A Comparison of 30-Day Perioperative Complications for Open Operative Care of Distal Upper-Extremity Fractures Treated by Orthopedic Versus Plastic Surgeons: A Study of the National Surgical Quality Improvement (NSQIP) Database

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Purpose: To determine whether surgeon specialty affects complications after open operative care of distal upper-extremity fractures.

Methods: We performed a retrospective cross-sectional study using the American College of Surgeons National Surgical Quality Improvement Database from 2005 to 2016. Patients were included if they received open operative treatment by an orthopedic or a plastic surgeon for distal radius/ulna, carpal, metacarpal, or phalangeal fracture. Univariate analysis and multivariable analysis of perioperative complications were performed to identify differences between the 2 specialties. Major complications assessed were 30-day reoperation and mortality. We also assessed transfusion, thromboembolic, surgical site infections, cardiac, pulmonary, and renal complications.

Results: A total of 20,512 patients were included. Most cases performed by orthopedic surgeons (71.2%) were for distal radius/ulna fractures, whereas the majority of cases performed by plastic surgeons were for metacarpal (41.0%) and phalangeal (37.9%) fractures. No difference was identified in most perioperative complications between specialties. Plastic surgeons had a higher incidence of surgical site infections (1.2% vs 0.5%) on univariate analysis. However, when controlling for variables such as patient demographics and comorbidities in multivariable analysis, surgical specialty was not significantly associated with surgical site infection. Rather, surgery on phalangeal bones (adjusted odds ratio [aOR] = 2.745; 95% confidence interval [CI], 1.559–4.833), higher wound class (wound class 3 aOR = 3.630; 95% CI, 2.003–6.577), and smoking (aOR = 1.970; 95% CI, 1.279–3.032) were independent risk factors for surgical site infection. Plastic surgeons were found to operate on proportionally more smokers, patients with higher wound class, and phalangeal fractures (37.9% of all fracture cases) compared with orthopedic surgeons.

Conclusions: Orthopedic and plastic surgeons achieve equivalent outcomes from a safety perspective after open operative treatment of upper-extremity fractures in terms of mortality and 30-day reoperation, which suggests that both specialties can safely perform call-related operative upper-extremity fracture care. Plastic surgeons operated on more smokers, patients with higher wound class, and phalangeal fractures, all of which were associated with increased incidence of surgical site infection, revealing differences in practice composition from their orthopedic colleagues.

Type of study/level of evidence: Therapeutic III.

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Declaration of interests: No benefits in any form have been received or will be received by the authors related directly or indirectly to the subject of this article.

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country are sponsored by orthopedic surgery or plastic surgery departments. Previous studies showed that trainees in orthopedic hand fellowships have more experience with bone and joint surgery, arthroscopy, and issues proximal to the wrist, whereas plastic surgery hand fellowships have more exposure to soft tissue reconstruction, microsurgery, and congenital hand issues. Among all fellowships, trainees experience considerable variability in exposure to pathology proximal to the forearm, shoulder arthroscopy, and congenital cases. A survey of hand surgery fellowship directors confirms this heterogeneity. In identifying clinical entities essential to hand surgery training, orthopedic surgery program directors favored forearm fractures and pathology more proximal, whereas plastic surgery programs directors favored management of burns, soft tissue reconstruction, and microsurgery.

These differences in training throughout residency and fellowship manifest in posttraining practice variability between orthopedic-trained and plastics-trained hand surgeons. Whereas phalanx and metacarpal fractures were repaired equally by both groups, plastic surgeons are more likely to treat nail bed and tendon injuries and perform replantations, free tissue transfer, and general microsurgical surgery. Orthopedic surgeons are more likely to treat carpal, radius, and ulna fractures.

