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Bandaging Techniques in Breast Cancer-Related Lymphedema: A Systematic Review

Ana Dominguez Garcia*

Department of Health Sciences, Miguel de Cervantes European University, Valladolid, Castilla y León, Spain

***Corresponding Author:** Ana Dominguez Garcia, Health Sciences, Miguel de Cervantes European University, Valladolid, Castilla y León, Spain*

E-mail: adominguez@uemc.es

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ABSTRACT

Introduction: *Breast Cancer-Related Lymphedema (BCRL) is characterized by fluid retention following failure of the lymphatic system, damaged by the oncologic, surgical and medical treatment, which was applied in breast cancer surgery. Physiotherapy currently addresses BCRL through Complex Decongestive Therapy (CDT) using manual lymphatic drainage, exercise, compressive bandaging and education and hygiene measures.*

Objetives: *This systematic review aims to analyze which bandaging type is most effective in reducing or controlling lymphedema's limb volume in patients who have suffered primary breast cancer.*

Methodology: *A systematic search was carried out according to PRISMA criteria in PubMed, PEDro and Web of Science databases, combining Mesh terms and lymphedema and bandaging related keywords.*

Results: *417 articles were initially obtained, and a total of 11 met eligibility criteria. The methodological quality of the selected articles was determined using the PEDro scale, obtaining a 6.5 means. Statistically significant improvements were found in reducing the volume of lymphedema by applying both multilayer bandage and Kinesiotape (KT) ($p<0.05$), showing very little difference in favor of multilayer bandage. In terms of quality of life, results were similar, but in this case in favor of KT, due to its greater ease of application and comfort in daily life.*

Conclusion: *The multilayer compressive bandage stands out for its effectiveness in reducing volume and improving quality of life. Meanwhile, KT shows somewhat less effectiveness in terms of volume reduction, but presents more benefits in quality of life because it is more comfortable and improves the psychological side effects associated with this type of bandages and pathologies.*

Keywords: Breast Cancer-Related Lymphedema (BCRL), Bandage, Kinesiotaping, Multilayer bandage

INTRODUCTION

Breast Cancer-Related Lymphedema (BCRL) is a frequent breast cancer complication, characterized by the accumulation of fluid following a failure of the lymphatic system, damaged after oncological, surgical and medical treatment, which was applied in breast cancer surgery.

One of the processes that most frequently generate cancer-related lymphedema is breast cancer surgical treatment, increasing even more when it is subsequently associated with radiotherapy [1].

This type of lymphedema presents as swelling in some or all of the upper limb, trunk or operated breast. Apart from all the psychological factors involved, such as anguish, anxiety, discomfort it generates other symptom types:

- Heaviness and stiffness of the affected limb.
- Pain or discomfort.
- Hardening and increase of the skin thickness.
- Frequent infections.
- Difficulty to mobilize the affected limb.
- Swelling with "orange peel texture" (with small dimples).

All these do not appear abruptly and suddenly, the most common ones that usually appear first are heaviness or hardening of some part of the arm [2,3]

Regarding the origin of lymphedema, it is still not completely clear, but different hypotheses have been developed to explain BCRL pathogenesis and the most accepted is the lymphatic insufficiency theory, where there is an imbalance between lymphatic load (interstitial water and protein filtrate) and transport capacity, being this transport inefficient, creating a lymphatic failure that produces interstitial edema [4].

When staging BCRL there are multiple schemes being the most used the one presented by the international society of lymphology [5]:

- **Stage 0:** There is no apparent edema, but there is an alteration in the lymphatic system.
- **Stage 1:** There is an early accumulation of fluids, but it is a reversible process by elevation of the limb or compressive therapy. Edema with pitting may occur.
- **Stage 2A:** Early. Pitting appears and elevation or compression no longer reverses edema.
- **Stage 2B:** Late. There is edema, with or without pitting, and fibrosis begins to develop in the tissues.
- **Stage 3:** Lymphostatic elephantiasis. It is characterized by skin thickening without edema reduction.

Epidemiology and risk factors: BCRL is a problem affecting 1 in 5 women who have undergone specific breast cancer oncologic treatment. These values hover around 21.4% of these women, although the exact incidence is unknown due to the lack of BCRL diagnostic criteria.

As with the prevalence of the tumor itself, BCRL incidence is on the rise because of all the risk factors related to our way of life. Some of the most important risk factors are the following:

- **Total mastectomy:** It has a higher risk of developing BCRL than a lumpectomy.
- **Axillary dissection:** It presents a higher risk than sentinel node biopsy, although this can also be considered a risk factor.
- Radiotherapy
- Adjuvant or neo-adjuvant chemotherapy: evidence shown is still inconclusive, but transient and persistent BCRL could be created.
- Obesity (BMI>25 Kg/m^2)
- High-fat diets
- Alcohol or tobacco consumption.
- Lack of physical exercise.

