

Lower Range of Recurrent Instability Rates Following Bankart Repair and Remplissage Compared to Isolated Bankart Repair in Patients With “Nonengaging/On-Track” Hill-Sachs Lesions and <20% Glenoid Bone Loss



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Purpose: To compare recurrent instability and return-to-sport rates along with external rotation differences between on-track (nonengaging) Hill-Sachs lesion patients undergoing either an isolated Bankart repair (IBR) or a Bankart repair augmented with a remplissage procedure (B+R). **Methods:** A search was conducted using 3 databases (PubMed, EMBASE, CINAHL) in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. Only clinical comparative (level of evidence I-III) studies were considered for inclusion. Quality assessment was performed using the Methodological Index for Non-Randomized Studies criteria. **Results:** Six level of evidence III studies, totaling 537 patients (202 B+R and 335 IBR) were included for analysis. All patients had <20% glenoid bone loss and a nonengaging, on-track Hill-Sachs lesion. At a median final follow-up of 34.7 months, recurrent dislocation rates ranged from 0% to 7.7% and 3.5% to 30% in the B+R and IBR groups, respectively. Moreover, subjective instability and revision surgery rates presented lower ranges in the B+R upon comparison with the IBR cohort (0%-32% vs 5%-71.4% and 0%-5% vs 0%-35%, respectively). Furthermore, return to preinjury level of sports ranged from 64% to 100% in the remplissage-augmented group and 50% to 90% in the IBR cohort. Postoperative external rotation at side varied from 50° to 63° in the B+R and 55° to 63° in the IBR arm. Additional subgroup analysis revealed recurrent dislocation rates in athletes and patients with near-track Hill-Sachs lesions undergoing remplissage augmentation to be 0% to 5% and 2% to 47% while ranging from 8.8% to 30% and 9% to 66% for IBR patients, respectively. **Conclusions:** Upon qualitative analysis, ranges of recurrent instability measures, including recurrent dislocation rates, are higher in patients undergoing IBR in comparison to B+R. Activity level influences outcomes as athletes were found to have a higher range of recurrent dislocation rates in the IBR group. The addition of remplissage showed a higher range of return-to-sport rates with comparable postoperative external rotation between groups. **Level of Evidence:** Level III, systematic review of Level III studies.

See commentary on page 1096

The approach to managing first-time anterior shoulder dislocation, occurring at an incidence of 23.9 per 100,000 person-years, has shifted toward

earlier surgical intervention given the reported lower recurrence rates upon comparison with the traditional conservative approach particularly in young, contact athletes.^{1,2} The optimal surgical intervention is patient specific and guided not only by activity level, hyperlaxity, and patient age but also by the presence/absence of associated glenoid bone loss (GBL) in addition to associated Hill-Sachs lesions. Both bony lesions have been reported to occur in up to 60% of first-time dislocations.³⁻⁵ Arthroscopic Bankart repair has been the surgical gold standard for patients with anterior instability, below-threshold (subcritical <15%-20%) glenoid bone loss, and small, nonengaging Hill-Sachs

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lesions. However, high rates of recurrent dislocation (3%-40%) persist, highlighting the need for ongoing improvement in the management of such cases.⁵⁻⁷

Although the suboptimal failure rates observed after an arthroscopic Bankart repair are likely multifactorial, it is well recognized that specific Hill-Sachs lesion characteristics, primarily size, contribute to the elevated reported recurrence rates after an isolated repair.^{5,6,8-10} Burkhart and De Beer⁹ first established the concept of engaging or nonengaging Hill-Sachs referring to the presence or absence of the posterolateral humeral defect articulating with the anterior edge of the glenoid in the abducted and externally rotated position. Later, the glenoid track concept was introduced where, by using objective preoperative measurements, authors were able to determine if the humeral head had adequate glenoid bony support through range of motion.⁸ On this regard, previous investigations utilizing the glenoid track concept have reported that off-track (engaging) lesions experience a higher recurrence rate after an isolated Bankart repair.¹⁰⁻¹² More recently, the concept of near-track lesions, referring to on-track lesions at higher risk of suboptimal outcomes given the narrower distance between the medial margin of the Hill-Sachs and the glenoid track, has been described.^{6,13-15} These studies categorized near-track Hill-Sachs lesions as those having a distance to dislocation (glenoid track/Hill-Sachs interval) <10 mm or having a Hill-Sachs occupancy (Hill-Sachs interval/glenoid track) of more than 75% of the glenoid track (i.e., medialized Hill-Sachs).

To date, it has been well established that augmentation of an arthroscopic Bankart repair with a posterior capsulodesis and infraspinatus tenodesis, known as a remplissage procedure, in patients with glenoid bone loss <20% and off-track (engaging) Hill-Sachs lesions, provides lower redislocation and higher return-to-sport rates with conflicting results regarding postoperative loss of shoulder external rotation.^{11,12,16-20} Nonetheless, whether these apparent benefits hold for patients with on-track (nonengaging) or near-track lesions has not been studied extensively. Therefore, the purpose of the present study was to compare recurrent instability and return-to-sport rates along with external rotation differences between on-track (nonengaging) Hill-Sachs lesion patients undergoing either an isolated Bankart repair or a Bankart repair augmented with a remplissage procedure. It was our hypothesis that augmentation via remplissage would confer a lower redislocation and higher return-to-activity/sports rate with no clinically relevant difference in loss of external rotation.

