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Original Research

Effect of Adding Kinesiotaping to Median Nerve Gliding Exercise Toward Hand Performance of Patients with Carpal Tunnel Syndrome by Using Michigan Hand Outcomes Questionnaire

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ABSTRACT

Background: CTS occurs due to local compression of the median nerve with manifestations of neuropathy, mostly in the productive population. Many conservative treatments have been observed to reduce the degree of pain and quality of life in CTS patients. Kinesiotaping is a new therapy that has been widely used for various musculoskeletal conditions and is known for reducing median nerve compression.

Aim: To determine the effect of adding kinesiotaping to median nerve gliding exercise on hand function in CTS patients by using the Michigan Hand Outcomes Questionnaire.

Methods: This research was an experimental randomized pre-and post-test group design. A sample of 24 patients from the Medical Rehabilitation Outpatient in RSUP Dr. Kariadi were divided into two groups randomly. The intervention group (n=12, dropout 1) got kinesiotaping application and median nerve gliding exercise. The control group (n=12, dropout 1) did the median nerve gliding exercise only. Hand performance has been evaluated before and at the end of the 4th week of treatment by using the Michigan Hand Outcomes Questionnaire.

Result: There were significant improvements in the intervention group's right-hand function (p<0,001), activities of daily living (ADLs) or the ability of the right hand to do certain tasks (p<0,001), work performance (p<0,001), pain (p=0,024), and satisfaction (p<0,001), as compared to the control group. Meanwhile, the intervention and the control group did not show significant differences in left-hand function score (p=0.884), left-hand ability score (p=0.884), and aesthetics score (p=1,000).

Conclusion: There was a positive effect on improving hand performance in CTS patients by adding kinesiotaping to median nerve gliding exercises.

Keywords: *carpal tunnel syndrome, kinesiotaping, Michigan Hand Questionnaire, hand performance, pain*

INTRODUCTION

Carpal Tunnel Syndrome (CTS) is a neuropathy that occurs due to local compression of the median nerve in the carpal tunnel and causes symptoms such as pain, tingling, numbness, and burning, or a combination of these symptoms affecting the palmar aspect of the thumb, index finger, middle finger, and the radial side of the ring finger.[1] A study conducted by Pangestuti on 39 grinding workers in Surabaya showed the prevalence of CTS by 87.2%.[2]

Some conservative therapies have been widely known, such as tendon gliding exercises, nerve gliding exercises, modality, kinesiotaping, wrist splints, injections of steroids or nonsteroidal anti-inflammatory drugs, vitamin B12, and activity modification.[2,3] Median nerve gliding exercises have been popular for CTS cases as a conservative treatment.[4,5] This exercise helps the nerve slide from the distal segment to the carpal tunnel and forearm, starting with the most relaxed median nerve and then gliding it to maintain or increase the distance to 10-15 mm.[5,6] The biomechanical effect of median nerve mobilization can reduce edema and adhesions in the carpal tunnel by increasing blood flow to median nerve thereby helping nerve regeneration and improving nerve conduction.[5,6] This treatment showed improvement in hand function.[4-7]

Several studies using nervus medianus gliding exercises compared to other conservative therapies in CTS patients reported greater and faster pain recovery, and also improved hand function, eventhought the differences were not significant. It can be concluded that the administration of nervus medianus gliding exercises can produce better symptom improvement when combined with other conservative therapies.[1,3,5]

Kinesiotaping is a new therapy that has been widely used for various musculoskeletal conditions.[8,9,10] Kinesio tape is developed by dr. Kenzo Kase in Japan. It is an elastic band consisting of polymer elastic material wrapped in 100% fiber which has elastic properties resembling muscles, skin, and fascia. The elastic quality of kinesio tape is effective for three to five days and can be stretched longitudinally from its original length.[11] Kinesiotaping application on the wrist of CTS patients can reduce compression of the median nerve and control the movement that compresses the tendons and ligaments, so it can prevent further injury and may facilitate tissue repair.[2,12-14] The study of Kulcu et al.[15] regarding the addition of kinesiotaping in CTS patients' therapy reported improvement in wrist pain and increasing the hand function. Another study by Kaplan et al.[16] reported the addition of kinesiotaping along with orthosis at night showed better symptoms improvement compared to orthosis usage alone.

