

Post-Mastectomy Phototherapy: a Systematic Review

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Fototerapia Pós-Mastectomia: uma Revisão Sistemática

Fototerapia Post-Mastectomia: una Revisión Sistemática

Alessandra de Jesus Mota Rocha¹; Giovana Bergheme Franciscon De Lemos²; Rachel Trinchão Schneiberg Kalid Ribeiro³

Abstract

Introduction: The breast cancer, a common pathology among women, promotes lesion in the ductal and lobular cell structures of the breast, as well as in the adjacent mammary tissue and lymphatic system. Mastectomy is the standard procedure for removal of the malignant nodule and areas where the surgery develops physical and functional complications. Phototherapy is one of the physiotherapeutic resources used to minimize the problems caused, offering an improvement in the quality of life of mastectomized women. **Objective:** To describe the effects of phototherapy on physical complications after mastectomy. **Method:** We performed a systematic review of the PubMed, LILACS, PEDro, SciELO, Bandolier, EBSCO, Clinical Evidence, MEDLINE and Cochrane Library databases from 2008 to 2018. **Results:** Of the 87 articles found, only six met the inclusion criteria, 5/10 higher grade in the PEDro Scale, being detailed in this review. Phototherapy promoted reduction of shoulder pain, decreased volume and circumference of lymphedema in the upper limb, regulation of the lymphatic and immune systems. **Conclusion:** It is concluded that the phototherapy applied in post-mastectomy complications has been shown to be a safe therapy in oncology patients, suggesting an improvement on aspects of the individual's functionality and quality of life.

Key words: Breast Neoplasms; Mastectomy; Phototherapy.

Resumo

Introdução: O câncer de mama, patologia mais comum entre as mulheres, promove lesão nas estruturas das células ductais e lobulares da mama, assim como no tecido mamário adjacente e sistema linfático. A mastectomia é o procedimento padrão para a retirada do nódulo maligno e áreas acometidas, no qual a cirurgia desenvolve complicações físicas e funcionais. A fototerapia é um dos recursos fisioterapêuticos utilizados para minimizar os problemas ocasionados, oferecendo uma melhora na qualidade de vida das mulheres mastectomizadas. **Objetivo:** Descrever os possíveis efeitos da fototerapia nas complicações físicas pós-mastectomia. **Método:** Realizou-se uma revisão sistemática nas bases de dados PubMed, LILACS, PEDro, SciELO, Bandolier, EBSCO, *Clinical Evidence*, MEDLINE e Biblioteca Cochrane no período de 2008 a 2018. **Resultados:** Dos 87 artigos encontrados, apenas seis preencheram os critérios de inclusão, nota superior de 5/10 na Escala PEDro, sendo detalhados nesta revisão. A fototerapia promoveu diminuição da dor em ombro, diminuição do volume e circunferência do linfedema no membro superior, regulação do sistema linfático e imunológico. **Conclusão:** Conclui-se que a fototerapia aplicada nas complicações pós-mastectomia mostrou ser uma terapêutica segura em pacientes oncológicos, sugerindo melhora sobre os aspectos da funcionalidade do indivíduo e sua qualidade de vida.

Palavras-chave: Neoplasias da Mama; Mastectomia; Fototerapia.

