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What types of treatment are provided for patients with carpal tunnel syndrome? A retrospective analysis of commercial insurance

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Abstract

Background—Treatment of carpal tunnel syndrome (CTS) in commercially insured patients across the spectrum of provider types has rarely been described.

Objective—The purpose of this study was to describe patterns of types of treatment for patients with CTS using a large commercial insurance database.

Design—Retrospective cohort descriptive study

Setting—Administrative health data from the Clinformatics® Datamart (OptumInsight, Eden Prairie, MN).

Patients—Adults with a primary diagnosis of CTS seen from between January, 2010 to December, 2012 who had a total of 48 months of continuous data (12 months prior to diagnosis and 36 months after diagnosis) (n = 24,931).

Outcomes—Frequency of types of treatment (heat, manual therapy, positioning, steroid, stretching, surgery) by number of treatments, number of visits, provider type, and characteristics.

Results—Fifty-three percent of patients received no reported treatment and 50.4% had no additional visits. Surgery (42.5%) and positioning (39.8%) were the most frequent single treatments. Patients who were seen by orthopedist for their first visit more frequently received some treatment (75.1%) and at least one additional visit (74.1%) compared to those seen by general practitioners (59.5%, 57.5% respectively) or other providers (65.4%, 68.4 respectively). Orthopedists more frequently prescribed positioning devices (26.8%) and surgery (36.8%) than general practitioners (18.8%, 14.1%, respectively) or other providers (15.7%, 19.7%, respectively). Older adults more frequently had CTS surgery as did people who lived in the Midwest. Overall, only 24% of CTS patients had surgery.

Conclusions—For more than half of patients with CTS no treatment was provided after an initial visit. Surgery rates were much lower than what has previously been reported in the

literature. Generally, patients with CTS receive treatments that are supported by current treatment guidelines.

Keywords

Treatment patterns; carpal tunnel syndrome; epidemiology

INTRODUCTION

Carpal Tunnel Syndrome (CTS) is the common name for median nerve compressive neuropathy caused by entrapment of the median nerve, and is the most common upper extremity peripheral entrapment neuropathy.¹ Patients with CTS experience considerable distress, significant decreases in function²⁻⁴, and reduced quality of life⁵. While CTS has been strongly associated with occupations which require repetitive, forceful hand use⁶, it is also common in the general population who do not have such jobs. In many cases the underlying disease process cannot be identified, and CTS is designated idiopathic.⁷ CTS is often viewed as only a work-related disorder, however, it is estimated that only 26% of CTS patients are covered under Workers' Compensation insurance.⁸ Unfortunately, there is very limited information documenting the remaining 74% of patients with CTS covered by Medicare, Medicaid, and private insurers in the U.S. population, and what information exists is outdated.⁸ Studies suggest that CTS patients with workers compensation are treated differently than those who have private insurance⁹, and are more likely to have poor outcomes after surgery.¹⁰

Current guidelines on CTS agree that most patients, except those with severe CTS, should receive an initial course of conservative treatment.¹¹⁻¹³ There are at least sixteen possible interventions for CTS with varying levels of evidence to support their use.¹³ Surgical treatment is considered the most effective treatment for severe CTS,¹⁴ but is a less than optimal initial approach for people with mild to moderate CTS due to the potential for adverse events¹⁵, recurrence¹⁶, and high medical costs^{17,18}. A recent international multidisciplinary treatment guideline¹² has suggested that treatment should be based on the duration and severity of the CTS, and advocated for combinations of education, splinting and steroids, with surgery provided for those with severe CTS or who did not respond well to conservative treatment. Yet, despite guidelines describing best practice for the treatment of CTS, there is very little information about actual treatment of CTS in clinical practice.

There are few recently published studies of usual courses/trajectories of conservative CTS care. A recent systematic review which described the clinical course and prognostic factors of CTS found 16 studies that were naturalistic studies of CTS treatment.¹⁹ Of these studies, 15 were on data from secondary or tertiary sites (e.g. hand clinic, electromyographic laboratory, surgical clinic), had relatively small samples (12 to 297 patients), and thus were biased by the nature of the sites where the data was collected: patients seen in these sites would routinely be people with more severe forms of CTS who would, thus benefit from surgery and not from conservative treatments. The single study that examined a general population of 425 patients was completed in 1997 with patients treated from 1979 to 1988.²⁰

Thus, there are no recent studies that have examined a general population of people with CTS to determine the types of treatments received and the general outcomes of treatment.

The ability to provide successful and cost-effective treatment for CTS will improve patient function and financial security, and reduce health care costs. Retrospective analysis of existing healthcare data is one method to describe current healthcare practices and examine long term outcomes. In this study, we performed a retrospective analysis and use descriptive statistics to assess the initial and late treatment patterns for CTS patients using a one of the nation's large commercial insurance databases to answer the following questions.

