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Original Research

The Effects of Patient Resilience and Catastrophizing on Carpal Tunnel Surgical Outcomes



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Purpose: Outcomes following carpal tunnel release (CTR) are generally favorable. When patient satisfaction or symptom resolution is not as expected, understanding what factors contribute to that outcome could allow for strategies targeted at improving results. Our purpose was to determine if measurable mental health factors, specifically resilience and pain catastrophization, correlate with patients' post-operative outcomes following CTR.

Methods: A prospective cohort study was performed. Ninety-four patients were recruited to take part in the study. Patients completed written consent, the Boston Carpal Tunnel Questionnaire (BCTQ), the Pain Catastrophizing Scale, and the Brief Resilience Scale. A single surgeon, or his resident under supervision, performed an open CTR under local anesthetic. Our primary outcome measure was a repeat BCTQ at 6 months. Pearson correlation coefficients and univariate analyses were performed to assess the correlation between Pain Catastrophizing Scale and Brief Resilience Scale scores and final BCTQ scores.

Results: Forty-three and 63 participants completed the BCTQ at 3 and 6 months, respectively. This was 10% below the number needed to achieve appropriate power. Among those that responded, all participants showed improvement in their symptoms ($P = .001$). There was no correlation between patients' Pain Catastrophizing Scale or Brief Resilience Scale scores and 6-month BCTQ scores or the amount of improvement in the BCTQ at final follow-up.

Conclusions: Most participants improved following CTR. Patients' self-assessed resilience, and the degree of pain catastrophization did not correlate with the amount of improvement patients had after surgery.

Type of study/level of evidence: Prognostic II.

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Carpal tunnel syndrome (CTS) is a common cause of upper extremity disability, with an average incidence of 103 per 100,000 people per year in Canada and even higher incidences in some occupations.^{1,2} Carpal tunnel release (CTR) has become the most commonly performed surgical procedure in the hand.³ Outcomes

following CTR surgery are generally favorable, with 70%–90% of patients having good to excellent outcomes; however, some patients have poor outcomes and higher postsurgical pain despite a perceived technical success by the surgeon.^{4,5} Poor results may be because of iatrogenic injury, incomplete release, alternate diagnosis, concomitant injury with overlapping symptoms, and modifiable or nonmodifiable patient factors. Given the prevalence of this procedure, an understanding of factors that may predict poor results is valuable.

Recently, researchers and practitioners have increasingly recognized mental health traits as correlating with pain-related postsurgical outcomes. Two factors that have been shown to play an important role in how patients experience and recover from a

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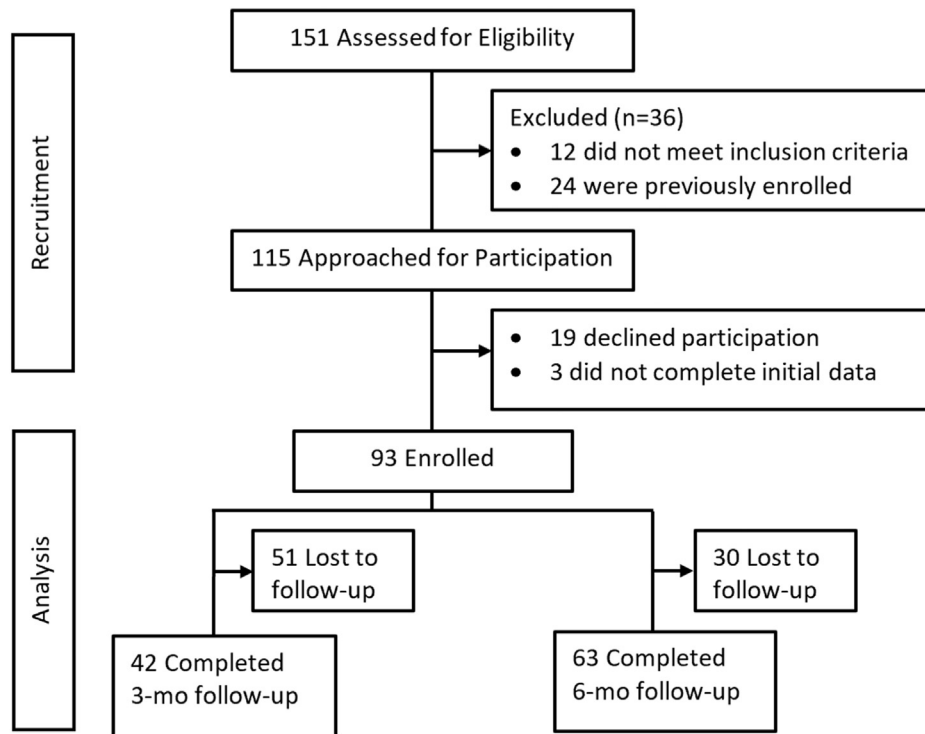