Studies in other fields have shown notable differences in clinical outcomes depending on training background. Vascular surgeons achieve lower rates of mortality than general surgeons when operating on abdominal aortic aneurysm, and surgeons are associated with lower mortality rates than interventionalists such as cardiologists and radiologists in endovascular repair of abdominal aortic aneurysms. With such heterogeneity in hand surgery, it is interesting to determine whether there are differences in clinical outcomes between specialties in the treatment of distal radius/ulna, carpal, metacarpal, and phalangeal fractures. The purpose of this study was to investigate the null hypothesis that there would be no difference in patient perioperative complications between orthopedic surgeons and plastic surgeons performing open operative treatment of fractures of the distal upper extremity. For the purposes of this investigation, we defined surgical specialty based on surgeons' residency background, and no distinction was made with regard to fellowship training.

**Materials and Methods**

**Case selection**

There was no source of funding for this research. A retrospective cross-sectional study was performed using the American College of Surgeons National Surgical Quality Improvement Database (NSQIP) from 2005 to 2016. The NSQIP database collects data on more than 130 variables on surgical patients at participating hospitals. Demographic information, comorbidities, perioperative events, and 30-day postoperative complication outcome data were collected. Patients were included for analysis if they were provided open operative treatment by an orthopedic surgeon or a plastic surgeon for an upper-extremity fracture on either an inpatient or outpatient basis as indicated by the following Current Procedural Terminology codes: distal radius/ulna (25607, 25608, 25609, 25652, and 25676), carpal bones (25628, 25645, 25670, 25685, and 25695), metacarpals (26615, 26685, 26688, and 26686), and phalangeal bones (26715, 26735, 26746, 26765, and 26785). Patients treated with percutaneous pinning of fractures were not included in this study.

**Outcomes**

Our primary outcomes were mortality and return to the operating room within 30 days after the index procedure. Secondary outcomes assessed include the following complications within 30 days after the index procedure: perioperative blood transfusion (during or after surgery within 72 hours from the time of operation), deep vein thrombosis, pulmonary embolism, sepsis, septic shock, surgical site infection (superficial, deep, or organ/space infection), wound dehiscence, unplanned reintubation, ventilator dependence for greater than 48 hours, peripheral nerve injury, pneumonia, urinary tract infection, acute renal failure requiring dialysis, progressive renal insufficiency not requiring dialysis, stroke, coma lasting greater than 24 hours, myocardial infarct, and cardiac arrest.

We performed univariate analysis of primary and secondary outcomes between orthopedic surgeons and plastic surgeons. For outcomes that met Bonferroni-adjusted significance (P < .002), multivariable analysis was performed to assess independent risk-adjusted associations attributable to surgeon specialty.

We used multivariable analysis to assess surgeon specialty, operative details, patient demographics, and patient comorbidities as potential confounders for differences in complications between surgical specialties. Operative details assessed include region of surgery (distal radius/ulna, carpals, metacarpals, phalangeal bones), operative time, emergency cases, inpatient status, and wound class as defined by the Centers for Disease Control and Prevention (Table 1). Patient demographics assessed include age and sex. Comorbidities assessed include body mass index, American Society of Anesthesiologists physical status classification, diabetes, hypertension requiring medication, smoking status, cardiac, pulmonary disease, renal disease, bleeding disorders, and chronic corticosteroid use.

**Statistical analysis**

Continuous variables are expressed as mean ± SD. Univariate analysis was performed using 2-tailed Student t tests or chi-square/Fisher exact tests as appropriate. Because 20 perioperative outcomes were assessed, a Bonferroni adjusted z value of 0.002 was set as statistically significant to address the problem of multiple comparisons. Otherwise, an α value of 0.05 was set as statistically significant. Missing data were not adjusted using multiple imputation methods. We performed multivariable regression analysis on perioperative outcomes with significant differences in surgeon specialty and completion percentage over 90%. Statistical analysis was performed using SPSS software (version 25.0, IBM, Armonk, NY).