Evaluation and differential diagnosis: To evaluate lymphedema, observation, palpation and exploration of the limb in question should be performed. In this way we can detect hardened or edematous areas. The simplest and most effective method of evaluation is the measurement of the arm diameter, taking measurements 5 cm above and below the epicondyle. A result becomes significant if between two consecutive measurements there is a difference greater than 2 cm.

There are also different tactics or complementary procedures to corroborate the presence of lymphedema and to see its extension. Among those, the lymphangiogram and lymphoscintigraphy stand out; being the latter the most widely used procedure because it is minimally invasive.

Physiotherapy intervention in BCRL: In the treatment of BCRL, the objectives pursued by physical therapy are focused

on limiting the patient's morbidity and improving her functionality and quality of life. To this end, the aim is to reduce edema, reduce infection rates, improve mobility and reduce the burden of daily therapies, among others.

So far, the literature shows multilayer bandage as the best choice, since the compression it exerts, added to the muscular contraction during exercise, simulates a massage effect and increases lymphatic flow. This type of bandage is composed of a cotton layer to protect the skin, a padded bandage unifing the limb with the bandages, and finally, these bandages that seek to exert pressure during movement [6].

Another bandage type trying to displace the multilayer one, is the neuromuscular or Kinesiotape (KT) bandage. It consists of cotton strip and acrylic heat-sensitive glue that seeks to expand the interstitial space, thus improving absorption and lymphatic flow.

Currently, the most commonly used therapy is CDT, *i.e.* complex decongestive therapy. It consists of 2 phases, an initial reductive one (3-8 weeks), which combines Manual Lymphatic Drainage (MLD), compression therapy with multilayer bandage, skin care, education and regular exercises. And a second maintenance phase, which applies lymphatic self-drainage, exercises, skin care and compression bandages or garments.
The application of these techniques separately is also quite frequent.

- Manual lymphatic drainage or lymphatic self-drainage aims to stimulate lymphatic circulation to decongest vessels and improve fluids' transport and absorption.
- Compressive bandaging seeks a continuous pressure to promote the increase of interstitial pressure and thus the effectiveness of muscle and joint pumping.
- The teaching of skin care and precautions or recommendations, such as keeping the skin clean, hydrated, free of wounds or infections, is recommended at any treatment stage and as measures remaining for life [7-11].
- Regarding the exercise program, in the last congresses of the Spanish association against cancer, more and more articles published in relation to training are coming to light, gradually incorporating strength exercises in patients with lymphedema at present and as a preventive treatment, in addition to aerobic exercise [12-14].

There are also other technique types such as the aforementioned compression garments, intermittent pneumatic compression pumps or low-level laser application among many others [15,16].

Even with all this, it is difficult to recognize which technique has better results, either in isolation or in combination among them.

Objectives
The main objective of this review will be:

- To analyze which bandaging type is most effective in reducing or controlling the volume of the lymphedema limb in patients who have suffered primary breast cancer.

The secondary objectives stated were as follows:

- To determine the impact of different bandages on the quality of life of BCRL patients.
- To analyze the most satisfactory bandaging protocol in BCRL patients.
- To determine the most effective bandage placement and pressure to reduce symptoms and improve quality of life in BCRL patients.

LITERATURE REVIEW

This systematic review is based on the order and composition of the PRISMA method-preferred reporting items for systematic review and meta-analyses and has been registered in the international database PROSPERO with the registration number CRD42023410705.

The research question or PICO question was posed based on the following elements:

- **P (Population):** BCRL patients.
- **I (Intervention):** Bandaging protocols.
- **C (Comparison):** Other bandaging protocols or interventions for BCRL treatment.
- **O (Results):** Lymphedema reduction, quality of life improvement, and pain and discomfort reduction.

The PICO question was:

In BCRL patients (P): Which bandaging protocols (I) are most effective for BCRL compared to other interventions (C) in

terms of lymphedema reduction, quality of life improvement, and pain and discomfort reduction (O)?

After performing a systemic search in different databases, we have selected a set of articles considered of interest for the resolution of our objectives.

Search strategy: The bibliographic search was carried out during the months of March-May 2023: the first search was carried out on March 20th, 2023, and the last was carried out on May 25th, 2023. Three different databases were queried: PubMed, Physiotherapy Evidence Database (PEDro) and Web of Science (WOS) [17].

To perform the search in PubMed, to perform the search in PubMed, the terms were divided into three subgroups, the first two dealing with the problems to be presented, and the last with the treatment. These subgroups were linked by the Boolean operator "AND", while there were numerous terms within each subgroup linked by the Boolean operator "OR".

In the Physiotherapy Evidence Database (PEDro), an advanced search was performed, naming the most global terms that framed our entire study between quotation marks (“”), and marking that all search terms were matched with the Boolean operator “AND”.

Finally, in the Web of Science (WOS), a search was performed using the same pattern as in PubMed. Each search line was written in one of the boxes, joining the terms using the “OR” operator and joining the boxes together with the Boolean operator “AND”. The search strategy can be consulted in Table 1.

