Are collision athletes at a higher risk of re-dislocation after an open Bristow-Latarjet procedure? A systematic review and meta-analysis

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Abstract

Background: The primary aim of the present study was to review, summarize and compare the redislocation risk for collision athletes and noncollision athletes after an open Bristow-Latarjet procedure. Our secondary aim was to summarize return to sport, satisfaction, pain and complications.

Methods: We conducted a systematic review in PubMed and EMBASE of articles until 1 July 2016. We included all studies describing Bristow-Latarjet like procedures as a result of glenohumeral instability, mentioning redislocation rates in collision athletes with >2 years of follow-up. We pooled the data using random-effects meta-analysis for redislocation risk-differences (RD) between collision and noncollision athletes, and assessed heterogeneity with I^2 and Tau² tests.

Results: From 475 titles and abstracts, 11 studies were included and eight studies were meta-analyzed. The pooled RD to develop a postoperative redislocation between collision athletes and noncollision athletes was -0.00 (95% confidence interval: -0.03 to 0.03 , $p = 0.370$). Return to sports rates were high (67–100%), and patients reported high satisfaction scores (93–100% satisfied) and low pain scores (mean visual analogue scale score of 1.6); however, postoperative complication rates varied from 0.8% to 19.2%.

Conclusions: Collision athletes are not more at risk for redislocation rates after an open Bristow-Latarjet procedure compared to noncollision athletes. Overall postoperative outcomes were good, although numerous complications occurred.

Keywords

athletics, Bristow, collision athletes, Latarjet, shoulder dislocation, shoulder injury

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Introduction

Approximately 50% of all major joint dislocations affect the shoulder, most frequently (95–97%) resulting in an anterior shoulder dislocation.^{1–5} Higher incidences of dislocations have been demonstrated in collision athletes (CA) and may lead to a decreased level of sport activities.⁶ Primary treatment for shoulder dislocations, including immobilization and physiotherapy, shows satisfactory results,^{7,8} although high recurrence rates have been reported.^{9,10} Moreover, recurrence rates for CA tend to be slightly higher.⁹

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Indications for acute surgical treatment include irreducible dislocations, displaced greater tuberosity fractures, Bankart fractures with glenohumeral instability and primary repair.¹¹ Indications for delayed surgical treatment include redislocations, activity limitations and presence of significant bone loss.^{11–13} Because most patients have a Bankart lesion (90%), the most common surgical treatment is the (arthroscopic) Bankart repair.¹⁴ After a Bankart repair, stable or improved sports levels are reported in 82.6% of patients;¹⁵ however, 35% of all patients have recurrent redislocations 8 years to 10 years after surgery.¹⁴ Furthermore, CA have a 2.2 times higher risk for redislocations after a Bankart repair.¹⁶

The Bristow-Latarjet procedure is an alternative surgical procedure for anterior shoulder dislocation, and mainly indicated in case of a bony Bankart lesion, or when recurrent dislocations wear away the glenoid.¹⁷ The coracoid and its attached muscles are transferred to the deficient part of the glenoid: the coracoid acts as a bone block, with the muscles acting as a sling to provide stability.¹⁷ The Bristow-Latarjet procedure (and its modifications) have proven successful for glenohumeral stability, with redislocation rates varying from 0% to 8%.^{18,19} However, it should be taken into consideration that complications may occur, including graft osteolysis, wound infections, shoulder stiffness, screw migration, bending or breakage, bony non-union, neurological injury, vascular injuries, subscapularis damage and osteoarthritis.^{19–21} It is generally accepted that CA may have an increased risk of developing redislocations after Bristow-Latarjet like procedures,²² even though this has been not generally confirmed.

Therefore, The primary aim of the present study was to review and summarize the redislocation risk for CA after an open Bristow-Latarjet procedure and compare the redislocation risk with non-CA. Our secondary aim was to summarize return to sport, satisfaction, pain and complications in CA.

