Carpal and Cubital Tunnel Syndrome

Who Gets Surgery?

Charles S. Day MD, MBA, Eric C. Makhni BS,
Erika Mejia BA, Daniel E. Lage, Tamara D. Rozental MD

Published online: 5 January 2010
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Abstract

Background Despite the prevalence of carpal and cubital tunnel syndrome, and relief of symptoms following timely surgical release, it is unclear how nonclinical patient characteristics affect disease management.

Questions/purposes We examined the effects of a variety of factors, such as age, gender, and socioeconomic status on the management of both carpal and cubital tunnel syndromes.

Patients and Methods We retrospectively reviewed the records of all 273 patients seen by two hand surgeons with a diagnosis of either carpal or cubital tunnel syndrome between January 2005 and January 2007. Demographic, clinical (diagnosis, treatment), and socioeconomic (insurance type, median income) information was collected.

Each author certifies that he or she has no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

Each author certifies that his or her institution approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research.

This study was performed at Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, MA.

C. S. Day (✉), E. C. Makhni, E. Mejia, D. E. Lage,
T. D. Rozental
Department of Orthopedic Surgery, Beth Israel Deaconess
Medical Center, 330 Brookline Avenue, Boston, MA 02215,
USA
e-mail: cday1@bidmc.harvard.edu

C. S. Day, E. C. Makhni, T. D. Rozental
Harvard Medical School, Boston, MA, USA

E. C. Makhni
Harvard Business School, Boston, MA, USA

Census data (2000) were used to collect information on median household income. The average age was 52 years (range, 19–87 years), and 65% of the patients were women ($n = 178$). Eighteen patients had Workers Compensation. Of the 273 patients, 86 (32%) had two or more diagnoses. **Results** Among patients with carpal tunnel syndrome, there was a higher proportion of female patients compared to male patients (68% versus 32%); male patients with multiple neuropathies had higher rates of surgery than their female counterparts (63% versus 41%). Only increasing age was associated with increasing likelihood of surgery. Among multiple-diagnosis patients, those with Workers Compensation ($n = 6$) had higher wait times for surgery than their counterparts ($n = 46$) (126 days versus 26 days). **Conclusion** Patient age was the most important predictor of surgical release, and among those with multiple neuropathies, male patients were more likely to have surgery than female patients. Patients with Workers Compensation may experience long wait times to surgery.

Level of Evidence Level II, prognostic study. See Guidelines for Authors for a complete description of levels of evidence.

Introduction

Carpal and cubital tunnel syndromes are the two most commonly diagnosed upper extremity mononeuropathies [6]. Several epidemiologic studies have linked disease incidence of carpal tunnel syndrome to female gender and increased BMI, as well as to patient age [7, 12, 15]. One study [7] reported an incidence of approximately 376/100,000 person years, with a higher incidence among women, along with a corresponding surgical release rate of 109/100,000. This incidence has increased over previous

years, whether due to an aging population, increasing frequency of comorbidities such as diabetes, or increased awareness of disease entity by physicians. Surgery generally provides symptom relief, as evident by both subjective and objective measures, even in advanced cases [1, 2]. Moreover, studies indicate that initial management with surgery is also cost-effective [16], and delays to treatment can cause increased disability [3]. Therefore, as surgical intervention may be beneficial—both from a clinical and cost-effective point of view—we sought to determine if all patients were managed equally, or if certain patient characteristics, such as age, gender, or socioeconomic status affected the likelihood of receiving surgery or delayed treatment.

Previous studies indicate an increasing rate of surgical release among older patients, possibly due to greater disease progression [7]. Carpal tunnel release was effective in this patient population [5, 18]. One study suggests surgical release as a first-line treatment for carpal tunnel syndrome, despite patient age [16]. In addition to age, patient gender must also be considered when investigating nonclinical factors contributing to disease management. While some studies suggest neither age nor gender affect ultimate surgical management and outcomes [10, 11], other studies demonstrated that female patients refusing surgery had concerns with issues such as transient weakness, financial burden, and scar pain associated with the procedure [8]. It is therefore important to determine if there exists any variation in rates of surgical release between male and female patients. Moreover, it is important to consider the precise diagnoses that these patients carry (ie, a single, isolated neuropathy or multiple diagnoses). Theoretically, if patients are managed the same, regardless of the number of diagnoses they have, then rates of surgical treatment, along with wait times, should be similar across these various patient groups (single diagnosis versus multiple diagnoses). If this is not the case, then having more than one neuropathy may affect the way the patient and clinician choose to manage the neuropathy. Past studies have typically not made this distinction [4, 11, 14].

