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National Utilization Patterns of Steroid Injection and Operative Intervention for Treatment of Common Hand Conditions

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Abstract

Purpose—To conduct a population-level analysis of practice trends and probability of surgery based on the number of steroid injections for common hand conditions.

Methods—Patients at least 18 years old receiving injection or surgery for carpal tunnel syndrome (CTS), trigger finger (TF), or De Quervain tenosynovitis (DQ) were identified for inclusion using the 2009–2013 Truven MarketScan databases. The number of injections performed was counted, and time between injection and operation was calculated for patients receiving both treatments. A multivariable logistic regression model was created to evaluate the odds of undergoing surgery based on the number of injections performed, controlling for patient age, sex, comorbidities, and insurance type.

Results—The study sample included 251,030 patients who underwent steroid injection or operative release for CTS (n=129,917), TF (n=102,778), and DQ (n=18,335). The majority of CTS patients were managed with immediate surgery (71%), whereas most patients with TF and DQ were managed initially with injection (74% and 84%, respectively). Among patients receiving both an injection and an operation, a single injection was the most common practice prior to surgery (69%, 58%, and 67% of patients with CTS, TF, and DQ, respectively). Multiple injections for DQ and TF were associated with relatively low predicted probability of surgery (17% and 26%, respectively, after 2 injections). However, the predicted probability of surgery after two injections was higher in patients with CTS (44%).

Conclusions—Given the associated probability of surgery after multiple injections for the three hand conditions examined, the practice of repeat injections should be critically examined to

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determine whether underuse or overuse is present and whether efficiency and resource utilization can be improved upon.

Level of Evidence—Level II (retrospective prognostic study)

Keywords

steroid injection; treatment utilization; carpal tunnel syndrome; De Quervain tenosynovitis; trigger finger

INTRODUCTION

Steroid injection and operative intervention are both used to treat a variety of hand conditions, such as carpal tunnel syndrome (CTS)(1), stenosing tenosynovitis (trigger finger [TF]) (2), and De Quervain tenosynovitis (DQ) (3). Steroid injections are simple, low cost, and easily performed in the office (4), whereas, operative intervention requires more time, resources, and has greater risk (5). Patients may report improved function and symptom relief for a period of time after steroid injection, with many patients being able to avoid an operation altogether (6). Thus, surgeons typically resort to operative intervention after nonsurgical treatments fail for many common hand conditions (7, 8).

The American Academy of Orthopedic Surgeons (AAOS) has developed guidelines for practitioners managing patients with CTS, where the decision to pursue nonoperative treatments such as steroid injection before surgery is dependent upon clinical severity, patient preferences, and availability of therapeutic modalities (9, 10). Depending on severity of presentation, conservative treatment is often recommended for TF, DQ, and mild to moderate CTS before operative intervention. However, there are no widely accepted guidelines for the number of injections to perform for common hand conditions prior to pursuing operative release. Attempting two injections prior to operative intervention for TF was recommended by Kerrigan et al to maximize cost-efficiency (4). Furthermore, Akram et al suggested that patients could see improvement with up to three steroid injections for treatment of DQ (11). However, a randomized clinical trial by Wong et al found no significant improvement in symptom relief with repeat injection for CTS (12). Despite recommendations by individual authors, practice trends at a population level are unclear.

Assessing population-level utilization practice trends and avoidance rates of operative intervention based on the number of steroid injections performed for common hand problems can better assist providers in counseling patients and maximizing efficiency and value of care. In this study we sought to evaluate the utilization and effectiveness of one or more steroid injections for common hand conditions. Specifically, we performed a population-level analysis of steroid injection use for patients with CTS, TF, and DQ to evaluate national utilization of steroid injection or surgery alone versus in combination and to evaluate the relationship between the number of injections and probability of surgery.

