

Patient Factors Associated With Increased Risk for Complications After the Latarjet Procedure

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Background: The open Latarjet has become the most common method of addressing significant glenoid bone loss in patients with recurrent glenohumeral instability.

Purpose: To describe national trends in Latarjet procedures and risk factors for complications associated with this procedure.

Study Design: Cohort study; Level of evidence, 3.

Methods: Eligible patients were identified through the National Surgical Quality Improvement Program (NSQIP) data set over the years 2014 to 2018 by using the Current Procedural Terminology (CPT) code for “capsulorrhaphy anterior with coracoid process transfer” (CPT 23462). Patient and surgical outcome variables were extracted and analyzed from the NSQIP database. Logistic regression analysis and odds ratios (ORs) were performed to evaluate the relative risk of complications.

Results: The authors identified 458 patients (399 men and 59 women) from the data set. The mean body mass index was 27.4 kg/m², and mean operative time was 130.2 minutes. Statistically significant variables included smoking status and sex, which were further stratified. Smokers were 2.19 times more likely to experience at least 1 adverse outcome, including deep vein thrombosis (DVT), pulmonary embolism, reoperation, wound infection, unplanned readmission, or readmission (95% CI, 0.62-7.82). Specifically, smokers were 7.8 times more likely to have a DVT (95% CI, 0.58-105.96), 1.4 times more likely to undergo reoperation (95% CI, 0.14-5.73), and 2.4 times more likely to have an unplanned readmission (95% CI, 0.19-28.68). Women were 2.2 times more likely to experience at least 1 adverse outcome. Specifically, women were found to be 6.4 times more likely to have a DVT (95% CI, 0.76-54.87), 4.1 times more likely to have an unplanned readmission (95% CI, 0.00-106.21), and 4.7 times more likely to have a readmission (95% CI, 0.00-13.92).

Conclusion: The results indicate that smokers and female patients are at a higher risk of experiencing adverse outcomes and may require additional pre- and postprocedural precautions when undergoing the Latarjet procedure. With the increase in frequency, providers should be aware of patient-related factors that may lead to adverse outcomes.

Keywords: shoulder; shoulder instability; Latarjet procedure

Glenohumeral instability is not uncommon, with an incidence of occurrence in 21.9 individuals per 100,000 in the general population.²² A subset of these individuals will experience subsequent dislocations and recurrent glenohumeral instability despite treatment, especially younger individuals.^{19,22} These events can lead to glenoid bone loss, compromise the static restraints of the glenohumeral joint, and further exacerbate joint instability.¹⁷ The Latarjet procedure is one common method of treating instability with glenoid bone loss that exceeds 20% of the glenoid, but is often not performed when glenoid bone loss exceeds 50%,¹⁸ with low rates of reported postoperative instability.^{5,12}

The Latarjet procedure is not without complications, with rates reported to be around 7% to 30%.^{6,11,15,26} Reported complications include reoperation, nonunion, implant-related failure, and neurologic complications, among others.^{4,6,11,15,26} Risk factors for complications and treatment failure after Latarjet surgery include atraumatic mechanism of primary dislocation,²¹ female sex,²¹ prior stabilization procedure,^{22,23} and age.²⁴

There have been limited reports of practice trends regarding the Latarjet procedure. A study of the American Board of Orthopaedic Surgery (ABOS) database between 2004 and 2013 found a small but increasing incidence of bone-block augmentation procedures being performed for shoulder instability among recent trainees.⁶ Factors such as increasing surgeon experience and a growing proportion of Latarjet procedures being performed for surgical stabilization may influence postoperative outcomes compared

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with prior reports in the literature.^{11,26} Understanding this relationship is important to prognosticate for patients indicated for coracoid transfer.

The goal of the present study was to further understand national trends in Latarjet procedures and evaluate postoperative complication rates and the patient factors that may influence them. We hypothesized that patient characteristics commonly associated with postoperative complications across the surgical literature, including high body mass index (BMI), diabetes, and smoking status, would also be significant in this particular data set and procedure.

