

# Manual Lymphatic Drainage and Exercises in Management of Secondary Lymphedema Following Mastectomy-Systemic Review

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**Abstract:** Lymphedema is a chronic and progressive disorder resulting from impaired lymphatic system function. In developed countries, upper extremity lymphedema is mainly the consequence of breast cancer surgery in which axillary lymph node dissection and radiation alter upper extremity lymphatic flow. Diagnosis of lymphedema is made clinically. Nevertheless, there are numerous diagnostic tools available for disease staging. Recently, a new technology namely magnetic resonance lymphangiography has emerged in the medical field to assist in both diagnosis and management. Controversy exists regarding the role of exercise in cancer patients with or at risk for lymphedema, particularly breast. Searching was done using Google Scholar, PubMed, ProQuest, EBSCO, Cinahl Plus, BMJ, Clinical Skills, Clinical Keys, DynaMed Plus, Medline, Nano-Springer, Nature, SpringerLink, Springer, Wiley Online Library. The aim of the study to compare the efficacy of manual lymphatic drainage and exercise in management of secondary lymphedema following mastectomy.

## Introduction

It is fluid circulatory system within a human body which drains fluid from the interstitial space to systemic circulation. It consists of organs like the spleen and thymus and 600 to 700 lymph nodes, vessels and fluids. It functions as immunity by protecting the body from infection. As circulatory by maintaining blood volume and preventing edema. As transportation of nutrition, hormones, lipids, and waste products. Lymph fluids contain 96% water, protein, hormones & other enzymes. It is yellow color plasma like. Normal body fluid hemostasis is maintained through the process of hydrostatic pressure and osmotic pressure in blood capillaries and interstitium, any leakage of protein into the interstitial space will be drained back into the venous circulation by the lymphatic capillaries that attached into the interstitium then filtered by the spleen, thymus and lymph nodes before entering the systemic circulation. Lymphangion is the functional unit of lymphatic vessels which is a muscle that pumps to push fluid through the lymphatic system<sup>1</sup>.

As per BMJ Best practice [is a Chronic, progressive swelling of tissue with protein-rich fluid in interstitial space, lymph= (a protein-rich fluid)] which can be primary or secondary, that accumulate in limbs and genital area. It is an illness not a symptom as per WHO. Lymphedema can be also defined as swelling and enlargement of the affected arm due to lymph drainage insufficiency within the body causing deformities decreased function discomfort and distress<sup>2</sup>. A collateral damage to the axillary lymph nodes following surgeries or radiotherapy most often lead to fluid accumulation whether regional or general<sup>3</sup>. It is due to disturbed lymphatic drainage which lead to accumulation of

extra fluid within the body as lymphatic drainage considered one of major components of circulatory system. Lymph drainage can occur superficially in skin and deep in the thoracic duct<sup>4</sup>. Symptoms may include pain, swelling, reduced shoulder ROM and arm heaviness. Risks if not treated include cellulitis, lymphangitis, axillary vein thrombosis, functional Impairment, cosmetic deformity, and breast cancer.

The appearance of tender, painful cord-like structures below the skin; may be due to inflammation or thrombosis of lymph vessels. Seroma is an accumulation of fluid at or near a surgical wound<sup>5</sup>. Incidence of secondary lymphedema may vary depending on the nature of the cancer, type of the surgery, number of lymph nodes dissected and chemotherapy or radiotherapy involvements. Treatment of cancer seen to be the main cause of secondary lymphedema in developing countries where prevalence of 12-60% following breast cancer treatment 28-47% following treatment of gynecological cancer<sup>5,6,7,8,9</sup>. Upper limb more than lower limb<sup>10</sup> There is less comorbidity with Sentinel lymph node biopsy and lumpectomy while high comorbidity with lymph node dissection and irradiation<sup>11,8</sup>. Approximately 60% of patients undergoing axillary resection & radiation will develop secondary lymphedema<sup>12</sup>, Incidence rate is very dependent, and first 2 years are the highly progressing period<sup>3</sup>.

CDT is recognized as the therapy of choice by “the International Society of Lymphology (ISL), the National Lymphedema Network (NLN), the Lymphology Association of North America (LANA), the American Lymphedema Framework Project (ALFP), and the North American Lymphedema Education Association (NALEA)” Practice guideline, also recommend CDT as the preferred treatment for cancer related lymphedema.

