ELECTROPHYSIOLOGICAL EVALUATION OF DIFFERENT CONSERVATIVE TREATMENT PROTOCOL IN CARPAL TUNNEL SYNDROME

Amr A. Abo Gazya*

Department of Basic Science Faculty of Physical Therapy, Kafr El Sheikh University, Egypt.

*Correspondence for Author

Amr A. Abo Gazya

Department of Basic science Faculty of Physical Therapy, Kafr El sheikh University, Egypt.

ABSTRACT

Objective: The objective of this study was to investigate the effectiveness of nerve gliding, splinting, and low-level laser therapy (LLLT) in the management of carpal tunnel syndrome (CTS). **Background Data:** Carpal tunnel syndrome (CTS) is the most common nerve entrapment. Electrodiagnostic studies are a valid and reliable means of confirming the diagnosis and prognosis. CTS is caused by compression of the median nerve at the wrist. Although several treatment modalities are routinely in use. **Materials and Methods:** In our study, Fifty four female patients (90 wrists) were completed this study. They were randomly assigned to one of the three groups: group I (N. 18), who received splinting, group II (N.18), who received nerve gliding exercise, and group III (N.18), who received low laser therapy. Patients were assessed electrophysiologically, patient satisfaction inquiry, visual analogue scale for pain. **Results and Conclusion:** The study was lasted for 8 weeks after treatment. At the end of the follow-up period, each of the groups had improvements to varying degrees. It appeared that LLL therapy group was more effective than splinting or nerve gliding groups in treating CTS. However, LLL therapy was more advantageous than splinting and nerve gliding, especially for the outcomes of lessening of symptom severity, pain alleviation, and increased patient satisfaction.

KEYWORDS: Carpal tunnel syndrome; conservative treatment; low level laser. Nerve-gliding exercises; splinting

INTRODUCTION

Median neuropathy at wrist or carpal tunnel syndrome (CTS) is the most common focal peripheral nerve entrapment.[1-3] The symptoms may improve with splinting, repositioning or shaking of the hand.[3-6] Physical examination findings in moderate cases may present with neurologic deficits, such as impaired sensation or thenar muscles weakness.[1, 2] On the other hand, mild cases may only present with positive carpal tunnel provocative maneuvers. (e.g., with Phalen's test and Tinel's sign) without any neurological deficit. Nerve conduction studies (NCS) are frequently used as a diagnostic tool for confirming the diagnosis of CTS7,8. Symptoms of CTS include pain, paraesthesia, numbness or tingling involving the fingers innervated by the median nerve. Symptoms are worst at night and often wake the patient to relieve the pressure on the median nerve, several treatment options, both surgical and conservative, are available.[2] Surgical treatment's complications and failures have been shown to occur in 3–19% in large series, requiring reexploration in up to 12% for a variety of causes.[6–10] Advocates of early surgery refer to its safety and effectiveness in electrophysiologically confirmed cases with no underlying reversible disorder. In addition, they point out that conservative therapy generally offers only temporary symptom relief and that surgery is unnecessarily delayed, causing further damage to the mmedian nerve.[11] Advocates of initial conservative management of CTS, however, refer to the potential benefits and safety of conservative treatment options and the potential complications of surgery.[12] The current conservative treatments include splints, nerve gliding exercise and low level laser therapy. Splinting is the most popular method among the conservative treatments of CTS.[13] Immobilization of the wrist in a neutral position with a splint maximizes carpal tunnel volume and minimizes pressure on the median nerve.[14] Tendon- and nerve-gliding exercises have been used particularly for the management of postoperative CTS,[15] while only two studies in the literature has used tendon- and nerve-gliding exercises in conservative management of CTS. The value of these exercises in conservative management of CTS is not well understood.[16, 17] In this study, we used different combinations of low level laser, splinting and tendon- and nerve-gliding exercises in the conservative management of CTS. Low intensity LASER may reduce pain related to inflammation by lowering levels of pain mediators such as prostaglandins, beta endorphins, interleukin 1-beta and tumor necrosis factor-alpha. Laser also enhances local microcirculation leading to better healing8. Remote immunomodulatory effects are also suggested for Laser.[9-11] These combinations number of treatments are used for carpal tunnel syndrome, with considerable controversy surrounding optimal management of the disorder. Among the

different options for conservative treatment, Low level laser may have the potential to induce biophysical effects within the nerve tissue.[18]

