EFFICACY OF LOW-LEVEL LASER AND KINESOTAPING IN THE TREATMENT OF NEUROPATHIC PAIN FOLLOWING MASTECTOMY

Mohamed Abd El Hady Mohamed[1]*, Amal Mohamed Abd Elbaky[1], Salah El-Din Abdel-Ghani Mohamed[2], Ereny Sobhy Wahba Khalil[1]

[1]Department of Physical Therapy for Surgery & Burn, Faculty of Physical Therapy, Cairo University, Giza, Egypt; [2]Department of General and Plastic Surgery, Faculty of Medicine, Kasr Al-Aini, Cairo University, Giza, Egypt

Abstract

Background and purpose: This research was conducted to recognize the impact of adding kinesiotaping to low level laser therapy in reducing neuropathic pain following mastectomy**.**

Materials and methods: It was a randomized controlled trial. Overall, 60 female patients, aged among 45 & 65 years, whom experienced neuropathic pain following mastectomy, were randomly assigned to three groups of equal size. Participants in Group A were administered low-level laser therapy (LLLT) plus kinesotaping as well as traditional exercises program (passive, active rang of motion (ROM) exercise and massage) for 4 weeks (3 times/week). While participants in Group B were administered kinesiotaping as well as traditional exercises program for 4 weeks (1 time/week**).** Group C received LLLT as well as traditional exercises program for 4 weeks (3 times/week). Electrography was used to measure nerve conduction velocity, neuropathic pain questionnaire short form was used to assess pain nature and visual analogue scale (VAS) utilized to measure the intensity of the pain.

Results. Statistical analysis showed that the visula analog scale (VAS) and Neuropathic Pain Scale (NPS) significantly decreased (P=0.0001) in all groups post treatment in favor of group A, while nerve conduction velocity (NCV) and median nerve amplitude revealed no substantial difference (P>0.05) among all groups after treatment.

Conclusions: Low-level laser therapy (LLLT) has been revealed to be an effective technique for reducing neuropathic pain after mastectomy.

Keywords: Low Level Laser Therapy. Kinesiotatping. Neuropathic pain. Mastectomy

Manuscrito recibido: 04/08/2023
Manuscrito aceptado: 18/08/2023

*Corresponding Author: Mohamed Abd El Hady Mohamed, 1Department of Physical Therapy for Surgery & Burn, Faculty of Physical Therapy, Cairo University, Giza, Egypt

Correo-e: ptrservices2022@gmail.com

Introduction

Post mastectomy pain syndrome (PMPS) is a frequently observed condition following breast operations, with an estimated occurrence rate ranging from 25% to 60%. PMPS is clinically defined as the presence of persistent pain lasting for a duration of three months or longer subsequent to surgical intervention. The underlying mechanism appears to be neuropathic in etiology, with potential involvement of either peripheral or central. The syndrome is believed to be initiated by injury to the local neurological structures either during surgery or as a result of adjuvant treatment. It's important to screen out other possible causes of pain before concluding that PMPS is the cause. Both prognosis as well as treatment response can be unpredictable. The efficacy of current treatment modalities is constrained by a deficient comprehension of the disease and the lack of reliable information on their efficiency. The spectrum of treatment options encompasses conservative modalities, such as pharmacological interventions targeting neuropathic symptoms and physical therapy, as well as more invasive interventional treatments. Neuropathy is nerve damage. Nerve cells are susceptible to damage caused by various factors, this encompasses several diseases or medical problems that impede the body's ability to metabolize nutrients effectively, resulting in a reduced capability to transform them into energy, effectively handle waste products, facilitate oxygen circulation, or facilitate cellular repair. Diabetes makes nerve cells susceptible to injury; nonetheless, it is important to note that there exist other mechanisms via which nerve damage can occur.