Resumen

Introducción: El cáncer de mama, patología más común entre las mujeres, promueve lesión en las estructuras de las células ductal y lobulares de la mama, así como en el tejido mamario adyacente y el sistema linfático. La mastectomía es el procedimiento estándar para la retirada del nódulo maligno y las áreas afectadas, donde la cirugía desarrolla complicaciones físicas y funcionales. La fototerapia es uno de los recursos fisioterapêuticos utilizados para minimizar los problemas ocasionados, ofreciendo una mejora en la calidad de vida de las mujeres mastectomizadas. **Objetivo:** Describir los efectos de la fototerapia en las complicaciones físicas post-mastectomía. **Método:** Se realizó una revisión sistemática en las bases de datos PubMed, LILACS, PEDro, SciELO, Bandolier, EBSCO, Clinical Evidence, MEDLINE y Biblioteca Cochrane en el período de 2008 a 2018. **Resultados:** De los 87 artículos encontrados sólo seis cumplieron los criterios de inclusión, nota superior de 5/10 en la Escala PEDRO, siendo detallados en esta revisión. La fototerapia promovió disminución del dolor en el hombro, disminución del volumen y circunferencia del linfedema en el miembro superior, regulación del sistema linfático e inmunológico. **Conclusión:** Se concluye que la fototerapia aplicada en las complicaciones post-mastectomía mostró ser una terapêutica segura en pacientes oncológicos, sugiriendo mejora sobre los aspectos de la funcionalidad del individuo y su calidad de vida.

Palabras clave: Neoplasias de la Mama; Mastectomia; Fototerapia.

¹ Centro Universitário UniRuy Wyden. Salvador (BA), Brazil. Orcid iD: <https://orcid.org/0000-0001-8820-8292>

² Universidade Federal da Bahia (UFBA). Escola Bahiana de Medicina e Saúde Pública (EBMSP). Salvador (BA), Brazil. Orcid iD: <https://orcid.org/0000-0002-3324-7283>

³ Centro Universitário UniRuy Wyden. EBMSP. Salvador (BA), Brazil. Orcid iD: <https://orcid.org/0000-0002-0555-8623>

Address for correspondence: Alessandra de Jesus Mota Rocha. Vila Dois Irmãos, 580 - Estrada das Barreiras. Salvador (BA), Brazil. CEP 41195-080. E-mail: alessandramrocha3@gmail.com



INTRODUCTION

Cancer can be defined as a disordered proliferation of neoplastic cells affecting tissues and organs. According to “Instituto Nacional de Câncer José Alencar Gomes da Silva (INCA)¹”, 59,700 new cases of breast cancer are expected in Brazil for 2018 and 2019 respectively and around 56,333 cases for each 100 thousand women. More frequent in women, breast cancer may occur in cells structures of ducts, lobes, mammary tissue and lymphatic system.

During the carcinogenesis, several physiopathological alterations are produced as the rupture of the regulation mechanisms of cellular multiplication, reparation of the genes, activation of the proto-oncogenesis, cellular modifications that lead to the genomic instability and genetic mutations. The discovery of cancer brings with it several repercussions in the social, financial, sexual and spiritual life of the women. The healthcare provider should contribute not only for the treatment it is proposed, controlling the symptomatology that affect and restrain the patients, but to reestablish their quality of life.

Depending on the clinical staging of each patient, mastectomy is suggested. This procedure aims the complete removal of the mammary gland associated or not to the axillary lymphadenectomy. When joined, mastectomy and lymphadenectomy increase the possibility of complications as, for instance, pain, lymphedema, seroma, scar dehiscence and reduction of the range of movement of the upper limbs, negatively impacting the functioning of the individual²⁻⁵.

During the whole cycle and phases of the treatment, it is essential to count with the presence of a multiprofessional team of which the physiotherapist participates and works since the prevention until the rehabilitation of the functional kinetic dysfunctions that affect these women. Among the physiotherapeutic conducts to treat the dysfunctions resulting from mastectomy is phototherapy that consists in the use of light for therapeutic purposes. Chromophores present in the skin capture the luminous stimulation and unchain the photobiomodulation in the cellular interior in order to promote the analgesic antiedematous, anti-inflammatory and scarring effect^{6,7}.

Phototherapy is applied through devices as *Light Amplification by Stimulated Emission of Radiation (laser)* and *Light Emitter Diode (LED)* that have several wavelengths and power ranging from low to high. Physiotherapists use low power phototherapy with the advantage of being a non-invasive procedure, promoting minimum side effects⁸.

The literature, despite describing some effects of phototherapy, is not clear, there are controversies about the

applicability and parameters, more so in post-mastectomy patients. Based in the aforementioned, the objective of this study is to describe the effects of the phototherapy applied in mastectomized patients and to review the parameters used in the complications resulting from this surgery.

