

# Resident Involvement in Shoulder-Stabilization Procedures Is Not Associated With an Increased Risk of 30-Day Postoperative Complications



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**Purpose:** To examine the 30-day postoperative outcomes of resident involvement in shoulder-stabilization surgical procedures using the American College of Surgeons National Surgical Quality Improvement database. **Methods:** We conducted a retrospective review of the National Surgical Quality Improvement database for all shoulder-stabilization procedures from 2010 to 2018. Procedures included arthroscopic Bankart, arthroscopic Bankart with SLAP repair, arthroscopic Bankart with Remplissage, open Bankart, anterior bone block, posterior bone block, Latarjet coracoid process transfer, and capsular shift/capsulorrhaphy for multidirectional instability. Data included preoperative demographics, comorbidities, and 30-day postoperative outcomes. Cases were categorized into 2 groups: “attending alone” and “attending and resident.” Statistical analysis comparing groups on demographics and comorbidities included independent *t*-test for continuous variables and Pearson  $\chi^2$  or Fischer exact for categorical variables. A logistic regression model including propensity score was used to calculate adjusted odds ratio for outcomes. **Results:** A total of 3,954 patients undergoing shoulder-stabilization procedures were included in the study and 28.8% of patients had a resident involved in their procedure. Residents were more likely to be involved in procedure for patients who were of minority ethnicity ( $P < .001$ ), a lower body mass index ( $P < .001$ ) and less likely to have a history of chronic obstructive pulmonary disease ( $P = .029$ ). Resident involvement resulted in statistically significant longer total operation time (91 vs 85 minutes,  $P < .001$ ). In terms of postsurgical outcomes, complication rates were low for both groups ( $\sim 0.8\%$ ). Resident involvement was not associated with any significant increase in 30-day postsurgical complications. **Conclusions:** Our results show that resident involvement in shoulder-stabilization surgery is associated with a significant increase in operative time without any significant increase in 30-day postsurgical complications. **Level of Evidence:** Level III, retrospective comparative study.

Shoulder instability is defined as either dislocation or subluxation of the glenohumeral joint due to pathology of the labrum, capsule, glenohumeral ligaments, and/or bony articular defects.<sup>1</sup> Shoulder instability can

be divided into 3 broad categories: anterior instability, posterior instability, and multidirectional instability. Anterior glenohumeral instability is a common problem among young, physically active individuals, with an increased occurrence in collision athletes (i.e., football and rugby players).<sup>2</sup> Posterior glenohumeral instability has a lower reported occurrence rate and is seen in both young, physically active athletes (i.e., weightlifters and football linemen) and in the military population.<sup>1</sup> Several shoulder-stabilization procedures exist for patients with glenohumeral instability that is refractory to conservative therapy. The arthroscopic Bankart, open Bankart, and Latarjet–Bristow are all effective treatment methods for patients with recurrent glenohumeral instability. Currently, the arthroscopic Bankart is the most widely used procedure in patients without critical glenoid bone loss. Although the arthroscopic Bankart has shown favorable outcomes with a low rate of postoperative complications, there is a high rate of recurrent instability in high-demand contact or overhead

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athletes.<sup>3,4</sup> For patients with critical glenoid bone loss, the Latarjet–Bristow has shown to have slightly greater complication rates, however, with decreased recurrence rates of postoperative instability.<sup>5-10</sup>

Through a system of graduated responsibility, residents acquire increased ownership throughout their training in preparation for independent practice.<sup>11-14</sup> Increased ownership with patient care, especially in the operating room, is critical for developing resident competency during their training.<sup>12,13</sup> Over the past decade, numerous studies have used large public databases to examine the impact of resident involvement on perioperative and postoperative outcomes in orthopaedic procedures, including ankle, spine, hip, knee, and shoulder surgery.<sup>11,15-21</sup> In a study using the National Surgical Quality Improvement (NSQIP) database, Cvetanovich et al.<sup>11</sup> found no significant association between resident involvement in total shoulder arthroplasty and 30-day postoperative complications. Similarly, Basques et al.<sup>22</sup> analyzed resident involvement during shoulder arthroscopy and found no significant difference in short-term postoperative complications or readmission rates. Although their study included analysis of both SLAP repair and arthroscopic Bankart procedures, they did not analyze other shoulder stabilization procedures such as the Latarjet–Bristow or open Bankart.

