Effects of Using Rehabilitative Exercises and Shiatsu on Carpal Tunnel Syndrome

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Abstract: This research aims to identify the effects of a rehabilitative program and shiatsu on the working muscles and nerves of the injured hand for patients with CTS. This can be done through investigating neural connectivity of carpal nerve fibers, grip strength, wrest range of motion (flexion – extension – abduction – adduction) and degree of pain**.** The researcher used the experimental approach (one-group design) with pre-, intermediate and post-measurements. Participants (n=10) were purposefully chosen as they were all female athletes (25-30 years) with CTS because of sports participation, who are under treatment in Physiotherapy Hospital - Kuwait. They were all free of deformities and diseases. They are not under treatment of any kind. Results indicated that the use of rehabilitative exercises along with shiatsu massage led to clear results in treatment and quick recovery of Carpal Tunnel Syndrome (CTS) or the wrest joint as it improved neural connectivity of the carpal nerve, increased grip strength and increased the range of motion of the wrest (flexion – extension – abduction – adduction) with eliminating pain.
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1. Introduction:

Carpal tunnel syndrome (CTS) results from muscular imbalance of wrest working muscles due to overuse of the hand and wrest in abduction position and exposing it to prolonged flexion. This creates swelling that puts pressure on the medial nerve of the wrest. This affects nerves and wrest working muscles. Injury may happen because of daily life activities like using mobile phones or driving, computer use. It may also happen because of sports participation like tennis, golf, cycling racket ball or wheel-chair sports. Sometimes, the injury is related to anatomical structure or pathological structure. Injury rate is 3.46 per 1000 persons. Women are more vulnerable to this injury than men with a rate of 3: 1. For non-working individuals, this injury mat develop at 50 years of age, while for working persons it can be developed between 20 and 40 years of age (Werner & Robert 2006; Keir et al 2009; De Vera Barredo 2007; Atroshi et al 2009).

Symptoms start with pain and burning in the hand with numbing and inability to hold things. In addition, CTS leads to weakness in hand fingers (index, middle, pinky and thump). Furthermore, patients become unable to perform daily life activities because of pressure over medial carpal nerve that provides hand fingers with neural feedback through carpal tunnel. Several tendons pass through carpal tunnel and vacancy inside it decreases because of swilling in these tendons or thickness of ligaments. This increases inside pressure and blood flow to the nerve in addition to decreasing neural signals. This injury may be related to other disorders like diabetes, thyroid and rheumatoid. So, these disorders should be treated first. Manual massage is a treatment technique that proved effective because of its limited requirements and positive effects on quick recovery and mood of athletes (Lazaro 2005; Lozano-Calderon et al 2008; Gelberman et al 2007; Tiong et al 2005; Muller et al 2004).

Shiatsu is a Japanese massage technique used in physiotherapy through applying figure pressure on specific points of the body to decrease pain, stress and exhaustion and maintain body power and vitality. It is used on specific points (Tsupu) on skin, nervous system or muscles as applying pressure on these points recirculates energy in the body to decrease pain. Patient's reaction to applied pressure is normal at the beginning as he/she feels pain. But later, pain decreases gradually. Success of this technique depends on discovering the specific points (Tsupu) with the same size and shape of finger tips and applying sufficient pressure on them to reach maximum results for the benefit of patient. When these points are discovered, usually the patient and therapist know it.

Optimum period for applying pressure with shiatsu technique is 2: 3 minutes. Points near the injured part require more attention and more time for pressure. The therapist moves from one point to the next as pain stops and patient feels anesthesia. Points for treating carpal tunnel syndrome are identified according to nervous paths (2 point over the upper arm, 3 points on the palm, 4 point on the wrest and three points on the forearm) (Browne 2006; Namikoshi 2010; Saski2006; Muller et al 2004).

