

## REVIEW

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# The Effication of Low-Level Laser Therapy, Kinesio Taping, and Endermology on Post-Mastectomy Lymphedema: A Systematic Review and Meta-Analysis

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### Abstract

**Background:** Post-mastectomy lymphedema is a common complication following breast cancer surgery, characterized by the accumulation of lymphatic fluid, causing swelling, discomfort, and functional limitations in the affected arm. Traditional treatments for lymphedema include manual lymphatic drainage and compression garments, but their effectiveness is variable, and many patients do not achieve satisfactory outcomes. Emerging therapeutic modalities such as Low-Level Laser Therapy (LLLT), Kinesio Taping, and Endermology offer potential non-invasive treatment alternatives. However, the relative efficacy of these approaches in reducing lymphedema, improving limb function, and enhancing quality of life in post-mastectomy patients remains unclear. **Objective:** This study aims to determine the effects of low-level laser therapy, kinesio taping, and endermology on breast cancer patients post-mastectomy with lymphedema. **Methods:** A systematic review and meta-analysis were conducted based on PRISMA guidelines. Searches were carried out in databases using keywords. Inclusion and exclusion criteria were applied to select the studies to be included. The selected studies were critically appraised using Cochrane's critical appraisal tool. The chosen studies were extracted and analysed both qualitatively and quantitatively. Quantitative analysis was performed using both fixed-effects and random-effects approaches. **Results:** Eighteen studies were included in this analysis. All studies were randomized trials with good quality based on critical appraisal. The analysis found a significantly greater reduction in arm volume in the combined intervention group (MD = 76.27; 95% CI = 33.84–118.69) and in each therapy group: low-level laser therapy (MD = 91.98; 95% CI = 41.99–141.97) and endermology (MD = 34.61; 95% CI = 20.81–48.41). However, there were no significant differences in the reduction of arm circumference or pain scale, either overall or for each therapy individually. **Conclusion:** Low-level laser therapy and endermology provide better outcomes for breast cancer patients with post-mastectomy lymphedema compared to conventional therapy.

**Keywords:** Post-mastectomy lymphedema- Low-Level Laser Therapy- Kinesio Taping- Endermology

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### Introduction

Breast cancer is one of the most common malignancies in women. It is known that at least one out of ten new cancer cases diagnosed each year is breast cancer. Breast cancer is generally not diagnosed at an early stage, resulting in significant morbidity and mortality [1, 2]. Breast cancer is the most common type of cancer found in Indonesia, with 65,858 new cases reported in 2020 according to GLOBOCAN. This figure represents 16.6% of the total cancer cases found in Indonesia. Breast cancer has resulted in healthcare budget expenditures of up to 7.6 trillion rupiahs during the 2019-2020 period [3]. Therefore, various efforts have been made to tackle breast cancer.

Mastectomy is one of the therapeutic approaches for

breast cancer. Mastectomy is a surgical procedure that involves the removal of part or all of the breast. This procedure can be performed exclusively or combined with other therapies such as adjuvant, neoadjuvant, radiation, chemotherapy, or hormonal therapy. The mastectomy method used depends on the characteristics, location, and nature of the breast tumor. Mastectomy is generally recommended for breast cancer patients with multifocal or multicentric tumors. Additionally, mastectomy is also recommended for patients with advanced locoregional disease, including large primary tumors (T2 lesions larger than 5 cm) with or without chest wall involvement [4, 5].

Mastectomy has a high tolerance rate. However, there are several complications that can occur post-mastectomy. One of the most common post-mastectomy complications is lymphedema. Lymphedema is swelling of the tissue

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or limbs caused by transport disruption in the lymphatic system. This mainly occurs in patients who undergo axillary lymph node dissection, with an incidence rate greater than 20%. Additionally, around 3.5% to 11% of patients who undergo sentinel lymph node biopsy also experience lymphedema [4, 5].

Various methods can be used to manage post-mastectomy lymphedema. Management of post-mastectomy lymphedema focuses on non-pharmacological approaches, including exercise, bandaging, diet and weight management, elevation, infection prevention, and massage. Emerging therapeutic modalities such as Low-Level Laser Therapy (LLLT), Kinesio Taping, and Endermology offer potential non-invasive treatment alternatives. The use of low-level laser therapy is one of the current management focuses for post-mastectomy breast cancer patients [6, 7]. A study by Farhan et al. [8] stated that the 23 breast cancer patients with lymphedema revealed that the use of low-level laser therapy is beneficial in reducing limb circumference and volume by 16–22%.