MATERIAL AND METHODS

Subjects

The study was conducted at the outpatient clinic of the Department of Physical therapy. A total 50 female patients with clinical and electrophysiologic evidence of CTS were studied. All patients had bilateral involvement, and they were right handed. The local ethics committee approved the study protocol. The aim and methods of the study were explained to all patients before their informed consent was given.

Patients

Fifty female patients of affected by CTS were recruited.

Inclusion criteria were as follows

1) The presence of pain /paresthesia in the distribution of the median nerve,

2) A positive clinical provocative tests for CTS (Tinel, Phalen),

3) The electrophysiological evidence of mild or moderate median nerve lesion at wrist (mild: sensory nerve latency >3.5 ms at third digit and median motor latency>3.6 ms).

Exclusion criteria were

Presence of conditions affecting nerve conduction or abnormal findings in other nerves such as the presence of polyneuropathies, as well as proximal neuropathies affecting nerve trunks, plexus or cervical roots diagnosed by physical examinations and comprehensive electrodiagnostic studies. A written consent was signed by all patients. They were randomly assigned to one of the three treatment groups by means of the random number table.

Therapy groups

When the patients satisfied the inclusion criteria, they were randomly divided into three groups. Fifty four (90 wrists) were completed the study. Were randomly assigned to one of the three groups: group I (N. 18), who received splinting, group II (N.18), who nerve gliding exercise, and group III (N.18), who received low laser therapy. Each patient received the same treatment protocol for both wrists. Forty five patients (90 wrists) completed the study. The Nine dropouts are described as follows: three patients (group II) underwent surgery; two patients (group II) were lost to follow-up. In group III, two patients were lost to follow-up,

and another two patients (group III) refused electrophysiologic study due to improvement of symptoms.

Intervention A: for group (I) custom-made neutral volar splint was given to patients in group I. The patients were instructed to wear the splints all night and during the day for 8 weeks.

Intervention B: for group (II) Brochures describing exercises were also given to patients. During tendon-gliding exercises, the fingers were placed in five discrete positions. Those were straight, hook, fist, table top, and straight fist. During the median nerve-gliding exercise, the median nerve was mobilized by putting the hand and wrist in six different positions. During these exercises, the neck and the shoulder were in a neutral position, and the elbow was in supination and 90 degrees of flexion. Each position was maintained for 5 seconds. The exercises were applied as five sessions daily. Each exercise was repeated 10 times at each session. Exercise treatment was continued for 8 weeks.

Intervention C. for group (III) Low-level laser therapy was administered by applying low intensity infrared laser (Enraf, Endolaser) with a wave length 830 nm and output power was 30mw. The laser probe (1 cm diameter) was applied directly and perpendicularly on five points over the course of the median nerve on the volar side at the wrist where it localized superficially.[26] The dose per tender points was (1.8 J). The total dose per treatment was (9 J) and accumulated dose for ten treatments was 72 joule. The treatment was conducted over the course of 8 weeks for 10 minutes/ day, 2times \week.

Outcome Measures

Patients were included in our study according objective electrophysiologic findings Assessing Motor and sensory distal latencies. Subjective symptoms were history of paresthesia or pain in the median nerve distribution, nocturnal pain, and dysesthesia. Physical examination included Tinel's test, Phalen's test, pain measurement, two-point discrimination test, and grip and pinch strength measurement. The staff who assessed the outcomes were different from the staff administering the treatments and were blinded to the type of treatment each patient had received. Pain measurement by means of a visual scale (VAS), on which the patients could indicate their assessment along a distance of 10 cm, ranging from 0 (no pain at all) to 10 (the most intense pain that I can imagine). Measurement of static two-point discrimination was performed on the pulp of the three radial digits, and the mean value was recorded. Hand-

grip strength was measured with a handheld dynamometer and pinch strength measured with a standard dynamometer between the tips of the thumb and the little finger. The patients' positioning was standardized, and the average force of three consecutive trials was calculated. The dynamometers were initially standard, and their sensitivity was controlled regularly by standard weights. Symptoms and functional status were evaluated by the symptom-severity scale and the functional status scale, respectively.[19]

