Comparative Systematic Review of Fixation Methods of the Coracoid and Conjoined Tendon in the Anterior Glenoid to Treat Anterior Shoulder Instability

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Background: Coracoid process transfer for the treatment of recurrent glenohumeral dislocations is a safe and reliable procedure; however, there is no consensus as to which is the best method, the Bristow or Latarjet procedure.

Purpose: To analyze the results of coracoid process transfer for the treatment of recurrent glenohumeral dislocations and to compare the results of this transfer between the Bristow and Latarjet techniques.

Study Design: Systematic review; Level of evidence, 4.

Methods: The databases surveyed for this review included J-STAGE; Cochrane Bone, Joint and Muscle Trauma Group Specialized Register; Cochrane Controlled Register of Trials; MEDLINE; Ovid; Embase; Google Scholar; and CINAHL. Inclusion criteria consisted of (1) studies related to anterior glenohumeral dislocations treated with transfer of the coracoid process to the anterior glenoid rim and (2) studies that could provide data to perform at least 1 meta-analysis or other statistical evaluation. Titles and abstracts were reviewed for inclusion; thereafter, outcomes and the risk of bias were extracted. Statistical analyses were performed according to the nature of the data. When possible, the 95% CI was included.

Results: Of the 779 studies found, 63 were able to provide data assessing 3395 shoulders. There were no randomized, blinded, or double-blinded trials. The recurrence of dislocations was assessed in 41 studies that used the Bristow technique (n = 2346 shoulders; percentage redislocations [mean ± SE], 1.00% ± 0.20%) and 18 studies that used the Latarjet technique (n = 930 shoulders; percentage redislocations, 2.13% ± 0.49%) ($P = .04$). The mean loss of external rotation was 12.91° for the Bristow procedure (n = 1440 shoulders) and 11.70° for the Latarjet procedure (n = 243 shoulders). The mean quality-of-life outcome scores were as follows for the Bristow and Latarjet procedures, respectively: Rowe score, 92.06 and 89.33; Western Ontario Shoulder Instability Index score, 16.44% and 19.68%; Japanese Orthopaedic Association score, 93.28 and 92.00; and American Shoulder and Elbow Surgeons score, 91.00 and 89.90.

Conclusion: Transferring the coracoid to the anteroinferior border of the glenoid through the subscapularis tendon is effective, regardless of the technique. When comparing the Bristow and Latarjet techniques, the recurrence of dislocations was the only outcome that could undergo a meta-analysis, and it presented a statistically significant difference in favor of the Bristow procedure. All other outcomes presented no clinically significant differences between their effect sizes. More studies presenting better methodology are still needed to achieve more robust conclusions.

Keywords: shoulder instability; shoulder dislocation; joint dislocation; joint instability

The glenohumeral joint is the most unstable articulation in the human body. Its dislocation incidence is 11.2 per 100,000 persons per year.[17] In the middle ages, Ruggero Frugardo of the famous medical school of Salerno, after anatomic studies, suggested that an anterior capsule injury was the cause of anterior shoulder instability.[61] In 1906, Perthes[57] brought more light on this subject. He was the first to suggest the importance of labral lesion repair (repair of the glenoid labrum to the bony ridge) to control shoulder instability, a principle also seen in the later works of Bankart.[5,6]

However, other methods that modify anatomy have also achieved success. One of the most reliable is transfer of the coracoid process to the anteroinferior glenoid rim. The

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treatment goals for anterior shoulder instability are to restore a functional, painless, and stable shoulder. The age of the patient, presence or absence of bone loss, history of dislocations, occupation, activity level, ligamentous laxity, and voluntary dislocators will influence the choice of treatment method.

There are 2 basic surgical approaches for shoulders with anterior instability: anatomic and nonanatomic.[45] The objective of a nonanatomic surgical procedure is to stabilize the shoulder by compensating the capsulolabral and bony structures damaged in recurrent dislocators. Among the nonanatomic stabilization techniques are the Bristow and Latarjet procedures. The Latarjet procedure restores glenoid bony anatomy in patients with significant glenoid bone loss. The 3 stabilizing principles of both the Bristow and Latarjet procedures are bone block, conjoined tendon as a shield, and increased tension in the lower portion of the subscapularis in abduction and external rotation.[23]

The first report on this transfer took place in 1954 by Michel Latarjet.[40] However, in 1958, Helfet,[26] in tribute to the tenth year of his mentor's death, reported the technique that he had learned 19 years prior (1939) with Walter Rowley Bristow at St Thomas' Hospital in London.

