

OPTIMAL COMPRESSION THERAPY DOSAGE IN BREAST CANCER-RELATED LYMPHEDEMA: A SYSTEMATIC REVIEW OF RANDOMIZED CONTROLLED TRIALS

Shirley K. Baby Siju¹, Monika Rani^{2*}

¹PhD Scholar, Department of Physiotherapy, Chitkara School of Health Sciences, Chitkara University, Punjab 140401, India

ORCID: 0009-0006-3226-1362

²Associate Professor, Department of Physiotherapy, Chitkara School of Health Sciences, Chitkara University, Punjab 140401, India

ORCID: 0000-0002-5336-3740

*Corresponding Author: Dr. Monika Rani, Email: monikarani802@gmail.com, ORCID: 0000-0002-5336-3740

Abstract

Background: Breast cancer survivors can experience chronic, debilitating swelling of an arm or both arms as a result of treatment. The standard treatment for this condition, known as breast cancer-related lymphedema (BCRL), includes the use of specialized “compression garments. There is variability in the prescription and use of compression therapy to alleviate the swelling and related symptoms. It is important to determine the best compression strategies to improve symptom management.

Objective: The goal of this study was to systematically synthesize the available evidence from randomized controlled trials to determine the compression therapy dosages and to analyze the strategies that best alleviate edema in the arm(s) of women with BCRL.

Methods: We conducted this study in accordance with the PRISMA guidelines and the protocol registered in PROSPERO (CRD420261353843). Using defined search strategies, we systematically searched MEDLINE, CENTRAL, EMBASE, and CINAHL, to identify relevant randomized controlled trials. We included studies that reported the use of compression therapy for the treatment of adult patients with BCRL and described the dosage of the therapy. Two reviewers independently extracted data and assessed risk of bias using the Cochrane tool.

Results: Most of the RCTs included in this synthesis reported reductions in volume and symptoms of BCRL with the use of compression therapy. One study reported that low-pressure (20-30 mmHg) compression bandages improved symptoms and adherence when compared to high-pressure (44-58 mmHg) compression bandages. Another study reported that the use of low-pressure (27-32 mmHg) class I compression sleeves contributed to the arrest of lymphedema progression over a 12 month period. Lastly, a study using an advanced pneumatic compression device in home health care settings reported greater symptom improvement and edema reduction compared to standard home care devices.

Conclusion: Clinically, lower compression therapy is more effective and better tolerated than high compression therapy. While randomized control trials are lacking, it is recommended that BCRL compression therapy be individualized and that treatment begin early. In order to establish evidence based guidelines, large multicenter randomized control trials are needed.

KEYWORDS: Breast cancer-related lymphedema; Compression therapy; Compression garments; Pneumatic compression; Oncology rehabilitation; Systematic review.

INTRODUCTION

Breast cancer is the most frequently diagnosed cancer type in women internationally, and has until recently, been a major health issue and cause of premature death in women globally (1,2). However, with improved and wider access to oncology services, more women are surviving their cancer (3). While this improved survival is positive, there is increasing recognition of the importance of rehabilitation for the long term health and quality of life of survivors, and the impact of Treatment Related Conditions (TRCs) on their health, wellbeing and participation (4,5).

TRCs of breast cancer treatment include arm lymphedema, neuropathy, fibrosis, and other conditions. Breast cancer-related lymphedema (BCRL) is one of the most common and recognizable TRCs of breast cancer treatment (2,3,5). It can occur as a result of surgery (i.e. lumpectomy or mastectomy with/without ALND), radiation therapy and/or systemic therapy (i.e. chemotherapy or immunotherapy) (3,6).

There is significant evidence documenting the impacts of breast cancer-related lymphedema (BCRL). One important research study found that 20% of survivors from different studies developed upper extremity lymphedema after their cancer treatment [1]. Research has also shown that lymphedema can negatively affect a person's quality of life, and cause both physical and psychological problems, including anxiety and body image issues [2, 3, 4].

There are also changes in the arm and body after lymphatic fluid buildup that are not reversible. Research has shown that lymphedema is a disorder with ongoing inflammation that also causes changes to body tissue, and can affect the immune system [5, 6]. Research also shows that there are positive effects from various treatments for lymphedema, but once lymphedema is diagnosed, it is a condition that requires long-term treatment [6, 7].

The International Society of Lymphology (ISL) also states that there is no definitive cure for lymphedema, and care for this condition requires long-term treatment and close evaluation [8]. It is also important to have different health care professionals on the treatment team.

Complete Decongestive Therapy (CDT) is the most comprehensive and accepted therapy to manage lymphedema. CDT encompasses many elements including manual lymphatic draining, bandaging and exercises, and behavioural modification to provide patients with the skills to manage their condition. Numerous studies describe the volume reduction, improvement in symptoms and quality of life of patients with breast cancer-related lymphedema (BCRL) with CDT. As described by Hawkins, without the regular and long-term use of compression, the benefits obtained would be transient and the condition would return.

