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ORIGINAL RESEARCH **PAIN MEDICINE**

The effect of nerve gliding on clinical outcome in batik workers of Yogyakarta with carpal tunnel syndrome

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ABSTRACT

Background: The carpal tunnel syndrome (CTS), if left untreated, handicaps the manual workers and incurs heavy financial loss to them due to loss of their productivity and the cost on treatment. The nerve gliding exercises can speed up the rehabilitation process in these patients and improve their function. We aimed to observe the clinical efficacy of nerve gliding in reducing pain enhancing productivity in batik workers.

Methodology: This study is a quasi-experimental and the subject were batik workers in Yogyakarta, Indonesia. Subjects who met the criteria were divided into Group I (n = 18) received nerve gliding with mecobalamin 3x500 µg and Group II (n = 17) as controls received 3x500 µg mecobalamin only. The pain relief was observed in the form of Visual Analog Scale (VAS) score and Boston Carpal Tunnel Questionnaire (BTCQ) score consisting of BTCQ symptom severity scale and functional status scale (FSS).

Result: In paired t-test we found significant decrease in VAS scores in Group II on week 2 and 3. From the Wilcoxon test we found significanly decreased VAS scores on week I, 2 and 3 in Group I. From the Wilcoxon test we found significanly reduced BTCQ scores on week 3 in Group II, and significanly reduced BTCQ scores in Group I at week I, 2, and 3. The decrease in VAS and BTCQ was significantly higher in the Group I than Group II. Based on the multivariate analysis of model I, the nerve gliding gave significant effect on VAS (P = 0.001) and BTCQ (P = 0,000) scores.

Conclusion: There is significant clinical improvement by using nerve gliding and mecobalamin for 3 weeks to batik workers in Yogyakarta.

Abbreviations: BTCQ - Boston Carpal Tunnel Questionnaire; CTS - Carpal Tunnel Syndrome; FSS - Functional Status Scale; NSAIDS - Nonsteroidal Anti-Inflammatory Drugs; PO – Per Orum; ROM - Range of Motion; VAS - Visual Analog Scale

Key words: Carpal Tunnel Syndrome; Clinical Outcome; Nerve Gliding; Safe Working Environment; Human

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1. INTRODUCTION

Batik processes involve repetitive hand movements, hand movements with force, pressure on the hands or wrists, static hand positions, non-ergonomic hand and upper body positions, and flexion and extension positions of the hands, all of which are risk factors for the carpal tunnel syndrome (CTS).[1,2]

CTS is a neuropathic condition caused by median nerve entrapment associated with workload. The prevalence in general population has been reported approximately 1/1000 per year.[3] In Indonesia, the prevalence of work-related CTS is unknown because of very few reported occupational diseases diagnosed. Studies related to CTS in high-risk occupations have reported prevalence of CTS as 5.6-14.8%.[4]

CTS is the most common entrapment neuropathy and musculoskeletal disorder of the upper extremity caused by work which causes functional disability and significant costs.[5]

The main problem in workers with CTS is the accessibility of proper therapy and its financing. Healthcare costs for CTS are estimated from $5000/- per case for conservative treatment to $60,000/- for surgical intervention. Workers with CTS lose significant productivity and wages.[6] Functional losses due to CTS affect the ability to perform daily activities.[7]

The diagnosis of CTS is made based on clinical criteria such as symptom assessment, physical examination, and clinically provocative tests, followed by electrodiagnostic evaluation such as electromyography (EMG) nerve conduction studies (NCS), carpal tunnel sonography, and magnetic resonance imaging (MRI) to confirm the diagnosis. Sonographic examination and electrodiagnostic evaluation are invasive tests for the diagnosis of CTS, but are expensive and not applicable in all health services.[8] The clinical diagnosis of CTS was established according to the criteria of Chang et al. which includes numbness and tingling in the median nerve area, nocturnal paresthesias, positive Phalen's test, positive Tinel's sign, and wrist pain radiating to the shoulder.[9] According to Giannini et al., only one clinical scale for CTS is available in the scientific literature, the clinical historical-objective scale (Hi-Ob).[10,11] This scale has no diagnostic purpose but correlates well with patient-oriented findings and neurophysiological disorders of the median nerve[10-13] and useful for clinical assessment of CTS severity.[10,11,14,15]