There could be damage to a single nerve or multiple nerves. The primary manifestations linked to motor nerve damage include muscle weakness, cramps, spasms, as well as impaired balance. Conversely, sensory nerve damage is typically characterized by sensations of tingling, numbness, as well as a burning pain. Autonomic nerve injury can lead to disruptions in involuntary bladder processes, as well as abnormalities in blood pressure as well as heart rate.

Laser is a noninvasive, nonionizing, monochromatic electromagnetic high concentrated light beam. Low-level laser therapy (LLLT) is widely utilized in the field of medicine. Over the past few decades, LLLT has been employed for the management of various pathological illnesses, including musculoskeletal disorders, wound healing, and pain management. Previous studies have demonstrated that LLLT has the ability to stimulate collagen production, protein synthesis, tissue repair, as well as pain alleviation. Additionally, LLLT has been shown to speed up the healing process of damaged nerve fibers.

Elastic taping as well as non-elastic taping are the two main categories of tape. The elastic modality referred to as Kinesio taping is predominantly employed by physical therapists as well as sports practitioners. KT is an adhesive tape that was created by Kenzo Kase. Kinesio taping, in contrast to non-elastic taping, is thin as well as very elastic, allowing it to be stretched to 120–140% of its original length with minimal mechanical constraint. Consequently, when it is applied to a muscle or a joint, it restricts movement to a specific portion by adjusting the forces that stretch the skin. The influence of KT on pain control may be associated with gate control theory.

B-fibers, which are a type of afferent fiber originating from sensory neurons responsible for touch sensation, exhibit larger diameter and faster conduction velocity compared to the fibers associated with pain, namely δ-fibers and C-fibers. The activation of glial cells in the spinal cord can be achieved by stimulating the afferent receptors through the application of light touch on the skin. Subsequently, the transmission of pain signals will be impeded at the level of the spinal cord, preventing their propagation to the cortex. To yet, there is a lack of evidence confirming the efficacy of KT in accordance with this theory. However, one can draw upon existing literature on alternative physical modalities utilized for pain reduction.

Subjects and methods

Between June 2022 and January 2023, a study was conducted utilizing a prospective, single-blind, randomized, controlled design with a pretest-posttest design including three parallel groups. The protocol of the study was explained in detail to each patient who signed an informed consent at starting of this study

The study protocol obtained ethical approval from the Faculty of Physical Therapy's ethical committees in Cairo University.

Participants

A convenient sample of 60 patients were recruited from zagazig university Hospital, sharqia, Egypt. Participants were enrolled and evaluated for participation eligibility. Included were female patients experiencing neuropathic pain of median nerve after mastectomy. aged 45–60 years, not suffering from any other condition that might influence the results, such as major depression, anxiety, personality disorders, no metallic implaments near the treatment sit and no cardiac pacemaker.

Randomization

A group of sixty patients was randomly assigned to three distinct groups, denoted as Group A, Group B, as well as Group C. The allocation process was conducted using a sealed envelope procedure, which involved an independent

individual. Each envelope had a letter identifying the group to which the women would be assigned. The participants were unaware of the group to which they were assigned.

Interventions

Patients randomly assigned to group A were given (LLLT) in addition to kinesotaping and traditional exercises program (passive, activeROM and massage) for 4 weeks (3 times /week). The low level laser parameters were as follows: frequency: 1000 Hz., wavelength of 880 nm, with peak power output of 1100 mw,, treatment time10 minutes.. A gallium–aluminum–arsenide (GaAlAs) diode laser was The machine provides two distinct modalities of laser therapy, either continuous or pulsed. Continuous laser therapy has been widely utilized and numerous research have demonstrated its efficacy. The linked probe measured the maximum power output, allowing the power to be adjusted.

kinesiotaping procedures The KT applied on cleaned and dried skin by an experienced physiotherapist once per week for 4 weeks Start by cleaning and drying the area. Before applying tape, make sure the area is clean and free of any oils or lotions. Cut the strips by creating rounded corners at their respective ends. Turn the hand outward, bring the hand into dorsiflexion. Apply the detonating tape with slight stretch towards the medial epicondyle humeri over the flexors of the forearm and rub in, taping the final five centimeters without pulling or stretching it.