Page and Bristow[53] wrote in 1929 that recurrent shoulder dislocations would need surgical intervention; however, no specification of the surgical procedure was reported at this time.

The Bristow procedure was based on detachment of the coracoid tip, preserving the pectoralis minor muscle insertion. This graft is inserted through a vertical incision in the subscapularis tendon and then sutured at the anteroinferior glenoid rim. The incised margins of the subscapularis tendon are then closed. However, the current literature considers the Bristow procedure as the insertion of the coracoid process through a horizontal subscapularis incision and fixation of the graft in the horizontal position at the anteroinferior glenoid neck. It is currently fixed with just 1 screw. The Latarjet procedure described in 1954 also reported the transfer of just the coracoid's tip to the anteroinferior glenoid rim, preserving all the pectoralis minor and utilizing single-screw fixation instead of suture fixation.[40]

Patte et al[56] were the ones who introduced a new modification of the original technique with the use of 2 screws and a larger graft. This procedure requires the pectoralis minor detachment and the graft to be inserted in an upright position, flat on the anterior rim of the glenoid; others place the curve of the coracoid parallel

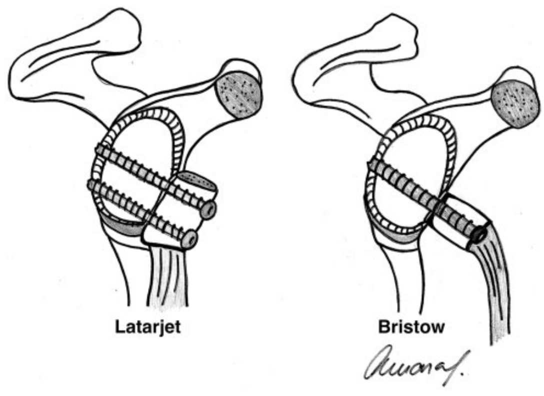

Figure 1. The Latarjet and Bristow procedures.

to the joint, which widens the joint. This modification is known as the modern-day Latarjet procedure. The Bristow procedure nowadays is considered very similar to the Latarjet procedure. Regardless of minor variations, the main differences between these techniques are the graft position (vertical for Latarjet and horizontal for Bristow) and number of screws (2 for Latarjet and 1 for Bristow) (Figure 1).

Many authors consider this to be the same surgical procedure, naming it the Bristow-Latarjet technique,[17] while others make a greater differentiation between them.[23] When differentiating among the procedures, some authors suggest the superiority of one procedure over the other.

The purpose of this review was to analyze the effectiveness of the transfer of the coracoid to the anterior portion of the glenoid for the treatment of glenohumeral recurrent dislocations and to compare the results of this transfer between the Bristow and Latarjet techniques. The effectiveness of treating anterior shoulder instability with transfer of the coracoid to the anterior border of the glenoid has already been established in the literature; however, there is no evidence in determining the preference of the Bristow versus Latarjet procedure with respect to patient outcomes.

The primary objective was to evaluate the efficacy of coracoid transfer in relation to the treatment of glenohumeral instability between all the reviewed studies, analyzing the recurrence of dislocations and the residual loss of external rotation after the surgical procedure. A specific secondary objective was to analyze the difference in results in terms of subjective outcomes between the techniques. We compared the postoperative results between studies that used the

