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Effect of Pulsed High Intensity Laser Therapy on Cervical Myofascial Pain Syndrome after Neck Dissection Surgeries

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ABSTRACT

Background: Surgery, radiation therapy and chemotherapy are used to treat head and neck cancer (HNC) patients, with the goal of maximizing survival while maintaining physical form and function**. Objectives**: The study's primary goal was to determine if pulsed high-intensity laser therapy (HILT) was effective in treating cervical myofascial pain and restoring cervical range of motion (ROM) following neck dissection procedures. **Subjects and methods**: This study was a randomized controlled trial and applied to a total number of forty patients from both genders who have cervical Myofascial Pain Syndrome (MPS) history at upper trapezius muscle (UTM) at least one month following a unilateral MRND and were randomly assigned into two groups equal in number (20 patients for each group); (HLIT group): received pulsed high intensity laser therapy in addition to traditional physical therapy program and (Control group): received traditional physical therapy program all treatment 3 times per week for one month . Pain was evaluated by Visual analogue scale and pressure algometer, while neck ROM was evaluated by universal goniometer before and after 4 weeks of intervention. **Results**: a comparison between the groups showed a significantly lower VAS, significantly higher PPT and a statistically significant difference between the study group's right and left bending and rotation and that of the control group (p< 0.001). **Conclusion**: Patients with cervical myofascial trigger points were found to benefit greatly from high intensity laser treatment as a kind of physical therapy.

Keywords: HILT, MPS, Neck dissection surgeries, VAS.

INTRODUCTION

Surgery, radiation treatment (XRT), and/or chemotherapy are used to treat patients who have been diagnosed with head and neck cancer (HNC), with the goal of maximising survival while maintaining physical form and function [(1)]. In order to treat cervical lymphatic metastases, a surgical operation known as a neck dissection involves the removal of the lymphatic and fatty tissue of the neck. Because cervical lymph nodes are the primary site of metastasis for upper aero-digestive tract cancers, neck dissection operations are often combined with surgical excision of these cancers [(2)]. The neck dissection procedures can be carried out in a number of ways. One of these strategies is the radical neck dissection surgery, which entails the complete excision of lymph nodes from one side of the neck, the sternocleidomastoid muscle, an important vein (the internal jugular vein), and the spinal accessory nerve, which is crucial for the full range of motion of the arm and shoulder. The key structures listed above are all preserved in the modified radical neck dissection [(3)].

Neck morbidity, such as discomfort, numbness, and reduced range of motion, was a severe and noticeable side effect of cancer treatment. Two forms of neck pain—neuropathic and myofascial pains—were documented in a study of 25 individuals who had neck dissection-related lifelong neck discomfort. Additionally, 33% and 37% of 220 patients who had neck dissection surgery had neck and shoulder discomfort, while 32% and 46% of patients reported neuropathic and myofascial pains [(4)].

In addition to muscular tightness, sensitive spots, restricted range of motion, tiredness, weakness, and possibly autonomic dysfunction, MPS is a common musculoskeletal condition that causes pain that is both intense and deep in one or more muscles and fasciae [(5)]. Myofascial trigger points are now treated manually utilising acupressure massage techniques as well as physical therapy technologies like ultrasound and laser [(6)]. Musculoskeletal disorders are treated using laser treatment, which includes shining red and near-infrared light on superficial wounds or wounded tissues to speed up soft tissue recovery and reduce both acute and long-term pain. HILT is regarded as one of the phototherapeutic devices that have become popular for treating both acute and chronic inflammatory pain, as well as the impairments that go along with it. However, recent research has shown that HILT has deeper effects on inflammation and edema, analgesic effects, and deeper joint stimulation. Therefore, the use of HILT for MPS may reduce pain and enhance function [(7)].

Because there is little information on the effectiveness of HILT in treating MPS after surgery, this research was created to look into the effects of pulsed HILT on patients who had a history of cervical MPS at the upper trapezius muscle (UTM) after receiving a unilateral MRND.

SUBJECTS AND METHOD

Subjects:

This study included 40 cervical MPS post-neck dissection surgery patients, aged 20 to 60, who were recruited from the Damanhur Oncology Centre.

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Twenty patients from each of the two groups (study and control groups) were randomly selected from the patient population. If a patient satisfied the following requirements, they were recruited in the experiment. (1) Male and female patients with ages ranging from 20 to 60. (2) All patients had unilateral modified radical neck dissection surgeries-related cervical myofascial discomfort. (3) Pain that is moderate to severe (VAS score <4).

Patients who satisfied one of the following criteria were barred from participating in the study: (1) Acute trauma, (2) Inflammatory joint/muscle disease, (3) Infection, (4) Cervical radiculopathy, (5) Pregnancy, (6) Epilepsy or any psychological disorder, (7) Rheumatoid arthritis.

