Carpal Tunnel Syndrome: Using Self-Report Measures of Disease to Predict Treatment Response

Jefferson J. Kaye, MD, and John M. Reynolds, MD

Abstract

Initial self-report assessments of symptom severity in patients with carpal tunnel syndrome was retrospectively examined. At initial evaluation, 86 patients completed a self-administered questionnaire previously shown to be reproducible, internally consistent, and responsive to clinical change. Within the next 2 years, 50 patients underwent carpal tunnel release; of the other 36 patients, 23 were managed adequately with conservative treatment alone, and 13 were lost to follow-up. Initial mean symptom severity scores were statistically significantly higher for the surgery group (P = .000012). Significantly higher symptom severity scores on self-administered questionnaires at initial evaluation from patients who eventually undergo carpal tunnel release may be of value in planning treatment.

Carpal tunnel syndrome (CTS) is the most common neuropathy affecting the upper extremity. The usual treatment for CTS is conservative and consists primarily of wrist splints and corticosteroid injections. Surgical intervention is usually considered only when a trial of conservative treatment fails or the patient presents with advanced disease.

Conservative therapy may provide temporary symptomatic relief, but most patients, especially those with advanced symptoms and thenar atrophy, will not be cured without surgery. In a prospective trial of splinting and steroid injection, Gelberman and colleagues[1] found that only 7 (39%) of 18 hands had continued relief at 26 months. Therefore, a reliable instrument for predicting a patient's response to conservative measures would be useful in treatment planning.

There are numerous objective measures of disease, including 2-point discrimination, provocative maneuvers, electrodiagnostic testing, Semmes-Weinstein monofilament testing, abductor pollicis brevis strength testing, and observation of thenar atrophy. All these may be useful adjuncts in diagnosis, but all have failed to show significant correlations with clinical outcome after carpal tunnel release (CTR).[2] Therefore, in the study of CTS, many authors have begun to analyze patient symptoms.[3]

In 1993, Levine and colleagues[4] introduced a self-administered questionnaire for assessing symptom severity in CTS. The questionnaire consists of 11 questions regarding severity of symptoms, such as numbness, pain, and tingling. Patients respond on a scale ranging from 1 (*little to no symptoms*) to 5 (*severe symptoms*). As reported by Levine and colleagues, these scales were reproducible in the same patient, were internally consistent (coherent among items), and responded to clinical change.

"...[existing objective measures] have failed to show significant correlations with clinical outcome after carpal tunnel release."[2]

Moreover, by measuring symptom severity, these scales measure outcome dimensions not captured by traditional objective evaluations of median nerve impairment. Results from follow-up studies using the same questionnaire showed in fact that these scales are considerably *more* responsive to clinical improvement than traditional measures.[5]

In numerous follow-up studies, investigators have used this questionnaire to compare various treatments in different populations.[6] To our knowledge, however, no one has tried using patient responses to such a questionnaire to *predict* response to conservative treatment and thereby predict probability of undergoing surgery. In the study reported here, we wanted to determine whether questionnaire responses could be used to predict the likelihood of undergoing CTR.

Materials and Methods

During initial consultation in our clinic, 89 patients who were diagnosed with primary CTS on the basis of history and physical examination completed the questionnaire developed by Levine and colleagues.[4] All patients com-

Dr. Kaye is Attending Orthopaedic Surgeon, Chairman Emeritus, Ochsner Orthopaedic Surgery Department, and Dr. Reynolds was Resident, Department of Orthopedics, Ochsner Clinic Foundation, New Orleans, Louisiana, at the time of writing. He is now Staff Orthopaedic Surgeon, Tennessee Orthopaedic Clinics, Knoxville, Tennessee.

Requests for reprints: Jefferson J. Kaye, MD, Ochsner Clinic Foundation, 1514 Jefferson Hwy, New Orleans, LA, 70121 (tel, 504-842-3970; fax, 504-842-6784; e-mail, jkaye@ochsner.org).

Am J Orthop. 2007;36(4):E59-E62. Copyright 2007, Quadrant HealthCom Inc.

plained of paresthesias in the median nerve distribution, and all had a positive Phalen test, a positive Tinel sign at the wrist, or both. Only 2 patients had clinically detectable thenar atrophy. For 62 of the 89 patients, the clinician was confident making the diagnosis by these history and physical findings alone; for the other 27 patients, electromyograms (EMGs) were obtained to confirm the diagnosis (3 patients were excluded from the study because of a negative EMG; the other 24 had an EMG positive for CTS).

