The Effects of Laser and Ultrasound Therapy on Carpal Tunnel Syndrome

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ABSTRACT

Background: Carpal tunnel syndrome (CTS) is the most common compressive neuropathy of upper limb and one of the causes of disability. The conservative management of CTS includes splints, intracarpal steroids and ultrasound therapy. Recently Low-energy Laser Therapy has been popularized in the treatment various treatment including carpal tunnel syndrome. We compared the effects of both of these therapies in a randomized trial.
Objectives: To compare the effects of laser versus ultrasound therapy on carpal tunnel syndrome
Methods: A total of hundred patients of unilateral carpal tunnel syndrome diagnosed clinically and electrophysiologically were included in the study and divided in two equal groups. One group was treated by UltrasoundTtherapy (1MHz, 1.0 Watt/cm^2) and the other group by Low Level Laser Therapy (830 nm infrared). Patients were blinded to the two types of treatment. Treatment Outcome was measured subjectively by Visual analogue scale, functional status scale and Symptom Severity Scale for gravity of symptoms. Objectively outcome was measured electrophysiologically before and after the treatment.
Results: Improvement was more marked in ultrasound treated group than laser treated group. Pain relief on Visual Analogue Scale, Symptom Severity Scale and Functional Status Scale was 2.30 points, 0.44 and 0.34 points more in Ultrasound treated group as compared to Laser treated group. Electrophysiologically improvement in Sensory Latency and Motor Latency was 0.46 ms and 0.62 ms more in ultrasound treated group. P value was less than 0.001
Conclusion: Ultrasound treatment proved to be more effective than Laser treatment.
Key words: Carpal Tunnel Syndrome, Ultrasound Therapy, Low Level Laser Therapy.

INTRODUCTION

Carpal tunnel syndrome is the most common compressive neuropathy of upper limb[1]. Carpal tunnel syndrome involves compression of median nerve at the carpal tunnel and results in a variety of symptoms and signs. The Symptoms are mostly sensory but if the compression persists motor symptoms may also result. Sensory symptoms are mostly in the form of paresthesias, numbness involving medial two and a half fingers. It can also involve whole of hand, forearm and even whole of the arm. Usually these symptoms occur at night due to posture of wrist and awaken the patient from sleep whereas they settle down with shaking or massage. Motor symptoms include decreased muscle power and wasting of thenar muscles in severe cases. The diagnosis is usually clinical and the symptoms can be easily precipitated by doing Phalen's or Reverse Phalen's test. The diagnosis is confirmed by nerve conduction studies and electromyography[2].

This syndrome usually appears after 30 years of age and mostly occurs bilaterally and more commonly in females. The incidence and prevalence of CTS is almost same in developed countries seems similar to the United States (e.g., incidence in the Netherlands is approximately 2.5 cases per 1000 subjects per year and prevalence in the United Kingdom is 70-160 cases per 1000 subjects[3,4]. Point prevalence is 0.2% in men and 8% in women[5]. In Pakistan no population based local data is available on CTS and this remains one of the most ignored and untreated condition as well. Carpal tunnel syndrome can be treated by splints, intracarpal corticosteroid injections and surgical decompression. Local steroids are effective mode of conservative in CTS[6]. Surgical decompression is considered to be radical treatment but all the patients still not respond to surgery[7]. Among the conservative treatment laser therapy and ultrasound therapy have biophysical effects and used to treat CTS[8,9].

Low-energy laser therapy and ultrasound therapy has been popularized in the treatment of various rheumatologic, neurologic, and musculoskeletal disorders such as osteoarthritis, rheumatoid arthritis,

fibromyalgia, carpal tunnel syndrome, rotator cuff tendinitis, and chronic back pain syndromes. In a recent review there is evidence that Ultrasound and Laser both were effective in treating CTS[10]. We have compared the clinical efficacy of the pulsed ultrasound versus low level laser therapy in CTS. This is the first local study on the subject and limited studies are available in the internationally. We planned to do this study because of three reasons; (1) to see the role of both modalities in the treatment of CTS, (2) to compare the effects of Laser Therapy and Ultrasound therapy in the conservative treatment of CTS and (3) to highlight the importance of the condition and find a better solution in local population.

