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The Open Orthopaedics Journal, 2016, *10*, 757-764 757

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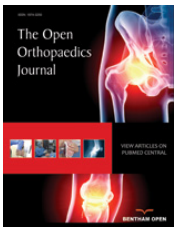
The Open Orthopaedics Journal

Content list available at: www.benthamopen.com/TOORTHJ/

DOI: 10.2174/1874325001610010757



RESEARCH ARTICLE

Outcomes and Satisfaction with Endoscopic Carpal Tunnel Releases and the Predictors - A Retrospective Cohort Study

Alvin Chao-Yu Chen[1,*], Meng-Huang Wu[2], Chun-Ying Cheng[1] and Yi-Sheng Chan[1]

[1]*Bone and Joint Research Center, Chang Gung Memorial Hospital-Linkou & University College of Medicine, Taiwan, R.O.C*

[2]*Department of Orthopedic Surgery, Taipei Medical University Hospital, Taiwan, R.O.C*

Received: October 13, 2016 Revised: October 29, 2016 Accepted: November 23, 2016

Abstract:

Background:

Patient's final satisfaction with endoscopic carpal tunnel release (ECTR) is still unpredictable. The study aims to find the predictive factors for satisfaction in patients with carpal tunnel syndrome (CTS) treated by ECTR using the Boston CTS questionnaire.

Methods:

We conducted a retrospective chart review of 37 patients (55 hands) who received ECTR and completed Boston carpal tunnel questionnaire at preoperative visit, 1 month and 6 months after operation while a telephone interview was conducted at 2 years after operation. Independent risk variables, including mean symptom severity scale, functional status scale, each item in questionnaire at all the time points, ASA physical status scale, age, gender, dominant site lesion, bilateral lesions, duration of symptoms and anesthesia method were recorded. Final outcome was determined by the patient's satisfaction at the interval of 2 years. Predictors to outcome were analyzed by stepwise multiple regression analysis and tested with Pearson correlation test. A p value of less than 0.05 was considered significant.

Results:

The severity of hand or wrist numbness during the daytime (Q6, explained 6.5% variances), the severity of numbness or tingling at night (Q9, explained 16.2% variances), the functional status of writing (q1, explained 13.9% variances), carrying grocery bags (q7, explained 13.6% variances) had significant predictive value ($p<0.001$). Other factors were not significant in the analysis including ASA, gender, age, dominant site lesion, bilateral lesions, anesthesia method and duration of symptoms.

Conclusions:

Boston questionnaire is a simple and reliable tool with high predictive values to evaluate patient's outcome and satisfaction in ECTR.

Keywords: Boston carpal tunnel questionnaire, Carpal tunnel syndrome, Endoscopic carpal tunnel release, Patient satisfaction, Predictor, Outcome.

INTRODUCTION

Carpal tunnel syndrome (CTS) is a common entrapment neuropathy and approximately 250,000 to 300,000 carpal tunnel releases are performed annually in the United States [1]. Patients with CTS treated with endoscopic surgery have good symptoms relief up to 70~90%, which is comparable to open decompression [2]. In spite of effective symptom release and early return to work, patient's satisfaction with endoscopic carpal tunnel release (ECTR) is still unpredictable [3]. Many factors have been proposed as outcome predictors of carpal tunnel release include age [4],

* Address correspondence to this author at the Bone and Joint Research Center, Chang Gung Memorial Hospital-Linkou, 5th, Fu-Shin Street, Kweishan District, Taoyuan 333, Taiwan, R.O.C; Tel: +886-3-3281200; ext. 3882; Fax: +886-3-32781134; E-mails: alvinchen@cgmh.org.tw, alvin_ortho@yahoo.com

underlying disease [5], occupation [6], response to preoperative steroid injection [7], duration of symptoms [3], preoperative clinical features such as nocturnal pain and bilateral pain [11], preoperative muscle weakness or atrophy, worker's compensation [2], incorrect diagnosis [12] and incomplete release of the transverse carpal ligament [12]. The Boston CTS questionnaire is a well-recognized, disease-specific, validated self-administered questionnaire in CTS [8]. It gives ordinal data that is easy to explain to the patients. Katz *et al.* advocated to evaluate outcome in CTS surgery and tried to find the predictive value [2]. However, the predictive value was not found when assessed with the mean score of symptom severity and functional status in the questionnaire. This study aims to find the predictive factors for satisfaction in patients with CTS treated by ECTR using the Boston CTS questionnaire.