The use of Kinesio taping also offers further prospects for cancer patients. A systematic review by Marotta et al. stated that the use of Kinesio taping is beneficial in increasing flow rate in cancer patients, although it has not yet been proven to reduce limb volume [9]. A study by Moseley et al. [10] indicated that the use of endermology can reduce fluid volume in patients with lymphedema [10]. Endermology is also being researched for its benefits in breast cancer patients with lymphedema by Malloizel-Delaunay et al. [11] through a randomized controlled trial.

There is not much evidence available regarding the use of low-level laser therapy, kinesio taping, and endermology in breast cancer patients with lymphedema. By comparing these modalities, this systematic review and meta-analysis aims to identify which treatment, or combination of treatments, provides the most effective management of post-mastectomy lymphedema in terms of volume reduction, functional improvement, and patient-reported outcomes.

## Materials and Methods

### Study Selection

A systematic review and meta-analysis were conducted based on the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [12]. Literature searches were carried out in the databases PubMed, Scopus, EBSCOHost, WileyOnline, ClinicalTrial.gov, as well as through manual searching (hand-searching). The keywords used for the search were: (“post-mastectomy lymphedema” OR “postmastectomy lymphedema”) AND (“laser”) OR (“Kinesio taping” OR “elastic therapeutic taping”) OR (“endermology”).

### Inclusion and Exclusion Criteria

The studies identified in the search will be selected using inclusion and exclusion criteria. The exclusion criteria are as follows: (1) not written in English or Indonesian; (2) no full text available; (3) unpublished studies; (4) duplicate publications. The inclusion criteria used in the study selection are: (1) randomized clinical

trials; (2) targeting the population of breast cancer patients who have undergone mastectomy; (3) studying the use of low-level laser therapy, Kinesio taping, or endermology in the population; (4) focusing on clinical outcomes of post-mastectomy breast cancer patients undergoing the interventions mentioned in criterion three.

### Evaluation of the quality of selected studies

The selected studies will be included in this research and will undergo a process of critical appraisal and extraction. Critical appraisal will be conducted using the Cochrane Risk of Bias tool v2.0 developed by Cochrane [13]. Studies will be categorized as having low risk of bias, uncertain risk of bias, or high risk of bias in five domains. Conclusions will be drawn regarding the overall quality of the studies as low risk of bias, uncertain risk of bias, and high risk of bias.

### Data Extraction

Studies that have undergone critical appraisal will proceed to the extraction process. Extraction will be performed on characteristics and outcomes. The characteristics extracted include: (1) name of the first author; (2) year of publication; (3) study location; (4) number of participants; (5) mean/median age of participants; (6) interventions received. The outcomes extracted are the clinical outcomes of the study participants. The outcome data obtained will be analyzed qualitatively and quantitatively. Qualitative analysis will be conducted to synthesize new knowledge and conclusions. Quantitative analysis will be conducted to strengthen the qualitative analysis.

### Statistical analysis

Quantitative analysis was performed using RevMan 5.4. The heterogeneity of the collected and analysable data was determined using Cochran's  $I^2$  test and Higgins' test. Data were considered heterogeneously distributed if the  $I^2$  value was greater than or equal to 50% and/or the P value was equal to or less than 0.05. Homogeneously distributed data were analyzed using a fixed-effects approach, while heterogeneously distributed data were analyzed using a random-effects approach. Outcomes were interpreted as odds ratio (OR) or hazard ratio (HR) if they were categorical. Numerical outcomes were interpreted as mean difference (MD). A P value of 0.05 or less was set as the threshold for statistical significance.

## Results

The search yielded 18 selected literatures that were included in the analysis. One study is currently under investigation and therefore could not be included in the study. These studies met the inclusion criteria and did not meet the exclusion criteria, allowing them to be included in this study. The entire search and inclusion flow of the articles in this study can be seen in Figure 1. All studies were of good quality after analysis using the Cochrane critical appraisal tool. All studies had a low risk of bias in all aspects, leading to the conclusion that all studies contain a low risk of bias, as described in Figure 2.