Table 1: Bibliographic search results

Data base	Terms	Results
PubMed	(Breast neoplasm(MeSH Terms) OR (breast neoplasm) OR (breast cancer (MeSH Terms)) or (breast cancer) OR (breast) OR (mastectomy) AND (lymphedema (MeSH Terms)) or (lymphedema) AND (bandage (MeSH Terms)) OR (bandage) OR (athletic tape (MeSH Terms)) OR (kinesio textape) OR (kinesiotaping) OR (taping) OR (tape) OR (kinesiotape) or (compressive bandaging)	338
PEDro	“Breast cancer-related lymphedema” and “Bandage”	8
WOS	(Lymphedema (topic)) AND (“Breast neoplasm” OR “breast cancer” (Topic)) AND (“bandage” or “kinesiotape” OR “taping” (Topic))	71

Eligibility criteria: When selecting articles of interest in our systematic review, the following criteria were established:

Inclusion criteria:

- Studies with a randomized experimental design.
- Patients diagnosed with primary breast cancer.
- Patients diagnosed with upper limb lymphedema.
- Studies that employed some bandaging type or technique as at least one of the treatments being compared against other intervention measures.
- Articles available in English or Spanish.

Exclusion criteria:

- Lymphedema due to causes other than breast cancer.
- Studies in which patients with any active tumor were present.
- Studies with patients under active cancer treatment of any type.

Data selection, extraction and analysis: The search described in each database was performed. Subsequently, titles and abstracts were selected according to the proposed eligibility criteria. Data from each article were included in a Microsoft Excel spreadsheet. The data extraction form included: Authors, year of publication, country, study design, setting, participants, interventions performed and outcome measures [18,19].

RESULTS

Selection of articles: Figure 1 shows the flow diagram, which depicts the selection of articles by the selection criteria used.

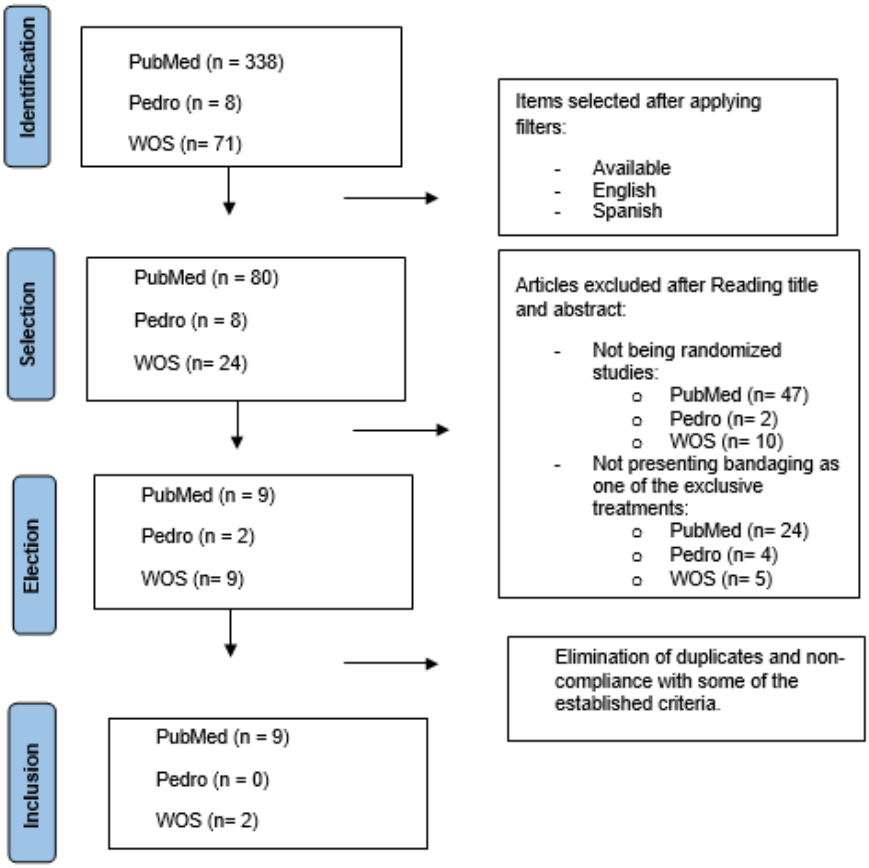

Figure 1: PRISMA flowchart of the articles included in the systematic review. **Note:** (n): Total number of items.

Methodological quality analysis: The methodological quality of the articles selected for this systematic review was assessed using the PEDro scale (Table 2).

Table 2: Article ratings according to PEDro scale

Authors	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	FINAL
Tantawy SA, et al.	No	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	7/10
Pajero Otero V, et al.	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	7/10
Oh SH, et al.	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	7/10
Yaman A, et al.	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	6/10
Malicka I, et al.	No	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	6/10
Smykla A, et al.	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	6/10
Selcuk Yilmaz S, et al.	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	7/10
Damstra RJ, et al.	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	7/10
Dhar A, et al.	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	7/10
Duymaz T	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	6/10
Ochalek K, et al.	Yes	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	6/10

This scale consists of 11 criteria used to determine the internal validity of the study (criteria 2-9) and to understand whether they provide sufficient statistical information to make the results interpretable (criteria 10-11). There is an additional criterion related to external validity (criterion 1), which is not recordable in the final score.