1. What percentage of people with CTS received each of the following types of care: positioning treatments, steroid treatments, manual therapy based treatments, heat based treatments, exercise treatments, and surgery over 36 months, and during the first 6 months.
2. What percentages of people with CTS received no treatment, or 1 or more types of treatment?
3. What percentage of people with CTS had more than one visit, and what were the most frequent types of treatment received during multiple visits?
4. How does treatment differ by the first provider type (general practitioner, orthopedist, or other provider)?
5. How does treatment differ by patient characteristics (age, sex, region of treatment)?

METHODS

The IRB at the XXX does not require approval for this type of study as the data does not meet the definition of "human subjects." We used existing data in which the information was recorded in such a manner that subjects could not be identified, directly or through identifiers linked to them. All principles of the Declaration of Helsinki were followed.

We conducted a retrospective cohort descriptive analysis using administrative health data from the Clinformatics® Datamart (OptumInsight, Eden Prairie, MN) database. This database is from one of the nation's largest commercial health insurers, and has been used to examine treatments in numerous epidemiological and health service studies.²¹⁻²³ Persons covered by this insurer are enrolled in a fee-for-service or managed care plan (health maintenance organizations, preferred provider organizations, and exclusive provider organizations). To receive reimbursement, providers must submit complete claims. During the two-year case identification period (2010 to 2012) over 19 million people had at least one day of eligibility.

Subjects

To assemble our study cohort, we identified all patients with a diagnosis of CTS (ICD9 code 354.0, 354.1) seen between January 1, 2010 and December 31, 2012. To be included in the study, all patients had to have a minimum of 48 months of continuous enrollment: 36 months from the date of diagnosis to ensure that we correctly obtained all treatments and 12 months

prior to the date of diagnosis with no incident of CTS (look-back period) to ensure that we examined new cases of CTS. Thus, patients first identified in 2010 were followed until 2013, those identified in 2011 were followed until 2014, and those identified in 2012 were followed until 2015. We omitted all patients with a claim for pregnancy at the first incident of CTS because they frequently develop CTS that ends post-partum.²⁴ Pregnant women with CTS are treated conservatively and, therefore, do not represent the distributions of potential treatments for more idiopathic CTS. We only included patients 18 or older. We retained only patients with a primary diagnosis of CTS, as it was more likely that any treatments reported during a visit were for CTS and not some other diagnosis. We also excluded 5199 patients whose CTS initial diagnosis was not from provider visits. Excluding these patients did not change the overall proportions of subject demographics of the subjects in terms of age, sex, or region.

Outcomes

Type of Treatment—We categorized treatment into six types: positioning treatments, steroid treatments (oral and injections), manual therapy based treatments, heat based treatments, exercise treatments, and surgery. Table 1 provides a list of the types of treatments and the CPT codes used to extract them from the data set. We categorized the number of different types of treatment received as 0, 1, 2, 3, or 4 or more. We calculated this number for the entire 36-month period as well as for the initial period (first 6 months) and late period (7 to 36 months).

To further describe surgical interventions, we calculated the median time to first surgery, and, where appropriate, the median time to a second surgery. Whether this second surgery was a revision of a failed first surgery or a new surgery on the other hand could not be determined from the dataset.

Number of office visits—We identified office visits after the initial visit using Evaluation and Management (E & M) codes and categorized them as: 0 (no further visits), 1 additional visit, 2–3 additional visits, and 4 or more additional visits.

First Provider—We identified the type of provider associated with the initiate diagnosis of CTS from the office visit. While there were multiple providers, we broke the categories into General Practitioner (Family Practice and Internal Medicine providers), Orthopedists, and Other because General Practitioners and Orthopedists saw the greatest number of people with CTS.

Demographics information—The dataset provided information on age, gender and region. We categorized age as 18–35, 35–49, 50–64, and 65–86. We also examined the percentage of claims by region.

Statistical analysis

Descriptive analyses of the participant characteristics were summarized using means and standard deviations, medians, and 95% Confidence Interval (CI) for continuous variables, and frequencies and percentages with 95% CI for categorical variables. If 95% CI's did not

overlap between characteristics, these characteristics were considered to be significantly different at $p = .01$.²⁵

RESULTS

There were 200,532 patients with a diagnosis of CTS between January 01, 2010 to December 31, 2012, approximately 1% of the entire dataset. There are 58,092 patients who had continuous coverage for one year prior and three years after the first claim for CTS. When we eliminated patients if they were under the age of 18, had a concurrent diagnosis of pregnancy, had carpal tunnel during the one-year look back period, did not have a primary diagnosis of CTS, or did not have a first provider, 24,931 patients remained (Figure 1).

