Photobiomodulation Associated or Not with Other Therapeutic Techniques in the Treatment of Post-Breast Cancer Lymphedema: Literature Systematic Review

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Fotobiomodulação Associada ou Não a Outras Técnicas Terapêuticas no Tratamento do Linfedema Pós-Câncer de Mama: Revisão Sistemática da Literatura

Fotobiomodulación Asociada o No a Otras Técnicas Terapéuticas en el Tratamiento del Linfedema Poscáncer de Mama: Revisión Sistemática de Literatura

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ABSTRACT

Introduction: Breast cancer is the most common neoplasm among women in Brazil. Despite the various therapeutic approaches, surgical treatment is still indicated in many cases and usually includes a sentinel lymph node biopsy or axillary dissection. These techniques are associated with an increased risk of developing lymphedema. As a form of treatment for this chronic condition, photobiomodulation (PBM) has stood out for its effects in reducing inflammation, edema, and fibrosis, favoring the recovery of patients. **Objective:** To systematize the effects of PBM as a complementary therapy associated or not with other therapeutic techniques in post-breast cancer lymphedema. **Method:** Systematic review carried out on PubMed/MEDLINE, ScienceDirect, PEDro, BVS, and SciELO databases, using descriptors in Portuguese and English. Randomized clinical trials were included, without restrictions on language or year of publication. **Results:** Ten articles were included out of a total of 227 (all randomized clinical trials, PEDro score 6-9). Isolated PBM demonstrated efficacy in reducing limb volume, improving pain and functionality, with more evident effects in the first months and possible long-term maintenance. When associated with other therapies, the results were enhanced. **Conclusion:** PBM has shown to be a promising complementary approach for the management of post-breast cancer lymphedema, with beneficial results on symptoms. Further research is needed to standardize protocols that favor reproducibility and expand its application in clinical practice.
Key words: Breast Cancer Lymphedema; Mastectomy; Low-Level Light Therapy; Systematic Review.

RESUMO

Introdução: O câncer de mama é a neoplasia mais incidente entre mulheres no Brasil. Apesar das diversas abordagens terapêuticas, o tratamento cirúrgico ainda é indicado em muitos casos e comumente inclui a biópsia do linfonodo sentinela ou a dissecção axilar. Essas técnicas estão associadas a um risco aumentado para o desenvolvimento de linfedema. Como forma de tratamento dessa condição crônica, a fotobiomodulação (FBM) tem se destacado por seus efeitos na redução da inflamação, edema e fibrose, favorecendo a recuperação das pacientes. **Objetivo:** Sistematizar os efeitos da FBM como terapia complementar associada ou não a outras técnicas terapêuticas no linfedema pós-câncer de mama. **Método:** Revisão sistemática realizada nas bases PubMed/MEDLINE, ScienceDirect, PEDro, BVS e SciELO, com uso de descritores em português e inglês. Foram incluídos ensaios clínicos randomizados, sem restrição de idioma ou período de publicação. **Resultados:** Foram incluídos dez artigos no total de 227 (todos ensaios clínicos randomizados, escore PEDro 6-9). A FBM isolada demonstrou eficácia na redução do volume do membro, melhora da dor e funcionalidade, com efeitos mais evidentes nos primeiros meses e possível manutenção em longo prazo. Quando associada a outras terapias, os resultados foram potencializados. **Conclusão:** A FBM se mostra uma abordagem complementar promissora para o manejo do linfedema pós-câncer de mama, com resultados benéficos sobre os sintomas. Novas pesquisas são necessárias para padronizar protocolos que favoreçam a reprodutibilidade e ampliem sua aplicação na prática clínica.
Palavras-chave: Linfedema Relacionado a Câncer de Mama; Mastectomia; Terapia com Luz de Baixa Intensidade; Revisão Sistemática.

