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ORIGINAL ARTICLE

Patient-reported outcomes of carpal tunnel syndrome surgery in a non-industrial area

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Abstract

Introduction and objective. This study aimed to determine the environmental conditions for the occurrence of carpal tunnel syndrome (CTS) in a non-industrial area, and patient-reported outcomes after surgical release.

Materials and method. This observational study utilized convenience sampling to screen 100 consecutive patients for carpal tunnel syndrome at the Orthopedic Clinic, using two questionnaires. Data were collected from the Disability of Arm Shoulder and Hand (DASH) questionnaire, and the PROMIS® (Patient-Reported Outcomes Measurement Information System) Upper Extremity and PROMIS® SF 3a questionnaire (Pain Intensity). The relationship of various repetitive musculoskeletal disorders to CTS was validated by questionnaire scores, PROMIS® T-score, and correlation coefficients.

Results. Finally, CTS was confirmed by electromyography in 69 patients (55 females and 14 males; average age: 47.5 years). Aging significantly influenced the occurrence of symptoms associated with pain (neck, thoracic, lower back, shoulder, and CTS ($p<0.001$)). Those employed for longer more frequently declared performing exercises to prevent overload pain ($p<0.001$). DASH results significantly correlated with the PROMIS Upper Extremity score ($r = -0.64$; $p<0.05$).

Conclusions. Geographical and environmental conditions indicate that even though working with a computer is described as an essential risk factor for CTS, the study group showed a predominance of elements that were unrelated to working at a computer. CTS also occurred among people working physically, and even among unemployed individuals. The existence of a statistically significant, strong, negative correlation ($r=-0.64$; $p < 0.05$) between the results obtained in the questionnaires DASH and PROMIS Upper Extremity has been demonstrated.

Key words

carpal tunnel syndrome, occupational disease, musculoskeletal pain, computers, Patient-reported outcomes, non-industrial area

INTRODUCTION

Carpal tunnel syndrome (CTS) is the most common peripheral nerve entrapment syndrome, and it frequently present in working-aged adults [1–6]. A recent meta-analysis suggested that excessive computer use, particularly mouse usage, might be a minor occupational risk factor for CTS [7].

The prevalence of the CTS in industrialized countries is estimated to be 0.2% among women and 0.05% in men in Piedmont Region, Italy [8], and 2.3% of the population of workers in the USA [9]. The prevalence was estimated between 7% – 18% of the general adult population in the UK by Ferry at al. [10]. CTS is usually treated by surgical decompression with generally favourable long-lasting outcomes [11–15].

OBJECTIVES

The aims of this study were to determine the environmental conditions for the occurrence of CTS in a non-industrial area, and patient-reported outcomes after a single postoperative outpatient clinic visit using the Disability of Arm Shoulder and Hand (DASH) [16], and Patient-Reported Outcomes Measurement Information System (PROMIS®) Upper Extremity and SF 3a questionnaires, and compare the results obtained using these two outcome instruments [17].

MATERIALS AND METHOD

The study included 100 consecutive patients observed in a specialist Orthopedic Clinic. The patients were informed about the purpose and methods of the study beforehand and signed informed consent to participate. During a visit to the out-patient clinic, patients filled in questionnaires under silent and focused conditions, in an independent research room without any influence from other people. Occupational risk related to the development of CTS was assessed based on the Repetitive Strain Injuries (RSI) questionnaire associated with computer use. The questionnaire was developed to identify syndromes associated with overload, including CTS, including CTS in people working at a computer [18]. The questionnaire was available via the Internet and has been active since 21 January 20125.

The study used the following research instruments (translated into Polish): PROMIS® Pain Intensity [19–26] (Short Form 3a); PROMIS® upper extremity [17, 27], and the widely used DASH [16, 28]. The PROMIS® Pain Intensity