Treatment for the 86 patients diagnosed with CTS was at first conservative and consisted of wrist splints and a variable number of steroid injections. Patients who responded favorably to these treatments and expressed satisfaction received no further treatment. CTR was offered to patients who did not obtain adequate relief after a trial of conservative therapy. Whether and when to proceed with surgery were decided by the patients after a discussion with the physician regarding the risks and benefits of the procedure. Patients' questionnaire scores were not considered in the treatment process.

After a minimum of 2 years from initial evaluation, a chart review was conducted to determine whether the patient had undergone CTR. Demographic data, including age, sex, worker compensation status, and presence of diabetes or other nerve compressions, were recorded. Physical examination findings, including Phalen test results, presence or absence of thenar atrophy, and presence or absence of a Tinel sign at the wrist, were also noted. Data were also collected regarding number of steroid injections the patient received and whether an EMG was obtained. Patients with a documented procedure were placed into a surgery group. Patients for whom our institution had no record of CTR were contacted by telephone to confirm that they had not undergone surgery elsewhere. Some of these patients did indeed undergo CTR at another institution and were included in the surgery group. Those who had not had surgery constituted the no-surgery group. Thirteen of the 86 patients could not be contacted for follow-up and were excluded from the study.

For analysis, scores from the 11-item symptom severity scale were averaged into a single score for each patient. The unpaired Student's t test assuming equal variances was used to determine statistically significant differences between the 2 groups with regard to symptom severity scores, age, and number of steroid injections. The χ^2 test was used to compare the number of patients of each sex in each group and to determine statistically significant differences between the numbers of patients in each group with diabetes, thenar atrophy, a positive Tinel sign at the wrist, a positive Phalen test, other nerve compressions, and worker compensation claims. Number of patients for whom an EMG was obtained in each group was also compared using the χ^2 test.

A sensitivity analysis was performed to study the effect of 13 patients' being lost to follow-up. The data were analyzed first with all 13 patients included in the surgery group and then with all 13 included in the no-surgery group. Student's t test was used to compare symptom severity scores between the groups in this sensitivity analysis.

Logistic regression, with initial symptom severity score as a single independent variable, was used to determine the probability that a patient would undergo surgery. The regression returns coefficient m and intercept b, which are used to calculate the predictor variable $y = mx + b$. The predictor variable is then transformed into probability of occurrence using the equation $p = e^y / (1 + e^y)$. To account for possible differences in absolute symptom severity scores among different populations, the entire population was divided into quartiles, and a second logistic regression was performed on the data using the quartile number as a single independent variable. Probabilities for undergoing surgery based on patient quartile number were then calculated.

Table I. Symptom Severity Scores and Patient Demographics

	Surgery Group (n = 50)		No-Surgery Group (n = 23)		
	Mean	SD	Mean	SD	*P*
Symptom severity score	3.27	0.68	2.54	0.56	.000012
Age in years	52.86	15.06	56.91	15.05	.1444
No. injections	2.68	2.11	1.65	2.12	.0290

Table II. Patient Demographics and Clinical Characteristics

	No. Patients in Each Group		
	Surgery (n = 50)	No Surgery (n = 23)	χ^2
Sex			
Male	13	8	0.441
Female	37	15	
Diabetes	7	3	0.912
Other nerve compressions	2	2	0.385
Worker compensation	1	0	0.495
Electromyogram obtained	14	9	0.342
Positive Phalen test	48	22	0.945
Positive Tinel sign	40	18	0.864
Thenar atrophy	2	0	0.331

Table III. Surgery Probability (*P*) Based on Symptom Severity Score

Score	*P*
1.0	.06
1.5	.15
2.0	.30
2.5	.51
3.0	.72
3.5	.86
4.0	.94

Table IV. Surgery Probability (*P*) Based on Symptom Severity Score Quartile

Quartile	Score Range	*P*
1	<2.5	.35
2	≥2.5, ≤3	.62
3	>3, ≤3.5	.83
4	>3.5	.93

Results

Fifty patients underwent CTR within 2 years of initial evaluation (surgery group). Twenty-three patients were managed adequately with conservative treatment during the 2-year follow-up (no-surgery group). Symptom severity scores and demographic data for these 2 groups are listed in Tables I and II. For all 4 patients with other compressive neuropathies, EMGs was obtained; these EMGs showed entrapment of the ulnar nerve at the elbow.

Mean symptom severity score was statistically significantly higher for the surgery group than for the no-surgery group ($P = .000012$). During the 2-year follow-up, surgery patients (vs no-surgery patients) also received statistically significantly more steroid injections before surgical intervention ($P = .0290$).

There was no statistically significant difference between the 2 groups with regard to age, sex, presence of diabetes, presence of other nerve compressions, or worker compensation status. There was also no significant difference between the numbers of patients in each group with a positive Tinel sign, a positive Phalen test, or thenar atrophy. There was no statistically significant difference between the numbers of patients for whom an EMG was obtained in each group.

