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Effect of Ultrasound Versus Transcutaneous Electrical Nerve Stimulation in Management of Carpal Tunnel Syndrome

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Abstract

Carpal tunnel syndrome (CTS) is the second most prevalent cause of work absence, resulting in hand functional loss and disability which affects 5.8% in women and 0.6% in men. This compression neuropathic syndrome causes pain, numbness& paraesthesia in the median nerve's distribution. Atrophy of thenar muscles may occur in later stage. The purpose of the study is to evaluate the effects of ULTRASOUND and TENS in the management of CTS. A total of 30 subjects with CTS were selected according to inclusion and exclusion standards. Patients were split into two groups at random (experimental -15, conventional-15). The experimental group will receive ULTRASOUND along with wrist mobility exercise. The conventional group will receive TENS along with wrist mobility exercise for the period of two sets of five reps, five times per week for six weeks. VAS pain scale and BCTQ (Boston carpal tunnel questionnaires) was utilized as an outcome measure. The mean value of pretest was (VAS-5.13, SSS-29.27, FSS-19.93) and the posttest values was (VAS-2.00, SSS-14.07, FSS-9.13) for experimental group and the mean value of pretest was (VAS-5.20, SSS-29.67, FSS-20.73) and the post values was (VAS-4.00, SSS-21.52, FSS-16.93) for conventional group, respectively. From the study, it has been concluded that ULTRASOUND showed the better results in pain relief and functional activity in patients with CTS. Although TENS showed gradual improvement in pain relief alone.

Keywords

Carpal tunnel syndrome, ultrasound therapy, TENS, wrist mobility exercise

Introduction

A compression neuropathic syndrome in wrist joint known as carpal tunnel syndrome causes pain, numbness & paraesthesia in the median nerve's distribution. Atrophy of thenar muscles may occur in later stage. Thumb, index, middle & a portion of ring fingers are supplied by the median nerve (Chang et al., 2014). Pain and paraesthesia also radiate to forearm, elbow and shoulder. It often worsens with time, causing numbness; tingling and can cause people to wake up from sleep. The

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abductor polices brevis often weakens and eventually wastes as a result of severe compression (Burke et al., 2003). Carpal tunnel condition involves both or only one dominant hand thus weakens the hands muscular strength, particularly on the side of the first three fingers (Bobowik et al., 2019).

CTS are primarily caused by occupational variables, such as constant mouse use and excessively repetitive or strong actions that require the hand that cause wrist vibration. These factors include localized trauma, stress, and chronic incorrect positioning of the hand or wrist (Tanaka et al., 1997). The prevalence of electro-physiologically validated CTS was 5.8% in women and 0.6 percent in males in a sample of 715 persons (33 percent men), aged 25 to 74 years (Atroshi et al., 1999). In adult women, the prevalence rate of undiagnosed TS was 5.8% (95% confidence interval (CI): 3.5-8.1%), with CTS being diagnosed in 3.4% (95 percent Cl: 1.5-5.3%) of cases. Men had a prevalence rate of 0.6 percent (95 percent confidence interval: 0.02–3.4 percent (Ablove et al., 2009). Compared to part-time store clerks (19.3%) and controls (16.3%), full-time clerks (31.0%) exhibited greater current CTS symptoms ($p = 0.055$) (Bonfiglioli et al., 2007).

Early stage -Initial symptoms are only present at night and are intermittent. Intermediate stage - Both nocturnal and diurnal symptoms are present. Micro circulation abnormalities are always present. Advanced stage - symptoms such as signs of sensory or motor impairments, which are represented by early axon damage at different levels represent axonotmesis.

When deep tissue injuries are present, ultrasound therapy uses high-frequency sound waves to enhance blood flow and cellular activity, reducing pain, spasms and accelerating recovery. High intensity - (5 W cm2) and low intensity - (0.125-3-W cm2) applications of therapeutic ultrasound are the two groups that form this therapy. Ultrasound frequency may vary from 1MHz to 3 MHz (TerHaar 1999). The mechanism of US therapy includes both thermal & non-thermal actions.