Conservative therapy includes splinting, local injection of corticosteroids, and oral treatment with other drugs such as corticosteroids, vitamin B6, vitamin B12 or nonsteroidal anti-inflammatory drugs (NSAIDs).[16] Standard conservative therapy is the most appropriate option for pain and functional improvement. Nerve gliding exercises can accelerate the rehabilitation process, improve pain and function, and avoid the surgical intervention.[17] Although there is evidence of the nerve gliding exercises effectiveness, their use still remains controversial.[18]

Nerve gliding is a range of motion (ROM) exercise of the upper extremity and neck that produces tension and longitudinal movement along the median and other nerves of the upper extremity. These exercises are based on the principle states the tissues of peripheral nervous system are designed for movement. The tension and nerve gliding produced may affect the neurophysiology through the changes in vascular and axoplasmic flow. The exercises are simple and can be performed by the patient himself after brief instructions.[19]

The purpose of this study was to determine and document the clinical improvement of CTS by administering nerve gliding exercises and mecobalamin for 3 weeks to batik makers in Yogyakarta.

2. METHODOLOGY

This study uses a quasi-experimental type of research. The subjects were batik makers in Lendah Kulonprogo Yogyakarta working at batik small and medium-sized enterprises (SMEs) in Lendah Kulonprogo Yogyakarta for at least 20 h/week for minimum of 12 months, with a clinical diagnosis of CTS according to the criteria of National Institute of Occupational Safety and Health (NIOSH). The respondents followed regular exercises every day for 3 weeks with consent. Exclusion criteria were CTS grade 4 and 5 based on the Hi-Ob scale, experiencing wrist trauma (fractures), pregnant, history of stroke, history of arthritis, alcohol consumption, currently taking steroids, NSAIDs, and cholesterol lowering drugs, and participated in neural glide exercises for less than 75% of the schedule.

The method was directed to determine the effect of nerve gliding exercise plus mecobalamin compared with only mecobalamin on the clinical outcomes in CTS.

The Group I was given daily nerve gliding exercise for 5-10 min and mecobalamin 3x500 µg for up to 3 weeks and being compared with the Group II given mecobalamin 3x500 µg for up to 3 weeks. Clinical evaluation in the form of Visual Analog Scale (VAS) and Boston Carpal Tunnel Questionnaire (BTCQ) score consisting of BTCQ symptom severity scale and functional status scale (FSS) was performed weekly in each group. Nerve gliding exercises performed according to the Totten and Hunter Exercises were taken from the leaflet of Arthritis Research UK in collaboration with the Chartered Society of Physiotherapy. Data analysis and statistical calculations

Table 1: Subjects Characteristics

Characteristics		Group II (Control)	Group I (Treatment)	Total	P
Sex	Male	5 (29.4)	3 (16.7)	8 (22.9)	0.443
	Female	12 (70.6)	15 (83.3)	27 (77.1)	
Age (y)	> 60	0 (0.0)	2 (11.1)	2 (5.7)	0.486
	< 60	17 (100.0)	16 (88.9)	33 (94.3)	
Mean		37.8 ± 8.7	46.4 ± 9.8		
Education	Low	10 (58.8)	16 (88.9)	26 (74.3)	0.060
	High	7 (41.2)	2 (11.1)	9 (25.7)	
No. obesity		17 (100.0)	18 (100.0)	35 (100)	
Mean BMI (Kg/m^2)		21.94 ± 3.47	22.48 ± 2.4		
Hypertension		0 (0.0)	1 (5.6)	1 (2.9)	1.000
DM		1 (5.9)	0 (0.0)	1 (2.9)	0.486
Smoke		3 (17.6)	3 (16.7)	6 (17.1)	1.000
Hormonal Contraception		4 (23.5)	6 (33.3)	10 (28.6)	0.711
Hand Injury		0 (0.0)	1 (5.6)	1 (2.9)	1.000
Occupation	Canting	9 (52.9)	12 (66.7)	21	0.849
	Cap	3 (17.6)	2 (11.1)	5	
	Celup	2 (11.8)	2 (11.1)	4	
	Serabutan	3 (17.6)	2 1.1)	5	