Figure 1. Participant recruitment and follow-up.

condition are resilience and pain catastrophization. Resilience is the ability to bounce back or recover after stress, and has also been shown to affect outcomes following total shoulder arthroplasty.^{6,7} Catastrophization is a maladaptive coping strategy involving an exaggerated response to anticipated or actual pain.^{8,9} It is a multidimensional concept composed of rumination, magnification, and helplessness, and has been shown to negatively impact outcomes following surgery for multiple conditions.^{8–11}

The purpose of this study was to determine if patients underlying mental health factors, specifically resilience and pain catastrophization, correlate with postoperative outcomes following CTR surgery. We hypothesized that patients with lower resilience or greater catastrophizing tendencies would have worse outcomes following CTR surgery.

Materials and Methods

Study design

Institutional Review Board approval was obtained. Given the continuous nature of our outcome measure, a prospective cohort design was used, following CONSOLIDATED Standards of Reporting Trials guidelines. We included men and women aged 18 years and older diagnosed with CTS and scheduled for CTR surgery. A diagnosis of CTS was made based on clinical findings, with electrodiagnostic tests used adjunctively but not required to establish the diagnosis. All patients who had undergone an unsuccessful trial of nonsurgical management (nighttime orthosis for 3 or more months) and who were subsequently scheduled for a CTR were eligible, regardless of CTS severity. Excluded were patients unable to provide informed consent for participation because of a language or cognitive barrier, those unable to complete the required questionnaires in English, and those with known concomitant ipsilateral hand pathology requiring ongoing treatment. Further, participants with bilateral CTS were only enrolled for 1 side. The first extremity

to undergo CTR was included, and they were not enrolled a second time when they underwent CTR on the contralateral side.

A power analysis was performed to guide the number of participants required for enrollment. This was based on the minimal clinically important difference of the Boston Carpal Tunnel Questionnaire (BCTQ).¹² Our primary outcome was to assess change in the BCTQ score from preoperative levels compared to 6-month postoperative levels and to determine whether this correlated with either resilience scores or pain catastrophizing scores as continuous variables. This analysis indicated that 70 participants would be required to detect a meaningful difference in postoperative BCTQ scores. We, therefore, aimed to enroll 90 participants to account for a 20% loss to follow-up rate.

Figure 1 illustrates participant recruitment and follow-up through the study. A total of 151 consecutive patients were assessed for enrollment. Inclusion and exclusion criteria were applied, and 36 were excluded, leaving 115 patients who were approached to participate in the study on the day of surgery by a research assistant not involved in the patients' medical care. Ninety-three patients were enrolled in the study, which exceeded our minimum enrollment based on our power analysis. Informed consent for study participation was obtained from all enrolled patients, and demographic information and standardized questionnaires were then completed. The BCTQ, composed of the Symptom Severity Scale (SSS) and Functional Status Scale (FSS), was used to assess the severity of symptoms prior to CTR and outcomes following CTR. BCTQ scores 6 months after surgery represented our primary outcome measure. The Brief Resilience Scale (BRS) and Pain Catastrophizing Scale (PCS) were used to assess the patients' self-assessed resilience and tendency to catastrophize. These were administered after participants were enrolled in the study but prior to undergoing CTR. The BRS is a tool created by Smith et al⁵ consisting of 6 questions with an equal number of positively and negatively worded items to reduce the effects of social desirability