Methods

Search Strategy

A search across 3 databases (PubMed, EMBASE, CINAHL) was conducted from database inception to

November 2023 in agreement with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.²¹ The following terms were combined for the search: shoulder instability AND Hill-Sachs AND remplissage.

The predetermined inclusion criteria were as follows: (1) clinical studies comparing outcomes following an isolated arthroscopic Bankart repair versus a Bankart repair augmented with the remplissage procedure, (2) level of evidence I to III, (3) English or Spanish published literature (due to Spanish language proficiency of some of the authors), (4) on-track or nonengaging Hill-Sachs lesions, and (5) glenoid bone loss of <20%. Exclusion criteria included (1) nonclinical studies (biomechanical, cadaveric, animal, editorial commentaries); (2) level of evidence IV, including case series, systematic reviews, or case reports; (3) non-English or non-Spanish language studies; (4) off-track or engaging Hill-Sachs; (5) glenoid bone loss >20%; and (6) no full-text availability.

Data Extraction

After search retrieval, 2 reviewers (J.B.V-E. and R.S.B.) independently performed the title/abstract and further full-text screening while implementing the predetermined inclusion criteria. Upon disagreements, consultation with a third reviewer (E.C.) was performed and consensus reached as a group. Data were extracted and collected in a predetermined Microsoft Excel Spreadsheet (version 2007; Microsoft). Study characteristics, including authors, year of publication, and level of evidence, were all extracted. Moreover, number of patients, age, sex, mean follow-up, percentage of glenoid bone loss, Hill-Sachs length/interval, arm dominance, and athlete status were also assessed. Regarding outcomes, instability measures (recurrent dislocations, revision surgery, or subjective instability), return to preinjury level of sport, and range of motion at final follow-up were extracted.

Quality and Risk of Bias Assessment

Quality of the retrieved studies was assessed by 2 of the authors (J.B.V-E. and R.S.B.) using the Methodological Index for Non-Randomized Studies instrument.²² Comparative studies may reach a global score of 24 points, whereas noncomparative studies can only add up to a maximum of 16 points. For comparative studies, a score of <15, 15 to 19, and >19 was established a priori to represent "low," "moderate," and "high" quality, respectively. Given the design of the included studies, the Risk of Bias in Non-Randomized Studies of Interventions tool²³ was utilized to assess for the risk of bias within each study. Selected articles were independently evaluated by the same 2 reviewers (J.B.V-E. and R.S.B.) and reviewed by a third in case of disagreement (E.C.).

Statistical Analysis

A qualitative analysis was performed due to the high risk of bias in pooling data from retrospective comparative studies. Descriptive statistics were presented for study and patient characteristics data, including age, sex, percentage of glenoid bone loss, Hill-Sachs length/interval, and duration of follow-up. Eligible studies were included in Review Manager version 5.4 (The Cochrane Collaboration) to generate forest plots displaying the changes in instability, return to sport, and range of motion measures. Heterogeneity between studies was assessed using I^2 , with an I^2 value exceeding 40% indicative of heterogeneity. In cases of significant heterogeneity among studies, random-effects models were applied; otherwise, fixed-effects models were utilized.

Results

Initial search, upon removal of duplicates, yielded 303 studies, out of which 17 were further assessed for eligibility. After full-text review, 6 level of evidence III studies,²⁴⁻²⁹ totaling 537 patients, met the predefined inclusion criteria (Fig 1). The mean Methodological Index for Non-Randomized Studies score among included studies was 20.5 (range, 18-22), indicative of high quality. Moderate risk of bias was observed in all 6 yielded studies (Fig 2). One investigation²⁷ reported the rate of recurrent dislocations while stratifying between on-track and off-track Hill-Sachs patients. Therefore, for the aforementioned study, recurrent dislocation was the only outcome included in the present study pertaining to on-track Hill-Sachs lesions. Additionally, the corresponding author of the study published by Yu et al.²⁹ was contacted asking for concrete postoperative external rotation measurements at final follow-up instead of the deficit reported in their original study.

The arthroscopic Bankart repair plus Remplissage (B+R) cohort comprised 202 patients (17% female) with an age and follow-up range of 15 to 40 years and 19.9 to 60.1 months (only 1 study totaling 25 patients had less than a 2-year follow-up with a mean follow-up of 19.9 months), respectively. In contrast, the isolated arthroscopic Bankart repair (IBR) cohort was composed of 335 patients (18% female) with an age ranging from 18 to 32 years and follow-up of 29 to 49.5 months (all included studies had a >2-year follow-up), respectively (Table 1).

All 6 studies reported on the percentage of GBL with results ranging from 2.7% to 20% and 0% to 20% for the B+R and IBR cohorts, respectively. Additionally, 5 of the retrieved studies described their mean Hill-Sachs interval/length with the B+R measurements ranging from 13.9 to 16.1 mm while the IBR cohort ranged from 2.7 to 14.9 mm. GBL and Hill-Sachs size calculation methods were reported in 5^{24,25,27-29} of the retrieved studies. GBL calculation

was performed via the Sugaya (best-fit circle) method in all 5 studies via magnetic resonance imaging (MRI) or computed tomography. Similarly, all 5 investigations utilized MRI (axial view) to measure the distance from the most medial aspect of the bony defect to the footprint of the rotator cuff laterally for estimation of the Hill-Sachs interval. Moreover, athlete status was reported in all 6 studies with 2 investigations^{26,28} composed of 100% overhead and contact athletes while the remaining were a mix of athletes and nonathletes, as shown in Table 2. Dominant arm involvement was also assessed for in 3 of the yielded studies.^{24,26,29}

One sole investigation²⁹ reported on the significance of clinical outcomes by expressing the achievement rate of the minimal clinically significant difference for patients in both treatment arms (85.7% or 24/28 for IBR and 100% or 25/25 for B+R, $P = .11$).