Sample characteristics: The total number of subjects analyzed in this review was 540, being mainly women, since only 2 of the articles did not specify that their sample excluded men. All of them were in an age range between 37 and 84 years, with 63% of the articles being younger than 74 years of age.

The Body Mass Index (BMI) was taken into account in most of the studies, since if it was high (>25 kg/m^2), it could be considered an aggravating factor for lymphedema. In general, it was around 30 Kg/m^2, but there were studies in which the values soared, as in the case of Selcuk Yilmaz S et al., where they reached 46,7 Kg/m^2, or lower, with values of 19.6 kg/m^2 in the same study or in Oh SH et al.

As previously exposed, radiotherapy and chemotherapy are risk factors for this pathology, so they were also study variables. Radiotherapy was a very common condition, since studies such as that of Damstra RJ et al., included 100% of their sample taking into account that they had undergone this oncological treatment. Chemotherapy, on the other hand, was only taken into account in 5 studies, but these showed that the number of patients who had undergone chemotherapy was also quite high.

As for the time elapsed from the time the surgery was performed to remove the cancer until the lymphedema appeared, the articles are very disparate. Most speak of less than 11 years, with the exception of the study by Pajero Otero V et al., which goes back almost 19 years.

Once lymphedema has developed, they are classified according to their stage. No pattern is found that relates the time that each patient has been in the lymphedema stage, so the results are completely random, finding patients in stages I, II or III, and with lymphedema from 6 months, in the case of Selcuk Yilmaz S et al., to 20 years as in the study by Oh SH et al.
The characteristics of the sample and the objective of each intervention proposal are summarized in Table 3.

Table 3: Sample characteristics

Authors	Year	Objective	Sample characteristics
Tantawy SA, et al.	2019	To compare the effects of KT and PG application in BCRL.	N=59 women; Group 1: KT=30 Group 2: PG=29
Pajero Otero V, et al.	2022	To compare the effect on lymphedema RCV change using KT vs. CDT + IPC. To contrast patient satisfaction with the textile devices used in both therapies and the effect of both interventions on lymphedema-related symptoms, functionality and ROM of upper limb joints.	N=40. Group A (CDT+IPC during the first intervention phase and KT during the second intervention phase) =19; Group B (same therapies in reverse order) =21.
Oh SH, et al.	2019	To compare the effects, satisfaction and performance improvement after bandaging treatment using the spiral method and the herringbone method for BCRL.	N=42 subjects. Spiral bandage=21 Herringbone bandage=21
Yaman A, et al.	2021	To evaluate the comparative efficacy of the 3MTM CobanTM 2-layer system and conventional multilayer short-stretch bandage in terms of volume reduction, ultra-sonographic measurements, functional status and QoL in the treatment of stage 1 CDT patients with BCRL.	N=60 women. Group 1: multilayered b=30; Group 2: 2-layer b. CobanTM= 30
Malicka I, et al.	2014	To evaluate the effects of KT applications on the extent of upper limb lymphedema in women after cancer treatment.	N=28 women. Group 1: KT=14; Group 2: GC=14.
Smykla A, et al.	2013	To evaluate the efficacy of KT to treat BCRL.	N=65 women. Group KT (KT tapes)=20 Group Quasi KT (GC)=22 Group MCT (multilayer compression tapes) = 23.
Selcuk Yilmaz S, et al.	2023	To compare the effects of LLLI therapy, KT and MLD, on affected arm volume, QoL, arm function, neuropathic pain and shoulder mobility in patients with stage II BCRL.	N=45 Group 1: MLD=15, Group 2: KT=15,

			Group 3: LLLI=15.
Damstra RJ, et al.	2009	To compare the effect of low versus high interface pressure for arm volume reduction in BCRL after 2 and 24 hours.	N=36 women.
			Group A: low interface pressure b. (20-30 mmHg)=18;
			Group B: high interface pressure b. (44-58 mmHg)=18
Dhar A, et al.	2022	To evaluate the use of a specific mobilizing bandage (Mobiderm®) in the reduction of lymphedema volume during the intensive phase of TCD.	N=49 women.
			Group Mobiderm=25
			GC=24.
Duymaz T.	2019	To compare the efficacy of compression bandage and compression device in the treatment of breast cancer patients with mild to moderate secondary mastectomy of the upper limbs with secondary lymphedema.	N=80 women.
			GC: Bandage =40;
			GE: IPC+Bandage=40.
Ochalek K, et al.	2023	To compare the effectiveness, comfort and possibilities of self-application of ACW or CB in the acute phase of treatment of advanced upper limb lymphedema.	N=36 Group
			ACW=18
			Group CB=18
Note: N: Sample; EG: Experimental Group; CG: Control Group; RCV: Relative Volume; LLLI: Low Level Laser Therapy; CDT: Complex Decongestive Therapy; PG: Compression Garments; KT: Kinesiotape; IPC: Intermittent Pneumatic Compression; BCRL: Lymphedema Secondary To Breast Cancer; MLD: Manual Lymphatic Drainage; QOL: Quality of Life; mmhg: Millimeters of Mercury; ACW: Adjustable Compression Bandages; CB: Compression Bandages; V: Bandage.			