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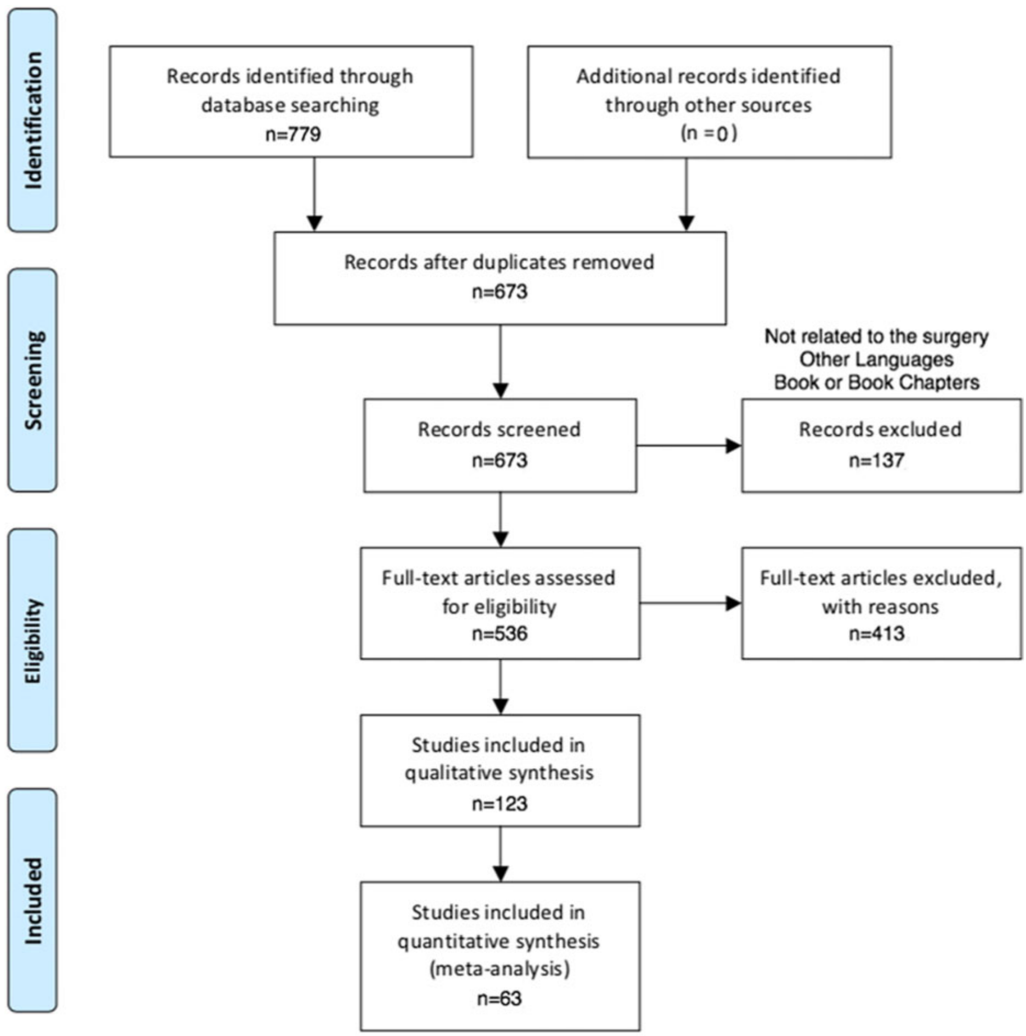

Figure 2. Flow diagram of the included studies.

Bristow procedure and studies that used the Latarjet procedure.

METHODS

The studies included in this review were those in which glenohumeral instability was treated by surgically performing transfer of the coracoid to the anterior border of the glenoid, regardless of the number of screws or graft position, and presenting a follow-up of longer than 2 years. We included studies written in English, Portuguese, Japanese, French, or Spanish. The excluded studies are shown in Figure 2 and comprised biomechanical studies, anatomic/cadaveric studies, case reports, duplicated studies, guidelines/morphogenic studies, images, reviews, technical notes, books, book chapters, studies not addressing anterior shoulder instability, other types of surgery, other issues out of target (arm position, osteoarthritis, arthroscopic findings, absence of available assessments, revision surgery, other complications, anchors), and languages different from those listed above.

The primary outcome was the percentage of dislocation recurrence (redislocations); it is an important and objective outcome that theoretically cannot be biased by an investigator. The other outcomes were instability (redislocations + subluxations), loss of external rotation, and quality of life outcome scores used in shoulder surgery, which were also assessed. Outcomes chosen were just those present for both the Bristow and Latarjet techniques that could make any comparison possible. Safety outcomes were also scored for all complications found through the studies.