MATERIALS AND METHODS

In this randomized controlled study we have compared the effects of laser treatment and ultrasound therapy on carpal tunnel syndrome. Patients with unilateral carpal tunnel syndrome suspected on clinical grounds and diagnosed on the basis of nerve conduction studies after written consent were included in the study. Study was conducted in Jan 10 to Jan 2012 at Department of Physical Medicine and Rehabilitation Combined Military Hospital Quetta. Patients referred from Neurology, Orthopedic and Neurosurgical Department Quetta, were invited to take part in the study. CTS was diagnosed on the basis of clinical and standard electrophysiological criteria, as Nerve Conduction Studies are first line investigation for CTS[11-13]. Inclusion criteria was unilateral idiopathic carpal tunnel syndrome, with symptoms were more than 4 months of duration, patients with no other compressive neuropathy and generalized neuropathy on electrodiagnosis. Patients with history of fracture, history of intracarpal injection and surgical decompression were excluded from the study. Patients were randomly divided and enrolled into two groups. Group A, who received ultrasound therapy and Group B, received low level laser therapy. 50 patients were randomly assigned in each protocol group. Computer generated randomization was done by the statistician and it was given to the physiotherapy dept in two sets of sealed envelopes. When patient qualified for the study and signed the informed consent, serial envelope was opened at reception and inside directed instructions guided the patient allocation to a specific group. Low-level laser therapy was administered by applying a low intensity (9 J), infrared laser diode (Enraf, Endolaser 830nm) at (1.8 J/point) over the wrist. A total of 20 laser therapies were performed once a day, 5 times a week for 4 weeks. Ultrasound Therapy was done at 1 MHz and intensity of 1.0 Watt/cm with Enraf Sonopuls 492. A total of 20 sessions in 4 weeks were done. The Outcome measures for each wrist consisted of (a) visual analogue scale (VAS): pain measurement by means of VAS on which patients could indicate their assessment along a 10 cm line ranging from 0-10, where 0 means no pain and 10 is the maximum pain could be imagined (b) symptom Severity Scale (SSS): Gravity of symptoms of carpal tunnel syndrome were assessed over a period of 24 hours. Symptoms of CTS were graded from 0-4 where 0 is none and 4 is very severe (c) functional Status Scale (FSS) different activities like buttoning, reading, holding small objects, opening of jars and bathing and dressing are graded on the basis of function depending upon severity from 0-4. Severity Scale: 0=Never; 1= Mild; 2=Moderate; 3=Severe; 4=Very severe and (d) nerve conduction studies and electromyography: Electrophysiological studies were done on Key point 2 channel Electromyography machine. Median motor latencies were recorded with surface electrodes. Median sensory latency was also recorded by antidromic method. All the studies were standardized at room temperature of 32 degree centigrade. Standard electrophysiological criteria included for the diagnosis of CTS was prolongation of motor and sensory latency. (i.e., motor latency > 4ms, sensory latency > 3.5 ms)[14]. Studies were done before the intervention and 4 weeks after the completion of study. Results were analyzed in SPSS 16, different variables used in the study VAS, SSS, FSS and electrophysiological studies (Median nerve motor and sensory latencies) were compared before and after the studies by student t test.

RESULTS

One hundred patients fulfilled the inclusion criteria and baseline characteristics did not differ in two groups. The mean age $\pm$ standard deviation for the all the patient was 35.59$\pm$ 6.1. Majority of the patients were females n=55 (55%) with most of them having involvement of the right side n=74 (73.3%). Group “A” included 50 patients who underwent laser therapy. In this group there were n=31 (51.67%) females and n=29 (48.33%) males with a mean age of 35.1$\pm$6.2. Group “B” which was treated by therapeutic ultrasound also included 50 patients having n=35 (58.33%) females and n=25 (41.67 %) males with a mean age of 36.08$\pm$5.9 (Table 1).

