

Laser Therapy Versus Kinesio Taping In Treatment Of Carpal Tunnel Syndrome in Type 2 Diabetic Patients: Comparative Study.

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Abstract: Background: Carpal tunnel syndrome (CTS) is one of the most common upper limb compression neuropathies, it accounted for approximately 90% of all entrapment neuropathies. It is due to an entrapment of the median nerve in the carpal tunnel at the wrist

Aim of the Study: To compare the effect of Laser therapy versus kinesio tape on carpal tunnel syndrome in treatment of type 2 diabetic patients.

Subject and Methods: Thirty type 2 diabetic female patients suffering from carpal tunnel syndrome participated in the study. Their age ranged from 40 to 50 years. The patients were assigned randomly into two equal groups; Laser group (A) and kinesio tape group (B). The first group (A) included 15 patients who received a program of Laser therapy on the affected wrist for 15 min ,3 session per week for four weeks. The second group (B) included 15 patients who received a program of kinesio tape application on the affected wrist for 3 days and then one day off and then another 3 days each week for 4 weeks. The median motor distal latency (MMDL) was measured by computerized electromyography (EMG). Ultrasonography (US) was used to assess the cross sectional area (CSA) of the median nerve. Boston carpal tunnel syndrome questionnaire (BCTQ) was analyzed to assess the health status.

Results: At the end of the study, there were significant changes in all variables in both groups. In both groups, there were significant decreases in MMDL, median nerve CSA and both components of BCTQ with no significant difference between the two groups ($p \leq 0.05$).

Conclusion: Both Laser and kinesio tape have positive effects on carpal tunnel syndrome in type 2 diabetic patients with no difference between them.

Key Words: Laser, kinesio tape, carpal tunnel syndrome , diabetics.

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I. Introduction

Carpal tunnel syndrome (CTS) is a sensorimotor peripheral nerve condition caused by localized compression of the median nerve as it crosses the wrist within the carpal tunnel, and often results from work-related activities. CTS is reported to be the most common peripheral nerve disorder seen in the working-age population (1).

The classic symptoms of CTS include pain and paresthesia along the median nerve distribution. The symptoms reported by patients include sensory disturbances presented as pain, numbness, tingling, and burning sensation. Motor dysfunction is witnessed by a loss of coordination and muscle weakness as noted by decreased grip and pinch strengths. Nocturnal pain, which interrupts the sleep cycle, is often a result of an increase in intra carpal pressure owing to flexion or extension positioning during sleep (2).

Diabetes is a complex, chronic illness requiring continuous medical care with multifactorial risk-reduction strategies beyond glycemic control (3). Having diabetes can increase the risk of getting CTS, while researchers have also found that having CTS could be a predictor for developing diabetes. CTS is widely reported in up to between 15-20% of people with diabetes, with research suggesting the link between diabetes and CTS could be due to excessively high blood sugar levels (4).

There are several treatment options for CTS and they can be broadly categorized into surgical and non-surgical methods. Non surgical methods are effective in patients with mild to moderate CTS; they are indicated

in patients with no muscle weakness, atrophy, or denervation and with only a mild abnormality on nerve conduction studies (5).

Low-intensity Laser therapy (LT) has been extensively used for treatment of several musculoskeletal disorders including the CTS. In the same way, several studies proved that LT is associated with improved functional outcome and electrophysiological parameters in patients with CTS (6).

Kinesio Tape (KT) enables people suffering from CTS to access the expert natural stretching therapy consistently and cost effectively with no downtime in the convenience and comfort of home. It offers relief from wrist pain, hand numbness and finger tingling of CTS in days (7).

Thus there was a need to determine which of LT and KT would actually benefit in an efficient and effective way to reduce the median motor distal latency (MMDL), the cross sectional area (CSA) of the median nerve and the health status. Thus the objective of the study was to compare the effect of LT and KT on carpal tunnel syndrome in type 2 diabetic patients.

II. Methods

Patients and Methods

A randomized controlled comparative study which was conducted on thirty type 2 diabetic female patients with mild to moderate CTS (8). All patients were diagnosed with type 2 diabetes with $HbA1c \leq 7$. They had positive electro diagnostic findings (MMDL $4.2 \geq ms$). They were also on oral hypoglycemic drugs at the same dose. The patients were clinically and medically stable when attending the study. Patients with diabetic polyneuropathy or patients on analgesics or patients with previous carpal tunnel release and skin sensitivity to KT were excluded.