RESUMEN

Introducción: El cáncer de mama es la neoplasia más común entre las mujeres en el Brasil. A pesar de los diversos enfoques terapéuticos, el tratamiento quirúrgico todavía está indicado en muchos casos y comúnmente incluye la biopsia del ganglio linfático centinela o la disección axilar. Estas técnicas se asocian con un mayor riesgo de desarrollar linfedema. Como forma de tratamiento para esta condición crónica, la fotobiomodulación (PBM) se ha destacado por sus efectos en la reducción de la inflamación, edema y fibrosis, favoreciendo la recuperación de los pacientes. **Objetivo:** Sistematizar los efectos de la PBM como terapia complementaria asociada o no a otras técnicas terapéuticas en el linfedema post cáncer de mama. **Método:** Revisión sistemática realizada en las bases de datos PubMed/MEDLINE, ScienceDirect, PEDro, BVS y SciELO, utilizando descriptores en portugués e inglés. Se incluyeron ensayos clínicos aleatorizados, sin restricciones de idioma ni periodo de publicación**. Resultados:** Se incluyeron diez artículos de un total de 227 (todos ensayos clínicos aleatorizados, puntuación PEDro de 6 a 9). La PBM aislada demostró eficacia para reducir el volumen del miembro, mejorar el dolor y la funcionalidad, con efectos más evidentes en los primeros meses y posible mantenimiento a largo plazo. Al asociarlo con otras terapias, los resultados se potenciaron. **Conclusión:** La PBM parece ser un enfoque complementario prometedor para el tratamiento del linfedema posterior al cáncer de mama, con resultados beneficiosos sobre los síntomas. Se necesitan nuevas investigaciones para estandarizar protocolos que favorezcan la reproducibilidad y ampliar su aplicación en la práctica clínica.
Palabras clave: Linfedema del Cáncer de Mama; Mastectomía; Terapia por Luz de Baja Intensidad; Revisión Sistemática.

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INTRODUCTION

Breast cancer is one of the most prevalent neoplasms worldwide. According to the National Cancer Institute (INCA), it is the most frequent cancer type in women, with 74,000 new cases estimated for each year of the 2023-2025 triennium in Brazil. When diagnosed early and properly treated, it presents a positive prognosis[1]. Despite having different forms of treatment, including chemotherapy, radiotherapy, hormone therapy, and immunotherapy, surgery is the main mode of breast cancer treatment, being defined based on specific criteria, including histological classification, disease staging, and clinical specificities of each patient[2-4].

Surgical breast cancer treatment can include different approaches, like conservative or non-conservative surgery, and, when indicated, immediate or later mammary reconstruction[3,5-7]. Regardless of the chosen technique, axillary lymph node investigation is fundamental for disease staging and defining a therapeutic plan and can be done through sentinel lymph node biopsy (SLNB) or axillary lymph node dissection (ALND). Both techniques can harm the lymphatic system, being associated with an increased risk of lymphedema, especially when combined with radiotherapy, due to the damage caused to the irradiated location[4,8-11].

Upper limb lymphedema is a common postoperative complication in breast cancer treatment, a consequence of the lymphatic returns due to manipulation or removal of axillary lymph nodes. Although its incidence can vary according to diagnostic criteria and individual characteristics, it significantly impacts functionality and quality of life[12-14]. It is a chronic illness that causes dysfunction in the lymphatic system, resulting in a flow obstruction due to the excessive accumulation of fluids and proteins outside of blood vessels and tissue cells, generating edema and discomfort in the affected limb[10,15,16]. This edema causes symptoms, like pain, heaviness, alterations to the skin and functionality, and sensibility on the limb ipsilateral to the surgery, in addition to affecting psychological well-being[17-20].

Lymphedema treatment includes Complex Decongestive Therapy (CDT), considered the gold standard for managing this condition. Internationally recognized CDT combines strategies that promote symptom control, such as skin care, compressive bandages, manual lymphatic drainage (MLD), and specific exercises[21]. Over the last years, there has been a rise in the search for complementary therapies that can enhance the effects of therapeutic resources in use. In this scenario, photobiomodulation (PBM) has been investigated as a promising complementary therapy that can optimize lymphedema treatment[22].