METHODS

A retrospective cohort study was performed using the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) data set over the years 2014 to 2018, which was chosen as to include the most recent data with sufficient follow-up. The NSQIP is a nationally validated, risk-adjusted, prospective database that calculates 30-day surgical outcomes, which allows for direct comparison among the more than 700 participant hospitals. Patients were identified using the Current Procedural Terminology (CPT) code for “capsulorrhaphy anterior with coracoid process transfer” (CPT 23462). Inclusion criteria were broad; all patients who underwent the procedure listed under the CPT code were included, with no specific exclusions. All variables were collected from the NSQIP database and included basic patient characteristics (age, sex, race/ethnicity, and preoperative weight, height, and BMI), the probability scores for mortality and morbidity, the American Society of Anesthesiologists (ASA) physical status classification (class 1 [normal] through 3 [severe systemic disease]), operation time, and length of hospital stay.

The outcomes were recorded as binary (yes/no) responses to the following complications: deep vein thrombosis (DVT), pulmonary embolism (PE), wound infection, reoperation, unplanned readmission up to 30 days, and readmission up to 30 days. Also, the overall binary outcome (a “yes” response here indicated at least 1 of the responses to the individual outcomes was “yes”) was created. Data were compiled on an annual and summative basis. Each binary outcome was compared by smoking status and sex. Smoking and female sex have been identified as risk factors in

Latarjet outcomes in previous studies^{2-4,7} and therefore were investigated in particular.

Statistical Analysis

To compare the characteristics and outcomes between smokers and nonsmokers, and between men and women, chi-square tests were used for categorical variables and *t* tests were used for continuous variables. Calculating the risk ratio or relative risk instead of the odds ratio (OR) may be appropriate because the OR could be overestimated when the outcome is common. However, if the incidence rates in the outcomes of the study are small (0%-5.7%), the OR would be close to the relative risk. To reflect small numbers of events in the outcomes, penalized logistic regression analysis was performed to calculate the OR of the covariates. $P \leq .05$ was considered statistically significant. All statistical analysis was performed using Stata statistical software (Version 13; StataCorp).

RESULTS

A total of 458 patients (399 men and 59 women) were identified in the NSQIP data set between 2014 and 2018. Over this time period, the number of annual cases steadily increased from 60 in 2014 to 119 in 2018. Overall, 209 (45.6%) patients were between the ages of 18 and 25 years and 261 (57.0%) identified as non-Hispanic White. The mean BMI was 27.4 kg/m², and the mean operative time was 130.2 minutes. Complete patient information is presented in Table 1. Of the entire cohort of patients who underwent the Latarjet procedure, 26.6% were smokers and 87.1% were male.

Baseline characteristics between smokers and nonsmokers were similar, but there was a significantly higher proportion of men in the smoking group compared with the nonsmoking group (92.6% vs 85.1%; $P = .03$). The smoking group had a higher mean weight (191.1 vs 180.3; $P = .01$), a higher morbidity probability score, and a higher ASA classification compared with the nonsmoking group. Regarding patient sex, women were significantly younger than men ($P = .01$), and the female group had significantly higher probability scores for mortality ($P < .01$) and morbidity ($P < .01$), a higher mean BMI ($P < .01$), and a higher ASA class ($P < .01$) than the male group. A comparison of

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Ethical approval was not sought for the present study.