Interventions performed: Most of our articles, present Complex Decongestive Therapy (CDT) as a basis. This therapy is composed of a combination of manual lymphatic drainage, compressive bandaging, skin care, education and exercise for lymphedema reduction.

In addition to this therapy, the most compared bandage has been kinesiotaping. Within kinesiotaping, there are various forms of application, although all agree that the tension should be between 15-20%.

In the study by Tantawy SA et al., a fan on the chest (5 strips), 2 fan shapes on the upper arm (4 strips), 2 on the forearm (4 strips) and a fan shape on the wrist (2 strips) were applied twice a week for 3 weeks. This treatment was compared with that of Compression Garments (CG), which was applied using a pressure between 20 and 60 mm Hg for at least 15 to 18 hours a day for 3 weeks.

The study by Pajero Otero V, et al. on the other hand, when applying KT, followed the Sijmonsma method, which consists of placing 3 strips 1.25 cm wide in parallel, from the contralateral axilla, passing through the back in the form of waves and crossing the upper limb in a spiroid fashion up to the wrist. This technique was maintained 24 hours a day for 3 consecutive weeks, with a physiotherapist renewing them every 3-5 days.

This method was compared with the application of CDT plus Intermittent Pneumatic Compression (IPC), which was performed 5 days a week for 3 consecutive weeks. This therapy consisted of performing manual lymphatic drainage for half an hour following the Vodder method, combined with 30 minutes of sequential IPC at 40 mm Hg and ended with the application of a multilayer bandage.

In the case of IPC therapy was also applied at 40-60 mmHg for 40 minutes compared to compressive bandaging, which was placed with the skin a little moist, first a layer of cotton and then a rigid compression bandage from distal to proximal rolled up in a spiral, going from 75% pressure distally, to 0% proximally.

Within the study group, in the article by Malicka I et al., two types of bandaging was performed with KT, performing a total of 4 applications, one in each consecutive week.

Tapes with a 1 cm wide base and tails divided into 4 parts were applied. One bandage consisted of applying the tape over the edematous upper limb in the form of a fan, placed at the level of the arm, forearm and anastomoses. The other technique was applied only on the upper limb in the form of a double fan, at the level of the arm and forearm.

Another technique was performed by Smykla A et al., where the KT anchorage started at the hand and fanned up the entire forearm, arm and thorax. Leaving the tapes on for the next 3 days.

This technique was compared with a control group, which performed the same bandaging, but with tapes without therapeutic effects such as adhesive tapes; and with Multilayer Compression Tapes (MCT), consisting of 4 layers. The first was an orthopedic sleeve, the second was a support bandage on the fingers and hand, the third was cotton covering the entire limb and the last was a Hartmann short stretch bandage.

A similar approach was used in Selcuk Yilmaz S et al., where MCT was applied to all participants, in addition to teaching strength and endurance exercises and educating about self-massage, skin care and lymphedema precautions. They faced the application of KT, Low Level Laser (LLLI) and Manual Lymphatic Drainage (MLD) for 5 days a week for 3 weeks.

The KT group used the paper tension technique. It starts by anchoring one tape to the anterior and one to the posterior part of the shoulder, bringing its fan ends to the lateral epicondyle and the other to the medial epicondyle respectively. From these last points, two other tapes are placed with the same methodology for the forearm. Finally, two other tapes are placed on the hand in the same way until reaching the back of the hand and fingers.

The remaining studies did not use the KT, but focused on the use of multilayer bandaging, as in the case of Yaman A et al., and Dhar A et al., who compared traditional bandaging with the 2 layer 3MTM Coban TM bandaging technique and the Mobiderm bandage, respectively.

In the first case, the CobanTM 2 layer bandage was composed of a tension-free foam layer and a contraction and compression layer with full stretch. While, in the second article, the Mobiderm bandage was composed of a cotton band, a Mobiderm intermediate band and a short stretch elastic outer bandage.

On the other hand, the study by Ochalek K et al., compared adjustable compression bandages (ACW) with Compression Bandages (CB) or multilayer bandages, as they were composed of a cotton mesh, a gauze layer on the fingers and hand, the foam padding layer and 3 bandages of different sizes (8, 10 and 12 cm wide) around the hand, wrist and elbow, respectively.

These techniques were applied for 2 weeks, the first by a physiotherapist and the second independently. In addition, an exercise program was introduced, which included aerobic exercise 15 minutes a day.

The other studies focused on the bandage as such, to see if there were differences between the spiral or herringbone compression bandage in the case of Oh SH et al. and distinguishes between high (44-58 mm Hg) or low (20-30 mm Hg) pressure bandage, studied by Damstra RJ et al., starting from the fingers and reaching the shoulder.

