

Clinical Research

# General Anxiety Is Associated with Problematic Initial Recovery After Carpal Tunnel Release

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## Abstract

**Background** Carpal tunnel release can stop the progression of idiopathic median neuropathy at the wrist (carpal tunnel syndrome). Intermittent symptoms tend to resolve after surgery, but loss of sensibility can be permanent. Both pathophysiology (severe neuropathy) and mental health (symptoms of despair or worry) contribute to problematic recovery after carpal tunnel release, but their relative associations are unclear.

**Question/purpose** Is problematic initial recovery after carpal tunnel release associated with psychologic distress rather than with disease severity?

**Methods** We retrospectively studied 156 patients who underwent in-office carpal tunnel release between November 2017 and February 2020, and we recorded their symptoms of anxiety (Generalized Anxiety Disorder-7 [GAD]) and depression (Patient Health Questionnaire), signs of severe median neuropathy (loss of sensibility, thenar muscle atrophy, and palmar abduction weakness), and problematic

recovery. The initial recovery (first 2 weeks) was categorized as problematic if the patient was upset about persistent numbness, experienced unsettling postoperative pain, developed hand stiffness, or experienced wound issues—all of which are routinely recorded in the medical record by the treating surgeon along with signs of severe median neuropathy. Twenty-four percent (38 of 156) of patients had a problematic initial recovery characterized by distress regarding persistent numbness (16% [25 of 156]), unsettling pain (8% [12 of 156]), hand stiffness (5% [8 of 156]), or wound issues (1% [2 of 156]); 6% (9 of 156) of patients had more than one issue. Associations between problematic initial recovery and age, gender, symptoms of anxiety and depression, disease severity, specific exam findings, and insurance were evaluated using t-tests, Mann-Whitney tests, and chi-square tests, with the plan to perform logistic regression if at least two variables had an association with  $p < 0.10$ .

**Results** The only factor associated with problematic initial recovery was greater symptoms of anxiety (median GAD score 1.5 [interquartile range 0 to 7.8] for problematic initial recovery compared with a median score of 0 [IQR 0 to 2] for nonproblematic recovery;  $p = 0.04$ ), so we did not perform a logistic regression. Physical examination findings consistent with severe median neuropathy were not associated with problematic initial recovery.


**Conclusion** The finding that problematic initial recovery after carpal tunnel release was related to symptoms of anxiety and not to the severity of median neuropathy highlights the need to study the ability of efforts to ameliorate anxiety symptoms before carpal tunnel release as an effective intervention to reduce unplanned visits and additional tests, therapy, and repeat surgery, while improving patient-reported outcomes and experience.

**Level of Evidence** Level III, therapeutic study.

Each author certifies that there are no funding or commercial associations (consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article related to the author or any immediate family members.

All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research*® editors and board members are on file with the publication and can be viewed on request. Ethical approval for this study was obtained from the University of Texas at Austin, Austin, TX, USA (number 2020-02-0155).

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**Introduction**

Idiopathic median neuropathy at the wrist (the symptoms and signs of which are referred to as carpal tunnel syndrome) is the most common idiopathic mononeuropathy of the upper extremity [15]. Carpal tunnel release (CTR) relieves intermittent symptoms and halts or prevents nerve damage. For the most part, people feel better after CTR and are thankful for more restful sleep and resolution of intermittent numbness. Problematic early recovery can take the form of disappointment that loss of sensibility is still present or perhaps that paresthesia has developed among people with severe median neuropathy [16]. Other forms of problematic initial recovery include unsettling pain intensity or duration, hand stiffness, and adverse events such as wound separation or infection. Prior studies identified that signs of severe neuropathy (loss of sensibility, thenar atrophy) and symptoms of depression and anxiety correlate with greater persistent symptoms and lower levels of satisfaction after surgery [8, 9, 13]. Patients with widespread pain or involvement in litigation may also be more likely to be dissatisfied after surgery [22]. Catastrophic thinking, symptoms of depression, and diminished sensibility on physical examination correlate with activity intolerance after CTR [13].