In Carpal Tunnel Syndrome, there are several instruments or measurements that can be used to assess the outcome of several therapies given to CTS sufferers, especially after carpal tunnel release. One of them is The Michigan Hand Outcomes Questionnaire (MHQ), a patient-rated questionnaire instrument, meaning that patients are self-assessing their health status. This instrument is based on the psychometric principles of psychological assessment (reliability, validity, standardization, and unbiasedness). The Michigan Hand Outcomes Questionnaire comprehensively assesses the upper extremity.[17]

The Michigan Hand Outcomes Questionnaire (MHQ) is developed using a questionnaire consists of 37 items and can be roughly divided into 6 domains consisting of overall hand function, activities of daily living (ADLs) or ability of hand to do certain task, work performance, pain, aesthetics, and satisfaction. The questions are based on a

patient's hand or upper extremity experience over the past week.[18]

There are currently no studies which explains the adding of kinesiotaping to median nerve gliding exercises for CTS patients. Therefore, this study aims to determine the effect of adding kinesiotaping to median nerve gliding exercise in CTS patients compared to median nerve gliding exercise alone on hand performance in CTS patients by using the Michigan Hand Outcomes Questionnaire. The hypothesis in this study is adding kinesiotaping could improve the hand performance of CTS patients who receive median nerve gliding exercises as measured by The Michigan Hand Outcomes Questionnaire

Material and Method

Participants

This study was carried out after obtaining ethical clearance from the Ethics Commission of the Faculty of Medicine, Diponegoro University/ RSUP Dr. Kariadi Semarang No. 267/EC/KEPK-RSDK/2019. This study was a randomized controlled trial with pre- and post-test group designs in CTS patients. All subjects that met the inclusion criteria and passed the exclusion criteria were divided into two groups. Group allocation was done through simple randomization. The sample size was calculated using the mean difference formula for each group. Based on the calculation of the sample size, the minimum number of research subjects for each group is ten. To anticipate the possibility of dropping out, the research subjects for each group were added to twelve people per group. The research was conducted at the Medical Rehabilitation Outpatient, Murai Installation, RSUP Dr. Kariadi Semarang, in October - November 2019. Inclusion criteria for this study are patients aged 30-60 years old, meeting the diagnostic criteria for CTS with pain in the first to third fingers, and also in half of the fourth finger. Regarding to the distribution of median nerve for more than four weeks in one hand, there was no atrophy of the muscles innervated by distal median nerve through carpal tunnel, such as abductor pollicis brevis, opponent pollicis, flexor pollicis brevis, and the first to second lumbrical muscles, positive provocative test, VAS 3-5 and moderate CTS based on EMG examination which had good SNAP, distal motor latency of the abductor pollicis brevis muscle counted <6.5 ms. Exclusion criteria for subjects were secondary etiologies of CTS such as fracture, diabetes mellitus with neuropathy, hypo/ hyperthyroidism, hand infection, tophus gout, rheumatoid arthritis, congenital carpal tunnel deformity, wrist tumor, hand edema, pregnancy, drug use (oral contraceptives, anticoagulants), had undergone CTS decompression surgery, received other conservative therapy for CTS, such as corticosteroid injection in the past one year, ergonomic modifications in the last three months, tendon – nerve gliding exercise in the last two months, splinting, manual therapy, SWD, MWD, taking diuretics and NSAIDs in the past one month, ultrasound diathermy therapy in the last six months, taking vitamin B6 in the last two months, taking vitamin B12 in the last two weeks, received oral corticosteroids/ iontophoresis/ phonopheresis in the last 3 months, acute inflammation in median nerve or in acute pain, there was another neuromusculoskeletal pain on the same side of the upper extremity.