**Results**

A total of 20,512 patients receiving open operative treatment of upper-extremity fractures of the distal radius/ulna, carpal bones, metacarpals, and phalangeals by an orthopedic surgeon or plastic surgeon were identified in the NSQIP database between 2005 and 2016 (Table 2). Orthopedic surgeons performed 87.0% of cases whereas plastic surgeons performed 13.0%. Surgical treatment of the distal radius/ulna region comprised most cases included in this study (63.7%).

The relative proportions of distal radius/ulna, carpal, metacarpal, and phalangeal fracture surgery revealed different practice patterns between orthopedic and plastic surgeons. Orthopedic surgeons perform more proximal fracture surgery, whereas plastic surgeons perform more distal fracture surgery. Most orthopedic fracture cases performed were for distal radius and ulna fractures (71.2%). Distal radius/ulna fracture surgery comprised only 14.1% of plastic surgery cases. For plastic surgeons, most cases performed were for metacarpal (41.0%) and phalangeal (37.9%) fractures,
whereas metacarpal and phalangeal surgery comprised only 12.2% and 11.2%, respectively, of cases performed by orthopedists. Evaluation of operative characteristics (Table 3) demonstrated that the mean operative time was longer for orthopedic surgeons (74.0 vs 68.1 minutes; \( \text{P} < .001 \)). Orthopedists performed emergency surgery a smaller proportion of the time compared with plastic surgeons (10.4% vs 12.2%; \( \text{P} = .006 \)), and plastic surgeons performed surgery on a higher wound class (\( \text{P} < .001 \)). There were no differences in terms of inpatient status.

Analysis of the demographics and comorbidities of patients demonstrated that orthopedic surgeons treated older patients (50.8 vs 41.2 years; \( \text{P} < .001 \)), more females (58.7% vs 33.2%; \( \text{P} < .001 \)), more Caucasians (82.9% vs 70.8%; \( \text{P} < .001 \)), and more smokers (28.8% vs 22.5%; \( \text{P} < .001 \)) (Table 4). Despite these differences in practice patterns, patient demographics, and patient comorbidities, there were no differences in most clinical outcomes after Bonferroni correction (\( \text{P} < .002 \) significance) (Table 5). With regard to the primary outcomes, there were no differences in 30-day return to the operating room (1.0% of orthopedic cases vs 1.6% of plastics cases; \( \text{P} = .014 \)) or death (0.1% of orthopedic cases vs 0% of plastics cases; \( \text{P} = .244 \)). In the analyzed secondary outcomes, orthopedic surgeons were found to have a lower incidence of surgical site infection (0.5% of orthopedic cases vs 1.2% of plastics cases; \( \text{P} < .001 \)) on univariate analysis. Multivariable analysis of surgical site infection identified several independent risk and protective factors (Table 6).

| Class | Definition |
|-------|------------|
| I/clean | An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tract is not entered. In addition, clean wounds are primarily closed and drained with closed drainage, if necessary. Operative incisional wounds that follow nonpenetrating (blunt) trauma should be included in this category if they meet the criteria. |
| II/clean-contaminated | An operative wound in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection in the biliary tract or major break in technique is encountered. |
| III/contaminated | Open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique (eg, open cardiac massage) or gross spillage from the gastrointestinal tract, and incisions in which acute, nonpurulent inflammation is encountered are included in this category. |
| IV/dirty-infected | Old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that organisms causing postoperative infection were present in the operative field before the operation. |

**Table 1**

Surgical Wound Class as Defined by the Centers for Disease Control and Infection

| Wound Class | Definition |
|------------|------------|
| I/clean | An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tract is not entered. In addition, clean wounds are primarily closed and drained with closed drainage, if necessary. Operative incisional wounds that follow nonpenetrating (blunt) trauma should be included in this category if they meet the criteria. |
| II/clean-contaminated | An operative wound in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection in the biliary tract or major break in technique is encountered. |
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| IV/dirty-infected | Old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera. This definition suggests that organisms causing postoperative infection were present in the operative field before the operation. |