In addition to patient age and gender, other factors, such as demographics and socioeconomic status, may ultimately affect whether or not a patient undergoes surgery. With the economic burden of carpal tunnel syndrome estimated at \$45,000 to \$89,000 per employed patient [6], it is important to clarify the role that these nondiagnostic factors play in choosing treatment options. While two studies have examined the relationship between disease incidence and occupation type [4, 7], few have investigated how occupation affects disease management, especially when considering other patient characteristics. One other key factor is insurance status, especially Workers Compensation. In our institution, there has been some preliminary, unpublished evidence to suggest patients with Workers

Compensation may experience higher rates of surgery than their non-Workers Compensation counterparts. Moreover, time to surgery must also be considered. Wasiak and Pransky reported a wide variety in time to surgery exists among Workers Compensation patients with carpal tunnel syndrome from different states [20]. Disability may be minimized by not only diagnosing carpal tunnel syndrome as soon as possible, but by also decreasing the time to surgery [3].

We therefore asked whether (1) patient age affected the type of treatment received (ie, nonoperative treatment versus surgical release); (2) patient gender had any effect on treatment; (3) any other variable, whether clinical (ie, wait time to surgery, symptom duration prior to diagnosis) or socioeconomic (ie, median household income, occupation) affected the type of treatment; (4) Workers Compensation patients experienced differences in wait time to surgery compared to their non-Workers Compensation counterparts. Finally, we (5) assessed the reasons for not undergoing surgery in those patients who were managed nonoperatively.

Patients and Methods

We retrospectively reviewed the records of all 273 patients seen by two hand surgeons with a diagnosis of either carpal or cubital tunnel syndrome between January 2005 and January 2007. ICD-9 codes from office notes were used to identify patients with the diagnosis of carpal and/or cubital tunnel syndrome. We included patients with one or both diagnoses (either unilateral or bilateral). We excluded patients younger than 18 years of age, as this study focused on only the adult patient population, who presumably are independent decision-makers regarding their clinical care. Patients were further classified and grouped according to their age. Those patients between the ages of 18–44 were considered to be in Group I, while those between the ages of 45–64 were in Group II, and those 65 years and older were Group III.

Of the 273 patients in the study, 188 (69%) had a single diagnosis, and 85 (31%) had more than one neuropathy diagnosis (Fig. 1). The most commonly seen neuropathy was unilateral carpal tunnel syndrome ($n = 159$; 58%), with bilateral carpal tunnel syndrome as the second most common ($n = 64$; 23%). Patients with multiple diagnoses included 30 male patients with 62 diagnoses, compared to 55 female patients with 116 diagnoses. The average age of all patients was 51.8 years; 178 (65%) were females. One hundred forty six (54%) had undergone an EMG nerve conduction study. Among multiple-neuropathy patients, 61% had received an EMG versus only 50% of single-neuropathy patients ($p = 0.09$) (Table 1). Among multiple-neuropathy patients, 61% had received an EMG versus

only 50% of single-neuropathy patients ($p = 0.09$) (Table 1). Eight percent were seen under Workers Compensation. The average patient income (median household) was \$54,380. Seventy eight (50%) of the 156 neuropathies were not treated surgically due to patient's preference. No patients were lost to followup. IRB approval was obtained from our institution for this study.