PBM is a therapy that applies light, like low-intensity laser (Light Amplification by Stimulated Emission of Radiation) and LED (Light Emitting Diode), to reduce pain and inflammation, in addition to promoting beneficial effects on tissues, modulating the activity of fibroblasts, and preventing the fibrotic tissue from thickening. Studies also indicate that PBM stimulates lymphangiogenesis by activating the expression of vascular endothelial growth factor C (VEGF-C), which favors lymphatic drainage and tissue reconstruction. On a cellular level, it promotes the activation of macrophages, contributing to strengthening the immune system[23-28].

Given the functional impacts and symptoms associated with lymphedema, it becomes necessary to systematize the effects and applications of PBM, aiming to amplify the resources available in clinical practice for the treatment of post-breast cancer patients who face this condition.

METHOD

Systematic review registered in the PROSPERO[29] (International Prospective Register of Systematic Reviews) platform under the number: CRD42025638462. The PubMed/Medline, ScienceDirect, PEDro, BVS, and Scielo databases were searched. All steps were based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[30] guidelines. The following health science descriptors (DeCS) and Medical Subject Headings (MeSH) were used in the article search, along with their counterparts in Portuguese and English: "Terapia com Luz de Baixa Intensidade", "Fotobiomodulação", "Exercício Físico", "Drenagem Linfática Manual", "Linfedema", "Mastectomia". "Low-Level Light Therapy", "Photobiomodulation", "Physical Therapy", "Therapeutic Approaches", "Manual Lymphatic Drainage", "Lymphedema", "Breast Cancer Lymphedema", "Mastectomy". The search strategy used Boolean descriptors "OR", "AND", and "NOT". The article search was conducted by two independent reviewers, who read titles and abstracts first, reading the article in full when meeting the inclusion criteria.

The criteria included randomized clinical trials, observational studies, case studies, and retrospective studies, with no limit regarding date of publication or language, conducted with individuals diagnosed with breast cancer who underwent mastectomy and developed lymphedema at any point of the postoperative period and who used PBM in isolation or association with other therapeutic techniques in the treatment of lymphedema. The exclusion criteria were studies that covered other pathologies, application of the technique in different areas of the body or animals, and therapeutic techniques

that did not use PBM, either in isolation or in association with other therapies.

Study selection was conducted by two independent reviewers, in two steps: title and abstract reading, followed by full reading to confirm eligibility. A third reviewer solved divergences. After selection, data from the included articles were extracted and organized on a standardized table. Variables analyzed included: author and year, sample size, demographic and clinical data, associated conducts, PBM location and dose applied, and evaluated outcomes.

The methodological quality of articles was assessed through the PEDro[31] scale, a widely used instrument for assessing methodological rigor and risk of bias in randomized clinical trials. This scale is composed of 11 criteria, of which 10 can be scored, related to internal validity and statistical presentation of the studies. The assessed aspects include random allocation, concealed allocation, between-groups comparison, blinding of participants, therapists, and evaluators, intention-to-treat analysis, and point estimated variability. The studies received a score from 0 to 10, with a higher score indicating greater methodological rigor.

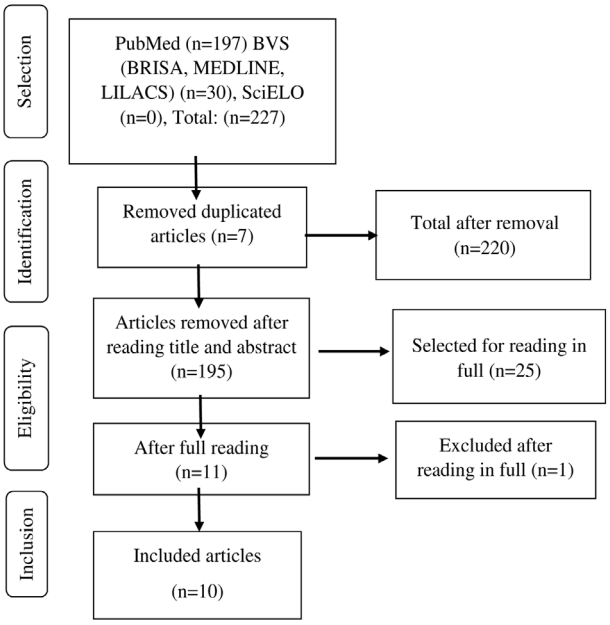

Figure 1. Flowchart showing the selection process of the articles
Source: Adapted from PRISMA[30].