METHOD

It is a systematic review whose search and evaluation of articles was made from January 2017 to March 2018. In order to have a more comprehensive range of information, the following databases were selected: PubMed, LILACS, PEDro, SciELO, Bandolier, EBSCO, Clinical Evidence, MEDLINE and Biblioteca Cochrane. Full original randomized clinical trial articles published from 2008 to 2018 in English, Spanish and Portuguese that addressed phototherapy in post-mastectomy complications in women were selected.

The following Health Science Descriptors were utilized (DeCS): *Breast Neoplasms, Phototherapy e Mastectomy*, and respective combinations: *Breast Neoplasms AND Mastectomy AND Phototherapy, Phototherapy AND Breast Neoplasm, Breast Cancer AND Phototherapy*. It were excluded the articles whose approach of phototherapy were for patients submitted to breast conservative surgery and score lower than 5/10 in the scale PEDro.

The scale PEDro is a tool of qualitative evaluation of controlled clinical trials that allows to know thoroughly how clinical trials were elaborated, score them and whether ethical criteria were complied with. The articles were evaluated by two independent reviewers, who used the scale PEDro with cut-off 5/10; had the two reviewers failed to reach an agreement a third reviewer was called. The information pertinent to the material encountered were tabulated and later discussed.

RESULTS

While searching the databases, 87 articles were encountered. The first evaluation was through the reading of titles and abstracts; 78 articles were excluded, remaining only nine for full reading shown in Figure 1.

For qualitative evaluation, scale PEDro was used, cut-off 5/10, where it were selected six articles to study and three were excluded because the score was below cut-off and lack of clarity of the methodology applied in clinical trials.

The total sample of all the articles encountered was 189 mastectomized women, treated predominantly with *laser* and infrared *LED*, with average of 56 consultations. Lymphedema was the main complication reported in the protocols of treatment with exclusive application of *laser*,