MATERIALS AND METHODS

This retrospective cohort study was approved by our hospital's Institutional Review Board. The inclusion criteria were patients who had received ECTR for symptomatic CTS by single surgeon (ACC) between February 2006 and November 2008 in one medical center. The diagnosis of carpal tunnel syndrome was made on the clinical basis of pain, numbness, weakness, paresthesia, nocturnal paresthesia in the distribution of the median nerve of the wrist or hand, and/or thenar muscle atrophy. Tinel's sign, Phalen provocative test and Durkan compression test were used to support the diagnosis. Some patients had electrophysiological findings (electromyography and nerve conduction velocity) consistent with median nerve compressive neuropathy when diagnosis was in doubt. All patients had neurologic symptoms of more than 6 months and failed to response to conservative treatment for more than 6 weeks. All of them were selected suitable candidates for ECTR without previous hand or wrist surgery and space occupying lesion at wrist. All the participants completed inform consent to participate in the study and completed the Boston questionnaires at preoperative visit, 1 month and 6 months postoperatively follow-up visits at outpatient clinics. The exclusion criteria were incomplete records for the Boston CTS questionnaire at any time point and intraoperative change of surgical procedure. The operation fees were mostly covered by the social welfare insurance and no worker's compensation was applied to all the patients. Demographic data were obtained from chart review including body weight, body height, operation time, ASA physical status class (ASA), anesthesia method, history and physical findings.

The self-administered questionnaire used for CTS evaluation was designed by Katz and Levine, which is also known as the Boston CTS questionnaire [8]. It consists of 2 parts and the first part consists of 11 questions concerning the severity in symptoms (Q1 ~ Q11, Table **1**), with each item scoring from 1 to 5 in the ascending order according to the severity of symptoms, making a total score of 55, with 11 being the best and 55 being the worst. This is the symptom severity score (SSS). The other section has 8 questions of activities of daily life (q1 ~ q8, Table **1**), scoring from 1 to 5 in ascending order according to the difficulty of a task, making a total score of 40, with 8 being the best and 40 being the worst. This is the function status score (FSS). Dividing the total SSS by11, we obtained the mean Boston score for symptom severity and dividing the total FSS by 8 gave us the mean Boston score for function. This questionnaire was translated to Chinese language and it had been validated [9]. As a final outcome factor, patient's satisfaction of each time point was determined by a 10-point verbal descriptor nominal scale (1 is very poor, 5 is fair, 10 is excellent) at the follow up visits at 1 month and 6 months after operation and a telephone interview at 2 years after operation of each patient. All patients had assistance to complete this questionnaire at the preoperative visit by the same surgeon.

Table 1. The score of Boston carpal tunnel.

A. Symptoms severity scale (SSS).

	Q1 Night pain severity	Q2 Wake up by pain	Q3 Daytime pain severity	Q4 Daytime pain frequency	Q5 Pain episode duration	Q6 Numbness severity	Q7 Weakness severity	Q8 Tingle severity	Q9 Night numbness	Q10 Wake up by numbness	Q11 Key or pen holding	Mean SSS
Pre-op	3.31±1.59	4.51±1.20	2.89±1.43	2.98±1.37	3.11±1.53	3.64±1.60	1.91±1.47	2.42±1.64	3.93±1.30	3.76±1.48	2.07±1.42	3.14±0.84
Post-op 1m	1.13±0.41‡	1.04±1.20‡	1.20±0.46‡	1.47±0.99‡	1.40±0.99‡	1.36±0.57‡	1.20±0.59‡	1.11±0.53‡	1.38±0.32‡	1.11±0.32‡	1.04±0.30‡	1.22±0.81‡
Post-op 6m	1.07±0.33‡	1.04±0.30‡	1.07±0.25‡	1.09±0.29‡	1.31±0.87‡	1.31±0.56‡	1.49±0.87	1.00±0.00‡	1.42±0.58‡	1.18±0.39‡	1.09±0.60‡	1.19±0.30‡

