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Predictors of coracoid graft osteolysis after the Latarjet procedure: A systematic review

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Abstract

Background: Coracoid graft osteolysis is a known complication following the Latarjet procedure and may influence postoperative shoulder stability. While prior studies have reported variable rates of graft osteolysis, the risk factors that influence this process are not well defined. Therefore, the purpose of this systematic review was to investigate the risk factors associated with coracoid graft osteolysis after the Latarjet procedure. We hypothesized that the location of coracoid graft placement on the glenoid would influence graft osteolysis.

Methods: This review followed PRISMA guidelines to query the Medline, Embase, and Cochrane online databases. Eligible studies included prospective or retrospective clinical studies, including cohort studies, comparative studies, and case series, reporting postoperative graft osteolysis assessed by computerized tomography (CT) after the Latarjet procedure. A qualitative analysis was performed.

Results: Fifteen studies met the criteria to be included in this review, encompassing 963 patients. Of the four studies that assessed open vs arthroscopic Latarjet, open Latarjet was associated with increased rates of graft osteolysis in 3 of the 4 of studies (214 of 262 patients). There was an inverse relationship found between preoperative glenoid bone loss and graft osteolysis in 3 of 6 studies (256 of 382 patients), and there were no relationships observed between graft osteolysis and graft position, fixation type, or patient demographics. One of six studies that assessed osteolysis impact on clinical outcomes found lower Walch-Duplay scores as well as recurrent instability, while all other studies found no relationships noted between graft osteolysis and patient-reported outcome measures (PROMs), range of motion, or strength.

Discussion and conclusion: Coracoid graft osteolysis after the Latarjet procedure appears to be influenced by surgical technique (open vs arthroscopic) and preoperative glenoid bone loss, with the arthroscopic technique and increased preoperative glenoid bone loss showing reduced graft osteolysis in some studies. However, most studies demonstrated no significant association between graft osteolysis and clinical outcomes, with contrary findings limited to small, underpowered cohorts.

Level of Evidence: IV

Keywords

Latarjet, coracoid graft osteolysis, shoulder instability, glenoid bone loss, graft position, shoulder range of motion

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Introduction

Anterior shoulder instability is a common problem that is seen most often in young and active populations, more often affecting males than females.[1,2] On average, over half of patients who experience shoulder instability will experience another one within 2 years of the primary event.[1] The Latarjet procedure is a reliable option for patients who have recurrent instability and clinically significant glenoid

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bone loss, including subcritical defects (13.5%–20%) of bone and critical defects (≥20%)of bone.[3,4]

While the Latarjet is an effective procedure for restoring shoulder stability, one of its major complications is coracoid graft osteolysis, which can lead to graft failure and recurrent shoulder instability.[5] A systematic review by Jackson et al.[6] found a 7.5%–100% occurrence of graft osteolysis on radiological imaging. The incidence and severity of coracoid graft osteolysis can be minimized by investigating risk factors.

Several potential risks of coracoid graft osteolysis have been proposed, but findings remain inconsistent across studies. Patient-related factors such as age, sex, diabetes, and smoking have been investigated without clear associations.[7] Preoperative glenoid bone loss has shown mixed effects on coracoid graft osteolysis, with some studies reporting the absence of preoperative bone loss to be the only risk factor associated with graft osteolysis, while others report no effect.[7,8] Surgical techniques, including open versus arthroscopic approach, fixation methods, and graft positioning on the glenoid, may also affect graft incorporation and osteolysis.[9–11] Understanding how these different factors contribute to coracoid graft osteolysis is important both for optimizing surgical technique and for counseling patients regarding expected outcomes.

Therefore, the purpose of this systematic review was to investigate the risk factors associated with coracoid graft osteolysis after the Latarjet procedure. We hypothesized that the location of coracoid graft placement on the glenoid would influence graft osteolysis due to its impact on contact forces that the graft will experience.