Complex decongestive physical therapy treatment for lymphedema components are 1) Manual lymphatic drainage (MLD), 2) compression bandaging, 3) exercises to enhance lymphatic drainage, and 4) skin care. MLD is a special massaging technique using hands movement in targeted directions to enhance pumping mechanism within the body.

MLD has numerous effect on the physiology of the body including increasing the contraction rate of lymphatic system, increased reabsorption of proteins, reduced micro lymphatic hypertension and improved collateral lymph drainage between the lymphatic territories in the skin. Good fluid circulation and drainage help to move them away from the edema cite toward the most functioning lymph node.

Patient awareness and education about self-care is an important value for long term success of the treatment. In the treatment of cancer patients, it shows massive outcomes in the survival rate in improving the QOL<sup>13</sup>. MLD stimulates the lymphangiomotoric which pushes fluid accumulation away from the edematous cite but unfortunately that was found not enough in treating patient with lymphedema<sup>2</sup>. CDP is spready followed in treatment of secondary lymphedema in two stages of treatment first is the intensive stage which consists of skin care, manual lymph drainage (MLD), multi-layered compression bandaging, and exercise with compression, while the second is supportive stage skin care, self-MLD, compression by an elastic garment, and continued exercise with compression to conserve the results obtained in the first phase<sup>20</sup>.

### **Classifications**

Water displacement and limb circumference are used to measure lymphedema volume<sup>9</sup>, Quality of life (QOL) is one of the growing interests in the medical field as a psychological complication in lymphedema patient leading to depression low self-esteem and decreased social life. Female with upper limb lymphedema may be disturbed psychologically leading to anxiety depression functional and physical impairment, QOL can be measured by variety of valid and reliable questionnaires focus on well-being<sup>13</sup>.

**Stages of lymphedema development (Staging as per international society of lymphology);**

It can be primary or secondary and develop in stages, Stage 0 silent or latent state of lymphedema that may occur months or years later.

Stage 1 first period of fluid-rich protein accumulation “pitting edema can be noticed” swelling can be reduced by elevation. Reversible stage.

Stage 2 pitting edema is significant; swelling cannot be reduced by elevation. Irreversible stage.

Stage 3 fibrotic phase, skin become thicker due to excess fat deposition, pitting cannot be noticed phase of elephantiasis a massive limb enlargement. Irreversible stage<sup>11</sup>.

This review was carried out to compare the efficacy of manual lymphatic drainage and exercise in management of secondary lymphedema following mastectomy.

Rehabilitation is the corner stone for treating patients with lymphedema but for a very, long time ago it was thought that exercise therapy is harmful on those patients.

**Methods**

**Search Strategy**

The searching was done in database of Saudi Digital Library, the SDL which can provides further databases like ProQuest, EBSCO, Cinahl Plus, BMJ, Clinical Skills, Clinical Keys, DynaMed Plus, Medline, Nano-Springer, Nature, SpringerLink, Springer, Wiley Online Library. Google Scholar was also one of the resources. We use the keywords like Lymphedema, Lymphoedema, Edema, Manual Lymphatic drainage, exercise, Criteria of research was depending on the availability of the peer reviewed articles.

We planned to focus on the secondary lymphedema following surgeries by evaluating the effect of manual lymphatic drainage and exercises while we exclude studies related to oncology patients but due to limited resources we only found 2 clinical trials evaluating the efficacy of manual lymphatic drainage after total knee arthroplasty from Australia and Switzerland respectively. Another key word was added: breast cancer, Mastectomy, Radiotherapy. Another database like PubMed Pedro and Science Direct where used.

