

Influence of Injection Volume on Rate of Subsequent Intervention in Carpal Tunnel Syndrome Over 1-Year Follow-up

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Purpose The optimal volume and dose of corticosteroid injections for treatment of carpal tunnel syndrome (CTS) have not yet been established. It is unknown whether the volume of injectate influences the outcome of carpal tunnel injection. The purpose of this study was to assess whether there is an association between the volume of injectate and subsequent intervention in the treatment of CTS.

Methods This study evaluated residents of Olmsted County, MN, who were treated with a corticosteroid injection for CTS between 2001 and 2010. Failure of treatment was the primary outcome, defined as a subsequent intervention: either a second injection or carpal tunnel release within 1 year of initial injection. General estimating equations logistic regression was used to assess the association between injectate volume and rate of treatment failure, adjusting for age, sex, effective dose of steroid, type of steroid injected, electrodiagnostic severity, and the presence of comorbidities such as rheumatoid arthritis, diabetes mellitus, peripheral neuropathy, and radiculopathy.

Results There were 856 affected hands in 651 patients. A total of 56% (n = 484) of treated hands received subsequent treatment within 1 year. Multivariable analysis showed that a larger injectate volume was significantly associated with reduced rate of treatment failure within 1 year. Rheumatoid arthritis, ultrasound-guided procedures, and severe electrodiagnostic results were also associated with increased rate of failure.

Conclusions This study showed that a larger volume of corticosteroid injection is associated with reduced odds of subsequent intervention after a single corticosteroid injection in CTS. Further research is needed to determine the optimal volume for steroid injections in the treatment of CTS. (*J Hand Surg Am.* 2018; ■(■): ■–■. Copyright © 2018 by the American Society for Surgery of the Hand. All rights reserved.)

Type of study/level of evidence Prognostic IV.

Key words Carpal tunnel syndrome, corticosteroid injection, reintervention, volume.

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FOR PATIENTS WITH CARPAL tunnel syndrome (CTS), local corticosteroid injection provides greater clinical improvement in symptom relief 1 month after the injection compared with a placebo injection.¹ An injection for CTS commonly involves a combination of steroid and local anesthetic.^{2,3}

A systematic review reported that the site of injection, dose of steroid, type of steroid and/or local anesthetic, and concomitant use of an orthosis after injection do not alter the underlying efficacy of a steroid injection for CTS.⁴ However, most recorded interventions involved injections of relatively low volumes of total injectate, most commonly 1 to 3 mL.

Although corticosteroid injection provides short-term benefit to many patients with CTS, and longer-term benefit to some, the optimal volume of corticosteroid injections for CTS has not yet been determined, and it is unknown whether the volume of injectate influences the outcome of carpal tunnel injection. It is the opinion of some practitioners that larger volumes may be associated with a reduced risk of symptom relapse, owing to the effects of the added volume to hydrodissect and mobilize the nerve.^{5,6} In addition, higher-volume injections could be related to a larger area of fluid dispersion or distribution, greater contact area with soft tissues, or extravasation of fluid outside the canal.⁷⁻⁹ Therefore, the aim of this retrospective study was to assess whether an association exists between the volume of injection and subsequent intervention after a single corticosteroid injection in patients with CTS.

MATERIALS AND METHODS

Data collection

The cohort of patients receiving an injection for CTS was identified from residents of Olmsted County, MN, using the medical records-linkage system of the Rochester Epidemiology Project (REP).¹⁰ The institutional review board approved the study. The REP is a research infrastructure system that links together nearly all of the medical records (1966 to the present) of residents of Olmsted County. The REP consists of demographic data, diagnostic codes, and surgical procedure codes organized in electronic indexes that can be searched. Multiple medical records for the same patient are linked within and across institutions to create a comprehensive record, irrespective of where a county resident is seen. Participating health care providers include those within Olmsted County as well as those in the surrounding region. Studies have shown that the database includes nearly all care provided to nearly all (i.e., greater than 90%) county

residents.¹¹ Thus, there is a high degree of confidence that treatment failures will be captured, even if subsequent treatment is provided at a different facility. Study subjects were selected based on an International Classification of Disease diagnosis code of CTS (ICD-9 354.0) and a Current Procedural Terminology (CPT) code for carpal tunnel injection (CPT 20526) between 2001 and 2010.

Failure of treatment, defined as any subsequent corticosteroid injection or carpal tunnel release (CTR) surgery performed on the injected hand within 1 year of initial injection, was the primary outcome of interest. Inclusion criteria included a diagnosis of primary CTS, no previous invasive intervention (injection or CTR) for CTS in that hand, a therapeutic corticosteroid treatment for CTS, age at least 18 years, and affirmative research authorization (over 90% of county residents provided such authorization for record review research). Subjects who had less than 1 year of follow-up in their medical record were excluded from the analysis. If a patient did not have at least one visit to any REP health care provider of any specialty by at least 1 year past their date of injection, we considered the patient to have less than 1 year of follow-up. All steroids were standardized to be able to compare the relative anti-inflammatory potency. The dose of steroid was standardized to an equivalent effective dose of triamcinolone, which had the highest use in the cohort and was converted according to Leverage.¹² For example, the equipotent dose of 0.6 mg betamethasone was 4.0 mg triamcinolone. Subsequently, the standardized dose (milligrams per milliliter) was multiplied by the volume of the steroid in milliliters. The volume of the steroid was documented in milliliters in the medical charts and ranged from 0.5 to 3.0, with an interval of 0.5 mL. The amount of anesthetic was documented separately.

Study data were collected and managed by 3 physicians (S.E., A.J.B., and T.L.S.) using Research Electronic Data Capture software. Age, sex, laterality, comorbidities including diabetes, rheumatoid arthritis, and peripheral neuropathy/cervical radiculopathy, and other relevant comorbidities such as previous trauma to the affected hand or wrist, Kienböck disease, or ganglion cyst were recorded. In addition, information on the diagnosis for CTS was abstracted from the medical charts. We required a clinical diagnosis of CTS to be entered in the medical record, based on the clinical impression of the treating physician. We also collected the type and dose of steroid injected, type and volume of anesthetic injected, number of injections, and surgical

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