Recurrent instability

All 6 retrieved studies²⁴⁻²⁹ reported on the rate of recurrent dislocations with 202 patients in the B+R treatment arm and 335 patients in the IBR arm. The recurrent dislocation rate ranged from 0% to 7.7% in the B+R cohort, whereas rates ranged from 3.5% to 30% in the IBR treatment arm (Fig 3). The ranges of study participants ranged from 20 to 56 (B+R) and 20 to 127 (IBR) and are included within Tables 1 and 2.

Subjective instability and revision surgery were also assessed with 4^{24,26,28,29} and 3^{25,26,29} studies, respectively. For subjective instability, the B+R cohort was composed of 101 patients, whereas the IBR cohort comprised 134 patients, with results showing a 0% to 32% rate in B+R patients, in contrast to a 5% to 71.4% rate in patients undergoing an IBR. Moreover, patients undergoing remplissage in addition to Bankart repair demonstrated a 0% to 5% revision surgery rate in comparison to a 0% to 35% rate for the IBR cohort.

Return to Sport

Four studies^{25,26,28,29} totaling 340 patients, 131 in the B+R and 209 in the IBR, were assessed for return to preinjury level of sports. Results showed a return to preinjury level of sport rate of 64% to 100% and 50% to 90% among patients who had undergone a B+R and IBR, respectively (Fig 4).

Range of Motion

Postoperative external rotation with the arm at the side, reported in 3 studies,^{25,28,29} was among the accessible range of motion measurement available for analysis. Upon comparison of 111 patients in the B+R cohort and 189 patients in the IBR cohort, postoperative degrees of external rotation at side ranged from 50° to 63° and 55° to 63°, respectively (Fig 5).

Forward flexion was compared between procedures in only 2 of the included studies^{25,28} with an additional study²⁶ reporting values only for the remplissage cohort. Nonetheless, postoperative forward flexion ranged from 155° to 177° and 170° to 176° in 106 remplissage versus 181 isolated Bankart repair patients, respectively.

Subgroup Analysis—Recurrent Dislocations

Yielded results allowed the authors to stratify recurrent dislocation rate based on contact/overhead athlete status and presence of a near track Hill-Sachs lesion. A total of 4 studies,^{24-26,28} including 92 and 145 overhead and contact/collision athletes in the B+R versus the IBR, respectively, were included for subgroup analysis.