Statistical Results

Are expressed as mean ± standard deviation (SD). Comparison between mean values of different variables measured per- and post-treatment within the same group was performed using paired t test. Comparison between mean values of different variables in the three studied groups was performed using one way ANOVA followed by least significant difference test if significant results were performed. SPSS computer program (version 19 windows) was used for data analysis. P value less than or equal to 0.05 was considered significant and < 0.01 was considered highly significant.

RESULTS

Measures of tinel's sign, phalen's sign, showed significant improvement in three groups, at the end of the treatment and also at 8 weeks follow-up (p < 0.05), Table 2. Measures of grip strength and pinch strength showed significant improvement in all groups at 8 weeks follow-up (p < 0.05), Table 2. A significant improvement was not recorded in two-point discrimination in three groups (Table 1). Pain There was a significant improvement in pain at the end of the treatment and also at 8 weeks follow-up in all groups (p < 0.05). Symptoms and functional status. There was significant improvement in functional status score and symptom-severity score at the end of the treatment and at 8 weeks follow-up in all groups (p < 0.05). The patient satisfaction questionnaire results are summarized in Table 4. The results of group III were better than the other groups (p < 0.05).

Table1: Comparison between mean values of pain measurement measured pre- and post-treatment within the same group in different studied groups.

	Pre	Post	% improvement	t test	p value
group III	5.56 ± 0.25	4.78 ± 0.22	17.1%	39.000	0.001**
group II	5.54 ± 0.19	4.96 ± 0.18	12.8%	13.931	0.001**
Group I	5.63 ± 0.21	4.38 ± 0.20	5.4%	2.824	0.014*

Data are expressed as mean ± SD. *p< 0.05= significant; **p< 0.01= highly significant.

Table 2: Comparison between mean values of pain assessment in the three studied groups measured pre- and post-treatment

	group I	group II	Group III	F test	p value
Pre-assessment	5.56 ± 0.25	5.54 ± 0.19	5.63 ± 0.21	0.668	0.518 (NS)
Post-assessment	4.78 ± 0.22	4.96 ± 0.18	4.38 ± 0.20	8.586	0.001**
p value vs IIgr.		0.018*	0.001**		
p value vs III gr.	---	---	0.010**		

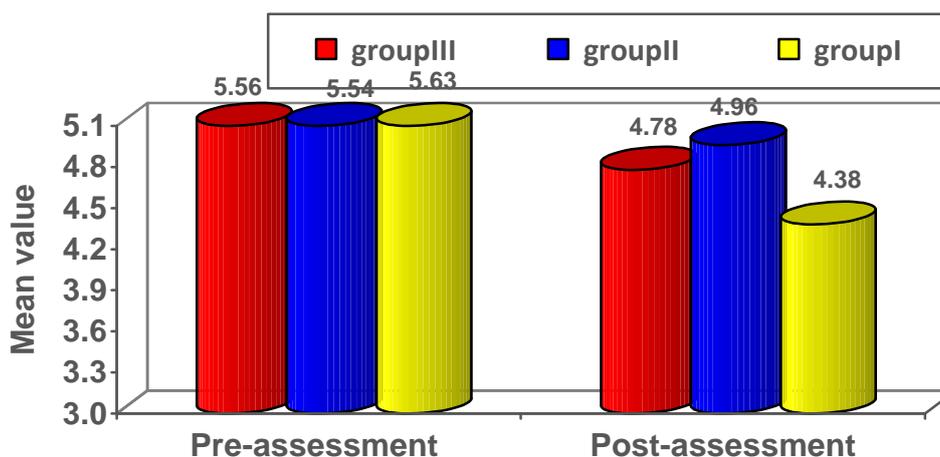Data are expressed as mean ± SD.