RESULTS

A total of 227 articles were retrieved from databases; 197 from PubMed and 30 from BVS, with no articles retrieved from SciELO. After removing 7 duplicated articles, 220 studies were screened. Of those, 195 were excluded after title and abstract reading, leaving 25 to be read in full. After this step, 11 articles remained, and 1 was excluded for not meeting the methodological criteria. Thus, 10 studies were included in this review. The selection process is detailed in Figure 1. The score of the works included according to the PEDro scale ranged from 6 to 9 out of a total of 10 points.

Chart 1 represents the characteristics of the studies included in this review. All the publications were written in English and are randomized clinical trials published between 2003 and 2023. All the clinical trials analyzed women diagnosed with post-mastectomy lymphedema and observed a great variation in the studies' samples, which ranged from 8[32] to 61[33] participants. Limb circumference reduction was assessed in every study[32-42], in addition to other outcomes, including pain in the affected limb[32,34-37], quality of life[35,37,38], range of motion[32,33,37,40], tissue endurance[33,41], manual grip strength[34-36,40], upper limb function[33,41] according to the DASH (Disabilities of the Arm, Shoulder and Hand) scale, and psychological symptoms[38,42]. Other conventional treatments were used in isolation[34,37,38] or in association with LLLT (low-level laser therapy)[36,42], of which five exclusively assessed the LLLT application protocol[32,33,35,40,41]. Two studies[34,36] addressed intermittent pneumatic compression (IPC) and one[36] compared its application in isolation and association with laser, while the other[34] assessed IPC separately. One study[38] analyzed the isolated effects of LLLT, lymphatic drainage, and the combination of both therapies. Similarly, another study investigated the effects of laser, MLD, and kinesio taping separately[37]. CDT was compared in association with laser as a complementary therapy[42].

DISCUSSION

The studies included in this review showed that PBM has been widely investigated as a therapeutic resource for post-breast cancer lymphedema, showing beneficial results regarding pain reduction, better quality of life, range of motion, and grip strength. Most studies assessed laser application in isolation, while others associated this therapy with other conventional treatments, such as IPC, CDT, and MLD.

Kaviani et al.[32] and Carati et al.[33] used similar protocols in terms of energy density (1.5 J/cm²) and frequency of application (three times a week). Both showed significant volume reduction in the treated limbs. However, studies differ regarding secondary outcomes and sample size. Carati et al.[33] had 61 participants and demonstrated that a two-cycle protocol was superior to an isolated cycle in reducing limb volume (>200 ml), in addition to improving tonometry and extracellular fluid index, with

Chart 1. Main characteristics of the studies using photobiomodulation for lymphedema treatment in post-breast cancer patients

