Outcome of Simple Decompression of Primary Cubital Tunnel Syndrome Based on Patient-Reported Outcome Measurements

Nienke H. A. Mendelaar, MD,[*†‡] Caroline A. Hundepool, MD, PhD,[*] Lisa Hoogendam, BSc,[*†‡] Liron S. Duraku, MD, PhD,[‡§] Dominic M. Power, MD,[‖] Erik T. Walbeehm, MD, PhD,[‡¶] Ruud W. Selles, PhD,[*†] J. Michiel Zuidam, MD, PhD,[*] and the Hand-Wrist Study Group[1]

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Disclosures for this Article

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Ryan Calfee, MD, MSc, has no relevant conflicts of interest to disclose.

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Learning Objectives

Upon completion of this CME activity, the reader will understand:

- The expected outcome of ulnar nerve decompression.
- The relationship between various outcome measures and preoperative symptomatology.
- How the outcome after ulnar nerve decompression compares to the outcome after ulnar nerve transposition.

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*From the *Department of Plastic, Reconstructive and Hand Surgery, Erasmus MC - University Medical Centre Rotterdam, The Netherlands; the †Department of Rehabilitation Medicine, Erasmus MC - University Medical Centre Rotterdam, The Netherlands; the ‡Hand and Wrist Centre, Xpert Clinic, The Netherlands; §Department of Plastic, Reconstructive and Hand Surgery, Amsterdam UMC, Amsterdam, The Netherlands; the ‖Birmingham Hand Centre, University Hospitals Birmingham, NHS Foundation Trust; and the ¶Peripheral Nerve Centre, Radboudumc, Nijmegen, the Netherlands.*

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[1]The collaborators of the Hand-Wrist Study Group are: RAM Blomme, MD; BJR Sluijter, MD, PhD; DJJC van der Avoort, MD; A Kroeze, MD; JM Smit, MD, PhD; J Debeij, MD, PhD; ET Walbeehm, MD, PhD; GM van Couwelaar, MD; GM Vermeulen, MD, PhD; JP de Schipper, MD; GJ Halbesma, MD; JFM Temming, MD; JH van Uchelen, MD, PhD; HL de Boer, MD; KP de Haas, MD; K Harmsen, MD; OT Zöphel, MD, PhD; R Feitz, MD, PhD; JS Souer, MD, PhD; R Koch, MD; SER Hovius, MD, PhD; TM Moojen, MD, PhD; X Smit, MD, PhD; WR Bijlsma, MD, PhD; JW Colaris, MD, PhD; CA van Nieuwenhoven, MD, PhD; BEPA van der Heijden, MD, PhD; CA Hundepool, MD, PhD; LS Duraku, MD, PhD; JM Zuidam, MD, PhD; R van Huis, PT, CHT-NL; PY Pennehouat, PT, CHT-NL; K Schoneveld, PT, CHT-NL, MSc; YE van Kooij, PT, CHT-NL, MSc; RM Wouters, PhD, PT, CHT-NL; J Veltkamp, PT, CHT-NL; A Fink, PT, MSc; WA de Ridder, MSc, PT, CHT-NL; HP Slijper, PhD; RW Selles, PhD; JT Porsius, PhD; J Tsehaie MD, PhD; R Poelstra, MD, PhD; MC Jansen, MD, PhD; S Evers, MD, PhD; MJW van der Oest, PhD; L Hoogendam, BSc; JS Teunissen, BSc; JE Koopman, MD; PO Sun, MD; J Dekker, MSc; MHP ter Stege, MSc; R Hagen.

Corresponding author: J. Michiel Zuidam, MD, PhD, Department of Plastic, Reconstructive and Hand Surgery, Erasmus MC - University Medical Centre Rotterdam, Dr. Molewaterplein 50, 3015 GE Rotterdam, the Netherlands; e-mail: j.zuidam@erasmusmc.nl.

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Purpose To evaluate the patient-reported outcome measures of patients with primary cubital tunnel syndrome and to assess whether they are affected by preoperative symptom severity.

Methods Patients who underwent simple decompression for primary cubital tunnel syndrome were selected from a prospectively maintained database. Outcome measurements consisted of the Boston Carpal Tunnel Questionnaire at intake and at 3 and 6 months after surgery. Also, 6 months after surgery, the patients received a question about their satisfaction with the treatment result. To determine a possible influence of preoperative symptom severity on postoperative outcomes, the sample was divided into quartiles based on symptom severity at intake.

Results One hundred and forty-five patients were included in the final analysis. On average, all patients improved on the Boston Carpal Tunnel Questionnaire. The subgroup of patients with the mildest symptoms at intake did not improve significantly on symptom severity but did improve significantly on their functional status. In addition, the patients with the most severe symptoms at intake did improve on both aspects. Moreover, no difference in satisfaction with treatment result between the severity of symptoms at intake was found.

