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Effect Of Ultrasound With Splinting And Splinting Alone For Carpal Tunnel Syndrome

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ABSTRACT

Study objective: Effect of Ultrasound with Splinting and splinting alone for Carpal Tunnel Syndrome.

Design: Quasi experimental

Method and measurements: 24 female patients from Prince Sultan Military Medical City Riyadh participated in this study. Their CTS was diagnosed by the nerve conduction velocity (NCV). Patients were divided into two groups; group A received Ultrasound with Splinting and group B received Splinting alone. Patients completed 3 consecutive weeks of follow-up. VAS, MPQ, was used to measure the pain in both groups. Before and after 3rd week of treatment pain was measured.

Results: Subjects in-group A that received US and Splinting showed greater Improvement in pain compared with the Splinting alone group on 3rd week compared with pre treatment. ($p < 0.050$)

Conclusion: The result of study suggests that both Ultrasound and Splinting improves the symptoms of CTS.

Splinting alone improved the pain symptoms but was too small to reach satisfactory outcome for patients. Based on these results US and Splinting should be the treatment of choice for CTS rather than Splinting alone.

Keywords: Carpal Tunnel Syndrome, Splinting, US, VAS, MPQ.

Introduction: Carpal tunnel syndrome (CTS) is a neurological disorder involving compression of median nerve in carpal tunnel of wrist^{1,2}. It is considered the most common entrapment neuropathy^{3,4}. Numbness, tingling and pain in

the hand, forearm, elbow or even shoulder, and weakness of the hand are common symptoms of CTS^{5,6}, the patient also may experience an electric-like shocking feeling. These impairments may cause a disability in the performance of

activities of daily living^{7,8}. The syndrome shows improvement with rest and worsen at night^{6,7,9}, or with repetitive upper extremity activity^{2,10}. It is more common in women than men^{9,11} and affects up to 10% of population⁹.

Patients complain of paraesthesia (with or without numbness or pain) involving the fingers innervated by the median nerve, and a weakness of thumb abduction. Symptoms are worst at night and often wake the patient. Standard treatments include splints, local injection of corticosteroids, and surgical decompression. Benefit from non-surgical treatment, however, seems to be limited,¹² and not all patients respond to surgery.¹³

Idiopathic CTS can be relieved with surgical or conservative intervention⁴. Current conservative treatments include splints^{2,3,4,7,14}, activity modification^{4,15}, non-steroidal anti-inflammatory drugs^{4,16} and local injection of corticosteroids^{1,7}. In addition, physical modalities like Ultrasound¹⁷, nerve gliding exercises^{14,18}, acupuncture^{6,10,19} and laser treatment have also been used²⁰.

US refer to mechanical vibrations, which are essentially the same as sound waves but of a higher frequency. US is a deep penetrating modality capable of producing changes in tissue through both thermal and non thermal

(mechanical) mechanisms. Depending on the frequency of the waves, US is used for diagnostic imaging, therapeutic tissue healing or tissue destruction²¹.

Splinting the wrist is the most common conservative intervention^{10,9,15}. The rationale for wrist splints was originally based on observations that CTS symptoms improve with rest and worsen with activity^{2,22}. The purpose of splint is to decrease pain, slow disease progression and improve physical function²³. Researchers have suggested that the therapeutic effect of wrist splinting arises from minimizing carpal tunnel pressure^{3,16} which is strongly implicated in the pathophysiology of CTS, that pressure increases with wrist positions other than neutral^{2,10,7,14,22}. The aim of Study to investigate the effects of US and Splitting combined with pre-defined doses, Splinting program alone on pain intensity and function in patients with CTS.