For each patient, demographic, socioeconomic, and clinical information was collected. Demographic information included patient age and gender. Socioeconomic information was comprised of median household income

Fig. 1 A chart shows the distribution of diagnoses among the patients with carpal and/or cubital tunnel syndrome. While 69% of patients had a single neuropathy, 31% had more than one diagnosis. Unilateral carpal tunnel syndrome was the most common neuropathy (58%), while bilateral carpal tunnel syndrome was the second most common (23%). No patients had contralateral carpal and cubital tunnel syndrome.

(as determined by 2000 US Census Data, which provided median household income within the patients' Zip Code Tabulation Area based on their home address [19]), occupation (such as manual labor versus clerical work versus healthcare employee), and insurance (including Workers Compensation status). Clinical information included the diagnosis, symptom duration before diagnosis, whether or not an EMG was performed, whether or not surgery was performed, and wait time between diagnosis and surgery. In addition to age, patients were also subgrouped according to occupation type. Of all patients ($n = 273$), a total of 113 patients were classified as having occupations that were clerical, manual, or in healthcare. Clerical patients comprised 50% of this group ($n = 56$), while manual laborers comprised 32% ($n = 36$) and healthcare workers 19% ($n = 21$). Except for median household income, all patient information was derived from the patients' electronic medical records, and there were no missing data for these patients. Each patient chart contained information from the initial clinical evaluation, along with progress notes that documented treatment, whether nonoperative or operative. The primary end point in this study was whether or not a patient underwent surgery for their neuropathy. Secondary variables included wait time to surgery (from date of diagnosis) for patients who underwent surgery, and reasons for not pursuing surgery in those who were managed nonoperatively. For patients with more than one neuropathy diagnosis, the outcome of "having surgery" referred to undergoing at least one operative procedure.

A regression analysis was performed to determine which input variables contributed to surgical release of their neuropathy and to wait time for those who underwent surgery. Input variables included age, gender, symptom duration before diagnosis, whether or not an EMG was performed, Workers Compensation status, and median household income.

Finally, reasons for not having surgery were also investigated and compared between subgroups. Patients who decided against surgery when the surgeon recommended the surgical option were recorded. For all patients (considering

Table 1. Demographics of all, single-neuropathy, and multiple-neuropathy patients

Variable	All patients	Single neuropathy	Multiple neuropathy	P value
Number of patients	273	188 (69%)	85 (31%)	
Age (years)*	51.8 (14.4)	51.0 (14.7)	53.7 (13.6)	0.1517
Number of female patients	178 (65%)	123 (65%)	55 (65%)	0.9080
Number of patients with Workers Compensation	23 (8%)	16 (9%)	7 (8%)	0.9395
Number of patients with EMG	146 (54%)	94 (50%)	52 (61%)	0.0865
Median income*	\$54,379.89 (\$24,315.38)	\$55,220.94 (\$23,733.40)	\$52,536.05 (\$25,605.45)	0.3992
Symptom duration (months)	30	29	32	0.489

* Values expressed as mean, with SD in parentheses.

each diagnosis independently), there were a total of 156 neuropathies that were not treated surgically.

To determine the differences in rates of surgery and time to surgery between patients of different age groups, a chi square test and ANOVA were utilized. Chi square was used for rates of surgery, as these were reported in whole number groups (also used when assessing reasons for not having surgery), and ANOVA was used for wait time to surgery, as this was continuous data. When considering the effects of gender upon rates of surgical release, a Fisher's exact test and ANOVA were used for similar reasons. To determine the effect of any single patient variable (clinical or nonclinical) compared to the other variables, a logistic regression was performed; for each analysis significance ($p < 0.05$) or a statistical trend ($p < 0.10$) was established.

Results

We observed no difference of the demographic characteristics between patients with a single, isolated neuropathy diagnosis and those with more than one such diagnosis.

Fig. 2 A graph shows the percentage of patients receiving at least one surgery for carpal or cubital tunnel syndrome by number of neuropathies. Patients with more than one neuropathy were more likely to receive surgery than patients with only one neuropathy (61% versus 45%).

Among all patients ($n = 273$), 137 (50%) received surgery at some point for their neuropathy diagnosis. For single-diagnosis patients, 85 (of 188; 45%) underwent surgery, compared to 52 (of 85; 61%) multiple-diagnosis patients (ie, they had at least one surgery) ($p = 0.01$) (Fig. 2). Thirty-one patients (11%) had more than one surgery.

