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The Effect of Wrist Braces on Curent Perception Threshold (CPT) among Female Data Processing Operators in Malaysia

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Abstract: A cross sectional study was conducted to evaluate the effect of wrist braces on current perception threshold value of median nerve among female data processing operators (n = 48). Respondents were interviewed using a validated questionnaire to obtain information such as demographics and background data, work history, symptoms pertaining to carpal tunnel syndrome. Electrodiagnostic examination was performed using Neurometer® CPT/C to obtain CPT level of median nerve on index and middle fingers among respondents before and after work, with and without wrist braces. CPT testing detected 15 respondents (31%) had median nerve abnormalities. Results from the paired t-test analysis showed no significant difference ($p > 0.05$) on CPT value after work with and without wrist brace used. However, this study suggests that CPT value showed an increased trend after data entry tasks when no wrist braces used and a reduced trend when wrist braces were used. This study concluded that wearing a wrist brace for a short period of time during repetitive activities has no immediate influence on CPT value among computer operators, however, this study suggests that wrist braces may be beneficial in protecting workers against median nerve compression.

Key words: Data processing operator · Current perception threshold · Wrist brace

INTRODUCTION

In Malaysia, no study had been done to evaluate the effect of using wrist braces on current perception threshold (CPT) level of the median nerve among persons with neurological symptoms associated with CTS or nerve compression. The emergence of the ergonomic products such as wrist braces has raises a concern on its effectiveness of usage.

The CPT is defined as the minimum amount of electrical impulses (Milliamperes) applied trans-cutaneously that an individual consciously perceives [1]. CPT testing is a lateral testing recommended enhancing the sensitivity of a peripheral neuropathy diagnosis procedure by testing the level of nerve impairment [2]. It is also used to screen for the onset of entrapment neuropathy such as carpal tunnel syndrome (CTS), which is associated with excess ergonomic stresses such as repetitive bending or flexing motions of the wrist and hand [3].

Recently in some countries, wrist braces have been marketed as personal protective equipment for preventing CTS in persons who work in high-risk occupations. The rationale for wrist braces was originally based on observations that CTS symptoms improve with rest and worsen with activity. There is only a study on the effect of wrist splint on the carpal tunnel pressure during repetitive hand activity [3]. It is not yet known, however, whether a wrist brace has effect on the CPT value.

The objective of this study was to evaluate whether the use of wrist brace during data entry task will influence the CPT values among computer operator workers. Simultaneously, this study was able to detect any median nerve abnormalities among them based on the grading criteria for CPT level.

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METHODS

The study was conducted as an intervention study and was done at the Department of Statistics Malaysia, Putrajaya. Samples frame were purposively selected using a simple questionnaire to determine the study sample. Purposive samplings were done to exclude factors that could confound the result of using wrist brace. The questionnaire included questions based for inclusive criteria's namely female with the age ranging from 20-50 years old, not pregnant during sample collection, currently free from chronic diseases and neurological problems such as diabetes, gout, arthritis and injury such as wrist fracture and had been working for at least 1 year as a data processing operator. Based on the inclusion criteria, forty eight female data processing operators were selected for this study. Respondents were interviewed using a validated questionnaires (κ = >0.8) to obtain related information such as demographics and background data, work history, hand symptoms and health status.

In this study, the same group of respondents was observed twice for 2 days. On the first day, they were observed without wearing any wrist brace and latter observation was made while wearing a wrist brace. Comparison was done to determine the difference between the two days. A full-time wearing of wrist braces (Model 2082) with difference sizes (S, M, L) were used.

The wrist braces was made up of breathable neoprene and 100% cotton inside lining with a removable aluminium splint which can easily be removed to fit left or right hand. The function of the wrist brace is to keep the wrist in a neutral position and avoid wrist injury. Figure 1 demonstrates the type of brace used.

