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Does resident involvement have an impact on postoperative complications after total shoulder arthroplasty? An analysis of 1382 cases

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Background: The impact of resident involvement on total shoulder arthroplasty (TSA) complication rate is unknown. The purpose of this study was to assess whether resident involvement in TSA is associated with 30-day complication rates.

Methods: The American College of Surgeons National Surgical Quality Improvement Program database was searched for all patients who underwent TSA between 2005 and 2012. Data were extracted for patient preoperative demographics, intraoperative variables, resident involvement in surgery, and 30-day postoperative complications. Resident and nonresident cases were grouped by a matched propensity score analysis. Univariate and multivariate analysis was performed to assess the effect of resident involvement on postoperative complications.

Results: We analyzed 1382 patients who underwent primary TSA, with matched groups of 691 with and 691 without resident involvement. The overall rate of 30-day complications was 2.60% in TSAs in which a resident was involved compared with 3.91% when no resident was involved ($P = .173$). Operative time and hospital stay were shorter in cases in which a resident was present ($P = .002$ and $P < .001$, respectively). Independent risk factors significantly associated with TSA complications identified by multivariate regression were higher patient age, higher American Society of Anesthesiologists classification, congestive heart failure, insulin-dependent diabetes, and peripheral vascular disease.

Conclusion: Resident involvement in TSA procedures is not a risk factor for 30-day complications. Patient factors including increased age, diabetes, and cardiac disease are risk factors for TSA complications. This information can be used in preoperative counseling to reassure patients about safety of resident involvement in TSA and to optimize patient comorbidities before surgery.

Keywords: Total shoulder arthroplasty; resident involvement; complications; NSQIP

Total shoulder arthroplasty (TSA), including anatomic and reverse TSA, is an effective treatment for patients with shoulder disorders including glenohumeral degenerative joint disease, rotator cuff arthropathy, and complex proximal humerus fractures.[1-3,17,36] Patients undergoing TSA

No Institutional Review Board approval was necessary for this study because the data were obtained from a de-identified national database.

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experience high rates of functional improvement, pain relief, and improved overall physical well-being.[9,16,26,30] The number of TSA procedures performed in the United States has been dramatically increasing in recent years, and evidence has shown the procedure to be cost-effective.[3,23-25] Nevertheless, both early and long-term TSA complications remain a concern, with recent studies reporting 30-day to 90-day postoperative complication rates of 3.6% to 25%.[8,10,11,28,31,33-35]

Orthopedic residency training prepares residents to transition to independent practice through a system of graduated responsibility. This has led to concern that resident involvement in medical care and surgery in particular could adversely affect patient outcomes.[12,21] In addition, there is concern of the ''July effect,'' in which inexperience among residents who graduated to the next postgraduate year on July 1 would lead to poor patient care at this time of year.[6,7] To date, there have been several analyses of the impact of resident involvement on rates of short-term complications after orthopedic surgery, with most data suggesting no difference in complication rates based on resident involvement in spine surgery and total hip and knee arthroplasty.[4,18-20,27,29,37]

Currently, there are no studies that evaluate the impact of resident involvement on TSA complication rates. Our primary objective was to determine the role of resident involvement in 30-day TSA complication rates using the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database. The null hypothesis was that there is no difference in TSA complication rates based on resident involvement, and the alternative hypothesis was that there is a difference in TSA complication rates based on resident involvement. Our secondary objective was to determine patient preoperative and operative risk factors independently associated with 30-day TSA complications in this large nationwide database.

Materials and methods

Data source

The NSQIP database is prospectively collected by the American College of Surgeons, with current data from >400 hospitals (http://site.acsnsqip.org). Hospitals include public and private, academic and nonacademic institutions, of a range of sizes, from across the United States. Surgical clinical reviewers evaluate the patients' medical records to collect preoperative demographics, medical comorbidities, preoperative laboratory results, and intraoperative data including resident involvement. The surgical clinical reviewers prospectively follow the patients' medical records to document complications including morbidity broken down into subcategories, mortality, readmissions, and reoperations in the 30-day postoperative period. The NSQIP data have been shown to be more accurate than other databases reporting complications, databases generated from insurance claims, and traditional surgical mortality and morbidity conferences.[13,15,22] The NSQIP database has been successfully used to determine risk factors for complications in a variety of orthopedic surgical procedures.[4,18-20,27,29,37]

Patient selection and data collection

The NSQIP database was searched to identify all patients who underwent primary TSA between 2005 and 2012. Patients were selected on the basis of *Current Procedural Terminology* (CPT) code 23472, which includes both anatomic and reverse TSA (''Arthroplasty, glenohumeral joint; total shoulder [glenoid and proximal humeral replacement (e.g., total shoulder)]''). Exclusion criteria included preoperative diagnoses of mechanical complications that may indicate a revision procedure and preoperative diagnoses of infection, malignant disease, or fracture. Patients undergoing TSA for fracture made up about 5% of the total cohort and were excluded because there are likely different outcomes expected after fracture than with an elective shoulder arthroplasty for osteoarthritis. In addition, patients were excluded when the presence or absence of surgical resident involvement in the TSA was not recorded or if the 2 distinct database indicators indicating resident involvement were discordant. The data collected were preoperative demographic, comorbidity, and laboratory data; operative variables including resident involvement, operative time, and transfusion rate; and 30-day postoperative complications. Surgical resident involvement data were extracted and analyzed in total and also stratified on the basis of postgraduate year (PGY) level of training (junior resident [PGY1-3], senior resident [PGY4-5], and fellow [PGY6 and above]). The specific outcomes identified in the 30-day postoperative period were surgical site infection, wound dehiscence, pneumonia, unplanned intubation, deep venous thrombosis, pulmonary embolism, ventilation >48 hours, renal insufficiency, acute renal failure, urinary tract infection, coma, stroke, peripheral neurologic deficit, cardiac arrest, myocardial infarction, sepsis, death, unplanned hospital readmission, and reoperation.

Statistical analysis

To account for patient selection bias based on resident involvement that may occur in retrospective analyses of prospectively collected data, a propensity score matching algorithm was used to create 2 groups with similar characteristics, except for 1 with and 1 without resident involvement in the procedure.[18-20] A propensity score determines the conditional probability of a patient's having resident involvement in TSA based on preoperative variables including demographics, comorbidities, laboratory values, and American Society of Anesthesiologists (ASA) grade. Thus, patients with and without resident involvement but with similar preoperative characteristics, and thus similar propensity scores, are selected for inclusion. Propensity score analyses control for the potential effects of confounding and allow improved determination of causal effects in observational studies.[5,14] Of note, preoperative international normalized ratio and blood urea nitrogen level were excluded from propensity score matching because >20% of patients were missing these data.

Preoperative demographic, comorbidity, and laboratory variables were compared for resident-involved and non-resident-involved cases by χ^2 test for categorical data and t test for continuous data. In the stratified analysis of resident level of training, a Fisher exact test was used instead of a χ^2 test because of small expected frequencies. Next, intraoperative (operative time and