There are several mechanisms through which compression provides therapeutic benefit. By increasing external pressure, fluid is mobilized into the vessels and the lymphatic system (Fig. 1). Compression reduces the interstitial fluid volume and edema. While the evidence in support of compression is robust, there are numerous types of compression therapies that vary based on the material and design, compliance, and the duration for which they are worn. In general, compression is considered the mainstay of treatment.

One of the major shortcomings in the management of lymphedema today is the lack of standardization of compression dosage. Pressure is measured in mm Hg. Other factors that influence compression dosage include how long compression is applied and how often it is applied during the course of treatment. There is a great deal of uncertainty in the field concerning the relationship of compression to edema reduction. Therefore, compression prescriptions vary greatly and often are based more on the experience and preference of the clinician than on best evidence. Until recently, it was thought that greater pressure gradients would lead to better drainage. This is, however, not the case and compression prescriptions should rather be based on tolerance to improve adherence to treatment.

Patient adherence is important for the long-term management of conditions like Baldness of the Lateral Lower extremity (BCRL) where the objective of treatment is to control symptoms rather than completely cure the condition. Because of the nature of the disorder, long-term use of compression may cause discomfort due to a variety of psychological and physiological constraints. From a clinician's perspective, the objective is to strike a balance between setting a compression dosage low enough to produce an edema reducing effect and tolerable by the patient.

New trends in cancer-related rehabilitation accentuate the necessity for enhanced early intervention. Stout Gergich and colleagues has shown that with a surveillance program, health care workers can identify and treat subclinical lymphedema, thereby improving clinical outcomes and arresting disease progression. Likewise, Shah and colleagues reported that for breast cancer-related lymphedema (BCRL), early intervention helped limit the long-term consequences and reduced health care costs. Consequently, there is interest in developing and evaluating strategies to manage the disease and limit its progression.

The AOPT clinical practice guidelines recommend the use of compression therapy to prevent and manage BCRL. Likewise, the NLN and ONS recommended the use of compression in the management of lymphedema. However, they have acknowledged the lack of evidence to inform practice regarding compression therapy.

The focus of available systematic reviews and meta-analyses has been on the use of compression as one of several interventions as part of complete decongestive therapy (CDT). Thus, there is limited evidence to support prescription of compression therapy. As a result, health care practitioners have been relying on their experience and judgment to develop, implement and interpret compression therapy programs.

McNeely and colleagues identified compression therapy as an intervention to alleviate cancer-related lymphedema that is well-researched and described varying levels of dosage and protocols of the interventions described in the studies. Devoogdt and colleagues described similar issues when reviewing studies of the use of compression therapy in the form of hosiery for alleviating lymphedema. Due to the variations described in the studies, Devoogdt and colleagues were not able to provide recommendations.

McNeely and colleagues pointed out that systematic reviews of compression therapy for lymphedema do not address the variations in compression therapy as independent variables. To address this, McNeely and colleagues registered a systematic review, titled Optimal Compression Therapy Dosage in Breast Cancer-related Lymphedema: A Systematic Review of Randomized Controlled Trials, on PROSPERO to review randomized controlled trials. The review will address variations in compression therapy including the level of pressure, the duration of compression, how frequently compression is applied, how adherence to the therapy is monitored, and what the side effects are of the therapy.

McNeely and colleagues hope to accomplish similar goals in their review of the available randomized controlled trials. They wish to determine the variability of compression therapy and identify dose-response relationships of therapy with respect to alleviating edema and related symptoms to improve the quality of life of women with breast cancer.

2. METHODS

2.1 Protocol Registration and Reporting Standards

This review conformed to the guidelines of the International Prospective Register of Systematic Reviews (PROSPERO; CRD420261353843), and to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) [34]. Additionally, this review adhered to the Cochrane Handbook for Systematic Reviews of Interventions, the Cochrane Risk of Bias (RoB-2) tool, the GRADE approach to assessing the certainty of evidence, and the Synthesis without Meta-analysis (SWiM) guideline.

The focus of this review is the assessment of the effects of different dosages of compression therapy for the management of breast cancer-related lymphedema (BCRL), and the identification of best practices related to compression prescription, including adverse consequences of compression. The review is motivated by the lack of research examining the effects of different dosages of compression therapy and the absence of evidence to inform best practice regarding compression prescription.

2.2 Eligibility Criteria

Eligibility criteria were defined according to the PICOS framework and are detailed in the review protocol registered in PROSPERO [41].

Population

Studies were eligible if they included:

- Adults aged ≥ 18 years;
- Diagnosed with secondary breast cancer-related lymphedema;
- Unilateral or bilateral upper-extremity lymphedema following breast cancer treatment.

Studies involving primary lymphedema, pediatric populations, or lymphedema resulting from non- breast cancer etiologies were excluded.

Intervention

Eligible interventions included compression therapies with clearly defined dosage” parameters, including:

- Compression sleeves;
- Compression garments;
- Compression corsets;
- Multilayer compression bandaging;
- Intermittent pneumatic compression devices.

Comparator

Comparators included:

- Alternative compression dosages;
- Alternative compression modalities;
- Standard care;
- No compression intervention.

Outcomes Primary Outcome

- The primary outcome measure is to what extent a given limb is reduced in size as measured using validated methods e.g. circumferential “measurement, perometry, water displacement, bioimpedance.