TABLE 1
Baseline Characteristics by Smoking Status and Sex^a

	Smoking Status			<i>P</i>	Sex		<i>P</i>
	Overall (N = 458)	Nonsmoker (n = 336)	Smoker (n = 122)		Female (N = 59)	Male (N = 399)	
Age group, y				.08			.01
18-25	209 (45.6)	162 (48.2)	47 (38.5)		17 (28.8)	192 (48.1)	
26-30	109 (23.8)	76 (22.6)	33 (27.0)		16 (27.1)	93 (23.3)	
31-35	58 (12.7)	36 (10.7)	22 (18.0)		8 (13.6)	50 (12.5)	
>35	82 (17.9)	62 (18.5)	20 (16.4)		18 (30.5)	64 (16.0)	
Smoking status							.03
Nonsmoker	336 (73.4)	—	—		50 (84.7)	286 (71.7)	
Smoker	122 (26.6)	—	—		9 (15.3)	113 (28.3)	
Sex				.03			
Male	399 (87.1)	286 (85.1)	113 (92.6)		—	—	
Female	59 (12.9)	50 (14.9)	9 (7.4)		—	—	
Race/Ethnicity				.18			.62
Non-Hispanic White	261 (57.0)	186 (55.4)	75 (61.5)		37 (62.7)	224 (56.1)	
Non-Hispanic others	74 (16.2)	51 (15.2)	23 (18.9)		7 (11.9)	67 (16.8)	
Hispanic	31 (6.8)	26 (7.7)	5 (4.1)		5 (8.5)	26 (6.5)	
Unknown	92 (20.1)	73 (21.7)	19 (15.6)		10 (16.9)	82 (20.6)	
Height	67.0 ± 17.8	67.1 ± 16.2	66.6 ± 21.7	.78	62.1 ± 21.6	67.7 ± 17.1	.02
Weight	183.2 ± 40.9	180.3 ± 42.8	191.1 ± 34.2	.01	177.1 ± 54.7	184.1 ± 38.5	.22
BMI	27.4 ± 5.1	27.2 ± 5.2	28.0 ± 4.9	.12	29.5 ± 8.8	27.1 ± 4.3	<.01
Operation time, min	130.2 ± 50.1	130.2 ± 50.3	130.5 ± 49.8	.95	116.3 ± 43.6	132.3 ± 50.7	.02
Hospital stay length, d	0.2 ± 5.1	0.1 ± 6.0	0.3 ± 0.5	.81	0.4 ± 1.0	0.1 ± 5.5	.68
ASA class				<.01			<.01
1	205 (44.8)	180 (53.6)	25 (20.5)		16 (27.1)	189 (47.4)	
2	226 (49.3)	137 (40.8)	89 (73.0)		34 (57.6)	192 (48.1)	
3	27 (5.9)	19 (5.7)	8 (6.6)		9 (15.3)	18 (4.5)	
Admission year				.17			.64
2014	60 (13.1)	38 (11.3)	22 (18.0)		6 (10.2)	54 (13.5)	
2015	69 (15.1)	51 (15.2)	18 (14.8)		11 (18.6)	58 (14.5)	
2016	88 (19.2)	66 (19.6)	22 (18.0)		13 (22.0)	75 (18.8)	
2017	122 (26.6)	86 (25.6)	36 (29.5)		12 (20.3)	110 (27.6)	
2018	119 (26.0)	95 (28.3)	24 (19.7)		17 (28.8)	102 (25.6)	

^aData are presented as n (%) or mean ± SD. Bolded *P* values indicate a statistically significant difference between the groups compared (*P* < .05). ASA, American Society of Anesthesiologists; BMI, body mass index.

patient information by smoking status and sex is presented in Table 1.

Table 2 presents an analysis and comparison of the outcomes by smoking status and sex. A higher proportion of smokers had at least 1 individual complication event compared with nonsmokers (5.7% vs 2.1%; *P* = .04). The smokers had higher proportions in all individual events than the nonsmokers, but they were not statistically significant. Although women experienced a higher proportion of overall complications than men, this difference was not statistically significantly different (5.1% vs 2.8%; *P* = .33).

Smokers were 2.19 times more likely to experience at least 1 complication, including DVT, PE, reoperation, wound infection, unplanned readmission, or readmission (95% CI, 0.62-7.82; *P* = .23). Specifically, smokers were 7.82 times more likely to have a DVT (95% CI, 0.58-105.96; *P* = .12), 5.3 times more likely to have a PE (95% CI, 1.30-21.58; *P* = .02), and 2.4 times more likely to have an unplanned readmission (95% CI, 0.19-28.68; *P* = .50). Women had a high likelihood of experiencing the listed complications with the exception of wound infection.

Specifically, women were found to be more likely to have a DVT (OR, 6.42; 95% CI, 0.76-54.87; *P* = .13), an unplanned readmission (OR, 4.13; 95% CI, 0.00-106.21; *P* = .65), and a PE (OR, 2.33; 95% CI, 1.09-1096.63; *P* < .01), although DVT and an unplanned readmission were not statistically significant. Penalized logistic regression was used to determine significance with small samples sizes, and smoking status and sex were found to be associated with increased risk of PE and increased ORs for multiple other complications that did not reach statistical significance, as seen in Table 3.