Author/ Year	Sample	PEDro scale	Parameters	Intervention protocol	Results
Kaviani[32] (2006) Clinical trial	EG: 4 CG: 4 Total: 8	8/10	1.5 J/cm² 890 nm 3,000 Hz	EG: Application of LLLT in 5 points at the axillary area, 3x/ week for 3 weeks, repeating after 8 weeks (18 sessions) CG: Received simulated irradiation under double-blinding conditions	EG presented a greater reduction in circumference every week, except on the 22nd. Moreover, there was pain reduction and greater treatment adherence in EG. Regarding post-session pain compared to pre-treatment, results were superior to the placebos in most assessments, except in weeks 3 and 9
Carati, et al.[33] (2003) Clinical trial	EG: 33 CG: 28 Total: 61	8/10	1.5 J/cm² 904 nm 800 Hz	EG: 2 LLLT (active laser) cycles, separated by an 8-week break CG: 1 LLLT (placebo) cycle, followed by an 8-week break, then 1 active LLLT cycle Sessions: 9 sessions per cycle (3x/week, for 3 weeks) for both groups Application: 17 axillary points (1 min/point) Crossovers: After the first cycle, 11 participants of the placebo group were moved to the active group	Significant reduction in the limb volume occurred after 2 LLLT cycles (31% of patients had a reduction > 200 ml in 2-3 months). There was no improvement with placebo or 1 laser cycle. The extracellular fluid and tonometry improved after 3 months, but there was no gain in the range of motion
Kozanoglu, et al.[34] (2009) Clinical trial	EG: 23 CG: 24 Total: 47	7/10	1.5 J/cm² 904 nm 2,800 Hz	EG: LLLT with sessions 3x/week, for 4 weeks (12 sessions), for 20 minutes. Application at 3 points in the antecubital fossa and 7 in the armpit CG: IPC (60 mmHg), for 2 hours, 5x/week, for 4 weeks Both groups: daily upper limb exercises (active, range of motion, elevation, and pumping), hygiene and skin care	Both groups decreased limb circumference in the first 6 months, but only EG maintained the effect by the end of 12 months. Pain on movement decreased in both groups at first, but only EG sustained improvement upon follow-up. Grip strength increased similarly in both groups with no significant differences
Storz, et al.[35] (2016) Clinical trial	EG: 20 CG: 20 Total: 40	8/10	4.9 cm² 980 nm	EG: LLLT sessions 2x/week, for 4 weeks, for 10 minutes. Application points throughout the whole armpit CG: Placebo LLLT	EG and CG presented similar pain reduction at 50%. For quality of life (MQOL-R and MMSQ), LLLT was slightly superior. Grip strength increased in both groups, being greater in EG after 2 months. Limb circumference was reduced in the placebo group, with no statistical significance
Kozanoglu, et al.[36] (2022) Clinical trial	EG: 21 CG: 21 Total: 42	6/10	1.5 J/cm² 904 nm 2,800 Hz	EG (IPC + LLLT): 5 laser sessions a week for 4 weeks, for 20 minutes. Laser was applied at 3 points in the antecubital fossa and at 7 points in the armpit CG (isolated IPC): device (MJS Healthcare Ltd., United Kingdom) generating a 60-mmHg pressure Both groups received 5 IPC sessions a week for 4 weeks (totaling 20 sessions), and each session lasted 60 minutes	There was significant improvement in the limb circumference and grip strength in EG and CG, especially in the 3rd month for EG. Pain on the resting shoulder did not present differences between groups but was lighter in the EG group at the 6th and 12th months. Pain upon movement was reduced only in EG, with a significant difference on pre-treatment assessments and follow-up