† $p < 0.01$; ‡ $p < 0.001$. None of the p-value for the postoperative data without sign ‡ was less than 0.01 as comparison to the preoperative data of the same item (Q1 to Q11).

B. Functional status scale (FSS).

(Table 1) contd.....

	q1 Writing	q2 Buttoning clothes	q3 Holding a book	q4 Gripping a telephone	q5 Opening jars	q6 Household chores	q7 Carrying grocery bags	q8 Bathing and dressing	Mean FSS
Pre-op	2.24±1.58	2.64±1.61	2.13±1.44	2.16±1.46	2.20±1.47	2.09±1.43	2.20±1.41	1.20±0.46	2.11±1.06
Post-op 1m	1.02±0.15‡	1.07±0.33‡	1.11±0.44‡	1.04±0.30‡	1.44±1.06†	1.02±0.149‡	1.76±1.21	1.02±0.15*	1.19±1.33‡
Post-op 6m	1.09±0.60‡	1.31±0.90‡	1.29±1.01†	1.29±1.01†	1.56±1.27*	1.29±1.01†	1.89±1.32	1.29±1.01	1.38±0.69‡

* $p < 0.05$; † $p < 0.01$; ‡ $p < 0.001$.

Statistical Methods

The data analysis was performed with SPSS 12.0 (SPSS, version 12.0, SPSS Inc. Chicago, Illinois) to compare the preoperative FSS and SSS scores with postoperative FSS and SSS scores at 1 month and 6 months using paired t test for the outcome of our treatment. Preoperative factors such as symptom duration, gender, dominant side lesion, preoperative mean SSS, mean FSS, and score of each item in preoperative SSS and FSS, were evaluated for the predictive value of the patient's satisfaction with stepwise multiple regression analysis. The duration of symptoms was divided into 3 groups for analysis: symptoms within 1 year, 1 year to 5 years, and more than 5 years. Items found to have predictive value were tested with Pearson correlation to the final patient's satisfaction. The demographic data, SSS and FSS scores of excluded patients were also compared with included patients with Student's t test. A *p* value of less than 0.05 was considered significant.

RESULTS

Participant Composition

During the study periods, eighty-seven patients with 110 hands received CTS release (Fig. **1**, Table **2**). Forty-eight patients with 64 hands receiving ECTR were allocated to the study. Among them, thirty-nine patients (6 men and 33 women) with 55 hands (17 having left, 8 having right, 15 being bilateral) completed the Levine SSS and FSS Questionnaire before surgery and at 1 and 6-month follow-up visits. All patients had telephone interviews for their final satisfaction at least 2 years after operation (mean follow-up time is 32.06 months, standard deviation (SD) is 5.12). The remaining 9 patients did not receive final telephone interview and were excluded from the study. The other 39 patients who did not meet the criteria were excluded as incomplete questionnaire data was found of 30 patients, loss of follow up at 1 month in 5 patients and of 6 months in 4 patients was observed. The comparison of preoperative demographics between included and excluded patients showed similar gender, body mass index (BMI), duration of symptoms, ASA, lesion site, mean SSS and FSS score except for the younger age (42.5 years, SD 5.32, $p = 0.018$) among the excluded patients. The average age at operation stage was 50.6 years (SD 10.54); the average BMI was 27.1 (SD 6.4), corresponding to the "over-weight" level (BMI>25.0) [10].Thirty-one patients had symptoms of CTS for less than one year, four patients had symptoms for an interval of one to 5 years, and four patients had symptoms for more than 5 years. Twenty-two patients reported heavy work to house chores and 17 patients were retired. The ASA were ranked as 1 in 31 patients and 2 in 8 patients due to old age and systemic diseases such as diabetes mellitus, hyperthyroidism, hypertension, chronic renal insufficiency, rheumatoid arthritis and gout. Seventeen patients received general anesthesia with concomitant admission in less than 4 hospital days; one day overnight stay was reported in 15 patients and 3 nights stay was reported in 2 patients. All patients had no major complications related to surgery or anesthesia. Mean operation time was 40.7 minutes (SD 15.1) for each hand. One patient shifted to open surgery intraoperatively due to tourniquet dysfunction with unclear endoscopic view. This patient was excluded due to loss of follow up at 6 months.