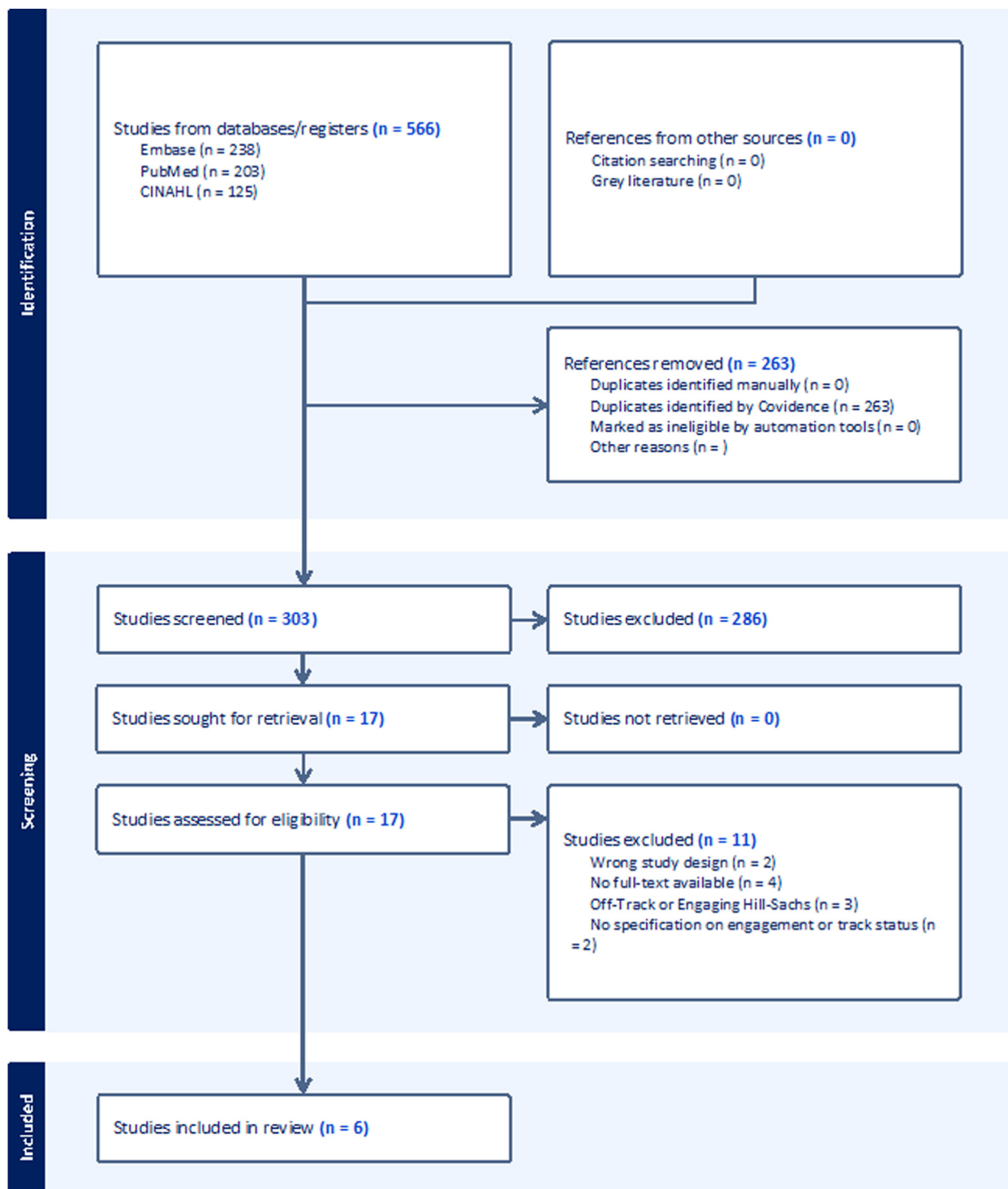


Fig 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram.

Recurrent dislocation rate was 0% to 5% for the remplissage-augmented cohort, in contrast to 8.8% to 30% in the isolated Bankart cohort (Fig 6).

Two studies^{24,25} defined a near-track lesion as those presenting with a distance to dislocation (glenoid track/Hill-Sachs interval) of less than 10 mm. Meanwhile, 1 additional study²⁹ referred to a near-track lesion as a lesion with a Hill-Sachs peripheral occupancy (Hill-Sachs interval/glenoid track) of >75% of the humeral head. Analysis of 84 B+R versus 65 IBR patients with near-track lesions revealed a recurrent dislocation rate of 2% to 47% in B+R versus 9% to 66% for the IBR group (Fig 7).

Discussion

The main finding of the present study is that, upon qualitative analysis, instability outcome ranges, including recurrent dislocation, subjective instability, and revision surgery rates, were found to be higher in patients with on-track Hill-Sachs lesions and subcritical GBL managed with an isolated arthroscopic Bankart repair. Additionally, return to preinjury level of activities/sport ranges appeared to favor the Bankart plus remplissage cohort with minimal to no difference in postoperative external rotation ranges at final-follow up. Lastly, after stratifying patients by athlete and near-track status, the addition of the remplissage seemed to decrease the recurrent dislocation range within these specific patient populations. Thus, our motto is "When to Remplissage? Whenever Possible!" A

summary of absolute recurrent dislocation values per study can be found in Table 3.

The results of the present systematic review suggest that the addition of a remplissage procedure to an arthroscopic Bankart repair in patients with anterior glenohumeral instability with on-track Hill-Sachs lesions lowers the recurrent dislocation rate (0%-7.7% for B+R vs 3.5%-30% for IBR). Although literature comparing both procedures in patients with on-track (nonengaging) Hill-Sachs lesions is scarce, the limited available studies have all reported a net benefit in terms of absolute dislocation rate upon augmentation with a remplissage procedure, although not always reaching significance²⁴⁻²⁹ (Table 3). For instance, a study by Águila et al.²⁴ reported that absolute redislocation rate was lower for remplissage-augmented procedures (7.7% vs 17.3%, $P = .21$). Similar findings were reported in the studies published by Horinek et al.²⁷ and Yu et al.,²⁹ in which both found lower absolute redislocation rates (2% vs 8%, $P = .18$ and 0% vs 3%, $P = .34$, respectively) among patients with an arthroscopic Bankart repair with remplissage. In contrast, the study published by Lin et al.²⁵ did report achievement of a significant difference between procedures (1% vs 11%, $P = .04$), which may be the result of a stronger powered study with 56 patients in the B+R group and 127 in the IBR group in their study. Furthermore, a study performed by Domos et al.²⁶ also reported a significant difference among the 2 cohorts (5% vs 20%, $P = .01$) using a population that consisted exclusively of

