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REVIEW ARTICLE

Long-term outcomes of the Latarjet procedure for anterior shoulder instability: a systematic review of studies at 10-year follow-up

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Background: This study systematically reviewed the evidence in the literature to ascertain the functional outcomes, recurrences rates, and subsequent revision rates after the open Latarjet procedure at a minimum of 10 years of follow-up.
Methods: Two independent reviewers performed the literature search based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, using the Embase, MEDLINE, and The Cochrane Library Databases. Studies that reported a minimum of 10 years of clinical follow-up after the Latarjet procedure were included.
Results: Our review found 13 studies including 822 patients (845 shoulders) meeting our inclusion criteria. Patients (82% men) were an average age of 27.4 years, and mean follow-up was 199.2 months (16.6 years). The commonly used functional outcome score was the Rowe score with a weighted mean average of 88.5. The overall rate of return to play sports was 84.9%, with 76.3% returning to the same level of play. The rate of good/excellent outcomes was 86.1%. The recurrent instability rate was 8.5%, with 3.2% of patients having recurrent dislocations. The revision rate was 3.7%, with 1.6% of patients undergoing revisions due to recurrence. There were arthritic changes in 38.2% of patients and residual shoulder pain in 35.7%, with 4.8% experiencing daily pain.
Conclusions: The Latarjet procedure for anterior shoulder instability results in excellent functional outcomes at long-term and a high rate of return to sport among athletes. However, varying rates of recurrence, residual pain, and progression of instability arthropathy are still of concern.
Level of evidence: Level IV; Systematic Review

Keywords: Latarjet; anterior shoulder instability; systematic review; long-term; glenoid bone loss; complications; recurrent instability

Glenoid bone loss is a challenging clinical problem in the setting of recurrent anterior shoulder instability.[31] The Latarjet procedure is a commonly used procedure, indicated in the setting of >15% glenoid bone loss and patients with significant risk factors for recurrence.[31] This involves transferring

Institutional Review Board approval was not required for this systematic literature review.

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the coracoid process and conjoined tendon to the anterior glenoid rim. The Latarjet procedure has traditionally been performed via an open approach; however, authors have recently advocated for performing it arthroscopically.[16,22,23,26,29]

The Latarjet procedure has a lower recurrence rate than the arthroscopic and open Bankart repairs.[2,14,18] There are concerns with performing a primary Latarjet procedure, because it has a high rate of reported intraoperative and early postoperative complications, including nonunion, hardware problems, and neurovascular damage.[10,12,13] Griesser et al[12] found in a recent systematic review of 1904 shoulders that 30% of patients had a complication, including recurrent instability, after the Latarjet procedure.

The long-term outcomes after the Latarjet procedure remain unclear. Therefore, the purpose of this study was to systematically review the evidence in the literature to ascertain the functional outcomes, recurrences rates, and subsequent revision rates after the open Latarjet procedure at a minimum of 10 years of follow-up. We hypothesized that the Latarjet procedure would result in excellent functional outcomes, with low recurrences rates and subsequent revision rates.

Materials and methods

Study selection

Two authors (EH, MJ) performed the literature search using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and reviewed the search results, with a senior author (LP) arbitrating any disagreement.[25] The titles and abstracts identified in the search were screened, and potentially eligible studies received a full-text review.

Search strategy

The following search terms were used in MEDLINE, Embase, and The Cochrane Library, databases in May 2018 as the search algorithm: (anterior shoulder instability or shoulder instability) AND (Latarjet OR open latarjet OR arthroscopic latarjet OR latarjet procedure OR bristow OR open bristow OR bristow procedure OR bristow-latarjet OR coracoid transfer). No time limit was given to publication date.

Eligibility criteria

The inclusion criteria were (1) clinical study on the open Latarjet procedure, (2) 10-year follow-up, (3) published in a peer reviewed journal, and (4) published in English. The exclusion criteria were (1) review studies, (2) cadaveric studies, (3) biomechanical studies, and (4) abstract only.

Data extraction and analysis

The relevant information regarding the study characteristics, including the study design, the level of evidence, the methodological quality of evidence (MQOE), population, clinical outcome measures, and the follow-up time points were collected by 2 blinded reviewers using a predetermined data sheet, with the results compared by a third independent reviewer.