Table 1
Participant Demographic Information

Demographic	Study Sample N = 94	
	n (%)	
Sex		
Male	48	(50.5)
Handed		
Left	14	(14.7)
Surgical side		
Left	43	(45.3)
Marital status		
Single	10	(10.5)
Married	76	(80.0)
Divorced	6	(6.3)
Widowed	3	(3.2)
Employment		
Employed	55	(58.5)
Unemployed	32	(34.0)
Disability	7	(7.5)
Diabetes	27	(28.4)
Smoking	15	(15.8)
Mean age (y)	57 ± 14	
Mean body mass index	32 ± 10	

and positive response bias. It is a reliable means of assessing resilience in patients of all ages and those with chronic diseases.⁶ The PCS consists of 13 statements covering each of the 3 components of catastrophizing; rumination, magnification, and helplessness. Participants are asked to indicate to what degree they experience each of the 13 thoughts or feelings on a 5-point scale from 0 (not at all) to 4 (all the time).⁸

Participants then underwent the scheduled open CTR under local anesthetic with epinephrine and without using a tourniquet in a minor procedures room. A 2–3 cm longitudinal incision was made at the base of the palm between the thenar and hypothear eminences. The transverse carpal ligament was divided in line with the incision, and the complete release of the nerve was visually confirmed. All procedures were completed by a single fellowship-trained upper-extremity hand surgeon or his resident under direct supervision.

All participants underwent routine follow-up. Participants were separately contacted by email and/or phone at 3 and 6 months after surgery by a study team member not involved in the patients' medical care. Patients were asked to repeat the BCTQ at these intervals. Patients who could not be reached by either means were sent a letter by standard mail requesting they complete the survey and return it in the enclosed envelope. As seen in Figure 1, 42 patients responded at 3-months, and 63 responded at 6 months, with 28 responding at both 3 and 6 months. Responses were accepted up to 5 weeks after the prescribed time frame. Responses were not shared with the treating surgeon.

Statistical analysis

Our primary outcome was to assess whether final (6-month) BCTQ scores or the amount of change (change from the initial score to 6-month score) in BCTQ scores correlated with PCS scores or BRS scores. This was assessed with Pearson correlation coefficients and univariate linear models. Several secondary outcomes were also assessed by univariate analysis, including patient demographics and BRS and PCS scores as categorical variables. Although there has been no evaluation of population or disease-specific norms for the BRS, we elected to subdivide participants in the same way as previously described by Tokish et al⁷ to evaluate participants with low resilience specifically. Based on the aforementioned work, participants were classified as having low resilience (LR) if they scored