Data presented as n (%) or mean ± SD; P ≤ 0.05 considered as significant

were carried out in order to test the difference in the efficacy of the nerve gliding exercises. The research analysis used an independent t test.

3. RESULTS

There were 22 subjects in the Group II or mecobalamin group, 5 subjects dropped out and 17 subjects were left. There were 18 subjects in the Group I or nerve gliding and mecobalamin group. The demographic characteristics and the co-morbids are shown in Table 1. The difference in the characteristics in both groups was not statistically significant (P > 0.05). In the initial VAS, FSS, and BTCQ evaluation, there was no difference in the mean VAS and FSS before treatment between Group I and II (P > 0.05). While the BTCQ score in the Group I was higher than the Group II with a significant difference (P < 0.05) (Table 2).

The VAS scores decreased every week in both control and treatment groups. The results of Paired T test in Group II show that there was a significant difference in VAS starting at week 2 and 3 (P < 0.05). The results of the Wilcoxon test in the Group I show a significant difference in VAS starting at weeks I, 2 and 3 (P < 0.05). This means that the pain reduction was significantly faster in nerve gliding and mecobalamin, as seen in week I (Table 3).

The weekly BTCQ data decreased in both groups. From the results of the Wilcoxon test, it was found that there was a significant difference between BTCQ pre therapy value and week 2 value in the Group II; a significant difference in BTCQ at week 3 in the Group II and at week I, 2, and 3 in the Group I. This means that the decrease in BTCQ was significantly faster in nerve gliding and mecobalamin, as seen in week I (Table 4).

Table 2: VAS, BTCQ, and FSS difference before treatment (homogeneity)

Variable	Group II (Control)		Group I (Treatment)		P
	Mean ± SD	Median (Min-Max)	Mean ± SD	Median (Min-Max)	
VAS	4.1 ± 2.0	4.0 (0.8-7.0)	4.3 ± 1.9	4.4 (1.0-8.5)	0.792
BTCQ	18.4 ± 5.5	16.0 (12.0-33.0)	22.4 ± 5.4	22.5 (13.0-36.0)	0.005
FSS	8.0 ± 0.0	8.0 (8.0-8.0)	8.0 ± 0.0	8.0 (8.0-8.0)	1.000

Mann Whitney test; P ≤ 0.05 considered as significant

The decrease of VAS in the Group I was higher than the Group II (P = 0.001) (Table 5), the difference being significant which means there was a positive effect of nerve gliding on the VAS of CTS subjects. The decrease in BTCQ in the Group I was also higher than the Group II (Table 5). The difference was significant (P = 0.000), which means there was a positive effect of nerve gliding on the BTCQ of CTS subjects.