Methods:

Subjects': 24 female patients with idiopathic chronic CTS, during exacerbation phase participated in this study. Their age ranged from 30 to 45 years (37.93 ± 5.24 years) and were recruited from Prince Sultan Military Medical City-Riyadh. The inclusion criteria was: female patients aged between 30-45 years, patients with idiopathic chronic carpal tunnel syndrome as diagnosed with nerve conduction study, patients who were in the exacerbation phase (acute) but

not under any anti-inflammatory medication, patients who didn't receive physiotherapy since 3 months, and patients adherence to splint wear at least 70% for continuous 3 weeks. The exclusion criteria was: patient with secondary entrapment neuropathies, trauma in the wrist area, muscle wasting or atrophy, patients with inflammatory arthritis, hypothyroidism, congestive cardiac failure, diabetes mellitus, obesity (Body mass Index (BMI) > 30), patients who were pregnant and patients who received surgery. The research proposal was approved by the Rehabilitation Health Science (RHS) department of King Saud University (KSU) and the Physical and Occupational therapy departments in Military Hospital.

Design : Quasi experimental

Equipments and measuring tools:

Sheets, Diaries, Exercises ball, US machine, US gel, Splints, VAS Scale, MPQ

Procedure:

Ultrasound treatment procedure and technique

Ultrasound treatment was administered for 15 minutes per session to the area over the carpal tunnel at a frequency of 1 MHz and an intensity of 1.0 W/cm², with pulsed mode duty cycle of 1:4 and a transducer area of 5 cm², using an

electrocare machine with aquasonic gel as the couplant. The apparatus was initially standard and the output was controlled regularly by a simple under-water radiation balance. A total of 15 Ultrasound treatments were performed once a day, five times a week for three weeks²⁴.



Figure (1) shows Ultrasound Technique

Placebo Ultrasound

Patients in placebo group received same duration of Ultrasound with the apparatus switched on (so that patients see lights flashing on machine) but without any current output. In this way, patients were blinded for Ultrasound treatment.

a) *Therapeutic procedures:*

Splint: Custom-made, thermoplastic, lightweight, neutral-positioned wrist splints (*figure2*) were given to patients provided by the hospital, and made by the occupational therapist at the occupational therapy department. The researcher instructed the patients to wear the splints daily depending on their groups,

for continuous successive 3 weeks. The minimum hours of splint wear in both groups were from 6-8 hours.

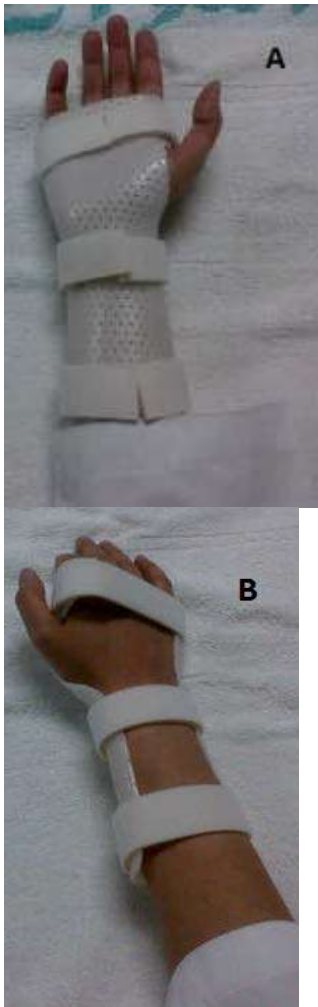


Figure (2): Custom made thermoplastic, light weight and neutral position wrist splint. A) Palmer view, B) Dorsal view.

Exercises: Patients were educated how to perform strengthening exercises to maintain their hands muscles power and self stretching exercises to stretch the flexor retinaculum.

Patient were trained at first session and supplied by a researcher-designed brochure that describes the exercises, which were repeated during each visit and used as home program exercises.

During the *strengthening exercises*, patients were asked to squeeze the ball (figure 3) and hold for 10 seconds while sitting on a chair with supported hand on padded table, keeping neck and shoulder in neutral position, forearm in supination and elbow 90° of flexion.