Several studies have examined the impact of resident involvement in other shoulder surgical procedures such as total shoulder arthroplasty and shoulder arthroscopy.<sup>11,22</sup> The purpose of this study was to examine the 30-day postoperative outcomes of resident involvement in shoulder stabilization surgical procedures using the American College of Surgeons (ACS)-NSQIP database. We hypothesized that there would be no significant difference in early postoperative complication rates in cases with resident involvement compared with cases with the attending surgeon alone.

## Methods

### Data Source

The ACS-NSQIP database is a national, validated, risk-adjusted, and prospectively maintained surgical outcomes registry that contains more than 240 clinical variables. The ACS-NSQIP provides extensive data for preoperative patient characteristics, operative variables, and 30-day postoperative outcomes. Using Current Procedural Terminology (CPT) codes, the NSQIP database allows for high-powered, retrospective analyses.<sup>23</sup> Other databases of surgical complications and those based on insurance claims, as well as surgical mortality and morbidity conferences, have been deemed less accurate than the NSQIP database.<sup>24-26</sup> No institutional review board approval was required due to the use of the NSQIP-ACS Database.

### Data Collection

In a retrospective review of the NSQIP database, we obtained data for all shoulder-stabilization procedures from 2010 to 2018. Shoulder-stabilization surgeries included arthroscopic Bankart, arthroscopic Bankart with SLAP repair, arthroscopic Bankart with remplissage, open Bankart, anterior bone block, posterior bone block, Latarjet coracoid process transfer, and capsular shift/capsulorrhaphy for multidirectional instability. These procedures were identified by their respective CPT codes (29806, 29807, 29827, 23455, 23460, 23465, 23662, and 23466). Cases were divided and analyzed based on resident presence in the operating room. Resident presence was determined by the NSQIP variable “level of residency supervision” and separated into cases as either “attending alone” or “attending and resident in operating room.”

Case demographics were defined by age, body mass index (BMI), sex, race, and ethnicity. The comorbidities analyzed included >10% body weight loss in <6 months, bleeding disorders, congestive heart failure, chronic obstructive pulmonary disease, current smoker, diabetes, disseminated cancer, dyspnea, alcoholism (defined as drinking >2 alcoholic drinks per day), functional status, hypertension, open/infected wound, peripheral vascular disease, renal failure, and exogenous steroid use for chronic conditions. Operative characteristics included American Society of Anesthesiologists classification, length of stay hospital stay, and total operation time.

Postoperative outcome variables were recoded into various groups for statistical analysis. Cardiovascular complications included cardiac arrest requiring cardiopulmonary resuscitation, myocardial infarction, bleeding transfusions, artery bypass graft failure, and deep-vein thrombosis or thrombophlebitis. Neurologic complications included cerebrovascular accident/stroke with neurologic deficits, coma >24 hours, and peripheral nerve injury. Pulmonary complications included pneumonia, unplanned intubation, pulmonary embolism, and the use of a ventilator >48 hours. Renal complication included progressive renal insufficiency, acute renal failure, and urinary tract infection. Surgical-site complications included superficial surgical-site infection (SSI), deep incisional SSI, organ space SSI, and wound dehiscence. Any readmission and reoperation were included as individual outcomes.

### Statistical Analysis

Demographics, comorbidities, operative characteristics, and outcomes were analyzed using descriptive and comparative statistics. For continuous variables, an independent samples *t*-test was used. For categorical variables, Pearson  $\chi^2$  or Fischer exact tests were used appropriately. Propensity scores were used for risk adjustment to control for baseline differences in the

**Table 1.** Demographic Data and Comorbidities in 3,954 Patients Treated With Shoulder-Stabilization Surgery in 2010 to 2018, Categorized by Resident Presence