**Inclusion**

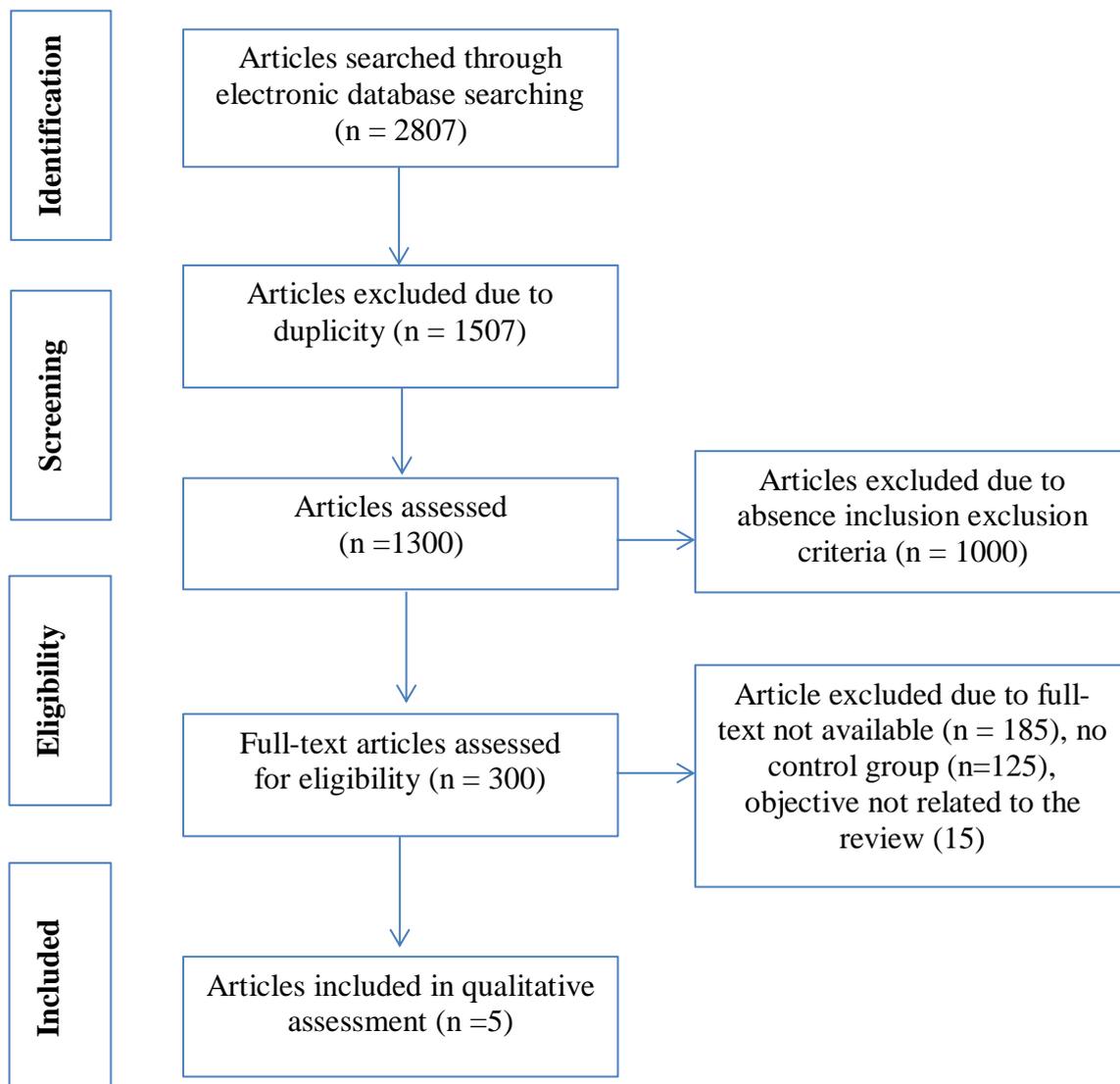
- ✓ Secondary lymphedema
- ✓ Oncology
- ✓ Mastectomy
- ✓ Lymph dissection
- ✓ Radiotherapy
- ✓ Chemotherapy
- ✓ Unilateral limb involvement

**Exclusion**

- ✓ Primary lymphedema
- ✓ Pulmonary edema
- ✓ Congestive heart failure
- ✓ Recurrent cancer
- ✓ Infections
- ✓ Venous insufficiency
- ✓ Secondary lymphedema due to trauma.
- ✓ bilateral limb involvement

**Importance**

- ✓ It has high prevalence affecting almost 3 million cancer survivor in USA<sup>14,15</sup>.
- ✓ Cost of treating secondary lymphedema in breast cancer survivor is \$14,887 to \$23,167 higher than those without lymphedema<sup>16</sup>.
- ✓ Earlier detection and management of secondary lymphedema is critical for optimal management of secondary lymphedema<sup>15</sup>.
- ✓ Secondary lymphedema can contribute to psychological problems by changing cosmetic appearance decreasing quality of life (QOL) which is one of the growing interests in the medical field as a psychological complication in lymphedema patient leading to depression low self-esteem and decreased social life<sup>13,14,17,18,19</sup>.
- ✓ Yet there is no definite cure for secondary lymphedema, but symptoms management can be obtained whether in clinics by professionals as manual lymphatic drainage or bandaging etc. or at home in form of exercise remedy, each one of them considered as an integrated treatment method regardless the need of the patients or their accessibility of care<sup>1,15</sup>, by demonstrating my study I hope to come to better understanding to aid the accessibility of care.