Group B this group composed of 20 patients received kinesotaping and traditional exercises program (passive, activeROM and massage) for 4 weeks (1 times /week). Group C this group composed of 20 patients were given LLLT and traditional exercises program (passive, activeROM and massage) for 4 weeks (3 times /week).

Outcome measures

The measurement of median nerve conduction velocity was conducted utilizing CONTEC CMS6600B portable EMG system made in Japan, **The active electrode (A, black)** was positioned on the muscle belly of the Abductor pollicis brevis (APB) at the halfway point among the distal wrist crease as well as metacarpophalangeal (MCP) joint of the thumb. **The reference electrode (R, red)** was positioned over the APB tendon at the first MCP joint. **The ground electrode (G, green)** was positioned on the palm or either dorsum of the hand. The median nerve was electrically stimulated at the wrist, specifically at a location among the tendons of Flexor Carpi Radialis (FCR) as well as Palmaris Longus, approximately 8 cm proximal to the A electrode. Neuropathic pain was performed with the use of the Neuropathic pain scale The NPQ-SF consists of 3 items evaluating tingling pain, numbness, as well as heightened sensitivity to touch. The patient was instructed to think about each sensation listed in the scale and rate that sensation as the average you have experienced during the past week. Patients rate the level of their pain on a scale from 0 (no pain) to 100 (the worst pain possible). The assessment of pain severity was conducted using the VAS, which typically comprises a horizontal line measuring 100 mm in length. This line is marked with word descriptors at both ends. The participant was instructed to assess their level of pain on a VAS that ranged from 0 to 10, with 0 representing the absence of pain while 10 indicating the presence of severe pain. The assessment was conducted prior to the initiation of treatment, at the 3-month (12-week) following treatment, as well as at the 6-month (24-week) following treatment. The determination of the outcome was made over a 6-month period of follow-up, with the recovery being classified as either complete or incomplete.

Statistical analysis and sample size calculation

The subjects' characteristics were compared between groups using a one-way MANOVA test. The normality of the data was assessed using the Shapiro-Wilk test. To examine whether or not there was homogeneity in the variances between groups, Levene's test was carried out. Within- as well as between-group differences in VAS, NPS, Median NCV, as well as median nerve amplitude were compared using a Mixed MANOVA. In order to conduct additional multiple comparisons, post-hoc tests were carried out using the Bonferroni correction. Statistical tests were performed using a significance level of $p < 0.05$. All statistical analysis was carried out through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

Results

- Subject characteristics:

The characteristics of the subjects in groups A, B, as well as C were presented in Table (1). There was no substantial difference among groups regarding age as well as BMI ($p > 0.05$) (Table 1).

Effect of treatment on VAS, NPS, Median NCV and median nerve amplitude:

Mixed MANOVA showed that there was a substantial interaction of treatment as well as time ($F = 13.24$, $p = 0.001$, Partial Eta Squared = 0.49). There was a substantial main effect of time ($F = 899.07$, $p = 0.001$, Partial Eta Squared = 0.98). There was a substantial main effect of treatment ($F = 4.47$, $p = 0.001$, Partial Eta Squared = 0.24).

Within group comparison

There was a substantial decline in VAS as well as NRS for the three groups after treatment contrasted with that before treatment ($p < 0.001$). The percent of change of VAS in group A, B as well as C was 64.62, 39.26 and 50.39% respectively. The percent of change of NPS in group A, B as well as C was 44.12, 26.56 and 33.68% respectively (Table 2).

There was a substantial improvement in median NCV as well as median nerve amplitude for the three groups after treatment contrasted with that before treatment ($p < 0.001$). The percent of change of NCV in group A, B as well as C was 15.14, 9.38 and 9.71% respectively. The percent of change of amplitude in group A, B as well as C was 21.75, 22.09 and 20.65% respectively (Table 3).