The sample mean age was 49.8 years (SD 11.8). We had almost twice as many females (65.9%) as males (34.1%). Almost half of the patients were from the South (47.7%) followed by the Midwest (27.7) (Table 2).

Number of types of treatment

Of the 24,931 people who had a diagnosis of a primary diagnosis of CTS through the 36-month window of treatment period, 53.5% received no reported treatments 28.4% received 1 type of treatment, and 11.0% received 2 types of treatment. Less than 5% of the sample received 3 or more types of treatment (Table 3).

Type of Treatment

Throughout the entire 36-month window of treatment, surgery was the most frequently reported type of treatment (24.0%) followed by positioning (20.7%). Steroids were provided to 10.7% of the sample. Heat was provided least frequently (1.3%) (Table 4).

If patients received only 1 type of treatment, it was most commonly surgery (42.5%), with positioning (39.8%) a close second. Greater than 50% of people who received 2 or more types of treatment received surgery (63.4%) or positioning (53.8%). Steroids were used in 14.3% of single treatments and 33.5% of 2 types of treatment. Use of all other types of treatment was less than 10% (Table 4).

Forty percent of people received at least one treatment in the first 6 months, compared to only 13.5% from months 7 to 36 (Table 3). When the follow-up period was limited to only the first 6 months, positioning and surgery were the most frequent types of treatment (18.7%, 17.8%, respectively). However, positioning was the most frequent type of treatment if only 1 or 2 types of treatment were given in the first 6 months (42.1%, 64.2%, respectively). Surgery was less frequent than positioning, present in 37.9% when 1 type of treatment was given, and 59.7% with 2 types. However, if 3 types of treatment were used, surgery (52.2%) was much more frequent than positioning (38.8%). Only 16.7% of patients received steroid treatments if 1 type of treatment was received. The percent increased to 35.9% if 2 types of treatment were provided. Heat, manual therapy, and stretching were very infrequent types of treatment (<2%) unless a person received 2 or more types of treatment (Table 4).

Treatment in the 7 to 36 month range was infrequent, only 13.5% received any type of treatment. Overall, if treatment was received, it was most frequently surgery (8.2%). Steroids was more common than positioning as a single type of treatment in the 7 to 36 month range (Table 4).

Type of treatment by number of visits

For the overall treatment period, 50.4% had no additional visits, 20.2% had 1 additional visit, 19.5% had 2 to 3 additional visits, and 10.0% had 4 or more additional visits. A small percentage of patients who only had the initial office visit with no additional visits had any type of treatment, and these types of treatment were most frequently positioning (17.2%). Patients with 1 additional visit most frequently received positioning (20.7%) or surgery (21.9%), but surgery was the most common treatment for people who had 2–3 visits or 4 or more visits (51.1% and 65.7%, respectively). A small percent of the sample had steroid treatments with 1 additional visit (12.2%). Heat, manual and stretching treatments were uncommon unless patients had 4 or more visits (Table 5)

Type of treatment by First Provider Type

General practitioners were 32.9% of the sample, orthopedists, 36.1%, and other providers 31.0%. Orthopedists were significantly more likely to provide treatments than other first provider types. Only 24.9% of patients did not receive treatments when their first provider was an orthopedist compared to 40.5% for general practitioners and 34.6% for other providers. In a like fashion, patients seeing orthopedists more frequently had at least one additional visit. Only 25.9% of patients did not have additional visits when their first provider was an orthopedist. Other providers were more likely to have additional visits than general practitioners. Only 31.6% of other providers compared to 42.5% for general practitioners did not have an additional treatment after their first office visit.

Patients seeing orthopedists were more frequently provided with positioning devices (26.8%), steroids (16.6%), and surgery (36.8%) than general practitioners (18.8%, 6.1% and 14.1%, respectively) or other providers (15.7%, 8.8%, and 19.7% respectively). These type of treatments were most often prescribed by orthopedists in the first 6 months. In the later time frame, patients received similar types of treatments regardless of the type of provider, although they were still more likely to receive surgery if they saw an orthopedist. Patients seeing other providers more frequently received heat or manual therapy than if they were seeing orthopedists or general practitioners (Table 6).

Type of treatment by patient characteristics

In general there were few significant differences between types of treatment and age or region. The only notable exception was for surgery. As adults got older, more of them received surgery: 36.5% of 65–86 year olds received surgery compared to 11.9% of 18–35 year olds, 19.8% 35–46 year olds, and 28.0% 50–64 year olds (Table 7). There were also regional differences in surgery: patients seen in the Midwest more frequently received surgery (31.1%) and those in the Northeast less frequently received surgery (18.4%). Patients in the South and West had similar frequencies for surgery (21.6% and 22.6% respectively). There were small but significant differences between types of treatment and

sex. In general, females more frequently received each type of treatment than males (Table 7) except for surgery, where males were more frequent.