The level of evidence was evaluated based on the guidelines by the Oxford Centre for Evidence-Based Medicine. The MQOE was evaluated using a Modified Coleman methodology score.[8] Studies were considered to be of excellent quality if they scored 85 to 100, good quality if they scored 70 to 84, fair quality if they scored 55 to 69, and poor quality if they scored less than 55. The clinical outcomes that were extracted and analyzed were (1) functional outcomes and return to sport, (2) recurrent instability, (3) revisions, (4) instability arthropathy, and (5) residual pain. When required information was not available in the text, the authors were contacted.

Statistics

Quantitative statistical analysis was performed using SPSS 22.0 software (IBM, Armonk, NY, USA). The results in the included studies were pooled, and the overall rates were subsequently calculated.

Results

Literature search

The initial literature search resulted in 771 studies. After duplicates were removed, the articles were screened for inclusion and exclusion criteria, and 516 unique studies were evaluated, and full texts were assessed for eligibility. The review included 13 clinical studies with 822 patients and 845 shoulders (Fig. 1).[1,5,11,15,16,18,21,24,27,28,32,33,38]

Study characteristics and patient demographics

There were 12 unique patient groups in 13 studies with 822 patients and 845 shoulders, all retrospective case series.[1,5,11,15,16,18,21,24,27,28,32,33,38] Two studies reported the same patient group, and the results of both were used.[17,18] The mean MQOE of the studies was 60.1. There were 624 men (82.0%) and 148 women (18.0%), with an average age of 27.4 years (range, 15-58 years) and a mean follow-up of 199.2 months. The study characteristics and patient demographics are reported in Table I.

Functional outcomes and return to play

The overall rate of return to play was reported in 8 studies (Table II) and was 84.9%, with 76.3% returning to the same level of play. The commonly used functional outcome score was the Rowe score with a weighted mean average of 88.5 (n = 353) at final follow-up. Overall, 86.0% (265 of 308) of patients had good-excellent outcomes, and 94.8% (383 of 404) were satisfied with the procedure.

Recurrent instability

The overall recurrent instability rate was reported in all studies for 845 shoulders (Table III). Overall, there