It would be helpful to discern the relative contribution of disease severity and symptoms of worry or despair to problematic recovery. Problematic recovery can lead to unplanned care, referrals to other specialists, new medications, and even repeat CTR. Disease severity cannot be modified, but symptoms of distress (depression and anxiety) are responsive to treatment [10, 11, 19]. If symptoms of distress have a relatively strong association with problematic recovery compared with disease severity, that might lead to new treatment strategies that prioritize diagnosis and treatment of distress before surgery. In our practice setting, patients complete measures of symptoms of depression and anxiety each time they come to the office. This creates an opportunity to investigate the relative influence of mental health on recovery from surgery.

Therefore, we asked: Is problematic recovery after carpal tunnel release associated with psychologic distress rather than with disease severity?

**Patients and Methods**

*Study Design and Setting*

This is a retrospective cohort study consisting of a review of the records of patients who underwent office-based open CTR under local anesthesia by a single surgeon in a university-associated, urban practice between November 2017 and February 2020.

*Participants*

All patients who underwent open, in-office CTR at our institution during the study period were eligible for inclusion. Minimum follow-up for study inclusion was 2 weeks. We excluded 3% (4 of 160) of patients who did not return for suture removal or at any subsequent time. One hundred fifty-six patients met the inclusion criteria (Fig. 1).

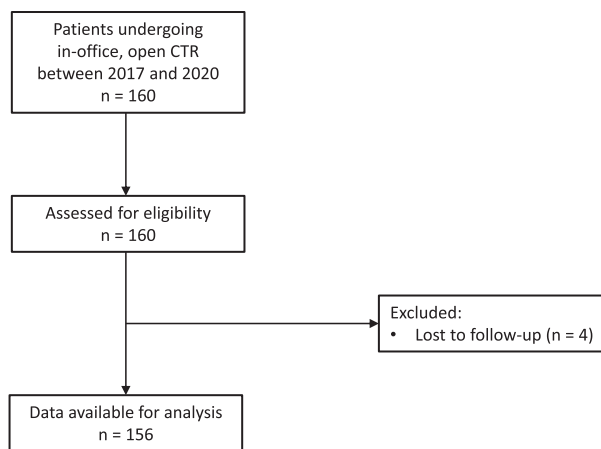
*Patient Demographics and Descriptive Data*

In our sample, 26% (41 of 156) of patients were men and 74% (115 of 156) were women, with a mean age of 51 ± 11 years (Table 1). Eighty-one percent (126 of 156) of our study population had either county safety net insurance or no insurance coverage (Table 1).

*Variables and Data Sources*

Patients who had carpal tunnel release were diagnosed with moderate or idiopathic median neuropathy at the carpal tunnel based on persistent waking with hand numbness despite wrist immobilization or loss of sensibility, respectively. Electrodiagnostic tests were occasionally ordered prior to referral and uncommonly obtained by us.

We recorded demographic information (age, gender, and insurance status), patient-reported outcomes (Patient-reported Outcome Measure Information System Global Health), and mental health questionnaires (the Patient Health Questionnaire [PHQ] and Generalized Anxiety Disorder [GAD] questionnaire), which are collected regularly at our office for both Spanish and English speakers. Per our office protocol, patients first completed the PHQ-2, a two-item measure of symptoms of depression in the past 2 weeks. Scores range from 0 to 6. Scores of 3 or



**Fig. 1** STROBE diagram of patient flow.

**Table 1.** Demographics

Parameter	Value (n = 156)
Age in years	51 ± 11
Preoperative PROMIS	29 ± 7
Global Health score	
PHQ	1 (0-3)
GAD	1 (0-2)
Women	74 (115)
EMG before visit	25 (39)
PE finding of severe CTS	42 (65)
Static numbness	35 (54)
Weakness	14 (22)
Atrophy	11 (17)
Dissatisfied	24 (38)
Insurance	
Safety net or none	81 (126)
Commercial or Medicare	19 (30)
PHQ > 2	26 (41)
GAD > 2	21 (33)
PHQ > 2 or GAD > 2	35 (54)