The patients were assigned randomly into two equal groups. The first group (A) included 15 patients with mean of age (44.83 ± 2.62 years) and BMI ($30.15 \pm 3.50 \text{ kg/m}^2$) received a program of LT on the affected wrist for 15 min ,3 session per week for four weeks. The second group (B) included 15 patients with mean of age (45.23 ± 2.67 years) and BMI ($29.60 \pm 3.26 \text{ kg/m}^2$) received a program of KT application on the affected wrist for 3 days and then one day off and then another 3 days each week for 4 weeks. This study was conducted in the out-patient clinic of the physical therapy unite at Kasr Al-Ainy hospital, Cairo University in the period from January 2019 to June 2019. All Patients signed on informed consent and the study was approved by the Ethics Committee of the faculty of physical therapy, Cairo University before beginning of the study to insure complete satisfaction.

Study design: A randomized controlled comparative study.

Instrumentation

I) for evaluation:

1. Computerized electromyography (EMG):

EMG/NCV NIHON KOHDEN system manufactured by (Compumedics Germany GmbH, Singen – The DWL® EMG Company) was used to measure median motor distal latency (MMDL) (9).

2. Ultrasonography (US):

Toshiba ultrasound machine manufactured by (Toshiba Xerio, Japan, 8 to 14 MHz) with linear transducer was used to measure the CSA of the median nerve (10).

3. Boston carpal tunnel syndrome questionnaire (BCTQ):

The questionnaire assesses health status of patients with CTS and comprises two scales, a symptom severity scale (SSS) and a functional status scale (FSS) (11).

II) For treatment:

1. Laser therapy (LT):

Diode Laser system , output Laser power: 0–500Hz (12 mW), Laser wavelength: low level Laser (904 nm Wavelength) manufactured by (MEDICAL ITALIA, Italy). LT was used for group(A).

2. Kinesio tape (KT):

Ares KT with a width of 5 cm and a thickness of 0.5 mm was made by (Ares, South Korea) was used. Ares KT is designed to the same thickness and elasticity of the epidermis (out layer) of the skin with longitudinal stretch of 30~40% of its resting length. KT was used for group (B).

III. Procedures

A- Assessment procedures:

Assessment was done before and after the end of the study using:

1. Median motor distal latency (MMDL):

Median nerve motor distal latency was measured at the Abductor Pollicis Brevis (APB) following stimulation at the wrist. The active surface electrode was placed over the motor point of the APB, which is innervated by the median nerve, with the reference electrode located over the metacarpophalangeal joint of the first digit (9).

2. Median nerve cross sectional area (CSA):

The ultrasound transducer was placed on the palmar surface of the wrist at the proximal wrist crease. Ultrasound gel was used as a contact medium between the transducer and the participant's skin (12).

3. Boston carpal tunnel syndrome questionnaire (BCTQ):

The questionnaire was completed by the participants to gather descriptive demographic information for every patient (13).

B- Treatment procedures:

1. Laser therapy (LT):

It was used for group A. Participants received LT for 12 sessions (three times a week). The duration of each session was 15 minutes with the protocol of 500 mW, 880 nm, 6 joules per square centimeter at 10 points in the volar wrist in the carpal tunnel within 1-cm intervals on a rectangular zone (14).

2. Kinesio tape (KT):

It was applied for group B. Kinesio Tex I Strip was measured from elbow to fingertips and cut. It was folded approximately two blocks from the end and cut into two triangles on the fold. The third and fourth fingers were slipped through holes and Kinesio Tex was applied on the palm of the hand with no tension. The position of elbow extension, wrist extension, and radial deviation was provided, and Kinesio Tex was applied from hand to medial epicondyle with 15%–25% tension and ended at medial epicondyle with no tension. The second Kinesio Tex I Strip was measured for wrist size and cut. It was applied to the carpal tunnel region with 25%–35% tension. Kinesio tape was applied 3 days on and 1 day off then another 3 days on per week for 4 weeks (15).

Statistical analyses were performed using SPSS software (version 20). Descriptive statistics and paired T-test to compare between pre and post treatment results for each group and unpaired T-test to compare results between groups. All statistically significant differences were determined with confidence interval of 95% and thus at $P \leq 0.05$.

IV. Results

Baseline and demographic data:

In the present study as shown in (Table 1), there were non-significant ($P \geq 0.05$) difference in age and BMI between both groups. The mean of age was 44.83 ± 2.62 yr and 45.23 ± 2.67 for group A and B respectively. The mean of BMI was 30.15 ± 3.50 and 29.60 ± 3.26 for group A and B respectively.

The effect on median motor distal latency (MMDL):

The obtained data presented in (Table 2) revealed that the mean values of MMDL pre and post study in group (A) were 4.63 ± 0.253 and 4.63 ± 0.253 respectively. There was a significant decrease ($p < 0.001$). The mean values of MMDL pre and post study in group (B) were 4.55 ± 0.267 and 4.11 ± 0.226 respectively. There was a significant decrease ($p < 0.001$).