Table 2. Demographic data of the patients.

Total patients/ hands	87 / 110
Included patients/ hands	39 / 55
Dominant site	24
Non-dominant site	16
Bilateral lesions	15
Gender	
Male	6
Female	33

(Table 2) contd.....

Age (years)	50.6 ± 10.54
<60yrs	33
>60yrs	6
Occupation	
Heavy work	1
Light work	4
House chore	17
Retired	17
Duration of symptoms	
<1 year	31
1~5 years	4
>5 years	4
BMI (kg/m^2)	27.1 ± 6.4
< 23 normal	4
23-25 overweight	13
> 25 obese	22
ASA	
1	31
2	8
> 3	
Anesthesia method	
Local anesthesia	22
General anesthesia	17

BMI: Body mass index, body weight divided by square of body height.
ASA: ASA physical status class.

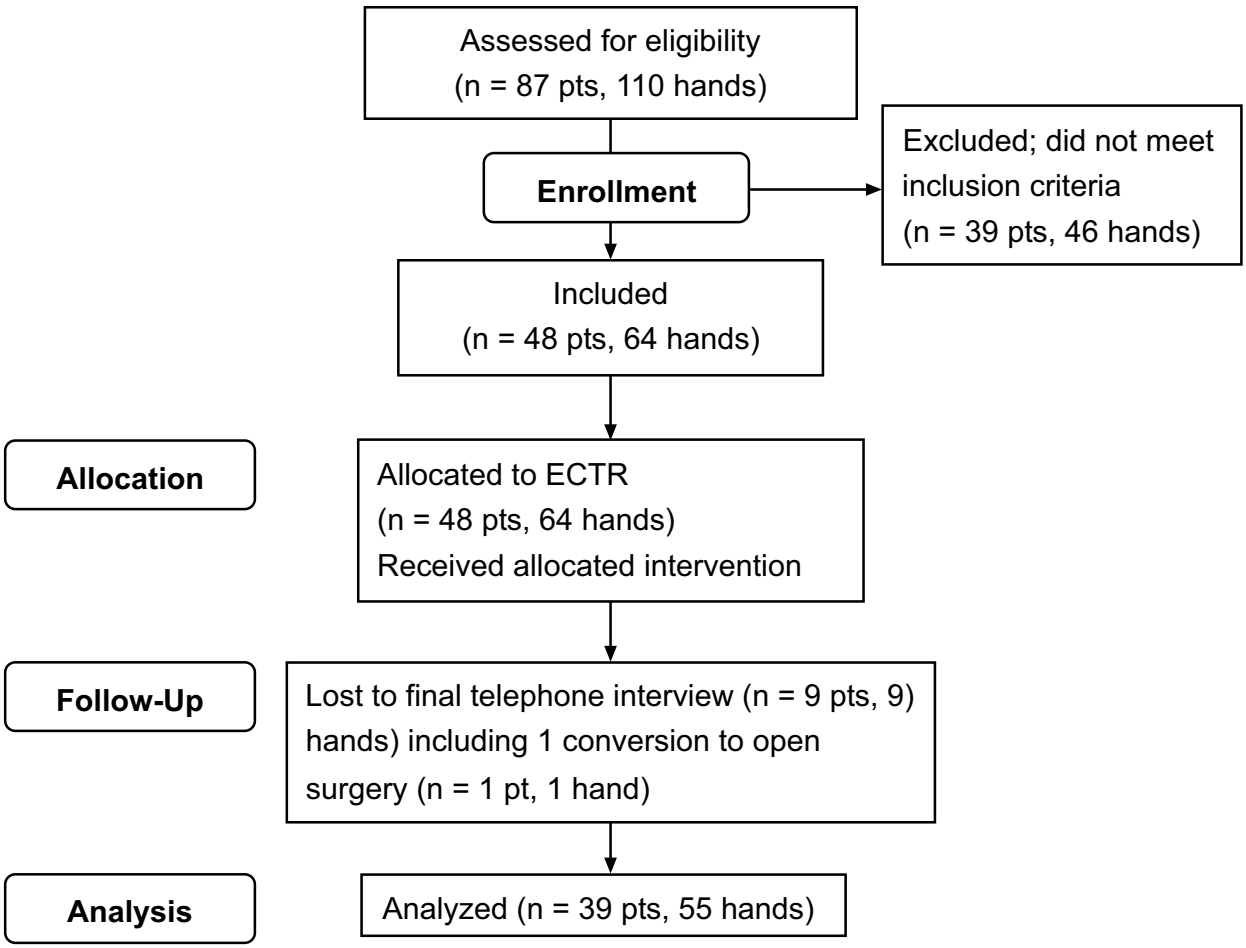


Fig. (1). The study flow chart (pts: patients, ECTR: Endoscopic carpal tunnel release).

Surgical Outcome

SSS and FSS

Both the Boston SSS and FSS scores showed a significant decrease after ECTR at 1 and 6 months on each item ($p < 0.05$~0.001, Table **1**) except in the cases of carrying grocery bags (q7) at 1 and 6 months, hand or wrist weakness (Q7) at 6 months, bathing and dressing (q8) at 6 months ($p > 0.05$). No difference was found between the scores of mean FSS and SSS at 1 month and 6 months post-operation ($p > 0.05$). In SSS group, the score of frequency of waking up from nocturnal pain (Q2) and numbness (Q10), and the numbness severity in daytime (Q6) and at night (Q9) showed greatest change, and the weakness severity (Q7) showed the least change. In the FSS, the function of buttoning clothes (q2) and writing (q1), while of bathing and dressing (q8) and carrying grocery bags (q7) showed the greatest change.

Table 3. Stepwise multiple regression of factors.

The sequence of variables entered	R	R^2	R^2 Change	F	*p*	Beta(β)	Variance
Q9 Pre-op night numbness	0.402	0.162	0.142	8.109	0.007†	0.329	16.2%
q1 Pre-op writing	0.548	0.301	0.139	8.818	0.001†	-0.639	13.9%
q7 Pre-op carrying grocery bags	0.661	0.437	0.136	10.340	<0.001‡	0.439	13.6%
Q6 Pre-op daytime numbness	0.708	0.502	0.065	9.822	<0.001‡	0.261	6.5%

Total explained variance: 50.2% Patient satisfaction at 2 year = 0.329 × Q9 - 0.639 × q1 + 0.439 × q7 + 0.261 × Q6 † $p < 0.01$ ‡ $p < 0.001$.

Patient's Satisfaction

The overall patient's satisfactions at 1 month, 6 months and 2 years were 7.40 (SD 1.90), 8.16 (SD 1.942), 8.01(SD 1.83) respectively. Twenty-eight patients (42 hands) had satisfaction scores more than 7 (good to excellent), nine patients (11 hands) had 4~6 (fair), and two patients (2 hands) had less than 3 (Poor) at 2 years follow up. The patients' satisfactions had statistical difference at 1 month and 6 month follow-up ($p=0.037$), but there was no difference at 6 months and 2 years follow-up ($p > 0.05$).