Surgery

Approximately three-quarter of patients with CTS did not have surgery (76.0%), 16.3% had 1 surgery, and 7.7% had 2 surgeries. Median time to first surgery was 63 days (range 0 – 1094) and from first to second surgery was 42 days (range 1 to 1067). Figure 2 shows the distribution of days to surgery for both first and second surgeries

DISCUSSION

In our study we found that 46.5% of patients with non-work related CTS received any reported treatment, and 49.6% attended more than a single office visit related to their CTS in a 3 year period. Thus, many patients with a diagnosis of CTS receive no treatments. These results were different from most studies that have examined the natural history of treatment of CTS.¹⁹ While results varied widely in these studies, between 23% and 58% of patients who received no CTS treatment got worse, and 23% to 89% were reported to have negative outcomes at 3 years. The difference in results is likely due to a form of referral filter bias,²⁶ in which more difficult (i.e. severe) CTS cases are referred to tertiary care centers, such as hand clinics, and therefore do not readily represent the spectrum of the disorder. Our study, with its large sampling of non-workers compensation patients obtained from the general population, rather than these tertiary care centers, provides unique insights into typical care of all CTS patients.

Among patients receiving any treatments over the full 36 months, patients more frequently received surgery than any other treatment. However, it is possible that patients with CTS are instructed by their health care provider to purchase splints and other positioning devices from local drug stores, and thus, the use of positioning devices is likely underreported. So, while we can be confident that positioning devices are, at minimum, used in 21% of CTS cases, we cannot be certain of the maximum range of use. It is likely that the actual frequency of positioning device use equals or is greater than surgery. Positioning devices are the most frequent treatment of choice in the first six months of treatment. These results are supported by current guidelines which find that there is strong evidence that the use of positioning devices is effective.^{11,12} Although treatments using steroid injections have good evidence that they are effective^{11,12} steroid treatments were not frequently used, with only 10.7% of our sample receiving steroid treatments. Other conservative treatments in our study were infrequently used, which, given that the evidence to support them is usually limited or moderate²⁶, is appropriate.

Seventy-six percent of patients received no or one additional visits after their first, diagnostic office visit. Positioning was the most frequent type of treatment provided in these cases. Surgery was uncommon at the first office visit, occurring in only 6.2% of claims. However, when patients had one additional visit the frequency of a surgical intervention increased 253 percent to 21.9%, while if they have two to three additional visits the frequency increased an additional 133 percent to 51.1%. It appears that, in general, patients with CTS are most likely to have conservative treatments first, and then to have surgery if the conservative

treatments are not effective. This treatment regime is consistent with recommended guidelines.^{26,27} The frequency of conservative treatments other than positioning and steroids, such as heat and stretching, was very low unless patients had 4 or more visits. This suggests that these types of treatments are most frequently done in later visits, may require a referral to a rehabilitation specialist, or may represent treatment related to patient care after surgery.

While patients with CTS may see a variety of first responders, the most frequent are general practitioners and orthopedists. In our sample, orthopedists more frequently provided some type of treatment for their patients with CTS. This may be due to referral patterns: it seems likely that orthopedists may be referred patients with more severe symptoms for diagnosis and treatment. Or patients with significant joint pain and numbness self-refer to an orthopedist in preference to other practitioners. Or it is possible that orthopedists are more familiar with guidelines for the treatment of CTS than other providers and provide treatments as recommended. Certainly, they were less likely to provide treatments with less strong evidence to support them, such as heat and manual therapy, and more likely to provide conservative treatments such as positioning and steroid injections.

There are age differences in how surgery is prescribed. The frequency of surgical intervention increases steadily as adults age. Older adults (over 65) are 3x more likely to receive a surgical intervention than young adults (18 to 35). The reason for this difference cannot be determined from our data. Some possible explanations include: older adults may prefer surgery over more conservative treatments; they may have better insurance and can afford surgery more easily; providers may feel less inclined to perform surgery on younger adults; or younger adults may have less severe CTS. Regional differences in surgery are a common phenomenon and are most commonly related to a physician's belief about the need for surgery and the degree to which patient preference is considered during treatment decisions.²⁷

Our study, which had information on patients from a spectrum of practice types, found that surgery is used much less frequently than previous studies, which focused on patients from tertiary clinics, would suggest. Previous studies have reported surgical rates from 57% to 66%¹⁹ while our study found surgical rates to be 24%. If surgery occurred, it was most likely to happen one to three months after diagnosis. This time frame suggests that providers likely tried some form of conservative care such as positioning, as per guideline recommendations.^{26,27} While a small percentage of our sample had 2 surgeries, these were most likely bilateral releases and not revisions of failed initial surgeries, although we could not tell from the data.