Main findings

Table 4 shows the variables studied in each article.

Table 4: Variables studied in selected articles. **Note:** (x): shows the variables studied in each article.

Variables analyzed in studies	**1 (45)**	**2 (44)**	**3 (38)**	**4 (46)**	**5 (40)**	**6 (41)**	**7 (37)**	**8 (39)**	**9 (42)**	**10 (47)**	**11 (43)**
Limb volume	X	X	X	X	X	X	X	X	X	X	X
Quality of life	X		X	X			X				
Disability and Pain (SPADI)	X										
Satisfaction /comfort		X	X	X							X
Hand grip strength	X										
Disability (DASH)		X	X	X			X			X	
Neuropathic pain (PDQ)							X				
ROM (Goniometry)		X					X			X	
Self-perceived symptoms		X									X
Pain (VAS)								X	X		
Skin thickness and subcutaneous tissue				X							
Physical functioning											X
Complications											X

Lymphedema measurement results: The assessment par excellence, which met our 11 articles, was to calculate the size

of the limb, either by simply measuring the arm contour at different points, or with various techniques to assess the volume (Table 5).

Table 5: Volume reduction results in selected studies

Authors	Intervention protocol	Results
Tantawy SA, et al.	KT *vs.* PG	KT group improved at the end of the intervention. (P< 0,05).
Pajero Otero V, et al.	TCD+IPC *vs.* KT	No significant results in reducing BCRL were achieved with either therapy (p=0,09).
Oh SH, et al.	Spiral bandage *vs.* herringbone bandage	Herringbone bandaging significantly improved limb volume versus spiral bandaging (p<0.05). None showed significant difference between proximal and distal.
Yaman A, et al.	CobanTM bandage *vs.* traditional short- stretch MCT	CT and CobanTM groups produced a PDV of 11% and 10%, respectively.
Malicka I, et al.	KT *vs.* GC	A significant PDV was obtained after KT application (p=0.0009), which was not found in GC (p=0.36).
Smykla A, et al.	KT tapes *vs.* GC (Quasi KT) *vs.* MCT	Volume decreased in KT group (p=0.002), in Quasi KT (p=0.002) and in MTC group (p=0.000001).
Selcuk Yilmaz S, et al.	DLM *vs.* KT *vs.* LLLI	KT group showed significant post-treatment PDV at 4 and 12 weeks (p=0.009, p=0.039 and p=0.042, respectively).
Damstra RJ, et al.	High *vs.* low pressure initial interface bandages	PDV occurred after 2 and 24 hours in the low pressure group (p<0.001 and p<0.01) and only after 24 hours in the high pressure group (p<0.01), but without showing significant differences in the comparison of one versus the other.
Dhar A, et al.	Conventional MCT *vs.* mobilizing bandages using Mobiderm	At 15 days, the absolute volume in both groups improved compared to baseline (p=0.001). The mean difference between groups in volume was in favor of the Mobiderm group (p=0.003).
Duymaz T.	(GC) Bandage *vs.* IPC+Bandage	There was a significant improvement in all circumferential measurements in both groups (p<0.001 and <0.001), showing greater improvement in CG when measuring 4 cm and 44 cm above the wrist (p<0.001).
Ochalek K, et al.	Adjustable Compression Bandages (ACW) *vs.* Compression Bandages (CB)	There was a reduction in both groups in the volume of the affected limb after 1 week (p< 0.001). Only in the CB group did it also decrease within the second week. Statistically significant difference between groups after 2 weeks (p=0.02).

Note: KT: Kinesiotaping; PG: Compression Garment; MCT: Multilayer Bandage/Multilayer Compression Tapes; CG: Control Group; PDV: Volume Decrease; CT: Conventional Treatment; CDT: Complex Decongestive Therapy; IPC: Intermittent Pneumatic Compression; BCRL: Lymphedema Secondary to Breast Cancer; MLD: Manual Lymphatic Drainage; LLLI: Low Level Laser Therapy; ACW: Adjustable Compression Bandages; CB: Compression Bandages.

Some articles used circometry (19,20,22,25–29), measuring with a tape measure the different anatomical references agreed in each study, and from which they are able to subsequently extract the volume of the limb by means of the truncated cone formula (19,20,25,26,28) or the limb volumes professional 5.0 program.

Both in the study of Tantawy SA et al., and Selcuk Yilmaz S et al., due to this measurement, significant decreases in volume could be observed when KT was applied (P<0,05) and (p=0,009, p=0,039 and p=0,042 after finishing treatment, at 4 and 12 weeks) respectively, which did not happen in the study of Malicka I et al., after the final evaluation with KT.

