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Original Article

Massage therapy and Splint in males with Carpal Tunnel syndrome

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ABSTRACT

Objective: The present study was conducted aiming to compare the effect of two exercise methods of massage therapy and splint with therapy exercise and splint on the range of motion and the ratio of wrist pain in male patients with carpal tunnel syndrome. Method of Investigation: Thirty male employees with carpal tunnel syndrome with the confirmation of specialist physician were selected as purposeful available and were located randomly into the first experimental group (15 people) with mean and standard deviation of age (43.33 ± 6.10 years), height (179.83 ± 5.79 cm), and weight (75.33± 3.24 kg) and second experimental group (15 people) (42.93± 6.70 years), height (175.73± 5.27 cm), and weight (78.07±5.45kg). The first experimental group performed therapeutic exercises and splint for eight weeks, three sessions in a week for 60 minutes and the second experimental group performed the same massage therapy exercises and splint for the same period. Goniometer was used to measure the wrist range of motion and pain self-efficacy questionnaires were used to measure pain ratio. To analyze the data, the statistical method of student t-test at the significance level of $p \leq 0.05$ was used. Results: The results showed that intragroup changes have increased the ratio of wrist flexion and extension range of motion and the post-test pain ratio has significantly increased in two experimental groups ($P < 0.05$). Intergroup changes also showed a significant difference in the ratio of wrist flexion range of motion and the pain ratio ($P < 0.05$), but these changes were not significant in the ratio of wrist extension range of motion ($P < 0.05$). Conclusion: The findings of this research showed that both exercise methods improved wrist range of motion factors and the ratio of pain. But the ratio of improvement in the experimental group of exercise therapy and splint was more than that of the massage and splint group.

Keywords: Carpal Tunnel Syndrome, Massage Therapy, Exercise Therapy, Range of Motion, Pain

Introduction

One of the most common types of neuropathy is the neuropathy caused by nerve entrapment, which occurs as a result of pressure on the healthy nerve and changes in nerve conduction. In the upper organ, this type of syndrome can be manifested based on the site of involvement and the nerve involved as carpal tunnel syndrome (CTS) (median wrist area nerve entrapment), cubital tunnel syndrome (ulnar nerve entrapment in the elbow area), Guyana channel syndrome (ulnar nerve entrapment in the wrist area), radial tunnel syndrome (radial nerve entrapment in the forearm area) or thoracic outlet syndrome and in some cases a combination of the above syndromes [1].

CTS is the most common type of peripheral nerve entrapment in the upper organ characterized by sensory and motor symptoms within the median nerve area [1, 2]. This syndrome is more prevalent in middle age, especially among women [3]. The prevalent age is estimated to be between 30 and 60 years, and 9% of women and 0.6% of men have this disease throughout their lives [4]. The median nerve has a special position because of its specific anatomical location and the prevalence of various involvements. The median nerve is pressurized due to the reduction of wrist duct size and shows itself with symptoms such as pain, drowsiness, nausea, dizziness, decreased sensation of position and weakness in the distribution of sensory and motor branches of the median nerve in the hand. These symptoms are

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observed permanently or temporarily in the thumb, index finger, and middle finger, which are intensified at night and often wake the patient up [3]. Numerous risk factors and causes are mentioned for CTS including age, gender, underlying diseases (secondary CTS), upper organ improper status (especially during work and sleep), and occupational exposure, but regarding some risk factors such as job, no similar opinion exists [5, 6]. In sum, any factor that increases the volume of contents in the carpal channel or the reduction of the capacity of the wrist tunnel can create or intensify this syndrome [7]. Patients with CTS are recommended to perform a course of treatment, including splinting, resting, massage therapy, and moderating their daily activity and works [8]. Exercise therapy has a significant role in the prevention and rehabilitation of patients. In the past 2-3 decades, less attention has been paid to the issue of exercise therapy and more emphasis has been on the use of physiotherapeutic devices for patients' rehabilitation, but over time and by understanding the role of exercise, not only as a factor in preventing disease but also as a factor in improving the disease, the issue of exercise therapy has severely received attention from physiotherapists and rehabilitation experts.