Strengths and limitations

This study used a naturally occurring, very large, claims database to examine actual treatment of people diagnosed with CTS, providing excellent representation of the types of treatments used for CTS. We used incident CTS cases and followed patients for 3 years, ensuring that we captured a significant portion of the treatment. We examined types of treatment identified as potential conservative treatments for CTS, and, thus, we are able to describe a gamut of treatments. This study is the first to only examine non-work related

CTS. Studies have indicated that there are differences in treatments and outcomes in CTS patients with workers compensation compared to those with private insurance.^{9,10}

Limitations

First, information on CTS come from diagnosis codes included in charges for outpatient visits, so we are unable to ascertain the accuracy of the diagnosis provided. Second, we are unable to state with any certainty the severity of the CTS. Third, undetected selection bias may have affected our study results since the study design was retrospective. However, we addressed this potential bias by restricting our sample to patients who had at least one physician visit and no diagnosis of CTS for at least one year prior to the incident diagnosis (look-back period) to ensure that we were examining new cases of CTS. We should note, that it is possible that people may have had CTS treatment beyond a year earlier. Fourth, positioning devices are likely to have been underreported, as patients may purchase them on their own, and thus have no codes associated with them. Thus, the credibility of the estimates of positioning device use is lower than that for surgery and steroids. Fifth, it is possible people received a diagnosis of CTS and then switched from private insurance to workers' compensation insurance. Workers' compensation claims are not covered within our data set, and their treatment information would be lost. However, some literature suggests that rather than switching to workers' compensation, many illnesses that might be treated as workers' compensation might be seen under private insurance.³⁵ Sixth, In this study we assumed that people with CTS would continue to receive treatments until their symptoms resolved to their satisfaction. Therefore, this study cannot indicate whether people with CTS were disease free, only that they no longer sought treatment for the disorder under private insurance.

CONCLUSION

Patients diagnosed with CTS with commercial insurance often do not receive treatments and frequently do not return for further visits. The most common conservative treatment for CTS is splinting. Surgery is performed in about one quarter of people with CTS, and it generally occurs after patients have had some conservative care. Generally, current care of patients with CTS match care regimens recommended by evidenced-based guidelines.

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Figure 1.

Flow chart of the study population from Optum Clinformatics Data Mart database: 2010–2012 (N=19,027,842).

Figure 2.
Time to first and second surgery for patients who received CTS decompression surgery
Clinformatics Data Mart database: 2010–2012 (n = 24,931)

Table 1

Conservative treatments used in this study, the evidence for their effectiveness, and the billing codes used to extract them

Intervention	Billing codes
<u>Positioning treatments</u>	
• Splints/orthotics (ME) ^{11,13,28-31}	HCPCS L3908
<u>Steroid treatments</u>	
• Corticosteroids (local injection/systemic) (SE) ^{11,13,28-29,31,32}	ICD-9 - 99.23; CPT – 20526
• Iontophoresis (IE) ^{13,33}	CPT – 97033
<u>Heat based treatments</u>	
• Therapeutic ultrasound/phonophoresis (ME) ^{11,13,28-29,31,32}	CPT - 97035
• Heat treatments (IE) ¹³	CPT - 97010, 97018, 97022, 97024, 97034
• Low-level laser treatments (IE) ²⁸	CPT – S8948
<u>Manual therapy treatments</u>	
• Mobilization and manual therapy (IE) ^{11,28,34}	CPT - 97140
• Massage therapy (IE) ^{11,13,29}	CPT - 97124
• Acupuncture (IE) ^{11,13}	CPT - 97810 - 97814
• Chiropractic manipulation (IE) ²⁸	CPT - 98940 - 98943
<u>Therapeutic exercise interventions</u>	
• Stretches (IE) ^{11,13,34}	CPT - 97110

* SE - Strong Evidence; ME – Moderate Evidence; IE – Inconclusive Evidence

Table 2

Demographics of Sample of patients with a primary diagnosis of CTS in the Clinformatics Data Mart database: 2010–2015. (N = 24,931)

Age (n = 24,931) Mean 49.8 years (SD ±11.8)			
	n	%	95% CI
18–35 years	2,601	10.4	(10.1, 10.8)
35–49 years	8,852	35.5	(34.9, 36.1)
50–64 years	11,558	46.4	(45.7, 47.0)
65–86 years	1,920	7.7	(7.4, 8.0)
Sex (n = 24,931)			
Male	8,504	34.1	(33.5, 34.7)
Female	16,425	65.9	(65.3, 66.5)
Region (n = 24,916)			
Midwest	6,915	27.7	(27.2, 28.3)
Northeast	2,642	10.6	(10.2, 11.0)
South	11,884	47.7	(47.1, 48.3)
West	3,475	13.9	(13.5, 14.4)