Comparison of the post study mean values of MMDL between both groups (Table 3) revealed no significant difference ($P = 0.917$).

The effect on median nerve cross sectional area (CSA):

The obtained data presented in (Table 2) revealed that the mean values of median nerve CSA pre and post study in group (A) were 13.09 ± 1.15 and 10.56 ± 0.98 respectively. There was a significant decrease ($p < 0.001$). The mean values of median nerve CSA pre and post study in group (B) were 12.70 ± 1.08 and 10.91 ± 0.94 respectively. There was a significant decrease ($p < 0.001$).

Comparison of the post study mean values of median nerve CSA between both groups (Table 3) revealed no significant difference ($P = 0.325$).

The effect on Boston CTS questionnaire (BCTQ):

A- Symptom severity scale (SSS):

The obtained data presented in (Table 2) revealed that the mean values of SSS pre and post study in group (A) were 23.60 ±5.64 and 18.80±4.84 respectively. There was a significant decrease (p<0.001).The mean values of SSS pre and post study in group (B) were 25±6.29 and 19.27±6.10 respectively. There was a significant decrease (p<0.001).

Comparison of the post study mean values of SSS between both groups (Table 3) revealed no significant difference (P =0.818).

B- Functional status scale (FSS):

The obtained data presented in (Table 2) revealed that the mean values of FSS pre and post study in group (A) were 16.33 ±5.05 and 12.07±4.55 respectively. There was a significant decrease (p<0.001).The mean values of FSS pre and post study in group (B) were 17.27±5.28 and 12.87±3.79 respectively. There was a significant decrease (p<0.001).

Comparison of the post study mean values of FSS between both groups (Table 3) revealed no significant difference (P =0.885).

Table (1): Baseline characteristics of the patients

Variable	A	B	P-value
Age(yr)	44.83± 2.62	45.23± 2.67	0.682
BMI(kg/m2)	30.15± 3.50	29.60± 3.26	0.658

Values are means ± SD, BMI: body mass index, P > 0.05 : Non-significant.

Table (2): Pre-post data within groups:

Variable		A	P-value	B	P-value
MMDL	Pre	7.41±0.596	<0.001*	Pre	7.37±0.603
	Post	6.65±0.475		Post	6.78±0.538
CSA	Pre	239.6±27.5	<0.001*	Pre	235.1±34.02
	Post	196.1±28.8		Post	194.65±29.4
BCTQ	SSS	Pre	<0.001*	Pre	235.1±34.02
		Post		192±18.9	
FSS	Pre	299.5±40.1	<0.001*	Pre	314.7±49.9
	Post	356.9±38.8		Post	350.4±48

Values are means ± SD, MMDL: median motor distal latency, CSA: cross sectional area, BCTQ: Boston carpal tunnel syndrome questionnaire, SSS: Symptom severity scale, FSS: Functional status scale, P≤ 0.05: Significant.

Table (3): post data between groups:

Variable	A	B	P-value	
MMDL	4.06± 0.21	4.11± 0.22	0.917	
CSA	10.56± 0.25	10.91± 0.24	0.325	
BCTQ	SSS	18.80± 4.84	19.27± 6.10	0.818
	FSS	12.07± 4.55	12.83± 3.85	0.885

Values are means ± SD, MMDL: median motor distal latency, CSA: cross sectional area, BCTQ: Boston carpal tunnel syndrome questionnaire, SSS: Symptom severity scale, FSS: Functional status scale, P > 0.05 : Non-significant.

V. Discussion

Entrapment of the median nerve at the wrist is the most common cause of sensory and motor disturbance in the hands and can be progressively disabling. Numbness, tingling, and burning within the median nerve innervated area of the hand are the most common symptoms, as well as nocturnal pain and ultimately muscle weakness (16).

The present study was conducted to compare between the effect of Laser therapy and kinesio tape on CTS in type 2 diabetic patients. The results of the present study proved that there was a significant improvement in MMDL, median nerve CSA and BCTQ in the Laser (A) and kinesio tape (B) groups with no significant difference between the two groups.

In group (A), the improvement may be attributed to that Laser therapy has anti-inflammatory and analgesic effects (17).These effects may be due to selective inhibition of nociceptive activation at peripheral nerves. There is an increase in ATP production, cellular respiration, and secretion of endogenous opioids. Also, improved blood circulation may lead to the clearance of algogenic substances (17,18).

