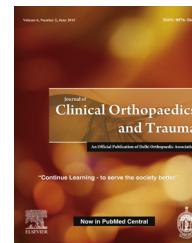


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# The impact of resident involvement on outcomes in orthopedic trauma: An analysis of 20,090 cases

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## ABSTRACT

**Background:** Involvement in patient care is critical in training orthopedic surgery residents for independent practice. As the focus on outcomes and quality measures intensifies, the impact of resident intraoperative involvement on patient outcomes will be increasingly scrutinized. We sought to determine the impact of residents' intraoperative participation on 30-day post-operative outcomes in the orthopedic trauma population.

**Methods:** A total of 20,090 patients from the American College of Surgeons National Surgical Quality Improvement Program database from 2006 to 2013 were identified. Patient demographics and comorbidities, surgical variables, and 30-day post-operative (wound, minor, and major) complications were collected. Chi-squared and analysis of variance statistical methods were used to compare the 30-day outcomes of patients with and without a resident's intraoperative involvement.

**Results:** Resident involvement had no effect in the incidence of wound and minor complications among all three anatomic sites of orthopedic trauma procedures (hip, lower extremity [LE], and upper extremity [UE]). There was no statistically significant difference in the incidence of major complications in the hip and LE groups. The UE group, however, demonstrated an increase in the rate of major complications (2.60% vs. 1.89%,  $p = 0.046$ ). There was no difference in mortality or readmission rates.

**Conclusions:** Resident involvement in orthopedic trauma cases did not significantly impact the 30-day outcomes in nearly all domains. Our findings support continued resident involvement in the care of the orthopedic trauma patient.

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## 1. Introduction

Resident involvement in patient care is integral in training physicians for independent practice. In the case of the surgical

trainee, supervised participation in the operating room during operations is an irreplaceable facet of surgical training. Recently, resident participation has come under increased scrutiny as an area for improved efficiency and safety in patient care.<sup>1,2</sup> As more emphasis is placed on outcomes and

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quality measures in the evolving healthcare system, the impact of orthopedic residents' involvement should be well defined.

The effect of residents' involvement on post-operative outcomes has been studied to varying degrees in both the orthopedic surgery and general surgery literature. Previous studies examining the effect of resident involvement in the field of general surgery have yielded mixed results, ranging from improved patient survival to increased patient mortality.<sup>3-11</sup> Comparatively fewer studies have evaluated this effect in orthopedic trauma surgery, and to date, the results of these studies have shown no significant impact of residents' involvement on post-operative morbidity and mortality. The most recent studies utilizing the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) in orthopedics have demonstrated no difference in the complication rates when evaluating the effect of residents' involvement in total joint arthroplasty, arthroscopy, lower extremity (LE) trauma, and spine surgery.<sup>12-16</sup>

To date, no study has looked at the impact of residents' intraoperative involvement in orthopedic trauma. Previous studies assessing the effect of residents' involvement in orthopedic surgery have evaluated cohorts composed largely of arthroplasty, spine, and arthroscopy patients. Notably, patients undergoing fracture fixation accounted for 3.9% to 15.1% of the total cohorts in these studies.<sup>12,15</sup> With this in mind, we sought to define the impact of resident participation on 30-day outcomes following hip, lower extremity, and upper extremity fracture care.

## 2. Methods

### 2.1. Dataset

This study was performed in accordance with the relevant regulations of the US Health Insurance Portability and Accountability Act (HIPAA) and the ethical standards of the 1964 Declaration of Helsinki. The protocol was approved by the Vanderbilt Institution Review Board. Access to the (ACS-NSQIP) dataset between 2006 and 2013 was granted by the ACS-NSQIP. NSQIP is a program that prospectively collects and audits over 250 standardized data points on patient demographics, risk factors, laboratory values, operative variables, and postoperative events in a broad group of surgical specialty cases. Patients are monitored for thirty days post-operatively for complications, reoperations, or readmissions. The data are collected by trained surgical clinical reviewers (SCRs) using standard tools and definitions and then are entered into the NSQIP database, the collection of which has been shown to be more accurate than that of insurance claims. Participating institutions include over 400 public, private, academic and non-academic hospitals in a variety of settings.

### 2.2. Patient selection

Current Procedural Terminology (CPT) codes were used to query the NSQIP database and group specific surgical

procedures for comparison. The surgical procedures used in this study and their corresponding CPT codes are listed in [Appendix 1](#).

We collected and analyzed relevant surgical variables for each group. These included: age, American Society of Anesthesiologists' (ASA) classification, gender, race, body mass index (BMI), smoking status, functional status, medical comorbidities, and operative variables. Medical comorbidities included diabetes mellitus, chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), dialysis, cancer, corticosteroid use, a recent history of unintended weight loss, dyspnea, or a bleeding disorder. Resident involvement in each case, in addition to their level of training, was also collected from the NSQIP database.

### 2.3. Outcomes

Complications were defined as surgical (wound), major medical, or minor medical. Surgical complications included: superficial and deep surgical site infections, wound dehiscence, graft/prosthesis/flap failure, and return to the operating room. Minor medical complications included: urinary tract infections, renal insufficiency, deep vein thrombosis, need for a blood transfusion, pneumonia, and peripheral nerve injury. Major medical complications included: pulmonary embolism (PE), prolonged ventilation (>48 h), unplanned intubation, acute renal failure (ARF), cardiac arrest, myocardial infarction (MI), stroke, coma (>24 h), organ space infections, sepsis, and septic shock.

Complication rates, mortality, operative time, length of stay, and rate of reoperation within 30 days were all calculated and compared among cohorts.

### 2.4. Statistical analysis

The demographics, comorbidities, operative time, length of stay, rate of reoperation, and complications were compared between the cohort with resident involvement and without resident involvement. Chi squared analysis was used for the categorical variables, and analysis of variables (ANOVA) was used to compare the continuous variables. Statistical significance was set at  $p = 0.05$ . Statistical programming was computed using the software Statistical Analysis System (SAS) 9.4 (SAS Institute Inc., Cary, NC, USA, 2013).

## 3. Results

A total of 20,090 patients met the inclusion criteria and underwent an orthopedic procedure designated by the CPT codes in [Appendix 1](#). Surgical procedures were then sub-categorized into anatomic region of injury. The distribution among hip (Hip), LE, and upper extremity (UE) cases is shown in [Table 1](#). Overall, residents participated in 33.0% of all the operative trauma cases included in this analysis analyzed. If no resident was involved in the surgery, the operation was recorded as "Attending only." The demographics of each group are shown in [Table 2](#).

There were no significant differences in wound complications or minor complications among all three sites (Hip, LE, UE)

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