Methods

This systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines for reporting systematic reviews and was registered in the PROSPERO registry for systematic reviews (CRD42024625508).

Search strategy

A search strategy was implemented to search the Medline, Cochrane, and Embase databases, with no restriction on publication date. The initial literature search was conducted in January 2026. This search strategy aimed to identify all studies that investigated graft osteolysis after the Latarjet procedure. Examples of search terms included "Latarjet", "shoulder dislocation", "radiograph", "outcomes", "osteolysis", "resorption", "risk factor", "coracoid", and "graft" to identify relevant articles.

Inclusion criteria were (i) patients ≥ 18 years of age, (ii) primary studies that assessed the Latarjet procedure as the index operation for the treatment of recurrent anterior glenohumeral instability, (iii) measurement of coracoid graft osteolysis by Computerized Tomography (CT) imaging during the postoperative course, (iv) evaluation of potential risk factors or predictors associated with coracoid graft osteolysis, and (v) full text articles in English. Exclusion criteria were (i) no mention of coracoid graft osteolysis in postoperative outcomes, (ii) no significant analysis of coracoid graft osteolysis, (iii) the concomitant use of another procedure with Latarjet, and (iv) case reports, technique articles, cadaveric studies, biomechanical studies, reviews, editorials, and conference abstracts.

Assessment of study quality

The methodological quality of included studies was assessed using the appropriate Critical Appraisal Skills Programme (CASP) checklist. Two reviewers independently applied the CASP tool to all included studies. Each checklist consists of a series of domains that assess clarity of research aims, appropriateness of design, recruitment strategy, data collection, risk of bias, ethical considerations, and overall validity. Each domain was rated as "Yes," "No," or "Can't tell." Discrepancies between reviewers were resolved through discussion until consensus was reached.

Data extraction

Extracted data included: (1) study design, (2) number of patients and shoulders, (3) demographic information: sex, age, dominant-sided procedures, (4) length of follow-up, (5) method of imaging used to quantify coracoid graft osteolysis, (6) risk factors for graft osteolysis: preoperative glenoid loss, fixation utilized in the Latarjet procedure, technique performed (open vs arthroscopic and screw vs. button), screw and graft placement on the glenoid, and (7) outcomes associated with graft osteolysis; patient-reported outcome measures (PROMs), shoulder range of motion and strength data.

Statistical analysis

The heterogeneity of the included studies in design, population, and outcomes hindered the ability to perform formal comparative statistics. To report data and outcomes, a qualitative method was utilized to summarize key findings by creating subgroups based on primary outcomes of each study, i.e., screw vs button and open vs arthroscopic techniques.

Results

Literature search

The initial database query yielded 956 potential studies. After excluding 119 duplicates, 837 studies entered the title and abstract stage of screening. Using the aforementioned exclusion criteria, two independent reviewers (J.D. and

C.B.) screened the 837 studies, yielding 73 possible studies for full-text review. Of the 73 potential studies left, 15 met the full criteria to be selected for this review. All disagreements during this process were resolved by an independent third-party reviewer (M.H.). The PRISMA flowchart for this study search is shown in Figure 1.

Study characteristics and demographics

A total of 963 patients were evaluated across the 15 included studies. There were 785 males (85.5%) and 133 females (14.5%). The average age of participants in studies ranged from 23.2 to 33 years. In studies that specified, the dominant arm was operated on in 566/842 procedures (67.2%). The final follow-up of all studies ranged from 3 to 102 months. All studies utilized computed tomography (CT) scans to assess osteolysis. The severity of osteolysis was most commonly classified using the Zhu et al. classification.[12] Other studies determined the percentage change in graft volume by comparing follow-up CT scans to the graft volume from early postoperative imaging**.** Full study characteristics are found in Table 1. The CASP appraisal of methodological quality is summarized in Table 2, with most studies meeting the majority of checklist criteria.