The rates of surgery increased ($p < 0.001$) with age (Fig. 3). In Group I, there were 81 patients (30%), while there were 145 (53%) and 47 (17%) patients in Groups II and III, respectively. Surgery was performed in 23 Group I patients (28%), compared to 82 (57%) and 31 (66%) patients for Groups II and III, respectively.

The proportion of male and female patients with a single neuropathy diagnosis (compared to multiple ones) was similar, as was the average patient age, symptom duration prior to diagnosis, proportion with Workers Compensation, and median household income (Table 2).

Among patients with carpal tunnel syndrome, there was a higher ($p < 0.01$) proportion of female patients compared to male patients (68% versus 32%). Further, among all female patients, a greater proportion had carpal tunnel

Fig. 3 A graph shows the percentage of patients who underwent at least one surgery for carpal or cubital tunnel syndrome by age group. The rates of operative treatment increased with increasing age. Only 28% of Group I patients underwent at least one surgery, compared to 57% and 66% of Groups II and III, respectively.

Table 2. Demographics of all male and female patients

Variable	All patients	Male	Female	P value
Number of patients	273	95 (35%)	178 (65%)	
Age (years)*	51.8 (14.4)	50.6 (14.3)	52.5 (14.4)	0.2988
Number of patients with multiple neuropathies	85 (65%)	30 (32%)	55 (31%)	1.0
Number of patients with Workers Compensation	23 (8%)	8 (8%)	15 (8%)	1.0
Number of patients with EMG	146 (54%)	56 (59%)	90 (50%)	0.5218
Median income*	\$54,379.89 (\$24,315.38)	\$54,065.03 (\$23,992.62)	\$54,551.98 (\$24,562.72)	0.8751
Symptom duration (months)	30	33	28	

* Values expressed as mean, with SD in parentheses.

Fig. 4 A graph shows the percentage of patients with carpal or cubital tunnel syndrome who were female. More patients with carpal tunnel syndrome were female (68%) than patients with cubital tunnel syndrome (47%).

Fig. 6 A graph shows the average wait time to surgery by gender, number of neuropathies, Workers Compensation status. The average wait time to surgery for all patients was 124 days. There were no differences in the wait times to surgery between single- and multiple-diagnosis patients (114 versus 141 days) and between patients with or without Workers Compensation (179 versus 117 days).

A

B

Fig. 5A–B These graphs show the percentage of patients receiving at least one surgery for carpal or cubital tunnel syndrome by gender. **(A)** Among all patients, there was no gender difference in the surgical rates between males and females (52% versus 44%). **(B)** However, among multiple-diagnosis (Dx) patients, there were more male patients than female patients (63% versus 41%).

compared to those with cubital tunnel (68% versus 47%) ($p = 0.004$) (Fig. 4). For single diagnosis patients, the percentage of male patients who underwent surgery was

A

B

Fig. 7A–B These graphs show the percentage of patients who refused surgery when it was recommended by surgeon by gender and Workers Compensation status. There were no differences observed in patient refusal of surgery **(A)** between male and female patients (53% versus 49%) and **(B)** between patients with (WC) or without Workers Compensation (Non-WC) (36% versus 51%).

similar to female patients. However, for multiple-diagnosis patients, there were more ($p = 0.004$) surgeries performed on male patients than on female patients (63% versus 41%) (Fig. 5).

For patients with a single diagnosis, as well as those with multiple diagnoses, only age ($p < 0.001$) predicted whether or not a patient underwent surgery for their neuropathy. The odds of receiving surgery increased by 10.5% multiplicatively for each year increase in age.

The wait time to surgery was not affected by number of diagnoses, but those with Workers Compensation ($n = 15$) waited longer than those without this insurance ($n = 122$; 179 versus 117 days; $p = 0.21$) (Fig. 6). This was not the case with Workers Compensation patients with single diagnoses (124 versus 110 days; $p = 0.65$), but was especially true for patients with multiple diagnoses ($n = 6$, 260 days versus $n = 46$, 126 days; $p = 0.003$). Among all Workers Compensation patients who had surgery ($n = 15$), a higher proportion had to wait 3 or more months (when compared to non-Workers Compensation counterparts), but this difference was not significant ($p = 0.11$).