All studies were published between 2003 and 2020. There were six studies discussing Kinesio taping interventions, nine studies discussing low-level laser therapy interventions, and three studies discussing the use of endermology in the treatment of post-mastectomy lymphedema in breast cancer. Follow-up was conducted for at least the first month and up to one year post-therapy. Various outcomes were measured by these studies, but most focused on arm biometrics (volume and circumference) (Table 1). Most studies provided good results in the Kinesio taping, low-level laser therapy, and endermology groups (Table 2).

Analysis showed that overall, there was a significantly greater reduction in limb volume in the intervention group compared to the control group (MD = 76.27; 95% CI = 33.84–118.69). Analysis of each type of therapy showed no significant difference in limb volume reduction between the Kinesio taping therapy group and the control group, but there was a significant volume reduction difference in the low-level laser therapy and endermology groups, with arm volume reduction differences of 91.98 (95%

CI = 41.99–141.97) and 34.61 (95% CI = 20.81–48.41), respectively (Figure 3).

Based on arm circumference, there was not enough data in the endermology group for analysis. However, there was no significant difference in arm circumference reduction between the intervention and control groups. Subgroup analysis also found no significant differences in each therapy, whether Kinesio taping or endermology (Figure 4). The same was found for changes in the pain scale, with no significant difference in the comparison between the endermology and control groups (Figure 5).

## Discussion

This study shows that there is a more significant clinical improvement in the endermology and low-level laser therapy groups compared to the control group. This finding is also observed in several other studies. The study by Özçete and Eyigör found that low-level laser therapy and Kinesio taping are beneficial for breast cancer patients with lymphedema because they stimulate lymphatic