The bias assessment used the same pattern of the Cochrane Bone, Joint and Muscle Trauma Group[27] as follows: balance at baseline, patients lost to follow-up of more than 20%, allocation concealed, randomization, blinded or double-blinded format, cointerventions avoided, and publication bias. The databases used to find the articles were J-STAGE; Cochrane Bone, Joint and Muscle Trauma Group Specialized Register; Cochrane Controlled Register of

TABLE 1
Reasons for Exclusion of Studies

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Biomechanical studies	86
Anatomic/cadaveric studies	38
Case reports	44
Duplicated studies	106
Guidelines/morphogenic studies	58
Images	33
No anterior shoulder instability	25
Reviews	37
Technical notes	23
Language not standardized and/or data not found	17
Not related to target surgery	112
Related to other issues out of target (arm position, osteoarthritis, arthroscopic findings, absence of available assessments, revision surgery, other complications, anchors)	69
Books or book chapters	8
Total	656

Trials; MEDLINE; Ovid; Embase; Google Scholar; and CINAHL.

Data were analyzed by 3 authors (J.C.G., F.M.A., R.J.B.), who reviewed and chose eligible studies according to the inclusion criteria. The titles of periodicals, authors, and supporting institutions were not masked at any stage. Titles and abstracts were reviewed for inclusion; thereafter, outcomes and the risk of bias were extracted. We classified the Bristow procedure when the study used just 1 screw and the graft in the horizontal position and the Latarjet procedure when a study used 2 screws and the graft in the vertical position.

Quantitative and qualitative data were analyzed and compared, when possible, according to statistical features. Heterogeneity between the comparable studies was assessed using the Q^2 and I^2 tests. Statistical analysis was performed according to the nature of the data, testing normality and the equivalence of standard deviations when possible. Statistical significance was established at $P < .05$ (2-tailed), and in studies presenting numerical data in which it was not possible to extract the standard deviations, just a simple weighted mean was used to achieve mean values.

RESULTS

Search Results

Of the 779 studies found, 656 were initially excluded, as presented in Table 1. Of the remaining 123 potentially eligible studies, 60 were excluded in the second assessment for the following reasons: 15 were arthroscopic techniques, 41 had less than 2-year follow-up, and 4 were duplicated studies.

There were 63 included studies (45 Bristow and 20 Latarjet), representing 3502 shoulders (2511 Bristow and 991 Latarjet). Two studies (Banffy et al[4] and Dossim et al[18]) used both the techniques and were considered as 4 different studies for statistical purposes. There were no randomized, blinded, or double-blinded studies.

TABLE 2
Redislocations and Subluxations

	Redislocations		Redislocations + Subluxations	
	Bristow	Latarjet	Bristow	Latarjet
Mean ± SE, %	1.00 ± 0.20	2.13 ± 0.49	2.37 ± 0.45	5.47 ± 1.01
95% CI, %	0.60-1.40	1.17-3.08	1.50-3.25	3.49-7.45
P value	<.0001	<.0001	<.0001	<.0001
Heterogeneity				
Tau-square	<0.00	<0.00	0.0003	0.0008
Q^4	34.20	18.53	98.00	34.85
P value	.73	.35	<.0001	<.0001
I^4	0.00	8.30	59.18	51.22

Regarding the occurrence of instability (redislocations and/or subluxations), 59 studies (41 Bristow and 18 Latarjet) with 3276 shoulders were analyzed (2346 Bristow and 930 Latarjet). A total of 75 redislocations (44 Bristow and 31 Latarjet) and 87 subluxations (53 Bristow and 34 Latarjet) were observed. Burkhart et al[15] performed 102 surgical procedures; redislocations and subluxations were assessed in all while loss of external rotation were in 47 surgical procedures. Results for redislocations and subluxations are presented in Table 2 and Figures 3 and 4. Differences between the Bristow and Latarjet groups were statistically significant in redislocations ($P = .01$) as well as in instability redislocations and/or subluxations ($P = .01$).

Regarding loss of external rotation, 31 studies met the inclusion criteria (25 Bristow and 6 Latarjet), with 1683 shoulders (1440 Bristow and 243 Latarjet). Results for loss of external rotation and other functional quality of life outcome scores are shown in Table 3.

None of the studies reviewed presented data that could allow one to extract the standard deviation; therefore, it was not possible to perform any meta-analysis or establish standard deviations and *P* values for the data. Just a simple weighted mean was possible to achieve mean values.

Regarding safety outcomes, they were present in 17 studies with 1190 shoulders for the Bristow procedure and 15 studies with 865 shoulders for the Latarjet procedure; all the data allowed us to perform a systematic review presenting the mean, standard error, and *P* value. Results are shown in Table 4.

