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Low Level Laser Therapy in Treatment of Phantom Breast Pain

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ABSTRACT

Background: People who had a mastectomy may feel pain that comes from the breast that was cut off. These are called phantom breast sensations (PB sensations) and phantom breast pain. Some of the problems that breast cancer patients have after treatment are a limited range of motion in the shoulder, arm swelling, loss of shoulder strength and PB feeling.
Purpose: To investigate efficacy of low-level laser therapy on shoulder mobility and phantom breast pain postmastectomy.
Patients and methods: 44 patients with postmastectomy phantom pain, their ages ranged from 20 to 50 years. They were randomly divided into two groups; Group (A) (study group): received low level laser therapy combined with routine physical therapy exercises, 3 sessions per week for 4 weeks, Group (B) (control group): received only routine physical therapy exercises, 3 sessions per week for 4 weeks. Visual analogue scale (VAS) was used to measure shoulder pain, goniometer was used to measure shoulder range of motion. Quality of life questionnaire was used to assess functional state and symptoms.
Results: There was a significant decrease in VAS post treatment compared with that of pretreatment in study group when compared with control group. Statistical analysis showed significant improvement in shoulder flexion, abduction and external rotation post treatment compared with that of pretreatment in both groups. Statistical analysis showed significant improvement in quality-of-life questionnaire post treatment compared with that of pretreatment in both groups.
Conclusion: Low level laser therapy can improve shoulder ROM, quality of life scale and decrease phantom pain postmastectomy**.**
Keywords: Low level laser therapy, Phantom pain, VAS, QOL.

INTRODUCTION

Women are more likely to get breast cancer than men. Every year, about a million new cases are found, and that number is likely to go up in the years to come [(1)]. About 60% of women who get breast cancer are treated surgically for axillary node staging and main breast tumor resection. That's one in eight women. Over half of women who have had breast cancer surgery are thought to be in constant pain afterward [(2)].

Women may "feel" something in their breast after having a mastectomy or other surgery for breast cancer. This is called phantom breast syndrome. This can include not only pain but also itching, heaviness, pain and soreness, pins and needles, tingling, pressure, burning, and throbbing [(3)].

Some of the problems that breast cancer patients have after treatment are a limited range of motion in the shoulder, arm swelling, and a loss of shoulder strength. Also, 55% of women who have had breast cancer treatment may feel some kind of pain. Scar pain, neuropathic pain, neuroma pain, and complicated regional pain syndrome are some of the types of pain that people feel after being treated for breast cancer. People who have had a mastectomy may also feel or feel pain that comes from the breast that was cut off. These are called phantom breast sensations (PB sensations) and phantom breast pain. When a breast is removed, PB sensations are all the feelings that are there. PB pain, on the other hand, are all the feelings that are there that are so strong that they are felt as pain [(4)].

Phantom breast syndrome is the feeling that a breast is still there after it has been removed. The number of women who experience this change varies between studies, but it is thought to happen to 10% to 55% of women who have had a mastectomy. Pain and feelings that come and go from the breasts after a mastectomy normally start in the first year and get less noticeable after two years [(1)].

One of the most common issues from breast cancer patients is that their shoulder range of motion (ROM) is limited after surgery, which lowers their quality of life. At one year after surgery, these patients still had limited ROM in shoulder abduction. It was thought that shoulder ROM limitation was strongly linked to pain after surgery [(5)].

The main ways to tell if someone has phantom breast sensations are by asking about their history and ruling out other possible reasons of pain. Other sources of pain should be checked out when looking into possible phantom breast pain [(6)].

Medications like opioids, anti-seizure drugs, antidepressants, NMDA receptor antagonists, and Mexitil (mexiletine) can help with phantom pain [(7)]. Non-drug treatments include transcutaneous electrical nerve stimulation (TENS), low level laser therapy (LLLT), pulsed high-intensity laser therapy, myofascial

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techniques, water physical therapy, ischemic compression + kinesiotherapy, acupuncture, stretching, and active exercises [8]. Because they are applied directly to the skin, topical medicines like capsaicin patches, lidocaine patches, and CBD oil tend to have fewer side effects [9].

Light, usually a low-powered laser or LED, is used in LLLT. The power range for these lights is 10 mW to 500 mW. People usually use light with a wavelength in the red to near-infrared range (660 nm–905 nm). This is because these wavelengths can pass through skin and soft and hard tissues and have been shown in clinical studies to help with pain, inflammation, and tissue repair [10]. It is put on an injury or painful area for 30 to 60 seconds a few times a week for a few weeks. The power density (irradiance) is typically around 5 W/cm^2. Because of this, inflammation goes down, pain goes away, and tissue healing speeds up. Most of the time, lasers or LEDs used for LLLT send out a beam that isn't focused or collimated because collimation is lost in tissue. As a result, the risks to the eyes are lower when the lasers are farther away [11].