Sample size determination:

Based on VAS results from a pilot study that included 5 subjects in each group, the necessary sample size for this study was determined to be 20 subjects in each group using G*POWER statistical software (version 3.1.9.2; Franz Faul, Universitat Kiel, Germany). Calculation parameters include α=0.05, 80% power, and 0.91 for the effect size.

Design:

Using the envelope technique, the patients were randomly divided into two equal groups. Cards with "HILT" or "Traditional exercise" written on them were sealed in envelopes after patients agreed to participate in the study. A blinded physical therapist was then requested to choose one envelope, and in accordance with the selected card, patients were allocated to the respective group. Twenty patients made up group A, who also received HILT in addition to exercise treatment, and twenty patients in group B, who just received exercise therapy. The allocated therapy was started following the first week of randomization, with start dates controlled. The physical therapist for the examiner was excluded from the randomization processes and was not informed of the therapy allocation. Patients were advised not to reveal to the physical therapist during the assessment how much therapy they would be receiving. Throughout the course of the therapy, the participants were instructed to report any negative side effects.

Measurement procedures:

Visual analogue scale (VAS):

On a scale of 0 to 10, the VAS was used to assess and gauge patient pain. Each participant was instructed to place a dot on the line according to how much pain they were now experiencing, with zero being no discomfort and ten the most intense agony they could possibly feel [(8)].

Goniometer:

In order to avoid errors and movement compensation, the neck ROM of the patients was measured while they were seated using the universal standard goniometer. Patients were told to sit with their backs straight and their arms resting on the back of the chair. To reduce thoracic motion, the patient was positioned with arms across the chest and knees, hips, and ankles at a straight angle [(9)]. A worldwide standard goniometer was used to measure the patients' active neck ROM (side bending and rotation on both sides) while they were seated.

Pressure algometer:

The PPT of the trigger locations was evaluated using PA. The Egyptian Algometer Patent No. 258 for 2017 research made use of the PA. 0-10kg/5g, 10-50g/10g. While the patients were seated, all trigger points were located by palpation[(10)]. The area of the trapezius that hurt the most was marked with a marker on the first appointment. Three measurements were made, and the average was calculated [(11)]. In order to ascertain the least amount of pressure that produces discomfort, PA was physically applied to it. The PA was held parallel to the tissue surface and constant pressure was applied. When the participant felt discomfort, the compression was administered slowly enough for them to respond.

Therapeutic procedures:

For one month, patients in both groups had typical physical therapy (ROM exercises, myofascial release exercises, and stretching exercises).

1. ***Patients in the study group received pulsed HILT:***

- Device Omega Laser (NewAge Inc., Italy) Peak power (14 W), frequency (20–100 kHz), adjustable duty cycle (20–100%), and adjustable spot size (8–20 mm) are the specifications of this device. 8 minute sessions were held three times a week for a month. When using high-intensity laser treatment, precautions were made to prevent side effects.
- To protect the retina of the eyes from harm, the patient and the treating researcher both donned appropriate eye protection glasses. In order to avoid pain from the laser's thermic effects, the treating investigator adjusted the laser probe frequently. Patients were warned that a flare of inflammation might cause some of them to have an aggravation of their symptoms soon after therapy. Inflammation is necessary for a therapeutic effect to occur [(12)], which reassured patients.
- The laser's probe was positioned parallel to the skin. Additionally, three stages were separated within each therapy session. 1364 J of total energy and quick manual scanning were used to construct the first phase. The laser fluence was tuned to two subphases of 682 J during this phase. Additionally, scanning was done over the UT muscle in both transverse and longitudinal planes. In the second stage, three active trigger points (25 J/point) were exposed to 75 J of radiation for around one minute (14 s/point). The last process was identical to the previous phase, although it involved laborious hand scanning. In the first and last stages, the treatment area was 100 cm^2, and it was scanned with 2728 J and an energy density of 27.28 J/cm^2.

In a single session, the patient received 2803 J of total energy over the course of around eight minutes.

2- The traditional physical therapy program:

A- Exercises for range of motion included: Exercises for cervical range of motion were performed using the following steps [12]:

- Neck rotations: Sit with your shoulders relaxed and your chin tucked in. Slowly turn your head to the left until you feel a gentle stretch. Hold for a short whil, then come back to the centre. On the right side, repeat. For one month, it was carried out once for 5-10 minutes, three times each week.
- Neck lateral flexion: Sit comfortably, shoulders back, chin tucked in. Bring your ear to your shoulder as you slowly incline your head to the left. Hold for a short while, then come back to the centre. On the right side, repeat. For one month, it was carried out once for 5-10 minutes, three times each week.