Materials and Methods

Protocol

The study was performed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (see Supplementary material, Appendix 1)²³

Literature search and study selection

We performed a literature search in PubMed and EMBASE on 1 July 2016 (see Supplementary material, Appendix 2). The search was not limited for year of publication. Titles and abstracts were screened in

accordance with pre-determined inclusion and exclusion criteria to select relevant studies. We included studies mentioning surgical glenoid articular arc reconstruction (i.e. any Bristow-Latarjet like procedure) as a result of glenohumeral instability and giving redislocation rates for CA. We excluded case reports, (systematic) reviews, meta-analyses, animal/cadaver/*in vitro* studies, biomechanical reports, letters to editors, instructional courses, studies with a follow-up period of less than 2 years and studies from which the redislocation rate of CA could not be calculated with certainty. We excluded articles mentioning arthroscopic procedures because a preliminary literature search revealed no mid-to-long term outcomes in CA regarding this relatively recent modification.

Subsequently, the remaining articles were full-text screened to assess applicability. All cross-references from reviews and included studies were screened for studies not identified by the initial literature search.

Assessment of methodological quality

All included studies were critically appraised and rated for applicability by pre-defined in- and exclusion criteria. To determine relevance, we scored studies on their domain (Bristow-Latarjet procedure, a modification or other), determinant (to what extent did the athlete group match to our study question) and outcome (to what extent were redislocations mentioned for CA). We assessed validity by scoring the study design, selection bias and information bias. Relevance, study design, loss to follow-up, follow-up period and analysis were considered as the most important factors. In addition, we used the Coleman Methodology Score (CMS) as an objective tool to assess the overall quality of the studies (Table 1).²⁴ The CMS is based on 10 methodological criteria, summing up to a total score ranging from 0 to 100 (100 points indicates that a study largely avoids chance, various biases and confounding factors). The CMS score can be categorized into excellent (85 points to 100 points), good (70 points to 84 points), fair (50 points to 69 points) and poor (<50 points).²⁴ The Coleman criteria were adjusted to make them reproducible and relevant for our systematic review; we have removed the item regarding the diagnostic certainty, and also modified the criteria for the amount of patients and the follow-up range.

We applied a number of actions to minimize the risk of bias. First, to maximize study homogeneity, articles mentioning a follow-up period of less than 2 years were excluded because redislocation rates consistently increase up to 10 years after surgical treatment.¹⁴ Second, studies in which the absolute risk for CA could not be calculated with certainty were excluded

Table 1. Modified Coleman Score.

A	Only one score to be given for each of the seven sections	
I	Study size (n)	
	<20	0
	20 to 50	4
	51 to 100	7
	>100	10
2	Mean follow-up	
	<12 months	0
	12 months to 36 months	4
	37 months to 60 months	7
	>61 months	10
3	Surgical or conservative approach	
	Different approach used and outcome not reported separately	0
	Different approaches used and outcomes reported separately	7
	Single approach used	10
4	Type of study	
	Retrospective cohort study	0
	Prospective cohort study	10
	Randomized controlled trial	15
5	Description of indications/diagnosis	
	Described without percentage specified	0
	Described with percentage specified	5
6	Description of surgical or conservative technique	
	Inadequate (not stated, unclear)	0
	Fair (technique only stated)	5
	Adequate (technique stated, details of surgical or conservative procedure given)	10
7	Description of postoperative rehabilitation	
	Described	5
	Not described	0

(continued)

Table 1. Continued

B	Scores may be given for each option in each of the 3 sections if applicable	
I	Outcome criteria	
	Outcome measures clearly defined	2
	Timing of outcome assessment clearly stated	2
	Used of outcome criteria that has reported reliability	3
	General health measure included	3
2	Procedure of assessing outcomes	
	Participants recruited	5
	Investigator independent of surgeon	4
	Written assessment	3
	Completion of assessment by patients themselves with minimal investigator assistance	3
3	Description of subject selection process	
	Selection criteria reported and unbiased	5
	Recruitment rate reported >90%	5
	Recruitment rate reported =90%	0

for further analysis. Third, two investigators (NRPP and JvD) independently performed the study selection, assessment of methodological quality and data extraction using pre-defined data charts. Any disagreements between the reviewers during the entire study process were resolved by discussion.