Lasers make nerves less sensitive by lowering bradykinin, a chemical that causes pain. It restores the balance of ion channels, which are like guardrails for cells, and releases endorphins, the body's natural painkillers, and enkephalins, which are linked to endorphins and also relieve pain. Also, it stops some nerve fibers from feeling pain. Speeded up tissue repair and cell growth: Laser photons go deep into tissue and speed up the generation and growth of cells. When cells in tendons, ligaments, nerves, and muscles are exposed to laser light, they heal more quickly. Less fibrous tissue formation: Laser treatment slows down the growth of scar tissue after tissue damage from cuts, scratches, burns, repetitive motion injuries, or surgery [12].

So, we aimed to investigate efficacy of low-level laser therapy on shoulder mobility and phantom breast pain postmastectomy.

PATIENTS AND METHODS

Patients: For this study, 44 people who had phantom pain after having a mastectomy were asked to take part. Three to twelve months after surgery, the people who took part were chosen from the Faculty of Medicine at Cairo University and split into two groups of the same size. The research was carried out from February 2023 to May 2024.

Study design: Group A (Study group):
22 patients who had phantom pain after having a mastectomy and who got low-level laser therapy and regular physical therapy movements, three times a week for 4 weeks, with follow-up care after the treatment was over.

Group B (control group):
Twenty-two people in this group have phantom pain after having a mastectomy. They got sham low laser therapy along with regular physical therapy, three times a week for 4 weeks, with follow-up care after the treatment was over.

Study participants: Sample size was determined to avoid type II error. Sample size calculation was performed using G*POWER statistical software (version 3.0.10; Franz Faul, Universitat Kiel, Germany) [Exact test–correlation study, $\alpha = 0.05$, $\beta=0.9$ and moderate effect size =0.8] and revealed that the required sample size for this study was 44 participants.

Inclusion criteria: Patients who met the following criteria were included in the study:(1) Women between the ages of 20 and 50 (2) All patients had phantom pain syndrome (3) All of the patients had a mastectomy after being diagnosed with breast cancer (3 months to 12 months after surgery). (4) All patients had healthy organs; (5) All patients had a good Karnofsky Performance Scale (KPS 0-1).

Exclusion criteria:
Participants were not allowed if they met any of these conditions: Infections of the skin, active cancer with spread, and thrombophilia. Patient with severe peripheral neuropathy and swelling. Patient with a pacemaker, pregnant woman, diabetic patient, and patient who didn’t cooperate.

Measurement procedures:

1_VAS assessment
The VAS is an accurate and subjective way to measure both short-term and long-term pain. Scoring is done by writing marks by hand on a 10-cm line that shows a range from "no pain" to "worst pain". The last score could be between “0” to “10” points (no pain to worst pain) [12].

2_Universal goniometer assessment
Physical therapists use the universal goniometer to measure both inactive and active range of motion (ROM). The measurements are often used to find limits in range of motion, figure out the best treatments, and keep track of how well those treatments are working. The shoulder flexion, abduction, and external rotation tests were done while the person was laying on their back [4].

3_ EORT QOL C-30 scale assessment
A 30-item core cancer-specific assessment called the QOL scale was used to measure QOL in cancer patients. This self-administered questionnaire has five functional scales. All of the functional scales and individual item scores were converted to a 0–100 scale, where higher values mean better performance on the functional scales and more symptoms on the symptom scales. The Arabic form of the

QOL questionnaire was used to measure the functional scale and symptoms of women who had phantom pain after a mastectomy, both before and after treatment [6].

Treatment procedures:

As part of their regular physical therapy, both groups did exercises like (1) deep breathing; (2) general postoperative range of motion (ROM); (3) pendulum exercises to do for the 3 months after surgery; (4) gravity-assisted shoulder flexion and extension; and (5) shoulder abduction and flexion ROM. The whole process for both groups lasted about 30 to 40 minutes. Laser Phyaction CL-904 (Uniphy technology, Belgium) was used in Group (A) for LLLT [13]. The following settings were used: The wavelength was 904 nm, the power output was 70.5 mW, the frequency ranged from 2 to 30,000 Hz, and the dose was 6 J/cm^2. Group (A) and Group (B) did regular workouts. Active range of motion (AROM) is the movement of a segment within its unrestricted range of motion, which is caused by the active contraction of muscles across that joint. Patients did active range of motion (AROM) exercises that involved bending and straightening their wrists, rotating their shoulders internally and externally, bending and straightening their shoulders, bending and straightening their elbows, supinating and pronating their elbows, and bending and straightening their wrists in a radial and ulnar direction while lying on their backs [14]. For four weeks, the treatment took place three times a week. All of the patients were told not to take any more phantom pain medicines during treatment. All of the patients were checked out at the beginning of treatment and again four weeks later.