Predictor of Patient Satisfaction at 2 Years

Pearson correlation test was performed to find the association between the scores of Boston questionnaire and patient's final satisfaction at 2 years. The mean SSS and mean FSS at preoperative time and postoperative 1 month, and mean FSS at postoperative 6 months, all showed no correlation to the patient's final satisfaction ($p > 0.05$), but only mean SSS at postoperative 6 month showed negative correlation to patient's final satisfaction ($p < 0.01$). We further examined the items inside the preoperative questionnaire, demographic data including ASA, age, gender, dominant site lesion, bilateral lesions, duration of symptoms and anesthesia method with stepwise multiple regression analysis (Table **3**). The severity of hand or wrist numbness during the daytime (Q6,explained 6.5% variances), the severity of numbness or tingling at night (Q9, explained 16.2% variances), the functional status of writing (q1, explained 13.9% variances), carrying grocery bags (q7, explained 13.6% variances) had significant predictive value ($p<0.001$). Other factors were not significant in the analysis including ASA, gender, age, dominant site lesion, bilateral lesions, anesthesia method, and duration of symptoms.

Reasons to Satisfaction

The reasons to good satisfaction included good wound cosmetics in 15 patients (38.4%), resolution of symptoms in 28 patients (71.9%), and life quality improvement in 23 patients (58.9%). The reasons to poor satisfaction included irreversible thenar atrophy in 1 patient (2.56%), discomfort at some posture in 2 patients (5.12%), incomplete resolution of symptoms such as weakness, pain and numbness in 10 patients (25.6%), and affected working ability in 2 patients (5.12%).

Postoperative Status

After operation, 18 patients returned to same work. Two patients did not return to work and two patients changed their work to less hand related activities. No major complication was observed. Five patients (12.8%) presented minor complications. Two patients had intermittent endoscopic entry portal wound pain and hypersensitivity without resolution after oral analgesics after 2 years. One patient had revision surgery for bilateral CTS due to incomplete symptom resolution at another hospital 1 year after the index surgery. After surgery, she had complete symptom release

without any complication. One patient had recurrent symptoms and received reoperation after 1 year. Operative findings showed extensive scarring around previous endoscopic releasing site of transverse carpal ligament. Symptoms improved after open revision surgery. One patient had mild pillar pain at the incision scar, and it resolved after 2 months with use of oral analgesics (Fig. **1**). The study flow chart (pts: patients, ECTR: Endoscopic carpal tunnel release)

DISCUSSION

The Boston CTS questionnaire could effectively evaluate the outcome and be used as a preoperative tool for predicting the final patient satisfaction for ECTR. While most patients have symptom improvement after surgical treatment, some patients still cannot be satisfied with the outcome. That is because CTS not only affects the function but also the psychosocial aspect. Previous studies had tried to predict outcome with various factors including age [4], underlying disease [5], occupation [6], response to preoperative steroid injection [7], duration of symptoms [3], preoperative clinical features such as nocturnal pain and bilateral pain [11], preoperative muscle weakness or atrophy, worker's compensation [2], incorrect diagnosis, and incomplete release of the transverse carpal ligament [12]. All these factors can be explained to patient in advance in order to prevent unwanted dissatisfaction. However, there is still no simple and quantifiable data to provide a prediction to outcome. The Boston CTS Questionnaire has been shown to be sensitive for detecting a change after carpal tunnel surgery [13]. Levine *et al.* detected the questionnaire's responsiveness by estimating the impact degrees and compared the change to the patients' satisfaction after open carpal tunnel release. He found the patients' satisfaction correlated highly with an improvement in the SSS score and correlated moderately with the change of the functional status score. Katz *et al.* found the SSS 4 times more responsive and the functional status scale 2 times more responsive than the sensibility and strength testing in estimating the impact degree and standardized response mean [14]. Gay *et al.* suggested that the Boston CTS Questionnaire are more sensitive to a clinical change than clinical examination, electrophysiological findings, or other generic questionnaires such as the Disabilities of the Arm, Shoulder, and Hand questionnaire and the Short-Form 36 [15]. Previous study had proved the questionnaire as being useful to measure the effect of open surgery, and in this study, ECTR has also showed similar improvement in open surgery [16]. With this self-administered questionnaire, the pre-op numbness or tingling at night, the pre-op hand or wrist numbness during the daytime, pre-op carrying grocery bags and the pre-op functional status of writing can predict a higher patient's satisfaction at 2 years.