Data items

Collision athletes (CA), as defined by the medical dictionary,²⁵ are athletes who participate in sports in which the athletes hit or collide with each other or inanimate objects, including the ground, with great force. We categorized CA and non-CA as suggested by the American Academy of Pediatrics Committee on Sports Medicine (Table 2).²⁶

Data extraction

We extracted the following variables from included studies: number of included patients and shoulders operated on; number of CA; number of non-CA; number of redislocations in CA and non-CA; and average follow-up time for redislocations. We extracted the following variables when these

were mentioned: return to sports; return to same level of sports; return to lower level of sports; change in sports; return to collision sports (only for CA); satisfaction scores; pain levels; pain scores; complication rates; and type of complications.

Statistical analysis

We present categorical variables with numbers and percentages. We present the CMS score per study, as well as in total, for all critically appraised studies with a median and interquartile range (IQR).

We calculated the absolute risk for redislocation by dividing the number of redislocations by the total of all operated shoulders within that group. The risk difference (RD) is calculated by subtracting the CA absolute risk from non-CA absolute risk.

For the meta-analysis, to minimize heterogeneity, we only included those studies that reported on redislocation rates for both CA and non-CA. Although we have excluded the studies that reported only on collision, we have included these studies in the Results because they can be used to assess the consistency of the other studies. Because we expected heterogeneity throughout included studies, we assessed variance and statistical

Table 2. Classification of sports described by the American Academy of Pediatrics Committee on Sports Medicine.

Contact/collision	Limited contact/ impact	Noncontact		
		Strenuous	Moderate strenuous	Nonstrenuous
Boxing	Baseball	Aerobic dancing	Badminton	Archery
Field hockey	Basketball	Crew	Curling	Golf
Football	Bicycling	Fencing	Table tennis	Riflery
Ice hockey	Diving	Field		
Lacrosse	Field	Discus		
Martial arts	High jump	Javelin		
Rodeo	Pole vault	Shot put		
Soccer	Gymnastics	Running		
Wrestling	Horseback riding	Swimming		
Rugby	Skating	Tennis		
	Ice	Track		
	Roller	Weight lifting		
	Skiing			
	Cross-country			
	Downhill			
	Water			
	Softball			
	Squash, handball			
	Volleyball			

significance using random-effect calculations.²⁷ We assessed the consistency of the results across studies with I^2 and Tau^2 statistics. The I^2 score represents the percentage of variation (i.e. heterogeneity) across studies, and ranges from 0% to 100%; higher values indicate more heterogeneity.²⁸ Tau^2 estimates the between study variance in a random-effects meta-analysis and a score greater than 1 indicates substantial statistical heterogeneity.²⁹ We assessed whether there was potential publication bias (i.e. the association of publication probability with the statistical significance of study results) by displaying funnel plots. Funnel plots are scatterplots of treatment effects (x -axis) estimated from individual studies against a measure of study size (y -axis). Asymmetry in funnel plots is usually caused as a result of small studies reporting greater

effects (on average) than large studies. Tests for funnel plot asymmetry (e.g. Egger's test) should only be used when at least 10 studies are included in the meta-analysis; because we included eight studies in the meta-analysis, we did not use funnel plot asymmetry tests.

We used Stata, version 14.0 (StataCorp LP, College Station, TX, USA) for statistical analyses. $p < 0.05$ were considered statistically significant.

Results

Study selection

The initial search resulted in 475 articles, of which 89 satisfied inclusion and exclusion criteria (Fig. 1). After

Figure 1. Flow chart of literature search and article selection. The last search was conducted on 1 July 2016.