Neither gender nor Workers Compensation status appeared to affect reasons for not undergoing surgery (Fig. 7).

Discussion

Carpal and cubital tunnel syndromes are among the most common neuropathies of the upper extremity. Surgical release generally provides symptom relief in these conditions [2, 5, 6, 18], with postoperative satisfaction as high as 93% [5], and one report suggests in some cases surgical release is the initial treatment of choice [16]. However, because these conditions can often be managed on an elective basis, it is important to understand the factors that are taken into account when considering a patient for such management. We sought to determine if there were any discrepancies in treatment among patients of different groups, according to their age, gender, or socioeconomic status. We additionally analyzed patients with a single, isolated neuropathy separately from those with more than one diagnosis. We attempted to determine if having more than one diagnosis affects ultimate patient management—i.e. if it causes patients to act in a different way than they otherwise would (refusing surgery more often, for example). As these neuropathies can be chronically progressive [2], we also sought to determine if there were any variations of time-to-surgery between these different groups of patients, especially among Workers Compensation patients. Finally, we analyzed patients who ultimately did not receive surgery to identify any possible demographic variations among them.

Our study has some limitations. First, all patients came from a single institution in a single city; therefore, the demographic and socioeconomic background of study participants may not be similar to patients in other parts of the country. However, the institution is in a major

metropolitan area and thus obviates some of this selection bias. Second, as this was a retrospective review, the patients did not undergo a standardized preoperative clinical/evaluative regimen. Such information would have been useful in constructing more stringently matched comparison groups. EMG testing has traditionally been used as one method of diagnosing carpal tunnel syndrome, but not every patient received such testing, and therefore it was not possible to correlate surgical rates and wait times with quantitative “disease severity” markers, such as EMG results. However, it has previously been reported by Graham that electrodiagnostic testing does not substantially change a diagnosis made on clinical grounds [9]. Third, when considering patient socioeconomic information, patient occupation was retrieved from the chart review, and median income was obtained from the public Census Data from 2000. As such, this information may not be as accurate as it would have been had the patients provided this information prior to enrolling in the study. Finally, additional neuropathies—such as radial tunnel syndrome or thoracic outlet syndrome—were not considered in the study design.

We found that increasing patient age was associated with an increasing likelihood of undergoing surgical release for carpal and cubital tunnel syndrome. Logistic regression confirmed that age was more important than any other variable tested in this study, including symptom duration. These findings corroborate those of Gelfman et al. [7], who also reported that age influenced rates of surgery for carpal tunnel release. They investigated long-term trends of carpal tunnel syndrome and identified incidence and first-time carpal tunnel release. The authors suggested the diagnosis of carpal tunnel syndrome increased over the duration of the study period. They also noted incidence of carpal tunnel release (per 100,000 person-years) was higher in older patients compared to younger counterparts. In their study, however, age and gender were the main variables of patient classification; in our study, a variety of characteristics, including demographic, socioeconomic and clinical, were used. Further, our study directly focused on patients with known disease, rather than focusing on rates of incidence and treatment in the population as a whole. It is also interesting to note that only 28% of Group I patients (18–44 years old) received surgery, compared to 57% and 66% of Groups II and III, respectively (45–64 years old and 65+ years old). Assuming that surgical release is recommended as a potential first line treatment, as suggested by Pomerance et al. [16], it is important to conduct further investigation into why younger patients have such decreased rates of surgery relative to older counterparts.