Preoperative glenoid bone loss

Six studies described the relationship between coracoid graft osteolysis and preoperative glenoid bone loss.[8,17,19–21,24] Across studies that reported specific percentages of bone loss, preoperative glenoid bone loss ranged from 0% to 34%. However, there was significant heterogeneity in the methods used to quantify glenoid bone loss. This included differences in imaging modality, measurement technique, and threshold defining glenoid bone loss, which may affect cross-study comparability. Three studies reported that preoperative glenoid bone loss was significantly associated with osteolysis of the coracoid graft,[7,19,20] and three studies reported that preoperative glenoid defects were not associated with coracoid graft osteolysis.[8,17,21] Surprisingly, less preoperative bone loss was associated with increased post-surgical coracoid graft osteolysis. Specific findings from studies are found in Table 3.

Demographic factors

Three studies evaluated the relationship between demographic variables and osteolysis of the coracoid graft.[8,17,24] No studies found a significant association between osteolysis and age, smoking status, and sex.

Surgical technique

Four studies commented on the relationship between technique (open Latarjet vs arthroscopic) and osteolysis of the coracoid graft.[11,13,18,22] Three studies found that the open Latarjet technique leads to significantly higher rates and amounts of coracoid graft osteolysis,[11,18,22] while one study found no differences in osteolysis between techniques.[13] Specific findings of respective studies are found in Table 4.

Screw and graft placement

Four studies evaluated whether coracoid graft location on the glenoid and screw positioning affected osteolysis of the coracoid graft.[7,8,16,22] There were no significant effects found for inferior or superior screw angles/positioning and graft osteolysis. Additionally, graft placement in the sagittal or axial planes had no significant effects on the osteolysis of the graft. One paper reported that a medially positioned graft had a case of early osteolysis.[16]

Fixation types

The effect of fixation type (screws vs buttons) on coracoid graft osteolysis was evaluated by two studies, while one additional study compared two vs four buttons.[10,23] Another study looked at screw fixation alone.[14] There were no significant findings associated with suspensory fixation compared to screw fixation of the coracoid graft in two studies.[10,23] Barrett et al.[15] found no significant differences in graft osteolysis between four-button and two-button groups; however, a significantly higher rate of osteolysis was noted in the four-button group in the proximal/superficial/lateral and medial zones of the graft. Specific data is found in Table 5.

Graft osteolysis and clinical outcomes

Six studies examined the effect that graft osteolysis has on clinical outcomes.[11,13,14,20,21,24] Balestro et al.[14] observed an association between severe osteolysis and inferior Walch-Duplay scores as well as recurrent instability. However, osteolysis did not uniformly result in clinical failure, and this study's findings are limited due to a small sample size. With regards to PROMs, no other studies found that osteolysis had a significant impact on either visual analog score (VAS), American Shoulder and Elbow Score (ASES), constant-Murley score (CMS), Rowe score, or Western Ontario Shoulder Instability Index (WOSI). No study reported a significant association between osteolysis and shoulder forward flexion, abduction, external rotation, or internal rotation. Ali et al.[13] also reported no significant association between graft osteolysis and loss of external/internal rotation strength.

Discussion

The most important finding of this review is that some studies showed increased preoperative glenoid bone loss, and an