full-text screening, 80 articles were excluded: 70 articles did not mention the number of CA or did not mention redislocation rates in CA and 10 articles were non-exact duplicates. Cross-referencing resulted in two additional studies, giving 11 included studies. The studies assessed the redislocation rates after a Bristow³⁰, Latarjet,^{31–35} Bristow-Latarjet,^{36,37} Latarjet-Platte,^{38,39} and a combination of a Bankart repair and Latarjet procedure.⁴⁰ The included studies did not discuss revision procedures. Indications for surgery were recurrent instability,^{30,35,38,39} primary dislocations,³¹ post-traumatic chronic antero-inferior involuntary instability of the shoulder,³² shoulder instability associated with inverted-pear glenoids or engaging Hill Sachs lesions (or both),³³ or patients with type 3,4 and 5 Bankart lesion according to Yoneda's classification⁴¹ and

patients requiring high shoulder joint stability for their job or sport.⁴⁰ In three articles, no indications were noted.^{34,36,37}

Critical appraisal and study population

Eleven articles were included and critically appraised (Table 3).^{30,40} The CMS score ranged from 44 to 63 and the median CMS score was 58.7 points; this indicated that the quality of the included studies was fair. No statistically significant difference was found between mean values of CMS calculated by the two independent researchers.

A total of 802 patients had undergone a Bristow-Latarjet like procedure with a minimum follow-up of 2 years; 411 (51%) were CA and 391 (49%) were

Table 3. Critical appraisal, studies listed alphabetically.

Studies (first author)	Validity										
	Relevance			Selection bias				Information bias			
	Domain	Determinant	Outcome	Design	Loss to follow-up	Missing data	Standardization of determinant	Standardization of outcome	Blinding of exposure status	Follow-up	Analysis
Allain ³⁰	+	+	+	-	-	-	+	-	-	+	+
Banas ³¹	+/-	+/-	+	-	+	-	+	+	+	+	+
Bessiere ³²	+	+	+	-	+	+	+	+	+	+	+
Burkhardt ³³	+/-	+	+	-	+	-	+	-	-	+/-	+
Cerciello ³⁴	+	+	+	-	-	-	+	-	+	+	+
Doursounian ³⁶	+/-	+	+	+	-	-	+	-	+	+/-	+
Hovellius ³⁷	+	+	+	+	+	+	+	-	-	+	+
Mizuno ³⁵	+	+	+	-	-	-	+	-	-	+	+
Neyton (2007) ³⁹	+/-	+	+	-	-	-	+	-	-	+	+
Neyton (2012) ³⁸	+	+	+	-	-	-	+	-	-	+	+
Yamashita ⁴⁰	+/-*	+/-	+	-	-	-	+	-	-	+/-	+

Domain: +, Patients treated by a Bristow-Latarjet procedure for anterior glenohumeral instability; +/-, Patients treated by a modified Bristow-Latarjet procedure for anterior glenohumeral instability; -, Other: Determinant: +, Stated as CA in article, or type of athletes specifically mentioned; +/-, Recreational athletes, mixed athlete population or CA group not well defined; -, Nothing mentioned on athletes. Outcome: +, Redlocations after surgical procedure mentioned for athletes; -, Redlocation rates for athletes not separately mentioned or other outcome used instead.

Design: +, Prospective study design; -, Retrospective study design.

Loss to follow-up: +, <10%; +/-, 10% to 15%; -, >15% or not reported.

Missing data: +, <10%; +/-, 10% to 15%; -, >15% or not reported.

Standardization of determinant: +, Definition for athletes is given; -, Definition for athletes not reported.

Standardization of outcome: +, Definition of redlocation is given; -, Definition of redlocation is not reported or standardized.

Blinding of exposure status: +, Blinding for athletes status when diagnosing redlocation; -, Blinding not performed or not described.

Follow-up: +, >5 years follow-up for redlocation rates; +/-, 2 years to 5 years of follow-up for redlocation rates; -, <2 years or not mentioned.

Analysis: +, Absolute risk/AUC available or may be calculated; +/-, Absolute risk/AUC may be calculated, although questionable; -, Absolute risk/AUC unavailable or cannot be calculated.

Bankart procedure followed by a Bristow procedure.

non-CA. Study populations varied from 27 to 126 and included patients with follow-up periods between 24.3 months and 240 months of which 18.3% to 100% were CA throughout the studies (Table 4).