MATERIALS AND METHODS

Database and Study Sample

The study qualified for exempt status from our institutional review board. We conducted a large database analysis using the 2009–2013 Truven MarketScan Commercial Claims and Encounters and Medicare Supplement and Coordination of Benefits (MarketScan) databases. The MarketScan databases contain patient-level healthcare encounters, including inpatient, outpatient, and pharmacy claims, for over 55 million enrollees annually. The database consists of a national convenience sample from large employers, health plans, and government and public organizations (13). MarketScan databases have an advantage in using Current Procedural Terminology codes to document surgical procedures in addition to identifying patients with a unique identifier. This allows longitudinal follow-up throughout the duration of participation in the health plan. Patients are followed across providers during that time.

International Classification of Diseases, 9th Revision diagnosis codes were used to identify patients age 18 years or older with primary diagnoses of CTS, TF, and DQ. The Current Procedural Terminology codes were examined to identify patients undergoing steroid injection and surgical release for each of the three diagnoses (see Appendix 1 for codes). In order to understand patterns of treatment between steroid injection and operative intervention, patients were included only if they pursued injection or surgical treatment for one of the three conditions. Patients were excluded if they did not have at least 24 months of observation after diagnosis and if more than one diagnosis of interest was present during the observation period. The minimum 24-month observation period was chosen based on the published typical time for recurrence of symptoms for the conditions of interest (2, 14, 15).

Study Variables

Patient variables included sex, age, insurance type, and associated comorbidities. Insurance was categorized as capitated (managed care) versus noncapitated (fee-for-service) insurance type. The International Classification of Diseases -9 diagnosis codes were used to examine all healthcare claims for the presence of relevant patient comorbidities, including diabetes, obesity, hypothyroidism, renal disease, congestive heart failure, alcohol abuse, drug abuse, rheumatoid arthritis/collagen vascular disease, hand/wrist fracture, osteoarthritis of the hand or wrist, pregnancy, or Dupuytren disease (see Appendix 1 for codes).

The date of diagnosis was recorded as the first encounter associated with a diagnosis of CTS, TF, and DQ. Dates of steroid injection, surgical release, and time between diagnosis and treatments were recorded. In addition, the time between steroid injection and operation was calculated for patients receiving both treatments. Lastly, for patients receiving steroid injection, the number of injections performed on separate days were counted.

Data Analysis

Treatments for each diagnosis were categorized as steroid injection alone, operation alone, or injection followed by operation. A multivariable logistic regression model was created to evaluate the odds of undergoing surgical release based on the number of steroid injections

performed, while controlling for patient age, sex, comorbidities, and insurance type. Margins estimation was performed to estimate the adjusted probability of operative intervention based on the number of steroid injections received to provide a clinically relevant interpretation of the regression results.

RESULTS

There were 251,030 patients in the final cohort who underwent steroid injection or operative release for one of the three primary hand conditions between 2009 and 2013. Patient characteristics are outlined in Table 1. Of patients in the cohort undergoing injection or surgery for one of the three hand conditions, mean total enrollment (pre- and post-diagnosis) was 49 months with an interquartile range of 30–60 months. Patients were followed for an average of 13 months prior to diagnosis (SD=10) and 39 months after diagnosis (SD=11). Thus, most patients remain enrolled for long-term observation in the dataset. The majority of patients with CTS were managed with immediate surgical release (71%). Conversely, most patients with TF and DQ were managed initially with steroid injection (74% and 84%, respectively). The probability of undergoing an operation after receiving injection was 39% for patients with CTS, 23% for patients with TF, and 12% for patients with DQ (Table 2).

Among patients receiving both an injection and an operation, a single injection was the most common practice prior to surgery (69%, 58%, and 67% of patients with CTS, TF, and DQ, respectively) (Table 2). Patients with TF were more likely to have more than one attempted injection (42%) compared to the other diagnoses (30% for CTS, 33% for DQ). The surgical intervention occurred within one year of steroid injection for the majority of patients among each diagnosis (81%, 77%, and 71% for DQ, CTS, and TF, respectively) (Figure 1). The median time to operation after first injection was greatest for TF (7.4 months; IQR 3.2–13.7) and least for CTS (4.3 months; IQR 1.5–10.9) (Table 2).