Carpal tunnel syndrome reportedly affects females more often than it does males [15], and this was confirmed in our

study. Less is known about cubital tunnel syndrome, however. One study by Richardson et al. [17] reported male gender was associated with an increased probability of having cubital tunnel syndrome. We found no association between gender and presence of a diagnosis for cubital tunnel syndrome. In the study by Richardson et al. [17], “definite” or “probable” cases of cubital tunnel syndrome were diagnosed based on the results of EMG testing. In our study, however, diagnoses were made based on a combination of diagnostic testing and clinical assessment. Therefore, while male patients may have an increased likelihood of having EMG results indicative of cubital tunnel syndrome compared to female patients, they may have similar rates of clinical presentation of the disease. Several studies have assessed the effects of gender on the incidence of carpal and cubital tunnel syndromes (especially carpal tunnel syndrome) [7, 11, 15, 17], but few have investigated the effects of gender on the ultimate management of these neuropathies. We did not identify any studies that compared the rates of operative treatment between male and female patients, but one study by Dias et al. [4] reported a cohort of 327 consecutive women with carpal tunnel syndrome who were classified according to their type of occupation. They found women who worked in nonrepetitive occupations were actually offered and had surgery more often than both those in repetitive occupations and those not working (82% versus 67% and 58%). However, they only followed female patients, and therefore no claims were made regarding comparative rates among male patients. We found female patients with a mono-neuropathy had an operative treatment rate of less than 50%, which is less than that found in the Dias et al. study [4]. Such a difference may be attributable to institutional or cultural differences among the patient population or surgeons in the study of Dias et al. [4], which was performed in the United Kingdom. We also found that among multiple neuropathy patients, females had a lower rate of surgery than did males (41% versus 63%). The reason for this finding is unclear. Given the findings of Gong et al. [8], which reported that a variety of concerns existed for female patients not undergoing surgery, female patients in our study may have had additional concerns regarding surgery not shared by male counterparts. However, we were unable to further investigate that possibility in the current study.

In addition to measuring rates of diagnosis and surgical treatment according to various patient characteristics, we also examined the wait times to surgery for those patients who received it.

Löfvendahl et al. [13] previously investigated wait times among orthopaedic patients (not exclusively hand surgery patients) and found patient gender, age, and living arrangement were not associated with wait times. These

findings were largely confirmed in our study of patients with carpal and cubital tunnel syndrome. While our logistic regression did not identify any contributing factors toward this time point (when considering all the various input variables), we did find that some patients with Workers Compensation, particularly with multiple diagnoses, may wait longer on average than patients without this type of insurance. Such a finding may warrant further investigation into this subject. Since carpal and cubital tunnel syndromes produce progressive neurologic deficits over time [2], it is important to institute systems dedicated to decreasing this wait time for patients with Workers Compensation. This is especially important given the financial burdens of such delayed treatment, as found by Daniell et al. [3].

In conclusion, we attempted to determine the reasons for not having surgery. We found no differences across gender or age groups. However, our investigation was limited as no detailed patient surveys were used that could help determine these reasons. Our study begins to probe the link between disease management and wait times with factors relating to patient clinical, socioeconomic, and demographic characteristics. We affirmed female gender was associated with a higher incidence of carpal tunnel syndrome but not with cubital tunnel syndrome in our study cohort. We found that while age was the most important predictor for receiving surgery for these neuropathies, male patients with multiple neuropathies had a higher likelihood of receiving surgery compared to female patients. There may be additional factors that prevent these female patients from having surgery more often, and further studies, potentially survey-based, may be needed. Given the positive outcomes with surgical release, it is important for clinicians to be aware of any possible limiting circumstances preventing patients from pursuing surgery, especially these female patients with multiple neuropathy diagnoses. Our study also showed a potentially increased time to surgery for patients with Workers Compensation. Bearing in mind the frequent relief of symptoms following surgical release, along with the progressive nature of these neuropathies, it is important for the clinician to be mindful of factors that may delay treatment in this patient population.

Acknowledgments We thank Dr. David Zurakowski (Childrens Hospital, Boston, MA) for his assistance with the statistical portion of this study.

References

1. Boyd KU, Gan BS, Ross DC, Richards RS, Roth JH, MacDermid JC. Outcomes in carpal tunnel syndrome: symptom severity, conservative management and progression to surgery. *Clin Invest Med*. 2005;28:254–260.