Risk of Bias in Included Studies

This review was adequately conducted; however, the methodological quality of the studies significantly influenced the outcome, primarily because of the lack of randomized, blinded, and double-blinded studies. This made the data potentially skewed; however, these were the only data available. In addition to these factors, the lack of data in most of the trials made it impossible to include a larger number of studies in the analysis. Studies seemed to present

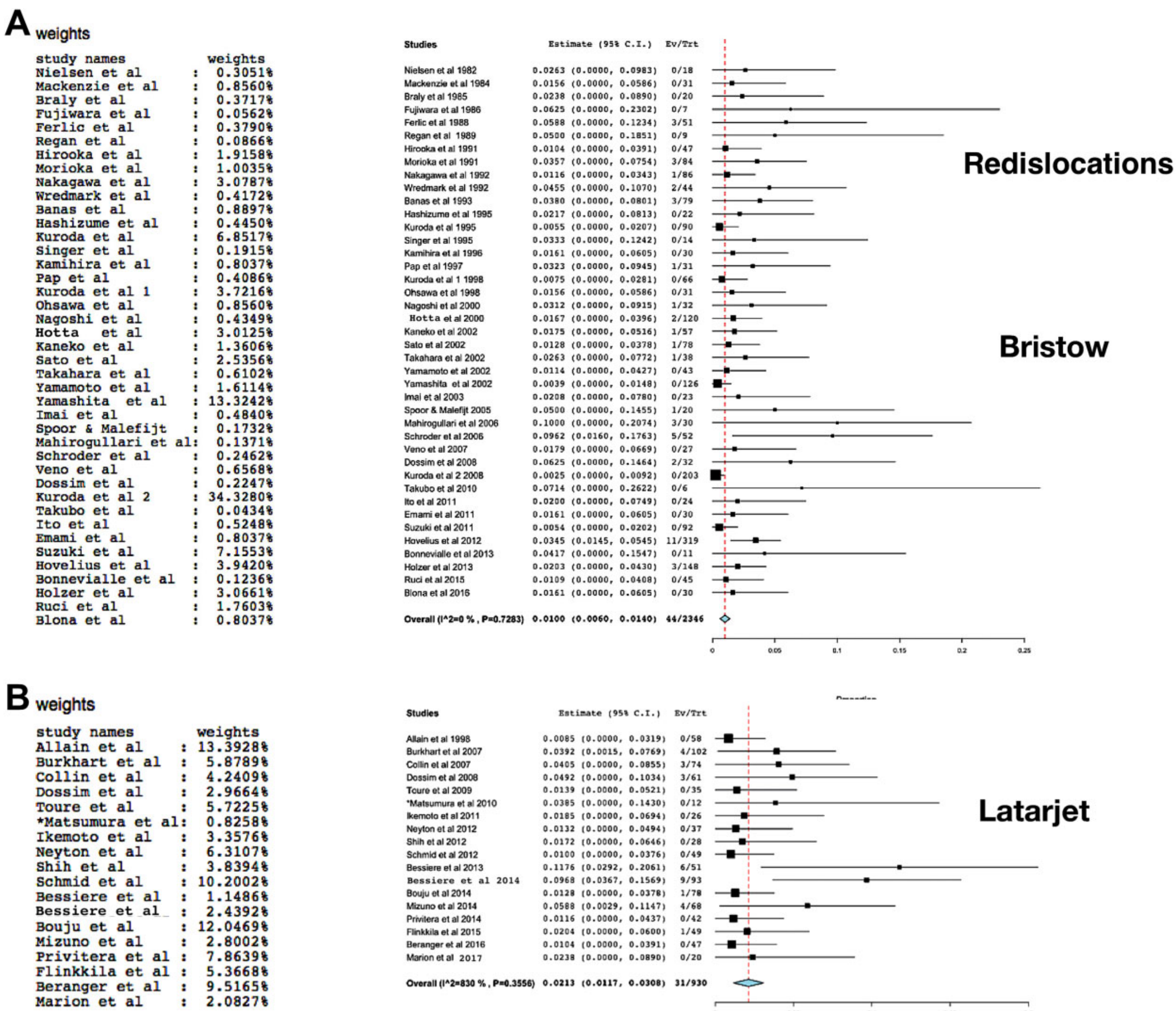

Figure 3. Meta-analysis of redislocations: (A) Bristow and (B) Latarjet.

similar characteristics at baseline, as patients with a shoulder dislocation frequently presented the same symptoms, and no concomitant conditions existed in any studies.

