias the BRR and Latarjet groups similarly within an individual study. However, in the end, we found no unacceptable differences in the baseline characteristics of both cohort groups included that prevent comparison.

Conclusion

Both the BRR and Latarjet procedures are effective for management of engaging HSLs with subcritical GBL and give comparable clinical outcomes. However, given the fewer overall postoperative complications, remplissage may be safer. Although the included studies would suggest no difference between the 2 procedures in terms of postoperative pain and ROM, strong conclusions are limited by the clinical and methodologic heterogeneity among the included studies. Although these conclusions are based on limited-quality studies as described earlier, this report presents the pooled data from the latest published literature.

Disclaimer

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Supplementary data

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