Variable	Resident Present				P Value
	No (2,813 Patients)		Yes (1,141 Patients)		
	Value	%	Value	%	
<b>Demographic</b>					
Age, y, mean ± SD	52.4 ± 15.3		51.7 ± 16.3		.230
BMI, mean ± SD*	29.5 ± 7.2		28.3 ± 8.4		<.001
Sex					.070
Male	1,713	61%	729	64.1%	
Female	1,096	39%	408	35.9%	
<b>Race*</b>					
Asian	36	1.3%	14	1.2%	<.001
Black	168	6%	78	6.8%	
Native American or Alaskan	18	0.6%	2	0.2%	
Native Hawaiian or Pacific Islander	3	0.1%	0	0.0%	
White	2,236	79.5%	744	65.2%	
Other	352	12.5%	303	26.6%	
<b>Ethnicity*</b>					
Hispanic	240	8.5%	39	3.4%	<.001
Non-Hispanic	2,573	91.5%	1102	96.6%	
<b>Comorbidities</b>					
>10% loss body weight in <6 mo	3	0.1%	1	0.1%	.865
Bleeding disorders	44	1.6%	15	1.3%	.558
CHF	3	0.1%	1	0.1%	.865
COPD*	71	2.5%	16	1.4%	.029
Current smoker	524	18.6%	184	16.1%	.063
Diabetes	320	11.4%	121	10.6%	.485
Disseminated cancer	0	0.0%	1	0.1%	.116
Dyspnea	86	3.1%	28	2.5%	.304
EtOH >2 drinks/d	78	2.8%	32	2.8%	.956
Functional status (partially dependent)	16	0.6%	8	0.7%	.653
Hypertension	1,030	36.6%	404	35.4%	.474
Open/infected wound	7	0.2%	6	0.5%	.168
PVD	0	0.0%	1	0.1%	.116
Renal failure	4	0.1%	0	0.0%	.203
Steroid use	31	1.1%	15	1.3%	.572

BMI, body mass index; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; EtOH, ethyl alcohol; PVD, peripheral vascular disease.

\*Denotes significant difference between cohorts ( $P < .05$ ).

cohort prior to surgery. The logistic regression model used propensity score and attending presence as the predictor variables to calculate the adjusted odds ratio for outcomes. All statistical analysis was performed using the Statistical Package for Social Sciences, Version 26 (IBM Corp., Armonk, NY) and statistical significance was set at an alpha level of 0.05.

## Results

Our search of the NSQIP database for all orthopaedic shoulder-stabilization surgeries yielded 3,954 cases. Dividing these cases based on resident involvement resulted in 2,813 cases for “attending alone” and 1,141 cases for “attending and resident in operating room” groups.

Patient demographics between the 2 cohorts differed significantly in BMI, race, and ethnicity. Residents were more likely to be present for operations of patients with

a lower BMI (attending alone  $29.5 \pm 7.2$  vs resident present  $28.3 \pm 8.4$ ,  $P \leq .001$ ). Residents were less likely to be present for operations on patients who were White (attending alone 79.5% vs resident present 65.2%) but more likely to be present for patients who were “other” race (attending alone 12.5% vs resident present 26.6%) ( $P \leq .001$ ), as well as patients who were non-Hispanic (attending alone 91.5% vs resident present 96.6%,  $P < .001$ ). Regarding comorbidities, residents were significantly less likely to be present in the operating room for patients who had a history of chronic obstructive pulmonary disease (attending alone 2.5% vs resident present 1.4%,  $P = .029$ ) (Table 1). There were no demographic differences between groups after stratification of propensity scores. Further, resident involvement resulted in significantly longer operative times (attending alone  $84.6 \pm 44.8$  vs resident present  $90.5 \pm 43.3$ ,  $P < .001$ ), which remained

**Table 2.** Operative Characteristics in 3,954 Patients Treated With Shoulder-Stabilization Surgery in 2010 to 2018, Categorized by Resident Presence

Operative Variable	Resident Present				P Value
	No (2,813 Patients)		Yes (1,141 Patients)		
	Value	%	Value	%	
ASA classification					.169
Class 1, no disturbance	509	18.1%	237	20.8%	
Class 2, mild disturbance	1,634	58.2%	655	57.5%	
Class 3, severe disturbance	652	23.2%	241	21.1%	
Class 4, life-threatening disturbance	13	0.5%	7	0.6%	
Class 5, moribund	0	0.0%	0	0.0%	
Length of hospital stay, d, mean $\pm$ SD	0.2 $\pm$ 1.9		0.6 $\pm$ 10.9		.083
Total operation time, min, mean $\pm$ SD*	84.6 $\pm$ 44.8		90.5 $\pm$ 43.3		<.001

ASA, American Society of Anesthesiologists; SD, standard deviation.

\*Denotes significant difference between cohorts ( $P < .05$ ).

significant after propensity score stratification ( $P < .001$ ) (Table 2).