Table 3

Number of patients who received treatments for the full window of treatment (0 to 36 months), 0 to 6 months and 7 to 36 months for Clinformatics Data Mart database: 2010–2015. (N = 24,931)

Treatments		
	N	% (95% CI)
<u>0 to 36 mos</u>		
Overall received tx	24,931	
0 tx	13,342	53.5 (52.9, 54.1)
1 tx	7074	28.4 (27.8, 28.9)
2 txs	2737	11.0 (10.6, 11.4)
3 txs	939	3.8 (3.5, 4.0)
4 – 6 txs	839	3.4 (3.1, 3.6)
<u>0 to 6 mos</u>		
Overall received tx	24,931	
0 tx	14,887	59.7 (59.1, 60.3)
1 tx	7249	29.1 (28.5, 29.6)
2 txs	1910	7.7 (7.3, 8.0)
3 txs	529	2.1 (1.9, 2.3)
4 – 6 txs	356	1.4 (1.3, 1.6)
<u>6 to 36 mos</u>		
Overall received tx	24,931	
0 tx	21573	86.5 (86.1, 87.0)
1 tx	2223	8.9 (8.6, 9.3)
2 txs	683	2.7 (2.5, 2.9)
3 txs	271	1.1 (1.0, 1.2)
4 – 6 txs	181	0.7 (0.6, 0.8)

Mos: months; txs: treatments

Number of treatments by types of treatments for the full window of treatment (0 to 36 months), 0 to 6 months and 7 to 36 months for Clinformatics Data Mart database: 2010–2015. (N = 24,931)

Table 4

	Heat		Manual		Positioning		Steroids		Stretches		Surgery	
	n	% (95CI)	n	% (95CI)	n	% (95CI)	n	% (95CI)	n	% (95CI)	n	% (95CI)
<u>0 to 36 mos</u>												
Overall received tx	869	3.5 (3.3, 3.7)	1,386	5.6 (5.3, 5.8)	5,165	20.7 (20.2, 21.2)	2,678	10.7 (10.4, 11.1)	1,782	7.1 (6.8, 7.5)	5,990	24.0 (23.5, 24.6)
1 tx	6	0.1 (0, 0.2)	125	1.8 (1.5, 2.1)	2817	39.8 (38.7, 41)	1013	14.3 (13.5, 15.1)	106	1.5 (1.2, 1.8)	3,007	42.5 (41.4, 43.7)
2 txs	97	3.5 (2.9, 4.2)	288	10.5 (9.4, 11.7)	1472	53.8 (51.9, 55.6)	918	33.5 (31.8, 35.3)	460	16.8 (15.4, 18.2)	1,736	63.4 (61.6, 65.2)
3 txs	215	22.9 (20.2, 25.6)	346	36.8 (33.8, 39.9)	445	47.4 (44.2, 50.6)	416	44.3 (41.1, 47.5)	490	52.2 (49, 55.4)	609	64.9 (61.8, 67.9)
4 – 6 txs	551	65.7 (62.5, 68.9)	627	74.7 (71.8, 77.7)	431	51.4 (48, 54.8)	331	39.5 (36.1, 42.8)	726	86.5 (84.2, 88.8)	638	76 (73.2, 78.9)
<u>0 to 6 mos</u>												
Overall received tx	613	2.5 (2.3, 2.7)	995	4.0 (3.7, 4.2)	4,653	18.7 (18.2, 19.1)	2181	8.7 (8.4, 9.1)	1,307	5.2 (5, 5.5)	4,440	17.8 (17.3, 18.3)
1 tx	9	0.1 (0, 0.2)	123	1.7 (1.4, 2)	3,050	42.1 (40.9, 43.2)	1210	16.7 (15.8, 17.6)	112	1.5 (1.3, 1.8)	2,745	37.9 (36.8, 39)
2 txs	89	4.7 (3.7, 5.6)	254	13.3 (11.8, 14.8)	1,227	64.2 (62.1, 66.4)	686	35.9 (33.8, 38.1)	424	22.2 (20.3, 24.1)	1,140	59.7 (57.5, 61.9)
3 txs	219	41.4 (37.2, 45.6)	304	57.5 (53.3, 61.7)	205	38.8 (34.6, 42.9)	162	30.6 (26.7, 34.6)	421	79.6 (76.1, 83)	276	52.2 (47.9, 56.4)
4 – 6 txs	296	83.1 (79.3, 87)	314	88.2 (84.9, 91.6)	171	48 (42.8, 53.2)	123	34.6 (29.6, 39.5)	350	98.3 (97, 99.7)	279	78.4 (74.1, 82.6)
<u>6 to 36 mos</u>												
Overall received tx	334	1.3 (1.2, 1.5)	571	2.3 (2.1, 2.5)	711	2.9 (2.6, 3.1)	849	3.4 (3.2, 3.6)	663	2.7 (2.5, 2.9)	2,053	8.2 (7.9, 8.6)
1 tx	1	0 (0, 0.1)	90	4 (3.2, 4.9)	297	13.4 (11.9, 14.8)	477	21.5 (19.8, 23.2)	62	2.8 (2.1, 3.5)	1,296	58.3 (56.2, 60.3)
2 txs	60	8.8 (6.7, 10.9)	149	21.8 (18.7, 24.9)	280	41 (37.3, 44.7)	223	32.7 (29.1, 36.2)	207	30.3 (26.9, 33.8)	447	65.4 (61.9, 69)
3 txs	125	46.1 (40.2, 52.1)	169	62.4 (56.6, 68.1)	67	24.7 (19.6, 29.9)	80	29.5 (24.1, 35)	214	79 (74.1, 83.8)	158	58.3 (52.4, 64.2)