Capral tunnel syndrome (CTS) dominates upper body injuries in athletes who participate in repetitive movement activities for wrest extension/flexion. This is because of injury of the medial carpal nerve or repetitive stress over the hand wrest. This creates swellings that pressure over the medial nerve. Therefore, the nerve loses function of receiving and executing orders from the brain. The limp linked to that nerve is therefore loses function and may suffer from atrophy. Due to these damages resulting from this injury, functional recovery is required through neural flexibility concept. Neural recovery never happens automatically in humans as nerves and muscles are similar according the principle of therapeutic exercises for improving strength and efficiency (Akuthota & Herring 2009; Scangas 2008).

Rehabilitative exercises induce crucial physiological and functional adaptations in the nervous and musculoskeletal systems. It works on eliminating swills, calcifications and drain in addition to increasing blood circulation and renewing damaged cells and tissues. It is very effective in stimulating nerves and muscles and increasing the efficiency of central nervous system. It also increases movement and response accuracy and improves attention. It has positive effects on neural connectivity as it decreases lapses and increases the distinctive ability among stimuli. It also decreases minor work and over stimulation in addition to increasing the nerve ability for quick transmission of motor signals. It should be practiced supporting the health of nervous system and to decrease the potential of weakness or inability to move. In this respect, directives of the German Union of Athletic Therapists, concerning the importance of neural exercises as therapeutic movements specially designed with specific doses to eliminate functional disorders of the injured part, should be considered (Huisstede et al 2010; Cooper et al 2008; Ashworth et al 2008).

Through review of literature and direct observation, the researcher noticed that this injury is prevalent among wide sectors in the society in general and especially among athletes. Patients usually suffer from hand pain and weak ability for holding things and this prevents him/her from performing job-related and daily life activities. The problem is prevalent among housewives and athletes participating in gripping sports like archery, cycling, racket sports and handball. It is also prevalent among female athletes. This led the researcher to investigate the effects of a rehabilitative program on the working muscles of the injured hand for patients with CTS.

Aim:

This research aims to identify the effects of a rehabilitative program and shiatsu on the working muscles and nerves of the injured hand for patients with CTS. This can be done through investigating neural connectivity of carpal nerve fibers, grip strength, wrest range of motion (flexion – extension – abduction – adduction) and degree of pain.

2. Methods:

Approach:

The researcher used the experimental approach (one-group design) with pre-, intermediate and post-measurements.

Participants:

Participants (n=10) were purposefully chosen as they were all female athletes (25-30 years) with CTS because of sports participation, who are under treatment in Physiotherapy Hospital - Kuwait. They were all free of deformities and diseases. They are not under treatment of any kind.

Table (1): Descriptive Data of Participants (n=10).

s	Variables	Measurement	Mean	Median	SD	Squewness
A	**Growth Factors:**					
1	**Age**	**Year**	28.90	28.50	3.28	-1.32
2	**Height**	**Cm**	170.10	170.0	3.44	-0.97
3	**Weight**	**Kg**	75.40	75.00	5.33	-0.70
B	**Neural connectivity variables**					
1	**Neural connectivity**	**m/s**	4.05	4.00	0.09	-0.51
2	**Muscular strength**	**Kg**	18.60	19.00	1.07	-0.88
C	**Wrest Range of Motion Variables**					
1	**Flexion**	**Degree**	128.90	130.00	5.54	-1.40
2	**Extension**	**Degree**	80.20	80.00	1.47	1.58
3	**Abduction**	**Degree**	40.50	40.60	1.77	-1.34
4	**Adduction**	**Degree**	25.90	26.00	1.19	0.37
D	**Pain**	**Degree**	8.56	8.55	0.17	0.05

Table (1) shows that squewness values for all variables range between (±3). This indicates data normality among participants.

Procedures:

Main application of the recommended program was from 1-6-2016 to 26-7-2016 in Physiotherapy Hospital – Kuwait. The program lasted for two months (8 weeks with 3 sessions per week). The program contained (24) rehabilitative sessions. Each session ranged from 25: 45 minutes. Proper dose of treatment (volume and intensity of exercises) is identified according each patient's condition. Shiatsu massage was applied individually. Pressure points (tsupu) (2 point over the upper arm, 3 points on the palm, 4 points on the wrest and three points on the forearm) were identified. Pressure was applied for 2: 3 minutes according to each patient's response. Improvement percentage for neural connectivity was measured through electromyography device. Grip strength was measured using a manometer. A goniometer was used for measuring wrest range of motion (flexibility). Visual Analogue Scale (VAS) was used for measuring pain degree. Other instruments were used in the program including treadmill, ergometer, rubber resistances and free weights.