**Figure 1. Flow diagram showing the screening and selection of articles**

**Table 1. Description of the included studies**

Author	Methods	Intervention	Outcomes	Results
Kim et al. 2010 <sup>21</sup>	RCT N=40 8 WEEKS Group B controlled	Group A: Active resistive exercise +CDPT Group B: CDPT alone	Volume calculated by converting circumference measurement into volume by special equation QOL by Korean version of the SF-36 version	Volume reduction in proximal part & QOL were significantly improved in group A ( <i>P</i> . 050)
Jeffs et al. 2012 <sup>22</sup>	RCT N=23 6-month Group A control group	Group A: Standard self-care Group B: standard self-care plus exercises	Relative excessive limb volume % ELV using Perometer 350S. ROM USING regular goniometer. QOL measured using 28-item LYMQOL questionnaire	Statistically significant reduction in limb volume at week 26 in group B ( <i>p</i> 0.013) but not in group A ( <i>p</i> 0.099) by Wilcoxon signed-rank test , while there is no statically significant difference in limb volume by Mann–Whitney U test <i>p</i> 0.187 no statically significant difference in ROM & QOL <i>P</i> >.05
Gautam et al. 2011 <sup>12</sup>	Pre-post intervention RCT study N=32 8-week contralateral upper limb was used as the control.	Progressive resistance exercise program	Limb circumference taken using a regular round tape. Limb volume water displacement. QOL was measured by using the 36-Item Short Form questionnaire	A statically significant reduction in volume ( <i>p</i> < 0.001) & circumference at three levels ( <i>p</i> < 0.001), except at the MCP joint level ( <i>p</i> = 0.04) Also, for QOL tables as follows.
Gradalski et al 2015 <sup>23</sup>	Prospective study RCT N=51 2 weeks intensive phase 6 months maintenance phase. Group B controlled	Group A: Compression bandaging Group B: Compression bandaging + MLD both received standardized active and active assisted ROM exercises and deep breathing exercise.	Volume calculated by converting circumference measurement into volume by special equation QOL measured by NRS: (0-10)	In two weeks of intensive phase, no statistically significant differences between the two groups were seen. RVC in both groups remained equal after six months. In two weeks of intensive phase and three months of the maintenance phase, high treatment satisfaction was achieved on NRS 8.8 (SD 1.9) in group A and 9.4 (SD 1.2) in group B ( <i>P</i> 0.2). The QoL in both groups improved: from a mean of 3.24 to 1.8 NRS in group A and from 3.1 to 1.4. in group B
Andersen, et al 2000 <sup>2</sup>	Prospective RCT study N=42 12 months Group A controlled After 3 months 10 participants from group A crossover to group B.	Group A: Standard treatment, Group B: Standard treatment plus MLD	Limb volume, first limb circumference was measured then volume was calculated by Simpson’s rule of integration Patients symptoms by questionnaire	No significant differences in lymphedema reduction between the two groups ( <i>p</i> 0.66) And no significant difference between the three groups ( <i>p</i> 0.86). No difference in change in symptoms between both groups

## **Discussion**

In Kim et al<sup>21</sup> study a sample of 40 patients diagnosed with breast cancer related lymphedema those who had 2cm greater circumference in affected side than the sound one, patients who had recurrent cancer, older than 70, with bilateral lymphedema or with neurological issues were excluded, patients were equally divided into 2 groups group A for active resistance exercise while group B for nonactive resistance both group received CDPT. All patients were aware of the study and signed a written consent form. Measurements were conducted pretreatment and 8 weeks post treatment limb circumference were measured then total limb volume were calculated, assessment of the QOL by Korean version of the SF-36 version 2 scoring from 0-100 containing 8 items each item containing 2-10 single items that evaluate physical function, role physical, physical pain, general health, mental health, emotional health, social functioning, and vitality. The CDPT consist of (manual lymphatic drainage, compression therapy, and remedial exercise) 1/day 5/week for 2 weeks for both groups remedial exercises consist of (warm up, active ROM exercises, decongestive exercises, and stretching) then followed by 15 minutes of ARE for group A using a 0.5kilos dumbbells for those given exercises (seated row, bench press, latissimus dorsi pull-down, 1-arm bent-over row, triceps extension, and biceps curl) for 2sets of 10 repetition. They concluded that ARE can reduce the volume of lymphedema with no adverse effects, despite what was revealed that there is no benefits or there is risk of adding resistance exercise in lymphedema exercise regime<sup>21</sup>.