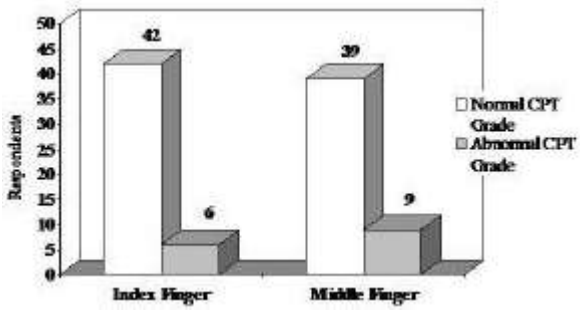

Fig. 1: CPT grade on median nerve of index and middle finger

On the first day, the respondents performed their daily works without wearing any wrist brace and on the second day, the same respondent was required to wear a wrist brace while performing their works. CPT measurement was performed twice in a day namely, before working and after working without wearing wrist brace and before working and after working with wrist brace. Measurement of CPT was done using Neurometer® CPT/C in a single-blind method with the equipment was placed out of the view of the respondents. A pair of 1 cm diameter disposable gold electrodes was applied: one on the lateral and the other on the medial aspect of index finger and middle finger. CPT was determined at three different sinusoidal frequencies of electrical stimuli, namely at 2000 Hz, 250 Hz and 5 Hz (Figure 2) and measured in milliamperes. Procedure was done according to guidelines provided by the Neurotron, Inc. Corp. USA. Classification of CPT was based on software interpretation (Neuval®) that graded abnormality into hyperesthetic, hypoesthetic and anaesthetic neuropathological condition. Table 1 shows CPT grading parameters.

Table 1: sNCT/CPT Grading Parameters

Grade Range	Clinical Characterization	Statistical Parameters
10.00 - 12.00	Anesthetic at one or more frequencies	No response to maximum stimulus
9.00 - 9.90	Severely hypoesthetic at one or more frequencies	Above healthy range and More than 4 S.D. above mean
8.00 - 8.82	Moderately hypoesthetic at one or more frequencies	Above healthy range and 3+ to 4 S.D. above mean
7.00 - 7.74	Mildly hypoesthetic at one or more frequencies	Above healthy range and 2+ to 3 S.D. above mean
6.00 - 6.62	Moderately hyperesthetic at one or more frequencies	Below healthy range and More than 2.5 S.D. below mean
5.00 - 5.52	Mildly hypoesthetic at one or more frequencies	Below healthy range and 1 to 2.5 S.D. below mean
4.00 - 4.82	Mild sensory dysfunction	Within-site ratio beyond healthy range by more than 30%
3.00 - 3.70	Very Mild sensory dysfunction	Within-site ratio beyond healthy range up to 30%
2.00 - 2.78	Extremely Mild sensory dysfunction	Between-sites ratio beyond healthy range by more than 30%
1.00 - 1.66	Extremely Mild sensory dysfunction	Between-sites ratio beyond healthy range up to 30%
0	No Abnormalities Detected	All measures within healthy parameters

This study was approved by the Medical Research Ethical Committee of Faculty of Medicine and Health Science, UPM (Reference no.: UPM/FPSK/TPK/100-11/40 (1-24)). All respondents had completed informed consent forms before involved in this study.

Data collected was analyzed using SPSS® (versions 11.0). Analyses involved descriptive statistics and paired t- tests. Significant level was determined at $p< 0.05$.

RESULTS

Demographic Information: A total of 48 out of 60 data processing operators were involved in this study. Ninety six percent of the respondents were Malay. Table 2 and Table 3 summarized the demographic information.

Distribution of CPT Intensity and CPT Grade on Right Hand Median Nerve: The study showed that the middle finger had higher mean CPT value at 2000 Hz and 250 Hz, while the index finger was higher at 5 Hz (Table 3). The study also showed that from CPT grading, 12.5% had abnormal CPT grade on the index finger and 18.75% had abnormality on the middle finger (Figure 1).

Comparison of CPT Level after Work with and Without Using Wrist Brace: Table 4 and Table 5 showed the obtained data for both groups (normal CPT grade and abnormal CPT grade respectively). The result showed that there were no significant differences ($P> 0.05$) on CPT value at all three frequencies after work when compared with using wrist brace and without using wrist brace for both groups. Figure 2 and Figure 3 showed changes in mean CPT at frequency of 2000 Hz at index and middle fingers before and after work when wrist brace was used and also when no wrist brace was used. It was observed that the group that had abnormal CPT grade showed a decreasing pattern of CPT intensity when wrist brace was applied compared to before wrist brace was used.