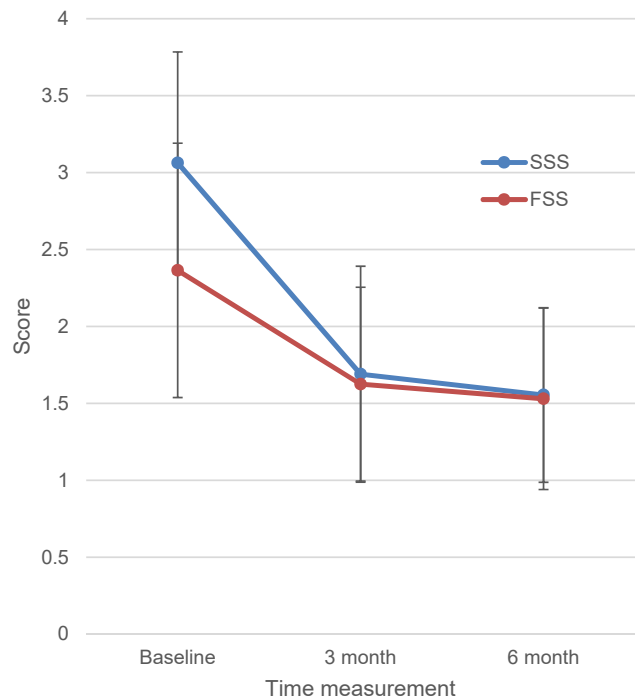


Figure 2. Change in BCTQ over time.

greater than 1 SD below the mean, normal resilience if they scored within 1 SD of the mean, and high resilience if they scored greater than 1 SD above the mean. Similarly, PCS scores were used to divide participants into those with a tendency toward catastrophization (CAT) (score >24) and those without a tendency to catastrophize (score <15), with participants scoring between 15 and 24 classified as indeterminate.⁸ This allowed an assessment of those classified as having a tendency toward catastrophizing. Lastly, we also evaluated whether there was any overlap between LR and those categorized as CAT using cross-tabulation.

Results

Of the 93 enrolled participants, 42 completed questionnaires at 3 months and 63 at 6 months, with 32 completing questionnaires at both time points (Fig. 1). Demographic data are listed in Table 1. No significant correlation between demographic data and BCTQ scores was identified. The mean BRS score was 3.6 ± 0.7 (1.5–5.0), and the mean PCS score was 11.6 ± 9.7 (3.0–17.5). Of those completing the final follow-up, 2 complications were identified (3%) during the study period, both of which were infections treated with antibiotics. Long-term complications beyond 6 months were not recorded.

A paired *t* test was performed comparing baseline BCTQ scores (FSS and SSS) with those at 3- and 6-month follow-up. Statistically significant improvements were seen between baseline and follow-up scores at both time points ($P < .0001$), indicating participants' symptoms improved following CTR. This was an expected outcome, illustrated in Figure 2. Because of a high loss to follow-up rate at the 3-month mark, we were unable to evaluate if significant improvements in the BCTQ occurred between the 3- and 6-month intervals.

We elected to use only BCTQ scores from 6-month follow-up in our primary assessment, given our loss to follow-up rate at 3-month assessment. The Pearson correlation coefficient for 6-month SSS and FSS scores with BRS and PCS scores showed no