Table 3. Difference of pre and post VAS scores

Group	Observation	Mean ± SD	Median (Min-Max)	P
Control	Pre	4.1 ± 2.0	4.0 (0.8-7.0)	
	Week I	3.6 ± 2.1	3.5 (0.2 − 6.5)	0.074#
	Week 2	2.9 ± 2.1	2.7 (0.0-6.6)	0.015#
	Week 3	2.6 ± 1.9	2.0 (0.0-6.4)	0.008#
Treatment	Pre	4.3 ± 1.9	4.4 (1.0 − 8.5)	
	Week I	2.5 ± 1.6	2.4 (0.0-6.4)	0.000$
	Week 2	1.3 ± 1.2	1.2 (0.0-4.1)	0.000$
	Week 3	.6 ± 0.7	0.3 (0.0-1.9)	0.000$

 # - Paired T test; $ - Wilcoxon test; P ≤ 0.05 considered as significant

Table 4. Difference of pre and post BTCQ scores

Group	Observation	Mean ± SD	Median (Min-Max)	P
Control group	Pre	18.4 ± 5.5	16.0 (12.0-33.0)	
	Week I	18.1 ± 5.9	16.5 (12.0-34.0)	0.929
	Week 2	15.8 ± 4.2	14.5 (11.0-22.0)	0.104
	Week 3	15.8 ± 4.1	15.0 (11.0-23.0)	0.030
Treatment group	Pre	22.4 ± 5.4	22.5 (13.0-36.0)	
	Week I	18.4 ± 4.9	20.0 (11.0-26.0)	0.000
	Week 2	17.0 ± 4.2	19.0 (11.0-23.0)	0.000
	Week 3	13.7 ± 3.1	13.0 (11.0-19.0)	0.000

 # - Paired T test; $ - Wilcoxon test; P ≤ 0.05 considered as significant

The results of the relationship of external variables with a decrease in VAS found that there was no significant correlation between sex, age, education, obesity, hypertension, diabetes, heart disease, smoking, hormonal contraception, hand trauma, and thyroid on a decrease in VAS (P > 0.05) (Table 6). The relationship of external variables with a decrease in BTCQ revealed that there was no significant correlation between gender, age, obesity, hypertension, DM, heart, smoking, hormonal family planning, hand trauma, and thyroid on a decrease in VAS (P > 0.05). Meanwhile, the decrease in BTCQ in lower education was higher than in higher education with a significant difference (P = 0.023) (Table 7).

Table 5: Overall differences of VAS and BTCQ decrement between the two groups

Parameter	Control Group	Treatment Group	*p*
VAS Difference	1.48 ± 2.02	3.76 ± 1.64	0.001
BTCQ	2.65 ± 5.02	8.78 ± 3.86	

Data presented as Mean ± SD; Independent T test; P ≤ 0.05 is significant

4. DISCUSSION

This study shows that nerve gliding positively affects clinical improvement of CTS. This research shows that administering nerve gliding exercises and mecobalamin 500 µg 8 hourly (PO is more effective than using mecobalamin 500 µg 8 hourly (PO) for CTS clinical improvement. The results of the VAS scores improved in the Group I compared to Group II (P = 0.001) and the decrease in BTCQ scores was higher in the Group I compared to Group II (P = 0.000).

Another similar study by Ballestero-pére et al. had similar results as our results; they reported greater and faster reduction in pain, decrement of distal sensitive latency, increment of stimulation time, and functional improvement such as pinch grip, which precluded patients from surgical intervention as CTS treatment involving nerve mobilization.[17] Wolny & Linek reported that neurodynamic techniques give better improvement for CTS, and were more effective in improving nerve conduction, pain and symptom severity, and functional status, but were not effective in improving motor strength.[20]

CTS clinical improvement in this study occurs due to the mechanism of neurogliding action according to Etema et al. and Mckeon & Yancosek who stated that nerve

Table 6: Correlation of external variables and VAS scores

Variables		VAS differences	P
Sex	Male	-3.47 ± 2.66	0.223
	Female	-2.41 ± 1.96	
Age	> 60 y	-3.80 ± 3.96	0.445
	< 60 y	-2.58 ± 2.08	
Education	Low	-2.57 ± 2.19	0.683
	High	-2.91 ± 2.12	
Obesity	No	-2.65 ± 2.15	
Hypertension	No	-2.54 ± 2.06	0.061
	Yes	-6.60	
DM	No	-2.59 ± 2.14	0.295
	Yes	-4.90	
Heart Disease	No	-2.65 ± 2.15	-
Smoke	No	-2.46 ± 1.92	0.241
	Yes	-3.60 ± 3.06	
Hormonal Contraception	No	-2.75 ± 2.22	0.689
	Yes	-2.42 ± 2.03	
Hand Injury	No	-2.60 ± 2.15	0.365
	Yes	-4.60	
Thyroid	No	-2.65 ± 2.15	