Massage involves regular manipulations over the soft tissues of the body such as muscles, connective tissue, tendons, ligaments, and joints, aiming to aid blood circulation, muscle relaxation or creating physical stimulations, and is divided into various types of touching, pressing, or continuous movements on the skin and underlying tissues, which are used to relieve muscle tension and pain and to promote health [9, 10]. In Western societies, physicians (83%) accept massage as a complementary treatment and many of them (71%) refer patient to a massage specialist [11]. Massage enhances arterial, venous, topical and stroke volume blood flows, and improves lymph drainage. In addition, massage inhibits the mechanism of pain and relieves insomnia [12]. There are limited studies about massage therapy in the treatment of CTS. Researchers have shown that hand massage therapy is not useful alone, but it is associated with a significant decrease in pain scores in motor diseases, especially in fibromyalgia, back pain, arthritis and migraine [12]. In the study conducted by Moraska et al. about the effect of massage on CTS, significant improvement was observed regarding pain scores, while the only group that received CTS-related hand massage showed significant improvement in the scores of hand function evaluation and grip strength [13]. Studies have also shown that massage, by reducing muscle Tunisia and increasing topical sympathetic activity, has an important role in reducing pain severity and also increases the level of the oxytocin hormone, the hormone which has analgesic properties [14]. Field et al., also investigated the effect of massage on CTS, and observed significant improvement in the massage group in terms of pain, anxiety, depression, hand grip strength, and median nerve delay scores, but an increase in median nerve conduction velocity was not significant [15]. Massage has been used throughout the world for rehabilitation and relaxation for centuries [16]. Exercise massage can help optimize functional factors such as muscle and connective tissue health, normal range of motion, high energy, painless and smooth movement, mental relaxation, alertness and concentration, and reduces negative factors such as muscle and the dysfunction in connective tissues, restriction in the range of motion, energy reduction, lack of happiness, pain and anxiety [17]. However, there are limited scientific evidence to support the use of massage to enhance performance [18]. Massage is becoming increasingly popular today, and massage therapists and professionals perform it not only in private beauty and sport institutions, but it is also used in hospitals and clinics [19, 20]. In general, massage and exercise therapy can be considered as an alternative treatment for carpal tunnel syndrome, because it does not require any special treatment place and equipment and the patient can apply it him/herself and rapidly and effectively access the tissue of forearm and hand. The aim of the present research was therefore to compare the two protocols of massage and splint with therapy exercise and splint on wrist range of motion and pain intensity in men with carpal tunnel syndrome.

Investigation Method

This research was of quasi-experimental type with pre-test and post-test design. Subjects in the present research consisted of 30 male employees with carpal tunnel syndrome who were selected with available purposeful method and were randomly located into two equal first experimental group (splint and exercise therapy protocol) and second experimental group (splint and massage therapy protocol). Inclusion criteria included: 1- No history of wrist surgery, 2- At least one of the following tests in the physical examination being positive: Tinel, Falun, 3- No sensitivity to massage performance, and 4- Not having specific disease. After selecting the subjects, while briefly describing the desired programs and tests, they were asked to sign a consent form to participate in the massage and splint, motion therapy and splint program. Then, patients' personal information such as name, surname, age, history of illness, education level were recorded. Pain ratio and the range of motion variables were measured before and after eight weeks of exercise (3 sessions per week, 24 sessions in total). A 10-question pain self-efficacy questionnaire was used to measure pain ratio. The efficacy of one's behaviors and attitude toward him/herself, others, and the future is equal to the score that one gets from the pain self-efficacy questionnaire [21]. This questionnaire consists of 10 questions that has score from 0 to 6, indicating how confident the person is that he can do the desired work. The lower a person's score is, it means that the greater his confidence is in doing that specific work. Goniometer was used to measure wrist flexion and extension range of motion. In a standing state, the person has lifted the desired hand from the shoulder and held it directly at 90 degrees of shoulder flexion, the elbow and wrist were also held along the shoulder, then the goniometer tester was placed on his wrist and the person was asked to extend his wrist as far as he could, and then, the specified degree was recorded. Then, in the same state, the individual was asked to flex his wrists and then, the specified degree was recorded [22].