During *self stretching exercises* patients were asked :1) to bring palms together with fingers pointed up toward ceiling and slowly slide them down until she felt a stretch in the inner wrist area²⁵, hold 20-30 second , then relax for 10 seconds and repeat the exercises. 2) to extend their affected arm straight so their palm is faced away from them, then used the other hand to gently pull their fingers toward them, to stretch the carpal tunnel area²⁵, hold 20-30 seconds , then relax for 10 seconds and repeat the exercises. 3) to interlace their fingers and stretched their arms out in front of them²⁵, hold for 20-30 seconds , then relax for 10 seconds and repeat the exercises. All these exercises were repeated 10 times, five sessions daily for 3 weeks.



Figure (3): Hand strengthening exercises using Egg squeeze ball.

Assessment procedures

The patients were treated for 3 weeks. Pain was assessed by VAS and MPQ before starting treatment and on 3rd week of post treatment session. On VAS Patient were asked to describe their pain status on a 10cms line where left end represents no pain and right end represents maximum pain.

No pain worst pain
.0 ____ .1 ____ .2 ____ .3 ____ .4 ____ .5 ____ .6 ____ .7 ____ .8 ____ .9 ____ .10

Figure (4) showed the Visual analogue scale

MPQ consists of a set of pain descriptor list, and are read to a patient with the explicit instruction that he chooses only those words which described his feelings and sensations at that moment.

PRI is based on the rank values of words. In this scoring system, the word in each subclass implying the least pain is given a value of 1, the next word is given a value of 2, etc. The rank values of words chosen by a patient are summed to obtain a score separately for the sensory (subclass 1-10), affective (subclasses 11-15), evaluative (subclass 18) and miscellaneous

(subclasses 17-20) words, in addition to provide a total score (subclasses 1-20).The PPI is recorded as a number and is associated with the following words 1-mild, 2-discomforting, 3-distrcession, 4-horrible, and 5-excruciating.

Data Analysis:

All Data was analyzed using statistical test-pair t test. Mean and SD for pre R_x and after 5th week Rx pain values were calculated for each group. Significance was accepted at 0.05 level of probability.

Findings:

In this study 24 female patients participated with a mean age of 36.7(5.14) in group A and 39.0(5.19) in Group B ranging from 30 to 45 years (Table 1). .

	Group A (N=12)	Group B (N=12)
	Mean(SD)	Mean(SD)
Age (Yrs)	36.7(5.14)	39.0(5.19)
BMI	27.1(2.80)	26.1(2.62)

Table1: Comparison of demographic data between group A and B.

Mean reduction in PRI, PPI & VAS of group A & B with p & t values:

Mean reduction in PRI (Table 2,)

Both groups had significant difference in pre R_x to 3rd week values as t and p values for group A and B were t=13.47, p=0.000 and t=9.53, p=0.000 respectively (table 2).

Groups	Pre R _x	3 rd week	Pre R _x to 3 rd week		
			Mean±SD	Paired t value	P value
Group A (N=12) Mean±SD	20.19±3.16	2.12±1.24	16.75±4.33	13.47	0.000
Group B (N=12) Mean±SD	15.35±3.54	7.55±3.72	6.23±2.53	9.53	0.000

Table 2: Mean reduction in PRI values between group A and B. Mean and standard deviation at pre treatment, 3rd week and pre treatment to 3rd week with t and p values.

Mean reduction in PPI (Table 3.)

Both groups had significant difference in pre R_x to 3rd week values as t and p values for group A and B were t=11.57, p=0.000 and t=10.58, p=0.000 respectively (table 3).

Groups	Pre R _x	3 rd week	Pre R _x to 3 rd week		
			Mean±SD	Paired t value	P value
Group A (N=12) Mean±SD	4.55±0.63	0.50±0.53	2.52±0.71	11.57	0.000
Group B (N=12) Mean±SD	4.22±0.63	1.52±0.66	1.76±0.54	10.58	0.000

Table3: Mean reduction in PPI values between group A and B. Mean and standard deviation at pre treatment, 3rd week and pre treatment to 3rd week with t and p values.