B- Myofascial release: MFR was performed unilaterally on the side of the surgery, and the patient was lying comfortably on their back with the arm on the treatment side laying next to them to loosen the periscapular muscles. The therapist performed MFR for 15 minutes three times a week for one month, using a pincer palpation to palpate the UTM with the thumb and index fingers until a slight relaxation of the tense band was felt [13].

C- Stretching Ex's, the taut band's tight muscular fibres can relieve localised muscle tension and enhance blood flow, ending the cycle of energy depletion [14]. Upper trapezius stretches. Patient sits erect on a chair and faces forward, his hands on the seat's bottom. The physiotherapist positioned himself behind the patient and flexed the head for 30 seconds while rotating it to the afflicted side and laterally flexing it away from it. For one month, upper trapezius stretching was done three times every session, three times per week.

Ethical approval:

The Cairo Medical Ethics Committee of the Cairo Faculty of Physical Therapy gave its approval to this study. All participants gave written consent after receiving all information. The Helsinki Declaration was followed throughout the study's conduct.

Statistical analysis

SPSS version 22 for Windows was used for all statistical analyses. The age of the groups was compared using an unpaired t-test. The distribution of sexes in the groups was compared using the chi-squared test. Shapiro-Wilk test was used to determine if the data had a normal distribution. To establish the homogeneity between groups, Levene's test for homogeneity of variances was performed. To compare the average values of the VAS, PPT, and neck ROM between groups, an unpaired t-test was used. A paired t-test was used to compare each group's pre- and post-treatment data. All statistical tests have a significance threshold of $p < 0.05$.

RESULTS

- *Subject characteristics*:

The subject characteristics of the research and control groups are shown in table 1. Age and sex distribution between groups did not significantly differ from one another ($p > 0.05$).

Table (1): Comparison of study group and control group subject characteristics

	Study group (n=20)	Control group (n=20)		
	Mean ± SD	**Mean ± SD**	**t-value**	**p-value**
Age (years)	47.30± 7.97	47.15 ± 7.21	0.06	0.95
Weight (kg)	73.55 ± 7.53	71.50 ± 6.70	0.91	0.36
Height (cm)	168.30 ± 6.71	167 ± 6.60	0.61	0.54
BMI (kg/m²)	25.89 ± 0.83	25.58 ± 0.82	1.16	0.25
Sex, N (%) Females	9 (45%)	8 (40%)	(χ^2 = 0.10)	0.74
Males	11 (55%)	12 (60%)		

Treatment effect on VAS, pressure pain threshold (PPT), and ROM:

- *Within group comparison:*

In comparison to pretreatment values in the study and control groups, there was a substantial drop in VAS and a significant rise in PPT. In comparison to pretreatment, there was a substantial increase in ipsilateral and contralateral bending and rotation in the study and control groups (Table 2 and 3).

- *Comparison between groups:*

There was no noticeable difference between the groups before to therapy. Following treatment, a comparison of the groups revealed that the study group had a considerably lower VAS and a significantly greater PPT than the control group. In comparison to the control group, the study group demonstrated a statistically significant increase in ipsilateral and contralateral bending, as well as rotation (Table 2 and 3).

Table (2): Mean VAS and PPT of the research and control groups before and after treatment

	Group A	Group B			
	Mean ± SD	Mean ± SD	MD	t- value	p value
VAS					
Pretreatment	6.70 ± 1.13	6.55 ± 1.32	0.15	0.38	0.70
Post treatment	2.70 ± 0.86	3.50 ± 1.05	-0.8	-2.62	0.01
MD	4	3.05			
% of change	59.70	46.56			
t- value	24.65	22.55			
	p = 0.001	***p = 0.001***			
PPT (kg)					
Pretreatment	1.35 ± 0.13	1.31 ± 0.15	0.04	0.98	0.32
Post treatment	1.98 ± 0.25	1.61 ± 0.22	0.37	5.04	0.001
MD	-0.63	-0.3			
% of change	46.67	22.90			
t- value	-13.99	-10.33			
	p = 0.001	***p = 0.001***			

Table (3): Mean neck ROM of the research and control groups before and after treatment