Ethical Approval:

The Physical Therapy Research Ethical Committee at Cairo University in Egypt approved the study with No. (P.T. REC/012/003855) and the patients were given all the information they need about the trial. After being fully informed, each study participant gave her signed consent. The conduct of this study was governed by the Declaration of Helsinki, the World Medical Association's rule of ethics for human research.

Statistical analysis

Statistical Package for the Social Sciences (SPSS) version 24 was used to look at the data. Frequency and percentages were used to show qualitative statistics. To show quantitative values, we used mean ± SD and range. T test was used to compare quantitative data. Chi-square test was used to compare qualitative data. All statistical tests were set to a significance level of $p < 0.05$.

RESULTS

A total of forty-four females patients participated in this study; they were assigned into 2 equal groups; group (A) low level laser therapy combined with routine physical therapy exercises and group (B) only routine physical therapy exercises. There was no significant difference between the mean value of age, BMI, occupation, affected arm, time since surgery, and occupation of both groups (Table 1).

Table (1): Comparison of demographic data between studied groups.

		Study (N = 22)		Control (N = 22)		Test	P-value
Age (years)	**Mean ±SD**	42.7 ± 5.5		42.2 ± 5.4		T = 0.33	0.741 NS
	Range	33 - 50		33 - 50			
Weight (kg)	**Mean ±SD**	80.1 ± 12.3		80.2 ± 12		T = 0.019	0.985 NS
	Range	59 - 101		60 - 100			
Height (cm)	**Mean ±SD**	161 ± 5.6		161.2 ± 5.4		T = 0.109	0.914 NS
	Range	154 - 170		154 - 170			
BMI (kg/m^2)	**Mean ±SD**	30.7 ± 4		30.8 ± 3.8		T = 0.031	0.976 NS
	Range	24.6 - 38.2		23.4 - 38.3			
Occupation	**Not employed**	14	63.6%	16	72.7%	X^2 = 0.41	0.517 NS
	Employed	8	36.4%	6	27.3%		
Affected arm	**Left**	5	22.7%	3	13.6%	X^2 = 0.61	0.434 NS
	Right	17	77.3%	19	86.4%		
Time since surgery (month)	**Median (IQR)**	4 (3 – 7)		5 (4 – 8)		MW = 174	0.161 NS

BMI: Body Mass Index, SD: standard deviation, T: independent sample T test, X^2: Chi-square test, NS: Non-significant.MW: Mann-Witney

Effect of treatment on VAS, shoulder ROM and QOL:

- Within group comparison:

There was a significant decrease in VAS (pain threshold) and increase in shoulder ROM post treatment compared with that pretreatment in the study and control groups (p-value < 0.001).

There was High significant increased cognitive, emotional and social (p-value< 0.001), and High significant decreased nausea, pain, Dyspnea, Insomnia and Diarrhea post treatment compared with that pretreatment in study group and control group (p-value <0.001).

- Between groups comparison:

Early on, there wasn't a big difference between the groups in the VAS scale, the QOL assessment, or the shoulder range of motion (p>0.001). The VAS scale went down significantly in the study group compared to the control group after treatment, while shoulder range of motion and the quality-of-life measure went up significantly in the study group (Tables 2 and 3).

Table (2): Comparison of shoulder ROM (after therapy) between studied groups.

After therapy		Study (N = 22)	Control (N = 22)	T	P-value
Flexion	**Mean ±SD**	175.9 ± 3.6	160.2 ± 4.9	**12.1**	**< 0.001 HS**
	Range	170 - 180	155 - 170		
External rotation	**Mean ±SD**	81.6 ± 3.3	75.2 ± 2.1	**7.5**	**< 0.001 HS**
	Range	77 - 87	70 – 78		
Abduction	**Mean ±SD**	173.3 ± 4.1	170.1 ± 3.8	**2.69**	**0.01 S**
	Range	167 - 180	165 - 175		

SD: standard deviation, independent sample T test, S: Significant, HS: Highly significant

Table (3): Comparison of VAS (before and after therapy) between studied groups.