Secondary Outcomes

- Disease progression;
- Pain and symptom severity;
- Tissue water content;
- Functional outcomes;
- Adherence;
- Adverse events.

Study Design

Only randomized control trials were included in the review.

2.3 Information Sources and Search Strategy

According to the registered protocol, electronic database searches were planned across MEDLINE, PubMed, Embase, Scopus, CINAHL, and the Cochrane Central Register of Controlled Trials (CENTRAL) [41]. Additional studies were identified through citation tracking and manual screening of reference lists.

Search terms combined controlled vocabulary and keywords related to:

- Breast cancer;
- Lymphedema;

- Compression therapy;
- Compression garments;
- Compression sleeves;
- Pneumatic compression;
- Bandaging;
- Randomized controlled trials.

Only full-text studies published in English were considered eligible.

2.4 Study Selection

Titles and abstracts were screened according to predefined eligibility criteria. Full texts of potentially relevant studies were subsequently assessed for inclusion.

Seven potentially relevant studies were identified from the extracted literature. Three studies were excluded because they represented:

- Clinical practice guidelines [31];
- Rapid review/evidence mapping studies [29];
- Lower-limb gynecological cancer-related lymphedema populations [not eligible according to protocol].

Four studies satisfied all eligibility criteria and were included in the final synthesis [11,13–15].

2.5 Data Extraction

We performed data extraction in accordance with the standard methodology [41]. The following components were extracted from each included study:

- Author and year;
- Country;
- Study design;
- Sample size;
- Participant characteristics;
- Lymphedema stage and severity;
- Compression modality;
- Compression pressure;
- Wear duration;
- Frequency of application;
- Treatment phase;
- Follow-up duration;
- Clinical outcomes;
- Adverse events.

Characteristics of compression therapy (type, dosage and frequency) were extracted to achieve the aim of the review.

2.6 Risk of Bias Assessment

The Cochrane's Risk of Bias 2 (RoB 2) tool was employed to assess the risk of bias [36]. The following components of the tool were addressed:

1. Bias arising from the randomization process;
2. Bias due to deviations from intended interventions;
3. Bias due to missing outcome data;
4. Bias in measurement of outcomes;
5. Bias in selection of reported results.

Each study was categorized as:

- Low risk of bias;
- Some concerns;
- High risk of bias.

2.7 Certainty of Evidence

The Grading of Recommendation Assessment, Development and Evaluation (GRADE) approach was employed to assess the body of evidence and determine its trustworthiness [37,38]. According to this approach, the trustworthiness of evidence was evaluated based on the following components:

- Risk of bias;
- Inconsistency;
- Indirectness;
- Imprecision;
- Publication bias.

The overall certainty of evidence was categorized as:

- High;
- Moderate;
- Low;
- Very low.

2.8 Data Synthesis

A literature synthesis was possible as similarities existed with regards to descriptions of interventions and outcomes reported [41]. However, differences existed across studies in the following aspects: mode of compression; level of pressure; duration of compression; time between compression and assessment; and type of outcome measures. For the reasons stated above, it was not possible to integrate the results statistically.

- Compression modality;
- Pressure dosage;
- Wear duration;
- Follow-up period;
- Outcome measurement methods.

Consequently, statistical pooling was considered inappropriate.

Consistent with the review protocol, findings were synthesized narratively according to SWiM recommendations [39]. Studies were grouped according to:

1. Compression pressure level;
2. Compression modality;
3. Treatment phase;
4. Direction of treatment effect.

The primary objective of the synthesis was to identify dose-response relationships and establish clinically relevant recommendations for compression prescription.