Conclusions The patients with the mildest symptoms at intake may not improve on symptom severity, but they do improve on functional status after simple decompression for cubital tunnel syndrome. In addition, patients with the most severe symptoms at intake do improve on both symptom severity and functional status. Moreover, all patients reported to be equally satisfied with the treatment result, which suggests that satisfaction is not dependent on the symptom severity at intake. Even those patients with both the mildest symptoms before surgery and the least improvement still seem to benefit from simple decompression. *(J Hand Surg Am. 2022;47(3):247–257.*

Type of study/level of evidence Therapeutic IV.

Key words Cubital tunnel syndrome, patient-reported outcome measures, simple decompression, surgery.

CUBITAL TUNNEL SYNDROME (CubTs) is the second most common peripheral neuropathy of the upper extremity with a reported incidence of 30 per 100,000 persons.[1] The severity of the sensory and motor symptoms determines the choice of treatment; the less severe cases often can be treated nonsurgically with anti-inflammatory medication, activity modification, or orthosis fabrication.[2,3] If nonsurgical therapy fails, which is seen in approximately 65% of the cases, surgical treatment may be required.[4] Several surgical techniques have been reported: simple decompression, anterior transposition of the ulnar nerve (subcutaneous, intramuscular, or submuscular), and medial epicondylectomy.[2–5] Previous studies have shown that all techniques can be equally effective, and simple decompression, which is the least invasive technique with the lowest rate of complications, is the preferred method of initial surgical treatment for primary CubTs.[6–10] Moreover, the Dutch guidelines for neuropathy of the ulnar nerve at the elbow state that simple decompression is preferable to anterior transposition and that anterior transposition and medial epicondylectomy are not recommended as routine treatment for CubTs because of the greater morbidity and invasiveness.[11]

Nevertheless, there is a discrepancy in the literature regarding the influence of preoperative symptom severity on the outcome of simple decompression, and it currently is unclear whether patients with severe symptoms improve equally compared with patients with minor symptoms.[12–17] For example, Burns et al[12] showed that there is no influence of symptom severity on the postoperative patient-reported outcome measures (PROMs), whereas Suzuki et al[17] stated that preoperative symptom severity was associated with higher risk of poor recovery and patient satisfaction. Knowing the possible influence of preoperative symptom

severity would help set a realistic goal for patients and physicians.

Therefore, the aim of this study was to investigate the improvement of the Boston Carpal Tunnel Questionnaire (BCTQ) scores in a cohort of patients undergoing simple decompression 6 months after surgery. Second, we explored the relationship among symptom severity at intake determined by the BCTQ, postoperative BCTQ outcomes, and satisfaction with treatment result to assess possible differences between patients who have different degrees of disease burden at intake. Finally, we explored by subgroup analyses whether concomitant surgery affected outcomes.

MATERIALS AND METHODS

Patients

Patients undergoing simple decompression for primary CubTs between December 2011 and February 2020 were included. The diagnosis of CubTs was based on clinical presentation with or without electrodiagnostic tests, which were performed in some cases to confirm the diagnosis. According to the Dutch guidelines for neuropathy of the ulnar nerve at the elbow, patients with mild-to-moderate complaints are first treated nonsurgically. Patients with mild complaints have subjective sensory symptoms without objective loss of sensibility or muscular atrophy, whereas patients with moderate complaints have objective weakness without muscle atrophy. If complaints persist, surgical treatment is recommended.[11] The patients were selected from a database with outcome data from a consortium of 18 hand surgery practice sites in the Netherlands. This database is designed for clinical and research purposes and contains routine outcome measurements.[18] The patients who did not complete the required questionnaires at intake and at 3 and 6 months after surgery were excluded. In addition, patients undergoing any other surgery on either hand 6 months after simple decompression were also excluded to prevent interference in the PROM scores, for example, due to postsurgical pain.

Patient demographics were recorded from the database, including age, sex, occupational status, diabetes, and any previous nerve surgery on either upper extremity. Patient records were reviewed to obtain information on complications, reoperations within 1 year following primary surgery, and whether a concomitant surgery was performed in the same session (eg, carpal tunnel release or trigger finger release).

The local institutional review board approved the study, and all patients provided written informed consent.

Surgical treatment

The simple decompression surgical technique consists of a 3 to 6−cm incision posterior to the medial epicondyle, preserving the medial antebrachial cutaneous nerve. After manual identification of the proximal and distal compression sites, an *in situ* release is carefully performed, preserving the nerve, including all branches. Next, anterior subluxation of the ulnar nerve is tested by elbow flexion. If subluxation is present, an anterior transposition is performed.