Author/ Year	Sample	PEDro scale	Parameters	Intervention protocol	Results
Yilmaz SS; Ayhan FF.[37] (2023) Clinical trial	G1:15 G2:15 G3:15 Total: 45	6/10	1.5 J/cm² 808 nm 30 mW/cm²	G1 (MLD): Received skin care, lymphatic drainage, compressive banding, and exercise G2 (kinesio-taping): Skin care, kinesio-taping, compressive banding, and exercise G3 (LLLT): Applied at 12 points in the axillary region and 8 points in the cubital fossa, 1 minute in each point, totaling 20 minutes + compressive banding + skin care and exercise	G2 was superior to G1 and G3 in reducing limb volume. There was significant improvement in upper limb function (Quick-DASH) for G2 and G3 at the end of treatment and in the 4th and 12th weeks after the treatment. As to the MLD group, this improvement occurred only at the end of treatment. Quality of life (LYMQOL-arm) was better in G2 at all times, at G1 at the end of treatment, and after 4 weeks, whereas G3 had significant improvement at the end of treatment
Ridner, Sheila H.[38] et al. (2013) Clinical trial	G1: 15 G2: 16 G3: 15 Total: 46	6/10	904 nm	G1: LLLT application for 20-30 seconds at each point, in 20-minute sessions G2: MLD following international guidelines (Földi[39]). A standard number of touches was used in each anatomical location. Each session lasted around 40 minutes G3: 20 minutes LLLT + 20 minutes MLD. At the end of each session, all groups received compressive banding	All groups presented significant reductions in arm circumference and volume, with no statistically significant differences between groups. LLLT (in isolation or combined with MLD) showed a tendency to produce greater effects in comparison with isolated MLD
Omar, Ebid and Morsy[40] (2011) Clinical trial	EG: 25 CG: 25 Total: 50	9/10	1.5 J/cm² 904 nm 2,800 Hz	EG: LLLT, 3x/week, for 20 minutes, for 36 sessions, with application at 3 points of the antecubital fossa and 7 points of the armpit CG: Placebo LLLT	EG overcame placebo in reducing limb circumference, improving range of motion (flexion/abduction), and grip strength, with significant effects in 8 and 12 weeks
Lau; Cheing[41] (2009) Clinical trial	EG: 11 CG: 10 Total: 21	7/10	2 J/cm² 905 nm 1 to 1,500 Hz	EG: 1 LLLT cycle, 3x/week, for 4 weeks, in the axillary area of the affected side, for 20 minutes CG: Placebo LLLT	LLLT significantly reduced arm volume (16% at the end of treatment and 28% at follow-up) and tissue softening. There were progressive improvements in upper limb function (DASH score), with no differences between groups, however
Kilmartin, Laurie et al.[42] (2020) Clinical trial	EG: 9 CG: 6 Total: 15	6/10	1.5 J/cm² 904 nm	EG: LLLT+ CDT: LLLT was applied at 10 points in the armpit and chest wall for 1 minute each, in 8 to 16 sessions, for one 4-week cycle. Application: 10 areas in the armpit and part of the chest wall of the affected side CG: laser (placebo) + CDT	LLLT reduced symptoms of impaired mobility (44.4% vs. 33.3%), improved sadness (73% to 11%), and negative self-perception (36% to 0%). Moreover, EG (55.6%) reported fewer lymphedema-related symptoms than placebo 12 months after the intervention. There was no significant impact on limb volume or liquid accumulation

Captions: EG: experimental group; CG: control group/placebo; LLLT: Low-level laser therapy; MLD: manual lymphatic drainage; CDT: complex decongestive therapy; IPC: intermittent pneumatic compression; J/cm²: Joules per square centimeter; nm: Nanometer; Hz: hertz; mW/cm²: milliwatts per square centimeter; MQOL-R: McGill Quality of Life Questionnaire-Revised; MMSQ: Mini-Mental State Questionnaire; DASH = Disabilities of the Arm, Shoulder and Hand; LYMQOL-arm: lymphedema quality of life – arm.

no gain in range of motion. Kaviani et al.[32], with a smaller sample of 8 participants, showed circumference reduction in almost every week in the laser group, in addition to reduced pain and greater treatment adherence. However, in the sample difference, both presented positive laser effects in managing lymphedema.

Similar outcomes were found by Lau and Cheing[41], who used a 2 J/cm² protocol with 20-minute sessions, three times a week, for four weeks, showing progressive volume reduction and functionality improvement. Additionally, tonometry indicated tissue softening after LLLT, which can be attributed to improvements in blood circulation and in the lymphatic drainage system, through scar tissue remodeling and prevention of formation in the axillary region. These findings corroborate the study by Lievens[43], who suggested that PBM can stimulate lymphatic system regeneration during the healing process, contributing to tissue restructuring and improving the lymphatic flow.

Omar, Ebid, and Morsy[40] used an intensive protocol with 36 LLLT sessions (1.5 J/cm², three times a week), resulting in significantly reduced limb circumference, better range of motion, and grip strength, with significant effects in 8 and 12 weeks. In contrast, Storz et al.[35] applied a lower number of sessions (twice a week for four weeks) with a higher dose (4.89 J/cm²). There was little difference between groups in terms of volume reduction, and the placebo group presented a slightly greater limb volume reduction. However, the group treated with laser had a significant increase in grip strength after two months. Intervention frequency and duration may have influenced the outcomes, showing that protocols with longer sessions tend to be more beneficial.