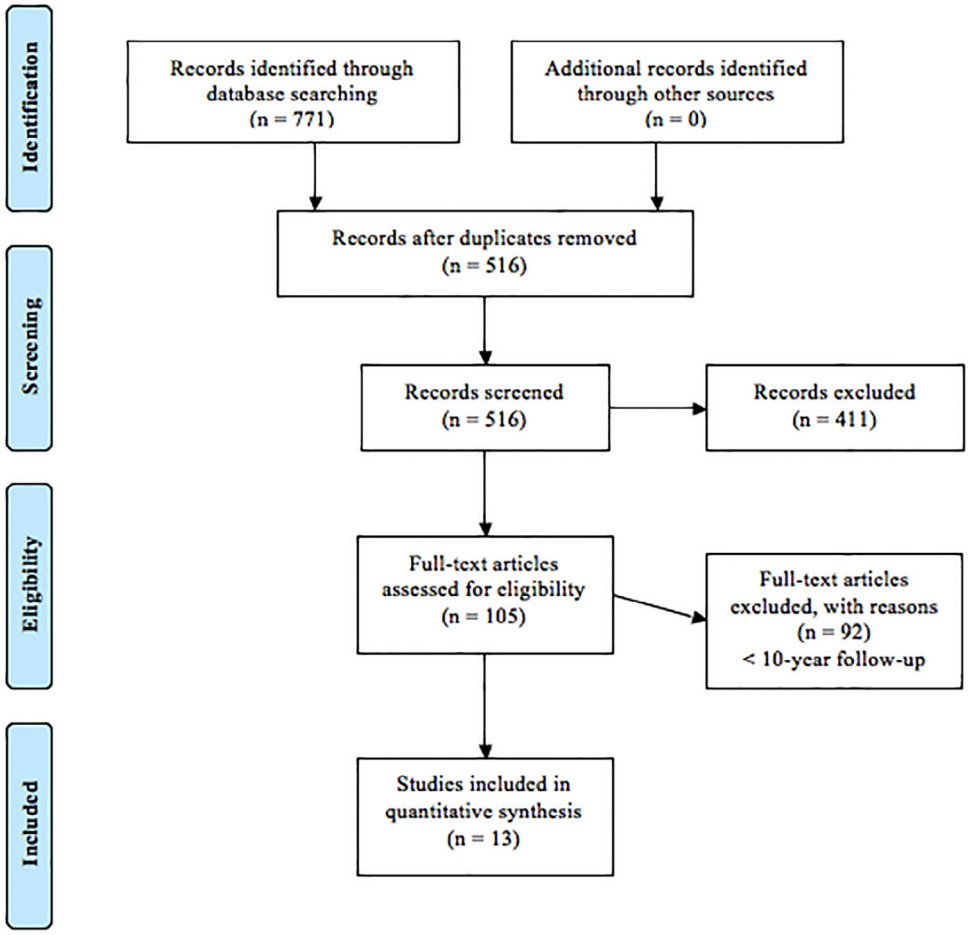

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) study.

Table I Study characteristics and patient demographics

Author	Year	Shoulders (patients)	LOE	MQOE	Male	Age	Follow-up	Previous surgery
		(No.)			(No.)	Mean (range), yr	Mean (range), mo	(No.)
Allain et al[1]	1998	58 (56)	IV	56	43	27.5 (15-58)	172 (120-23)	2
Bouju et al[5]	2014	78 (76)	IV	71	48	26.7 (N/R)	156 (120-180)	10
Gordins et al[11]	2015	31 (31)	IV	58	23	27.0 (15-39)	408 (396-420)	11
Hovelius et al[17,18]	2004/2006	118 (113)	IV	66	95	27.0 (15-57)	182 (172-250)	7
Hovelius et al[19]	2012	167 (167)	IV	69	142	28.0 (17-53)	204 (120-276)	8
Ladermann et al[20]	2013	117 (117)	IV	57	82	28.4 (16-55)	194 (120-266)	N/R
L'Escalopier et al[22]	2018	20 (2)	IV	49	20	26.5 (N/R)	196 (180-288)	0
Mizuno et al[26]	2014	68 (60)	IV	66	49	29.4 (16-58)	240 (216-264)	0
Neyton et al[27]	2012	37 (34)	IV	59	34	23.4 (17-33)	144 (68-237)	0
Schroder et al[30]	2006	52 (49)	IV	62	48	20.5 (18-22)	317 (296-338)	N/R
Singer et al[31]	1995	14 (14)	IV	40	8	25.0 (18-36)	246 (240-270)	N/R
Zimmermann et al[36]	2016	93 (93)	III	68	82	30.8 (N/R)	119 (N/R)	0

LOE, level of evidence; *MQOE*, methodological quality of evidence; *N/R*, not reported.

were 72 recurrent instability events (8.5%). The rate of recurrent instability and recurrent subluxations was reported in 12 studies with 728 shoulders. There were 23 shoulders with recurrent dislocations (3.2%) and 47 shoulders with recurrent subluxations (6.7%). The rate of persistent apprehension was reported in 6 studies with 487 shoulders. Persistent apprehension was present in 48 shoulders (9.9%).

Table II Functional outcomes and return to play

Outcome	Studies (No.)	Result % (No.)
Return to play		
Total	8	84.9 (529)
Same or higher level	5	76.3 (299)
Rowe	6	88.5 (353)
Constant	2	83.2 (72)
Walch-Duplay	3	88.5 (224)
Subjective Shoulder Value	6	89.1 (319)
Good/excellent outcomes	5	86.0 (308)
Satisfaction	6	94.8 (404)

Table III Recurrent instability

Outcome	Studies (No.)	Percentage (No.)
Total recurrence	13	8.5 (72/845)
Redislocations	12	3.2 (23/728)
Subluxations	12	6.7 (47/702)
Apprehension	6	9.9 (48/487)

Table IV Revisions

Outcome	Studies (No.)	Percentage (No.)
Total revisions	11	3.7 (26/714)
Revisions due to recurrence	12	1.6 (12/728)

Revisions

The overall revision rate was reported in 11 studies with 714 shoulders (Table IV). Overall, there were 26 revisions (3.7%), mostly due to recurrence or removal of hardware. The revision rate due to recurrence was reported in 12 studies with 728 shoulders, with 12 revisions (1.6%) due to recurrence. The most common reason for revision other than recurrence was screw removal in 7 patients (1.0%). Other reasons for revisions included infection washout, hematoma removal, arthroplasty, acromioplasty, superior-labral anterior-posterior repair, posterior stabilization, and hardware removal (all in 1 patient).