To ensure homogeneity of our study sample, patients were excluded if an anterior transposition was performed. According to the general postoperative protocol, patients were fitted with a supportive bandage and sling for the first few postoperative days. Within 5 days, patients were seen by a hand therapist to remove the dressings and to check the wound. Hand therapy was scheduled 1 to 3 times per week, depending on the patient-specific assessment of the hand therapist, aiming for the restoration of full range of motion of the elbow. From week 3, advice on activities of daily living and work was provided with strength and functional exercises. Finally, all patients were reviewed by the surgeon at the 3-month postoperative time point.

Measurements

The BCTQ at intake and at 3 and 6 months after surgery were used to assess PROMs. The International Consortium for Health Outcomes Measurement Hand and Wrist Working Group (ICHOM) has suggested the BCTQ as an appropriate PROM for the follow-up of CubTs. The ICHOM guidelines are the result of a working group in which experts have decided what the minimum measurements are for certain disorders.[19] The BCTQ is a validated questionnaire that contains 19 items, divided into 2 domains: a Symptom Severity Scale (SSS) and a Functional Status Scale (FSS) covering ulnar nerve symptoms as well.[20−25] Scores of each item range from 1 to 5, with higher scores representing greater symptom severity or functional difficulty.

To determine satisfaction with treatment result, a recently validated questionnaire was used in which patients were asked to score their satisfaction 6 months after surgery based on 5 choices: excellent, good, fair, moderate, and poor.[26] When comparing satisfaction between groups, "excellent" and "good" are classified as "satisfied," and "fair," "moderate," and "poor" are classified as "dissatisfied." To assess this categorization of satisfaction, we performed a

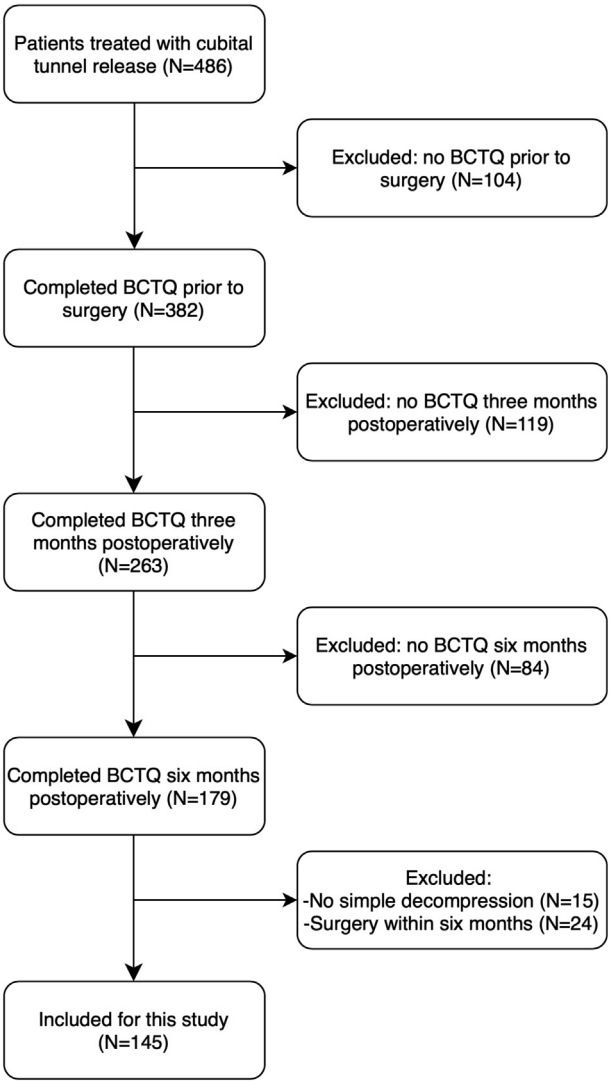

FIGURE 1: Establishment of the study cohort.

TABLE 1. Patient Characteristics at the Intake of Treatment

Characteristics	N = 145
Age (y),mean (SD)	48 (14)
Female sex, n (%)	96 (66)
Occupational intensity (%)	
Unemployed/retired	40 (28)
Light (eg, office work)	42 (29)
Medium (eg, cleaning)	37 (26)
Heavy (eg, construction work)	26 (18)
Duration of symptoms (mo), mean (SD)	23 (36)
Affected hand, right (%)	76 (52)
Diabetes, yes (%)	19 (13)
Tobacco use, yes (%)	38 (26)
Body mass index (kg/m^2), mean (SD)	27.7 (5.2)
Combined treatment, yes (%)	19 (13)
Previous surgery same side, yes (%)	29 (20)
Other previous nerve decompression, yes (%)	29 (20)
Preoperative EMG	93 (64)

sensitivity analysis with different cutoff points to see if this affected our findings. The analysis shows that if "excellent," "good," and "fair" are classified as "satisfied," this had no effect on our outcomes.