**Table 2**

Orthopedic Surgeons Tend to Treat More Proximal Fractures Whereas Plastic Surgeons Tend to Treat More Distal Fractures

| Current Procedural Terminology Code, n (%) | Orthopedics | Plastics | \( \text{P} \) Value |
|----------------------------------------|-------------|-----------|---------------------|
| Distal radius/ulna, n (%)               | 12,692/17,836 (71.2%) | 377/2,676 (14.1%) | \( < .001 \) |
| 25607 Open treatment of extra-articular distal radial fracture or epiphyseal separation, with or without fracture of ulnar styloid, with or without internal or external fixation | 12,692/17,836 (71.2%) | 377/2,676 (14.1%) | \( < .001 \) |
| 25608 Open treatment of intra-articular distal radial fracture or epiphyseal separation with internal fixation of 2 fragments | 964/17,836 (5.4%) | 188/2,676 (7.0%) | |
| 25609 Open treatment of intra-articular distal radial fracture or epiphyseal separation with internal fixation of \( \geq 3 \) fragments | 964/17,836 (5.4%) | 188/2,676 (7.0%) | |
| 25652 Open treatment ulnar styloid fracture | 2,174/17,836 (12.2%) | 1,098/2,676 (41.0%) | |
| 25657 Open treatment of distal radioulnar dislocation, acute or chronic | 2,174/17,836 (12.2%) | 1,098/2,676 (41.0%) | |
| Carpal bones, n (%)                     | 12,692/17,836 (71.2%) | 377/2,676 (14.1%) | \( < .001 \) |
| 25627 Open treatment of carpal scaphoid navicular fracture, with or without internal or external fixation | 964/17,836 (5.4%) | 188/2,676 (7.0%) | |
| 25628 Open treatment of carpal scaphoid navicular fracture, with or without internal or external fixation with 3 fragments | 2,174/17,836 (12.2%) | 1,098/2,676 (41.0%) | |
| 25645 Open treatment of carpal fracture (excluding carpal scaphoid navicular), each bone | 2,174/17,836 (12.2%) | 1,098/2,676 (41.0%) | |
| 25670 Open treatment of radiocarpal or intercarpal dislocation, \( > 1 \) bones | 2,174/17,836 (12.2%) | 1,098/2,676 (41.0%) | |
| 25671 Open treatment of radiocarpal or intercarpal dislocation, \( \geq 1 \) bones | 2,174/17,836 (12.2%) | 1,098/2,676 (41.0%) | |
| 25678 Open treatment of transscaphophalangean type of fracture dislocation of each bone | 2,174/17,836 (12.2%) | 1,098/2,676 (41.0%) | |
| Metacarpals, n (%)                       | 2,174/17,836 (12.2%) | 1,098/2,676 (41.0%) | |
| 25685 Open treatment of CMC dislocation, other than thumb Bennett fracture; single, with or without internal or external fixation | 2,006/17,836 (11.2%) | 1,013/2,676 (37.9%) | |
| 25686 Open treatment of CMC dislocation, other than thumb Bennett fracture; complex, multiple, or delayed reduction | 2,006/17,836 (11.2%) | 1,013/2,676 (37.9%) | |
| Phalangeal bones, n (%)                  | 2,006/17,836 (11.2%) | 1,013/2,676 (37.9%) | |
| 26715 Open treatment of metacarpophalangeal dislocation, single, with or without internal or external fixation | 2,006/17,836 (11.2%) | 1,013/2,676 (37.9%) | |
| 26735 Open treatment of phalangeal shaft fracture, proximal or middle phalanx, finger or thumb, with or without internal or external fixation, each | 2,006/17,836 (11.2%) | 1,013/2,676 (37.9%) | |
| 26746 Open treatment of articular fracture, involving metacarpophalangeal or proximal interphalangeal joint, with or without internal or external fixation, each | 2,006/17,836 (11.2%) | 1,013/2,676 (37.9%) | |
| 26765 Open treatment of distal phalangeal fracture, finger or thumb, with or without internal or external fixation, each | 2,006/17,836 (11.2%) | 1,013/2,676 (37.9%) | |
| 26785 Open treatment of interphalangeal joint dislocation, with or without internal or external fixation, single | 2,006/17,836 (11.2%) | 1,013/2,676 (37.9%) | |