The odds of undergoing surgical release increased directly with the number of steroid injections performed for each hand condition in the multivariable analysis (Appendix 2). The predicted probability of undergoing an operation was relatively low for patients receiving two and three injections for TF (26 – 29%) and DQ (17 – 20%). However, the predicted probability of surgery was higher among patients receiving two and three injections for CTS (44 – 47%) (Figure 2). Capitated and fee-for service insurance types were associated with similar surgical odds for all diagnoses (Appendix 2).

Select comorbidities notably impacted the odds of surgery. Hypothyroidism was associated with increased odds of surgery for all hand conditions (OR=1.06 – 1.19, $P<0.001$ – 0.047). Similarly, osteoarthritis and obesity were associated with increased odds of an operation for CTS and trigger finger (Appendix 2). Pregnancy was associated with decreased odds of an operation for all three hand conditions (OR=0.38 – 0.54, $P<0.001$). Renal failure, congestive heart failure, and rheumatoid arthritis were similarly associated with decreased odds of surgery in two out of three conditions (Appendix 2).

DISCUSSION

In this study of population-level practice trends among patients receiving steroid injection or surgical treatment for common hand conditions, we found that incidence of operation in patients who first underwent injection were 39%, 23%, and 12% among patients with at least 24 months of observation after diagnosis of CTS, TF, and DQ, respectively. An increased number of steroid injections was associated with a higher probability of operative release for each of the conditions examined. Although the predicted probability of surgical intervention after two or three injections remained relatively low for TF and DQ, more than half of patients underwent a single injection prior to operative intervention. Conversely, despite higher probability of operation after repeated injections for CTS, 30% of patients receiving both treatments underwent multiple injections prior to carpal tunnel release. With the push toward bundled payments for the global care of patients with a specified diagnosis, effectiveness and efficiency of nonoperative and operative interventions will need to be critically examined.

A majority of patients with CTS underwent an immediate operation, which is in line with previous evidence that surgery offers more definitive symptom relief, lower incidence of recurrence, and improved nerve conduction study parameters compared to steroid injection (14, 16–21). Girlanda et al found that 90% of CTS cases treated with steroid injection had worsening of nerve conduction parameters 18 months after injection (14). Better response to steroid injection is reported for other conditions, with symptom remission rates of 83 – 100% for DQ (15, 22–24) and 60 - 99% for TF (2, 25–27). Given the clear benefits of steroid injection for treatment of TF and DQ, it is not surprising that our study showed that the majority of patients with these conditions received injection initially. The magnitude in which patient, provider, and clinical factors influenced the decision to pursue immediate operation in these patients is unknown.

There are no universally accepted guidelines for the number of injections that should be performed prior to transition to surgery for CTS, TF, or DQ. Two injections for TF have been reported to be the most cost-effective strategy prior to considering surgical release (4). Despite the potential to avoid surgery with repeated injection attempt, our study found that 58% of patients who underwent surgery after injection for TF received only one attempted injection. Several authors have reported improved symptom relief for DQ after two or three injections (11, 15, 23). Similarly, our finding of low predicted probability of operation after two or three injections (17% and 21% respectively) may suggest that symptom improvement is likely to some degree after more than one injection. Among patients with DQ who received an operation after failed injection, 67% received only one injection prior to having an operation. However, in the case of CTS, unlike TF and DQ, multiple injections are not widely advocated in the literature. Given the temporary relief seen after steroid injection and similar reported direct cost with immediate surgical release compared to prolonged nonoperative treatments, there has not been a clear reported benefit of multiple injections reported for patients with CTS (5, 12, 28). However, this study noted that in the group of patients with CTS who underwent an operation after initial injection, 30% received two or more steroid injections.