Studies indicate that PBM, when applied in isolation, can be effective in reducing limb volume and improving lymphedema-related symptoms, depending on the protocol and follow-up period. Still, the combination with other therapies can enhance its effects. Kozanoglu et al.[34] compared LLLT to IPC and observed more lasting effects with the laser. Later, the same authors[36] evaluated the association of both techniques, demonstrating additional benefits, such as pain relief in the arm and shoulder. Thus, its association with other approaches, like IPC, can enhance results.

Kilmartin et al.[42] investigated laser application as a complement to CDT using the same energy dose from previous studies, 1.5 J/cm². Despite their findings registering no significant change in limb volume, after 12 months of the intervention, 44.4% of patients in the laser group reported less than two of the seven symptoms associated with impaired mobility of the upper limb, including restrictions on shoulder, arm, elbow, wrist, and fingers, in addition to difficulties with grip and rigidity, while the placebo group showed a lower percentage (33.3%). In addition, patients submitted to laser application showed a statistically significant reduction in emotional suffering related to sadness, dropping from 73% to 11%, which suggests a positive impact of PBM not only on physical symptoms, but also on psychological well-being.

Ridner et al.[38] compared LLLT and MLD in isolation and combination, reporting a clinically significant reduction in volume for all groups, but with no statistical differences among them, suggesting LLLT as a possibly superior alternative, reducing treatment time for both patients and therapists. With a similar intervention, Yilmaz et al.[37] also investigated isolated LLLT and MLD, in addition to kinesio taping, demonstrating arm volume reduction and better functionality, with greater efficacy of kinesio taping in the long term. LLLT was applied at an energy of 1.5 J/cm² per minute, in 12 points on the lymphatic axillary, and 8 on the cubital, totaling 20 minutes. These findings reinforce the effectiveness of laser, either in isolation or in combination, but demonstrate the need for well-defined protocols to validate its effects.

The studies included in this review indicate that PBM is effective in reducing the volume of affected limbs, whether in isolation or association with other therapies. It also showed pain reduction and improvement in mobility and quality of life. A strength of this study is the inclusion of 10 randomized clinical trials with moderate to high methodological quality (scores ranging from 6-9 on the PEDro scale). Despite the diversity of utilized parameters, all the studies investigated LLLT without including LED interventions. As a limitation, we highlight the reduced sample size in most studies, which can limit the generalization of findings. Nevertheless, the methodological design strengthens the reliability of results and reinforces the need for further studies with larger samples and standardized protocols to increase the reproducibility of findings.

Despite the existence of prior systematic reviews that demonstrated the benefits of PBM in breast cancer-related lymphedema treatment, the literature still presents limitations, such as the heterogeneity of protocols, lack of parameter standardization, and a reduced number of clinical trials included. Studies such as those by Wang et al.[44], Baxter et al.[45], Mahmood et al.[46], and Chen et al.[47] reinforce these findings, but also highlight the need for more recent investigations focused on standardizing therapeutic protocols. Therefore, the present review stands out for bringing an up-to-date synthesis, exclusively including randomized clinical trials, and for critically discussing the main outcomes and variations in protocols, contributing to strengthening and complementing available evidence and guiding clinical practice.

CONCLUSION

The present review demonstrated PBM to be a promising approach for managing lymphedema, reducing the circumference of the affected limb, improving functionality, and providing pain relief. Although CDT is considered the treatment gold standard, the association of PBM with other approaches can enhance results, being suggested as complementary therapy. However, the different parameters used in the laser application and the reduced size of samples limit the reproducibility of the findings. Therefore, further studies are needed to standardize protocols and conduct long-term follow-up, ensuring the applicability of PBM in managing lymphedema.

CONTRIBUTIONS

All the authors have substantially contributed to the study design, planning, data collection, analysis, and interpretation, wording, and critical review. They approved the final version for publication.

DECLARATION OF CONFLICT OF INTERESTS

There is no conflict of interest to declare.

DATA AVAILABILITY STATEMENT

All the contents associated with the article are included in the manuscript.

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