Statistical analyses

The change in the BCTQ score over time was analyzed for patients meeting the inclusion criteria using paired *t* tests. To determine potential differences in treatment effect between patients with lower and higher scores on both domains of the BCTQ at intake, patients were grouped into 4 equally-sized groups (quartiles) to represent the preoperative severity of CubTs. Because no BCTQ thresholds are known, this distribution was based on patients' preoperative scores for SSS at intake.

For the SSS, quartile 1 contains 25% of patients with mildest symptoms at intake and quartile 4 contains 25% of patients with the most severe symptoms at intake. Change over time per quartile was evaluated using paired *t* tests. The association between BCTQ SSS quartiles at intake and change scores of SSS and FSS was analyzed using analysis of variance tests. To analyze the potential influence of symptom severity at intake on satisfaction with treatment result, logistic regression modeling with the BCTQ SSS as single predictor variable was used.

We performed a subgroup analysis to evaluate whether patients undergoing concomitant surgery in the same session (eg, carpal tunnel release or trigger finger release) differed in symptom severity at intake and at 6 months using a *t* test. $P < .05$ was considered statistically significant. To determine whether our study was sufficiently powered for the analyses, we performed *post hoc* power calculations (Appendix E1, available online on the *Journal's* website at www.jhandsurg.org).

RESULTS

A total of 145 patients were included in the final analysis. Figure 1 shows the process of cohort creation. This cohort consisted of 96 women and 49 men, with a mean age of 48 ± 14 years (mean ± SD). Preoperative electrodiagnostic tests were performed in 64% of the patients. When analyzing patients with concomitant treatment in the same session, no

TABLE 2. BCTQ Scores (Mean, SD) and Satisfaction With Treatment Result (Number [%]) With Effect Sizes (95% Confidence Interval)

Measured PROM	Intake	3 Months After Surgery	6 Months After Surgery	*P* Values*	Effect Size†
BCTQ SSS, mean (SD)	2.9 (0.7)	2.1 (0.7)	2.2 (0.8)	<.001	1.00 (0.75−1.24)
BCTQ FSS, mean (SD)	2.7 (0.8)	2.1 (0.9)	2.0 (0.8)	<.001	0.82 (0.57−1.06)
Overall satisfaction, n (%)					
Excellent		22 (15)	19 (13)		
Good		37 (26)	37 (26)		
Fair		43 (30)	41 (28)		
Moderate		28 (19)	33 (23)		
Poor		15 (10)	15 (10)		

**P* values for the mean difference between intake and 6 months after surgery.
†Effect sizes are calculated between intake and 6 months after surgery.