CMC, carpometacarpal.
Surgical specialty was not a significant independent risk factor for surgical site infection upon adjusting for confounding variables (P = .166). Surgery on phalanges (adjusted odds ratio [aOR] = 2.745; 95% confidence interval [CI], 1.559–4.833; P < .001) relative to surgery on the distal radius/ulna, wound class 3 (aOR = 3.630; 95% CI, 2.003–6.577; P < .001) relative to wound class 1, and smoking (aOR = 1.970; 95% CI, 1.279–3.032; P = .002) were independent risk factors for surgical site infection. Female gender (aOR = 0.439; 95% CI, 0.266–0.726; P = .001) and hypertension requiring medications (aOR = 0.500; 95% CI, 0.332–0.810) were independent protective factors against surgical site infection.

Discussion

Most practicing hand surgeons in the United States are orthopedic surgeons, but the makeup of this distribution has been shifting. There is evidence that there has been a steady decline in the proportion of plastics-trained surgeons applying to a hand fellowship, obtaining subspecialty certification, and actively practicing with subspecialty certification.10 In our study, orthopedic surgeons performed 87% of the distal upper-extremity fracture cases nationally compared with only 13% performed by plastic surgeons. This roughly correlates with the estimation that in the United States, 72.1% of hand surgeons are orthopedic-trained and 18.3% are plastics-trained,1 indicating that treatment of upper-extremity fractures is appropriately distributed among orthopedic and plastic surgeons nationally.

Previous studies evaluated differences in exposure to various clinical problems and surgical techniques experienced by plastics versus orthopedic surgery trainees.2,24,12 These training dissimilarities might translate to differences in distribution of cases performed and perioperative complications after training with regard to fracture treatment. Our findings demonstrated that practice composition varied by specialty and appeared to reflect previously reported differences in training: orthopedic surgeons tended to treat more proximal fractures and plastic surgeons tended to treat more distal fractures. Despite the variations in practice patterns, there were no statistically significant differences in any reviewed clinical perioperative primary outcome measures (30-day mortality and return to operating room rate) between orthopedic surgeons and plastic surgeons. Although plastic surgeons had higher surgical site infection rates, multivariable analysis suggested that this was due to different patient factors such as wound class, smoking, and surgery on phalangeal bones, not surgical specialty itself.

These differences in practice patterns should be further explored.

The overall 30-day surgical site infection rate after distal upper-extremity fracture was low (0.6%) and comparable to rates reported in the prior literature.13,14 The 3 independent risk factors for surgical site infection identified on multivariable analysis were more frequently encountered in plastic surgery patients (smokers, higher wound class, and phalangeal fractures). Associations between smoking and wound class with surgical site infections were reported in prior literature.15–17 However, there is a paucity of research on surgical site infections after open operative treatment for fractures of the distal upper extremity. Our results suggest that surgical site infections occur more frequently after open operative fixation of phalangeal fractures compared with forearm and wrist fractures. Phalangeal fracture surgery comprises a small proportion (11.2%) of distal upper-extremity fracture cases performed by orthopedic surgeons compared with plastic surgeons (37.9%). No independent association was seen between surgical specialty itself and infection rate. All of this suggests that the different incidence of surgical site infection between specialties is likely related to practice composition and patient-related factors.