Redislocations

The overall redislocation risk for patients among included studies was 2.7% (22/809). The absolute risk for having a redislocation in CA varied from 0% to 15.8%^{30,40} compared to 0% to 4.3% for non-CA.^{30–33,36,37,40}

We included eight studies for the meta-analysis because these reported on redislocation rates for both CA and non-CA.^{7,30–33,35,36,40} Statistical and clinically relevant heterogeneity was low among these studies ($I^2=7.8\%$, $\text{Tau}^2=0.0002$). The funnel plot suggested that smaller studies did not report negative study results (Fig. 2).

There was no significant difference in postoperative redislocation risk between CA and non-CA as

shown by the pooled-effects analysis (RD: 0.00, 95% confidence interval = -0.03 to 0.03 , $p=0.370$) (Fig. 3).

Return to sports

Nine studies report on the return to sports rate,^{30,32–34,36–40} of which five are for CA (see Supplementary material, Appendix 3).^{33,37–40} The overall return to sport rates varied from 67% to 100% and the return to sport rate for CA from 65% to 96.4%. Only one study reported on return to sports for both the CA and non-CA groups:⁴⁰ there was a statistical difference in return to sports between the CA (78.3%) and non-CA (100%, Fisher's exact test: $p < 0.001$).

Satisfaction

Nine studies report on patient satisfaction scores (see Supplementary material, Appendix 4).^{31,32,34–40} Overall, studies report that 52% to 82% of the patients

Table 4. Results, studies listed alphabetically.

Study (first author)	Included patients (shoulders) [n (N)]	CA (n)	Non-CA (n)	Redislocation rate CA (n)	Redislocation rate non-CA (n)	AR for CA (%)	AR for non-CA (%)	RD (%)	Follow-up (months)
Allain ³⁰	56 (58)	12	46	0	0	0	0	0	171.6
Banas ³¹	78 (86)	34*	45*	0	3	0	6.7	−6.7	103
Bessiere ³²	51 (51)	38	13	6	0	15.8	0	15.8 [†]	66
Burkhart ³³	102 (102)	55	47	2	2	3.6	4.3	−0.7	52
Cerciello ³⁴	46 (51)	51	0	1	NA	2.0	NA	NA	85
Dourounian ³⁶	27 (27)	17*	10*	1	0	5.9	0	5.9	24.3
Hovellius ³⁷	113 (118)	46	72	2	2	4.3	2.8	1.5	180
Mizuno ³⁵	60 (68)	13*	55*	0	2	0	3.6	−3.6	240
Neyton (2007) ³⁹	79 (85)	85	0	1	NA	1.2	NA	NA	75
Neyton (2012) ³⁸	34 (37)	37	0	0	NA	0	NA	NA	144
Yamashita ⁴⁰	126 (126)	23*	103*	0	0	0	0	0	41

CA, Collision athletes; Non-CA, Non collision athletes; AR, Absolute risk; RD, Risk difference (AR of CA minus AR of non-CA); NA, not available (information is unavailable for this measurement).

*Number of patients as number of shoulders was not (clearly) stated in the article.

[†]Univariate analysis $p=0.31$. Note that subluxation was also scored as a recurrence.

This classification was designed by the American Academy of Pediatrics Committee on Sports Medicine to assist practitioners in deciding whether athletes should be allowed to participate in particular sports. In this guideline, sports are divided in their degree of strenuousness and probability on collision. Further on, these groups were assessed in light of common medical and surgical conditions to determine whether participation would create a substantial risk of injury.

Figure 2. Funnel plot to evaluate potential publication bias.

Figure 3. Forest plot illustrating the risk differences between collision athletes and non-collision athletes per study, as well as the overall pooled risk difference showing no statistical difference ($p = 0.370$). CA, collision athlete; RD, risk difference; CI, confidence interval.

were 'very satisfied', 7% to 94% were 'satisfied' and 1% to 7% were disappointed or unhappy. When combining 'very satisfied' and 'satisfied', the overall satisfaction rate was 93% to 100%

Pain

Six studies report on pain levels (see Supplementary material, Appendix 4).^{30–32,34,37,38} Overall, studies

report that daily pain was present in 1.8% to 9% of the patients, occasional pain in 24.3% to 54% of the patients and no pain in 16% to 88% of the patients. The mean visual analogue scale score from two studies was 1.6.^{32,38}

Complications

All eleven studies reported on postoperative complications, with complication rates varying from 0.8% to 19.2% (see Supplementary material, Appendix 5). The most common complications were infection (range 0% to 5.3%), perioperative or postoperative bone block/coracoid fracture (0% to 8.1%), severe pain symptoms (0% to 9.3%), screw loosening (0% to 2.9%) and screw breakage (0% to 1.5%).