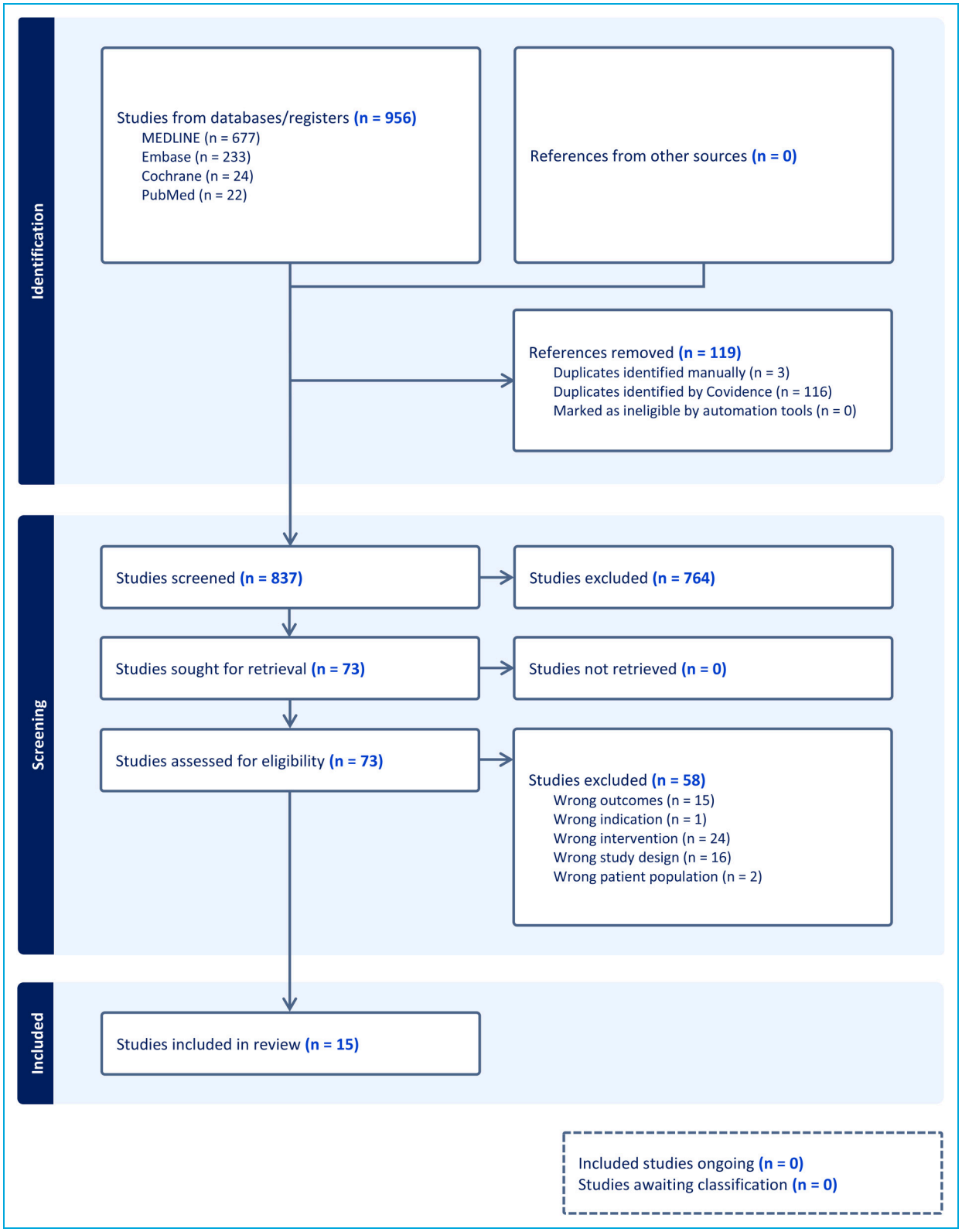

Figure 1. PRISMA flowchart for study selection.

Table 1. Study characteristics and demographics.

Author	LOE	Patients (N)	Shoulders (N)	Sex (M:F)	Dominant side (N)	Mean age (Year)	Radiographic follow-up (Months)
Ali et al.[13]	III	48	48	41:7	26	29.4	30.5
Balestro et al.[14]	IV	11	12	7:4	6	28.6	At least 24 months
Barret et al.[15]	III	69	69	63:6	39	25	At least 6 months
Casabianca et al.[16]	IV	19	19	16:3	11	27.6	3
Cohen et al.[7]	IV	37	38	32:5	-	33	27
Dalmas et al.[17]	IV	27	27	23:4	-	26	12
Delgado et al.[17,18]	III	20	20	16:4	12	29.5	17.4
Di Giacomo et al.[19]	II	34	34	29:5	15	31.7	16.1
Di Giacomo et al.[20]	IV	344	358	287:57	258	30.6	75
Ernstbrunner et al.[21]	IV	48	50	45:3	27	27	102
Kordasiewicz et al.[22]	III	110	110	101:9	70	26.9	35.9
Ohin et al.[23]	III	45	45	-	-	29.9	At least 6 months
Sahu et al.[8]	III	49	49	45:4	46	25.5	25
Wang et al.[10]	III	12	12	12:0	-	23.2	6
Zhu et al.[11]	III	90	90	68:22	56	33.4	24