Our findings suggest that there are no notable differences in perioperative complications after surgery of the distal upper extremity between orthopedic and plastic surgeons. This finding supports the way in which upper extremity call responsibilities are divided at many major academic centers where they are often shared between the 2 specialties. Our findings argue that both...
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surgical specialties are able to perform call-related fracture care without differences from a safety perspective.

There were several limitations to this study. As with any database study, we were restricted by the available data. The NSQIP database is limited to perioperative outcomes within 30 days of the index procedure, and longer-term outcomes, such as successful healing of the fracture site, avoidance of nonunion, and functional outcomes, could not be evaluated. The NSQIP is a database that does not necessarily include procedures at ambulatory surgery centers that are not affiliated with hospitals; therefore, the data from surgeries performed in this setting are not captured in this study. The structure of the database and the use of Current Procedural Terminology coding limited the amount of surgical detail that could be assessed, and evaluation of soft tissue procedures such as tendon, nerve, and vascular surgery was not included. Confounding factors potentially affecting our finding of increased surgical site infection rates among plastic surgeons, such as antibiotic use, also could not be evaluated. Although we were able to identify smoking status as an independent risk factor for surgical site infection, the database did not allow us to discern whether this included alternative forms of tobacco use such as chewing tobacco. Although most of our data had good completion (greater than 90%), there were several potential confounding variables with a low completion percentage. Although we adjusted our model accordingly, this may have led to unaccounted bias in the findings. Finally, we were unable to evaluate potential outcomes further related to the level of surgical training. Both orthopedic and plastic surgeons are exposed to hand surgery during residency; however, we could not assess whether surgeons included in this study had completed a hand fellowship or received a subspecialty certificate in surgery of the hand.

Despite these limitations, this study used a large patient population to compare perioperative complications of fracture care between orthopedic surgeons and plastic surgeons. It demonstrated that orthopedic and plastic surgeons achieved equivalently low complications and showed there was no difference from a safety perspective between the specialties. This equivalently low complications and showed there was no difference from a safety perspective between the specialties. This suggests that both surgical specialties can safely perform call-related, operative upper-extremity fracture management.

Table 5
Univariate Analysis of Primary and Secondary Perioperative Complications for Orthopedic Surgeons Versus Plastic Surgeons Operatively Treating Distal Upper-Extremity Fractures

| Characteristic                                      | Data Available | Orthopedics | Plastics | P Value* |
|----------------------------------------------------|----------------|-------------|----------|----------|
| Primary outcome, n (%)                             | 20,512 (100%)  | 185 (1.0%)  | 42 (1.6%)| .014     |
| Death                                              | 20,512 (100%)  | 15 (0.1%)   | 0        | .244     |
| Secondary outcomes, n (%)                          | 20,512 (100%)  | 38 (0.2%)   | 3 (0.1%) | .357     |
| Perioperative blood transfusion                     | 20,512 (100%)  | 10 (0.1%)   | 0        | .379     |
| Pulmonary embolism                                 | 20,512 (100%)  | 5 (0%)      | 0        | > .999   |
| Sepsis                                             | 20,512 (100%)  | 13 (0.1%)   | 0        | .398     |
| Septic shock                                       | 20,512 (100%)  | 3 (0%)      | 0        | > .999   |
| Surgical site infection                            | 20,512 (100%)  | 81 (0.5%)   | 32       | < .001   |
| Wound dehiscence                                   | 20,512 (100%)  | 3 (0%)      | 2 (0.1%) | .130     |
| Unplanned reintubation                             | 20,512 (100%)  | 9 (0.1%)    | 1 (0%)   | > .999   |
| Ventilator > 48 h                                  | 20,512 (100%)  | 3 (0%)      | 0        | > .999   |
| Peripheral nerve injury                            | 7,319 (35.7%)  | 7 (1%)      | 0        | > .999   |
| Pneumonia                                          | 20,512 (100%)  | 21 (0.1%)   | 1 (0%)   | > .999   |
| Urinary infection                                  | 20,512 (100%)  | 51 (0.3%)   | 1 (0%)   | .017     |
| Acute renal failure                                | 20,512 (100%)  | 2 (0%)      | 0        | > .999   |
| Progressive renal insufficiency                    | 20,512 (100%)  | 6 (0%)      | 0        | > .999   |
| Stroke                                             | 20,512 (100%)  | 7 (0%)      | 0        | .605     |
| Coma                                               | 7,460 (36.4%)  | 0           | 0        | > .999   |
| Myocardial infarct                                 | 20,512 (100%)  | 5 (0%)      | 0        | > .999   |
| Cardiac arrest                                     | 20,512 (100%)  | 4 (0%)      | 0        | > .999   |