DISCUSSION

Within our cohort, the number of Latarjet procedures performed almost doubled within a 4-year span between 2014 and 2018. This is consistent with a study of the ABOS database between 2004 and 2013 that found an increasing incidence of bone-block augmentation procedures being performed for shoulder instability.⁶ Given the incremental

TABLE 2
Outcomes by Smoking Status and Sex^a

Complications	Overall (N = 458)	Smoking Status		P	Sex		P
		Nonsmoker (n = 336)	Smoker (n = 122)		Female (N = 59)	Male (N = 399)	
Overall outcomes ^b				.04			.33
No	444 (96.9)	329 (97.9)	115 (94.3)		56 (94.9)	388 (97.2)	
Yes	14 (3.1)	7 (2.1)	7 (5.7)		3 (5.1)	11 (2.8)	
DVT				.11			.29
No	455 (99.3)	335 (99.7)	120 (98.4)		58 (98.3)	397 (99.5)	
Yes	3 (0.7)	1 (0.3)	2 (1.6)		1 (1.7)	2 (0.5)	
Pulmonary embolism				.09			.70
No	457 (99.8)	336 (100.0)	121 (99.2)		59 (100.0)	398 (99.7)	
Yes	1 (0.2)	0 (0.0)	1 (0.8)		0 (0.0)	1 (0.3)	
Reoperation				.22			.87
No	449 (98.0)	331 (98.5)	118 (96.7)		58 (98.3)	391 (98.0)	
Yes	9 (2.0)	5 (1.5)	4 (3.3)		1 (1.7)	8 (2.0)	
Wound infection				.09			.70
No	457 (99.8)	336 (100.0)	121 (99.2)		59 (100.0)	398 (99.7)	
Yes	1 (0.2)	0 (0.0)	1 (0.8)		0 (0.0)	1 (0.3)	
Unplanned readmission				.09			.10
No	448 (97.8)	331 (98.5)	117 (95.9)		56 (94.9)	392 (98.2)	
Yes	10 (2.2)	5 (1.5)	5 (4.1)		3 (5.1)	7 (1.8)	
Readmission				.13			.09
No	318 (97.0)	229 (97.9)	89 (94.7)		39 (92.9)	279 (97.6)	
Yes	10 (3.0)	5 (2.1)	5 (5.3)		3 (7.1)	7 (2.4)	

^aData are presented as n (%). Bolded P value indicates a statistically significant difference between the groups compared ($P < .05$). DVT, deep vein thrombosis.

^bA “yes” response indicates at least 1 of the responses to the individual complication events was “yes.”

TABLE 3
Factors Associated With the Risk of Complications

	Odds Ratio (95% CI)	P
Overall complications		
Smoking	2.19 (0.62-7.82)	.23
Female sex	2.23 (0.07-2.69)	.38
Deep vein thrombosis		
Smoking	7.82 (0.58-105.96)	.12
Female sex	6.42 (0.76-54.87)	.13
Pulmonary embolism		
Smoking	5.29 (1.30-21.58)	.02
Female sex	2.33 (1.09-1096.63)	<.01
Reoperation		
Smoking	1.39 (0.14-5.73)	.60
Female sex	1.13 (0.86-1.18)	.90
Wound infection		
Smoking	26.08 (0.23-47.12)	.39
Female sex	0.71 (0.01-8.81)	.52
Unplanned readmission		
Smoking	2.36 (0.19-28.68)	.50
Female sex	4.13 (0.00-106.21)	.65
Readmission		
Smoking	3.33 (0.21-52.54)	.39
Female sex	4.71 (0.00-13.92)	.49

increase in the number of Latarjet procedures, a better understanding of the corresponding complications and associated risk factors is necessary.

