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Original Article

Effects of Soft Tissue Massage Along with Mobilization Technique on Intensity of Symptoms and Functional Status of Carpal Tunnel Syndrome: A Randomized Controlled Trial

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ABSTRACT

The median nerve in the wrist is compressed in the carpal tunnel, causing Carpal Tunnel Syndrome (CTS). The symptoms of this condition include numbness, tingling, and pain in the hand and fingers. The effectiveness of soft tissue massage along with mobilization techniques in managing CTS symptoms and improving functional status is an area to explored. **Objective:** To determine the effects of soft tissue massage along with mobilization technique on intensity of pain and functional status in Carpal tunnel syndrome patients. **Methods:** A randomized controlled trial was conducted on 60 patients with mild and moderate carpal tunnel syndrome at Sindh Institute of Physical Medicine and Rehabilitation, Karachi. In group A, soft tissue massage (Medenci hand massage technique) was combined with joint (radiocarpal and inter-carpal) and median nerve mobilization sliders, whereas in group B, only joint and median nerve mobilization sliders were used. A visual analog pain scale, the Boston scale of carpal tunnel syndrome, a dynamometer and a pinch gauge were used to evaluate participant on day 1 and the last treatment session. **Results:** There was no significant difference between group A and B after treatment. However, there was significant improvement ($p<0.05$) in intragroup analysis in all outcome measures after treatment in both groups with $p< 0.05$. **Conclusions:** Soft tissue massage along with joint and nerve mobilization is effective in symptoms severity and functional status. To further validate the findings of this study, similar investigations will need to be undertaken in the future to consider it before surgical intervention in CTS.

INTRODUCTION

Carpal Tunnel Syndrome (CTS) is considered one of the most common work-related musculoskeletal disorders of the upper limb [1]. Presently days, an increment in the usage of computers among the general population influences 1-5 % of the population with Carpal Tunnel syndrome [2]. In Pakistan, the overall prevalence of CTS among computer users is 61.5% which includes 13.5% of females and 48.1 % of males. In the general population, the prevalence rate of carpal tunnel syndrome varies from 7%-19% [3], and it commonly occurs in middle age females with an annual incidence of 1.5 per 1000 as compared to 0.5 per 1000 males [4]. The etiology of this syndrome is idiopathic [5]. It is related to various factors. Non-occupational variables reported to be related to carpal tunnel syndrome

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includes; chronic diseases like inflammatory disease (rheumatoid arthritis, gout), endocrine disorders (diabetes mellitus, hypothyroidism), inherited defects like anomalous muscles, wrist trauma (fracture), age, female gender, obesity, oral contraceptive use, pregnancy, menopause. Occupational related factors reported in CTS includes vigorous and repetitive hand task, poor ergonomics, mechanical stress at the base of the palm, and prolonged use of vibratory tool [6]. Usually, the patient presents subjectively with unpleasant sensations like pain on CTS, which is known as a factor that influences the psychological status of various musculoskeletal diseases. A previous study suggests that some psychological issues named as depression and pain-related anxiety correlated along with the severity of CTS which may affect the overall outcome of the patient [7]. In addition, other symptoms paresthesia and numbness on the volar side of the hand, three fingers and half fourth finger (radial side), and atrophy of thenar muscles have been noted in the advanced stage [8]. It can be diagnosed based on the clinical presentation of the patient's signs and symptoms, electrodiagnostic tests, and different provocative tests like Phalen, and Tinel's signs [9]. Physical therapy management for CTS includes electrophysical modalities (Transcutaneous Electrical Nerve Stimulation (TENS)), Interferential Current (IFC) [10], Ultrasound, manual therapy, neural mobilization, Kinesio-taping [6], wrist splints, acupuncture [11]. It has been reported in existing evidence that Soft Tissue Massage (STM) is used to promote positive physical, functional and psychological outcomes in clinical health practice [12], but weak base evidence on massage is present. So, there is a need to bridge a gap in research on massage and observed significant outcomes of massage mainly on symptom severity, functional imitation, and also related psychological issues. This study examined the effects of soft tissue massage with mobilization technique on pain intensity and functional status in patients with Carpal Tunnel Syndrome using a Jamar hand-held dynamometer, a pinch gauge, and the Boston Scale. This study aimed to determine the effectiveness of soft tissue massage with mobilization technique versus mobilization technique alone in the management of Carpal tunnel syndrome.