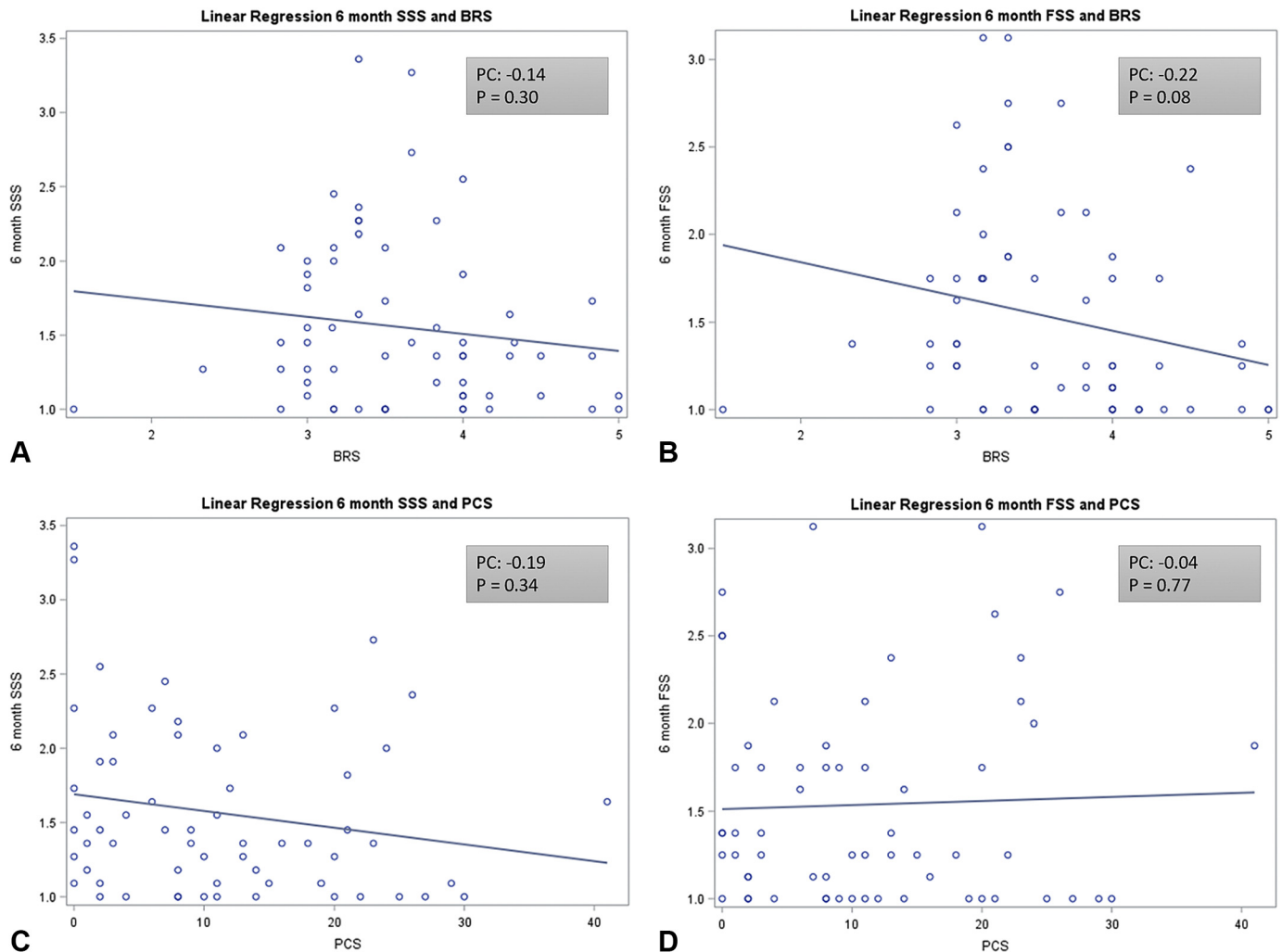


Figure 3. A–D Univariate general linear regression models for 6-month BCTQ scores with BRS and PCS scores. Pearson correlation coefficients for each assessment and respective *P* values for the linear model are displayed. PC, Pearson correlation coefficient.

meaningful correlation, and the univariate linear regressions indicated no statistically significant linear relationships. Further, no significant trends toward a correlation were identified. This result is shown in Figure 3. Similarly, no meaningful correlations or linear relationships between the change in SSS and FSS scores from baseline to 6-month follow-up and BRS and PCS scores were identified (Fig. 4).

A secondary analysis of BRS subgroups showed 9 participants categorized as LR (score < 2.95), 70 as normal resilience (score 2.95–4.27), and 14 as high resilience (score > 4.27). Assessment of demographic factors with respect to resilience showed that those in the LR group were significantly younger (46 vs 58 years, $P = .04$). Average BCTQ scores according to resilience group are shown in Table 2. Catastrophizing tendencies were similarly analyzed, with 62 participants categorized as those without a tendency to catastrophize (score < 15) and 11 as CAT (score > 24). No significant relationship between demographic data and PCS subgroups was identified. Average BCTQ scores according to PCS subgroups are shown in Table 3.

Lastly, a cross-tabulation was performed to assess for overlap between the LR group and those in the CAT group. This analysis showed minimal overlap, with 2 participants being classified as both LR and CAT. This represents 2.1% of the entire cohort and 18% of the LR cohort.