In this study, we can identify patients who might not be satisfied with the result and provide additional information to these patients by this simple questionnaire. Higher preoperative severity of numbness or tingling at night, severity of hand or wrist numbness during the daytime, better function carrying grocery bags, lower functional status of writing showed 50.2% predictive value for higher patient's final satisfaction. The reason of higher severity of numbness or tingling at daytime and night having better satisfaction is the greater improvement of life quality related to numbness after surgery. Besides numbness, the other symptoms showed no predictive value including pain and weakness in symptom severity score. This might be due to the unpredictable recovery degree after surgery related to nerve degeneration. The worse ability to carry grocery bag showed better satisfaction after 2 years due to improvement of the functional status. In contrast, the patient having more inability to write preoperatively had worse satisfaction score. The score of writing ability before surgery had significant correlation to the score of postoperative writing ability. The total predictive value of these items in Boston CTS questionnaire was 50.2% which offered a simple way to identify these poor satisfaction predicted cases without additional examination or cost. While these patients expect more for ECTR for better outcome, these factors can provide a reference to surgeons for surgical planning and identifying patients who might have poor results. Some factors including ASA [5], gender [17], duration of symptoms [18], were considered as outcome predictors in open CTS surgery. This might be related to the patient selection or small patient number which may need further investigation. However, this study has 81.2% postoperative follow-up rate and complete questionnaire records for 2 years which can provide detailed information related to patients' outcomes. Otherwise, this questionnaire would have been validated to reflect the outcome of patients in carpal tunnel release. The analysis of predictive factor can provide more information for surgical planning and preoperative patient education.

CONCLUSION

Boston questionnaire is a simple and reliable tool to evaluate patient's outcome and final satisfaction in ECTR. The severity of numbness or tingling at night, the severity of hand or wrist numbness during the daytime, the ability of carrying grocery bags and the ability of writing can predict higher patient's final satisfaction with 50.2% predictive value.

LIST OF ABBREVIATIONS

ASA	=	Physical status class
BMI	=	Body mass index
CTS	=	Carpal tunnel syndrome
ECTR	=	Endoscopic carpal tunnel release
FSS	=	Function status score
SD	=	Standard deviation
SSS	=	Symptom severity score

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

ACKNOWLEDGEMENTS

Declared none.

REFERENCES

[1] Keller RB, Largay AM, Soule DN, Katz JN. Maine Carpal Tunnel Study: small area variations. J Hand Surg Am 1998; 23(4): 692-6. [http://dx.doi.org/10.1016/S0363-5023(98)80057-9] [PMID: 9708385]

[2] Katz JN, Losina E, Amick BC III, Fossel AH, Bessette L, Keller RB. Predictors of outcomes of carpal tunnel release. Arthritis Rheum 2001; 44(5): 1184-93. [http://dx.doi.org/10.1002/1529-0131(200105)44:5<1184::AID-ANR202>3.0.CO;2-A] [PMID: 11352253]

[3] Vasiliadis HS, Xenakis TA, Mitsionis G, Paschos N, Georgoulis A. Endoscopic *versus* open carpal tunnel release. Arthroscopy 2010; 26(1): 26-33. [http://dx.doi.org/10.1016/j.arthro.2009.06.027] [PMID: 20117624]