METHODS

This study was conducted at Sindh Institute of Physical Medicine and Rehabilitation (IPMR) and Civil Hospital Karachi at the Neurology Department. This study was approved by the Institutional Review Board of Dow University of Health Sciences with the reference IRB-1992/DUHS/Approval/2021/456.This trial is trial registry clinicaltrials.gov: with Trial registration number NCT05466162. It was conducted using a non-probability purposive sampling technique. A sample size of 48 was calculated through open EPI version-3.0 software. Using 80 % of power and 95% of confidence interval with after intervention mean 1.90 standard deviation 0.62 in Group A and mean 2.55 standard deviation 0.55 in Group B by using Boston Carpal Tunnel-Functional status scale Questionnaire (FSS BCTQ-FSS) [13]. Due to low sample size, we considered 30 subjects in each group. Total sample size of this study is 60, 30 samples in each group. The inclusion criteria were Consultant Physiatrist diagnosed patients of CTS on electro diagnostic test i.e., Nerve Conduction Studies, Mild and moderate severity of CTS, Age from 18-50 years, both gender patients with unilateral involvement of hand. Patients with electrodiagnostic test results or motor or sensory deficits in the ulnar nerve and radial nerve, and other neurological conditions (cervical myelopathy, motor neuron disease such as amyotrophic lateral sclerosis), neoplasm around the affected arm, musculoskeletal problems of the upper quadrant (such as rheumatoid arthritis or fibromyalgia, cervical radiculopathy) or recent upper extremity trauma on the affected side were excluded. Each participant was explained the study purpose and procedure before consent was taken (either in Urdu or English). Medications were continued during the study, prescribed by Physiatrist (figure 1).

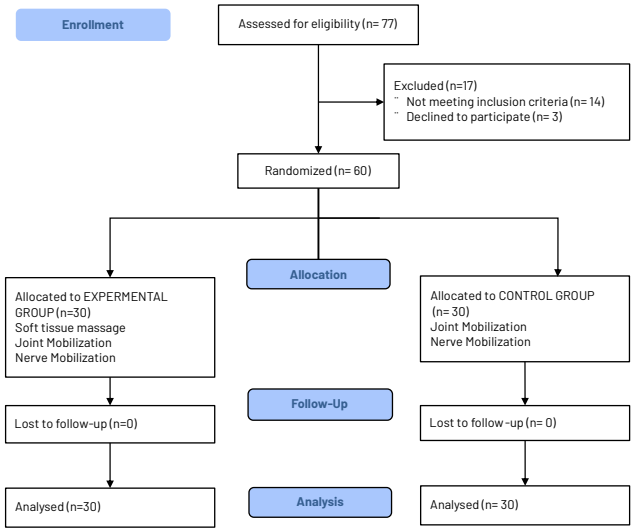

Figure 1: Consort Diagram

An outcome assessor blinded to the intervention performed an assessment at baseline and at the end of the sixth week. Using a Visual Analog Scale, measure the change in pain intensity. The pain level was rated on a 0-10 cm scale, with 0 cm meaning 'no pain' and 10 cm meaning the most excruciating pain. Increasing the number of cm suggests the worst pain [14]. Hand and Pinch Grip strength was quantified in kilogram by using Jamar dynamometer