Treatment Protocol

The treatment program for the first experimental group in this research consisted of two parts. The first part was a therapeutic exercise considered for patients with 6 stretching movements. In the first session, which was jointly held with all patients, the necessary explanations and trainings were given by the researcher to the patients (all movements with shape, explanation, the number of repetition related to each movement were also provided individually in a sheet to the people of the first experimental group). The treatment course was designed and implemented for 8 weeks. Subjects performed therapeutic movements (15-20 minutes) in each session. Due to the individuality of the treatment exercise program, the movements were performed by the researcher and according to the patient's ability, observing the overload was performed. To ensure the efficacy and safety of the therapeutic movements used in the research, all the movements were performed as an introductory study on three patients for 4 sessions before beginning the exercise course. It should be mentioned that patients participating in this part of the study were excluded. The second part for the first group was to use the splint. Dorsal splint was made for each patient, using thermoplastic on each patient's mold, in a way that the dorsal wrist and forearm were wrapped and the wrist was at a neutral angle. Patients used splint for eight weeks full-time and two hours rest daily. In the second exercise group, the exercise was two parts that the second part was massage by the researcher, and the program of doing the massage has been shown in Table 1. The second part similar to the first group was to use dorsal splint, which was used for the first group as for the second experimental group.

Table 1: Type of Techniques Used and Time Allocated to Each Technique in Each Massage Area

Massage Technique	Massage Time	
	Forearm	Wrist and Palm
Caress	1 Minute	1 Minute
Pressure	2 Minutes	3 Minutes
Rub	2 Minutes	---
Impact	1 Minute	---
Rub	2 Minutes	---
Pressure	2 Minutes	---
Caress	1 Minute	---
Total	11	4

After collecting information, data were analyzed by SPSS version 20 software, so that the data were calculated using descriptive statistics (mean and standard deviation) and Kolmogorov-Smirnov test was used to ensure the distribution normality of the data. Correlated statistical t-test was used to compare intragroup means, and an independent statistical t-test method was used to compare the intergroup means.

Results

The anthropometric characteristics of the research subjects have been presented in Table 2. Statistical tests showed that the two groups did not have a significant difference in terms of anthropometric indicators ($P \geq 0.05$). The normality of all data was confirmed by Kolmogorov-Smirnov test ($P \geq 0.05$).

Table 2: Descriptive Statistics of Anthropometric Characteristics of Research Subjects

Variable	Group	Standard Deviation ± Mean (M ± SD)	t	P
Age (Year)	First Experimental	43.3±6.1	0.17	0.866
	Second Experimental	42.9±6.7		
Height (Cm)	First Experimental	17.98±5.8	2.03	0.052
	Second Experimental	17.57±5.3		
Weight (Kg)	First Experimental	75.3±3.2	-1.67	0.109
	Second Experimental	78.1±5.4		
Body Mass Index (Kg / m^2)	First Experimental	23.3±1.3	1.94	0.073
	Second Experimental	25.3±1.8		

Results obtained from pre-test and post-test data analysis show that after eight weeks of treatment interventions for both groups, intragroup changes in the variables of wrist flexion (first experimental: $p = 0.001$, second experimental: $p = 0.025$), wrist extension (first experimental: $p = 0.001$, second experimental: $p = 0.008$) and pain ratio (first experimental: $p = 0.001$, second experimental: $p = 0.001$) have significantly changed in both groups ($P < 0.05$). A comparison between intergroups means also showed that there was a significant difference between the mean of the variables of wrist flexion ($p = 0.018$) and pain ratio ($p = 0.037$), but the difference in wrist extension ($p = 0.502$) was not significant. However, the first experimental group experienced 8.75% improvement in the field of wrist extension and the second experimental group experienced 7.00% improvement in post-test compared to the pre-test, indicating further improvement of the first experimental group (Table 3).