Neither did it happen in the case of Pajero Otero V et al., where, despite achieving better results in the IPC group compared to the KT group, no significant improvements were achieved with any treatment. It also occurred in the study by Yaman A et al., and Duymaz T when comparing traditional multilayer bandages with the 2 layer 3MTM Coban TM bandage, or the bandage group versus bandage plus intermittent compression respectively, which showed significant improvements in volume, but not between them. On the other hand, according to Oh SH et al., there were improvements in favor of herringbone versus spiral bandaging (p<0,05), and in the study by Ochalek K et al., both groups showed a parallel reduction in volume after the first week (p<0,001), but only the CB group, continued to decrease in the 2nd week. Thus, there was a significant difference between the groups after 2 weeks (p=0,002).

Other methods were also used to evaluate volume, such as the 40T optoelectronic perimeter, in the case of Smykla A et al., where in comparison with the KT and the control group, the multilayer dressing (MCT) showed the best volume reductions (P=0,000001); the volume displ Multilayer compression bandaging a cement method, used by Dhar A et al. to obtain improvements in favor of the Mobiderm group (P=0.003) versus traditional multilayer bandaging; or Inverse Water Volumetry (IWV), which was studied in the article by Damstra RJ et al., and showed improvement at 2 hours (P<0.001) and 24 hours (P<0.01) in the low pressure bandage group versus the high pressure bandage group, which only showed significant improvement at 24 hours (P<0,01).

Quality of life outcomes: Quality of Life (QoL) assessment was also very important. It was generally assessed with the EORTC QLQ-C30 questionnaire in the study by Tantawy SA et al., showing a significant improvement in all QoL domains (P<0.05) when KT was applied. This is currently the most widely used questionnaire for QoL assessment in cancer patients

and in daily clinical practice.

On the other hand, more specific QoL questionnaires were developed for lymphedema, such as the LYM-QoL. This was used by Yaman A et al., and Selcuk Yilmaz S et al., who showed significant improvements with all treatments applied in both studies. Or questionnaires to assess upper limb disability, using the Quick DASH, used in several of the studies, or SPADI questionnaire, which assesses shoulder pain and was used by Tantawy SA et al., to show an improvement in the KT and compression garment group (P<0,05).

Range of motion results: The Range of Motion Assessment (ROM) by goniometry, was controlled in the studies of Pajero Otero V et al., Duymaz T and Selcuk Yilmaz S et al., without finding significant limitations at any time during treatment in the case of the latter quoted. On the contrary, in the case of Pajero Otero V et al. and Duymaz T showed an improvement in flexion (P=0.049) (p<0.001), extension (P=0.001) (p<0.032) and abduction (P=0.024) (p<0.001) of the shoulder in the IPC group respectively. Improvements that were not found in elbow or wrist ranges of motion.

Patient satisfaction results: The studies by Pajero Otero V et al., and Oh SH et al., were concerned with measuring their subjects' satisfaction with the comfort of the textile therapeutic devices applied, using the SQ-TTD-BCRL questionnaire and the EVA scale respectively in each study.

The KT scored better in all dimensions assessed compared to the multilayer bandage, with the exception of perceived benefits, where no significant differences were shown between the two groups 26). While in the case of the comparison between herringbone or spiral bandaging, the latter showed better scores, but also did not reach significance. In the case of Ochalek K et al., a numerical scale based on the Questionnaire-Part was used, where no differences were observed between groups in terms of perceived comfort associated with compression, but the ACW group did feel less comfortable in the 2nd week versus the first week (p=0,049).

Other noteworthy findings: The rest of the assessments were more in line with the objectives specific to each article, using:

Dynamometers to assess manual grip strength in the case of Tantawy SA et al., observing significant improvements only in the group that used KT (P<0,05). The PDQ for neuropathic pain, used by Selcuk Yilmaz S et al., showed significant intergroup improvement between the start and end of DLM, KT and LLLI treatment (p=0,011, p=0,028, p=0,007, respectively). But not when comparing them with each other at the end of treatment, at the 4th and 12th week (p=0,475, p=0,600, p=0,601, respectively).

Ultrasonographic measurements, measured by Yaman A et al., to measure skin and soft/subcutaneous tissue thickness decreased in both multilayer bandage treatments at the end and at 2 months.

Pajero Otero V et al., carried out an assessment of symptoms such as pain, pressure, heaviness and hardness, using a scale from 0 to 5, where only significant improvements were found in pain, with KT showing greater improvement compared to CDT+IPC (P=0,035).

VAS scale to evaluate the volume and heaviness of the affected limb in the study Dhar A et al., which showed improvements after 15 days in the Mobiderm group (p=0.001) and the control group (p=0.004), with greater reductions observed in favor of the Mobiderm group (p=0,001).

Or the numerical scale based on the International Compression Club (ICC) patient questionnaire-party used in the study by Ochalek K et al. Physical functioning was measured, decreasing significantly in both groups after the 1st week (p=0.02);

symptoms, which in the case of the ACW group improved only after the 2nd week (p=0.005), while the CB group showed improvements from the beginning (p<0.001), therefore, when comparing them the CB group presented greater improvements in the decrease of symptoms (p=0.001); and complications, where the ACW group showed to have them more frequently in relation to compression.