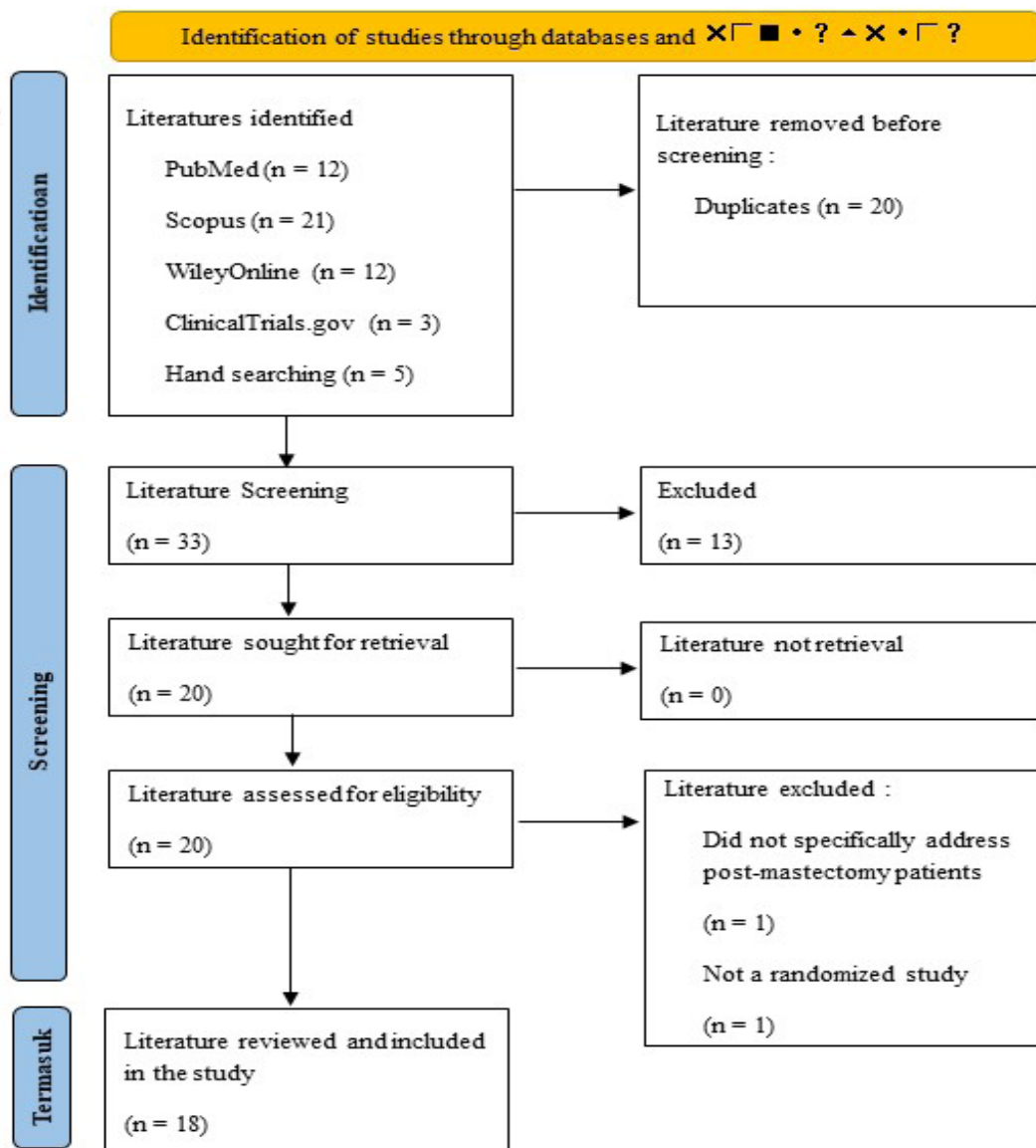


Figure 1. Flow Chart and Screening of Selected Studies

Table 1. Characteristics of Selected Studies

Studies, Year	Design	Population and Intervention	Follow up (month)	Outcome
Tsai et al.[7]	Randomized, controlled, single-blind	41 participants with unilateral lymphedema secondary to moderate to severe breast cancer. Divided into: Group 1(n = 20): modified CDT + KT Group 2(n = 21): CDT + bandage	Pre-terapi, 3	1. Arm Circumference 2. Arm Volume
Smykla et al. [22]	Randomized, single-blind	65 participants with unilateral lymphedema secondary to moderate to severe breast cancer. Divided into: Group 1 (n = 20): KT Group 2 (n = 22): Kwasi-KT Group 3 (n = 23): MCT	Preterapi, 1, 3	1. Arm Volume
Pekyavaş et al. [26]	Randomized, single-blind	45 participants with post-mastectomy lymphedema at stages 2 and 3. Divided into: Group 1 (n = 15): CDT, MLD, exercise, and bandage Group 2 (n = 15): CDT and KT Group 3 (n = 15): CDT without bandage and KT		1. Arm Circumference 2. Arm Volume
Malicka et al. [24]	Randomized	28 participants with secondary lymphedema at stage I. Divided into: Group 1 (n = 14): KT Group 2 (n = 14): without anti edema therapy	Pre-terapi, 0,5; 1	1. Arm Circumference 2. Arm Volume
Taradaj et al.[25]	Randomized	70 participants with grade 2 and 3 lymphedema. Divided into: Group 1 (n = 22): KT Group 2 (n = 23): Kwasi-KT Group 3 (n = 25): bandage	Pre-terapi, 3	1. Arm Volume
Tantawy et al. [27]	Randomized, controlled	66 participants with grade 2 and 3 lymphedema. Divided into: Group 1 (n = 33): KT Group 2 (n = 33): PG		1. Arm Circumference
Mogahed, Badawy and Aziz, [28]	Randomized, controlled, single-blind	30 participants with grade 2 and 3 lymphedema. Divided into: Group 1 (n = 15): Active laser Group 2 (n = 15): Placebo laser Other interventions received: MLD Shoulder ROM Pneumatic compression	Pre-terapi, 3	1. Arm Circumference 2. Arm Volume
Kilmartin et al. [23]	Randomized, controlled, double-blind	22 participants with grade 2 and 3 lymphedema. Divided into: Group 1 (n = 11): Active laser + CDT Group 2 (n = 11): Placebo laser + CDT	Pre-terapi, 3, 6, 12	1. Arm Circumference
Baxter et al. [20]	Randomized, double-blind	16 participants with lymphedema. Divided into: Group 1 (n = 8): Active laser Group 2 (n = 8): Placebo laser Other interventions received: PG Massage and exercise therapy	Pre-terapi, 6, 12	1. Arm Circumference
Storz et al. [29]	Randomized, controlled, double-blind	40 participants with lymphedema. Divided into: Group 1 (n = 20): Active laser Group 2 (n = 20): Placebo laser Other interventions received: Daily limb exercise Skin care	Pre-terapi, 4, 8, 12	1. Arm Circumference
Bramlett et al. [21]	Randomized, controlled, double-blind	14 participants with lymphedema. Divided into: Group 1 (n = 7): Active laser Group 2 (n = 7): Placebo laser	Pre-terapi, 3, 6, 12, 18	1. Arm Circumference 2. Arm Volume
Ridner et al. [30]	Randomized, controlled, single-blind	46 participants with grade 1 and 2 lymphedema. Divided into: Group 1 (n = 15): Active laser Group 2 (n = 16): MLD Group 3 (n = 15): Laser + MLD Other interventions received: Compression bandage	Pre-terapi, harian, mingguan, pasca-terapi	1. Arm Circumference 2. Arm Volume
Lau and Cheing, [31]	Randomized, controlled, single-blind	21 participants with lymphedema. Divided into: Group 1 (n = 11): Active laser + education Group 2 (n = 10): Placebo laser + education	Pre-terapi, 1	1. Arm Volume
Omar, El Gayed and El Morsy, [32]	Randomized, controlled, double-blind	50 participants with grade 2 and 3 lymphedema. Divided into: Group 1 (n = 25): Active laser Group 2 (n = 25): Placebo laser Other interventions received: Limb exercises Skin protection PG	Pre-terapi, 4, 8, 12, 26	1. Arm Circumference 2. Arm Volume