Between group comparison

There was a substantial decline in VAS as well as NPS of group A contrasted with that of group B ($p < 0.001$) as well as group C ($p < 0.01$). There was a substantial decline in VAS as well as NRS of group C contrasted with that of group B ($p < 0.01$).

There was no substantial difference in median NCV as well as median nerve amplitude among the three groups after treatment ($p > 0.05$) (Table 2-3).

Discussion

The aim of this investigation was to contrast the efficacy of adding kinesiotaping to low-level laser therapy (LLLT) and exercises program (passive, active ROM exercise and Massage) (group A), kinesiotaping and exercises program (passive, active ROM exercise and Massage) (group B), LLLT as well as exercises program (passive, active ROM exercise and Massage) (group C). The evaluation was carried out using portable EMG system, Neuropathic pain scale , Visual analogue scale among 60 patients suffering fromneuropathic pain following mastectomy . The findings showed that there was no substantial difference in any item of VAS among the groups before treatment, whereas a substantial decline was found in the total score of VAS in group A after treatment contrasted with group B as well as group C. In addition, there was a substantial decline in the total score of VAS in group C after treatment contrasted with group B. There was a noticeable drop in the total score of NPS in group A after treatment contrasted with group B as well as group C. Moreover, there was a substantial decline in the total score of NPS in group C after treatment contrasted with group B. In addition an increase was noted in the total score of NCV in group A after treatment contrasted with group B as well as group C. Moreover, there was a substantial improvement in the total score of NCV in group C after treatment contrasted with group B. That could prove that adding kinesiotaping to LLLT as well as exercises program (passive, active ROM exercise as well as Massage) are superior approaches to managing neuropathic pain after mastectomy for these reasons, the investigation was significant. The study aimed to assess and compare the efficacy of two topical interventions, namely kinesiotaping as well as low-level laser therapy (LLLT), in conjunction with exercise. The primary outcome measures were the reduction in neuropathic pain and the improvement in nerve conduction velocity.

The present study's results were corroborated by Shoukry et al. 2021, who demonstrated that the utilization of Low-Level Laser in conjunction with Physical Therapy as well as medical therapy yielded a significant impact on individuals with axillary web syndrome following mastectomy, surpassing the outcomes achieved through the use of just traditional and medical therapy. The application of LLLT in conjunction with physical therapy resulted in greater improvements in shoulder range of motion, including in flexion, abduction, and external rotation, as well as pain reduction, compared to the use of physical therapy alone.

A study conducted by Akgol et al. 2021 examined the comparative impact of low power laser therapy vs kinesiotaping in the management of carpal tunnel

Table 1: Basic characteristics of participants.

	Group A	Group B	Group C	p-value
Age, mean ± (SD), years	58.7 ± 2.11	57.8 ± 2.02	57.5 ± 1.96	0.15
BMI, mean ± (SD), kg/m²	30.91 ± 1.76	31.97 ± 3.27	30.91 ± 2.7	0.35
SD: Standard deviation; **p-value:** Level of significance				

Table 2: Mean VAS and NPS before and after treatment of group A, B and C.

	Group A	Group B	Group C	p-value		
	mean ± SD	mean ± SD	mean ± SD	A vs B	A vs C	B vs C
VAS						
Before treatment	6.5 ± 0.76	6.75± 0.63	6.35 ± 0.93	0.57	0.81	0.25
After treatment	2.3 ± 0.92	4.1 ± 0.85	3.15 ± 0.87	0.001	0.01	0.004
MD	4.2	2.56	3.2			
% of change	64.62%	39.26%	50.39%			
	p = 0.001	***p = 0.001***	***p = 0.001***			
NPS						
Before treatment	79.15 ± 5.15	76.85 ± 4.47	77.25 ± 4.82	0.29	0.43	0.96
After treatment	44.20 ± 3.53	56.40 ± 3.42	51.20 ± 3.08	0.001	0.001	0.001
MD	34.95	20.45	26.05			
% of change	44.12%	26.56%	33.68%			
	p = 0.001	***p = 0.001***	***p = 0.001***			