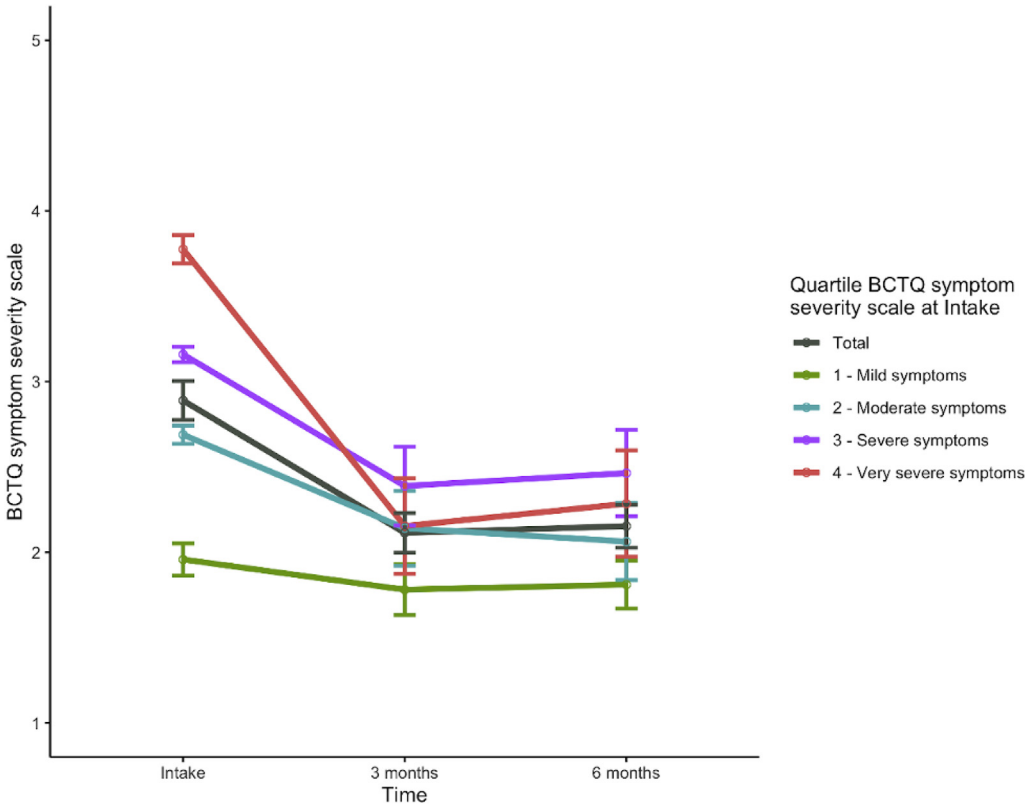

FIGURE 2: BCTQ SSS over time. Preoperative and postoperative measurements of BCTQ SSS for simple decompression. The graph indicates mean values at intake and at 3 and 6 months follow-up, with error bars representing the 95% confidence interval in total and divided in quartiles. *P* values represent differences between intake and 6 months after surgery. *$P < .05$.

significant difference in outcomes for BCTQ was seen compared with patients who only received simple decompression. Therefore, we included these patients in our cohort. All patient demographics are depicted in Table 1.

Symptom severity and functional status

Overall outcomes of BCTQ SSS and FSS at intake and at 3 and 6 months after surgery are represented along with corresponding effect sizes in Table 2. The patients reported significant improvement in

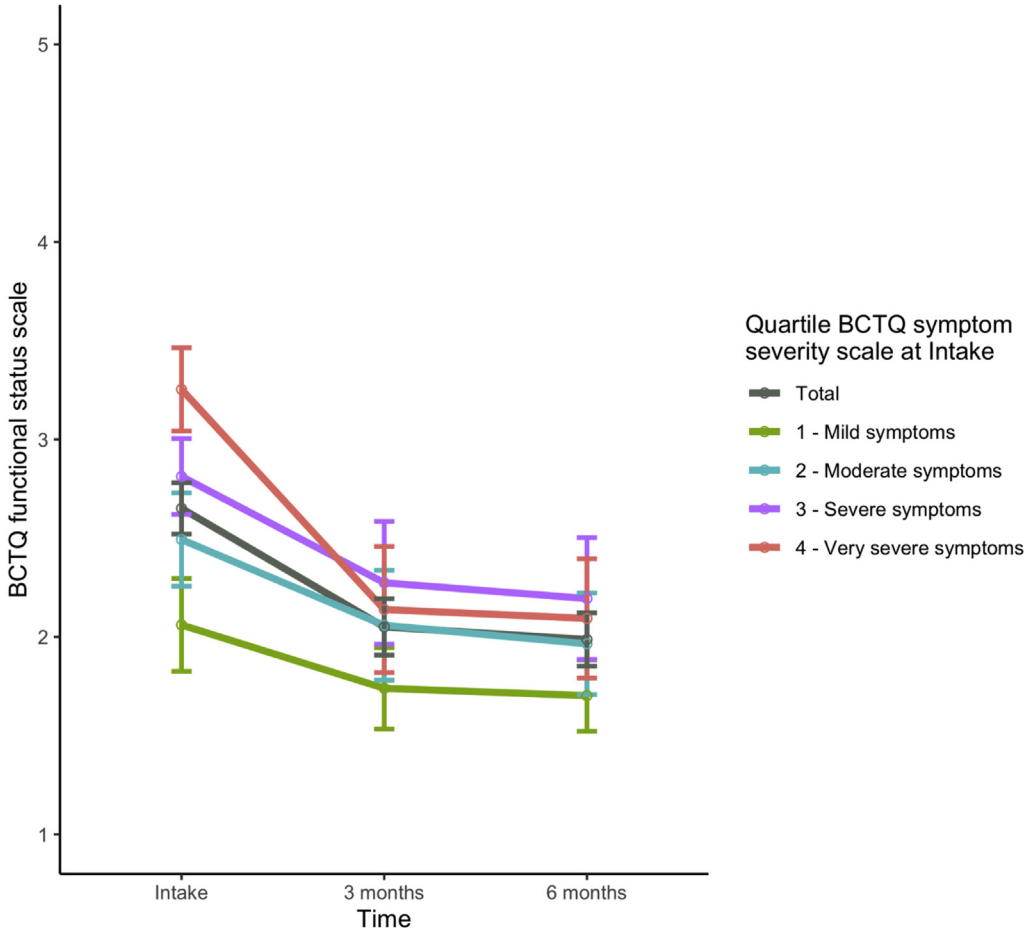

FIGURE 3: BCTQ FSS over time. Preoperative and postoperative measurements of BCTQ FSS for simple decompression. The graph indicates mean values at intake and at 3 and 6 months follow-up, with error bars representing the 95% confidence interval and the improvement in total and divided in quartiles. *P* values represent differences between intake and 6 months after surgery. *$P < .05$.

symptoms ($P < .05$) and function ($P < .05$), with a decrease on SSS and FSS of 0.7 at 6 months after surgery. In addition, the improvement on SSS equals the minimum clinically important difference (MCID) of 0.7; improvement on FSS is greater than the MCID of 0.3 at 6 months after surgery.[27]