CDT, complete decongestion therapy; KT, kinesio taping; MCT, manual compression therapy; MLD, manual lymphatic drainage; PG, pressure garment; ROM, range of motion; DLT, decongestion lymphatic therapy



Table 1. Continued

Studies, Year	Design	Population and Intervention	Follow up (month)	Outcome
Carati et al. [33]	Randomized, controlled, double-blind	61 participants with lymphedema. Divided into: Group 1 (n = 33): Active laser Group 2 (n = 28): Placebo laser	Pre-terapi, 1, 3, 6	1. Arm Volume 2. Shoulder mobility
Moseley et al. [10]	Randomized, single-blind	30 participants with secondary lymphedema. Divided into: Group 1 (n = 10): Endermology Group 2 (n = 20): MLD	Pre-terapi, 1	1. Arm Circumference 2. Arm Volume 3. Shoulder mobility 4. Pain
Ahmed, [16]	Randomized, controlled	20 participants with secondary lymphedema. Divided into: Group 1 (n = 10): Endermology Group 2 (n = 10): DLT	Pre-terapi, 1	1. Arm Circumference 2. Arm Volume 3. Shoulder mobility 4. Pain
Mohamed and Abol- Atta, [34]	Randomized, controlled	40 participants with secondary lymphedema. Divided into: Group 1 (n = 20): Endermology + bandaging Group 2 (n = 20): Bandaging	Pre-terapi, 1	1. Arm Circumference 2. Arm Volume

CDT, complete decongestion therapy; KT, kinesio taping; MCT, manual compression therapy; MLD, manual lymphatic drainage; PG, pressure garment; ROM, range of motion; DLT, decongestion lymphatic therapy

movement and lymphangiogenesis. Kinesio taping techniques are an efficacious approach for managing early-stage oedema. Kinesio Taping may be a safe novel therapeutic alternative for people contraindicated for current treatment modalities [24]. Additionally, these therapies can soften fibrotic tissue and increase the

contractility of lymphatic vessels, thereby facilitating lymphatic flow and reducing the impact of lymphedema by decreasing the presence of extracellular fluid through lymphatic drainage [14, 22, 25]. The study by Smoot et al. stated that breast cancer patients with lymphedema also found that low-level laser therapy is beneficial in