Table 2: General character of studied represent

Variables	Mean	SD	Median	S.E	Min	Max
Age	33	10.73	30.2	1.55	20	50
Weight (kg)	66.0	16.30	62.8	2.35	38	116
Height (cm)	154.9	5.65	155.85	0.82	142.8	167.5
BMI	27.5	6.19	27.27	0.89	18.36	45.69
Monthly income (RM)	926.5	308.69	800.0	44.56	543	1377
Employment Duration (year)	10.8	9.90	5.67	1.43	1	29

Table 3: Demographic and background information of the respondents

Variables	N=48 (%)
Races	
Malay	46 (96%)
Chinese	0
Indian	1 (2%)
Others	1 (2%)
Marital Status	
Single	24 (50%)
Married	23 (48%)
Divorce	1 (2%)
Educational Status	
SRP	2 (4%)
SPM	46 (96%)
Previous Employment	
Yes	31 (64.6%)
No	17 (35.4%)
Part time work	
Yes	0
No	48 (100%)
Dominant hand used for data entry	
Right	48 (100%)
Left	0

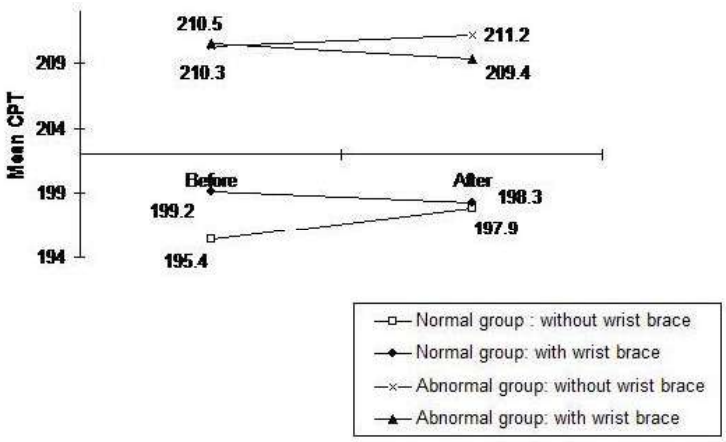

Fig. 2: Changes in mean CPT 2000Hz at index finger after work (with and without wrist brace)

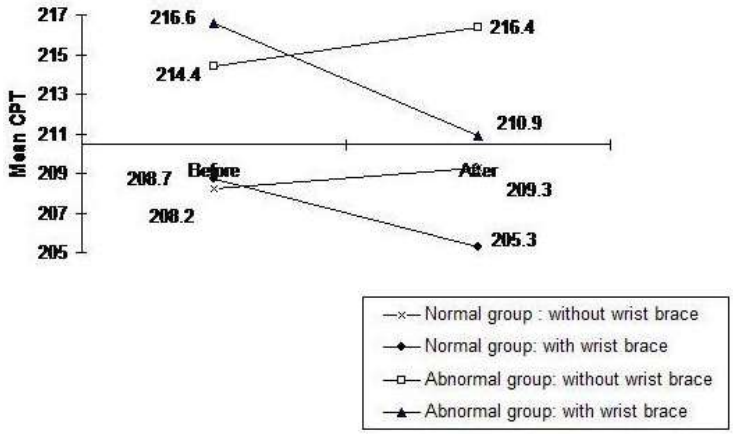

Fig. 3: Changes in mean CPT 2000Hz at middle finger after work (with and without wrist brace)

Table 4: CPT intensity on right hand

Fingers	Frequency (Hz)	Mean ± SD	Minimum	Maximum
Index	2000	200.06 ± 36.019	151	360
	250	78.98 ± 21.063	41	143
	5	47.25 ± 17.348	16	95
Middle	2000	210.15 ± 35.595	151	350
	250	81.73 ± 23.873	36	141
	5	44.77 ± 20.324	14	103

Table 5: The difference of mean CPT after work with and without wrist brace among normal CPT grade group

Fingers	Frequencies	With wrist brace (Mean ± SD)	Without wrist brace (Mean ± SD)	t- value	p- value
Index	2000Hz	198.3 ± 28.01	197.88 ± 31.01	-0.216	0.831
	250Hz	77.79 ± 19.57	81.52 ± 20.35	1.261	0.217
	5Hz	45.88 ± 14.57	47.64 ± 13.67	1.135	0.265
Middle	2000Hz	205.3 ± 30.52	209.33 ± 33.16	1.432	0.162
	250Hz	87.36 ± 20.39	87.45 ± 17.18	0.041	0.967
	5Hz	45.97 ± 18.75	46.24 ± 16.32	0.185	0.854

Table 6: The difference of mean CPT after work with and without wrist brace among abnormal CPT grade group

Fingers	CPTFrequencies	With wrist brace (Mean ± SD)	Without wrist brace (Mean ± SD)	t- value	p- value
Index	2000Hz	209.40 ± 40.92	211.20 ± 41.76	0.709	0.490
	250Hz	75.27 ± 25.91	78.13 ± 26.41	0.733	0.476
	5Hz	41.27 ± 19.02	43.47 ± 19.79	1.074	0.301
Middle	2000Hz	210.93 ± 28.97	216.40 ± 33.38	1.021	0.324
	250Hz	69.53 ± 24.23	73.60 ± 23.74	0.893	0.387
	5Hz	39.00 ± 27.10	41.67 ± 25.69	1.776	0.097

DISCUSSION

This study involved a total of 48 female workers aged 20 - 50 years (mean = 33 ± 10.73 years). A majority of the respondents were Malay and all use right hand while performing data entry task. The mean duration of employment was 10.8 ± 9.90 years with the median of 5.67 years.