Data presented as mean ± SD, median (range), or % (n); PROMIS = Patient-reported Outcome Measure Information System; PHQ = Patient Health Questionnaire; GAD = Generalized Anxiety Disorder questionnaire; PE = physical examination; CTS = carpal tunnel syndrome.

greater prompt administration of the nine-item version (PHQ-9). Scores for the PHQ-9 range from 0 to 27. The GAD-7 is a seven-item measure of symptoms of anxiety in the past 2 weeks. The total score ranges from 0 to 21 [4]. Twenty-six percent (41 of 156) of patients had a PHQ score greater than 2, and 21% (33 of 156) scored more than 2 on the GAD questionnaire. Thirty-five percent (54 of 156) of our sample had either a PHQ or GAD score greater than 2 preoperatively. The mean preoperative PHQ and GAD scores were 1.6 and 2.9, respectively (Table 1).

We reviewed patient records for symptoms or signs of severe idiopathic median neuropathy at the carpal tunnel, including loss of sensibility in the median nerve distribution, thenar muscle atrophy, and palmar abduction weakness, all of which are routinely recorded by the treating surgeon. Forty-two percent (65 of 156) of patients had evidence of severe median neuropathy on physical examination. Eighty-three percent (54 of 65) of patients had diminished sensibility, 34% (22 of 65) had palmar abduction weakness, and 26% (17 of 65) had thenar muscle atrophy on examination. Only 25% (39 of 156) of patients had a prior electrodiagnostic study at the time of surgery. Fifty-one percent (20 of 39) of patients with electrodiagnostic tests had findings of moderate or severe carpal tunnel syndrome.

We categorized any one of the following as a problematic initial recovery and coded it as a dichotomous variable (yes/no) for analysis: upset about residual numbness or paresthesia, unsettling postoperative pain, hand stiffness, and wound problems (separation, suture infection)—all of which are routinely recorded by the treating surgeon. We erred toward categorizing the initial recovery as problematic because the typical initial result after CTR is a relatively easy recovery, and there is notable patient gratitude for relief of intermittent numbness. If a person presented to suture follow-up with no aspects of a problematic initial recovery, we considered it highly unlikely that they would develop a problematic recovery later. Eleven percent (17 of 156) underwent bilateral CTR on the same day. We treated this as one episode and included any problems with recovery on either side.

### Bias

There is some selection bias in this sample in the sense that strict clinical criteria were used as the basis to offer surgery, surgery was only offered to people with symptoms and signs consistent with moderate or severe median neuropathy, routine electrodiagnostic testing was not used, the patient population is relatively disadvantaged, and people with notable symptoms of anxiety and depression were evaluated and treated by our social worker before scheduling surgery. The assumption that the absence of aspects of problematic initial recovery 2 weeks after surgery (at suture removal) indicates that the first 6 months of recovery will be non-problematic seems reasonable to us, but it might be open to question. The assessments of disease severity (diminished sensibility, atrophy, and palmar abduction weakness) were performed by a single surgeon. Documentation of unsettling symptoms and hand stiffness is also based on surgeon assessment, with routine documentation, and being relatively inclusive of even mild levels of unsettlement.

### Primary Study Outcome

The primary outcome was categorization of the initial recovery as problematic. Twenty-four percent (38 of 156) of our sample experienced problematic initial recovery (Table 1). Reasons for problematic recovery included persistent or new nerve symptoms (66% [25 of 38]), unsettling postoperative pain (32% [12 of 38]), hand stiffness or kinesiphobia (21% [8 of 38]), or wound issues (5% [2 of 38]). A total of 24% (9 of 38) of patients had multiple concerns postoperatively. Eleven percent (4 of 38) of patients were concerned about both persistent nerve symptoms and unsettling postoperative pain. Eight percent (3 of 38) of patients experienced persistent numbness combined with