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Pinch Gauge. Participants hold it in tested hand, with the arm at right angles and the elbow by the side of the body. Participants were instructed to perform maximum isometric contraction and hold it for 5 seconds. Participants repeated it 3 times with rest period of one minute between two consecutive trials. The best score was recorded. In order to calculate the mean of these readings, measurements were taken three times for each individual [15]. Boston Carpal Tunnel Questionnaire was used to assess changes in symptoms severity and functional status. Each item on the scale of symptom severity contains 11 items and each item on the scale of functional status contains 8 items. Higher scores on both scales indicate greater severity and difficulty. Scores below or equal to 11 are considered asymptomatic, 12-22 are mild, 23-33 are moderate, 24-44 are severe, and 45-55 are very severe. Functional status scale cut-off: less than 8 or 8 = Asymptomatic, 9-16 = Mild, 17-24 = Moderate, 25-32 = Severe, 33-40 = Very Severe [16]. The treatment duration was 30 - 45 minutes, 3 sessions per week in alternate days for 6 weeks. After recruiting CTS patients, participants were randomly assigned to one of two groups (1:1) using www.random.org. A statistician constructed the computer-generated randomization sheet. Following initial screening, the primary investigator intervened, and the participant was assigned to a treatment by the first researcher. As an effort to avoid the interaction between the participants, each intervention was given on a different time window. The outcome assessor was not informed of the allocation and recorded the readings at baseline and after the fourth week. Joint mobilizations and the nerve mobilization was provided to both groups. for the joint mobilization the Patient was lying in a supine position, and affected arm was place in a supination for radiocarpal flexion and in pronation for radiocarpal extension. Therapist was standing at the patient's waist level and side of the table and facing superiorly. For the Radio-carpal flexion Technique; while maintaining joint in traction, from a position midway between flexion and extension, the patient wrist was moved downward towards the floor while the carpus held firmly between therapist's index finger and thumbs, is flexed on radius and ulna. While performing this movement the carpus must be held firmly. For Radio-carpal Extension Technique; with traction, extension movement is produced through a very firm localized grasp with the fingers and thumb while lowering the wrist toward the floor as the wrist is extended. The oscillation is completed by returning the patient's arm to the starting position, while at the same time returning the extended radio-carpal joint to its mid –position. Patient was supine – lying, affected side elbow was flexed to 90 degree and forearm in supination. Therapist was standing at the patient's affected hand and facing toward patient's body for applying inter-carpal horizontal flexion. Therapist changed position and stand beyond patient's flex elbow with supinated forearm and facing across patient's head. For Inter-carpal Horizontal Flexion Technique; the oscillatory movement was provided by opposite pressure through forearm. Therapist's one hand provided a cupping action on the patient's hand around the pivot formed by the therapist's thumb of another hand. For Inter-carpal Horizontal Extension Technique; The oscillatory movement was provided by the thumb pressure against the center of the carpus posteriorly and pulling against the medial and lateral margins of carpus with finger. The action will produce by wrist extension of therapist and will facilitate by pushing the patient's hand away with thumb [17]. The nerve mobilization was provided as described by the Stephanie and colleague [18]. However, the Soft Tissue Massage Technique with Madenci hand massage technique was provided to only experimental group. Patient position was supine – lying with affected arm in supination. The therapist's position was standing at the patient's waist level and side of the table and facing superiorly. Effleurage: On the ventral surface of forearm, scrubbing from distal to proximal in a direction for 30 seconds. Petrissage: Scouring depths on forearm, from distal to proximal direction for 30 seconds. Friction: Slow stroking for sedative effect, from distal to proximal in a clock wise direction, on volar surface of deep tissue for 60 seconds. Shaking: Patient will actively shake his hand for thirty seconds [19]. Data were stored and analyzed using IBM-SPSS version 23.0; Counts with percentages were reported for baseline characteristics and outcomes on VAS, BCTQ (BCTQ-SSS and BCTQ-FSS), scales. Mean with standard deviation were given on age, BMI, mean scores on VAS, BCTQ-SSS and BCTQ-FSS, involved hand grip and pinch strengths. Within group comparison was made using paired sample –test, between group comparisons was done using independent sample t-test, Pearson Chi Square test was used to check the association on qualitative outcomes of scales. P-values less than 0.05 were considered statistically significant.

RESULTS

Table 1 below lists the baseline characteristics of the patients who were being studied. According to the Pearson Chi Square test, there was no significant correlation between baseline characteristics and treatment groups ($p>0.05$).

