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ORIGINAL ARTICLE

Risk factors for revision surgery following isolated ulnar nerve release at the cubital tunnel: a study of 25,977 cases

Christopher L. Camp, MD[a], Claire B. Ryan, BS[b], Ryan M. Degen, MD[c], Joshua S. Dines, MD[c], David W. Altchek, MD[c], Brian C. Werner, MD[d,*]

[a]*Sports Medicine Center, Department of Orthopedics, Mayo Clinic, Rochester, MN, USA*
[b]*Weill Cornell Medical College, Cornell University, New York, NY, USA*
[c]*Sports Medicine and Shoulder Service, Hospital for Special Surgery, New York, NY, USA*
[d]*Department of Orthopedic Surgery, University of Virginia School of Medicine, Charlottesville, VA, USA*

Background: The literature investigating risk factors for failure after decompression of the ulnar nerve at the elbow (cubital tunnel release [CuTR]) is limited. The purpose of this study was to identify risk factors for failure of isolated CuTR, defined as progression to subsequent ipsilateral revision surgery.

Methods: The 100% Medicare Standard Analytic Files from 2005 to 2012 were queried for patients undergoing CuTR. Patients undergoing any concomitant procedures were excluded. A multivariate binomial logistic regression analysis was used to evaluate patient-related risk factors for ipsilateral revision surgery. Adjusted odds ratios (ORs) and 95% confidence intervals were calculated for each risk factor.

Results: A total of 25,977 patients underwent primary CuTR, and 304 (1.4%) of those with ≥2 years of follow-up required revision surgery. Although the rate of primary procedures is on the rise ($P = .002$), the revision rate remains steady ($P = .148$). Significant, independent risk factors for revision surgery included age <65 years (OR, 1.5; $P < .001$), obesity (OR, 1.3; $P = .022$), morbid obesity (OR, 1.3; $P = .044$), tobacco use (OR, 2.0; $P < .001$), diabetes (OR, 1.3; $P = .011$), hyperlipidemia (OR, 1.2; $P = .015$), chronic liver disease (OR, 1.6; $P = .001$), chronic anemia (OR, 1.6; $P = .001$), and hypercoagulable disorder (OR, 2.1; $P = .001$).

Conclusions: The incidence of failure requiring ipsilateral revision surgery after CuTR remained steadily low (1.4%) during the study period. There are numerous patient-related risk factors that are independently associated with an increased risk for revision surgery, the most significant of which are tobacco use, younger age, hypercoagulable disorder, liver disease, and anemia.

Level of evidence: Level IV; Case Series from Large Database; Treatment Study

Keywords: Cubital tunnel syndrome; ulnar nerve decompression; cubital tunnel release; elbow; revision surgery; ulnar nerve

Ulnar nerve entrapment at the cubital tunnel, known as cubital tunnel syndrome, is the second most common compression neuropathy in the upper extremity.[5,13] An estimated 75,000 new cases occur each year, more commonly in men than in women.[2,14,16] Whereas conservative treatment is often

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*Reprint requests: Brian C. Werner, MD, Department of Orthopaedic Surgery, University of Virginia, PO Box 800159, Charlottesville, VA 22908, USA.

E-mail address: bcw4x@virginia.edu (B.C. Werner).

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effective, many patients require surgery in the form of cubital tunnel release (CuTR) to relieve symptoms and to improve function.[13] Although ulnar nerve decompression is generally an effective procedure with excellent outcomes reported in the literature, failures do occur. Failure of CuTR is generally defined as persistent symptoms after surgery or return of symptoms after an initial period of relief.[12] Failure rates ranging from 3% to 35% have been reported in the literature, depending on severity of symptoms before surgery.[2,3,6,9-11] Failure of CuTR can be due to a variety of modifiable and nonmodifiable factors, including incorrect diagnosis, inadequate surgical decompression, and postoperative biologic complications such as perineural fibrosis.[12] Although causes of failure have been discussed in the literature, little is known about the patient-specific risk factors that predispose to treatment failure. Current studies examining predictors of failure of in situ decompression suggest that younger age of the patient could lead to an increased need for surgical revision.[9] A history of elbow trauma and elbow arthritis have also been implicated as possible factors that increase the risk of failure.[10] Rates of failure in these studies have ranged from 3.2% to 19%, but the sample sizes were relatively small.[9,10] Existing studies have not been sufficiently powered to examine the impact of potential risk factors for failure of ulnar nerve decompression and are often confounded by inclusion of cases requiring concomitant procedures, such as fracture fixation, ligament reconstruction, or arthroplasty.