Naeser et al. (19) investigated the effects of LT plus microamperes transcutaneous electric nerve stimulation in CTS patients. They used Laser to acupuncture points on the finger and hands. In addition, TENS was applied to the affected wrist. Significant decrease was observed in pain, sensory latency and Phalen, Tinel signs after real Laser treatment.

Another study examined the results of LT and placebo Laser in CTS patients, confirmed clinically and by electrodiagnostic testing. There were improvements in clinical parameters in LT group compared to placebo group. In EMG evaluation, MMDL and median sensory distal latency (MSDL) were reduced in the Laser group (20).

One randomized trial involving 42 participants with CTS compared LT to fascial manipulation. The study authors reported a significant increase in SSS and FSS of LT group compared to fascial manipulation group (21).

In another controlled study, **Branco and Naeser (22)** used the same treatment technique (low-level Laser acupuncture and TENS) and found a significant improvement in median nerve CSA and functional status of the patients. It was thought to be cost effective and a good treatment choice for the ones with mild to moderate CTS.

The results of the present study contradicted with the finding of **Bakhtiary and Rashidy-Pour (23)** who examined the efficacy of ultrasound and LT in the treatment of CTS. They applied Laser therapy over the median nerve at the wrist in a total of 15 sessions. Although an improvement in finger pinch and hand grip strength was observed in both groups, pain reduction was obtained only in the ultrasound group. EMG evaluation showed non significant decrease in motor latency and non significant increase in motor and sensory amplitudes in both groups, but the mean changes were higher in the ultrasound group. The discrepancy between results of the current study and results of **Bakhtiary and Rashidy-Pour** may be due to difference of Laser type and parameters used as **Bakhtiary and Rashidy-Pour** used 9 joules, 830 nm infrared Laser at five points for 15 daily treatment sessions (5 sessions/week), while the present study used 6 joules, 880 nm diode Laser at 10 points in the volar wrist (3 sessions/week).

In group (B), the improvement may be attributed to several benefits of KT providing a positional stimulus through the skin, appropriate arrangement to fascial tissues, creating more space by lifting fascia and soft tissue above area of pain/inflammation, providing sensory stimulation, assisting or constraining movement and to aid in the removal of edema through directing exudates toward a lymph channel (24,25).

There are various studies that have investigated the effect of KT by comparing placebo application in several musculoskeletal conditions such as shoulder diseases and patellofemoral pain syndrome (26). Similar to the results of the present study, **Shakeri and Massoud Arab (27)** conducted a study on patients with patellofemoral pain syndrome and found that KT caused significant improvement in terms of pain level and function.

Our results agreed with **Ali, Battecha and Mansour (8)** who compared the effect of traditional physical therapy program (strengthening and stretching exercises for wrist muscles and ligaments) with KT versus traditional treatment only on pain intensity and electromyography in CTS. The study revealed that there was significant decrease in pain level, MMDL and MSDL in both groups with high significance in the group that received traditional physical therapy program with KT compared to the other one.

In line with the present study, a study published by **GELER KÜLCÜ et al. (28)** compared the effect of KT on pain level, median nerve CSA, and functional status with that of placebo KT and orthotic device in patients with CTS. With KT, It provided pain relief, reduction of median nerve CSA, and improvement in functional status as compared to the other group.

The results of the present study disagreed with the results of **Aytar et al. (29)** who conducted a study to compare the effect of KT or placebo KT in CTS patients. They did not find any improvement in terms of pain level, MMDL and function in either experimental KT or placebo KT groups. They concluded that this result may due to the low level of pain intensity at baseline. Moreover, Aytar et al. conducted the study through a limited duration (one week only).

In comparison between the two groups, the results obtained in the current study showed no significant difference between the two groups. This agreed with **Nagib, karkousha and Aly (30)** who conducted a study to compare between KT and low level Laser therapy for CTS in postmenopausal women. **Nagib, karkousha and Aly** found significant differences pre and post treatment in both groups for grip strength, MMDL and Boston Questionnaire scores while also there was no significant difference between both groups, so, both KT and LILT are effective in treating CTS for postmenopausal women.

The present study had several limitations. The study was limited to females which were only available. Also, the small sample size was insufficient to generalize the results to all patients with CTS and different levels of education of the patients limited the study.

A prospective study could be taken up to evaluate the effect of Laser therapy and kinesio tape in other different ages. This study can also be repeated by using a different target population such as patients with hypertension or other other types of diabetes such as type 1 and gestational diabetes.

VI. Conclusion

Based on the findings of the current study, Laser therapy and kinesio tape are effective methods for improving MMDL, median nerve CSA and BCTQ on CTS in type 2 diabetic patients and should be added to the care of such patients with no preference of either of them over the other.

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