Statistical treatment:

The researcher used SPSS for calculating: mean – median – SD – squewness – variance analysis – F test – (t) test – LSD test. (Eiaco 2009; Londa et al 2004; Marcus 2009; Ohasni et al 2005).

3. Results:

Table (2) indicated statistically significant differences among the three measurements. This led the researcher to perform LSD test.

Table (2): Variance analysis among the three measurements (pre- - intermediate – post-) for all research variables (n=10)

S	Variable		Source of variance	Freedom degree	Squares sum	Squares mean	F
1	Neural connectivity variables	Neural connectivity (m/s)	Inter-measurements	2	0.421	0.210	19.057*
			Intra-measurements	27	0.298	0.011	
			Sum	29	0.719		
2		Muscular strength (kg)	Inter-measurements	2	88.800	44.400	21.255*
			Intra-measurements	27	56.400	2.089	
			Sum	29	145.200		
1	Wrest range of motion variables	Flexion	Inter-measurements	2	2739.467	1369.733	32.229*
			Intra-measurements	27	1147.500	42.500	
			Sum	29	3886.967		
2		Extension	Inter-measurements	2	110.867	55.433	35.134*
			Intra-measurements	27	42.600	1.578	
			Sum	29	153.467		
3		Abduction	Inter-measurements	2	72.200	36.100	18.391*
			Intra-measurements	27	53.000	1.963	
			Sum	29	125.200		
4		Adduction	Inter-measurements	2	156.800	78.400	46.523*
			Intra-measurements	27	45.500	1.685	
			Sum	29	202.300		
1	Pain		Inter-measurements	2	195.685	97.842	175.54*
			Intra-measurements	27	15.049	0.557	
			Sum	29	210.734		

Table (3) indicated statistically significant differences among the three measurements in favor of post-measurements.

Table (3): LSD test among the three measurements (pre- - intermediate – post-) for all research variables (n=10)

s	Variable		Measurement	Means	Means differences			LSD
					Pre-	Intermediate	Post-	
1	Neural connectivity variables	Neural connectivity (m/s)	Pre-	4.05		0.14↑*	0.29↑*	0.05
			Intermediate	3.91			0.15↑*	
			Post-	3.76				
2		Muscular strength (kg)	Pre-	18.60		1.80↑*	4.20↑*	0.76
			Intermediate	20.40			2.40↑*	
			Post-	22.80				
1	Wrest range of motion variables	Flexion	Pre-	128.90		12.20↑*	23.40↑*	3.45
			Intermediate	116.70			11.20↑*	
			Post-	105.50				
2		Extension	Pre-	80.20		2.10↑*	4.70↑*	0.66
			Intermediate	82.30			2.60↑*	
			Post-	84.90				
3		Abduction	Pre-	40.50		1.80↑*	3.80↑*	**0.74**
			Intermediate	42.30			2.0↑*	
			Post-	44.30				
4		Adduction	Pre-	25.90		2.70↑*	5.60↑*	**0.68**
			Intermediate	28.60			2.90↑*	
			Post-	31.50				
1	Pain		Pre-	8.56		3.64↑*	6.37↑*	**0.39**
			Intermediate	4.92			2.73↑*	
			Post-	2.19				

4. Discussion:

Table (2) indicated statistically significant differences among the three measurements (pre- - intermediate – post-) for all research variables as F calculated values on freedom degrees of 2 and 27 were higher than its table value (3.35). to identify the least significant difference, the researcher performed LSD test. Table (3) indicated statistically significant differences among the three measurements (pre- - intermediate – post-) for all research variables in favor of post-measurements. Least significant differences were in favor of post-measurements on neural connectivity (0.29) and muscle strength (4.2) in addition to improvements of wrest range of motion and pain in favor of post-measurements.