Regarding patients lost to follow-up, none of the selected studies exceeded 20%. No study presented concealed allocation. Cointerventions were found in 4 studies: 3 for the Bristow procedure (Hirooka et al,[28] Hotta et al,[30] and Ito et al[34]) and 1 for the Latarjet procedure (Matsumara et al[44]). All 4 studies used coracoid transfer associated with the Bankart procedure.

Regarding the sample size in the interim analysis, the Bristow procedure had a suitable number of studies with a significance of .05 and statistical power of 90%; however, more studies can add statistical power to data on the Latarjet procedure. Studies on the Bristow procedure are older and may present some possible bias, showing fewer complications than may actually exist. Other possible sources of bias include the surgical indication standards.

DISCUSSION

Coracoid transfer to the anteroinferior glenoid rim is one of the most reliable and effective procedures for anterior stabilization of the shoulder.[23] There are 2 different ways to perform this technique: the first using 1 screw and the graft in the horizontal position, and another with 2 screws and the graft in the vertical position. Some authors use the term "Bristow-Latarjet procedure" for both techniques; however, other authors have stated that the first should be named

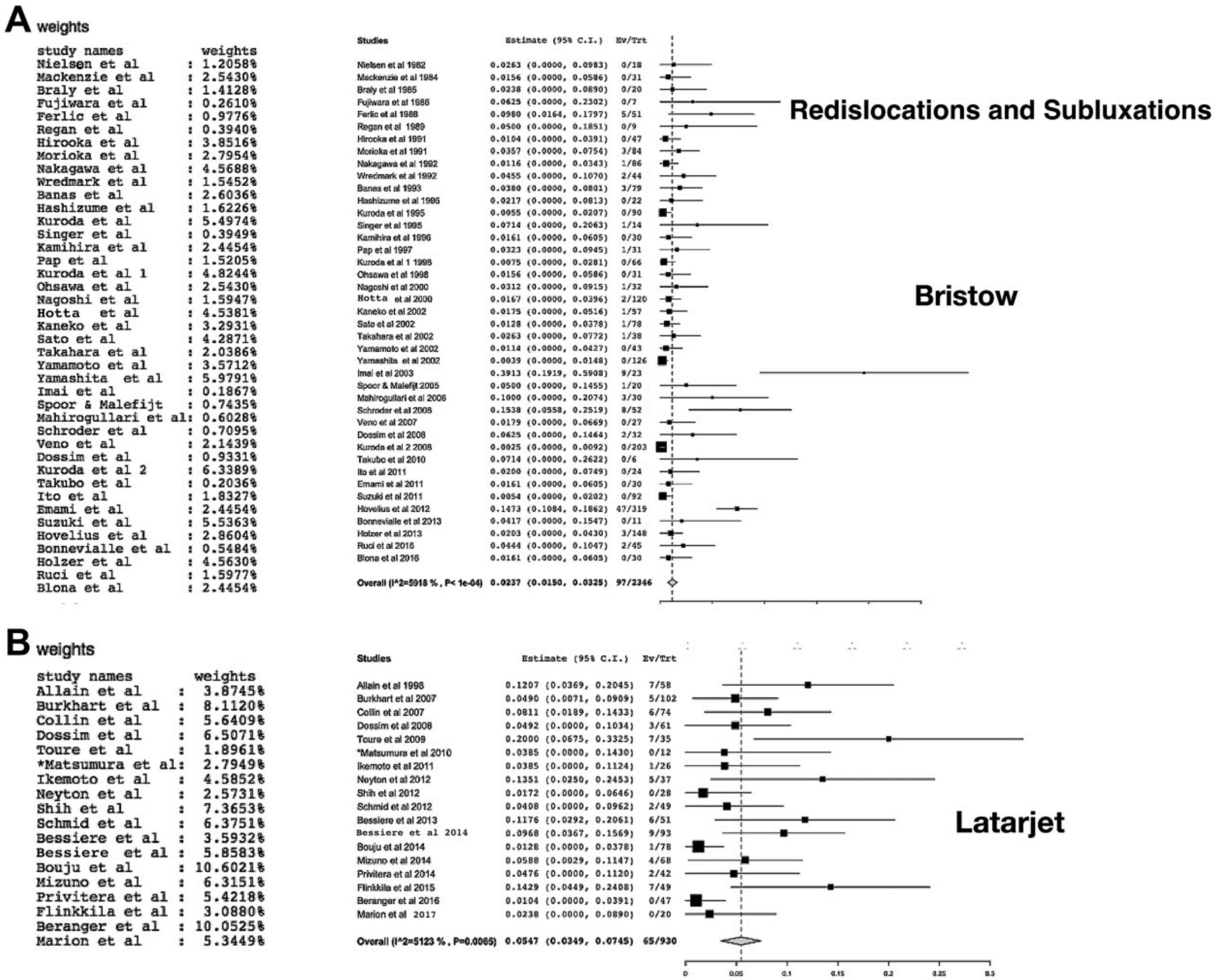

Figure 4. Meta-analysis of redislocations + subluxations: (A) Bristow and (B) Latarjet.

TABLE 3
Effectiveness Outcomes[a]

	Mean Value		No. of Studies		No. of Shoulders	
	Bristow	Latarjet	Bristow	Latarjet	Bristow	Latarjet
Loss of external rotation, deg	12.91	11.70	25	6	1440	243
Rowe score	92.06	89.33	15	4	748	141
WOSI score, %	16.44	19.68	4	6	321	229
JOA score	93.28	92.00	11	1	644	12
ASES score	91.00	89.90	1	1	126	42

[a]ASES, American Shoulder and Elbow Surgeons; JOA, Japanese Orthopaedic Association; WOSI, Western Ontario Shoulder Instability Index.

the Bristow procedure and the second the Latarjet procedure.