### Comparison of Outcomes

In the analysis of operative outcomes, with propensity score adjustment in a logistic regression model, resident presence in the operative room was not associated with any increased risk of adverse outcomes (Table 3). Further analysis stratified by procedure type likewise resulted in no association between resident present and adverse outcomes.

### Discussion

In our sample of 3,941 patients, we found that resident involvement in shoulder-stabilization surgery was not associated with a significant increase in 30-day postsurgical complications. In fact, the resident group demonstrated a lower rate of overall complications as compared with the attending alone group but did not reach statistical significance.

Although no study, to our knowledge, has addressed shoulder instability, several other studies have used the ACS-NSQIP database to assess postoperative

complications in various orthopaedic surgical procedures. Many of these studies found that resident involvement is not associated with any increase in short-term post-operative complications.<sup>11,16,20,22</sup> Basques et al.<sup>22</sup> studied the impact of resident involvement in shoulder arthroscopy and found no significant difference in short-term complications or readmission rates. Their analysis included arthroscopic shoulder-stabilization procedures such as the SLAP repair and arthroscopic Bankart. Interestingly, their study found no significant difference in operative times, while our study found that resident involvement was associated with significantly longer operative times.

Our study supports the findings of several other orthopaedic studies that show an increase in operative time with resident involvement.<sup>16,19,20</sup> Examining a variety of orthopaedic procedures including total joint replacement, arthroscopy, and trauma, Pugely et al.<sup>20</sup> determined that resident involvement had a minimal effect on morbidity and no effect on mortality despite a significant increase in surgical times. Other studies examining total shoulder arthroplasty as well as foot and ankle procedures also concluded that resident

**Table 3.** Postoperative Outcomes in 3,954 Patients Treated With Shoulder Surgery in 2010 to 2012, Categorized by Resident Presence, With Propensity Score-Adjusted OR

Outcome	Resident Present				OR	CI	P Value
	No (2,813 Patients)		Yes (1,141 Patients)				
	Value	%	Value	%			
Any complication	24	0.9%	7	0.6%	0.713	0.30-1.67	.438
Cardiovascular complications	6	0.2%	0	0.0%	0.00	0.00	.989
Neurologic complications	1	0.04%	2	0.2%	4.58	0.40-51.99	.220
Pulmonary complications	7	0.2%	2	0.2%	0.747	0.15-3.66	.719
Renal complications	7	0.2%	3	0.3%	0.965	0.24-3.82	.960
Surgical-site complications	5	0.2%	1	0.09%	0.566	0.07-4.94	.607
Readmission	9	0.3%	2	0.2%	0.633	0.14-2.98	.562
Reoperation	4	0.1%	3	0.3%	1.83	0.40-8.36	.435

CI, confidence interval; OR, odds ratio.



involvement is associated with no significant increase in postoperative complications despite a significant increase in total operative time.<sup>16,19</sup> Despite the fact that our study shows a statistically significant association between operative time and resident involvement, the absolute difference between groups is 5.9 minutes, which may not have any clinical significance.

Our findings provide further evidence supporting the idea that resident involvement is both safe for patients and necessary to train the next generation of orthopaedic surgeons. Some studies have shown that although patients receiving care at academic medical centers understand the need to train residents, many are not fully comfortable with trainee involvement with their procedures.<sup>2,27</sup> This study can be used as a counseling tool for physicians to ease the minds of patients who may be concerned with resident involvement in their procedures. Using this study and studies similar to ours, physicians can point to the fact that there is no evidence of increased short-term adverse outcomes with resident involvement in a wide array of orthopaedic surgical procedures.

### Limitations

This study includes several limitations. First, the ACS-NSQIP databases captures retrospective data and only reports 30-day postoperative outcomes. This excludes any complications that may have occurred outside of the 30-day postoperative window. The database only indicates whether a resident was present in the operating room and not the degree of surgical involvement. Second, many orthopaedic-specific outcomes, such as functionality and pain scores, are not captured by the ACS-NSQIP database. Additional functional variables not collected in the database include recurrent instability, stiffness, and graft nonunion. In addition, this study looked at various Current Procedural Terminology codes including both open and arthroscopic techniques. Because procedures were not assessed on an individual level, we are only able to speak to the outcomes regarding shoulder-stabilization surgeries as a collective group.

### Conclusions

Our results show that resident involvement in shoulder-stabilization surgery is associated with a significant increase in operative time without any significant increase in 30-day postsurgical complications.

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