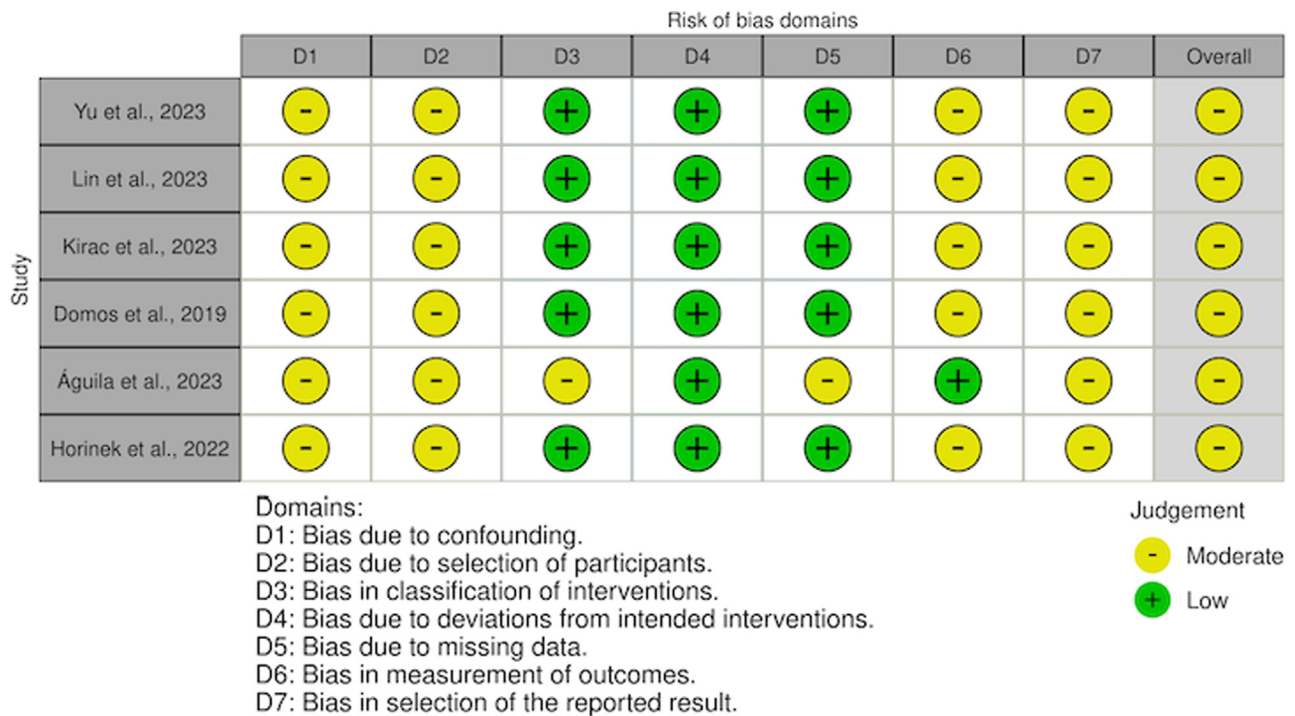


Fig 2. Representation of Risk of Bias in Non-Randomized Studies of Interventions tool for risk of bias assessment utilizing risk-of-bias visualization (Robvis).³⁹

Table 1. Mean Demographics

Study	Study Design	MINORS	B+R, n	IBR, n	B+R: Age,* y	IBR: Age,* y	B+R: Female, n (%)	IBR: Female, n (%)	B+R: F/U,* mo	IBR: F/U,* mo
Yu et al., 2023 ²⁹	Retrospective comparative (Level III)	22	25	28	28.2 (8.8)	29.3 (10.3)	4 (16)	1 (3.5)	19.9 (7.3) (12-33)	38.5 (16.4) (12-68)
Lin et al., 2023 ²⁵	Retrospective comparative (Level III)	20	56	127	25.8 (8.1)	24.8 (7.8)	10 (18)	26 (21)	33.3 (17.6)	38.4 (21.6)
Kirac et al., 2023 ²⁸	Retrospective comparative (Level III)	22	30	34	26 (5)	26.8 (4.9)	8 (26.6)	11 (32.3)	36.2	37.8
Domos et al., 2019 ²⁶	Retrospective comparative (Level III)	20	20	20	25 (15-40)	25 (18-32)	2 (10)	0	26 (24-43)	29 (25-47)
Águila et al., 2023 ²⁴	Retrospective comparative (Level III)	18	26	52	Median 31 (23-37)	Median 23 (19.5-29.5)	2 (7.7)	7 (13.5)	Median 60.1 (43.5-76.9)	Median 49.5 (33.6-83.5)
Horinek et al., 2022 ²⁷	Retrospective comparative (Level III)	21	45	74	27.4 (8.7)	25.3 (8.9)	8 (16.7)	16 (21.3)	30 (24-45.6)	30 (24-45.6)

NOTE. In Horinek et al.,²⁷ the number of subjects per treatment arm only includes patients classified as having an on-track Hill-Sachs lesion (otherwise, there would be a total 48 and 75 patients in the remplissage-augmented and isolated Bankart repairs, respectively).

B+R, Bankart repair augmented with a remplissage procedure; F/U, follow-up; IBR, isolated Bankart repair; MINORS, Methodological Index for Non-Randomized Studies.

*Values are presented as mean (SD) or range (X-X); median (range).

Table 2. Baseline Patients Characteristics

Study	B+R: Glenoid Bone Loss (%)	IBR: Glenoid Bone Loss (%)	B+R: Hill-Sachs Length/Interval, mm	IBR: Hill-Sachs Length/Interval, mm	B+R: Contact Sports Athlete, No. (%)	IBR: Contact Sports Athlete, No. (%)	B+R: Dominant Arm, No. (%)	IBR: Dominant Arm, No. (%)
Yu et al., 2023 ²⁹	7.8 (5.6)	5.9 (3.1)	16.1 (2.8)	14.9 (5.1)	0 (all recreational)	0 (all recreational)	18 (64)	19 (76)
Lin et al., 2023 ²⁵	5.3 (4.8)	3.2 (4.2)	14.9 (2.9)	4.3 (5.1)	31 (55.4)	62 (48.8)	NA	NA
Kirac et al., 2023 ²⁸	2.7 (1.7)	2.3 (2)	13.9 (0.8)	14 (0.8)	100% overhead athletes	100% overhead athletes	NA	NA
Domos et al., 2019 ²⁶	<20	<20	NA	NA	20 (100)	20 (100)	12 (60)	9 (45)
Águila et al., 2023 ²⁴	Median 7.4 (4.6-9.1)	Median 0 (0-7.8)	Median 15.6 (12.2-19)	Median 14.3 (10.3-16.6)	8 (30.8)	18 (34.6)	15 (57.7)	32 (61.5)
Horinek et al., 2022 ²⁷	6.1 (4.9)	2.5 (4.1)	14.5 (3.7)	2.7 (4.5)	32 (66.7)	51 (68)	NA	NA

B+R, Bankart repair augmented with a remplissage procedure; IBR, isolated Bankart repair; NA, not available.