DISCUSSION

In this systematic review, we evaluated the effects of different bandaging methods in the treatment of breast cancer-related lymphedema compared with other treatments. Eleven studies were included with a total of 540 participants, all of whom received some type of taping-based intervention for their lymphedema and were overwhelmingly women, as only 2 of the articles did not specify that their study sample excluded men.

The main findings of the review show how statistically significant improvements were achieved in reducing lymphedema volume by applying some type of bandage either kinesiotape or multilayer compression bandage, but without demonstrating major differences between them. In terms of quality of life, KT proved to be a great ally, since it improved values on the Q-DASH scale, relieved pain and produced greater satisfaction due to its ease in putting on and taking off the bandage, as well as its comfort in daily life. In contrast, multilayer compressive bandages were effective in terms of VDP, increased ROM and improved quality of life, but were more uncomfortable and therefore less satisfactory.

Bandage treatment can be combined with other interventions such as manual lymphatic drainage, exercise, skin care or education, as we have seen so far, which is complemented in most articles by applying CDT.

Bandage intervention can change according to the type of bandage used, its placement, the pressure applied, frequency and duration of treatment, and the personal characteristics of each patient, such as lymphedema stage, surgery received, BMI or age. However, according to the findings of this review, there are no significant results to support the application of a specific treatment in a person with specific characteristics.

Intervention with bandaging generates great benefits in comparison with the adverse effects that may occur. In the case of multilayer taping, these negative effects translate into discomfort and reduced quality of life, while in kinesiotape, the biggest problem is usually the allergy the material may cause and, consequently, skin irritation.

The results obtained in this review are in line with other studies carried out to date. In the case of Tsai HJ et al., no significant differences were found between the application of kinesiotape or multilayer bandage in all the study variables, including PDV. However, there was a greater acceptance of kinesiotape due to its greater ease of use, comfort and convenience ($P<0,05$).

What we can observe is that there is more and more evidence supporting the application of compression bandaging for this type of lymphedema, becoming the first line of treatment, even before CDT. This is due in part to studies in which MLD has not been shown to be as effective in reducing volume, QoL or symptoms when compared to other treatments, as it has shown contradictory results. When combined with compression bandaging, its effectiveness may increase slightly, although it does more significantly so, if patients are in a mild to moderate lymphedema state.

In addition to multilayer bandaging and kinesiotape, there are various bandaging applications and materials. Torres-Lacomba et al., conducted a study comparing the volume reduction produced with multilayer, simplified multilayer, cohesive, adhesive and kinesiotape bandaging. It showed that the simplified multilayer bandage, followed by the cohesive bandage, and were the most effective. This first one seemed to be the most effective and comfortable among the multilayer bandages, while the kinesiotape seemed to be the least effective despite the advantage of its comfort.

This systematic review provides evidence that different interventions may have beneficial effects for breast cancer-related lymphedema. However, the evidence is limited by the quality and heterogeneity of the included studies, as well as by the lack of information on the mechanisms of action, adherence, and adverse effects of the interventions.

This review has several limitations that should be taken into account, when interpreting the results. First, the heterogeneity of the included studies in terms of design, interventions, outcomes and methodological quality, which had a mean of 6.5, makes data comparison and synthesis, difficult. Second, the number of studies and participants was small, which reduces the statistical power and generalization of the findings. Finally, some studies had a high risk of bias due to lack of blinding, dropout or follow-up loss, or intention-to-treat analysis. Other studies did not report sufficient data to extract or calculate treatment effects or measures of variability because they did not present data such as time since diagnosis or cancer treatment, lymphedema stage or use of other adjuvant therapies.

From this work, some recommendations can be made for clinical practice and future research. For clinical practice, it is suggested that patient preference and comfort should be considered when choosing the most appropriate bandaging method for each case, as this will reduce the psychological impact and increase adherence to treatment. It is also recommended that bandaging be combined with other complementary interventions, such as physical exercise, skin care or self-massage. For future research, it is proposed that more studies be conducted with robust designs, larger and more representative samples, standardized and validated outcome measures, and adjustments for confounding factors. It is also suggested that the long-term effects of bandaging and its impact on health and social costs be evaluated.

CONCLUSION

The present systematic review has examined and synthesized the available scientific evidence regarding the impact of different physical exercise interventions on improving quality of life in people with autism. The results consistently support the efficacy of physical exercise in several key areas of quality of life. Of life of individuals with autism, including physical, emotional, social and cognitive well-being.

As for the most effective type of physical exercise, intervention in recreational activities stands out as the most beneficial, since it has shown significant benefits in different aspects of quality of life in people with autism, such as improvements in physical health, mood, social interaction, as well as in the cognitive abilities of individuals with autism.

As for the interventions in motor skills and sports activities, it should be noted that physical exercise has succeeded in promoting relaxation and reducing anxiety, as well as disruptive behaviors in people with autism.

These findings support the importance of implementing physical exercise programs tailored to the individual needs of each person with autism in order to efficiently improve their quality of life. However, they emphasize the need for additional research to further explore the underlying mechanisms and long-term effects of physical exercise in this population.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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