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		Heat		Manual		Positioning		Steroids		Stretches		Surgery	
		n	% (95CI)	n	% (95CI)	n	% (95CI)	n	% (95CI)	n	% (95CI)	n	% (95CI)
4 – 6 tss		148	81.8 (76.1, 87.4)	163	90.1 (85.7, 94.4)	67	37 (30, 44.1)	69	38.1 (31, 45.2)	180	99.4 (98.4, 100)	152	84 (78.6, 89.3)

Number of additional visits by types of treatments for the full window of treatment (0 to 36 months) for Clinformatics Data Mart database: 2010–2015.
(N = 24,931)

Table 5

	Heat		Manual		Positioning		Steroids		Stretches		Surgery			
	n	%	n	% (95CI)	n	% (95CI)	n	% (95CI)	n	% (95CI)	n	% (95CI)		
no visits	12,571	50.4	145	1.2 (1.0, 1.3)	301	2.4 (2.1, 2.7)	2,168	17.2 (16.6, 17.9)	825	6.6 (6.1, 7.0)	315	2.5 (2.2, 2.8)	778	6.2 (5.8, 6.6)
1 visit	5,024	20.2	91	1.8 (1.4, 2.2)	165	3.3 (2.8, 3.8)	1,041	20.7 (19.6, 21.8)	613	12.2 (11.3, 13.1)	205	4.1 (3.5, 4.6)	1,100	21.9 (20.8, 23)
2–3 visits	4,852	19.0	143	2.9 (2.5, 3.4)	263	5.4 (4.8, 6.1)	1,139	23.5 (22.3, 24.7)	784	16.2 (15.1, 17.2)	381	7.9 (7.1, 8.6)	2,479	51.1 (49.7, 52.5)
4+ visits	2,484	10.0	490	19.7 (18.2, 21.3)	657	26.4 (24.7, 28.2)	817	32.9 (31, 34.7)	456	18.4 (16.8, 19.9)	881	35.5 (33.6, 37.3)	1,633	65.7 (63.9, 67.6)

Table 6

Types of treatments by provider for the full window of treatment (0 to 36 months), 0 to 6 months and 7 to 36 months for Clinformatics Data Mart database: 2010–2015. (N = 24,931)