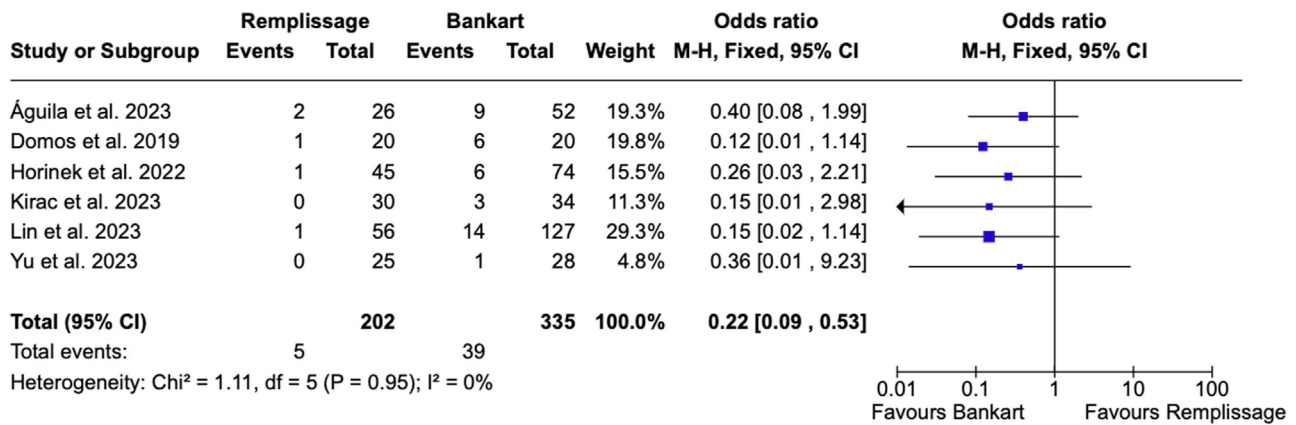


Fig 3. Forest plot demonstrating recurrent dislocation rates.

athletes. These findings suggest that the addition of the remplissage could confer a lower recurrent dislocation rate in patients with on-track (nonengaging) Hill-Sachs lesions.

In addition to lower redislocation rates, subjective instability and consequent revision surgery rates were also found to be lower (0%-32% B+R vs 5%-71.4% IBR and 0%-5% B+R and 0%-35% IBR, respectively) in remplissage-augmented patients in the present review. Two of the included studies^{24,26} reported small, nonsignificant differences in subjective postoperative instability and subsequent revision surgery, which may be the result of the smaller sample size. Kirac et al.²⁸ reported the rate of subjective instability in a population of overhead athletes with on-track Hill-Sachs as being significantly higher (13% vs 38%, $P = .021$) in the isolated repair group. Furthermore, in a nonelite athlete population, Yu et al.²⁹ found a significantly higher subjective instability rate (71.4% vs 32%, $P = .004$) in patients exposed to the isolated procedure, falling in line with the findings reported in the present study.

Regarding rate of return to preinjury level of sports, the present systematic review revealed a 64% to 100%

rate of remplissage-augmented patients returning to their preinjury levels of activity in contrast to 50% to 90% in the isolated repair group. In a study²⁹ evaluating return to preinjury level of sports for recreational athletes, the return to preinjury level favored the remplissage-augmented treatment arm, yet in a more conservative manner (64% vs 50%, $P = .20$). Moreover, 2 studies^{25,26} reporting on return-to-sport rates for collision/contact athletes found higher rates among the remplissage-augmented cohort, yet none reached significance (100% vs 90%, $P = .14$ and 91% vs 79%, $P = .06$). In contrast, a comparative study²⁸ reported that elite overhead athletes who underwent Bankart repair plus remplissage returned to preinjury level of sport at a significantly higher rate than their isolated Bankart counterpart (87% vs 65%, $P = .02$). Thus, these findings could suggest that, irrespective of athletic activity, there is a higher return-to-sport rate in the B+R cohort. However, the effects on overhead athletes were not specifically evaluated.

The general applicability of the remplissage procedure has been traditionally limited by the clinical and biomechanical reported loss of external rotation that is associated with a nonanatomic procedure.³⁰⁻³² However,

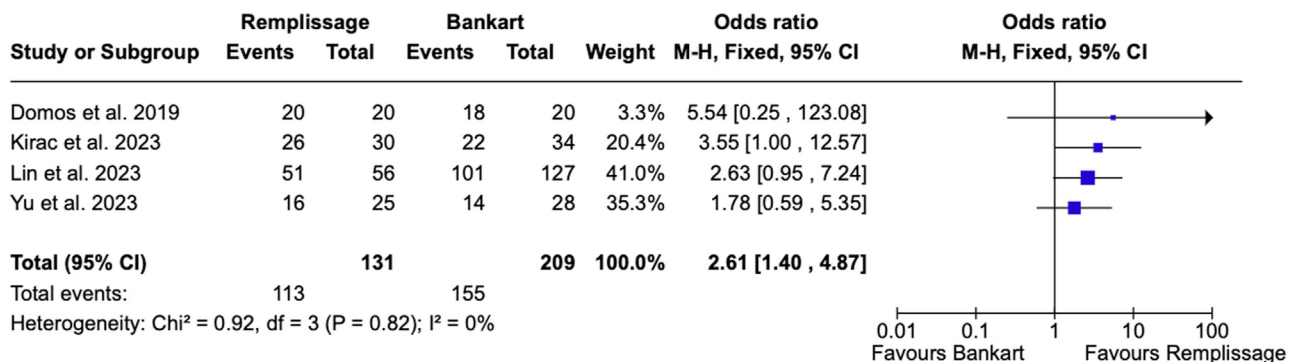


Fig 4. Forest plot demonstrating return to preinjury level of sport.