A previous systematic review also has reported that data from primary studies are skewed and presented a lack of evidence to guide surgeons' preference for one technique over the other.[7] Some authors consider the Latarjet procedure to be superior to the Bristow procedure in terms of results[24]; however, never before has a study this extensive

TABLE 4
Safety Outcomes[a]

Complications	Latarjet	Bristow	*P* Value
Axillary artery aneurysm	0.0059 ± 0.0026	0.0037 ± 0.0017	.49
Apprehension	0.1053 ± 0.0189	0.0130 ± 0.0053	**<.001**
Crepitation	0.0059 ± 0.0026	0.0037 ± 0.0017	.49
Pain	0.0433 ± 0.0119	0.0151 ± 0.0054	**.0431**
Lateral graft	0.0257 ± 0.0080	0.0037 ± 0.0017	**.0166**
Medial graft	0.0076 ± 0.0030	0.0038 ± 0.0018	.29
Coracoid fracture	0.0079 ± 0.0030	0.0038 ± 0.0017	.25
Glenoid fracture	0.0067 ± 0.0027	0.0039 ± 0.0018	.39
Hematoma	0.0067 ± 0.0027	0.0037 ± 0.0017	.35
Anterior impingement	0.0059 ± 0.0026	0.0037 ± 0.0017	.49
Infection	0.0082 ± 0.0030	0.0038 ± 0.0017	.28
Axillary nerve	0.0061 ± 0.0026	0.0037 ± 0.0017	.45
Musculocutaneous nerve	0.0069 ± 0.0028	0.0038 ± 0.0017	.35
Screw migration	0.0059 ± 0.0026	0.0088 ± 0.0026	.44
Neurodystrophy	0.0063 ± 0.0027	0.0037 ± 0.0017	.42
Osteoarthritis	0.1327 ± 0.0223	0.0058 ± 0.0022	**<.001**
Osteolysis	0.1490 ± 0.0051	0.0075 ± 0.0025	**<.001**
Short screw	0.0067 ± 0.0027	0.0038 ± 0.0018	.38
Long screw	0.0059 ± 0.0026	0.0037 ± 0.0017	.49
Plexopathy	0.0059 ± 0.0026	0.0037 ± 0.0017	.49
Nonunion	0.0130 ± 0.0046	0.0424 ± 0.0096	**.011**
Broken screw	0.0061 ± 0.0026	0.0043 ± 0.0019	.58
Consolidation delay	0.0061 ± 0.0026	0.0037 ± 0.0017	.45
Subscapularis lesion	0.0059 ± 0.0026	0.0037 ± 0.0017	.49
Loosening screw	0.0077 ± 0.0029	0.0065 ± 0.0026	.76
Rotator cuff tendinopathy	0.0059 ± 0.0026	0.0037 ± 0.0017	.49
Deep vein thrombosis	0.0069 ± 0.0028	0.0037 ± 0.0017	.34
Gastroduodenal ulcer	0.0061 ± 0.0026	0.0037 ± 0.0017	.45

[a]Data are shown as mean ± SE. Bolded values indicate statistical significance ($P < .05$).

assessed the differences between these 2 techniques in terms of effectiveness for live patients.