TENS is an inexpensive non-pharmacological, that uses high-frequency stimulation to activate huge afferent fibres, which helps to relieve neuropathic pain. It is used at different frequencies, intensities, and pulse durations (Sluka et al., 2003). TENS at these pressure points reduces the pain and would be more beneficial than when applied to non-acupoint locations when measuring pain and pain sensitivities to pressure and temperature in healthy individuals (Cheing et al.,2009; Schliessbach et al., 2011; Wang et al., 2003).Exercises are useful to the entire human body, In order to reduce pressure around the nerve, manual treatment methods such as carpal bone mobilization, transverse carpal ligament stretching, ligamentous release, and flexor tendon gliding are targeted at mechanical interfaces(Walsh et al., 2005).During different positions and movements of the limbs, the peripheral nerves have the ability to glide and create tension (Hough et al.,2005; Byl et al., 2002; Kazantzidou et al., 2021).

Physical therapy is the most common treatment for patients who have injured their wrists. Wrist rehabilitation is usually a time-consuming process that requires both the patient and the physiotherapist to put in a lot of effort (Kuryło et al., 2019). In order to reduce CTS symptoms, mobility of the median nerve can assist in lowering internal nerve pressure and enhancing nerve blood flow, allowing the nerve to regenerate and recover (Tal-Akabi et al., 2000; Shacklock 2005). The physiotherapy is relieved by therapeutic devices such as IFT, Laser, UST, rehabilitative

manipulators etc. The proposed therapies, which is useful in wrist rehabilitation, allows for accurate repetition of movements as well as adjustment of action speed and strength (Butler et al., 1991). Therefore, this study is conducted to identify the effects of ULTRASOUND and TENS along with wrist mobility exercise among patients with mild to moderate symptoms.

Methodology

A total of 30 subjects with carpal tunnel syndrome were chosen using convenient sampling method which includes both men and women, for mild to moderate condition (2-6 vas pain scale), presence of paraesthesia and positive for phalen's and tinel's test and excluded the subjects with predisposing factors for CTS's presence (e.g. Diabetes mellitus, acute trauma, Rheumatoid arthritis, kidney failure, pregnancy, hyper and hypothyroidism). They were informed about the simplicity of the procedure and informed consent was obtained from them. The patients were classified into two groups (experimental group -15, conventional group -15). All the patients were initially evaluated with VAS pain scale and BOSTON carpal tunnel questionnaire which was considered for pre and post-test. {VAS – 1 TO 10 pain rating scale, BCTQ - contains -Symptoms Severity Scale (11) and Functional Severity Scale (8).

Experimental group was given ULTRASOUND at the frequency - 1 MHz, intensity - 1.0 W/5cm^2 with pulsed mode of 1: 4 and a transducer area of 5cm^2 (Bakhtiary et al., 2004) were administered to the wrist crease to the palmar region for 15 min per session, five days a week over the period of six weeks, along with wrist mobility exercise.

Conventional group was given negative electrodes were administered to the carpal ligament and positive electrodes to the palmar region for 20 minutes per session (Koca et al., 2014) for five days a week over the period of six weeks, along with wrist mobility exercise. Wrist mobility exercise will be common treatment for both the groups. Each exercise should be done for 5 reps of 2 sets per day.

Table 1. Demographic data of the participants

Analysis	Average	Total
Age	25-40	18
	41-55	12
Gender	Male	16
	Female	14

To compile and assess the collected data, descriptive and inferential statistics were used. All parameters were averaged and subjected to mean and standard deviation. A paired t-test was conducted to ascertain whether there were any significant variations between pre-and post-test measurements, and an unpaired t-test was conducted to determine whether there was a significant difference between the two groups. A P-value of 0.0001 was utilized as the statistically significant cut-off.

Results

The quantitative data's statistical examination revealed statistically significant differences between the pre and post-test periods.

Table 2. Comparison of pre and post-test values which was measured by VAS (pain scale)

Groups	VAS	Mean	SD	T-value	P-value
Experimental group	Pre-test	5.13	0.92	18.9632	<0.0001
	Post-test	2.00	0.53		
Conventional group	Pre-test	5.20	1.01	11.2250	<0.0001
	Post-test	4.00	1.00		

From the above tables: Table 2 shows the mean value of pre-test and post-test values of ULTRASOUND [5.13 is reduced to 2.00] and TENS [5.20 is reduced to 4.00] which was measured by VAS. TABLE 3 shows the mean value of pre and post-test values of ULTRASOUND [29.27 is reduced to 14.07] and TENS [29.67 is reduced to 21.53] which was measured by BCTQ [SSS]. TABLE 4 shows the value of pre and post-test values of ULTRASOUND [19.93 is reduced to 9.13] and TENS [20.73 is reduced to 16.93] which was measured by BCTQ [FSS]. The findings were extremely statistically significant, with the p-value of less than 0. 0001.From the result, it was observed that experimental group showed significant improvement in pain relieving factors and also showed improvements in functional activities among CTS patients.