**p< 0.01= highly significant.

Fig1: Comparison between mean values of pain assessment in the three studied groups measured pre- and post-treatment

Table3: Comparison between mean values of distal motor latencies (DML) measured pre- and post-treatment within the same group in different studied groups.

	Pre	Post	% improvement	t test	p value
group III	4.56 ± 0.25	3.78 ± 0.22	17.1%	39.000	0.001**
group II	4.54 ± 0.19	3.96 ± 0.18	12.8%	13.931	0.001**
Group I	4.63 ± 0.21	4.38 ± 0.20	5.4%	2.824	0.014*

Data are expressed as mean ± SD. *p< 0.05= significant; **p< 0.01= highly significant.

Table4: Comparison between mean values of distal motor latencies (DML) in the three studied groups measured pre- and post-treatment.

	group I	group II	Group III	F test	p value
Pre-assessment	4.56 ± 0.25	4.54 ± 0.19	4.63 ± 0.21	0.668	0.518 (NS)
Post-assessment	3.78 ± 0.22	3.96 ± 0.18	4.38 ± 0.20	8.586	0.001**
p value vs IIgr.		0.018*	0.001**		
p value vs III gr.	---	---	0.010**		

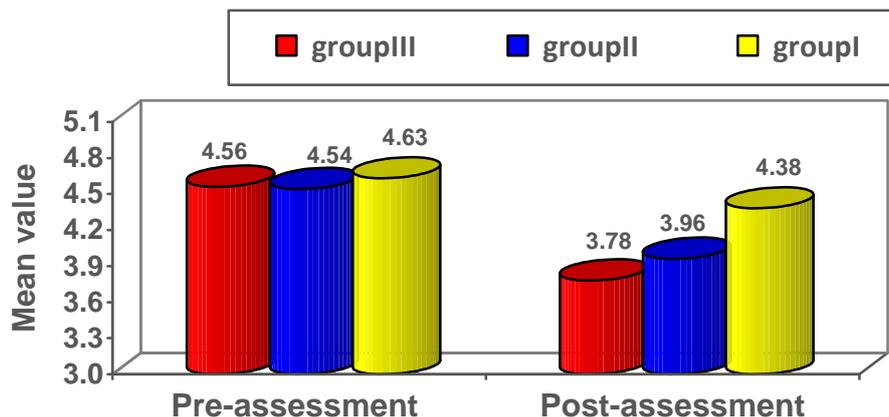Data are expressed as mean ± SD.

**p< 0.01= highly significant.

Fig. 2: Comparison between mean values of distal motor latencies…..(DML) in the three studied groups measured pre- and post-treatment

Table5: Comparison between mean values of sensor distal latencies …..(SDL) measured pre- and post-treatment within the same group in different studied groups.

	Pre (n= 15)	Post (n= 15)	% improvement	t test	p value
group III	4.43 ± 0.27	3.78 ± 0.19	14.7%	13.604	0.001**
group II	4.43 ± 0.27	3.98 ± 0.24	10.6%	12.237	0.001**
group I	4.47 ± 0.27	4.24 ± 0.29	5.1%	11.784	0.001**

Data are expressed as mean ± SD. **$p < 0.01$= highly significant

Table 6: Comparison between mean values of sensory distal latencies (SDL) in the three studied groups measured pre- and post-treatment.

	Group III	groupII	group I	F test	p value
Pre-assessment	4.43 ± 0.27	4.42 ± 0.27	4.47 ± 0.27	0.129	0.879 (NS)
Post-assessment	3.78 ± 0.19	3.98 ± 0.24	4.24 ± 0.29	13.660	0.001**
p value vs III gr.	---	0.031*	0.001**		
p value vs II gr.	---	---	0.005**		

Data are expressed as mean ± SD.

NS= $p > 0.05$= not significant.