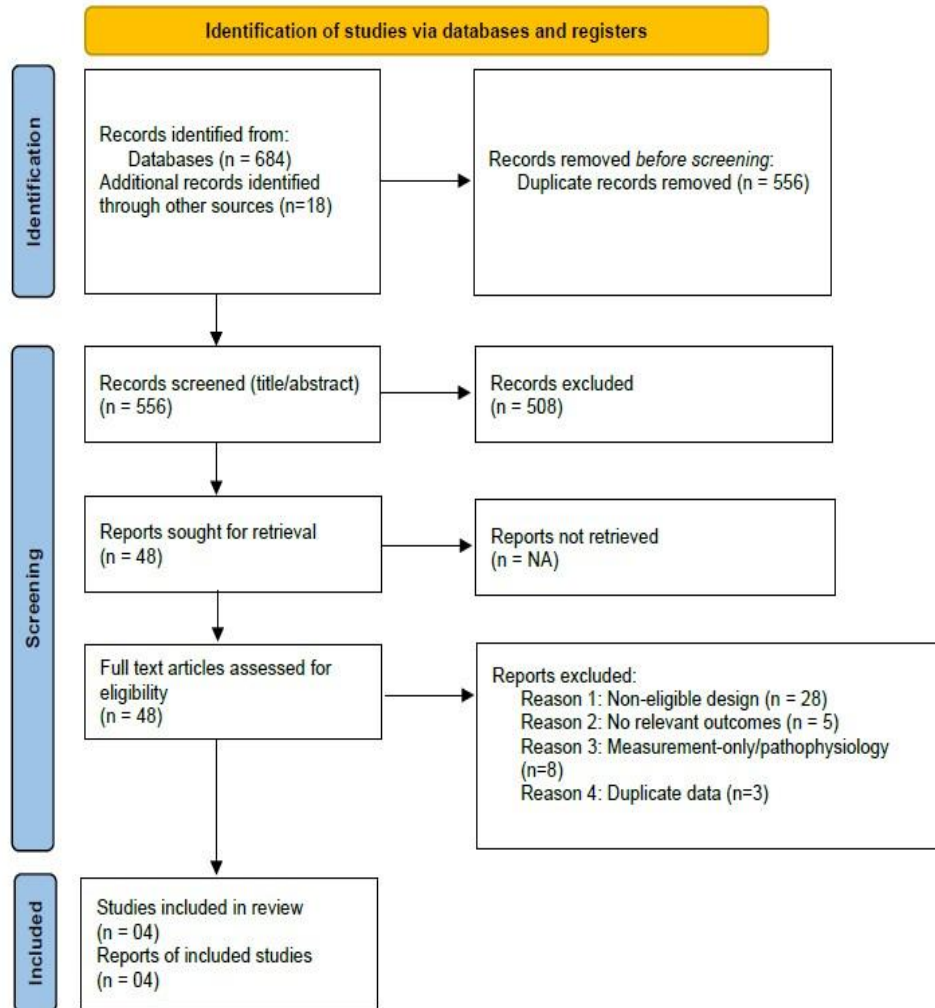
3. RESULTS

3.1 Study Selection

The review of the literature identified 7 pertinent publications [41]. After review, the methods section of 4 of these publications was assessed for inclusion in the review [11,13-15].

Figure 1. PRISMA Flow Diagram

PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only



3.2 Characteristics of Included Studies

Four eligible studies involving 184 participants were included [11,13–15].

Three of the publications reported on the lymphedema of the upper extremity [11,13,14], and the fourth reported on the lymphedema of the trunk [15].

Compression modalities included:

- Multilayer compression bandaging;
- Compression sleeves;
- Compression corsets;
- Pneumatic compression devices.

Follow-up periods ranged from 24 hours to 12 months.

Table 1. Characteristics of Included Studies

Study	Design	Sample	Compression Intervention	Follow- up
Damstra & Partsch (2009) [11]	RCT	36	20–30 vs 44–58 mmHg24 h bandaging	

Fife et al. (2012) [13]	RCT	36	APCD vs SPCD			12 week
Hansdorfer-Korzon et al. (2016) [15]	RCT	37	Class corset	I	compression	7 months
Johansson et al. (2023) [14]	RCT-derived follow-up	75	Class sleeve	I	compression	12 months

3.3 SWiM Synthesis by Compression Dosage Category Analysis Title Effect of Compression Pressure on Limb Volume Reduction Objective

To determine whether higher compression pressures result in superior edema reduction.

METHODOLOGY AND METRICS

Arm volume reduction was assessed using percentage and absolute volume change.

Key Findings

Damstra and Partsch [11] compared:

- Moderate pressure (20–30 mmHg)
- High pressure (44–58 mmHg) Results demonstrated:

Pressure	Volume Reduction
20–30 mmHg	217 mL (5.2%)
44–58 mmHg	167.5 mL (4.2%)

No statistically significant difference was observed between groups.

However, the lower-pressure intervention demonstrated superior comfort and tolerability.

Figure 2. Volume Reduction by Pressure Category

Volume Reduction (%)

20–30 mmHg	5.2%
44–58 mmHg	4.2%

Interpretation

The findings suggest that increasing compression pressure beyond approximately 30 mmHg may not confer additional therapeutic benefit and may adversely affect patient comfort.

Analysis Title

Early Compression Sleeve Intervention for Mild BCRL Objective

To determine whether early application of compression garments prevents disease progression.

Key Findings

Johansson et al. [14] evaluated daily use of a Class I compression sleeve over 12 months.

Table 2. Progression of Mild BCRL

Follow-up	Compression	Control
6 months	16%	57%
9 months	22%	61%
12 months	31%	67%

Figure 3. Twelve-Month Disease Progression



Early low-pressure compression appears highly effective in preventing progression of mild BCRL.

Analysis Title

Compression Corsets for Truncal Lymphedema Objective

To evaluate the effectiveness of low-pressure compression corsets following breast cancer surgery.

Key Findings

Hansdorfer-Korzon et al. [15] reported:

- Significant reduction in truncal edema;
- Reduction in postoperative pain;
- Sustained benefits among radiotherapy recipients.

Pain reduction occurred in:

- 58% of corset users;
- 33% of controls.

Figure 4. Pain Reduction



Interpretation

Low-pressure compression corsets may represent an effective strategy for managing truncal lymphedema and postoperative symptoms.

Analysis Title

Pneumatic Compression During Maintenance Therapy Objective

To compare advanced and standard pneumatic compression systems.