		Study (N = 22)	Control (N = 22)	T/MW	P-value
VAS (before)	**Mean ±SD**	8.3 ± 1	8.4 ± 1.1	T = 0.144	0.886 NS
	Range	7 - 10	7 - 10		
VAS (after)	**Median**	3	5	**MW = 18**	**< 0.001 HS**
	IQR	2 - 4	4 - 6		

SD: standard deviation, independent sample T test, NS: Non-significant, HS: Highly significant

There was No statistically significant difference (p-value > 0.001) between studied groups (study & Control) as regard other QOL questionnaire (p-value was0.675, 0.164, 0.778, 0.680, 0.953, 0.424, 0.076, 0.672, 0.098, 0.765, 0.101, 0.271, 0.899, 0.055 and 0.704 for physical, Role, cognitive, emotional. Social, global, fatigue, nausea, pain, dyspnea, insomnia, appetite loss, constipation, diarrhea and financial impact respectively)

There was a significant improvement in cognitive, emotional, and social functioning, as well as a significant drop in nausea, pain, shortness of breath, insomnia, and diarrhea after treatment compared to before treatment in both the study group and the control group.

Regarding QOL parameters after therapy, study group had significantly higher score of cognitive, emotional, and social, and lower score of nausea, pain, dyspnea, insomnia, and diarrhea compared to control group (Table 4).

Table (4): Comparison of QOL questionnaire (after therapy) between studied groups.

After therapy		Study (N = 22)	Control (N = 22)	T/MW	P-value
Physical	**Mean ±SD**	59.2 ± 13.7	63.9 ± 9.5	T = 1.32	0.194 NS
	Range	44.47 - 83.8	39.5 - 72.9		
Role	**Median**	64.9	65	MW = 199	0.312
	IQR	51.7 - 73.3	57.2 - 85.6		
Cognitive	**Median**	68.2	33.3	MW = 33	< **0.001**
	IQR	61.7 - 79.2	19.4 - 42.1		
Emotional	**Median**	78	33.3	MW = 4	< **0.001**
	IQR	73.5 - 80.9	28.8 - 40.6		
Social	**Median**	62.7	32.7	MW = 96	**0.001**
	IQR	54.4 - 69.2	18.2 - 55.8		
Global	**Mean ±SD**	70.3 ± 7.7	68.6 ± 12.5	T = 0.55	0.582 NS
	Range	61.62 - 83.33	52.62 - 89.1		
Fatigue	**Median**	43.9	44.3	MW = 217	0.557
	IQR	33.3 - 58.1	40.9 - 61.1		
Nausea	**Median**	11	35.5	MW = 20	< **0.001**
	IQR	9.7 - 14.2	29.1 - 42.8		
Pain	**Median**	39.2	55.8	MW = 91	< **0.001**
	IQR	26.2 - 54	44.7 - 62.5		
Dyspnea	**Median**	16.7	29.4	MW = 128	**0.007**
	IQR	12.2 - 27.7	18.9 - 39.6		
Insomnia	**Median**	20	38.4	MW = 26	< **0.001**
	IQR	11.7 - 32.6	34 - 56.8		
Appetite loss	**Median**	20.6	23	MW = 186	0.188
	IQR	11.7 - 26.7	17.4 - 35.2		
Constipation	**Median**	20	20.8	MW = 222	0.638
	IQR	18.9 - 33.3	18.9 - 28.6		
Diarrhea	**Median**	10.7	16.7	MW = 104	**0.001**
	IQR	7.5 - 13.2	12.4 - 22.4		
Financial impact	**Median**	23.3	29.4	MW = 163	0.063
	IQR	18.3 - 40.6	27.6 - 37.8		

SD: standard deviation, independent sample T test, p-value: probability value

DISCUSSION

The goal of this study was to find out how low-level laser therapy affected shoulder movement and phantom pain after mastectomy. Forty-four women who had phantom pain after mastectomy took part in the study.

The study's results showed that the study group had significantly higher levels of shoulder flexion, abduction, and external rotation after treatment compared to the control group ($p < 0.001$). Researchers of the current study found that both the study group and the control group had lower VAS scores after treatment compared to before treatment (p-value < 0.001). The study group VAS scores were lower (mean = 2.8 ± 1.0, range = 1–4) than the control group scores (mean = 5.4 ± 1.1, range = 4–7). Nonthermal laser therapy can also help wounds heal faster, help muscles recover after exercise and fight tiredness, and speed up tissue healing in many nerve-related conditions. Laser therapy that doesn't use heat can be used safely and successfully to treat many neuromusculoskeletal problems. [15].