Data presented as Mean ± SD; Independent T test; P ≤ 0.05 is significant

Table 7: Correlation of external variables and BTCQ scores

Parameters		BTCQ Differences	*P*
Sex	Female	-6.15 ± 5.56	0.490
Age	>60 y	-9.50 ± 3.54	0.324
	<60 y	-5.58 ± 5.43	
Education	Low	-7.00 ± 5.03	0.023
	High	-2.33 ± 5.10	
Obesity	No	-5.80 ± 5.38	
Hypertension	No	-5.62 ± 5.35	0.248
	Yes	-12.00 ±	
DM	No	-5.50 ± 5.16	0.053
	Yes	-16.00 ±	
Heart Disease	No	-5.80 ± 5.38	-
Smoke	No	-5.93 ± 5.42	0.757
	Yes	-5.17 ± 5.64	
Hormonal Contraception	No	-5.80 ± 5.67	1.000
	Yes	-5.80 ± 4.87	
Hand Injury	No	-5.59 ± 5.32	0.179
	Yes	-13.00 ±	
Thyroid	No	-5.80 ± 5.38	-

Data presented as Mean ± SD; Independent T test; P ≤ 0.05 is significant

gliding is a technique that improves symptoms associated with CTS.[21,22] Mckeon & Yancosek explained that neural gliding can improve nerve travel, reduce adhesions, and reduce symptoms by allowing the nerves to move freely. Thereby, it helps to improve the

oxygenation of nerves and thus relieve the ischemic pain.[22] Nerve gliding is an exercise consisting of a wide range of motions (ROM) of the upper limb and neck that produces quality and longitudinal movement along the median and other nerves of the upper extremity. This appropriates with the principle that states nervous system tissues are designed to move and glide, and nerve gliding may effects on neurophysiology through vascular and axoplasmic flow changes.[19] Bardak et al. described nerve gliding effects on CTS symptoms obtained by stretching the adhesions in the carpal canal, expanding the longitudinal contact area between the median nerve and the transverse carpal ligament, reducing tenosynovial edema, improving venous return of the nerve bundle, and reducing pressure in order to improve carpal flow.[23] Wolny & Linek's hypothesis states that nerve gliding exercises may increase blood supply, reduce irritation, and increase nerve's longitudinal movement to improve its physiological function which is to reduce intraneural edema, increase axial transport, reduce intraneural pressure, and reduce the mechanical sensitivity.[20]

Nerve gliding is able to improve CTS patients clinically especially in batik makers with CTS; it can reduce treatment costs and prevent functional disorders causing the decreased batik productivity.

5. LIMITATIONS

The possibility of recall bias, interviewer bias, and follow-up bias while getting information, lack of control and ineffective use of drug control cards are the limitations of this study. The geographical condition of the Lendah sub-district which is far from researcher makes the CTS diagnosis to be based on clinical questionnaires and post-treatment evaluations only.

5. CONCLUSION

There was a clinical improvement in CTS by administering nerve gliding exercises and mecobalamin for 3 weeks to batik makers in Lendah Kulonprogo Yogyakarta.

6. Data availability

The numerical data generated during this research is available with the authors.

7. Conflict of interest

Authors declare no conflict of interests.

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This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

10. Authors' contribution

CT, A: concept of the work, literature research, manuscript drafting

HBH: literature research, data analysis, manuscript editing

VAP, EFI: literature research, manuscript reviewing and revising

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