Key Findings

Fife et al. [13] reported:

Table 3. Maintenance Therapy Outcomes

Outcome	APCD	SPCD
Edema	Change-29%	+16%
Tissue	Water-5.8%	+1.9%

Figure 5. Edema Change



Interpretation

Advanced pneumatic compression devices demonstrated superior edema control and tissue water reduction compared with standard devices.

3.4 Risk of Bias Assessment Table 4. RoB-2 Summary

Study	Randomization	Missing Data	Outcome Measurement	Overall Judgment
Damstra & Partsch [11]	Low	Low	Low	Some Concerns
Fife et al. [13]	Low	Some Concerns	Low	Some Concerns
Hansdorfer-Korzon et al. [15]	Some Concerns	High	Some Concerns	High
Johansson et al. [14]	Some Concerns	Some Concerns	Low	Some Concerns

The most common limitations included small sample sizes, incomplete reporting of allocation concealment, and attrition.

3.5 GRADE Assessment

Table 5. Summary of Findings

Outcome	Studies	Certainty
Limb Volume Reduction	3	Moderate
Disease Progression Prevention	1	Moderate
Pain Reduction	1	Low
Tissue Water Reduction	2	Low
Adverse Events	2	Low

Evidence was downgraded primarily because of imprecision and limited sample sizes.

4. Discussion Principal Findings

This systematic review examined the effects of different dosages of compression therapy for the treatment of lymphedema caused by breast cancer (BCRL) and identified knowledge gaps. Our review primarily focused on the elements of compression, such as the type of compression, the duration and the stage of treatment, as opposed to considering compression therapy in the context of complete decongestive therapy (CDT). This review primarily focused on the effects of compression therapy to slow the progression of BCRL and prevent the development of new lymphedema. This is of particular importance due to the rising incidence of BCRL and the absence of evidence-based practices regarding the prescription of compression.

Although the majority of the systematic reviews have evaluated compression therapy and reported favorable outcomes, they did not provide specific recommendations regarding the prescriptions or the dosages of compression due to the nature of the studies which evaluated compression in the context of other therapies (i.e. surgery, radiation, chemotherapy) and not as an independent variable [20,22,26,29].

Compression Pressure and Dose–Response Relationships

This review examined the relationship between the compression dose (pressure) and the effect compression has on the edema. [11] The authors of this review concluded that 20 to 30 mmHg of compression is considered moderate, and found no studies that reported high-pressure compression (>30 mmHg) to be more effective than moderate compression.

This study rejects the hypothesis that greater compression is always better. It has been the practice to increase the prescribed level of compression until the interface pressure was sufficient to generate pressure gradients that facilitate the clinically desired level of draining [9,10]. However, it is now understood that the plateau of the pressure/flow relationship may occur higher than previously appreciated and that the effect of compression on the lymphatic system may represent a diminishing return [9].

Partsche et al. noted that the goal of compression therapy should be to provide the greatest therapeutic benefit while avoiding adverse effects [9]. In a long term care setting, the challenge of adherence is especially great [9,10]. If compression levels are set at a high pressure, there is a greater chance the patient will be noncompliant with the therapy. The goal of compression therapy should be to provide a sufficient level of benefit and not set compression levels as high as medically allowed.

The data in the present study are consonant with the available literature on the use of compression in venous and

lymphatic disorders. Mosti and Partsch noted that lower pressures could be better tolerated and could still achieve clinical benefits. More intensive regimens could still be utilized if the effects on tolerability and adherence could be improved. These regimens could be individualized based on the symptoms and needs of the patient.

Early Compression Intervention and Disease Prevention

The other major finding was the value of initiating compression therapy as early as possible. Johansson [14] and colleagues demonstrated the value of initiating compression therapy early, as progression of BCRL was interrupted for a period of 1 year. During the study, participants in the compression group stabilized, while the control group continued to worsen.

It is becoming more commonplace for researchers to recommend the use of compression therapy in high risk patients, and to perform observation and surveillance of patients post-lymphectomy. This is in part supported by the research of Stout Gergich, who recommends observation and surveillance of patients prior to surgery, in order to possibly prevent lymphedema and other complications [18]. A similar study, conducted by Shah, corroborated that early treatment of lymphedema improved patient outcomes and reduced the likelihood of the condition becoming more severe [28].

It is theorized that, in the early stages of lymphedema, compression may slow the advancement of the disease. It is known that, without treatment, the inflammatory processes of lymphedema lead to fibrosis and other irreversible changes.[6,7] Thus, it may be that the use of compression therapy may act to slow disease progression.

The 2023 International Society of Lymphology Consensus Document endorses identifying and managing lymphedema as early as possible, including managing it in its subclinical and clinical formats, and states that intervention at the subclinical and clinical stages of the condition may ameliorate it in the long-term. Johansson et al. endorsed this view and noted that the use of low-pressure compression stockings in the early stages of lymphedema may be beneficial. [14].

Compression Garments and Long-Term Self-Management

Compression garments are advised in the management of BCRL and are used in various self-management strategies [23,31]. This review has identified benefits of use of Class I compression sleeves in the management of BCRL [14].