This study suggests certain differences in favor of the Bristow procedure over the Latarjet procedure for all outcomes, with the exception of the loss of external rotation . Our study's findings did not correlate with the results of some biomechanical studies,[23] the reason being that shoulder stability is more dependent on dynamic interactions,[60] proprioception, and other biological mechanisms than just biomechanical passive stability. Other cadaveric studies have shown that the bony block effect is not important for shoulder stability, suggesting that the sling effect is the most effective biomechanical addition for these procedures.[54]

With respect to recurrences, there was a statistically significant advantage to the Bristow technique. These results used solely objective data and seemed to be highly consistent between the studies reviewed. Because these objective data were cited across the studies, they seem to be reliable data.

With respect to the loss of external rotation, a difference of 1.21° was noted in favor of the Latarjet procedure; however, this result can be considered clinically not significant.

The Rowe score presented an effect size difference of just 3.27 points. Regarding the qualitative Rowe score, results had no statistical difference. In the same way, the Japanese Orthopaedic Association score, Western Ontario Shoulder Instability Index, and American Shoulder and Elbow Surgeons scores presented minimal differences in favor of the Bristow procedure.

The safety outcomes in general showed very similar trends; however, rates of apprehension, pain, lateral graft, osteoarthritis, and osteolysis were higher for the Latarjet procedure than the Bristow procedure. On the other hand, the Bristow procedure presented more nonunions but with no clinical significance.[31]

With the results mentioned above, data seem to be favorable for the Bristow procedure; however, it is also rational to consider both procedures to be similar, as the difference in the effect sizes between the techniques was quite small. There is also a possible publication bias because studies on the Bristow procedure are older and cannot describe their complications so well. Most of the studies on complications also did not specify the initial number of surgeries and therefore could not be included within this systematic review. These missing data can also introduce some kind of bias.

Even for dislocation recurrences that presented statistically significant differences that favored the Bristow technique, we do not overall prefer one technique over the other based on these results. *P* values have been overestimated in the current medical literature; the effect size is much more important but routinely neglected.[2] We suggest that they are equivalent and just small variations of the same procedure.

Limitations

Low-quality standards of the primary studies were noted in this systematic review. No randomized or double-blinded studies were found, and the lack of standardization needs to be better discussed to create minimal conditions to improve future systematic reviews. There were also potential data lost because of the inability to assess studies written in different languages from those cited above.

In general, studies did not mention bone loss or other inclusion criteria; however, it is important to cite that in Europe, studies on the Bristow and Latarjet procedures tend to not care about bone loss, while American studies tend to perform the Bristow or Latarjet procedure only when bone loss is present. Other countries do not mention any criteria. Primary studies about the Bristow procedure are older and may underestimate the incidence of complications. There was also a lack of reporting follow-up, with a majority of studies describing only a minimal follow-up of 2 years.

The data that we observed regarding subluxations plus redislocations can potentially present some bias because older studies may tend to omit subluxations, focusing just on the recurrence of dislocations. Thus, we suggest that this difference can present a bias.

Primary studies tend to overestimate effectiveness, not paying the required attention to safety issues. Knowing that medicine uses a paraconsistent logic, which employs positive and negative data to make decisions, this study also highlights the necessity to improve and better expose safety data within primary studies, making it possible to use these data also in systematic reviews.

CONCLUSION

Transferring the coracoid to the anteroinferior border of the glenoid through the subscapularis tendon is effective, regardless of the technique: Bristow or Latarjet. Except for the loss of external rotation, all other parameters evaluated were favorable to the Bristow procedure over the Latarjet procedure. A recurrent dislocation was the only outcome possible to conduct a comparative meta-analysis, and it presented a statistically significant difference favorable to the Bristow procedure. While showing statistical differences, the effect sizes between techniques do not seem to present significant clinical differences. More studies presenting better methodology are fundamental to better explore coracoid and conjoined tendon transfer to the anterior glenoid rim.

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