LOE = Level of evidence

arthroscopic technique may lead to less osteolysis of the coracoid graft after the Latarjet procedure.

Open Latarjet was associated with increased graft osteolysis in three out of four studies that evaluated the effect of technique with respect to osteolysis.[11,18,22] This could be due to the fact that open Latarjet procedures may negatively affect a congruent apposition of the graft, thereby changing healing characteristics.[25,26] The open procedure also requires significantly more dissection in the area of the coracoid, which may lead to reduced localized blood flow to both the coracoid and the glenoid and result in increased osteolysis when using this approach.[2]

The preoperative amount of glenoid bone loss was also shown to have an inverse relationship with graft osteolysis after Latarjet.[19,20,24] This is likely due to increased shoulder instability in patients with reduced glenoid surface area, requiring the bone graft to experience greater stress as it takes on a more primary role in maintaining shoulder stability in these patients. The more stress placed on the bone graft, the more it strengthens and remodels, and less osteolysis will occur as a result of Wolff's Law.[26] However, preoperative glenoid bone loss that exceeds 25–30% or if there is bipolar glenoid bone loss, Latarjet may not provide the best option. In these cases, a distal tibial allograft or Eden-Hybinette procedure may be preferred as the larger graft will restore anatomy more effectively.[27,28]

While preoperative glenoid bone loss and open vs arthroscopic technique did appear to significantly influence graft osteolysis, graft location on the glenoid (in axial and sagittal planes) did not result in significant changes to graft osteolysis.[8, 17,22] While one study reported early osteolysis in medially positioned grafts, the short duration of

Table 2. Critical appraisal skills programme (CASP) checklist.

CASP scale	Ali et al.[13]	Balestro et al.[14]	Barret et al.[15]	Casabianca et al.[16]	Cohen et al.[7]	Dalmas et al.[17]	Delgado et al.[18]	Di giacomo et al.[19]	Di giacomo et al.[20]	Ernstbrunner et al.[21]	Kordasiewicz et al.[22]	Ohin et al.[23]	Sahu et al.[8]	Wang et al.[10]	Zhu et al.[11]
Clearly focused question	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Appropriate recruitment	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Outcome accurately measured to minimize bias	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Appropriate outcomes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Confounding factors accounted	No	No	Yes	No	No	Yes	Yes	Yes	Yes	No	No	Cannot Tell	Yes	Cannot Tell	No
Appropriate follow-up	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Appropriate analysis	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Precise statistical results presented	Yes	Cannot Tell	Cannot Tell	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Cannot Tell	Yes
Ability to generalize results	Yes	Cannot Tell	Cannot Tell	Cannot Tell	Yes	Cannot Tell	Yes	Yes	Yes	Yes	Cannot Tell	Yes	Yes	No	Yes
Interpretation related to existing evidence	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total Score	**High**	**Moderate**	**Moderate**	**Moderate**	**High**	**High**	**High**	**High**	**High**	**High**	**Moderate**	**Moderate**	**High**	**Moderate**	**High**

Table 3. Preoperative glenoid bone loss.