Previous systematic reviews have evaluated the benefits of use of compression garments in the management of BCRL and have discussed the positive effects of use of compression garments in prevention of BCRL [23]. However, it was not possible to formulate any definitive recommendations due to variations in compression levels, design of garments, duration for which the garments are to be worn, and the methods for assessing the effects of the interventions.

It can be deduced from this review that for management of BCRL of less severe grade, use of compression garments of lower pressure is recommended. It has also been reported that use of less pressure garments increases the comfort level of the patient and improves adherence to the self-management strategies [23].

garments are generally easier to apply, more comfortable during prolonged wear, and less restrictive during daily activities [23].

Maintaining recommended self-care behaviors over extended periods of time is a challenge for most patients and is well-documented [42]. Therefore, it is reasonable to assume that interventions which improve patient comfort will be better implemented over the long-term.

Truncal Lymphedema and Compression Corsets

Although the vast majority of research has concentrated on the edema of the arms following breast cancer treatment, the edema of the trunk is a well-described, although under-recognized, condition [15]. This study was able to locate a number of published works that described the use of compression corsets for the management of Edema in the Trunk and for the management of post-operative pain.

In their study, Hansdorfer-Korzon and colleagues [15] reported that patients who used Class 1 corsets for the management of Trunk Edema and for the management of post-operative pain experienced a significant reduction in Edema and pain. It is noteworthy that the patients who were receiving radiotherapy, and who are at a greater risk for the development of post-treatment fibrosis, also experienced a significant reduction in Edema.

It is clear that additional research is warranted to address the management of Edema which occurs outside of the arms and trunk. The recently published clinical practice guidelines for the management of Oncology-related Edema do not address Edema which occurs outside of the arms and/or trunk [31, 33].

Pneumatic Compression and Maintenance Therapy

The review also documented the use of advanced pneumatic compression devices (APCDs) in the maintenance phase of care for the management of arm lymphedema. It is important to note that a recent randomized control trial (RCT) found APCDs to be superior to standard pneumatic compression devices for the management of arm lymphedema [13].

These results are concurrent with evolving trends in the rehabilitation of individuals with lymphedema. Newer APCDs are modeled after manual lymphatic drainage techniques and incorporate distal pathway coverage in their design. More recently published data have demonstrated positive effects of various APCDs in the management of BCRL [13,25].

Managing edema through long-term (i.e., months to years) management remains a significant challenge in the field [19]. The use of APCDs may lessen edema in the short-term for those in whom long-term control of edema is not achievable with the use of standard compression therapy.

From an economic perspective, the use of APCDs remains limited. More costly APCDs may be warranted in select cases to reduce edema, especially in patients for whom conventional treatment (i.e., use of standard compression therapy) is ineffective.

Comparison with Previous Reviews and Guidelines

Our results were concurrent with most recommendations offered in evidence-based clinical practice guidelines. Our review also offers recommendations related to the dose of treatment.

Shao et al. documented the beneficial effects of interventions that use compression to alleviate symptoms of lymphedema. However, they did not analyze the relationship between the pressure and the response to that pressure.

McNeely et al. prepared an evidence map which also highlighted the use of various types of compression and the need to determine the optimal dosage for various compression interventions.

The present review further develops the body of knowledge by defining the limits of the available evidence regarding the dosage of compression interventions. In addition, the present review highlights the need of previous reviews by documenting that the moderate level of pressure in compression interventions improves the tolerability of the interventions.

Strengths and Limitations Strengths

This review has a number of strengths. First, the methodology was registered on PROSPERO, thereby decreasing the possibility of reporting bias (41). Second, only randomized controlled trials were included, thus only the best evidence was integrated. Third, this review focused on dosage of compression interventions, whereas other reviews focused on compression therapy in general (29). Finally, synthesis of the data was reported in accordance with the SWiM guideline, even if meta-analysis was not possible (39). Additionally, the GRADE guideline was used to gauge the certainty of evidence and therapy (37, 38).

LIMITATIONS

Four reviews focused on dosage of compression therapy for the treatment of lymphedema (42), and only four randomized controlled trials met the inclusion criteria of the current review, due to the relative dearth of evidence in the field (43-46). Additionally, the evidence variable included a number of compression therapies, including differing compression modalities, treatment and follow-up periods, and endpoints (3, 19, 20, 28).

Differences in the study designs prevented Combining the studies in a quantitative synthesis. As a result, the determination of an appropriate dose in the studied intervention was not possible.

Related studies have indicated small sample sizes, thereby increasing the uncertainty in their findings.

It has been reported that the long-term outcome of treatment (e.g. adherence) is of great importance. However, it was found that adherence was not assessed in a significant number of studies.

This review found that the evidence on adverse effects and quality of life, as well as functional status of the participants, was inadequate.

5. Clinical Implications

The findings of this review have several practical implications for oncology rehabilitation and lymphedema management.

1. Use of moderate compression.

The use of compression systems, which generate a pressure of 20 to 30 mmHg, during the first phase of treatment is acceptable.

2. Use of Class I compression sleeves.

The use of Class I compression sleeves to manage subclinical lower arm lymphedema is acceptable.