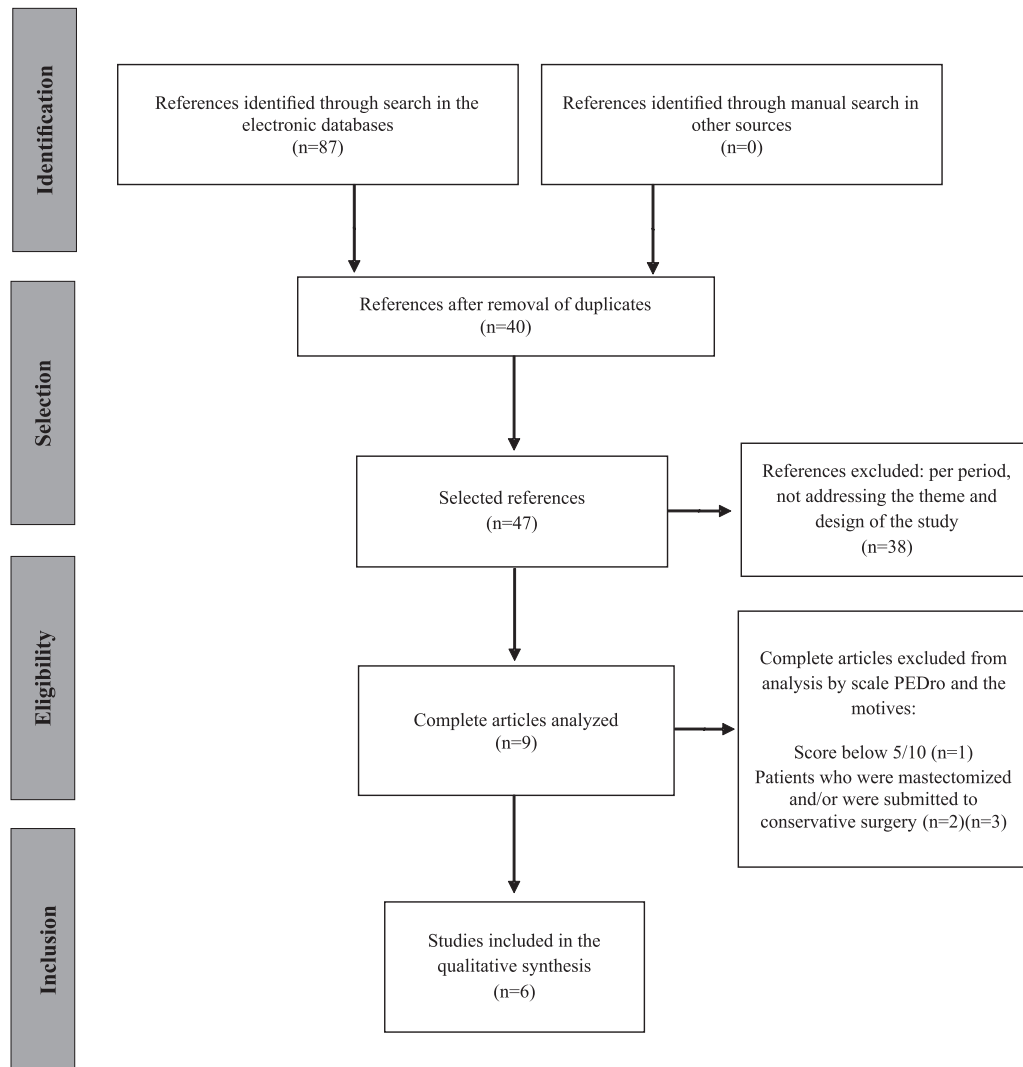


Figure 1. Flowchart showing the process of selection of the studies

followed by pain, reduction of mobility and palmar grip strength.

The protocols applied for lymphedema and analgesia adopted an association of *laser* wavelengths of 905 nm and 808 nm with dose of two joules per cm^2 (J/cm^2) each one; for mobility and palmar grip strength, a wavelength of 904 nm and dose of 1.5 joules. Patients who participated of these clinical trials had reduction of the lymphedema-affected arm volume with improvement of the lymphatic flow and function of the skin and consequently, less pain.

When shoulder mobility and palmar grip strength were addressed, the tissue functions reached their balance and joint congruence was reestablished. Therefore, the functions of the upper limbs was slowly reestablished by the action of the *laser* already known for its capacity of action in inflammatory and scarring processes.

The application of *LED* was used to treat immunologic and scarring alterations resulting from mastectomy, with parameters that ranged 480 to 3,400 nm, dosing of 12

J/cm^2 and it was verified that the action of *LED* in the organisms affects the capacity of the immunologic system in defending against the aggressor agent, activating lymphocytes and Killer natural cells and *LED* exposed-cells failed to show disordered multiplication capacity, which is a characteristic of cancerous cells, and much less adverse reactions.

As for scarring and inflammatory factors, *LED* activates pro-inflammatory cells, making the window time of the inflammatory process to cease quicker, contributing for collagen and elastin deposition in the affected site.

The information about the study selected are shown in Table 1.

DISCUSSION

Based in the articles reviewed, it was used therapeutic *laser* and, in the majority of the trials searched, infrared to apply phototherapy in mastectomized patients.

Table 1. Studies encountered that demonstrated the application of phototherapy, its endpoints and parameters utilized in mastectomized patients