2. Capasso M, Manzoli C, Uncini A. Management of extreme carpal tunnel syndrome: evidence from a long-term follow-up study. *Muscle Nerve*. 2009;40:86–93.
3. Daniell WE, Fulton-Kehoe D, Franklin GM. Work-related carpal tunnel syndrome in Washington State workers' compensation: Utilization of surgery and the duration of lost work. *Am J Ind Med*. 2009 Oct 28. [Epub ahead of print]
4. Dias JJ, Burke FD, Wildin CJ, Heras-Palou C, Bradley MJ. Carpal tunnel syndrome and work. *J Hand Surg Br*. 2004;29:329–333.
5. Ettema AM, Amadio PC, Cha SS, Harrington JR, Harris AM, Offord KP. Surgery versus conservative therapy in carpal tunnel syndrome in people aged 70 years and older. *Plast Reconstr Surg*. 2006;118:947–958.
6. Foley M, Silverstein B, Polissar N. The economic burden of carpal tunnel syndrome: long-term earnings of CTS claimants in Washington State. *Am J Ind Med*. 2007;50:155–172.
7. Gelfman R, Melton LJ 3rd, Yawn BP, Wollan PC, Amadio PC, Stevens JC. Long-term trends in carpal tunnel syndrome. *Neurology*. 2009;72:33–41.
8. Gong HS, Baek GH, Oh JH, Lee YH, Jeon SH, Chung MS. Factors affecting willingness to undergo carpal tunnel release. *J Bone Joint Surg Am*. 2009;91:2130–2136.
9. Graham B. The value added by electrodiagnostic testing in the diagnosis of carpal tunnel syndrome. *J Bone Joint Surg Am*. 2008;90:2587–2593.
10. Hobby JL, Venkatesh R, Motkur P. The effect of age and gender upon symptoms and surgical outcomes in carpal tunnel syndrome. *J Hand Surg Br*. 2005;30:599–604.
11. Ibrahim T, Majid I, Clarke M, Kershaw CJ. Outcome of carpal tunnel decompression: the influence of age, gender, and occupation. *Int Orthop*. 2008 October 16 [Epub ahead of print].
12. Lam N, Thurston A. Association of obesity, gender, age and occupation with carpal tunnel syndrome. *Aust N Z J Surg*. 1998;68:190–193.
13. Löfvendahl S, Eckerlund I, Hansagi H, Malmqvist B, Resch S, Hanning M. Waiting for orthopedic surgery: factors associated with waiting times and patients' opinion. *Int J Qual Health Care*. 2005;17:133–140.
14. Lorgelly PK, Dias JJ, Bradley MJ, Burke FD. Carpal tunnel syndrome, the search for a cost-effective surgical intervention: a randomised controlled trial. *Ann R Coll Surg Engl*. 2005;87:36–40.
15. Moghtaderi A, Izadi S, Sharafadinzadeh N. An evaluation of gender, body mass index, wrist circumference and wrist ratio as independent risk factors for carpal tunnel syndrome. *Acta Neurol Scand*. 2005;112:375–379.
16. Pomerance J, Zurakowski D, Fine I. The cost-effectiveness of nonsurgical versus surgical treatment for carpal tunnel syndrome. *J Hand Surg Am*. 2009;34:1193–1200.
17. Richardson JK, Green DF, Jamieson SC, Valentin FC. Gender, body mass, and age as risk factors for ulnar mononeuropathy at the elbow. *Muscle Nerve*. 2001;24:551–554.
18. Townshend DN, Taylor PK, Gwynne-Jones DP. The outcome of carpal tunnel decompression in elderly patients. *J Hand Surg Am*. 2005;30:500–505.
19. U.S. Census FactFinder Web site. "2000 Summary File 3." http://factfinder.census.gov/servlet/DTGeoSearchByListServlet?ds_name=DEC_2000_SF3_U&_lang=en&_ts=276019791361. Accessed September 2, 2008.
20. Wasiak R, Pransky G. The impact of procedure type, jurisdiction and other factors in workers' compensation on work-disability outcomes following carpal tunnel surgery. *Work*. 2007;28:103–110.