After dividing SSS into quartiles, the greatest treatment effect was found in quartile 4; the patients with the most severe symptoms reported an improvement of 1.5 on SSS (MCID = 0.7) and 1.2 on FSS (MCID = 0.3; $P < .005$; Figs. 2, 3). In addition, for patients with mildest symptoms at intake, improvement did not reach significance regarding symptom severity (SSS intake vs 6 months: 2.0 vs 1.8; $P = .093$). Nevertheless, these patients did improve significantly on functional status (FSS intake vs 6 months: 2.1 vs 1.7; $P < .005$). For both domains, there was a significant difference in improvement between each quartile compared with all other quartiles (Δ SSS, $P < .05$; Δ FSS, $P < .05$).

Patient satisfaction

The patients with the mildest symptoms at intake and those with the most severe symptoms reported approximately equal satisfaction with treatment results at 6 months after surgery (Fig. 4; $P = .92$).

Complications and reoperations

During follow-up, 10 complications occurred: 4 patients had a local wound infection and 6 patients required reoperation because of persistent complaints within 1 year after primary treatment.

DISCUSSION

This study demonstrates that simple decompression is an effective treatment for primary CubTs. On average, there is a significant improvement in symptom severity and function at 6 months after surgery, which is in line with previous studies.[6–10,28–30] If patients are divided into quartiles

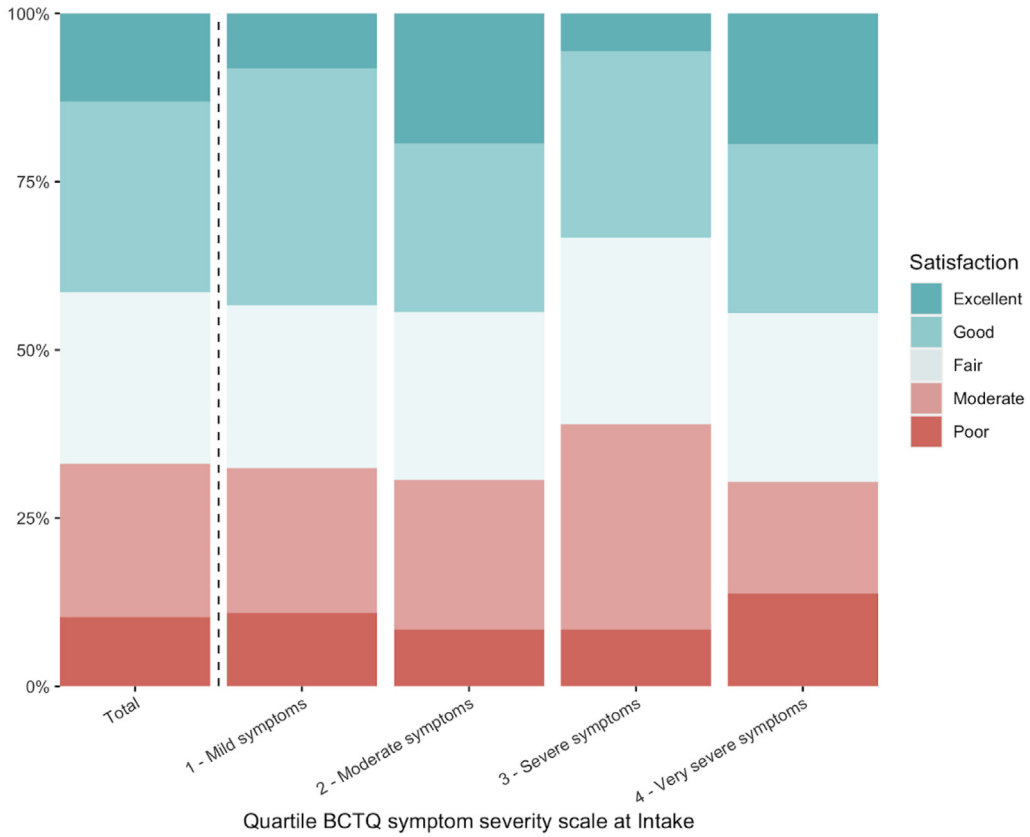

FIGURE 4: Satisfaction with treatment result distributed in quartiles of SSS. The satisfaction with treatment result in the total study population and divided into quartiles of SSS at intake on the x axis. The possible patient-reported satisfaction outcomes "excellent," "good," "fair," "moderate," and "poor" are shown in percentages. There is no significant difference regarding satisfaction with treatment result between quartiles 1 (mild symptoms) and 4 (very severe symptoms) ($P = .92$).

based on their SSS at intake, patients with the mildest symptom severity did not improve significantly on symptom severity but did improve significantly on their functional status. Moreover, their satisfaction with treatment result is statistically comparable with the group with the most severe symptoms at intake.