**Table 2.** Bivariate analysis

Variable	Problematic initial recovery			p value
	Yes (n = 38)	No (n = 118)	Mean difference or risk ratio (95% CI)	
Age in years	52 ± 10	50 ± 11	2 (-5.4 to 2.1)	0.37
Preoperative PROMIS Global Health	27 ± 11	30 ± 7	3 (-0.3 to 5.0)	0.08
Gender			1.5 (0.57 to 4.1)	0.50
Men	21 (8)	28 (33)		
Women	79 (30)	72 (85)		
Electrodiagnostic test	21 (8)	26 (31)	0.75 (0.27 to 1.9)	0.66
Exam finding of severe median neuropathy	50 (19)	39 (46)	1.6 (0.7 to 3.5)	0.30
Diminished sensibility	45 (17)	31 (37)	1.8 (0.78 to 4.0)	0.20
Palmar abduction weakness	18 (7)	13 (15)	1.5 (0.5 to 4.5)	0.55
Thenar muscle atrophy	8 (3)	12 (14)	0.6 (0.1 to 2.5)	0.68
Insurance			1.1 (0.4 to 3.2)	
Safety net or none	82 (31)	80 (94)		> 0.99
Commercial or Medicare	18 (7)	19 (23)		
PHQ total	2 (0-4)	1 (0-2)		0.88
GAD total	1.5 (0-7.8)	0 (0-2)		0.04
PHQ > 2	39 (15)	22 (26)	2.3 (1.0 to 5.4)	0.056
GAD > 2	29 (11)	19 (22)	1.8 (0.7 to 4.4)	0.20
PHQ > 2 or GAD > 2	47 (18)	22 (26)	2.1 (0.9 to 4.9)	0.07

A recovery was categorized as problematic if the patient was upset about persistent numbness, experienced unsettling postoperative pain, developed hand stiffness, or experienced wound issues. Continuous variables are presented as mean ± SD or median (interquartile range). Discrete variables are presented as % (n); PROMIS = Patient-reported Outcome Measure Information System; PHQ = Patient Health Questionnaire; GAD = Generalized Anxiety Disorder questionnaire.

unsettling pain and hand stiffness. Three percent (1 of 38) of patients experienced hand stiffness and unsettling persistent pain. Additionally, one patient had concerns about the surgical incision as well as unsettling postoperative pain.

and identify factors associated with dissatisfaction. Given that only variations of the GAD and PHQ questionnaire scores had  $p < 0.10$ , we did not perform logistic regression because we felt these are likely collinear (Table 2).

*Ethical Approval*

This study was reviewed and approved by our institutional review board.

*Statistical Analysis*

All demographic data, other than age, were dichotomized (Table 1). Insurance type was grouped as either commercial or Medicare, or county safety net, Medicaid, or no insurance coverage. We used chi-square tests to assess the relationships between dichotomous variables. Student t-tests were used to assess any association between dichotomous and continuous, normally distributed variables. Mann-Whitney U tests were used to analyze differences between dichotomous and non-parametric continuous data. We planned to use a multivariable logistic regression model including all factors with  $p < 0.10$  in bivariate analysis to adjust for potential confounders

**Results**

Problematic initial recovery was associated with worse general anxiety (median GAD score of 1.5 [interquartile range 0 to 7.8] versus median GAD score of 0 [0 to 2];  $p = 0.04$ ). However, problematic initial recovery was not associated with physical examination findings of severe carpal tunnel syndrome (50% [19 of 38] versus 39% [46 of 118];  $p = 0.30$ ). When evaluating specific signs of severe carpal tunnel syndrome including loss of sensibility, thenar muscle atrophy, and palmar abduction weakness, none were associated with problematic initial recovery (Table 2).

**Discussion**

Previous studies have associated dissatisfaction and continued symptoms after carpal tunnel release to both

symptoms of distress and severe pathology [8, 9, 13]. The relative association of problematic initial recovery after CTR with distress and pathology is uncertain. In a cohort of patients with a relatively high proportion of severe median neuropathy and notable symptoms of anxiety and depression, where signs of severe median neuropathy and problematic initial recovery were routinely recorded, we found that problematic recovery after surgery was associated with greater symptoms of anxiety and not with symptoms and signs consistent with severe median neuropathy at the carpal tunnel.