The drop-out criteria was not coming for installation or removal of kinesiotaping on schedule (one time), not performing median nerve gliding exercise for five days, obtaining other conservative therapy while the study was ongoing, and not complying with research procedures.

All subjects who met the research criteria were grouped into two groups. The control group only got median nerve gliding exercise, while the intervention group got

the addition of kinesiotaping to median nerve gliding exercise.

The median nerve gliding exercise protocol consisted of; 1. wrist in neutral position with flexed fingers and thumb; 2. wrist in neutral position with extended fingers and thumb; 3. extended wrist and fingers with neutral thumbs; 4. extended wrist, fingers, and thumb; 5. extended wrist, fingers, and supinated thumb forearm; 6. extended wrist, fingers, and thumb, supinated forearm, thumb stretched toward extension. These series of movements are performed sequentially, with each movement held for 5 seconds. All movements are repeated 10 times, 3-5 times a day.

Application of kinesio taping in CTS with installation techniques direction of the target muscle fiber from insertion (distal) to origin (proximal) using kinesio tape with a standard width of 5 cm, the length is measured at a distance of 5 cm from the folds between the III-IV digits on the dorsum of the manus, passing through the folds between the III-IV digits to the volar aspect to the elbow crease. Kinesio taping is first applied in an I-shape from insertion to origin, starting from 5 cm without traction on the dorsum of the manus; through the folds between the third and fourth digits of the manus with 25% traction towards the medial epicondylus; elbows and wrists positioned in full extension; and terminating at the medial epicondyle without tension, 2.5 cm long. The second I-shaped kinesio taping is measured according to the circumference of the wrist and applied circularly to the wrist joint. In this kinesio taping application, the direction of the stretch is parallel to the flexor tendon, so the flexor pressure is reduced, and resulting in reduced pain.

The intervention group received kinesio taping seven times for four weeks; kinesio taping was installed for three days, then removed on the third day, the following installation will be in the next 24 hours; and median nerve gliding exercises was three times a day, seven days per week (Monday-Sunday) for four weeks. The control group only received nerve gliding exercises with the same frequency.

Examination Protocol

At the beginning of this study, the subjects were explained about carpal tunnel syndrome, treatment options, goals and benefits, and the study protocol. Patients were given directions not to do other therapies.

The hand performance was evaluated by using the Michigan Hand Outcomes Questionnaire at the beginning and end of the fourth week of the treatment.

The hand function domain is scaled from 1 to 5 and defined as; 1 very good; 2 good; 3 fair; 4 poor; 5 very poor. The activities of daily living (ADLs) or ability of the hand to do certain task domains are scaled from 1 to 5 and defined as follows; 1 no difficulties; 2 slight difficulties; 3 marked difficulties; 4 moderate difficulties; 5 very difficult. The work performance and pain domains that refer to how often participants did daily activity (including both job and housework) and how often participants felt pain are scaled from 1 to 5 and defined as: 1 always; 2 often; 3 sometimes; 4 rarely; and 5 never. The aesthetics domain refers to the appearance (look) of hands and is scaled from 1 to 5 and defined as; 1 strongly agree; 2 agree; 3 neither agree nor disagree; 4 disagree; 5 strongly disagree. The satisfaction domain is scaled from 1 to 5 and defined as: 1 very satisfied; 2: satisfied; 3: neither satisfied nor dissatisfied; 4: dissatisfied; and 5: very dissatisfied. Monitoring of the median nerve gliding exercise was carried out three times a day via group in WhatsApp every day for four weeks and the subjects need to report their median nerve gliding exercise at home.

RESULTS

In this study, the age of the subjects ranged from 23-57 years, with a mean of age 41 (9,1) in the intervention group and age 40,1 (±7,98) in the control group. Table 1 described the demographic data of the subjects. There was no significant differences between the groups. Two subjects, one from each group, were out from the study due to a side effect of the treatment (itching) and not performed median nerve gliding exercise for six times. Therefore, twenty-two subjects, eleven subjects each group, were included in the analysis of this study.