Consistent with other studies,^{1,10} individuals who underwent Latarjet procedures in this study tended to be young men with a low BMI. The overall incidence of complications in individuals undergoing Latarjet procedures in this NSQIP database was 3.1%, which is lower than in previously reported literature.^{1,4,8,9,10,21} This could be due to several factors, including differences in the outcomes included in the analysis, differences in indications,²⁵ or possibly the increase in Latarjet procedures being performed and the concomitant increase in surgeon comfort and proficiency. Latarjet procedures are technically demanding, and there is a well-documented learning curve associated with them, especially for all arthroscopic versions.^{14,20,24} Two systematic reviews^{1,10} of Latarjet outcomes reported reoperation rates of 5.0% and 7.0%, with a large proportion of reoperations relating to technical aspects of the procedure such as hardware complications and screw mispositioning. The reoperation rate in this patient cohort was 2.0% between 2014 and 2018. We speculate that the lower reoperation rates seen in our cohort are because of the variable follow-up rates among these studies, as our cohort reflects acute 30-day reoperation rates (not long-term reoperation rates). Other possible explanations for the decreased reoperation rate seen in our cohort include increased surgeon proficiency as incidence increases, and an increased utilization of the Latarjet procedure for primary surgical stabilization rather than just as a salvage option.

Despite low overall complication rates and a patient population that is generally young and healthy, trends emerged regarding patient factors that may lead to adverse outcomes. Not surprisingly, we found that smoking status is associated with a significant increased risk of DVT, reoperation, and readmission in individuals undergoing Latarjet procedures. Smoking has previously been identified as a risk factor in Latarjet outcomes²⁻⁴ and has well-known detrimental effects on wound healing and bony union.¹⁶ In addition to the potential risk of nonunion, an important consideration in patients who underwent the Latarjet procedure and smoke is thromboembolic risk. Smoking is a modifiable risk factor that may influence the risk of DVT, and smoking status should be elicited and considered when choosing operative candidates, counseling patients undergoing Latarjet, and deciding on chemoprophylaxis in the postoperative period.

In the female cohort in this study, we had to rely on the pooled incidence of complications because of the small number of instances for each specific adverse outcome. The low overall figures made it difficult to statistically compare differences in cardiovascular complications, reoperation, or 30-day readmission. Nevertheless, the increased risk of adverse outcomes in female patients in the NSQIP database is consistent with a study that found lower return to sport and higher reoperation rates in women undergoing the Latarjet procedure.⁷ According to Knapik et al,¹³ one potential factor that may explain increased complication rates in female patients is decreased glenoid and coracoid size, which in turn may influence stability of a coracoid transfer. Knapik et al¹³ further postulate that with defects larger than 33%, careful preoperative planning to judge coracoid size is essential, as not all patients will have enough coracoid bone stock, necessitating alternative bone donor sites.

This study has numerous strengths pertaining to its methodology. The NSQIP database includes data from multiple centers and surgeons, which helps to make the results of this study widely representative and generalizable. Further, this study included 458 patients, which to our knowledge is one of the largest cohorts of Latarjet procedures that has been analyzed to date in the literature. Given the increasing incidence and evolution of this procedure, the outcome analysis of this cohort may be even more reflective of current practice trends than prior reports. With that said, the data analyzed in this study are retrospective and limited by the accuracy of coding and associated coding resolution of NSQIP data. For instance, this study was not able to stratify results based on open versus arthroscopic or mini-open Latarjet procedures, which may have shifted in incidence over the course of the study period and may influence outcomes. The short-term follow-up included in the NSQIP data makes tracking of long-term outcomes not possible beyond 30 days, which is a significant limitation inherent to the database. Finally, the number of adverse outcomes in this study was small, which makes it difficult to perform regression analyses and compare variables with a cohort of this size. A larger sample size would enable more definitive conclusions from comparisons between cohorts.

Despite these limitations, we have shown that the Latarjet procedure for the treatment of glenohumeral instability is increasing in incidence annually based on retrospective analysis of the NSQIP database. The results of this study indicate that the increasing incidence of Latarjet surgeries may be accompanied by a reduction in rates of adverse outcomes compared with historical reports of outcome in the literature. Smokers and female patients may be at increased risk of adverse outcomes and thus may require additional pre- and postprocedural precautions. A better understanding of the patient factors associated with increased risk of complications in Latarjet procedures can further inform surgical decision-making and patient counseling.

CONCLUSION

The data obtained through the NSQIP database suggest that smokers and female patients are at a higher risk of experiencing adverse outcomes and may require additional pre- and postprocedural precautions when undergoing the Latarjet procedure. With the increase in frequency, providers should be aware of potential patient-related factors that may lead to adverse outcomes.

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