Table 3: Investigation of Intragroup Changes and Intergroup Difference of Dependent Variables

Variable	Group	Stage		Intragroup Changes		Intergroup Differences		Effect Size
		Pre-Test	Post-Test	T	P	T	P	

		(M ± SD)	(M ± SD)					
Wrist Flexion (Degree)	First Experimental	42.3±2.7	48.3±3.1	-4.91	*0.001	-2.52	**0.018	0.43
	Second Experimental	40.5±3.2	42.7±2.9	-2.50	*0.025			
Wrist Extension (Degree)	First Experimental	45.7±2.6	49.7±2.6	-4.61	*0.001	-0.68	0.502	0.13
	Second Experimental	44.3±3.3	47.4±3.3	-3.09	*0.008			
Pain Ratio	First Experimental	15.4±3.1	4.7±1.2	12.42	*0.001	2.19	**0.037	0.38
	Second Experimental	16.5±3.2	8.5±2.2	8.45	*0.001			

*: significance at P≤ 0.05 level for intragroup changes

**: significance at P≤ 0.05 level for intergroup comparison

Discussion

The results of the present research showed that both exercise programs improved the range of motion of the wrist flexion in men (P <0.05), but the exercises in the first experimental group had more effect than the second experimental group (first experimental group: 14.18% improvement, second experimental group: 5.43% improvement). The range of motion of wrist flexion in pre-test in the first and second experimental groups was 42.3 and 40.7 degrees, respectively. At post-test, this ratio reached 48.3 and 42.7 degrees, respectively. The range of motion of wrist extension in the pre-test in the first and second experimental groups was 45.7 and 44.3 degrees, respectively. At post-test, this ratio has reached 49.7 and 47.4 degrees, respectively.

According to the obtained results, there was a significant difference between the wrist extension and flexion range of motion scores in the pre-test and post-test of the first and second experimental groups (p <0.05). No research was found regarding the comparison between exercise therapy with a splint, and massage and splint on the range of motion of the wrist in men. The findings of this research are in line with the findings of Mustafa Lu et al. (2012), Field et al. (2007), Hosseini et al. (2013) [23-25], but are inconsistent with the findings of Barlow et al. (2004) [26]. In this respect, Mustafa Lu et al. (2012) in their research that investigated three massage methods of static stretch, a combination of massage with the static stretch of lower organ on flexibility, and anaerobic power and agility of football players, concluded that a significant increase was created in the flexibility of football players in all three groups [24].

Field et al. (2007) studied the effects of massage therapy on back pain and sleep disorders. The results showed that massage can cause physical and psychological changes without creating harm in patients. The range of motion of patients with chronic back pain who received 30 minutes of massage therapy twice a week for 5 weeks, significantly improved compared to before intervention, in comparison with the control group [23]. Hosseini et al. (2013) by investigating the effect of six weeks massage therapy on depression, quality of life, flexibility and general health of female patients with depression in Isfahan, found that there is a significant improvement in the flexibility of the massage group [25].

In another study Barlow et al. (2004) investigated the effect of receiving massage in the sit-and-reach test in the hamstring muscles group on 11 men, and concluded that there was no significant difference in the sit-and-reach test in the hamstring muscles between receiving and not receiving massage, the results of which contradict the results of the present research [26]. This inconsistency seems to be due to the existence of difference in population selection, independent and dependent variables, and statistical methods in the studies and experimental designs. In addition, in these studies, the lower organ massage was performed, which in this respect contradicts the present research.