Mean reduction in VAS (Table 4.)

Both groups had significant difference in pre R_x to 3rd week values as t and p values for group A and B were t=18.04, p=0.000 and t=11.25, p=0.000 respectively (table 4).

Groups	Pre R _x	3 rd week	Pre R _x to 3 rd week		
			Mean±SD	Paired t value	p value
Group A (N=12) Mean±SD	7.43±1.24	0.41±0.45	6.47±1.24	18.04	0.000
Group B (N=12) Mean±SD	6.37±1.41	2.79±1.14	2.93±0.84	11.25	0.000

Table 4: Mean reduction in VAS values between group A and B. Mean and standard deviation at pre treatment, 3rd week and pre treatment to 3rd week with t and p values.

Thus, it can be concluded from above results that both interventions (US and Splinting) were effective in Pain reduction as reflected by VAS

and MPQ .But, Patients (group A) that received US with Splint showed greater improvement in pain compared with Splint alone (group B)on 3rd week compared with pre treatment .

Discussion:

An increase in pressure in the carpal tunnel is usually caused by non-specific flexor tenosynovitis⁴⁵. Chronic focal compression of a nerve trunk can cause focal demyelination by mechanical stress deforming the myelin lamellae. Ischaemia also plays a pathogenic role in the carpal tunnel syndrome. It could account for intermittent paraesthesia that occurs at night or with wrist flexion¹².

The positive clinical effect of splint in CTS symptoms including pain relief have been approved in many studies which investigated the effect of splint alone^{20,22,26} or compared it with other treatment, such as with oral prednisone²⁷, yoga²⁸, laser¹⁹, and acupuncture²⁹. In addition, splint was effective if it is combined with other conservative treatment^{6,12,25}.

In this study, fair inclusion and exclusion criteria were used to ensure validity of the results. Only females were included to overcome the gender factor effect. It was approved that females have lower thresholds

of pain, greater abilities to discriminate pain, and higher pain ratings or less tolerance of noxious stimuli than males^{30,31}.

Women generally have an increased sensitivity to experimental pain when compared to men³². Male and female's pain experiences might be attributed to differences in their biology, as well as the perceptions and behaviors of health care professionals and a society that treats the genders differently.³²

All patients were right handed. Moreover, results showed homogeneity of both patients groups. There were no significant differences in their age, BMI, and initial pain threshold. In addition there were no significant differences of the percentage of change of pain threshold between both the groups. This homogeneity added to results validity and strength.

This was not surprising because a lot of studies have approved the long effect of splint in CTS patients^{22,33,34}.

The findings of the study confirm preliminary data that Ultrasound treatment may facilitate recovery from the carpal tunnel syndrome.³⁵⁻³⁶ Given the favourable response rate of 68% of patients at the end of treatment, ultrasound treatment may be similar in effectiveness to steroid injections or wrist splinting;

improvements persisting for at least 6 months in most patients might even suggest the potential superiority of ultrasound treatment. Palmar wrist splints worn at night seem suitable only when symptoms are mainly nocturnal,³⁷ and ergonomic strategies have not yet been evaluated.

The findings of the study confirm that Ultrasound treatment is more effective than laser treatment in patients with carpal tunnel syndrome. The rate of improvement from ultrasound treatment was similar to that reported in other studies (Ebenbichler et al 1998, Walling 1998) and may indicate its similar effectiveness to steroid injection or wrist splinting (Girlanda et al 1993, Gonzales and Bylak 2001), but without their complications (McConnel and Bush 1990) or limits (Burk et al 1994)²⁴.

These all study findings support the results of the present study.

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Conclusion:

The result of study suggests that both Ultrasound and Splinting improves the symptoms of CTS. Splinting alone improved the pain symptoms but was too small to reach satisfactory outcome for patients. Based on these results US and Splinting should be the treatment of choice for CTS rather than Splinting alone.

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