Subjective symptoms gauged on symptom severity scale and functional status scales were almost the same for both groups at the time of initial evaluation. Objectively the results of electrophysiological studies did not significantly differ in terms of sensory latencies and motor latencies in ultrasound treated and laser treated groups. Baseline data in either group did not differ much as evident from table 1. Subjective improvement after the therapy was seen in both groups as evident from symptom severity scale. Functional status also improved in either group as shown by functional status scale in ultrasound and laser treated group. Pain decreased significantly in both groups but more so the group B treated by ultrasound. Electrophysiological studies done at baseline were done to confirm the extent compression before and after the intervention. Distal motor latency and sensory latencies were recorded before the commencement of treatment and reevaluated after treatment and mean changes were found to be significantly improved in ultrasound treated group (P value <.001) [Table 2].

Table 1: Baseline characteristics in ultrasound and laser therapy group showing means and SD

Variables at presentation	**Group A**		**Group B**	
	Mean	**Standard Deviation**	**Mean**	**Standard Deviation**
Pain	8.00	1.00	8.00	1.00
symptom severity scale	3.53	0.25	3.76	0.19
Functional status scale	2.74	0.26	3.13	0.26
Nerve conduction studies sensory latency	4.43	0.26	4.35	0.23
Nerve conduction studies motor latency	4.66	0.21	4.08	0.17

Table 2: Change from baseline in both treatment groups mean difference; p value

Variables	**Group B**		**Group A**		**Mean Difference**	**95% confidence interval of difference**		**P value**
	Mean	**S D**	**Mean**	**S D**				
Pain	-4.90	1.46	-2.60	1.07	-2.30	-2.81	-1.79	<0.001
Symptom severity scale	-0.87	0.18	-0.44	0.18	-0.44	-0.51	-0.37	<0.001
Functional status scale	-0.75	0.12	-0.40	0.17	-0.34	-0.40	-0.29	<0.001
Nerve conduction studies sensory latency	-0.54	0.28	-0.07	0.07	-0.46	-0.55	-0.38	<0.001
Nerve conduction studies motor latency	-0.80	0.23	-0.18	0.13	-0.62	-0.70	-0.55	<0.001

DISCUSSION

Although CTS is also associated with a number of systemic conditions and a variety of local causes like local trauma, overuse of the hand or wrist, or prolonged improper positioning but in most of the cases no definite cause could be found.[15] Prolonged extreme posture of the wrist, high amount of repetitive movements and handling of instruments involving vibration are associated with Carpal Tunnel Syndrome.[16] Steroids and splinting are effective but have their limitations and complications[17]. This study compared the therapeutic role of ultrasound therapy and laser therapy in the treatment of CTS. Shooshtari et al[18] suggested that the laser therapy is effectively a new conservative treatment in treating CTS and proved it both subjectively and with electrophysiological parameters.[18] Our study confirmed that ultrasound and laser are both effective conservative mode of treatment of CTS. Ultrasound is an effective mode of treating carpal tunnel syndrome and rate of improvement is higher than in laser therapy. Similar findings were also reported by Ebenbichler et al and Walling[9,19].

Study by Viera et al[20] denied any electrophysiological changes with laser treatment at 940 nm on median nerve whereas Baxtar et al[21] used 830 nm with total energy of 9.6 Joules over Median nerve and proved that electrophysiological parameters did change. Basford et al[22] also used infrared Laser 830 nm and 1.2 J/cm sq at 10 points on the patch of median nerve that also changed the electrophysiological parameters. It reduced both the sensory and motor latencies. In a study by Naseer et al[23] laser therapy

632 nm and 904 nm with intensity of 15 mv used on shallow and deep acupuncture points on wrist and upper limb and combined with microampere TENS. Recent study by Bakhtiary[10] compared 830nm over carpal tunnel and ultrasound therapy over wrist and found Ultrasound therapy to be effective tool. It appeared that the combinations of US or LLL therapy with splinting were more effective than splinting alone in treating CTS. However, LLL therapy plus splinting was more advantageous than US therapy plus splinting, especially for the outcomes of lessening of symptom severity, pain alleviation, and increased patient satisfaction. 23% complete recovery was seen when LLLT was combined with splinting for 03 weeks in a study done by Yagci I et al[24].

We recommend that both the modalities may also be studied in combination with each other or splinting to look for an ideal or most effective conservative treatment method. For this purpose more work is required on this topic as the CTS remains one of the most common and untreated condition.

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