Author, year	Study Design	Scale PEDro	Complications	Intervention/ parameters	Endpoints
Li et al., 2017	Clinical trial	7/10	Lymphedema	Sample: 63 women GI: 32 Length of the wave between 6.0 and 14.0 μm , duration of 1 hour per day during 4 weeks (total 20 days) at a temperature of 42°C GB: 31 Application of compression bandage during 12 hours/day	The infrared did not affect the apoptotic state of the cellular lineages MCF-7 and MDA-MB 231, the cellular feasibility and the cellular proliferation without adverse reaction. It is suggested that the infrared is an effective method for lymphedema, which probably will not induce tumoral recurrence or metastasis
Zhevago et al., 2017	Clinical trial	7/10	Immunologic Alterations	Sample: 19 patients GI: 11 Irradiation of the lumbosacral area, 15 cm of diameter of 480-3400 nm, level of polarization 95%, duration of 10 minutes and 7 daily sessions GC: 8	After mastectomy utilizing infrared, the values of the monocytes increased and returned to the initial pre-operative values, which hampered the reduction of the lymphocytes, stimulated the production of the natural Killer cell and promoted the correction of many immunologic parameters altered post-surgery
Zhevago et al., 2012	Clinical trial	8/10	Immunologic Alterations	Sample: 19 patients GI: 11 Irradiation of the lumbosacral region from 1 to 7 days post-surgery, , 480-3400 nm, 40 mW/cm ² , 95% of polarization with the diameter of the light spot of 15 cm GC: 8	Infrared was able to stop postoperative reduction of monocytes and Killer natural cells, the total quantity of lymphocytes T and levels of IgA; promoted faster normalization of leukocytosis and did not cause cancer relapse
Ahmed Omar; Abd-El-Gayed Ebid; El Morsy et al., 2011	Clinical Trial	8/10	Lymphedema	Sample: 50 patients GL: 25 Length of the wave of 904 nm over the axillary and areas of the arm, 3 times a week during 12 weeks, dose of 1.5 J/cm ² , 20 minutes GC: 25	Laser improved post 8-12 weeks the mobility of the shoulder for flexion and abduction reduced totally the circumference of the member and raised the gripping strength
Zimin; Samoiloava; Zhevago, 2010	Clinical trial	7/10	Lymphedema	Sample: 17 patients GI: 10 Length of the wave 480-3400 nm, 95% of polarization, 40 mW/cm ² , per 10 minutes with diameter of 15 cm GC: 7	Infrared produced a reduction of the proliferative activity of some tumoral cells and stimulated the production of the natural cell Killer
Lau; Cheing, 2009	Ensaio clínico	7/10	Linfedema	Sample: 21 patients GL: 11 Length of the wave: 905 nm, 2 J/cm ² , 3 times a week during 20 minutes in scan GC: 10	The laser reduced the volume of the arm, pain and inability of daily life activities; the therapeutic effects showed improvement after treatment cessation and DASH scores, in addition to blood flow, restauration of the drainage system an formation of scar tissue

Captions: GB: Group bandage; GC: Group Control; GI: Group intervention; GL: Group laser; J/cm²: Joules per square centimeter; Hz: hertz; mW: miliwatt; nm: nanometer; μm : 1 millionth of meter.

The bibliographic analysis revealed that phototherapy diminishes the main post-mastectomy complications as the limitation of the shoulder mobility, lymphedema and pain.

Li et al.⁹ evaluated the effect of infrared in lymphedema in 32 mastectomized patients and compared lab data pre and post mastectomy. Infrared was applied with wavelength between 6.0 and 14.0 μ m and the result was the promotion of Langerhans cells, macrophages and endothelial cells activation with restoration of the immunological function and of the lymphatic system in patients who had lymphedema.

Corroborating the results aforementioned exposed about the action of the infrared over the immunologic system, studies indicate that phototherapy by infrared stimulates the defense cells of the organism as the natural cell Killer, monocytes and lymphocytes T after mastectomy. There is an inhibition of the inflammatory cycle and even with the cellular stimulation and production in the elevation of the temperature in superficial tissues, infrared was unable to change the capacity of proliferation, feasibility and apoptotic status of cancerogenous cells¹⁰⁻¹².

Infrared was also applied with good results in a study with 19 patients that revealed synthesis of free radicals available in the blood circulation, allowing tissue regeneration with the deposition of collagen in the scarring site, avoiding occasional postoperative complications as, for instance, the scarring dehiscence that generates pain and restriction of the shoulder mobility⁶. In this study, the wavelength used was 480-3400 nm, it is considered a wide wavelength, while in the article of Study and Emitting¹³, the wavelength was only 540 nm during 30 minutes.