Discussion

Several modifiable and nonmodifiable patient factors have previously been identified as having an impact on outcomes following CTR surgery. Specifically, poor health status, diabetes, smoking, alcohol consumption, educational status, and marital status have all been associated with worse outcomes.^{4,5} The role that mental health factors may have has received less focus. This study evaluated 2 specific mental health factors and their correlation with CTR outcomes. Expectedly, we found that participants significantly improved following CTR surgery. We found no correlation between CTR outcomes and pain catastrophizing as measured by the PCS, nor between CTR

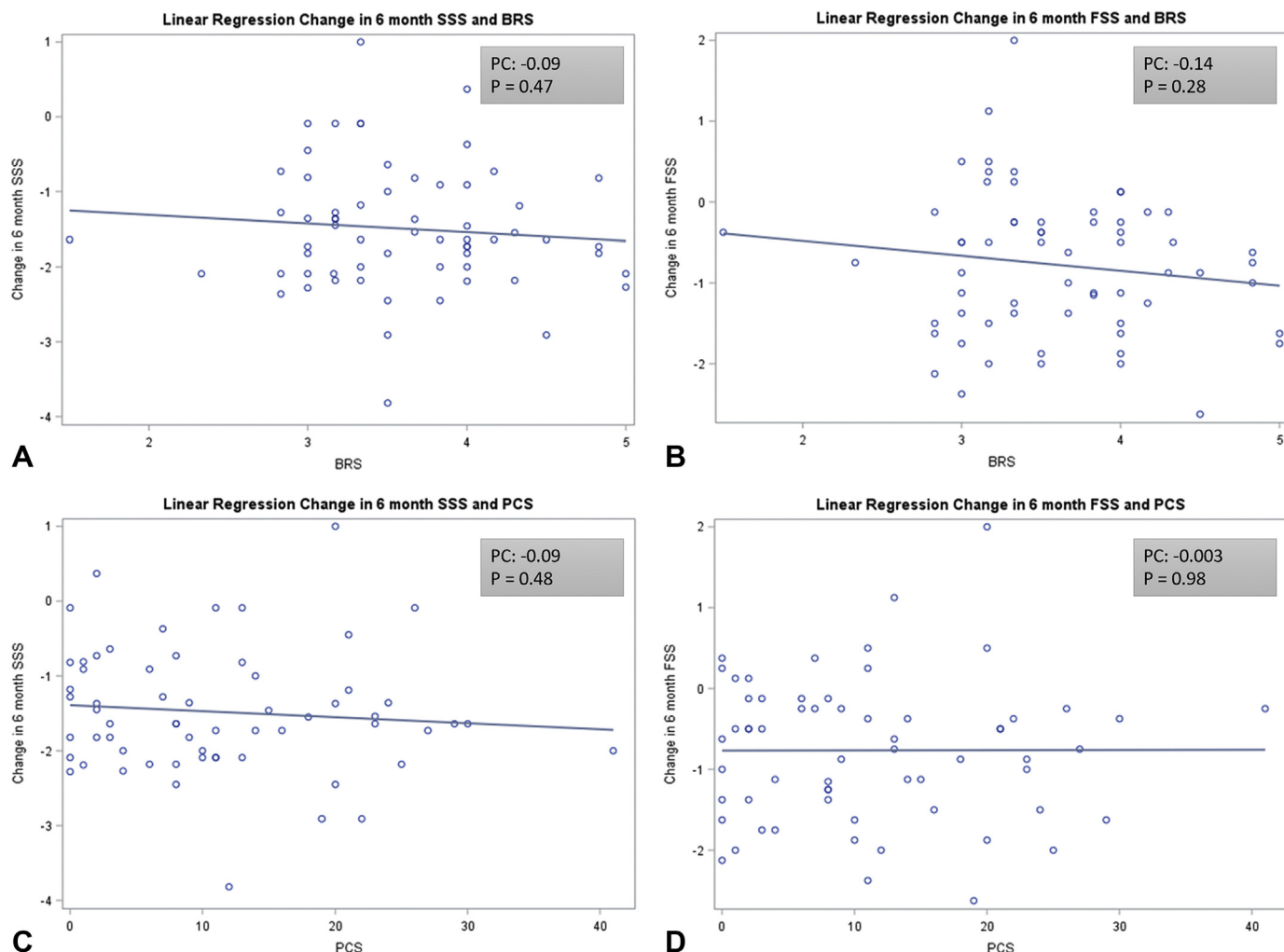


Figure 4. A–D Univariate general linear regression models for improvement in BCTQ scores at 6 months with BRS and PCS scores. Pearson correlation coefficients for each assessment and respective *P* values for the linear model are displayed. PC, Pearson correlation coefficient.

Table 2
BCTQ Scores Over Time According to Resilience

Score Assessed		Low Resilience (n = 9)	Normal Resilience (n = 70)	High Resilience (n = 14)	<i>P</i> Value
Baseline BCTQ	SSS	3.2 (2.7, 3.7)	3.1 (2.9, 3.2)	3.1 (2.7, 3.5)	.8
	FSS	2.5 (1.9, 3.0)	2.3 (2.1, 2.5)	2.4 (2.0, 2.9)	.9
3-mo BCTQ	SSS	1.6 (1.1, 2.2)	1.8 (1.5, 2.0)	1.5 (1.0, 2.0)	.7
	FSS	1.4 (0.9, 1.9)	1.7 (1.4, 1.9)	1.7 (1.2, 2.2)	.5
Δ 3-mo BCTQ	SSS	1.6 (1.0, 2.2)	1.2 (0.9, 1.5)	1.3 (0.7, 2.0)	.5
	FSS	1.1 (0.5, 1.7)	0.4 (0.1, 0.7)	0.3 (–0.3, 0.9)	.09