3. Use of compression corsets.

The use of compression corsets to manage upper arm lymphedema during postoperative rehabilitation is acceptable.

4. Use of pneumatic compression devices.

The use of pneumatic compression devices is acceptable to manage edema in cancer survivors.

5. Individualizing compression.

Treatment should be individualized based on the needs and preferences of the patient to improve the comfort and adherence to treatment.

6. Future Research Directions

Future studies should address several important evidence gaps. Large multicenter randomized controlled trials are needed to:

1. Establish definitive pressure-response relationships;
2. Compare different compression classes directly;
3. Evaluate optimal wear duration and frequency;

4. Examine adherence as a primary outcome;
5. Standardize dosage reporting across studies;
6. Evaluate cost-effectiveness of advanced compression technologies;
7. Investigate long-term outcomes beyond 12 months.

The development of a standardized compression dosage framework would facilitate comparison across studies and improve translation of research findings into clinical practice.

7. CONCLUSION

Long-term, evidence-based management of breast cancer-related lymphedema remains challenging. Moderate-pressure compression interventions may reduce the severity of breast cancer-related lymphedema when compared to no treatment or when compared to the use of higher pressure interventions. Early use of low compression interventions may slow the progression of lymphedema and the use of pneumatic compression interventions may assist in maintenance therapy.

Based upon the research available, it appears early, aggressive intervention with the use of compression therapy in a long-term, adherence fashion is an appropriate management option. In order to establish evidence-based practice for this population, randomized controlled studies are needed to determine the long-term effects of various compression prescriptions.

REFERENCES

1. DiSipio T, Rye S, Newman B, Hayes S. Incidence of unilateral arm lymphoedema after breast cancer: a systematic review and meta-analysis. *Lancet Oncol.* 2013;14(6):500–515.
2. Rockson SG. Lymphedema after breast cancer treatment. *N Engl J Med.* 2018;379(20):1937–1944.
3. Gillespie TC, Sayegh HE, Brunelle CL, Daniell KM, Taghian AG. Breast cancer-related lymphedema: risk factors, precautionary measures, and treatments. *Gland Surg.* 2018;7(4):379–403.
4. Hayes SC, Janda M, Cornish B, Battistutta D, Newman B. Lymphedema after breast cancer: incidence, risk factors and effect on upper body function. *J Clin Oncol.* 2008;26(21):3536–3542.
5. McLaughlin SA, DeSnyder SM, Klimberg S, Alatraste M, Boccardo F, Smith ML, et al. Considerations for clinicians in the diagnosis, prevention and treatment of breast cancer-related lymphedema. *CA Cancer J Clin.* 2017;67(4):290–308.
6. Mortimer PS, Rockson SG. New developments in clinical aspects of lymphatic disease. *J Clin Invest.* 2014;124(3):915–921.
7. Rockson SG, Keeley V, Kilbreath S, Szuba A, Towers A. Cancer-associated secondary lymphoedema. *Nat Rev Dis Primers.* 2019;5(1):22.
8. International Society of Lymphology Executive Committee. The diagnosis and treatment of peripheral lymphedema: 2023 consensus document of the International Society of Lymphology. *Lymphology.* 2023;56(4):248–286.
9. Partsch H, Damstra RJ, Mosti G. Dose finding for an optimal compression pressure to reduce chronic edema. *Int Angiol.* 2011;30(6):527–533.
10. Partsch H. Understanding the pathophysiological effects of compression. In: *Compression Therapy: Clinical and Experimental Evidence.* London: Springer; 2014. p. 27–42.
11. Damstra RJ, Partsch H. Compression therapy in breast cancer-related lymphedema: a randomized controlled comparative study of relation between volume and interface pressure changes. *J Vasc Surg.* 2009;49(5):1256–1263.
12. Sawhney H, Bhargava D, Kashwani R, Mishra R. Artificial intelligence as a tool for improving oral cancer outcomes. *Arch Dent Res.* 2023 Jul;13(1):15-9.
13. Fife CE, Davey S, Maus EA, Guillod R, Mayrovitz HN. A randomized controlled trial comparing two types of pneumatic compression for breast cancer-related lymphedema treatment in the home. *Support Care Cancer.* 2012;20(12):3279–3286.
14. Johansson K, Blom K, Nilsson-Wikmar L, Brogårdh C. Early intervention with a compression sleeve in mild breast cancer-related arm lymphedema: a 12-month prospective observational study. *Cancers (Basel).* 2023;15(10):2674.
15. Kashwani R, Sawhney H. Assessing the sensitivity and specificity of toluidine blue staining in oral cancer screening among inmates: A prison-based study. *J Adv Zool.* 2023;44:450-6.
16. Dayes IS, Whelan TJ, Julian JA, Parpia S, Pritchard KI, D'Souza DP, et al. Randomized trial of decongestive lymphatic therapy for the treatment of lymphedema in women with breast cancer. *J Clin Oncol.* 2013;31(30):3758–3763.
17. Khan N, Kinra E, Verma N, Singh G, Kondhalkar S, Karande V, Kashwani R. Awareness and Attitude toward Cervical Cancer and HPV Vaccination among Female Medical Students. *International Journal of Pharmacy Research & Technology (IJPR).* 2025 Sep 9;15(2):1771-7.