This study had several limitations. The MarketScan database is a snapshot of enrollees over a 5-year period. Some patients may see a physician for diagnosis of a common hand problem and delay treatment. Patients also commonly have more than one of the examined hand conditions over time. Given the need to associate the steroid injection with one of the three diagnoses, patients were excluded if they presented with more than one primary diagnosis of interest. The role of therapy and splinting was also outside of the scope of this study. Furthermore, the specialty of the provider performing the injection or operation is not recorded in the dataset. However, on a national level, we were able to evaluate the practices of performing injections, numbers of injections, and use of operative intervention among patients who pursued an invasive procedure to understand the relationship between repeat injections and utilization of operative intervention. In addition, the provider and patient influences on treatment could not be determined from the dataset. Severity of symptoms and clinical information, such as electrodiagnostic testing findings or presence of flexion contracture, were not available to evaluate treatment patterns across the spectrum of disease severity. For this reason, we attempted to exclude patients with mildest disease who received neither an injection or operation. Also, patients with the most severe disease, such as presence of flexion contracture with TF or thenar wasting with CTS are less likely to receive an injection due to unlikely benefit. Lastly, information about patient outcomes and post-treatment quality of life were not available for analysis. Thus, we are unable to understand the impact of repeated injection versus operative intervention on patient outcomes and quality of life. However, it is insightful at a population level to study patients who attempted initial steroid injection for various hand conditions to determine the future number of repeated injections and the time that surgeons are deciding to pursue surgery after injection.

Overall, there is need to better understand practice trends in transitioning from repeated injections to surgery for common hand conditions. With a transition toward bundled payment reimbursement, providers should consider the most efficient and effective treatments for a given condition. As a whole, health systems, providers, and insurers can save on health care costs by avoiding excessive costs related to early surgery or prolonged conservative treatment (e.g. multiple steroid injections). These savings could then be passed down to the patients, ultimately reducing out-of-pocket expenses and freeing scarce resources. This study found a relatively low probability of surgery associated with repeated injections for TF and DQ and a higher probability of surgery with repeated injections for CTS. The practice of repeat injections for common hand conditions should be critically examined to determine whether underuse or overuse is present and whether efficiency of symptom relief and resource utilization can be improved upon.

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Timing of Operation After First Steroid Injection

Figure 1.

Timing of operation after first steroid injection for common hand conditions in a national sample from 2009–2013. At least 70% of patients received an operation within 1 year after failed steroid injection for each of the diagnoses.

Predicted Probability of Operation Based on Number of Steroid Injections **Figure 2.**

Predicted probability of operative intervention based on number of steroid injections received for carpal tunnel syndrome (CTS), trigger finger, and De Quervain tenovaginitis.

Table 1

Patient Characteristics

	Carpal Tunnel (CTS)		Trigger Finger		De Quervain Tenosynovitis	
	Number	Percent	Number	Percent	Number	Percent
N=251,030	129,917		102,778		18,335	
Demographics						
Female	82,782	63%	62,044	60%	14,368	78%
Age, mean (SD)	55 (14)		58 (14)		50 (14)	
Insurance Type						
Noncapitated	515,962	79%	82,182	80%	14,803	81%
Capitated	102,955	12%	13,853	13%	2,373	13%
Unspecified	11,000	8%	6,743	7%	1,159	6%
Comorbidities						
Diabetes	28,769	22%	26,792	26%	2,974	16%
Obesity	18,449	14%	10,065	10%	1,741	10%
Hypothyroidism	22,037	17%	17,038	17%	2,833	15%
Renal Failure	5,909	5%	5,037	5%	428	2%
CHF	6,281	5%	4,504	4%	398	2%
Alcohol Abuse	1,817	1%	864	1%	147	1%
Drug Abuse	2,154	2%	840	1%	182	1%
RA/CVD	4,496	3%	3,016	3%	296	2%
Wrist Fracture	4,148	3%	2,047	2%	513	3%
Osteoarthritis	9,576	7%	7,424	7%	2,862	6%
Pregnancy	2,202	2%	610	1%	1,740	10%
Dupuytren Disease	716	1%	1,262	1%	51	0.3%