6-mo BCTQ	SSS	1.4 (0.9, 1.8)	1.6 (1.5, 1.8)	1.3 (1.0, 1.7)	.2
	FSS	1.3 (0.8, 1.8)	1.6 (1.4, 1.8)	1.3 (0.9, 1.7)	.2
Δ 6-mo BCTQ	SSS	1.7 (1.0, 2.4)	1.4 (1.2, 1.6)	1.8 (1.3, 2.3)	.3
	FSS	1.1 (0.4, 1.8)	0.7 (0.4, 0.9)	1.1 (0.5, 1.6)	.3

outcomes and resilience as measured by the BRS. Instead, we found that all participants improved following CTR regardless of these specific mental health factors. We secondarily analyzed participants categorized as LR or CAT and found no significant differences; however, the number of participants in these groups was small and unlikely to have sufficient power to detect a difference if one existed. An evaluation of those in the LR and CAT groups showed minimal overlap, suggesting that these 2 measures are different from one another, representing individual patient factors.

The connection between mental health factors and clinical outcomes has been examined in other areas of orthopedics. Higher scores on the PCS have correlated with worse scores on disease-specific patient-reported outcome tools for rotator cuff tears, spinal stenosis, knee osteoarthritis, and following total knee arthroplasty.^{7,9,11,13,14} On the other hand, resilience has been found to be a positive predictor of functional status at discharge following orthopedic trauma.¹⁵ Interestingly, neither of these factors were correlated with patient outcomes following CTR surgery in this study. It is possible that surgical outcomes following CTR are