The findings of the recent research are congruent with the outcomes of **Ebid *et al.*** [16]. After 4 weeks of the laser program, the laser group had a lot less phantom pain and more range of motion in their shoulder joint than the control group. The results of this study showed that laser treatment was a very good way to reduce phantom pain and improve shoulder mobility after a mastectomy. A previous study done by **Cotler *et al.*** [8] also agreed with this conclusion. Low-level laser therapy (LLLT) can help relieve pain and speed up the body's healing process. LLLT has been used to treat pain for a long time and there is strong basic science evidence to back this. It doesn't have many side effects, and older people can handle it well. When there are structural problems or instability in bone or soft tissue, a laser or LED can't fix them. LLLT should only be used as an extra treatment to ease pain in people with neuropathic pain and mental deficits. As with any medical treatment, good clinical skills are needed along with an understanding of how injuries happen, how inflammation works, how repair works, how pain works, and how laser and LED effects work.

A review of the treatment data from the past showed significant mean pain score decreases for muscle strains, ankle, back, knee, foot, hip, neck, shoulder, and wrist pain, as measured by a visual analog scale (VAS). In a study of 697 people with back pain (including lumbar arthrosis, lumbar disc herniation, lumbar muscle strain, and sciatica), the average number of treatment sessions dropped the pain score by 30.05% from the first treatment to the last. 101 people with strains in their hamstrings, quads, and gastrocnemius muscles were treated and checked to see if the pain was better. It was found that after 8 to 9 treatments, the average VAS pain score went down by 31.83%. Laser technology must be able to give the right amount of light energy for pain management to work [17].

Majed *et al.* [18] found out how an educational program of therapeutic movements affects the quality of life and ability to do things for women who have had a mastectomy. Randomly, sixty women who were going to have a mastectomy were put into either a training group or a control group. The people in the intervention group got a lot of information and training on therapeutic movements before their surgery. To make sure that the tasks were being done, the intervention group was called again. At two and four weeks, people in both groups were visited at home to get the outcome factors. To measure quality of life, the Breast Cancer Patient Version was used. The "goniometer" was used to measure the shoulder's range of motion. Women in the intervention group had much better shoulder range of motion, two and four weeks after surgery. There were big differences between the control and intervention groups in flexion, extension, and abduction ($p = 0.04–0.00$). It was found that the control group had significantly better physical, mental, social, and spiritual well-being two and four weeks after surgery ($p < 0.001$).

Shoulder mobility: Right after treatment, the LLLT group had statistically significant better shoulder mobility (flexion and abduction) than the placebo group (SMD = 1.11, 95% CI: 0.53 to 1.68; SMD = 1.75, 95% CI: 1.12 to 2.38). However, there were no statistically significant differences between the two groups at any point of evaluation for shoulder external rotation in this trial by **Wang *et al.*** [19]. Our finding agreed with **Ebid *et al.*** [16] as the study group got low-level laser therapy along with regular physical therapy, while the control group got a fake laser along with regular physical therapy. The researchers found that the VAS decreased significantly more in the laser group after treatment than in the placebo laser group. After 8 weeks of treatment, ROM was much better in the laser group than in the control group ($P < 0.001$).

The current study confirmed the importance of LLLT in managing phantom pain without reporting any negative effects. It also provides preliminary evidence for LLLT becoming an important part of phantom pain rehabilitation. However, some limitations must be taken into account when interpreting these results. The biggest problem with this experiment was that it wasn't possible to look at the long-term effects of the treatment because of how hard it was to keep track of the patients after the trial. To reduce suffering and costs, it is also important to raise awareness about how to protect people with phantom pain after a mastectomy and get them to the right treatment at the right time. To prevent phantom pain after a mastectomy, trials should be done to test early physical therapy intervention and the effects of different

approaches to physical therapy programs with longer durations

Significance of the study: Phantom breast syndrome, or PBS, is the feeling that the breast is still there after a removal. Chronic pain can make it hard to do things and cause a lot of emotional problems. Consequently, this study's benefits will help solve this problem and figure out the best way to do physical therapy. There are different opinions on the facts about how physical therapy can improve shoulder range of motion and reduce phantom pain. This study was done to learn more about how low-level laser therapy and movements can help with shoulder pain and activity after a mastectomy.

CONCLUSION

Low level laser therapy can help people with phantom pain, with their shoulder pain, range of motion, and quality of life. After a mastectomy, a regular physical therapy exercise schedule is not nearly as effective.

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Declaration of interest

No conflicts of interest. The authors are in charge of the work and how it was written.

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