Figure 2. Results of the Critical Appraisal of Selected Studies

Table 2. Results of Selected Studies

Studies, Year	Intervention	Outcome
Tsai et al. [7]	KT	There is no significant difference in outcomes, but both groups show promising results. Kinesio taping offers better comfort because it is easy to use and comfortable. (P < 0.05)
Smykla et al. [22]	KT	There is no significant difference in outcomes, but both groups show promising results
Pekyavaş et al. [26]	KT	Kinesio taping reduces edema better than the control group after 10 days (P < 0.05)
Malicka et al. [24]	KT	Kinesio taping reduces edema better than the control group (P < 0.05).
Taradaj et al. [25]	KT	Kinesio taping does not show an advantage over the control and cannot yet be considered as an alternative.
Tantawy et al., [27]	KT	Kinesio taping provides better outcomes in arm circumference, disability & pain index, handgrip strength, and quality of life compared to the control group (P < 0.05).
Mogahed, Badawy and Aziz, [28]	LLLT	Significant reductions in limb volume and pain scale were observed in the laser group compared to the control group (P < 0.05).
Kilmartin et al. [23]	LLLT	There is no significant difference in arm volume changes between therapies, but significant improvements in sadness symptoms and self-perception were observed in the laser group (P < 0.05).
Baxter et al. [20]	LLLT	Compliance with therapy was higher in the laser group (P < 0.05), and patients in the laser therapy group achieved satisfaction with their therapy without significant side effects.
Storz et al. [29]	LLLT	There is no significant difference in outcomes, but both groups show good results.
Bramlett et al. [21]	LLLT	There is no significant difference in arm volume changes between therapies.
Ridner et al. [30]	LLLT	There is no significant difference in outcomes, but both groups show promising results.
Lau and Cheing, [31]	LLLT	Significant reductions in limb volume and increased tissue softness were only observed in the laser group (P < 0.05).
Omar, El Gayed and El Morsy, [32]	LLLT	A trend of greater limb volume reduction was seen in the laser group compared to placebo at weeks 8 and 12 (P < 0.05).
Carati et al. [33]	LLLT	There was a significant reduction in limb volume at follow-up after one month and three months of therapy.
Moseley et al. [10]	E	There was no significant difference in limb volume reduction - both therapies yielded good results.
Ahmed, [16]	E	Significant reductions in limb volume and pain were observed in the endermologie group compared to the control group (P < 0.05).
Mohamed and Abol-Atta, [34]	E	Significant arm swelling reduction compared to the control group (P < 0.05) despite no significant difference in overall improvement.