Table 3: Comparison of pre and post-test values which was measured by BCTQ [SSS]

Groups	BCTQ(SSS)	Mean	SD	T-value	P-value
Experimental group	Pre-test	29.27	1.03	28.3423	<0.0001
	Post-test	14.07	1.39		
Conventional group	Pre-test	29.67	0.62	19.7170	<0.0001
	Post-test	21.53	1.68		

Table 4: Comparison of pre and post-test values which was measured by BCTQ [FSS]

Groups	BCTQ(FSS)	Mean	SD	T-value	P-value
Experimental group	Pre-test	19.93	2.34	18.9237	<0.0001
	Post-test	9.13	1.25		
Conventional group	Pre-test	20.73	2.12	10.7174	<0.0001

Discussion

The current study is to compare the efficiency of TENS versus ULTRASOUND in patients with CTS. VAS and BCTQ are used as an outcome measure for the assessment of pain and functional activities. The differences between pre and post-test values of experimental group and conventional group are quite significant. The mean value of pre-test was (VAS-5.13, SSS-29.27 , FSS-19.93) and the post-test values was (VAS-2.00, SSS-14.07, FSS-9.13) for experimental group and the mean value of pre-test was (VAS-5.20, SSS-29.67, FSS-20.73) and the post-test values was (VAS-4.00, SSS-21.52, FSS-16.93) for conventional group.The unpaired t test between the post-test values of both groups reveals a significance difference between groups. The difference is statistically significant, as the experimental group's mean values were lower than those of the

conventional group, which indicates that TENS treatment showed minimal effects on CTS patients, although it showed a gradual improvement in the symptom severity scale. A study conducted by Page MJ et al., Physical therapy techniques such as carpal bone mobilisation, therapeutic ultrasonography, and nerve glide exercises have little scientific support (Page et al., 2012: 2013). CTS Therapies, which include Carpal bone mobilization and therapeutic ultrasound, both need a skilled therapist, have even less proof of their efficacy, and require a number of sessions, usually five days a week for two to four weeks with therapeutic ultrasound (Page et al., 2013). In this current study, patients received a combination of both ULTRASOUND and wrist mobility exercise as a conservative treatment, which showed improvement in pain relief and functional activity. The demographic data (Table 1) indicates male participants (16) show more improvement than female participants (14), and the total of 21 working participants shows lesser improvement than the non-working 9 participants. A study (Palmer et al., 2011) concludes that CTS is a condition that affects a large number of persons who are working age. Clear correlations between CTS and work-related activities that expose workers to hand-transmitted vibration and/or repetitive, forceful hand/wrist movements have been demonstrated.

The results of the study by (Oztas et al., 1998) showed that after 2 weeks of treatment with ULTRASOUND, patients with CTS showed statistically significant clinical improvement. Despite no obvious functional improvement being observed after the therapy, they were still utilized in continuous mode at 1.5W/cm² intensities and frequencies, with application times of 4 and 8 minutes. In the future, comparable experiments using various US parameters will allow researchers to get a larger range of outcomes. We utilized ULTRASOUND with pulsed mode, intensity of 1.0 W/5cm^2, with frequency of 1MHz 15min per session, five times a week for the duration of 6 weeks which showed better results in pain relief and functional activities.

Future investigations should be conducted with a bigger sample size so that ULTRASOUND can be compared to other frequencies and other specific modalities like Extracorporeal shock wave therapy (ESWT) in CTS (Razali et al. 2023). Due to the self-report nature of the study's questionnaires (BCTQ), participants may be exposed to external bias.

Conclusion

According to the research, ULTRASOUND and wrist mobility exercises, both significantly reduced the symptoms and functional severity scores of BCTQ while also improving factors that contribute to pain relief. Patients who underwent TENS and wrist mobility exercises only noticed a significant reduction in the severity of their symptoms in BCTQ scores.

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