Bolded values highlight results that are statistically significant.

* Bonferroni adjusted P value set at .002 for statistical significance.

Table 6
Multivariable Analysis Identifies Several Independent Risk and Protective Factors for Surgical Site Infection

| Characteristic                                      | Odds Ratio | SE | 95% Confidence Interval | P Value |
|----------------------------------------------------|------------|----|-------------------------|---------|
| Surgical specialty, n (%)                          | 1          |    |                         |         |
| Orthopedics                                        | (reference)|    |                        |         |
| Plastics                                           | 4.746      | .238| 3.282–6.803             | < .001  |
| Procedure, n (%)                                   | 1          |    |                         |         |
| Distal radius/ulna                                 | (reference)|    |                        |         |
| Carpal bones                                       | 1.832      | .357| 1.181–2.846             | .003    |
| Metacarpals                                        | 1.525      | .213| 1.049–2.217             | .022    |
| Phalangeal bones                                   | 1.448      | .206| 1.107–1.922             | .007    |
| Emergency surgery, n (%)                           | 1          |    |                         |         |
| Wound class, n (%)                                 | 1          |    |                         |         |
| 1                                                   | (reference)|    |                        |         |
| 2                                                   | 1.467      | .064| 1.342–1.596             | < .001  |
| 3                                                   | 1.204      | .038| 1.144–1.268             | < .001  |
| 4                                                   | 1.994      | .130| 1.729–2.307             | < .001  |
| Age, y (n [%])                                     | 1          |    |                         |         |
| < 60                                                | 1          |    |                         |         |
| 60–70                                              | 1.693      | .070| 1.599–1.817             | < .001  |
| > 70                                               | 1.092      | .024| 1.066–1.118             | .001    |
| Sex, n (%)                                         | 1          |    |                         |         |
| Male                                                | 1          |    |                         |         |
| Female                                             | 0.439      | .027| 0.266–0.726             | .001    |
| Body mass index, n (%)                             | 1          |    |                         |         |
| < 18.5                                             | 1          |    |                         |         |
| 18.5–24                                            | 1.299      | .026| 1.174–1.403             | .001    |
| 25–29                                              | 2.027      | .051| 1.873–2.191             | < .001  |
| 30–34                                              | 1.244      | .039| 1.177–1.315             | < .001  |
| > 39                                               | 2.975      | .057| 2.739–3.236             | < .001  |
| American Society of Anesthesiologists class, n (%) | 1          |    |                         |         |
| 1                                                   | (reference)|    |                        |         |
| 2                                                   | 1.274      | .021| 1.091–1.476             | .002    |
| 3                                                   | 1.916      | .036| 1.605–2.270             | < .001  |
| 4                                                   | 3.013      | .082| 2.594–3.478             | < .001  |
| Specific comorbidities, n (%)                       | 1          |    |                         |         |
| Diabetes                                           | 1.816      | .039| 1.632–2.016             | < .001  |
| Hypertension                                       | 0.500      | .019| 0.389–0.645             | < .001  |
| Smoking                                            | 1.970      | .020| 1.813–2.137             | < .001  |
| Pulmonary disease                                  | 0.786      | .047| 0.607–0.998             | < .001  |

Bolded values highlight results that are statistically significant.

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