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(Short Form 3a v1) instrument was developed to assess the intensity of perceived pain. The Pain Intensity short form is usually used as a patient self-evaluation, independent of disease. It is based on the ability of the patient to provide relatively quick, quantitative pain intensity estimates. Most measures of pain intensity tend to be closely-related to one another. The Short Form 3a Pain Intensity instrument is used in adults. Translation into the Polish language was performed by FACITtrans using standardized PROMIS® methodology and was approved by the PROMIS® Statistical Center. The translation included two forward translations, one back-translation, three independent reviews, followed by pretesting [29]. The Patient-Reported Outcome Measurement Information System (PROMIS®), funded by the National Institutes of Health, aims to provide clinicians and researchers with the access to efficient, precise, valid, and responsive adult-, and child-reported measures for physical, mental, and social well-being. PROMIS® tools measure what patients can do and how they feel. Health measurement instruments (PROMIS®) can be used as primary or secondary endpoints in clinical studies of the effectiveness of treatment. Together with traditional clinical measures of health, patient-oriented outcomes provide clinicians and researchers with important patient-reported information to better understand the influence of various treatments on their physical functioning and other symptoms they experience. All results generated through PROMIS® were analyzed by the scoring tool available online (www.healthmeasures.net) through the Assessment Center. The Assessment Center is a free online research management tool enabling researchers to create study-specific websites for capturing participant data securely. This non-interventional study was approved by the institutional Review Board (Reference No. NR KB 22/12).

Statistical analysis was carried out using STATISTICA 12.0 software (StatSoft, Inc., Tulsa, OK, USA) [30]. Descriptive statistics were generated, and the data were subjected to Shapiro–Wilk testing for normality of variances. The differences between groups were assessed using the Wilcoxon matched pair test (dependent data), and the Mann-Whitney U and Kruskal-Wallis tests (independent data). For analysis of the correlation between measured parameters, the Spearman rank correlation was used. The internal correlation test was used to measure whether several items of PROMIS and DASH questionnaires produce similar scores. Differences were considered as significant with $P<0.05$.

RESULTS

Reliable results from the questionnaires were obtained from 69 patients, comprising 55 women and 14 men, aged between 20–79 years (mean age 46 years). 21 respondents were aged between 51–60 years, whereas young people, under 30 years of age (n=10) accounted for only a small percentage.

Of the respondents, 30 did not work professionally for various reasons (either unemployed, pensioners, or retirees). Farmers and people working in the household were also among the respondents (n=5). The largest group of patients (n=53) had at least a high school education. 36 respondents worked at a computer, 21 of whom had worked with computers for 10–20 years, 13 respondents declared working with computers for less than 10 years, and only 2 respondents reported that they had been working at the computer for 30 years or longer. In the group of persons working at the computer, 16 worked 5–8 hours a day. Only 3 subjects declared more than 8 hours of work. Five people worked 1–4 hours per day. Professionally, the study group presented a high diversity, and computer work was not the dominant way of performing their job.

Employment history at the computer significantly influenced the occurrence of symptoms; the reported problems occurred in people with a longer employment history (specifically, pain-related symptoms: neck pain ($p<0.001$), thoracic back pain ($p<0.001$), lower back pain ($p<0.001$), shoulder pain ($p<0.001$), and CTS ($p<0.001$).

The group with a longer employment history more frequently declared performing exercises to prevent overload pain ($p<0.001$). Breaks in work caused by CST were significantly more often reported in these patients ($p<0.001$).

DASH scores significantly correlated with the average intensity of the pain ($r=0.86$) and the level of pain at the moment of filling questionnaire ($r=0.58$). Average pain level was strongly associated with pain occurring at the worst time.

Table 1. Spearman correlation coefficient for pain intensity scale before treatment (PROMIS® SF 3a Pain Intensity Short Form 3a responses)

Variable		Spearman's r correlation		
		1	2	3
1	How intense was your pain at its worst?	-	0.72	0.82
2	How intense was your average pain?	0.72	-	0.67
3	What is your level of pain right now?	0.82	0.67	-

Everyday activities selected in the study population hindered functioning in the social environment to a great extent. The obtained results were then used to identify correlated activities, which may have further had the greatest impact on the experienced pain.

A set of inter-correlated activities were observed in these results ($p<0.05$). The value of the relationships between responses had a strong, positive character ($r>0.5$). Among the everyday activities, significantly positive correlations were observed for the following items at $p<0.05$: "Place an object on a shelf above your head" and "Push open a heavy door" ($r=0.74$). The detailed list of the most correlated activities tested by DASH questionnaire is shown in Table 2.

Test results using the PROMIS® Short Form 3a (Pain Intensity) questionnaire were obtained from respondents before and after CTS treatment. Distribution of the tested variables was obtained using the Shapiro-Wilk test. Results of the PROMIS® Short Form 3a (Pain Intensity) questionnaire were compared with the standardized results using the T-score.

Before treatment, an average T-score was 58. After the surgery, an average T-score significantly decreased to 40, which means a decrease of the pain intensity and improvement after surgery (Fig. 1).