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Table 1: Baseline Characteristics of Studied Patients (n=60)

Characteristics		Treatment Group		p-value
		A	B	
		n (%)	n (%)	
Age Group	25 - 40 years	14 (46.7)	14 (46.7)	0.99
	41 - 50 years	16 (53.3)	16 (53.3)	
	Mean ±SD	41.7 ± 6.0	40.1 ± 7.1	
Gender	Male	5 (16.7)	7 (23.3)	0.51
	Female	25 (83.3)	23 (76.7)	
BMI (kg/m2)	Normal	7 (23.3)	2 (6.7)	0.19
	Overweight	21 (70.0)	16 (53.3)	
	Obesity	2 (6.7)	2 (6.7)	
	Mean ±SD	26.6 ± 4.1	27.6 ± 4.0	
Involved hand	Right	12 (40)	11 (36.7)	-
	Left	18 (60)	19 (63.3)	
Dominant hand	Right	29 (96.7)	29 (96.7)	0.99
	Left	1 (3.3)	1 (3.3)	
Occupation	House chores	22 (73.3)	18 (60.0)	0.32
	Desktop worker	1 (3.3)	5 (16.7)	
	Field worker	1 (3.3)	2 (6.7)	
	Other	6 (20.0)	5 (16.7)	
Working Hours per day	Less than 2 hours	0 (0.0)	3 (10.0)	0.08
	2-5 hours	17 (56.7)	17 (56.7)	
	6- hours	10 (33.3)	4 (13.3)	
	More than 9 hours	3 (10.0)	6 (20.0)	
CTS classification according to electrophysio-logical test	Mild	9 (30.0)	9 (30.0)	0.99
	Moderate	21 (70.0)	21 (70.0)	

*p-value<0.05 was considered statistically significant

The improvement in VAS after treatment was statistically significant in both groups with p<0.05. However, between group analysis showed no significant mean difference in the VAS scores between treatment both groups after treatment, p>0.05 (table 2). The improvement in BCTQ scores for both BCTQ-SSS and BCTQ-FSS after treatment was also statistically significant within both groups with p<0.05. However same as VAS, the findings had no significant mean differences between treatment A and B after treatment, p>0.05 shows below in table 2.

Table 3: Outcome differences within and between groups

Outcome Measures	Baseline[a]	After treatment[a]	p-value within groups	p-value between groups
VAS (0-10)				0.380
Group A	6.32±1.2	2.83±1.3	<0.01	
Group B	6.07±1.1	3.17±1.5	<0.01	
BCTQ				0.258
BCTQ-SSS				
Group A	32.17±7.96	2.83±1.3	<0.01	
Group B	29.23±64.26	3.17±1.5	<0.01	
BCTQ-FSS				0.105
Group A	23.73±5.22	13.66±2.31	<0.01	
Group B	25.33±4.47	14.66±2.40	<0.01	
Involved HGS				0.784
Group A	23.50±9.65	33.27±12.13	<0.01	
Group B	25.40±13.04	34.17±13.14	<0.01	
Involved HPG				0.889
Group A	8.80±2.39	11.52±3.1	<0.01	
Group B	9.05±3.56	11.38±4.18	<0.01	

VAS=Visual analogue scale, BCTQ= Boston Carpal Tunnel Questionnaire, BCTQ-SSS= Boston Carpal Tunnel Questionnaire Symptom Severity Scale, BCTQ-FSS= Boston Carpal Tunnel Questionnaire, FSS=Functional Status Scale, HGS= Hand Grip Strength, HPG Hand Pinch Grip

[a]Values of mean and standard deviation

[b]Values of mean difference and p-value

DISCUSSION

The study was intended to ascertain the effects of soft tissue massage along with joint and nerve mobilization on symptoms and functional status of CTS. So, purpose was to determine the effect of soft tissue massage along with mobilization technique on intensity of pain and functional status by using Jamar hand-held dynamometer, Pinch Gauge and Boston Scale for carpal tunnel syndrome questionnaire in Carpal tunnel syndrome patients. The findings showed significant improvement before and after treatment in both groups but no significant difference after treatment between both groups. It is observed that that SSS, FSS and strength were improved in both groups though not significant difference observed between groups. In contrast of this study, other study mentioned dominant hand more commonly involved [7]. Symptoms severity and functional status were used to assess by Boston scale of carpal tunnel syndrome questionnaire. BSCTQ contain items that assess uni-manual and bimanual tasks of daily living. These tasks are mainly performed by both hands. Most of the participants in this study have involvement of non-dominant hand i.e., left hand in both groups [8]. Variety of parameters were used to assess usually in studies conducted on CTS were; pain, grip strength and symptoms severity and functional status. For pain measures, mainly VAS used but in another study the patient global assessment and the physician global assessment were used to assess pain. However, it is a self-assessment of overall disease activity in a rheumatoid arthritis [20]. The findings of the present study stated that significant reduction in pain, symptoms as regards VAS and SSS score, and improvement in functions via FSS score, handgrip, and pinch strength after 6 weeks of treatment in both treatments' groups. Similar to this study, various studies show significant improvement in outcome