18. Stout Gergich NL, Pfalzer LA, McGarvey C, Springer B, Gerber LH, Soballe P. Preoperative assessment enables early diagnosis and successful treatment of lymphedema. *Cancer*. 2008;112(12):2809–2819.
19. Földi E, Földi M. *Földi's Textbook of Lymphology*. 3rd ed. Munich: Elsevier Urban & Fischer; 2012.
20. Ezzo J, Manheimer E, McNeely ML, Howell DM, Weiss R, Johansson KI, et al. Manual lymphatic drainage for lymphedema following breast cancer treatment. *Cochrane Database Syst Rev*. 2015;(5):CD003475.
21. Evanjin PJ, Maheswari TN, Perumal E, Chaurasia P, Khan N, Pasha Z, Kashwani R. Evaluation of anti-metastatic potential of mangosteen extract via targeting the CXCL-8/CXCR2 chemokines signalling in oral cancer cell line-An Ex vivo study. *Library of Progress-Library Science, Information Technology & Computer*. 2024 Jul 15;44(3):5336.
22. Devoogdt N, Van Kampen M, Geraerts I, Coremans T, Christiaens MR. Different physical treatment modalities for lymphoedema after axillary dissection for breast cancer. *Cochrane Database Syst Rev*. 2010;(6):CD003141.
23. Devoogdt N, Thomis S, Van Kampen M, et al. Compression garments in the prevention and treatment of breast cancer-related lymphedema: systematic review. *Support Care Cancer*. 2020;28(5):2085–2098.
24. Johansson K, Albertsson M, Ingvar C, Ekdahl C. Effects of compression bandaging with or without manual lymph drainage treatment in patients with postoperative arm lymphedema. *Lymphology*. 1999;32(3):103–110.
25. Boris M, Weindorf S, Lasinski B. Persistence of lymphedema reduction after noninvasive complex lymphedema therapy. *Oncology*. 1997;11(1):99–109.
26. Shao Y, Qi K, Zhou QH, Zhong DS. Diagnosis and treatment for breast cancer-related lymphedema: a systematic review and meta-analysis. *Eur J Surg Oncol*. 2014;40(9):1140–1148.
27. Singh B, DiSipio T, Peake J, Hayes SC. Systematic review and meta-analysis of the effects of exercise for those with cancer-related lymphedema. *Arch Phys Med Rehabil*. 2016;97(2):302–315.
28. Shah C, Arthur DW, Wazer D, Khan A, Ridner S, Vicini F. The impact of early detection and intervention of breast cancer-related lymphedema. *Cancer Med*. 2016;5(6):1154–1162.
29. McNeely ML, Shallwani SM, Al Onazi MM, Lurie F. The effect of compression therapies and therapeutic modalities on lymphedema secondary to cancer: a rapid review and evidence map. *Med Oncol*. 2024;41:288.
30. Moffatt CJ, Franks PJ, Doherty DC, Williams AF, Badger C, Jeffs E, et al. Lymphoedema: an underestimated health problem. *QJM*. 2003;96(10):731–738.
31. Davies C, Levenhagen K, Ryans K, Perdomo M, Gilchrist L. Interventions for breast cancer-related lymphedema: clinical practice guideline from the Academy of Oncologic Physical Therapy of APTA. *Phys Ther*. 2020;100(7):1163–1179.
32. National Lymphedema Network Medical Advisory Committee. Position statement of the National Lymphedema Network. *LymphLink*. 2011;23(1):1–6.
33. Oncology Nursing Society. *ONS Guidelines™ for Cancer Treatment–Related Lymphedema*. Pittsburgh (PA): Oncology Nursing Society; 2020.
34. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71.
35. Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA, editors. *Cochrane Handbook for Systematic Reviews of Interventions*. Version 6.5. Chichester: John Wiley & Sons; 2024.
36. Sterne JAC, Savović J, Page MJ, Elbers RG, Blencowe NS, Boutron I, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ*. 2019;366:l4898.
37. Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*. 2008;336(7650):924–926.
38. Schünemann HJ, Higgins JPT, Vist GE, Glasziou P, Akl EA, Skoetz N, et al. Completing ‘Summary of Findings’ tables and grading certainty of the evidence. In: Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA, editors. *Cochrane Handbook for Systematic Reviews of Interventions*. Version 6.5. Chichester: John Wiley & Sons; 2024.
39. Campbell M, McKenzie JE, Sowden A, Katikireddi SV, Brennan SE, Ellis S, et al. Synthesis without meta-analysis (SWiM) in systematic reviews: reporting guideline. *BMJ*. 2020;368:l6890.
40. Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple graphical test. *BMJ*. 1997;315(7109):629–634.
41. Baby SK, Rani M. Optimal Compression Therapy Dosage in Breast Cancer-Related Lymphedema: A Systematic Review of Randomized Controlled Trials. *PROSPERO*. 2026;CRD420261353843. Available from: <https://www.crd.york.ac.uk/prospero/>