Quantitative distribution of patient response to a question about the level of pain intensity at the worst time before and after treatment is shown in Figure 2.

None of the respondents reported very strong pains after treatment, with 24 patients (34.78%) reporting a total disappearance of pain, and no cases with very strong pain. After treatment, no deterioration of the physical conditions in the tested group was reported. Only 2 patients (3%) showed no improvement after treatment (Fig. 3).

Table 2. Spearman's r correlations for Disability of arm shoulder and hand questionnaire (DASH) items responses (selected questions regarding significance and value)

Variable	Spearman's r correlation												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Open a tight or new jar	1.00	0.74	0.59	0.45	0.58	0.50	0.63	0.53	0.52	0.68	0.63	0.50	0.42
2. Write	0.74	1.00	0.67	0.49	0.57	0.53	0.61	0.68	0.65	0.71	0.65	0.53	0.53
3. Turn a key	0.59	0.67	1.00	0.58	0.41	0.63	0.71	0.49	0.51	0.60	0.46	0.51	0.42
4. Prepare a meal	0.45	0.49	0.58	1.00	0.34	0.51	0.56	0.46	0.34	0.40	0.41	0.46	0.37
5. Push open a heavy door	0.58	0.57	0.41	0.34	1.00	0.56	0.48	0.55	0.53	0.61	0.76	0.46	0.50
6. Place an object on a shelf above your head	0.50	0.53	0.63	0.51	0.56	1.00	0.64	0.53	0.54	0.59	0.47	0.60	0.57
7. Perform heavy household chores (e.g. wash walls/floors)	0.63	0.61	0.71	0.56	0.48	0.64	1.00	0.53	0.51	0.59	0.54	0.50	0.33
8. Gardening or yard work	0.53	0.68	0.49	0.46	0.55	0.53	0.53	1.00	0.69	0.63	0.63	0.39	0.42
9. Make a bed	0.52	0.65	0.51	0.34	0.53	0.54	0.51	0.69	1.00	0.70	0.56	0.52	0.56
10. Carry a shopping bag or briefcase	0.68	0.71	0.60	0.40	0.61	0.59	0.59	0.63	0.70	1.00	0.71	0.60	0.55
11. Carry a heavy object (over 10 lbs)	0.63	0.65	0.46	0.41	0.76	0.47	0.54	0.63	0.56	0.71	1.00	0.50	0.51
12. Change an overhead light bulb	0.50	0.53	0.51	0.46	0.46	0.60	0.50	0.39	0.52	0.60	0.50	1.00	0.70
13. Wash/blow dry your hair	0.42	0.53	0.42	0.37	0.50	0.57	0.33	0.42	0.56	0.55	0.51	0.70	1.00

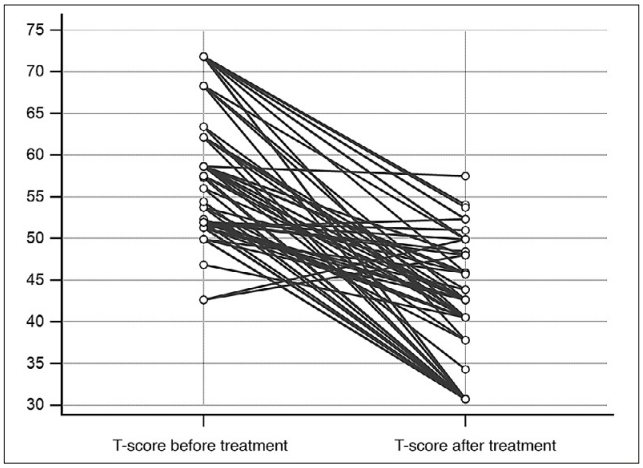

Figure 1. Dot and Line diagram of the Wilcoxon test for PROMIS® T-score before and after treatment

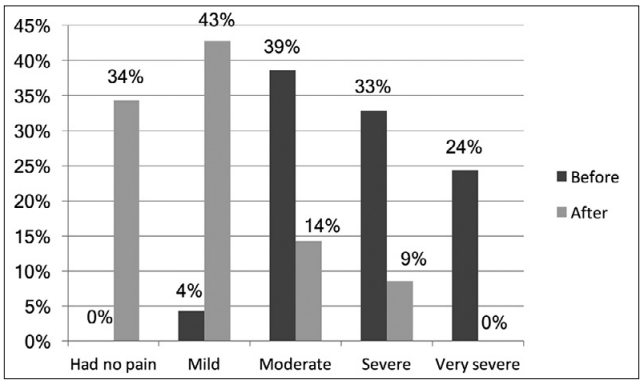

Figure 2. Pain intensity changes measured with a PROMIS® score before and after treatment (PROMIS® Pain Intensity Short Form 3a)