Discussion

It is often assumed that CA have an increased risk of developing redislocations after Bristow-Latarjet like procedures, although there is no literature supporting this. With this systematic review and meta-analysis, we showed that CA have comparable risk at developing redislocations after these surgeries compared to non-CA. In addition, these studies report that patients have high return to sports levels, are often satisfied and have little pain. However, the relatively high complication rates should be taken into consideration when deciding to go to surgery. Four studies had a follow-up of more than 10 years,^{30,35,37,38} which did not have an increased risk for instability (2.1% for >10 years versus 3.0% for <10 years; $p = 0.51$).

The results of the present study should be interpreted carefully because there were limitations. First, only three studies were scored as relatively highly relevant and no studies were scored with a good or excellent CMS score. The inclusion of better quality studies could have enforced our conclusions. Second, a universally accepted classification for athletes at high risk of developing an anterior shoulder dislocation is lacking; definitions for CA may vary between studies, especially when details are not provided in the original articles. To account for this, we categorized sports in the articles according to the categorization of the sports by the American Academy of Pediatrics Committee on Sports Medicine.²⁶ Third, some articles mention the number of redislocations for all treated shoulders and do not specify whether patients had bilateral procedures; this could have resulted in skewed absolute risk ratios. Fourth, because the included articles were chosen to determine redislocation rates in CA, redislocation rates for non-CA may not represent accurate literature rates. Fifth, funnel plots did suggest that publication bias might have occurred

because there were no studies with small study size that reported on a negative RD. However, the intent of the included articles was never to compare CA with non-CA; therefore, we consider that there was no intentional publication bias for this specific study question. Sixth, as a result of the nature of the outcome that we assessed in the present study, we used a modified version of the CMS, although this version was not validated for these types of patients.

We did not find other reviews addressing redislocation rates for CA after a Bristow-Latarjet procedure. Our findings suggest that CA are not at higher risk for developing redislocations after an open Bristow-Latarjet procedure. There are plausible explanations for these findings: (i) CA might have better proprioception than non-CA, therefore being more conscious of joint movements and limitations after surgery, and (ii) after surgery, CA will probably be accompanied more strictly by their physiotherapist and be more compliant during rehabilitation than non-CA because there is more at stake.⁴²

The alternative (i.e. Bankart repair) has shown to have a risk of 69% to develop osteoarthritis 13 years after surgery and a 2.2 times higher risk for CA to develop a redislocation.¹⁶ However, the Bankart repair has lower complication rates (0% to 3.9%) compared to the Bristow-Latarjet procedure (0% to 30%).^{19,20,43}

Choosing the most adequate surgical treatment for shoulder dislocations for CA remains challenging. Risks and benefits must be weighted for each individual patient when choosing the preferred surgical procedure. It would merit further study to compare important outcomes (e.g. complications, patient-reported outcomes and redislocations) in a prospective fashion between CA and non-CA after the Bristow-Latarjet procedure.

Conclusions

CA are not more at risk for postoperative redislocation rates after an open Bristow-Latarjet like procedure compared to non-CA. In terms of redislocations, CA equally deserve a Bristow-Latarjet like procedure compared to non-CA. Overall postoperative outcomes were good (i.e. return to sport, satisfaction level and pain), although several complications occurred. The results of the present study can be used to educate CA who are surgical candidates for the Bristow-Latarjet like procedure and aid in decision-making for the surgeon.

Declaration of Conflicting Interests

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This article does not contain any studies with human participants or animals performed by any of the authors.

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