Based on within-group comparisons (pre-treatment vs. post-treatment), the subjects in the control group and the intervention group showed a statistically significant improvement in the right hand function, activities of daily living (ADLs) or ability of the right hand and both hands to do certain tasks, work performance, pain, and satisfaction scores ($p<0.05$, all).

Pre- and post-treatment evaluation of the parameters in both groups is presented in Table 2. Before treatment, both groups showed similarities in all parameters except in ADLs, or the ability of the right hand ($p < 0.001$) and both hands ($p < 0.018$) to do certain tasks, and aesthetics ($p = 0.028$). After treatment, a statistically significant improvement was found in all parameters except left hand function ($p=0.128$) and ADLs or the ability of the left hand to do certain tasks ($p=0.948$) in the intervention group. There were a significant differences between groups in right hand function, ADLs or the ability of the right hand to do certain tasks, work performance, pain, and satisfaction.

From the beginning until the end of the study, the intervention group and the control group did not show a significant differences in left hand function with mean score ($p=0.884$), left hand ability score ($p=0.884$), and aesthetics score ($p=1.000$), at the end of the study ($p=0.039$) and ($p=0.006$). the difference in mean (delta) scores for activities of daily living and pain scores by using the Mann-Whitney test was significantly different between the two groups with ($p<0.001$) and ($p=0.02$), hand ability score ($p=0.884$) and aesthetics score ($p=1.000$).

Table 1. Demographic data of the subjects

Variable	Group				p
	Control		Intervention		
	n	%	n	%	
Affected hand					
Right	10	90,9	10	90,9	1,000
Both	1	9,1	1	9,1	
Occupation					
Cleaning service	10	90,9	10	90,9	1,000
Physiotherapist	1	9,1	1	9,1	
Gender					
Male	0	0	2	18,2	0,238
Female	11	100	9	81,8	
Education					
SMA	10	90,9	10	90,9	1,000
S1	1	9,1	1	9,1	
Repetitive Movements					
Yes	11	100	11	100	-
No	0	0	0	0	

Table 2. Comparasion of Michigan Hand Outcomes Questionnaire domains between pre- and post-treatment

	Pre-treatment			Post-treatment			Delta		
	Intervention group	Control Group	p	Intervention group	Control Group	p	Intervention group	Control Group	p
Right Hand Function	17,27 ± 1,68	15,82 ± 3,06	0,182§	9,82 ± 0,60	12,55 ± 1,97	0,002‡*	-7,45 ± 1,37	-3,27 ± 1,74	<0,001§*
Left Hand Function	10,45 ± 2,70	8,45 ± 3,86	0,128‡	9,91 ± 1,81	7,91 ± 2,91	0,128‡	-0,55 ± 1,21	-0,55 ± 1,21	1,000‡
ADL									
Right Hand	14,64 ± 1,12	9,91 ± 3,05	<0,001‡*	5,55 ± 0,52	6,64 ± 1,12	0,016‡*	-9,09 ± 1,38	-3,27 ± 1,95	<0,001‡*
Left Hand	6,91 ± 4,25	6,36 ± 3,64	1,000‡	5,18 ± 0,60	5,27 ± 0,91	0,948‡	-1,73 ± 3,85	-1,09 ± 2,77	0,884‡
Both Hands	21,73 ± 1,42	19,55 ± 2,42	0,018§*	8,91 ± 1,45	13,00 ± 2,37	<0,001§*	-12,82 ± 1,08	-6,55 ± 0,52	<0,001‡*
Work Performance	17,73 ± 1,10	18,00 ± 1,95	0,892‡	21,91 ± 0,94	20,45 ± 1,97	0,039§*	4,18 ± 0,87	2,45 ± 0,82	<0,001‡*
Pain	15,73 ± 0,65	15,45 ± 0,93	0,073‡	18,91 ± 0,83	17,55 ± 1,04	0,006‡*	3,18 ± 1,17	2,09 ± 0,94	0,024‡*
Satisfaction	21,82 ± 0,60	21,00 ± 1,55	0,199‡	14,18 ± 0,87	17,45 ± 2,16	0,003‡*	-7,64 ± 1,03	-3,55 ± 1,44	<0,001§*
Aesthetics	15,64 ± 1,12	14,36 ± 1,21	0,028‡*	15,64 ± 1,12	14,36 ± 1,21	0,028‡*	0,00 ± 0,00	0,00 ± 0,00	1,000‡