For the 13 patients lost to follow-up, mean symptom severity score was 2.92 (SD, 0.84). When the sensitivity analysis was performed, the difference in symptom severity scores between the groups remained significant whether all the patients lost to follow-up were included in the surgery group ($P = .000073$) or in the no-surgery group ($P = .000075$).

The logistic regression for predicting surgery on the basis of symptom severity score returned a coefficient m of 1.8132 and an intercept b of -4.4918, with a standard error for m of 0.5138 ($P = .0004$). Probabilities of surgery for given symptom severity scores are listed in Table III. A mean score of 2.5 resulted in a 51% probability of surgery, a score of 3.0 resulted in a 72% probability, and a score of 3.5 resulted in an 86% probability.

When the entire population was divided into quartiles based on mean symptom severity score, the logistic regression using quartile number as the independent variable returned a coefficient m of 1.0867 and an intercept b of -1.6938, with a standard error for m of 0.2989 ($P = .0003$). The quartiles, along with approximate score range and probability of surgery, are listed in Table IV. Patients in the first quartile had only a 35% chance of surgery, whereas those in the second quartile had a 62% probability; those in the third quartile, 83%; and those in the fourth quartile, 93%.

Discussion

Patients in our population who had higher self-reported symptom severity scores at initial evaluation were significantly more likely to fail conservative treatment and undergo surgery during the next 2-year period. Therefore, the symptom severity questionnaire is useful not only in evaluating response to therapy but also in *predicting* response to therapy. We know of no other study in which such a questionnaire was used to try to predict response to therapy.

We analyzed many possible confounders to ensure that there were no alternative explanations for our findings. Indeed, with the exception of number of steroid injections received, there were no significant differences between the 2 groups with regard to any of the baseline demographics or clinical characteristics noted in Tables I and II. We believe that we addressed the most likely potential confounders, but there may be other, unknown ones.

One potential limitation of this study is the method of CTS diagnosis. For the majority of patients, the diagnosis was made without an EMG—consistent with the general approach to CTS at our institution. Although we do not believe that obtaining an EMG for all patients would significantly alter the results, future studies could address this issue.

It is unfortunate that 13 patients were lost to follow-up, but the sensitivity analysis still yielded a highly significant difference between the symptom severity scores of the 2 groups, whether the patients lost to follow-up were included in the surgery group or in the no-surgery group. These results support the conclusion that loss to follow-up is not an issue in this study.

Our study results suggest that symptom severity scores at initial evaluation may be of use in treatment planning. For example, patients in the top quartile of symptom severity scores, which corresponded to scores higher than 3.5, had a 93% probability of surgery. Such a finding could suggest to the physician that conservative treatment is not likely to be of benefit for such a patient. In this study, however, we did not evaluate surgical results. Before early surgical intervention is recommended for patients with high symptom severity scores, a study comparing outcomes should be performed—perhaps a randomized trial of early surgery versus nonsurgical treatment in patients whose initial symptom severity score is higher than 3.5 or in patients whose score falls in the top quartile of the total population.

Our study results show that patients with higher symptom severity scores at initial evaluation are more likely to undergo CTR. Although this finding may be useful in clinical decision making, further study is needed to outline definitive recommendations for treatment.

Author's Disclosure Statement and Acknowledgement

The authors report no actual or potential conflict of interest in relation to this article.

References

1. Gelberman RH, Aronson D, Weissman MH. Carpal tunnel syndrome: results of a prospective trial of steroid injection and splinting. *J Bone Joint Surg Am.* 1980;62:1181-1184.
2. Wintman BI, Winters SC, Gelberman RH, Katz JN. Carpal tunnel release. Correlations with preoperative symptomatology. *Clin Orthop.* 1996;326:135-145.
3. Amadio PC. Outcomes measurements. *J Bone Joint Surg Am.* 1993;75:1583-1584.
4. Levine DW, Simmons BP, Koris MJ, et al. A self-administered questionnaire for the assessment of severity of symptoms and functional status in carpal tunnel syndrome. *J Bone Joint Surg Am.* 1993;75:1585-1592.
5. Katz JN, Gelberman RH, Wright EA, Lew RA, Liang MH. Responsiveness of self-reported and objective measures of disease severity in carpal tunnel syndrome. *Med Care.* 1994;32:1127-1133.
6. Katz JN, Punnett L, Simmons BP, Fossel AH, Mooney N, Keller RB. Workers' compensation recipients with carpal tunnel syndrome: the validity of self-reported health measures. *Am J Public Health.* 1996;86:52-56.