Abbreviations: SD: standard deviation; CHF: congestive heart failure; RA/CVD: rheumatoid arthritis/collagen vascular disease

Table 2
National Trends in Utilization of Steroid Injection Versus Operative Intervention in Common Hand Conditions

	Carpal Tunnel		Trigger Finger		De Quervain Tenosynovitis	
	Number	Percent	Number	Percent	Number	Percent
N=251,030	129,917		102,778		18,335	
Treatment Distribution in Patients Receiving Injection or Operation						
Injection Only	22,676	17%	58,866	57%	13,470	73%
Operation Only	92,536	71%	26,213	26%	2,985	16%
Injection and Operation	14,705	11%	17,699	17%	1,880	10%
Probability of Operation after Injection		39%		23%		12%
Number of Injections Prior to Operation						
1	10,167	69%	10,219	58%	1,254	67%
2	2,810	19%	4,567	26%	467	25%
3	942	6%	1,679	9%	122	6%
>3	786	5%	1,234	7%	37	2%
Time to Operation after Failed Injection						
Median Time After First Injection, Months (IQR)	4.3	(1.5 – 10.9)	7.4	(3.2 – 13.7)	5.8	(2.7 – 10.8)

Abbreviations: IQR: interquartile range

Appendix 1

Procedure Codes and Diagnosis Codes for Patient Selection and Identification of Treatment and Comorbidities

Diagnosis and Procedure Codes	
Diagnoses (ICD-9 Diagnosis Codes)	
Carpal Tunnel Syndrome	354.0
Trigger Finger	727.03, 727.00, 727.05
De Quervain Tenosynovitis	727.04
Treatments (CPT Procedure Codes)	
Steroid Injection	20550, 20526
Carpal Tunnel Release	29848, 64721
Trigger Release	26055, 26145, 26160, 25110
De Quervain Release	25000, 25110
Comorbidities (ICD-9 Diagnosis Codes)	
Alcohol Abuse	291.00, 291.10, 291.20, 291.30, 291.50, 291.80, 291.81, 291.82, 291.89, 291.90, 303.00, 303.01, 303.02, 303.03, 303.90, 303.91, 303.92, 303.93, 305.00, 305.01, 305.02, 305.03
Congestive Heart Failure	398.91, 428.00, 428.10, 428.20, 428.21, 428.22, 428.30, 428.31, 428.32, 428.33, 428.40, 428.41, 428.42, 428.43, 428.90
Diabetes	without chronic complications: 250.00, 250.01, 250.02, 250.03, 250.10, 250.11, 250.12, 250.13, 250.20, 250.21, 250.22, 250.23, 250.30, 250.31, 250.32, 250.33, 648.00, 648.01, 648.02, 648.03, 648.04, 249.00, 249.01, 249.10, 249.11, 249.20, 249.21, 249.30, 249.31 with chronic complications: 250.40, 250.41, 250.42, 250.43, 250.50, 250.51, 250.52, 250.53, 250.60, 250.61, 250.62, 250.63, 250.70, 250.71, 250.72, 250.73, 250.80, 250.81, 250.82, 250.83, 250.90, 250.91, 250.92, 250.93, 775.10, 249.40, 249.41, 249.50, 249.51, 249.60, 249.61, 249.70, 249.71, 249.80, 249.81, 249.90, 249.91
Drug Abuse	292.00, 292.82, 292.83, 292.84, 292.85, 292.89, 292.90, 304.00, 304.01, 304.02, 304.03, 304.10, 304.11, 304.12, 304.13, 304.20, 304.21, 304.22, 304.23, 304.30, 304.31, 304.32, 304.33, 304.40, 304.41, 304.42, 304.43, 304.50, 304.51, 304.52, 304.53, 304.60, 304.61, 304.62, 304.63, 304.70, 304.71, 304.72, 304.73, 304.80, 304.81, 304.82, 304.83, 304.90, 304.91, 304.92, 304.93, 305.20, 305.21, 305.22, 305.23, 305.30, 305.31, 305.32, 305.33, 305.40, 305.41, 305.42, 305.43, 305.50, 305.51, 305.52, 305.53, 305.60, 305.61, 305.62, 305.63, 305.70, 305.71, 305.72, 305.73, 305.80, 305.81, 305.82, 305.83, 305.90, 305.91, 305.92, 305.93, 648.30, 648.31, 648.32, 648.33, 648.34
Dupuytren Disease	72.86
Wrist Fracture	814.00, 814.10, 813.00
Obesity	278.00, 278.01, 278.03, 649.10, 649.11, 649.12, 649.13, 649.14, V85.30, V85.31, V85.32, V85.33, V85.34, V85.35, V85.36, V85.37, V85.38, V85.39, V85.41, V85.42, V85.43, V85.44, V85.45, V85.54
Osteoarthritis (Hand or Wrist)	715.03, 715.04, 715.13, 715.14, 715.23, 715.24, 715.33, 715.34, 715.83, 715.84, 715.93, 715.94
Pregnancy	V22.00, V22.10, V22.20, V23.00, V23.10, V23.20, V23.30, V23.40, V23.50, V23.60, V23.70, V23.80, V23.90, V24.00, V24.10, V24.20
Renal Failure/Renal Disease	585.30, 585.40, 585.50, 585.60, 585.90, 586.00, V42.00, V45.10, V45.11, V45.12, V56.00, V56.10, V56.20, V56.30, V56.31, V56.32, V56.80
Rheumatoid Arthritis/Collagen Vascular Disease	701.00, 710.00, 710.10, 710.20, 710.30, 710.40, 710.80, 710.90, 714.00, 714.10, 714.20, 714.30, 714.31, 714.32, 714.33, 714.40, 714.80, 714.81, 714.89, 714.90, 720.00, 720.10, 720.20, 720.80, 720.81, 720.89, 720.90, 725.00