Author	Shoulders (N)	Study design	Comparators	Finding(s)
Cohen et al.[7]	38	Retrospective cohort	Group A: Patients with none/minor coracoid graft osteolysis (n = 27) Group B: Patients with major/total coracoid graft osteolysis (n = 11)	Patients in Group B possessed significantly lower preoperative glenoid bone loss compared to Group A (13.4% vs 22.8%, **p = 0.0075**)
Di Giacomo et al.[19]	34	Prospective Cohort	Group A: Preoperative glenoid bone loss >15% (n = 13) Group B: No preoperative glenoid bone loss (n = 21)	Graft osteolysis across the entire graft: 39.6% in Group A and 65.1% in Group B (**p < 0.05**) Proximal superficial lateral graft: Significantly higher osteolysis in Group B (81.6% ± 5.7 vs 54.4% ± 11.0, **p = 0.009**) Proximal deep lateral graft: Significantly higher osteolysis occurred in Group B (57.9% ± 7.8 vs 27.4% ± 6.5, **p = 0.007**) Distal superficial lateral graft: Significantly higher osteolysis occurred in Group B (55.2% ± 6.6 vs 26.4% ± 10.4, **p = 0007**) Distal deep lateral graft: Significantly higher osteolysis occurred in Group B (62.8% ± 5.7 vs 30.8% ± 10.6, **p = 0.007**)
Sahu et al.[8]	49	Retrospective Cohort	Group A: No preoperative glenoid bone loss (n = 25) Group B: Preoperative glenoid bone loss >15% (n = 24)	Coracoid graft osteolysis was not significantly different between Groups No significant differences in the bony healing of the graft between groups No significant differences in osteolysis at the superior or inferior screw in the sagittal or axial planes
Dalmas et al.[17]	27	Case Series	N/A	Preoperative glenoid bone loss did not significantly influence the osteolysis rate at 1 year after multivariate analysis
Di Giacomo et al.[20]	384*	Prognostic	Recurrent Instability Group and No Recurrent Instability	On -track subjects: 85.3% ± 2.5% osteolysis for on-track subjects (n = 73) >13.5% bone loss: 42.9% ± 2.3% osteolysis (n = 86) Off-track subjects: 23.9% ± 4.8% osteolysis (n = 25).
Ernstbrunner et al.[21]	50	Case Series	N/A	0% to 5% preoperative glenoid bone: lost 28% of the volume at the final follow-up (**p = .002**). >5% to 10% preoperative bone loss: lost 26% of volume at final follow-up (**p < .001**). >10%-<15% preoperative bone loss: lost 14% of bone at final follow-up (p = .067). No significant differences were observed in graft resorption between the different groups of preoperative glenoid bone loss at the final follow-up (p = .329).

Bold values represent significant findings.
* of the 384 patients there were 184 patients that were assessed based on pre-operative bone loss.

Table 4. Open vs arthroscopic Latarjet.

Author	Shoulders (N)	Study design	Comparators	Finding(s)
Zhu et al.[11]	90	Prospective Cohort	Arthroscopic Latarjet (n = 46) Open Latarjet (n = 44)	The arthroscopic group showed significantly less graft osteolysis compared with the open group **(p = 0.044)**
Kordasiewicz et al.[22]	104	Retrospective Cohort	Arthroscopic Latarjet (n = 61) Open Latarjet (n = 43)	Significantly higher number of patients who had total graft osteolysis were in the open group (11.9% vs 0%, **p = 0.025**) Significantly higher number of patients had superior graft osteolysis in the arthroscopic group (53.3% vs 23.8%, **p = 0.029**) There was no significant difference between groups for inferior graft osteolysis
Ali et al.[13]	48	Retrospective Cohort	Arthroscopic Latarjet (n = 33) Open Latarjet (n = 15)	No significant difference in graft osteolysis rates between groups (21% ± 23 vs 34% ± 21, p = 0.087)
Delgado et al.[18]	20	Prospective Cohort	Arthroscopic Latarjet (n = 10) Open Latarjet (n = 10)	20% of patients in the open group have >20% of graft osteolysis in the open group, compared to 0% in the arthroscopic group (**p < 0.001**)

Table 5. Suspensory vs screw outcomes on coracoid graft osteolysis.