The largest treatment effect is reached relatively early in the postoperative period. The significant improvement appears to be mainly during the first 3 months after surgery for symptom severity and functional status. Subsequently, only limited improvement is reported between 3 and 6 months after surgery. The Ulnar Nerve Study group showed similar results; however, in their study, the sensory and strength measurements improved continuously during the first postoperative year.[31] The release of the compressed nerve provides patients with relief from pain and paresthesia, even in the group with severe symptoms. In this group, one would expect a slower recovery, due to prolonged and severe nerve compression with associated axonal loss, as described by previously.[16,17,32,33]

Guiding prognosis for patients is essential when discussing the role of surgery. However, there is conflicting evidence regarding the predictive value of symptom severity at intake.[12–17,25] Bartels et al[29] determined that poorer functional outcomes were to be expected after surgery for higher-grade compression neuropathy. These results seem in contrast with the results of our study. In our study, patients with severe symptoms had a significant comparable improvement to the entire group (BCTQ scores 2.3 vs 2.2). This is in line with results of Song et al[25] and Bimmler and Meyer,[20] who also demonstrated that the groups with severe symptoms do improve significantly with simple decompression. The meta-analysis by Mowlavi et al[34] showed poor symptom relief after surgery in their severe symptoms group. However, Mowlavi et al[34] used different parameters to determine a good outcome. They used objective parameters, including persistent atrophy and weakness, whereas our results were based on PROMs. Moreover, the literature shows the difference in outcomes between patients with the most severe

symptoms at intake and those who reported the least severe symptoms for carpal tunnel syndrome; the study by Sun et al[35] reports that patients with a higher SSS on intake improve the most after carpal tunnel release. However, there may be multiple other conditions contributing to worse postoperative outcomes, for example, age and motor degeneration, that were not examined in our study.[32,36]

In addition, we found that the satisfaction with treatment result rate of the group with the mildest symptoms at intake is comparable with that of the other groups. This group of patients did improve significantly on their functional status. Therefore, we suggest that satisfaction with treatment result may depend more on the improvement of functional status. In addition, satisfaction with treatment result seems to be independent of symptom severity at intake, as the group with the most severe symptoms at intake were comparably satisfied. Nevertheless, satisfaction is a complex and multidimensional concept, involving more than just symptom relief.[37,38] Nonetheless, the aim of our study was not to analyze the entire concept of satisfaction but to determine the possible influence of preoperative symptom severity. Hence, it can be indicated in preoperative counseling of patients that, regardless of the severity of symptoms, improvement can be expected after simple decompression.

Although, on average, all patients demonstrated improvement in symptoms and function, approximately 30% of our patients reported moderate-to-poor satisfaction with treatment result. These results are comparable with the results of the study by Mowlavi et al,[34] who reported 75% of the patients being satisfied.

Giladi et al[31] reported that only age and severity of symptoms determined the outcome of surgery. Recent studies from our group have shown that the psychological profile of patients, such as illness perception and pain catastrophizing, are associated with worse pain and play an independent role in self-reported severity in carpal tunnel syndrome.[39] Although not determined in this study, these factors may also be important in CubTs and could explain the dissatisfaction rates.

The total complication rate in our study was 6.8%, with 2.8% infection and 4.1% reoperation for persistence of symptoms. These results are comparable with the literature, which shows rates from 3.8% to 12% excluding reoperations.[40,41] Aldekhayel et al[41] showed a higher complication rate, which can be explained by their broad definition that includes even scar tenderness. In our study, the reoperation rate within 1 year was 4.1%, which is in line with the literature reporting reoperation rates varying from 2.5% to 2.8%, with a comparable mean follow-up of 1 year.[40,41]

Our study had several limitations, such as the use of the BCTQ, a questionnaire specifically developed for carpal tunnel syndrome.[21] The lack of improvement of the BCTQ might have been the result of the lack of sensitivity or relative unimportance of some of the questions for patients with CubTs. There is an ulnar nerve-specific questionnaire, the Patient-Related Ulnar Nerve Evaluation.[42] However, the Patient-Related Ulnar Nerve Evaluation has only 4 specific questions about complaints of the little finger, 3 of which are, in a more general form, included in the BCTQ. Also, the system-specific questionnaires, such as the Disabilities of the Arm, Shoulder, and Hand and Michigan Hand Outcomes Questionnaire, have been validated for ulnar nerve surgery; however, there is no gold standard in PROMs for CubTs yet.[43] In addition, a previous study stated that the BCTQ demonstrated strong validity, originating from a correlation with functional outcomes and a high responsiveness over time for CubTs.[24,25] Another study stated that the BCTQ even can be used to identify CubTs,[44] and Zimmerman et al[24] showed that the BCTQ corresponds strongly with clinical staging of CubTS and is even more discriminating for clinical stage than the biomechanical instruments. Finally, ICHOM has determined to use the BCTQ as PROM for CubTs.[19]

We used a distribution of quartiles based on our patients' symptom severity instead of specific cutoff points because these do not exist for the BCTQ for CubTs. Although a slight difference in results may occur in other cohorts, we do not expect any clinically relevant differences. In addition, our results are in line with previous studies in which patients with mildest symptoms at intake improved the least in terms of symptom severity.