Instability arthropathy

The overall rate of instability arthropathy at final follow-up was reported in 11 studies with 541 shoulders (Table V). At final follow-up, there were grade I arthritic changes in 26.5% (143 of 540), grade II changes in 6.1% (33 of 540), and grade III changes in 6.1% (30 of 520). Only 1 shoulder (0.12%) in the included studies went on to have a shoulder arthroplasty. Changes in arthropathy status from baseline were

Table V Instability arthropathy

Outcome	Studies (No.)	Percentage (No.)
Arthroplasty	13	0.12 (1/845)
Grade at final follow-up		
Grade 0	11	61.9 (334/540)
Grade I	11	26.5 (143/540)
Grade II	11	6.1 (33/540)
Grade III	11	5.6 (30/540)
Without preoperative arthropathy		
Grade 0	6	77.4 (212/274)
Grade I	6	16.7 (46/274)
Grade II	6	3.6 (10/274)
Grade III	6	2.2 (6/274)
With preoperative grade I arthropathy		
Grade I	5	76.5 (26/34)
Grade II	5	14.7 (5/34)
Grade III	5	8.9 (3/34)
With preoperative grade II arthropathy		
Grade II	2	20 (1/5)
Grade III	2	80 (4/5)

reported in 6 studies with 313 shoulders. Arthritic changes in those without preoperative arthritis were reported to be grade I changes in 16.7% (46 of 274), grade II changes in 3.6% (10 of 274), and grade III changes in 2.2% (6 of 274), with no arthritic changes were noted in 77.4% (212 of 274). Arthropathy in those with preoperative grade 1 was reported to be grade II arthropathy in 14.7% (5 of 34) and grade III arthropathy in 8.9% (3 of 34), with no arthritic changes noted in 76.5% (26 of 34). Arthropathy in those with preoperative grade 2 was reported to progress to grade III arthropathy in 20% (1 of 5), while no arthritic changes were noted in 80% (4 of 5).

Residual pain

Residual pain was reported in 8 studies with 499 shoulders (Table VI). Residual pain was reported in 35.7% (178 of 499) of shoulders overall, including daily pain in 4.8% (24 of 499) and occasional pain in 30.9% (154 of 499). One study

Table VI Residual pain

Outcome	Studies	Percentage (No.)
Residual pain	8	35.7 (178/499)
Daily pain	8	4.8 (24/499)
Occasional pain	8	30.9 (154/499)

reported the visual analog scale score in 37 shoulders, with a mean of 1.5 (range, 0-5.5). The full results of the included studies are listed in Supplemental Table S1.

Discussion

The most important finding from our study was that the Latarjet procedure results in excellent functional outcomes at the long-term follow-up with a low rate of recurrence and complications. In addition, there was a high rate of return to sport among athletes. Progression of instability arthropathy was uncommon, and most changes were minor. However, recurrent pain was common and is a concern in the long-term. In addition, the literature consisted entirely of low-level studies, all of which were retrospective, showing the need for further high-level studies with long-term follow-up.