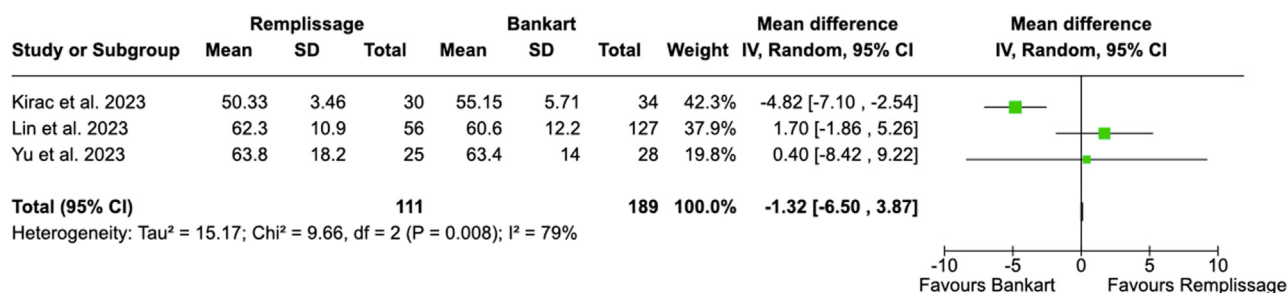


Fig 5. Forest plot demonstrating postoperative external rotation at side.

more recent studies comparing outcomes after an isolated Bankart repair or a Bankart repair augmented with a remplissage in patients with off-track (engaging) Hill-Sachs lesions suggest that the apparent loss of external rotation is not significantly different from that associated with an isolated Bankart repair.^{17,20,33-35} Although Kirac et al.²⁸ reported a significant difference favoring the isolated Bankart repair ($55.1^\circ \pm 5.7^\circ$ vs $50.3^\circ \pm 3.4^\circ$, $P < .001$), the results of the present systematic review only reflect a minimal difference in ranges of postoperative external rotation between augmented and non-augmented procedures (50° - 63° B+R vs 55° - 63° IBR). Furthermore, Yu et al.²⁹ ($63.8^\circ \pm 18.2^\circ$ B+R vs $63.4^\circ \pm 14^\circ$ IBR, $P = .42$) and Lin et al.²⁵ ($62.3^\circ \pm 10.9^\circ$ B+R vs $60.6^\circ \pm 12.2^\circ$ IBR, $P = .43$) reported nonsignificant postoperative external rotation upon comparison between their cohorts. Additionally, although not able to be assessed for in the present study, Ding et al.³⁶ concluded that limitation in external rotation following a remplissage procedure correlated with medial placement of the remplissage anchors, which may explain the significant heterogeneity regarding range of motion variability present across the available literature.

Upon subanalysis of patients described as athletes, the present review found a higher rate of recurrent dislocations in athletes who had undergone an isolated Bankart repair (0%-5% B+R vs 8.8%-30% IBR). These findings support the belief that high-risk patients with

on-track (nonengaging) Hill-Sachs lesions benefit from the addition of the remplissage even in an on-track (nonengaging) setting.^{13,26,28,37,38} Additionally, recurrent dislocation rates in patients with established near-track lesions ranged from 2% to 47% for the B+R cohort and 9% to 66% in the IBR population. In accordance with the results of this study, higher redislocation rates, in patients with near-track lesions, have been reported in the isolated Bankart group upon comparison with the addition of a remplissage.^{13,14}

Despite limitations, these data confer evidence, in the form of outcome trends, that surgeons should consider adding a remplissage to an arthroscopic Bankart repair in patients at higher risk from a demographic and/or an activities perspective in the setting of a nonengaging Hill-Sachs lesion without critical glenoid bone loss. These trends are of particular importance as there appears to be minimal range differences regarding risk of complications or range of motion deficits between procedures. Nonetheless, further prospective high-quality studies are warranted before definitive conclusions can be drawn.

Limitations

The present study is not exempt of limitations. First, the number of included studies comparing outcomes after an isolated Bankart repair or a Bankart repair plus remplissage for on-track (nonengaging) Hill-Sachs