Singkatan: KT, Kinesio taping; LLLT, Low-level laser therapy; E, Endermologie

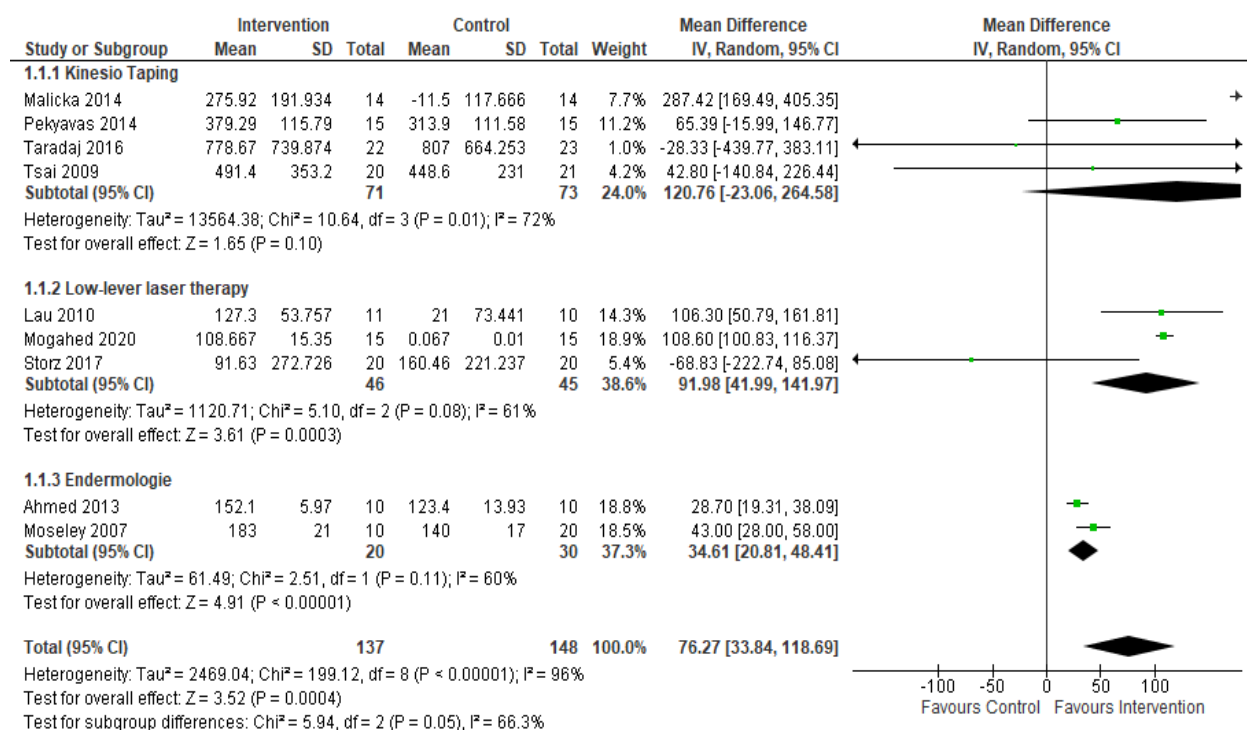


Figure 3. Analysis of the Difference in Arm Volume Changes between the Intervention Group and the Control Group

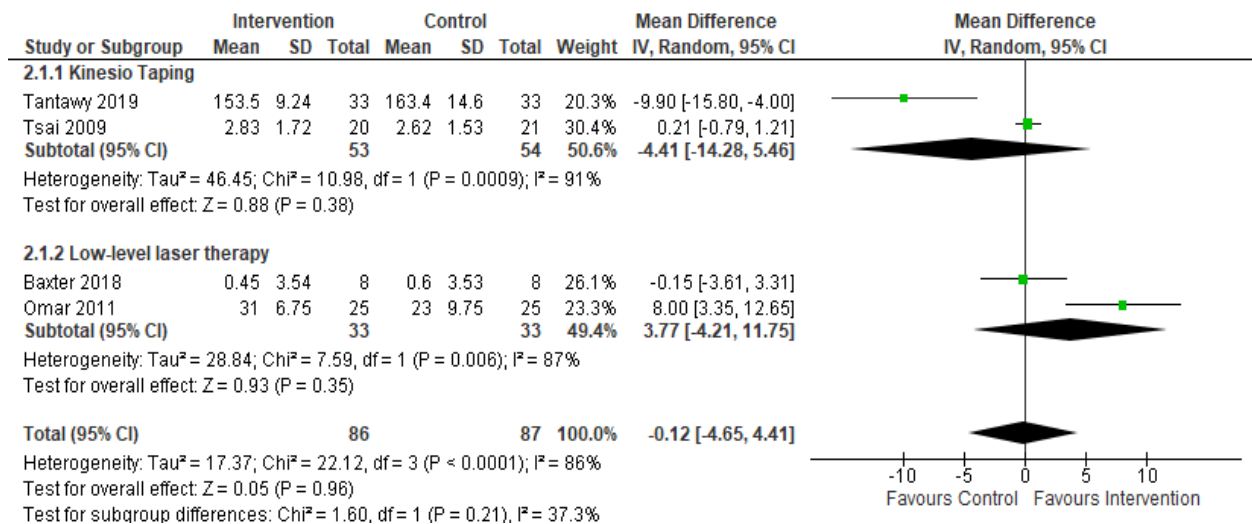


Figure 4. Analysis of the Difference in Arm Circumference Changes between the Intervention Group and the Control Group