Features of disability regarding physical activities of the upper limb associated with CTS and the change before and after treatment were also verified using the PROMIS® Upper Extremity Questionnaire. Raw score distribution, i.e., physical activities of the upper limb before CTS treatment, was

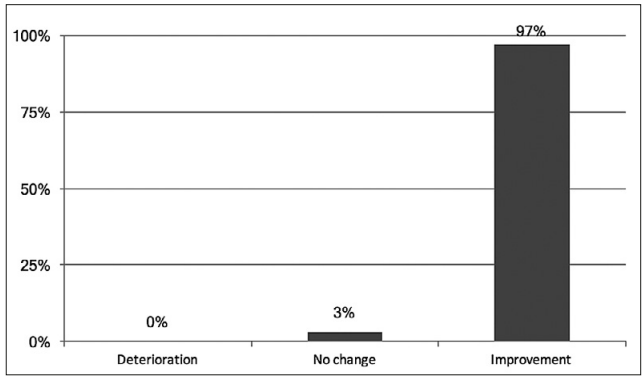

Figure 3. Efficiency of CTS treatment measured with the PROMIS® pain scale after treatment

consistent with a normal distribution, and the CTS treatment was not consistent with a normal distribution. Detailed results for the PROMIS® Upper Extremity questionnaire are shown in Table 3. Differences before and after treatment

Table 3. T-score distribution for PROMIS® Upper Extremity results before and after treatment

Variable	Min.	Max.	M±SD	Me	p
Before treatment	25.00	76.00	54.54 ± 11.16	55.00	<0.001
After treatment	18.00	80.00	67.80 ± 9.38	69.00	

proved to be statistically significant ($p<0.001$), and confirmed the effectiveness of the treatment.

Results obtained with the PROMIS®Upper Extremity, and PROMIS® Short Form 3a (Pain Intensity) questionnaires obtained before, and after CTS treatment clearly confirmed the effectiveness of the surgical treatment. The effectiveness of the treatment resulted in both a reduction in pain scores and reduction in disability. Based on the DASH and PROMIS® Upper Extremity questionnaires, a strong negative correlation was observed ($r=-0.64$; $p<0.05$), which indicates a high correlation between the questionnaires.

DISCUSSION

The increased incidence of CTS among women observed in this study is similar to that described elsewhere [31, 32]. In a study population of 100,000 people, Bongers [33] recorded 280 cases of CTS per year among women and only 90 cases among men per year. A higher incidence of CTS has also been reported in other studies [34]. The average age of manifestation of CTS was not significantly different from other studies (including a Polish study) [35]. A group of patients aged 51–60 years (21 persons) and 41–50 years of age (15 people) dominated in this study.

Working at the computer has been described in the literature as an important risk factor for CTS [36–46], but it is not the only cause of CTS associated with work [4, 6, 47]. In the study group of 69 respondents, up to 33 persons did not use a computer at work. Thomsen [48] concluded that there is insufficient evidence that working at the computer causes carpal tunnel syndrome. In that study, the average number of hours of work at a computer in the group of patients is very similar to other Polish studies [35].

Among the respondents, up to 87% reported a reduction in the average intensity of pain after surgery, which is consistent with the literature [49–54]. The final results of treatment evaluated using the PROMIS® Upper Extremity questionnaires proved that surgery helps to recover physical fitness of the upper limb. The use of research instruments, such as the PROMIS® Upper Extremity, PROMIS® Short Form 3a (Pain Intensity), and DASH questionnaires (translated into Polish), demonstrated favourable patient-reported results and allow for reliable comparisons with the results described in the literature.

CONCLUSIONS

The current study confirmed the efficacy of surgical treatment of CTS, which is reflected by the improved quality of life, as tested by the PROMIS® research instruments. Geographical and environmental conditions indicate that even though working with a computer is described as an important risk factor for CTS, the presented study group showed a predominance of factors that were unrelated to working at a computer. CTS also occurred among people working physically, and even among unemployed individuals.

Surgical release of the median nerve in nearly 90% of patients provided a reduction in average pain intensity. The existence of a statistically significant, strong, negative correlation ($r=-0.64$; $p<0.05$) between the results obtained in the questionnaires DASH and PROMIS®Upper Extremity has been demonstrated.

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