Table 3
BCTQ Scores Over Time According to Catastrophization

Score Assessed		Noncatastrophizing (n = 62)	Catastrophizing (n = 11)	P Value
Baseline BCTQ	SSS	3.0 (2.8, 3.2)	3.0 (2.6, 3.4)	.5
	FSS	2.3 (2.1, 2.5)	2.2 (1.8, 2.7)	.2
3-mo BCTQ	SSS	1.8 (1.5, 2.1)	1.5 (0.8, 2.2)	.6
	FSS	1.6 (1.4, 1.9)	1.4 (0.8, 2.1)	.8
Δ 3-mo BCTQ	SSS	1.2 (0.8, 1.5)	1.3 (0.5, 2.1)	.3
	FSS	0.5 (0.2, 0.8)	0.5 (−0.3, 1.3)	.8
6-mo BCTQ	SSS	1.6 (1.4, 1.8)	1.3 (0.9, 1.8)	.6
	FSS	1.5 (1.3, 1.7)	1.4 (1.0, 1.9)	.6
Δ 6-mo BCTQ	SSS	1.5 (1.2, 1.7)	1.6 (0.9, 2.2)	.99
	FSS	0.8 (0.5, 1.0)	0.9 (0.1, 1.6)	.95

consistent enough that resilience and catastrophizing traits are not differentiating factors in the outcome following surgery. This was an unexpected finding in our study, as we had expected similar results to other conditions.

Others have looked at different mental health factors and the role they play in patients with CTS. Study results on the relationship between depression and CTS are mixed. Lozano et al¹⁶ found a limited but significant correlation between depression and decreased patient satisfaction following CTR surgery. A subsequent systematic review concluded that there is a correlation between depression and increased pain following CTR, however, cautioned that pain is not the defining symptom of CTS.¹⁷ Contrastingly, Dateman et al¹⁸ found no difference in surgical outcomes based on preoperative depressive symptoms but did find that patients who had CTR surgery had an improvement in their depression symptoms measured 6 months following surgery.¹⁸ This demonstrates that physical symptoms and mental state may be interconnected. In our study, we were interested in identifying factors that could predict outcomes following CTR surgery and did not evaluate whether surgical outcomes would have an impact on these specific mental health factors. We, therefore, did not repeat the BRS or PCS at any point following CTR surgery but recognize that this may be an exciting area for future research.

An objective of this study was to aid practitioners in identifying which patients may have better or worse outcomes following CTR surgery. Since we began our study, another was published that showed physicians are not good at predicting a patient's degree of catastrophization.¹⁹ It is important to recognize that, despite some patients having factors that might be perceived by surgeons as predictors of a poor outcome (catastrophizing and LR), these patients showed significantly improved outcomes similar to the general population following CTR surgery. Surgeons should therefore be cautious when using subjective judgments to predict patient outcomes, particularly in a surgery that has uniformly good outcomes.

We recognize limitations in this study. We had higher than expected attrition rates despite trying to contact patients by phone, email, and standard mail. This limited our ability to perform meaningful statistical analysis of the 3-month data. Further, we remained below the numbers required by 7 participants at a 6-month follow-up according to our power analysis. This represents an enrollment 10% below our target number. While we did not detect a trend in our statistical analysis indicating that increased enrollment would alter our findings, it is difficult to say whether these remaining 7 participants would have resulted in significant findings. Additionally, it is unclear why we had a higher than anticipated attrition rate and whether a selection bias in those who chose to follow-up impacted our results. We attempted to perform a secondary analysis of PCS and BRS subgroups; however, only a minority of participants were categorized as LR or CAT. Therefore, although we did not find any significant difference between these

groups and the remaining cohort, we lacked sufficient power to detect a difference, if one exists. Further studies with appropriate numbers are needed to assess this appropriately. Lastly, there may be a ceiling effect with respect to the amount of improvement we were able to identify using the BCTQ since most participants had significant improvements following CTR surgery.

Despite these limitations, we believe that this study identifies important findings with respect to catastrophizing and resilience and their relationship to CTR outcomes. Specifically, we found that CTR surgery is highly effective at relieving symptoms and improving the patient's functional status and that a patient's resilience or tendency to catastrophize did not correlate with this. Therefore, we should continue to offer this successful surgery to those who meet diagnostic criteria regardless of these mental health factors.

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