Our study found high patient-reported functional outcome scores after the Latarjet procedure, with 86% of patients achieving good to excellent outcomes and more than 90% satisfied with the procedure at an average of 16 years postoperatively. However, a variety of functional outcome scales were used, including the Rowe score and Walch-Duplay score, both of which are specific to shoulder instability, and Constant score for general shoulder condition.[37] The Rowe score was the most commonly used outcome measure, being used in 6 of the studies, all of which found mean Rowe scores greater than 80, indicating a "good" result.[37] The high level of satisfaction might be attributable to the high rate of return to play, because Warth et al[35] found the greatest concern in patients undergoing surgery for anterior shoulder instability was the ability to return to sporting activity. In addition, the rate of return to play at the previous level was high in more than 75% of patients. Several studies have compared the results of return to play between the Latarjet procedure and Bankart repairs, with similar results reported between the 2 techniques.[3-5,7,14,17,38]

Our study established that there was a low recurrence rate at long-term follow-up after the Latarjet procedure. Most of recurrent instability events were subluxations, with recurrent dislocations comprising less than one-third of instability events. Griesser et al[12] found in their systematic review of complications after the Latarjet procedure that 73% of recurrences occurred in the first year. Zimmerman et al[38] reported in a study of 93 patients with 10 years of follow-up that all recurrences occurred in the first 2 years after the Latarjet procedure. This is in contrast to the arthroscopic Bankart repair, where they found that the results declined over time. The Latarjet procedure is often indicated in patients with significant risk factors for recurrent instability after the operation, such as the Instability Severity Index Score, previous instability surgery, glenoid bone loss, young age, male sex, and collision sports.[34,38] However, we were unable to evaluate risk factors for recurrence due to under-reporting of the data.

Overall, there was a low rate of revisions in the 16-year mean follow-up, with less than 5% of patients undergoing a revision procedure. The most common reason for revision was recurrent instability, although this occurred in less than 2% of patients. Problems related to the hardware, such as screw breakage or loosening or screws penetrating into the joint, resulted in several revisions.[12] However, despite the low rate of revisions overall, complications remain a concern with the Latarjet procedure, given that Griesser et al[12] reported a 30% complication rate after the Latarjet procedure in the literature. The systematic review by Griesser et al[12] focused extensively on complications, and as a result, we chose not to focus on the complications in this review other than arthropathy and pain, which occur in the long-term.

There was a high reported rate of progressive instability arthropathy in the long-term follow-up after the Latarjet procedure, with one-quarter of patients progressing in arthropathy grade. Less than 10% of patients overall had grade II/III arthropathy at final follow-up, and in most of the shoulders, degenerative changes over time were limited to progression of arthropathy by one grade according to the Samilson and Pietro classification.[6] This is in contrast to patients treated with a Bankart repair for anterior shoulder instability, because studies have shown up to a 70% rate of arthropathy at long-term follow-up.[20,30] Only 1 patient overall went on to require a shoulder arthroplasty for instability arthropathy. Several studies identified risk factors for progressive instability arthropathy, including older age, high-demand sports, and lateral positioning of the transferred coracoid in relation to the glenoid rim.[11,20,26] Shoulder arthroplasty after the Latarjet procedure is rare, and few reports exist in the literature. Willemont et al[36] reported the results of 33 patients who underwent shoulder arthroplasty after the Latarjet procedure and found it was technically challenging but reliable in improving pain.

Despite the high rate of satisfaction, some degree of residual pain was found in a significant number of patients. This relatively high rate of residual pain could be related to the progressive degenerative changes in the joint. Laderman et al[20] found that instability arthropathy was related to lower patient satisfaction, which would support this theory. They also reported similar rates of osteoarthritis and residual pain. It is worth noting, however, that pain is a multifactorial process and is unlikely to be due entirely to osteoarthritis, because concomitant pathologies may also play a role. However, the degree of pain was generally very low, and overall, less than 5% of patients experienced daily pain.

This study has several limitations and sources of potential biases, including the limitations of the included studies themselves. The biggest source of potential bias in this study is that the search criterion was limited to English articles, which excluded other foreign language articles on the long-term outcomes of the Latarjet procedure. All of the included studies were retrospective and uncontrolled, which may introduce selection bias.

There was a lack of information in patient demographics, including risk factors for recurrence such as glenoid bone loss, Instability Severity Index Score, and previous instability events.[34] In addition, there are significant variations in the

Latarjet procedure technique between centers, which may affect the outcome.[9]

Conclusion

The Latarjet procedure for anterior shoulder instability has been shown to result in excellent functional outcomes at long-term and a high rate of return to sport among athletes. However, varying rates of recurrence, residual pain, and progression of instability arthropathy are still of concern.

Disclaimer

The authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jse.2018.08.028.

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