Massage can affect the soft tissues of the body. Massage enhances lymph and vein drainage, removes excess metabolic products, strengthens deep tissue relaxation, and facilitates stretching the muscle strands and causes greater tissue movement. These factors appear to increase the flexibility due to massage by decreasing the stiffness in the strand surface and increasing desired muscle length. However, it has been said that massage can enhance muscle strength and tissue motility and stimulate the subcutaneous reflexes [24].

In the present research, patients had the highest dissatisfaction with doing flexion motion. After doing the exercise protocol, it was observed that the patients had an increase in flexion range of motion and had a decrease in extension range of motion. It can be deduced that since wrist flexor muscles are most influenced in this illness and in some cases, the contraction and stiffness of these muscles results in the emergence of CTS symptoms and the patient becomes ill, we conclude that the release and reduction of wrist flexor muscle stiffness through massage and exercise therapy lead to a better performance of these muscles, that by this conclusion, this increase in flexion range and decrease in extension range can be justified. With better and more powerful flexor muscles function, the flexion range of motion increases, and as the antagonist muscles of extensor muscles have become more active, hence the extention range of motion decreases.

Concerning the ratio of pain, the results of the present research also showed that both exercise programs have improved the wrist pain ratio in men (P <0.05), but the exercises in the first experimental group have more impact than the second experimental group (first experimental group: 237.78% improvement, second experimental group: 94.12% improvement). Pain self-efficacy ratio in the pre-test in the first and second experimental groups was 15.4 and 16.5, respectively. At post-test, this ratio has reached 4.7 and 8.5, respectively.

According to the researcher's search about comparing the exercise method of corrective movements by splint, massage and splint on the ratio of pain in men with CTS, no research was found. However, the present results in terms of pain ratio were consistent with the results of Maqadasi et al. (2013), Akabi Tal, and Rushton (2000) and O'Connor et al. (2008) [27-29]. After an eight-week course of rehabilitation exercises on patients with

CTS, Moghadasi et al. concluded that doing eight-week postural retraining protocols, doing stretching and mobility exercises, along with taking into account rest intervals between working time by bank employees with carpal tunnel syndrome, have a significant effect on reducing pain, reducing paresthesia, and improving nerve conduction of their hands. They stated that the cause of the symptoms improvement in the patients of research has probably been the flexibility increase of wrist structures, prevention of fatigue and prolonged work, and ultimately the removal of pressure from the median nerve [27]. In our research, although both groups had a significant difference in respect of pain ratio after the implementation of protocols, more improvement in pain ratio was observed in respect of mean in the exercise therapy group compared to the massage. Akabi and Rushton also observed similar results after a course of exercise therapy on patients with CTS, and reported that CTS symptoms are significantly reduced after 3 weeks of wrist joint mobility exercises [28]. O'Connor et al., also in a study by investigating the role of non-surgical treatments in mild to moderate patients, concluded that CTS with the use of steroid medicines, wrist splints, topical ultrasound, yoga, and mobility exercises special for wrist bones have significant yet short-term benefits [29].

According to the theory of mechanical pressure, the emergence of CTS symptoms results from median nerve being pressured in the carpal tunnel. Also, according to the theory of micro-vascular insufficiency, the lack of optimal blood supply leads to impaired nutrition and oxygenation to the median nerve, the point that causes the slow reduction of the ability to transmit nerve impulses and eventually creates symptoms [30]. On this basis, it can probably be stated that the mobility exercises and also performing massage in the present research, by removing the pressure from the nerve and thus improving the blood supply can improve the nutrition and oxygenation of the nerve and reduce pain in patients with CTS.

Conclusion

Overall, the results of the present research showed that doing therapy exercise, splint, massage and splint for patients with CTS for eight weeks, three sessions a week, significantly improved the scores of wrist flexion and extension range of motion and pain self-efficacy. Therefore, regarding the obtained results, the patients with CTS are suggested, in addition to using splint, to perform therapy exercise and massage as well in order to be able to complete their treatment course faster.

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