Laser-based phototherapy was applied by Lau and Cheing¹⁴ in 11 mastectomized patients with pain and lymphedema in the upper limb and in the group control without intervention. The wavelength used was 905 nm, three times a week; *laser* showed to be effective in reducing the pain and lymphedema even after suspending the treatment in the fourth week in this group, which suggests its continued efficiency in the long time. The study demonstrated that one of the benefits of *laser* is the ability to accelerate the tissue restoration, as seen by the earlier normalization of the skin aspects and recovery of the lymphatic system function because of the lymphangiogenesis, results also encountered in another study¹⁵.

Similar results were found in the study of Ahmed Omar¹⁶. Identical wavelength 904 nm *laser*, dose of 1.5 J/cm was applied in a 25 patients sample; in the group control, *laser* was deactivated in the moment of its application. The group intervention had also a significant improvement of the lymphedema with the reduction of

the circumference of the upper limbs and range of the movement of the shoulder region and of the hand grip strength.

More recently, Storz et al.¹⁷ utilized *laser* with wavelength 980 nm and dose of 4.8 J/cm², parameters bigger than the utilized in previous protocols, and encountered similar results of *laser* action in mastectomized patients. Even with different parameters in their protocols, there is a consensus in both articles about the efficacy of *laser* application for treatment of pain and lymphedema.

Lau and Cheing¹⁴, in a sample with 11 patients checked *laser* with wavelength of 905 nm, dose of 2.0 J/cm² during 20 minutes, whose functionality was evaluated through DASH score and observed that the *laser* treatment improved the functionality, quality of life and accelerated the return to daily life activities. They validated that as early as the postoperative recovery with the lessening of its complications occurs, the better will be the prognosis, promoting the insertion of these patients in their social and family conviviality.

Some studies reported that the small number of participants was a limitation, associated to short duration protocols; more evidences may be found in next trials about the effect of phototherapy with larger groups of subjects and long duration protocols. Another limitation was the not-blinding in articles of therapists who applied *laser* or *LED*, because they knew previously how the devices functioned which could be a bias of the results obtained.

Though there are innumerable publications that address mastectomy postoperative physiotherapy, few are the articles with good methodological foundation and scarcer yet are those randomized clinical trials that approach the application of phototherapy in post-mastectomy patients. Maybe, this difficulty is explained due to the complexity involving ethical questions in research, because these are studies with application of photoelectric resources in oncologic patients and unfamiliarity about how phototherapy works.

Photobiomodulation in oncology is still seen by some authors and healthcare providers with a certain apprehension. Because of the reduced knowledge about this subject, the authors feel insecure for being potentially encouraging cancer relapse either in its primary source or stimulating metastasis. Consequently there is but few adherence to this conduct.

CONCLUSION

Phototherapy through *laser* and *LED*, promotes satisfactory results to reduce pain and lymphedema and stimulates the immunologic and lymphatic systems post-

mastectomy. The parameters applied for the use of *laser* ranged between 904 and 908 nm wavelength and dose from 1.5 to 4.8 J/cm²; for *LED*, the variation was only in the wavelength, from 480 to 3.400 nm. In the studies evaluated, phototherapy has shown to be a safe therapy in oncologic patients, suggesting improvement of the individual functioning and quality of life.

CONTRIBUTIONS

Alessandra de Jesus Mota Rocha and Giovana Bergheme Franciscan De Lemos planned the study since the selection of the theme, design and methodology, evaluation and interpretation of the data collected and wording of the final version with the support of Rachel Trinchão Schneiberg Kalid Ribeiro who contributed with the critical review of the final version. All the authors approved the final version of the manuscript.

DECLARATION OF CONFLICT OF INTERESTS

There are no conflict of interests to declare.

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