The result showed that the middle finger had higher mean CPT value at 2000Hz and 250Hz, while the index finger was higher at 5 Hz. The frequency at 2000 Hz was used to test the large myelinated nerve fibers, whereas the frequency at 250 Hz used to test the small myelinated nerve fibers and 5 Hz used to test the small unmyelinated nerve fibers. The study indicate an overall normal mean of CPT intensity of index and middle finger but looking at the maximum intensity showed that large mylinated nerve fibers were very high indicating abnormal CPT intensity for both index and middle finger (3.6 mA and 3.5 mA respectively). Therefore we can indicate an early stage of CTS since the study reveal that the CPT grade with a total of 31% had abnormal CPT grade on right hand. Then result showed 6% had hyperesthetic condition, beside 2% were characterized as hypoesthetic and 23% showing a gradual problem of early CTS.

Study done by Subra [4] among insecticide applicators in Klang Valley to determine the effect of pesticide reveal a similar pattern indicating that a higher CPT intensity was found at 2000 and 250 Hz. This would indicate problem affecting the mylinated nerves fibers compared unmylinated fibers. A higher intensity was observed compared to the current study indicating that majority of the insecticide applicators has worked more than 24 years.

Another study done by Husin [5] also indicated that farmers that were exposed to pesticide had significant elevated CPT values for both 2000 Hz and 250 Hz compared to control groups. While no significant elevation was observed for 5 Hz indicating that mylinated sensory nerve fiber was affected. A study done by Youichi [6] also found the similar pattern among Japanese workers that were exposed to vibration.

Several studies had shown that the use of CPT could indicate the effectiveness of an intervention program to reduce CTS problem such as studies done by Katims [7], but the focus was given more into surgical treatment rather than conventional type of treatment such as wrist brace. Akiyo [8] in his study also indicate a comparative measurement of pre and postoperative of CTS and indicate that CPT was a good indicator to determine the effectiveness of the operation.

The finding from this study showed there was no significance difference ($p > 0.05$) on CPT value after work, either wrist braces were used or no wrist braces used for both groups. Although the finding of this study showed no significant difference statistically on CPT value, we were able to observe that the CPT value tend to reduce when the wrist brace were applied compared when no wrist brace were applied. From this study we are able to observe that the use of wrist brace will reduce the compression of the media nerve especially the large and small mylinated sensory nerve fibers as the neurometer measures the intensity of CPT value of large mylinated at 2000 Hz and the small mylinated at 250 Hz.

There are several assumptions on the reason that we are not able to observe a significant reduction of CPT intensity. One of the setbacks of this study was that we are not able to determine a long effect of wrist brace application to the respondent. In this study, we tried to limit a period of only 4 hours for each respondent to reduce uneasiness and to standardize their break hour. Therefore longer period of wearing is needed to observe any significant improvement in wearing a wrist brace as suggested by Peæina *et al*. [9]. Pecina reported that, 50% to 70% of all patients diagnosed with CTS had relief symptoms without surgical treatment but the treatment of splinting on CTS patients needed about 3 to 6 weeks to recover, provided the wrist was kept in a neutral position always. O'Connor [10] in another study suggested that the effectiveness and duration of benefit for non surgical treatment such as the use of wrist brace remain unknown.

Another possible reason was the number of sample size. The sample size in the study considered being very small but from the selective of inclusive criteria, out of 60

data processing operators; only 48 respondents were suitable to be included in the study. We can assume if a bigger sample were available, we would be able to observe a significant reduction of CPT values.

CONCLUSIONS

This study is a preliminary study to evaluate the effect of wrist braces on CPT value among data processing operators. At the same time, this study was able to assess median nerve function, in which CPT testing detected 15 respondents (31%) with abnormal CPT grade.

Though this study was not able to proof the effectiveness of the wrist brace statistically, through CPT measurement, we were able to observe that a reduction trend when the wrist brace were applied to the respondents. This study concluded that wearing a wrist brace for a short period of time during repetitive activities has no immediate effect on CPT value.

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