### Limitations

Our study has several limitations. First, the cohort represents a single surgeon's management strategy. That strategy included the diagnosis of idiopathic median neuropathy at the carpal tunnel without routine neurodiagnostic testing and an offer of surgery to patients suspected of having moderate or severe median neuropathy. We also relied on that surgeon's determination and documentation of signs of severe median neuropathy and problematic recovery in the medical record. The advantage is consistency, but the possibility that the findings are specific to this surgeon's practice style and determinations of disease severity and problematic initial recovery merit consideration. We contend that these determinations are likely subject to some variations between surgeons but are relatively representative. In addition, the diversity within the sample is what makes the experiment work rather than the absolute rates, with any similarly diverse sample likely to find similar associations. Although a large study would have advantages, our numbers were large enough to discern statistical differences. The setting and statistical power to detect large differences give us confidence that longitudinal studies and larger studies are likely to have similar findings. Second, we did not measure satisfaction because it is a relatively ambiguous concept—several editorials have detailed the many limitations [6, 14, 17, 20]—and attempts to quantify satisfaction are associated with high ceiling effects [2, 12, 21]. Our use of recovery sufficiently problematic to be recorded in the medical record may be a better reflection of what might be considered as dissatisfaction in daily practice. Third, our high 42% proportion of severe median neuropathy is evidence that people with more limited access to medical care (80% of our cohort) are at risk of nerve damage because of delayed treatment. This is a good setting for studying problematic recovery, but it is also a problem in need of remedy. Socioeconomic status correlates with health outcomes, disease severity, and mortality [5, 24]. Lastly, we used diminished sensibility, weakness of palmar abduction, and atrophy of the thenar eminence as signs of severe carpal tunnel syndrome rather than electrodiagnostic studies, which are more objective, reliable, and accurate. Because many hand specialists

forgo electrodiagnostic testing and rely on symptoms and signs [7], our study represents this common practice strategy. Given that there is debate about the best way to diagnose idiopathic median neuropathy at the carpal tunnel and rate its severity, it seems reasonable to use clinical criteria (essentially the CTS 6 clinical prediction rule) to make the diagnosis [7].

### Discussion of Key Findings

The finding that symptoms of anxiety are associated with problematic initial recovery from CTR and signs of severe disease do not point to a potential benefit of diagnosing and treating notable symptoms of anxiety before surgery. Potential benefits of this approach include fewer unplanned visits, referrals to other clinicians, new medications, and revision surgeries. A large percentage of our patients had notable symptoms of anxiety or depression (35% had a score of 3 or greater on the GAD or PHQ)—an indication of that a more comprehensive approach might benefit a large percentage of patients. A large percentage (42%) of our patients had signs of severe median neuropathy, but pathology severity was not associated with problematic recovery. Persistent symptoms are often the focus of unsettlement (66% [25 of 38] of patients with problematic recovery), but having severe disease was not independently associated with problematic recovery. There is a growing understanding that the biopsychosocial paradigm of health that incorporates the physical, mental, and social aspects of well-being accounts for variations in symptoms and activities better than a biomedical model that attempts to relate all symptoms directly to pathologic findings [25]. Our findings support prior studies in which dissatisfaction and less relief of symptoms after CTR correlated with symptoms of distress [9, 13]. There is evidence that unexpected pain, incapability, and stiffness are associated with unhelpful thoughts and symptoms of distress [1, 3, 18, 23].

### Conclusion

The observation that nearly one in four patients had a problematic initial recovery is notable and provides strong support for interdisciplinary care incorporating attention to mental and social health opportunities. Routine evaluation of thoughts and feelings about symptoms and treatment strategies that aim to optimize them before surgery and during recovery merit additional attention and study.

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