ROM (degrees)	Study group	Control group			
	Mean ± SD	Mean ± SD	MD	t- value	p value
Ipsilateral bending					
Pretreatment	39.75 ± 2.46	40.55 ± 2.74	-0.8	-0.97	0.33
Post treatment	47.50 ± 2.72	44.25 ± 3.66	3.25	3.18	0.003
MD	-7.75	-3.7			
% of change	19.50	9.12			
t- value	-18.08	-6.04			
	p = 0.001	***p = 0.001***			
Contralateral bending					
Pretreatment	41.05 ± 4.22	40.10 ± 3.21	0.95	0.80	0.42
Post treatment	48.45 ± 2.83	43.55 ± 3.36	4.9	4.98	0.001
MD	-7.4	-3.45			
% of change	18.03	8.60			
t- value	-10.28	-6.33			
	p = 0.001	***p = 0.001***			
Ipsilateral rotation					
Pretreatment	72.55 ± 5.88	71.40 ± 5.07	1.15	0.66	0.51
Post treatment	85.20 ± 5.66	81 ± 3.97	4.2	2.71	0.01
MD	-12.65	-9.6			
% of change	17.44	13.45			
t- value	-15.96	-16.11			
	p = 0.001	***p = 0.001***			
Contralateral rotation					
Pretreatment	*72.45± 5.85*	*70.90± 5.69*	1.55	0.84	0.40
Post treatment	*84*.50 ± 4.78	80.30 ± 3.61	4.2	3.13	0.003
MD	-12.05	-9.4			
% of change	16.63	13.26			
t- value	-14.94	-9.13			
	p = 0.001	***p = 0.001***			

DISCUSSION

The study's findings demonstrated a statistically significant improvement in VAS score, PPT score, ipsilateral and contralateral bending, and rotation 1 month after treatment in HILT group than control group. In the HILT group, the VAS and PPT changed by 59.70 and 46.67%, respectively, while in the control group, the changes in VAS and PPT were 46.56 and 22.90%, respectively, ipsilateral bending, contralateral bending, ipsilateral rotation, and contralateral rotation of HILT group were 19.50, 18.03, 17.44 and 16.63% respectively and that of control group were 9.12, 8.60, 13.45 and 13.26% respectively.

The findings of the present study may demonstrate that conventional physical treatment alone is not as successful in enhancing cervical range of motion, decreasing VAS score, and improving PPT score as conventional physical therapy combined with pulsed high-intensity laser therapy. More deeply penetrating than low-level lasers, the pulsed high intensity laser delivers high power (14W) at a 1,064 nm wavelength, and it is hypothesised that these effects include photothermal, photochemical, and photomechanical effects [(15)].

An extensive spectrum of illnesses have been treated using high intensity laser treatment [(16-18)]. High-intensity laser therapy's analgesic effects are based on a variety of mechanisms of action [(19–21)], some of which include enhancing blood flow, vascular permeability, and cell metabolism[(22)]. Through direct nerve stimulation, the inhibition of A-delta and C fibres, the release of encephalin and endorphins [(21)], which block pain, and other mechanisms, pulsed high intensity laser treatment reduces trigger point pain. Additionally, HILT raises the PPT by activating sensory receptors and relieves the spasm and tense band brought on by the trigger point [(23)].

Because pulsed high-intensity laser treatment inhibits the transmission of the pain stimuli and increases the body's creation of morphine-mimetic chemicals, it is used to treat chronic pain, it encouraged patients to engage in more physical activity, significantly improved cervical range, and reduced muscle pain [(19,20, 24, 25)]. Some studies have shown pulsed HILT as one of the most efficient and secure therapy approaches for treating trigger points. The impact of HILT on spinal diseases and musculoskeletal illnesses has been demonstrated in a number of systematic review studies [(26)].

The infrared portion of the electromagnetic spectrum may be penetrated deeper by a high-power laser with a wavelength of 1064 nm than it can by a low-power laser [(24)]. High-intensity laser therapy's properties, such as its wavelength, mode, pulse duration, energy, and power, determine how it will affect the body biologically. Deep penetrating energy is included in the high-intensity laser treatment wavelengths, which improve cell metabolism without causing any untoward adjustments [(19)]. The photomechanical and thermodynamic effects of high intensity lasers promote cellular bio-stimulation, lymphatic and venous microcirculations, cell mitotic index, extracellular ion transport, and the healing process [(23)].

This research has several restrictions. First, tests for ROM and shoulder discomfort should not be performed since they might improve statistical analyses. Second, the study's conclusions could be constrained by high-intensity laser therapy's low cost-effectiveness from the standpoint of health services. Third, because there were very few patients in the study, further research is required to be done with a bigger sample size. Fourth, there was no follow-up, so further research is required to determine the long-term impact of combining high-intensity laser treatment with exercise.

The results of the present study highlight the importance for physical therapists and other healthcare providers to consider the benefits of combining high-intensity laser therapy with a safe and well-tolerated exercise programme in the management of cervical myofascial pain following neck dissection surgeries. Prior to this being regarded to be unequivocally advantageous, the authors of this study emphasise that more research will be necessary. Future study may examine the effects of pulsed high-intensity laser therapy combined with a personalised exercise programme on myofascial pain rehabilitation in patients with neck dissection so they may perform work activities and return to their career.

CONCLUSION

The extremely significant reductions in VAS, increase in PPT, and cervical ROM show that adding HILT to the conventional therapy had a beneficial impact on the myofascial trigger points.

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