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measures after treatment using multimodal manual therapy [9]. Unlike the present study, a series of chronic CTS patient was conducted which assessed pain by Numeric Pain rating scale (NPRS) which reduced, but did not change in pain pressure threshold by using algometer at different sites: mainly over peripheral nerve of the arm (median, radial, and ulnar nerves), C5-C6 zygapophyseal joint, the carpal tunnel, and the tibialis anterior muscle. Also, study applied soft tissue mobilization over anatomical sites of median nerve and neurodynamic slider technique. Nerve mobilization can be used as an adjuvant treatment along with other manual technique. Similarly, to current study findings on pain by using VAS, a randomized control trial compared nerve mobilization with ultrasound and result showed that pain intensity reduces significantly and improve function by following median nerve mobilization. A mark significant mean difference was found pre and post treatment on VAS [6]. Contrary to this, independent effects of nerve mobilization did not assess in this study but previous studies supported it on the basis of facts that increase in nerve strain while extending a joint causing elongation of nerve bed concurrently counteract by reduction in nerve strain while flexing and adjacent joints [11, 21]. Pain reduction was also observed immediately after therapy in manual therapy (MT) and electrical modalities (EM) group on VAS scale conducted by Wolny et al. This study assesses electrophysiology parameters after treatment and found that median nerve sensory conduction velocity enhanced by 34% and the motor conduction velocity increased by 6% in the MT group. However, the sensory and motor conduction velocities of the median nerve remain same in the EM, a reduction in distal motor delay in both groups were analyzed. Moreover, functional status of both groups improved, and subjective CTS symptoms decreased according to BCTQ these were more significantly improved in MT [22]. In contrast to the present study, this study showed improvement in electrophysiological parameters which was not an outcome measurement tool in the current study due to the limited time of trial and accessibility of resources. The present study used electrophysiological test only for diagnostic purpose and did not used as an outcome measure. Author found studies that solely implement joint mobilization, nerve mobilization in CTS. Gunay et al., reported that Carpal bone mobilization improved symptom severity strength, functional status after treatment [17]. Similar techniques were used in the present study and findings were also in agreement with the available literature. On the basis of result author suggest that this multimodal technique including soft tissue massage can be used as conservative management in CTS. It is non-invasive affordable treatment. To further validate the findings of this study, similar investigations will need to be undertaken in the future. The limitations of this study are that the follow-up session has not been conducted so, long term effects of treatment are not known. The pregnant women were not included however, CTS is prevalent among them. Electro diagnostic test was not repeated after treatment so would not analyze effects of treatment on test parameters. However, there is no gender biasness, males are equally included in both groups. Patients were included after confirmation of electro diagnostic and physical test which are standardized.

CONCLUSIONS

The present study concluded that STM along with joint and nerve mobilization is a non-surgical treatment, and it is found in the present study that this treatment was effective in symptom severity and functional status and reduced pain in both groups with mild to moderate CTS. The results indicated statistically significant within groups and non-significant between groups. The findings of the present study stated that there was a significant reduction in pain, and symptoms as regards VAS and SSS score and improvement in functions as measured by the FSS score, handgrip, and pinch strength after 6 weeks of treatment in both treatment groups. As a result, the study findings support the null hypothesis. STM along with joint and nerve mobilization was effective but not superior to the mobilization technique alone. However, to further validate the findings of this study, similar investigations will need to be undertaken in the future to consider them before surgical intervention in CTS.

Authors Contribution

Conceptualization: HS
Methodology: SIA
Formal analysis: AA
Writing-review and editing: MZ, NNS, MK
All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

Source of Funding

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