		Heat		Manual		Positioning		Steroids		Stretches		Surgery		
	n	%	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)	n	% (95%CI)		
0 to 36 mos														
GP	8,198	32.9	183	2.2 (1.9, 2.6)	306	3.7 (3.3, 4.1)	1,539	18.8 (17.9, 19.6)	503	6.1 (5.6, 6.7)	374	4.6 (4.1, 5)	1,152	14.1 (13.3, 14.8)
Ortho	9,002	36.1	340	3.8 (3.4, 4.2)	482	5.4 (4.9, 5.8)	2,411	26.8 (25.9, 27.7)	1,498	16.6 (15.9, 17.4)	803	8.9 (8.3, 9.5)	3,314	36.8 (35.8, 37.8)
Other	7,731	31.0	346	4.5 (4, 4.9)	598	7.7 (7.1, 8.3)	1,215	15.7 (14.9, 16.5)	677	8.8 (8.1, 9.4)	605	7.8 (7.2, 8.4)	1,524	19.7 (18.8, 20.6)
0 to 6 mos														
GP	8,198	32.9	77	0.9 (0.7, 1.1)	136	2.4 (2.1, 2.8)	1,388	16.9 (16.1, 17.7)	361	4.4 (4, 4.8)	244	3 (2.6, 3.3)	734	9 (8.3, 9.6)
Ortho	9,002	36.1	241	2.7 (2.3, 3.0)	341	3.8 (3.4, 4.2)	2,207	24.5 (23.6, 25.4)	1,296	14.4 (13.7, 15.1)	613	6.8 (6.3, 7.3)	2,651	29.4 (28.5, 30.4)
Other	7,731	31.0	252	3.3 (2.9, 3.7)	455	5.9 (5.4, 6.4)	1,058	13.7 (12.9, 14.5)	524	6.8 (6.2, 7.3)	450	5.8 (5.3, 6.3)	1,055	13.6 (12.9, 14.4)
7 to 36 mos														
GP	8,198	32.9	77	0.9 (0.7, 1.1)	136	1.7 (1.4, 1.9)	206	2.5 (2.2, 2.9)	194	2.4 (2, 2.7)	161	2.0 (1.7, 2.3)	512	6.2 (5.7, 6.8)
Ortho	9,002	36.1	125	1.4 (1.1, 1.6)	192	2.1 (1.8, 2.4)	301	3.3 (3, 3.7)	395	4.4 (4, 4.8)	268	3.0 (2.6, 3.3)	931	10.3 (9.7, 11)
Other	7,731	31.0	132	1.7 (1.4, 2.0)	243	3.1 (2.8, 3.5)	204	2.6 (2.3, 3)	260	3.4 (3, 3.8)	234	3.0 (2.6, 3.4)	610	7.9 (7.3, 8.5)

mos: months; GP: General Practitioner; Ortho: Orthopedist; Other: Other Provider

Types of treatments by demographic characteristics of patients with CTS for the full window of treatment (0 to 36 months) for Clinformatics Data Mart database: 2010–2015. (N = 24,931)

Table 7

	Heat		Manual		Positioning		Steroids		Stretches		Surgery	
	n	% (95CI)	n	% (95CI)	n	% (95CI)	n	% (95CI)	n	% (95CI)	n	% (95CI)
<u>Age</u>												
18–35 yrs	74	2.8 (2.2, 3.5)	137	5.3 (4.4, 6.1)	547	21 (19.5, 22.6)	276	10.6 (9.4, 11.8)	150	5.8 (4.9, 6.7)	309	11.9 (10.6, 13.1)
35–49 yrs	302	3.4 (3.0, 3.8)	496	5.6 (5.1, 6.1)	1,886	21.3 (20.5, 22.2)	928	10.5 (9.8, 11.1)	594	6.7 (6.2, 7.2)	1,749	19.8 (18.9, 20.6)
50–64 yrs	423	3.7 (3.3, 4.0)	651	5.6 (5.2, 6.1)	2,373	20.5 (19.8, 21.3)	1,220	10.6 (10, 11.1)	893	7.7 (7.2, 8.2)	3,232	28.0 (27.1, 28.8)
65–86 yrs	70	3.6 (2.8, 4.5)	102	5.3 (4.3, 6.3)	359	18.7 (17.0, 20.4)	254	13.2 (11.7, 14.7)	145	7.6 (6.4, 8.7)	700	36.5 (34.3, 38.6)
<u>Sex</u>												
male	231	2.7 (2.4, 3.1)	385	4.5 (4.1, 5.0)	1,661	19.5 (18.7, 20.4)	827	9.7 (9.1, 10.4)	524	6.2 (5.7, 6.7)	2,161	25.4 (24.5, 26.3)
female	638	3.9 (3.6, 4.2)	1,001	6.1 (5.7, 6.5)	3,504	21.3 (20.7, 22.0)	1,851	11.3 (10.8, 11.8)	1,258	7.7 (7.3, 8.1)	3,829	23.3 (22.7, 24.0)
<u>Region</u>												
Midwest	222	3.2 (2.8, 3.6)	315	4.6 (4.1, 5.0)	1,541	22.3 (21.3, 23.3)	729	10.5 (9.8, 11.3)	531	7.7 (7.1, 8.3)	2,152	31.1 (30.0, 32.2)
Northeast	123	4.7 (3.9, 5.5)	200	7.6 (6.6, 8.6)	398	15.1 (13.7, 16.4)	212	8.0 (7.0, 9.1)	251	9.5 (8.4, 10.6)	485	18.4 (16.9, 19.8)
South	389	3.3 (3.0, 3.6)	611	5.1 (4.7, 5.5)	2,504	21.1 (20.3, 21.8)	1,419	11.9 (11.4, 12.5)	761	6.4 (6.0, 6.8)	2,565	21.6 (20.8, 22.3)
West	134	3.9 (3.2, 4.5)	258	7.4 (6.6, 8.3)	721	20.7 (19.4, 22.1)	316	9.1 (8.1, 10.0)	239	6.9 (6.0, 7.7)	786	22.6 (21.2, 24.0)