These significant improvements resulted from using shiatsu massage as it is distinct from other massage techniques or mechanical massage by the increase of therapist/patient interaction. It is completely directed to neural points of the injured part and this increases the quick neural response as a result of reaction to local pressure.

Improvements in neural connectivity resulted from shiatsu too as it increases blood concentrations of calcium, sodium and potassium. This improves motor frequency and functional capacity of central and terminal nerves. All these factors improve the connectivity of neural signals with quick recovery to normal condition.

Improvements in grip muscular strength, wrest flexibility, wrest range of motion and disappearance of pain resulted from shiatsu massage as it increases neural stimulation because of increased concentrations of mineral and decreased levels of creatine, cortisol and LDH. This improves neural signals and increases fiber alertness in muscles, ligaments and tendons, in addition to increasing blood flow and improving tissue and fiber nutrition. This improves sensitivity of fibers. Therefore, they perform contractions more effectively. All these factors improve grip muscular strength, wrest flexibility, wrest range of motion, functional capacity and disappearance of pain.

Mechanically speaking, shiatsu plays a vital role in treating CTS injuries, in addition to rehabilitative exercises, as it applies pressure on specific points on the upper arm, hand and wrest. This decreases the rate of transferring neural signals and eventually pain disappears. With the increase of mineral concentrations and Acetyl Choline (a neural enzyme for muscle contractions), Acetyl Colin is activated through pressure and is metabolized into acetic acid and Choline. This increases ionic exchange for calcium and potassium in muscles,

which in turn increases functional capacity for moving the joint without pain (Andrew & Hammah 2003; Michael et al 2006; Nathan et al 2010; Van M et al 2009; Pinar et al 2005).

As for rehabilitative exercises, they are considered as one of the best treatment techniques for decreasing pain and improving range of motion, flexibility and muscular strength in addition to improving physical fitness and bone conditions. This prevents joint injuries in old ages. These exercises are used in treating nerves, bones and joints because of its mechanical and biological effects on all body vital systems. These exercises eliminate functional disorders because of treating weakness of muscles, ligaments and joints in addition to treating swills and drain. In turn, this improves functional capacity of the injured joint and improves muscular strength, joint flexibility and neuromuscular coordination. All these factors decrease recovery time according to the notion of the American Association of Pain "Use it or Lose it".

Training volume and intensity for these exercises are identified according to adaptability of patient and inside pain limits with special consideration to muscular work angles for the injured part. Rehabilitative exercises improve blood circulation and functional capacity to eliminate pain. The rehabilitative program included strength and flexibility exercises to support neural work and improve muscular strength through increasing muscle mass and strengthening connective tissues in addition to improving ligaments and tendons. It also improves arterial blood pressure, muscle fibers and mitochondria in the working muscles. This increases energy production and delays fatigue. Using muscular work angles improve muscular balance and integrated growth of muscle fibers in the wrest in addition to inducing protein changes and hemoglobin increase. These effects improve muscle breathing and eliminate neural inflammations in addition to increasing flexibility and muscular strength. Using rehabilitative exercises along with shiatsu massage leads to quick recovery of CTS and improves neural connectivity and functional efficiency of the injured joint through increasing grip strength and joint flexibility (Riston 2007; Robert 2001; Scott & Kothari 2009; Hui et al 2004; Trombly 2008).

Conclusions:

According to this research aim, methods and results, the researcher concluded that the use of rehabilitative exercises along with shiatsu massage led to clear results in treatment and quick recovery of Carpal Tunnel Syndrome (CTS) or the wrest joint as it improved neural connectivity of the carpal nerve, increased grip strength and increased the range of motion of the wrest (flexion – extension – abduction – adduction) with eliminating pain.

Recommendations:

1. Strength exercises should be applied for wrest muscles to prevent carpal tunnel syndrome
2. The recommended rehabilitative exercises and shiatsu massage program should be used in treating carpal tunnel syndrome

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