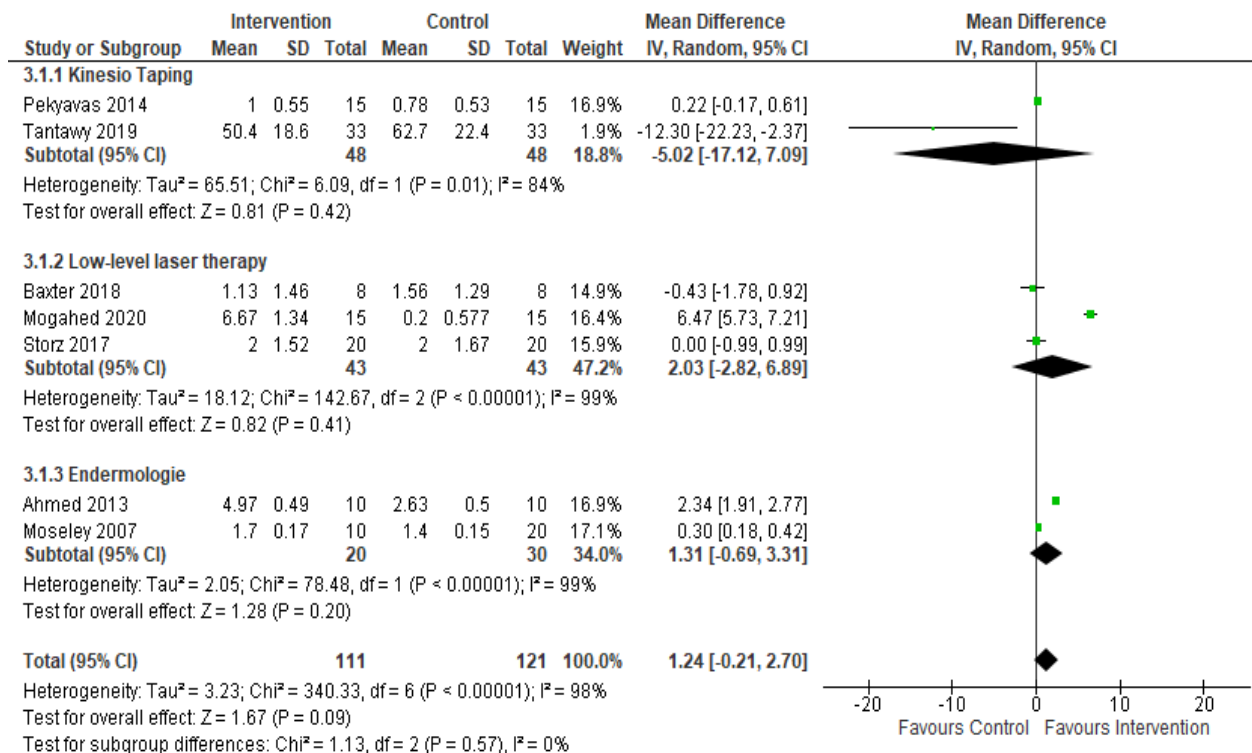


Figure 5. Analysis of the Difference in Pain Scale Changes between the Intervention Group and the Control Group.

improving outcomes [15, 21].

The protocol by Malloizel-Delaunay et al. also estimates that endermologie is beneficial for lymphedema by reducing limb volume compared to standard therapy [11]. This may be due to the increased lymphatic flow facilitated by endermologie therapy. This is reflected in the results of a study by Ahmed which indicated that endermologie improves range of motion (flexion, abduction) and reduces limb volume and pain [16]. Therefore, endermologie not only reduces the biometrics of the limb affected by lymphedema but also enhances quality of life. The study by Moortgat et al. analyzed the physiological effects of vacuum therapy on various skin layers: dermal and epidermal. This study found

that vacuum therapy increases tissue strength and skin elasticity, thereby increasing the number of fibroblasts and collagen. These mechanisms facilitate lymphatic flow and are believed to improve outcomes for patients with lymphedema [17, 19].

When comparing the two significant therapies in this study, it is evident that low-level laser therapy results in a more significant reduction in arm volume compared to endermologie, although there are no significant differences in other aspects. The study by Ziethar compared endermologie with low-level laser therapy in patients with post-mastectomy lymphedema. This study found no significant differences in arm volume and circumference between the two groups at the start

of therapy. Differences were observed at the end of the therapy, where endermology resulted in more significant changes in arm volume and circumference compared to low-level laser therapy. The discrepancy between the findings of Ziethar et al. and those of this study provides insights for future research [18, 20, 21, 23].

This research is one of the first systematic studies investigating the latest non-therapeutic options (endermology, Kinesio taping, low-level laser therapy) for post-mastectomy breast cancer patients with lymphedema. However, not all studies included in this review had sufficient data to be incorporated into the quantitative analysis. Therefore, future research can be conducted by focusing on biometric profiles and quality of life as outcomes, thereby generating knowledge that can be further synthesized to produce stronger and higher hierarchical evidence.

In conclusion, low-level laser therapy and endermology provide better outcomes for breast cancer patients with post-mastectomy lymphedema compared to conventional therapy by reducing limb volume. Further studies are needed to determine the effect of Kinesio taping on this population.

## Author Contribution Statement

All authors contributed equally in this study.

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