Author	Shoulders (N)	Study design	Comparators	Finding(s)
Ohin et al.[23]	45	Retrospective Cohort	Endobutton fixation (n = 32) Screw fixation (n = 13)	There was no significant difference between endobutton and screw fixation with regards to osteolysis (p = 0.47)
Wang et al.[10]	12	Retrospective Cohort	Button fixation (n = 6) Screw fixation (n = 6)	At 3 months follow-up: Average bony resorption rates were 13.82% and 5.26% in the screw fixation group and the button fixation group, respectively At 6 months follow-up: Average bony resorption rates were 25.2% and 10.18% in the screw fixation group and the button fixation group, respectively
Barret et al.[15]	69	Retrospective Cohort	4 Button fixation (n = 23) 2 Button fixation (n = 46)	The percentage of bone block osteolysis was similar between the groups: 28% in group 4B and 23% in group 2B (p = 0.71) The rates of bone block osteolysis were significantly increased in the four-button group compared to the two-button group for the proximal/superficial/lateral **(0.038)** and proximal/superficial/medial **(0.04)** zones of the graft
Balestro et al.[14]	12	Retrospective Case Series	Screw Fixation (n = 12)	At 3-month follow-up, graft union was observed in 100% of shoulders and there with no radiographic evidence of osteolysis. At 2-year follow-up there was some degree of osteolysis and remodeling of the graft in all cases. Eight of 12 shoulders had severe osteolysis with an almost complete disappearance of the graft

follow-up precluded assessment of long-term osteolysis across other graft positions.[16] In the sagittal plane, grafts are recommended to be placed at the typical location of bone loss, within the 3–5 o'clock position on the right shoulder (9–7 o'clock on the left) due to biomechanical studies showing increased shoulder stability.[29] Proper graft placement to maximize glenohumeral stability in the axial plane has been suggested to be with a lateralization between 1.5 mm and 3.0 mm with respect to flush positioning and between −1.8 mm and 0.4 mm according to the axial circle method.[30] While the clinical benefits of placing grafts within these parameters are to be considered, this review has found no benefit radiographically when evaluating their effects on graft osteolysis.

Graft osteolysis is important to consider as it may lead to graft failure, recurrent instability, and the need for a revision procedure.[5] The current review suggests that graft osteolysis is not consistently associated with inferior patient-reported outcomes, range of motion, strength, or recurrent instability, with the exception of one small study reporting worse clinical outcomes in cases of severe osteolysis.[7,11,13,14,20,21] This is meaningful as graft osteolysis is often assessed by postoperative CT grading,[12] which carries a high financial cost and radiation exposure. With graft osteolysis demonstrating no significant impact on postoperative functional outcomes, it is debatable if routine CT scans to assess graft integrity are necessary with regard to appropriate resource allocation and patient safety. A potential alternative would be to utilize CT scans to assess graft integrity and bony anatomy only after recurrent instability or clinical deterioration of a patient's shoulder after they have undergone the Latarjet procedure.

Limitations

The largest limitation of this review is the heterogeneity of the included retrospective studies with small sample sizes, which limited the performance of comparative statistics or pooling of data and reduced the generalizability of the study's findings. Additionally, there was also a lack of ability to control confounding variables such as patient demographic factors or the inter- and intra-observer reliability of assessing coracoid graft osteolysis. Lastly, this systematic review shares limitations that are common to systematic reviews, such as publication bias, reviewer bias, and the quality of included studies.

Conclusion

Coracoid graft osteolysis after the Latarjet procedure appears to be influenced by surgical technique (open vs arthroscopic) and preoperative glenoid bone loss, with the arthroscopic technique and increased preoperative glenoid bone loss showing reduced graft osteolysis in some studies. However, most studies demonstrated no significant association between graft osteolysis and clinical outcomes, with contrary findings limited to small, underpowered cohorts.

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