Jeffs et al<sup>22</sup> conducted a 6-month pilot RCT in lymphedema clinic for breast cancer survivor only 23 participants with stable unilateral lymphedema were recruited in the study out of 532 patients files reviewed, participants were blindly randomized into two groups, group A for standard self-care alone as a control group while group B for self-care + exercise as an intervention group. Both groups adhered to their daily prescribed self-care prescription which consists of compression hosiery, skin care and general activity/exercise. Compression hosiery were prescribed prior to randomization, handheld-pumping instrument were also prescribed for each participant to practice while exercising to avoid congestion and enhance flow, patients were informed not to change any exercise routine without prior discussion. Group B where instructed for isotonic antigravity exercise in a manner to stimulate MLD according to Leduc et al<sup>24</sup> first 3 exercises were as follow (1) Deep breathing exercise to stimulate drainage in trunk (2) Four anti-gravity arm exercises to stimulate drainage in limbs (3) Repeating the first 3 exercises to eliminate fluid caused by exercise. Compression hosiery was worn throughout the exercises and most awaking hours. Group B were instructed to do their exercises at day one then continues the same way 10-15 minutes daily, photos and illustrations of exercises were also provided. Group A were offered the same exercise program at the end of the study. Both groups considered adhered to the study as self-report questioning were assessed. Limb volume, weight (to obtain BMI), range of shoulder movement, and participant self-report of quality of life were measured at each visit weeks 0-4-12-26. Limb volume were assessed using Perometer 350S which is a valid optoelectronic objective measure instrument. Both affected & non-affected limbs volume was assessed tow times at each visit then relative excessive limb volume (%ELV) was determined<sup>22</sup>.

In a pre-post intervention study 32 breast cancer female patients underwent mastectomy and received radiotherapy & chemotherapy for two years, 200 mL volume or more or 2 cm or more in circumference more compared with the sound limb were included. Patients who were excluded those are with primary lymphedema, secondary lymphedema due to different pathology, stage III lymphedema, bilateral disease, cancer recurrence, and those are at risks of exercises. Participants were recruited out of 137, 6 patients were dropped before the post intervention measures, circumferential measurement were taken using a regular round tape at 4 levels of both limbs metacarpophalangeal joints, wrist joint, 15 cm distal to the lateral epicondyle, and 10 cm proximal to the lateral epicondyle, tow measurements were taken, and mean value were calculated. Volumetric measurement was taken by water displacement through limb immersion at two levels of both limbs at the ulnar styloid process level and 45 cm proximal to the ulnar styloid process. Quality of life were assessed using 36-Item Short Form questionnaire which is a valid and reliable measurement tool that

covers physical, social, and emotional functioning as well as vitality, bodily pain, mental health, and general health. Contralateral limb was assumed as control, so systemic body pathology will affect both sides<sup>22</sup>.

Participants were instructed for 8 weeks home-based exercise program, that consist of progressive resistance exercises modified from Franklin et al. and Harris et al. Patients were monitor every week by telephone and at week 4 in hospital or a home visit final measurement were finalized at end of exercise program at week 8. They concluded that home-based exercise program is beneficial in reducing limb volume and circumference as well as improving QOL<sup>22</sup>.

In a prospective study done by Gautam et al 2011<sup>12</sup>, 60 participants with unilateral stage 2 lymphedema (mild lymphedema less than 200 mL difference between the affected and sound limb) following mastectomy, accepted the experiment and signed a consent form, they were recruited out of 446 as they fulfilled the inclusion requirements, those who were excluded was due to, metastasized cancer or current chemotherapy or radiotherapy, infections in the affected limb, history of contralateral breast cancer, previous physiotherapy treatment for lymphedema, heart, renal diseases or thrombosis. Limb measurements were done prior to the first, second, third, fourth, fifth, and 10<sup>th</sup> day of the intensive phase of physiotherapy, and once again after one, three, and six months of maintenance phase treatment. Measurements were taken by blinded therapist. Limb circumference were measured with arm abducted at 30 degrees at the ulnar styloid process, and every 4 cm above this level along both limbs. Then limb volume was calculated, lymphedema volume was the sum of swollen limb SL from normal limb NL, then limb relative volume change (RVC) was calculated. QOL were assessed before the intensive phase and at the end of the third month of the maintenance phase by questionnaire, they rated their QOL by numerical rating scale where 0 means no complaint and 10 means the worst complaint (NRS: 0-10) and rated treatment satisfaction by NRS (0 the least to 10 the best QoL)<sup>12</sup>.