[4] Hansen TB, Larsen K. Age is an important predictor of short-term outcome in endoscopic carpal tunnel release. J Hand Surg Eur Vol 2009; 34(5): 660-4. [http://dx.doi.org/10.1177/1753193409104563] [PMID: 19395531]

[5] Rege AJ, Sher JL. Can the outcome of carpal tunnel release be predicted? J Hand Surg Br 2001; 26(2): 148-50. [http://dx.doi.org/10.1054/jhsb.2000.0544] [PMID: 11281668]

[6] al-Qattan MM, Bowen V, Manktelow RT. Factors associated with poor outcome following primary carpal tunnel release in non-diabetic patients. J Hand Surg [Br] 1994; 19(5): 622-5. [http://dx.doi.org/10.1016/0266-7681(94)90130-9] [PMID: 7822924]

[7] Edgell SE, McCabe SJ, Breidenbach WC, LaJoie AS, Abell TD. Predicting the outcome of carpal tunnel release. J Hand Surg Am 2003; 28(2): 255-61. [http://dx.doi.org/10.1053/jhsu.2003.50031] [PMID: 12671857]

[8] 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(11): 1585-92. [http://dx.doi.org/10.2106/00004623-199311000-00002] [PMID: 8245050]

[9] Lue YJ, Lu YM, Lin GT, Liu YF. Validation of the chinese version of the boston carpal tunnel questionnaire. J Occup Rehabil 2014; 24(1): 139-45. [http://dx.doi.org/10.1007/s10926-013-9438-9] [PMID: 23546645]

[10] Expert Consultation WH. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 2004; 363(9403): 157-63. [http://dx.doi.org/10.1016/S0140-6736(03)15268-3] [PMID: 14726171]

[11] Gong HS, Oh JH, Bin SW, Kim WS, Chung MS, Baek GH. Clinical features influencing the patient-based outcome after carpal tunnel release. J Hand Surg Am 2008; 33(9): 1512-7. [http://dx.doi.org/10.1016/j.jhsa.2008.05.020] [PMID: 18984332]

[12] Eason SY, Belsole RJ, Greene TL. Carpal tunnel release: analysis of suboptimal results. J Hand Surg [Br] 1985; 10(3): 365-9. [http://dx.doi.org/10.1016/S0266-7681(85)80063-2] [PMID: 4078466]

[13] 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(11): 1585-92. [http://dx.doi.org/10.2106/00004623-199311000-00002] [PMID: 8245050]

[14] 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(11): 1127-33. [http://dx.doi.org/10.1097/00005650-199411000-00005] [PMID: 7967853]

[15] Gay RE, Amadio PC, Johnson JC. Comparative responsiveness of the disabilities of the arm, shoulder, and hand, the carpal tunnel questionnaire, and the SF-36 to clinical change after carpal tunnel release. J Hand Surg Am 2003; 28(2): 250-4.
[http://dx.doi.org/10.1053/jhsu.2003.50043] [PMID: 12671856]

[16] Lopez-Vidrierox E, Angulox J, Expositox S, Lara J. Endoscopic menon technique *vs*. open carpal tunnel release surgery: a prospective and randomized study arthroscopy. Arthroscopy 2007; 23(6): e31.
[http://dx.doi.org/10.1016/j.arthro.2007.03.076]

[17] 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(6): 375-9.
[http://dx.doi.org/10.1111/j.1600-0404.2005.00528.x] [PMID: 16281919]

[18] Burke FD, Wilgis EF, Dubin NH, Bradley MJ, Sinha S. Relationship between the duration and severity of symptoms and the outcome of carpal tunnel surgery. J Hand Surg Am 2006; 31(9): 1478-82.
[http://dx.doi.org/10.1016/j.jhsa.2006.08.017] [PMID: 17095377]