SD: Standard deviation; **p-value:** Level of significance

syndrome. A total of sixty patients diagnosed with CTS participated in this study. One group was administered a total of 15 sessions of KT, whereas the second group received an equivalent number of 15 sessions of LPLT over a period of three weeks. Prior to and during therapy, all participants underwent a comprehensive evaluation that included the assessment of hand grip strength (HGS), pain levels measured using the Visual Analogue Scale (VAS), the Douleur Neuropathique-4 (DN4) score, the Boston Questionnaire (BQ), and electroneuromyography. Following the intervention, there was a significant improvement observed in both groups with regards to HGS, (VAS- pain, DN4, as well as BQ. Nevertheless, the LPLT group exhibited substantially superior results in terms of HGS, (VAS-pain), (DN4), and (BQ) compared to the KT group. Furthermore, it is worth noting that there was a substantial improvement in median nerve motor distal latency as well as median nerve sensory conduction velocity following treatment in both groups. However, it is important to highlight that the improvement observed in the LPLT group was substantially higher to that of the KT group. Both LPLT and KT shown efficacy as therapies for patients diagnosed with CTS. Nevertheless, the group receiving LPLT shown much greater benefits compared to the group receiving KT.

Nalbant et al., 2021 presented contrasting findings to our study, as they saw positive changes in the indications and symptoms of CTS, sensory nerve conduction studies, as well as a decrease in median nerve CSA. They attributed the observed increase in vascularity within the LLLT group to the anti-inflammatory as well as analgesic properties associated with LLLT. New evidence of LLLT's clinical and electrophysiological efficacy in the United States has been provided by this study. The LLLT appears to be a simple, painless method of treatment.

Twenty people took part in a study on the effects of kinesiotaping on pain, with equal numbers in each of two groups. The intervention proceeded on the initial day following the surgical procedure. One of the groups (n = 10) were given therapeutic exercise program, while, the other group (n = 10) were given. The KT was applied to therapeutic exercise program fan-shaped KT over a duration of four weeks. The upper limb on the surgical side, and the impact of the therapies was assessed in terms of shoulder pain as well as function, utilizing the SPADI questionnaire. The study's results revealed that both groups experienced substantial enhancements in pain reduction and functional ability during the four-week intervention period. The exercise group combined with the use of kinesiology tape (KT) demonstrated a considerably better enhancement in shoulder function compared to the control group. However, no statistically substantial difference was observed between the two groups in terms of shoulder pain. (**Afkhami et al., 2019)**

Poursalehan et al., 2018 conducted a study to examine the impact of low power laser treatment on immediate postoperative pain. A total of 80 candidates were randomly assigned to two groups, namely the control group as well as the laser group. Both groups underwent the same type of surgery, which involved the utilization of the spinal anesthetic technique. Following the completion of the surgical procedure, patients who underwent treatment with laser were subjected to laser irradiation on the surgical incision using two specific wavelengths: GaAlAs (804 nm) as well as GaAlInp (650 nm). The control group was similarly subjected to laser off using the same methodology. Patients were observed for a full twenty-four hours after surgery to record data on their VAS pain scores, initial analgesics requests, as well as overall analgesics consumption. The laser group experienced much less pain than the control group at 1, 4-, 8-, 12,16-, and 24-hours following surgery. Furthermore, the mean amount of analgesic administered in the laser group was lower compared to the control group. The duration of the initial request for analgesia in the laser-treated group exhibited a statistically significant increase compared to the control group. Because it is a non-invasive and safe treatment option, patients are generally accepting of low power laser therapy for post-operative pain relief.

Conclusions

Neuropathic pain after a mastectomy can be effectively treated with Low Level Laser Therapy, an exercise program consisting of both active and passive range-of-motion (ROM) exercises, as well as massage.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest

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