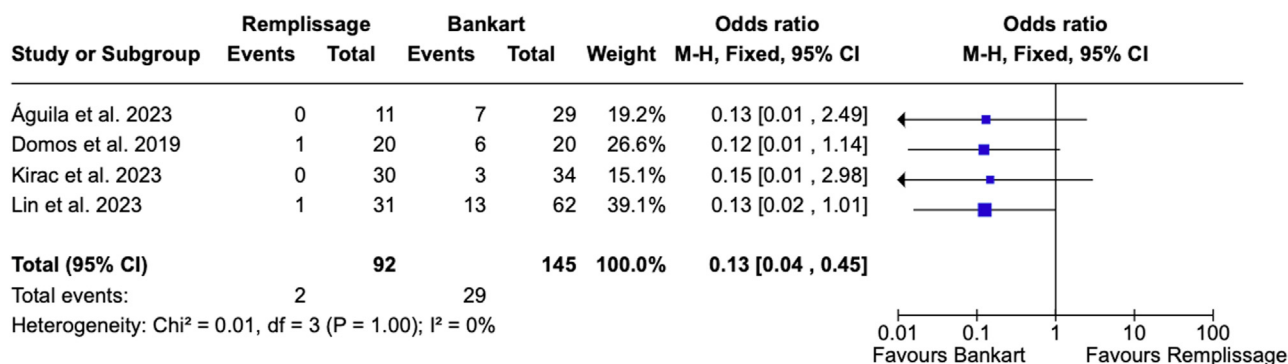


Fig 6. Subgroup analysis—forest plot demonstrating recurrent dislocation rates in overhead/contact athletes.

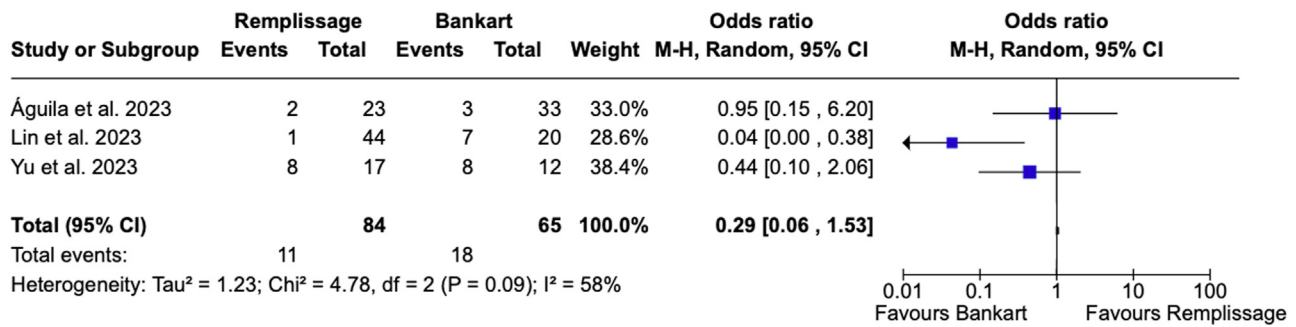


Fig 7. Subgroup analysis—forest plot demonstrating recurrent dislocation rates in near-track Hill-Sachs lesions.

lesions is limited. Thus, the number of patients per treatment arm was relatively small. Furthermore, only level of evidence III studies were available for inclusion, which are susceptible to selection and measurement of outcome (unblinded examinations) bias due to their retrospective nature. Given the encountered study quality limitations and inability to perform a quantitative meta-analysis, careful interpretation of the results is warranted. Additionally, anticipated statistical heterogeneity was expected. However, the authors aimed to address this issue by conducting a qualitative interpretation of the results. Furthermore, a more thorough analysis of postoperative range of motion or significance of clinical outcomes was limited as they were not widely reported in the yielded studies. It is also important to note that the percentage of bone loss varied across the included studies, ranging from 2.7% to 20% and 0% to 20% for the B+R and IBR cohorts, respectively, potentially introducing confounding to the results of the present study. Moreover, although glenoid and humeral bone loss assessment methods remained consistent, imaging modality of choice varied between MRI and computed tomography. Lastly, the technique of how Bankart repairs and remplissage were performed was heterogenous, and it is unknown how differences, however small, may have affected the outcome of the procedure.

Conclusions

Upon qualitative analysis, ranges of recurrent instability measures, including recurrent dislocation rates, are higher in patients undergoing IBR in comparison to

B+R. Activity level influences outcomes as athletes were found to have a higher range of recurrent dislocation rates in the IBR group. The addition of remplissage showed a higher range of return-to-sport rates with comparable postoperative external rotation between groups.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: J.C. is a board member of the American Orthopaedic Society for Sports Medicine, Arthroscopy Association of North America, and International Society of Arthroscopy Knee Surgery and Orthopaedic Sports Medicine; is a consultant or advisor for Arthrex, Ossur Americas, Smith & Nephew, and CONMED Corp; and receives speaking and lecture fees from Smith & Nephew. N.N.V. is a board member of the American Orthopaedic Society for Sports Medicine, American Shoulder and Elbow Surgeons, Arthroscopy Association of North America, and Slack Incorporated; has received funding grants from Arthrex, Breg, Ossur Americas, and Stryker; and is a consultant or advisor for Stryker. All other authors (J.B.V-E., R.S.B., E.C., J.R.G., S.G.A., Z.A.K.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table 3. Absolute Recurrent Dislocation Values Per Study

Study	B+R: Recurrent Dislocation, n (%)	IBR: Recurrent Dislocation, n (%)	P Value
Yu et al., 2023 ²⁹	0/25 (0)	1/28 (3.5)	.34
Lin et al., 2023 ²⁵	1/56 (1.8)	14/127 (11)	.04*
Kirac et al., 2023 ²⁸	0/30 (0)	3/34 (8.8)	.24
Domos et al., 2019 ²⁶	1/20 (5)	6/20 (30)	.01*
Águila et al., 2023 ²⁴	2/26 (7.7)	9/52 (17.3)	.21
Horinek et al., 2022 ²⁷	1/45 (2.2)	6/74 (8.1)	.18

B+R, Bankart repair augmented with a remplissage procedure; IBR, isolated Bankart repair.

*Denotes significance.

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