Because of the stochastic nature of clinical measurement scales, such as the BCTQ, it seems obvious that patients with the most severe symptoms at intake improve the most because there is more room for improvement. At the time of our study, there was no patient acceptable symptom state for the BCTQ for CubTs that could have increased the value of our results. As we primarily focused on improvement scores rather than end scores, we used the MCID. Nevertheless, this is an interesting topic for investigation in the future.

Another shortcoming is that we did not perform objective neurologic examination; therefore, the severity of postoperative complaints could not be proven by more objective measurements, such as

strength and range of motion. Nevertheless, the current guideline of the ICHOM states that follow-up by means of PROMs is sufficient for nerve compression syndromes.[19]

Our follow-up reached to 6 months after surgery, whereas previous studies showed that improvements could be seen up to 1 year after simple decompression.[6,14,16,25,45] Moreover, the period of 1 year to report reoperations also can be seen as incomplete, since reoperations can occur after 1 year. At the time of the current study, we did not have these data and, therefore, opted for a relatively short follow-up. In addition, we had to retrieve the complications and reoperations retrospectively from medical records. Therefore, it is possible that not all information had been documented.

Finally, we only included patients who had no subjective subluxation and underwent primary simple decompression. Therefore, our results may be less generalizable to other clinical practices using a different technique as their preferred method to treat primary CubTs.

This study demonstrates that patients with the mildest symptoms at intake may not improve on symptom severity but do improve on their functional status. In addition, patients with the most severe symptoms at intake improve on symptom severity and functional status. Moreover, all patients, regardless of the preoperative symptom severity, are equally satisfied with the treatment results. In conclusion, it appears that all patients with cubital tunnel syndrome, regardless of their preoperative symptom severity, benefit from simple decompression.

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JOURNAL CME QUESTIONS

Outcome of Simple Decompression of Primary Cubital Tunnel Syndrome Based on Patient-Reported Outcome Measurements

1. When treating cubital tunnel syndrome surgically, the literature suggests which of the following ultimate outcomes of ulnar nerve decompression vs ulnar nerve anterior transposition?

a. Better overall
b. Worse overall
c. Similar overall
d. Quicker to improve early but then worse after 1 year
e. Slower to improve early but then better after 1 year

2. In this study, how did patient improvement on the Boston Carpal Tunnel Questionnaire (BCTQ) vary based on the degree of preoperative symptoms?

a. BCTQ scores improved the most in patients with the most symptoms/functional impediment preoperatively.
b. BCTQ scores improved the least in patients with the most symptoms/functional impediment preoperatively.
c. BCTQ scores improved comparably in patients with the most and least symptoms/functional impediment preoperatively.
d. BCTQ scores were not able to be calculated in the patients with the most symptoms/function impediment preoperatively.
e. BCTQ scores improved to the ceiling on this scale for all patients.

APPENDIX E1

Power calculations

To determine whether this study was sufficiently powered for the analyses, we performed post hoc power calculations. In these calculations, we used the number of available patients to calculate the effect size (Cohen's d) that we could detect using a conventional power of 80% and a significance level of .05.

Primary analyses

For comparing mean PROM scores before surgery and 6 months after surgery, 145 patients were available. This resulted in a Cohen's d of 0.33 that could be detected with at least 80% power, which corresponds to a small to medium effect.[46]

Quantile analyses

Patients were grouped into 4 quantiles based on preoperative symptom severity. This resulted in 3 groups of 36 patients and 1 group of 37 patients. When comparing mean PROM scores before and after surgery within each quantile, this resulted in a Cohen's d of 0.66 to 0.67 that could be detected with at least 80% power.

The analysis of variance test, used to identify differences in preoperative and postoperative mean PROM scores between each quantile, could detect a Cohen's f of 0.28, which corresponds to a medium to large effect.

For logistic regression to detect differences in satisfaction with treatment results between the 4 quantiles, our calculation resulted in a Cohen's f of 0.08 for a model with 3 coefficients, indicating that a small effect could be detected with at least 80% power.

Subgroup analysis

A subgroup analysis was performed to determine whether patients undergoing concomitant surgery (n = 19) differed before and after surgery from patients who did not undergo concomitant surgery (n = 126). Using these numbers of available patients, we could detect a medium to large difference (Cohen's d 0.69) between these groups with at least 80% power.