Given the limitations of the current literature published on risk factors for revision surgery following CuTR, additional study is warranted. One way to overcome many of these shortcomings is use of a national database. This will allow inclusion of a large enough sample size to appropriately power an investigation of this relatively uncommon occurrence. Accordingly, the purpose of this study was to investigate the factors that increase the risk of failure in patients undergoing ulnar nerve decompression at the cubital tunnel. More specifically, the objectives were to determine the incidence of revision surgery for isolated ulnar nerve release at the cubital tunnel, to identify variables that independently correlated with an increased risk for failure requiring revision surgery, and to compare and contrast these variables with previous reports. We hypothesized that the annual number of primary CuTRs would increase, rates of revision surgery would decrease, and a number of patient-specific factors would carry an increased risk for requiring revision surgery.

Materials and methods

The PearlDiver patient records database (www.pearldiverinc.com, Fort Wayne, IN, USA) was used to query the 100% Medicare Standard Analytic Files from 2005 to 2012 for all patients undergoing isolated ulnar nerve decompression at the cubital tunnel. Overall, the database contains approximately 100 million patients with orthopedic diagnoses. All data are deidentified and anonymous. Patients, surgical cases, and medical comorbidities were identified by *International Classification of Diseases, Ninth Revision* (ICD-9) diagnosis codes and *Current Procedural Terminology* (CPT) codes. Only cases of isolated ulnar nerve decompression at the cubital tunnel with or without transposition (CPT code 64718: neuroplasty or transposition of the ulnar nerve at the elbow) were included. Patients were excluded if their procedure included any codes for endoscopic or arthroscopic surgery, ulnar nerve decompression at sites other than the cubital tunnel, carpal tunnel release, elbow ligament reconstruction, treatment of elbow fractures, arthroplasty, treatment for infection, or any other surgical code related to the upper extremity. Patients without a CPT modifier for laterality were also excluded. Treatment failure was defined as the need for ipsilateral revision CuTR. Patients with subsequent (revision) CuTR on the ipsilateral arm were identified by the same CPT code for revision within the study period. For the calculation of revision rates and risk factors for revision, patients were observed until revision surgery, and those without revision were included only if at least 2 years of postoperative data were available following their index procedure.

Patient demographics studied included gender, age, body mass index (BMI), smoking status, and alcohol use. Obesity was defined as BMI of 30 to 40; morbid obesity was defined as BMI >40. Medical comorbidities were identified using ICD-9 codes for the following diagnoses: chronic anemia, chronic kidney disease, chronic liver disease, chronic lung disease, congestive heart failure, coronary artery disease, depression, diabetes mellitus, hemodialysis requirement, hypercoagulable disorder, hyperlipidemia, hypertension, hypothyroidism, inflammatory arthritis, and peripheral vascular disease.

Statistical analysis

Trends over time were assessed with linear regression analysis and results are reported with their corresponding R^2 and P values. Regional incidences were compared with χ^2 tests. A binomial multivariate logistic regression analysis was used to evaluate the independent effect of all study variables (patient demographics and medical comorbidities) on the risk for ipsilateral revision surgery. This allows independent evaluation of each variable while controlling for all other variables inserted into the model. Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for each risk factor. For statistical tests, only P values < .05 were considered to represent statistical significance.

Results

During the study period, a total of 25,977 patients underwent isolated ulnar nerve decompression at the cubital tunnel. Of these, 13,387 (51.5%) were male and 12,590 (48.5%) were female (Table I). The most common age group was <65 years old (n = 10,426; 40.1%), and only 631 (2.4%) were older than 85 years. The highest regional incidence was observed in the Midwest (14.5 per 100,000 population), followed by the South (11.9 per 100,000), Northeast (11.3 per 100,000), and West (10.2 per 100,000) (Table I). The incidence in the Midwest was significantly higher than in all other regions ($P < .001$ compared with all regions); the incidence in the Northeast was significantly higher than in the South and West regions ($P = .003$ and $P < .001$, respectively); the incidence in the South was significantly higher than in the West region only ($P < .001$).