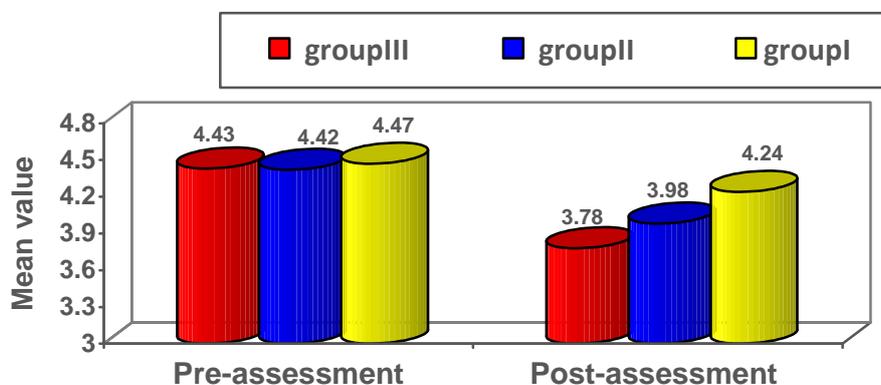*$p < 0.05$= significant; **$p < 0.01$= highly significant.

Fig.6: Comparison between mean values of sensor distal latencies (SDL) in the three studied groups measured pre- and post-treatment.

DISCUSSION

Our study evaluated the electrophysiological sensory and motor distal latencies of 45 patients who were completed the study that before and after applying three different conservative protocols for CTS that revealed significant improvement for low laser therapy group than the other 2 groups (splinting and nerve gliding groups). CTS has the potential to substantially limit performance of activities of daily living for some individuals.[20] The pathophysiology involves a combination of mechanical trauma and ischemic injury to median nerve within the carpal canal.[21] This syndrome occurs most commonly in adults older than 30 years, particularly women and involves compression of the median nerve at the wrist, affecting both sensory and motor branches.[22] The hand-intensive nature of housework and typing may contribute to higher incidence in women.[23] Similarly, all patients in our study were over 30 years old, hand-intensive housewives and computer-using clerks. To relieve the pressure on the median nerve (directly or indirectly), several treatment options, both surgical and conservative, are available.[1] There is no consensus with regard to the choice of initial treatment for CTS. The American Academy of Neurology advises non-invasive treatment first, i.e. wrist splints, modification of activities, NSAIDs or diuretics and using invasive steroid injections or open carpal tunnel release only if noninvasive treatment have turned out to be ineffective.[24] Even though surgery for CTS is generally considered safe and effective, the possible risk associated with surgery and the potential for complications may contribute to the preference of some patients for non-surgical treatment.[20] A lot of studies have been published concerning the efficacy of conservative treatment in CTS. The treatment choice seems controversial. In contrast there were some studies reporting the conservative treatment of CTS as ineffective[8, 24–27]; however, some researchers suggested that CTS could be treated without surgery.[6, 9, 16] A population-based study of CTS showed that approximately 40% of conservatively treated patients with CTS continued to experience symptoms after 30 months.[25] Approximately 60–70% of conservatively managed patients remained symptomatic after 18 months.[24] The current study addressed the superiority of LLLT as a non invasive treatment option for mild to moderate CTS. Incorporation of nerve and tendon gliding exercises as a cost-effective intervention in treating CTS might play an important role in enhancing the effectiveness of the conservative treatments and delay the need for surgery. Further researches are required to investigate the long-term efficacy of LLLT versus exercises using different laser parameters, and whether the combination of these two treatments is superior to either treatment alone. Future recommendations for more research include well-controlled randomized clinical trials, follow-up periods, and combination with

other physical therapy modalities. In a similar study 80 patients were randomly assigned into two groups: Laser and sham Laser. In that study, Laser therapy was effective in treating CTS paresthesia and numbness and improves the subjects' power of hand grip and electrophysiological parameters.[21] There are theories regarding the effect of Laser in pain and inflammation control. The effect of low energy laser is not thermal, rather, it is believed to stimulate microcirculation and endorphin secretion, also block the enzymes that block pain enzymes leading to reduce pain and inflammation.[21-25]

CONCLUSION

Low level laser therapy was effective in the present study to reduce pain and disability associated with mild to moderate CTS. Splinting and nerve gliding exercise also improved electrophysiological findings. However, further researches with larger sample size and longer follow up periods should be conducted to obtain more conclusive results.

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