Appendix 2

Multivariable Logistic Regression Model of Operation Odds for Common Hand Conditions

	Carpal Tunnel (CTS)		Trigger Finger		De Quervain Tenovaginitis	
	OR	P-value	OR	P-value	OR	P-value
N=251,030						
Demographics						
Female	0.96	0.051	1.02	0.341	1.43	<0.001
Age (mean)	1.00	0.001	1.00	<0.001	0.99	<0.001
Insurance Type						
Noncapitated	ref		ref		ref	
Capitated	0.99	0.723	0.96	0.072	0.87	0.067
Unspecified	1.08	0.067	1.20	<0.001	1.14	0.196
Comorbidities						
Diabetes	0.93	0.010	1.19	<0.001	1.12	0.101
Obesity	1.18	<0.001	1.07	0.029	0.88	0.164
Hypothyroidism	1.06	0.047	1.11	<0.001	1.19	0.011
Renal Failure	0.84	0.002	0.96	0.292	0.60	0.018
CHF	0.77	<0.001	0.70	<0.001	0.75	0.176
Alcohol Abuse	1.06	0.500	1.02	0.809	1.15	0.618
Drug Abuse	0.84	0.033	0.78	0.018	0.84	0.538
RA/CVD	0.72	<0.001	0.49	<0.001	0.69	0.097
Wrist Fracture	0.94	0.0375	0.95	0.378	1.09	0.549
Osteoarthritis	1.32	<0.001	1.19	<0.001	1.05	0.625
Pregnancy	0.54	<0.001	0.38	<0.001	0.52	<0.001
Dupuytren Disease	0.94	0.672	1.90	<0.001	1.54	0.341
Number of Injections						
1	ref		ref		ref	
2	1.35	<0.001	1.70	<0.001	1.75	<0.001
3	1.53	<0.001	2.10	<0.001	2.25	<0.001
>3	0.99	0.769	2.71	<0.001	2.35	<0.001

CHF: congestive heart failure; RA/CVD: rheumatoid arthritis/collagen vascular disease