* Significant (p<0,05); § Independent t; ‡ Mann Whitney; † Wilcoxon

DISCUSSION

The results obtained in this study showed a significant improvement of adding kinesiotaping to median nerve gliding exercises in the Michigan Hand Outcomes Questionnaire domains (right hand function, ADLs or ability of the right hand to do certain tasks, work performance, pain, and satisfaction) compared to the median nerve gliding exercises alone, except for left hand function, ability of the left hand to do certain tasks, and aesthetics.

Chatterjee et al.[19] investigated the hand performance of CTS patients by using the Michigan Hand Outcomes Questionnaire and obtained significant score differences in all domains after performing CTS decompression surgery. It might be expected due to the presence of a scar after carpal tunnel surgery, which may deteriorate the aesthetic aspect. In our study, there was no significant difference in the aesthetic domain, because we did not perform surgery, which may have had no effect on the shape of the affected hand.

This study is in line with previous study conducted by Chatterjee et al.[19] regarding the measurement of hand performance in CTS patients by using the Michigan Hand Outcomes Questionnaire after carpal tunnel release, which all domains had improved. The domain of function and ability toward the unaffected hand (left hand) was different compared to the study by Chatterjee et al.[19] because most of our subjects were affected by CTS on the right hand, meanwhile the previoys study did not include the unaffected hand as a statistical calculations.

Tal Akabi et al.[20] concluded that the effect of median nerve gliding exercise was effective in reducing pain for CTS patients with biomechanical principles. Median nerve gliding exercise was effective for reducing pressure in the carpal tunnel, reducing edema and adhesions in the carpal tunnel by increasing blood flow to the median nerve, which can help regenerate nerves and improve conduction.[20] There was significant improvement in right hand function, ADLs or the ability of the right hand to do certain tasks, work performance, and pain. It was possible because of nerve regeneration, and the improvement of nerve conduction may increase the function of the affected hand, both in ability and pain felt by the participant. All of these may improve pain scores for both groups. Tissue improvement in median nerve entrapment in CTS patients is supported by the effect of kinesiotaping, adapting gate control theory

by Melzack and Wall in Kase.[21] In addition, kinesiotaping supports positional stimulation of the skin, directs soft tissue to create looser spaces by elevating fascia and soft tissue over areas of pain or inflammation to increase intraneural blood and lymph flow, thereby reducing intraneural edema, and provides sensory stimulation to limit movement.[17] Thus, the addition of kinesiotaping to median nerve gliding exercise, which was done in this study, may be considered to help the process of reducing pain.

The improvement of the right hand's function, ADLs or ability of the right hand to do certain tasks, work performance, and satisfaction scores indicated that CTS may substantially affect the patient's ability to perform basic ADLs and work. With the improvement in the degree of pain, the right hand's function, ADLs or ability of the right hand to do certain tasks, work performance, and satisfaction were also improved.

This study had several limitations. Most of the participants were women, so this study could not be generalized to all genders. The post-treatment evaluation was only carried out once, namely at the end of the fourth week of treatment, so it could not assess how long the long-term effect of adding kinesiotaping can reduce pain degrees and improve quality of life in CTS patients.

CONCLUSION

From this study, we concluded that adding kinesiotaping may improve the hand performance of CTS patients who receive median nerve gliding exercises, as measured by The Michigan Hand Outcomes Questionnaire.

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