In Gradalski et al<sup>23</sup> study participants were randomized equally into two groups: group A as compression bandaging group and group B as compression bandaging and MLD Group A were treated by a multilayered compression bandaging alongside a standard active assisted exercise with deep breathing exercise. Compression bandaging starting from the hand, then wrist, then below the elbow and final covering all arm. Bandaging were removed the day after treatment exercises were preformed while bandages on which include active + active assisted ROM exercise for 15 minutes once a day, group B were seen for 30 minutes of MLD Vodder 2 technique which consist of (stationary circle, rotary technique, pump technique, scoop technique) for (the neck, chest, abdomen then arm proximal from shoulder progressively to distal limb). Both groups were treated for 2 weeks 5 days each week this is for the intensive phase then followed by six months of maintenance phase patients were advised to control weight and to protect their limbs by good hygiene and avoid overheating it, in this phase patient were provided with custom made flat-knitted compression garments to wear at daily and remove it at night, also during this phase light aerobic exercise for 10-15 minutes 2/day while garment on. They concluded that improvements in limb volume and QOL were found in both groups which means benefits may be obtained by CDT without MLD while compression bandaging is essential<sup>23</sup>.

In a prospective randomized study conducted by Andersen, et al<sup>2</sup>, 42 female participant who developed stage 1 or 2 unilateral lymphedema post breast cancer treatment, they were examined in a lymphedema clinic and those who were included who are with one or more symptoms of lymphedema (numbness, tightness, stiffness, pain, aching, heaviness or other kinds of discomfort), a difference of at least 200ml in limb volume between normal and affected limb (measured at 15 cm above the elbow), and: or a difference between the circumference of the two arms of at least 2 cm (measured 15 cm above or 10 cm below the elbow). Those who were excluded who are with evidence of recurrence breast cancer, had bilateral breast cancer, or received previous treatment for lymphedema.

Measurement of both upper limbs circumference were measured from level of wrist joint and each 5 cm above till 40 cm, then limb volume was calculated by [using numerical integration by piecewise quadratic approximation, known as Simpson's rule of integration.] shoulder AROM was assessed in flexion, extension, abduction, and adduction. Patients symptoms reduction measured by questionnaire discomfort, tightness, heaviness, aching, pain, function, and loss of shoulder mobility. Measurement were taken pretreatment and after 3, 6, 9 and 12 months.

Participants were randomized into two groups, group A 22 participants for standard treatment as control group and group B for standard treatment plus MLD as experimental group after three months of the study 10 patients who are assigned in group A and they are not satisfied with treatment allowed to join group B. standard therapy group received a custom-made garment and education about exercises, skin care and precaution. For group B MLD were applied for 8 times for 2 weeks 1 hour each session, moreover patients were educated how to do self-massage. They concluded that volume reduction was found in both groups, MLD did not add further reduction. Symptoms improved in both groups<sup>2</sup>.

### **Conclusion**

Secondary lymphedema continues to present a challenge to breast cancer patients and survivors. Several treatment options exist for its management. Although the literature does not identify which treatment is superior, education, exercise, and lymphatic drainage massage are important components of a successful treatment program. Recent systemic review indicates that, exercises seen to be superior in management of secondary lymphedema as stand-alone treatment compared to manual lymphatic drainage.

Further research on lymphedema management should use designs that minimize biases and identify optimal treatments. To evaluate exercise prescription for lymphedema management, comprehensive information (exercise frequency, duration, mode, intensity, and progression strategy) is required. Future research could identify the exercises with the greatest effect on lymphatic drainage and evaluate efficacy at different stages of cancer treatment. It would also be beneficial for prospective trials to investigate the contribution of exercise to secondary lymphedema prevention, reversal, and management, and the long-term effects of exercise on cancer survivors' health and well-being.

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### **Conflicts of interest**

There are no conflicts of interest.

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