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In Adult Breast Cancer Patients, the Effect of Compression Garments on Changes in the Volume of Breast Cancer lymphedema: A Literature Review

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Abstract: Background About 21% of women treated for cancer develop breast cancer-associated lymphedema (BCRL), which could lead to negative changes in self-image, increased anxiety and reduced quality of life. Currently, there are a variety of treatments to improve lymphedema, and wearing compression garments is considered necessary, however, evidence is lacking to assess the effectiveness of BCRL compression garments. Purpose To evaluate the efficacy and safety of wearing compression garments for lymphedema volume in adult breast cancer patients. Methods By searching MEDLINE, PubMed, Psych Articles, Academic Search Complete, CINAHL and Cochrane Library, the search was limited to peer-reviewed literature published between 2017 and 2022 in English. Inclusion criteria were participants aged ≥18 years and the intervention was wearing a compression garment. The primary outcome was lymphedema volume change and adverse events. Results A total of 903 literature were obtained, and the literature were screened through the PRISMA flow chart, and five literature that met the criteria were finally included, all of which were randomized controlled trials (RCT). Risk of bias assessment and quality of evidence graded for these five RCTs were performed by two independent researchers using the Cochrane Risk of Bias Tool and the GRADE grading System. The five included RCTs were biased to varying degrees because the intervention was obvious, and the quality of the evidences were moderate, but wearing compression garment was effective and safe in all trials. Conclusion In adult breast cancer patients, wearing compression garments could significantly reduce the volume of lymphedema, and the longer the daily wear time, the better the effect, and the safer than Kinesio Taping. Future studies should conduct higher-quality, multicenter randomized controlled trials to further determine the optimal pressure range for compression garment use.

Keywords: Breast Cancer, Breast Cancer Lymphedema, Compression Garments, Evidence-Based Nursing

1. Introduction

Breast cancer is still the most common type of cancer in the world, and its prevalence is rising [22]. Lymphedema is the most common chronic complication in breast cancer treatment. According to data, approximately 21% of women undergoing cancer treatment develop breast cancer–related lymphedema (BCRL) which can be managed but often not cured [4, 7]. Signs and symptoms of lymphedema include swelling, tightness, pain limited arm movement, and skin changes [11]. Untreated lymphedema tends to progress gradually and limit the patient's Activities of Daily Living (ADL) [2]. It can also lead to negative self-image changes, increased anxiety, and a lower quality of life [1, 19]. At present, different conservative treatments are chosen according to the clinical severity of lymphedema, including skincare, weight loss, different compression therapies, physical therapy, and comprehensive anti-swelling therapy [6]. The compression garment is a compression therapy that is often used in the early stages of BCRL and during the maintenance phase of complex decongestant therapy (CDT). However, there is a lack of evidence to evaluate the

effectiveness of compression garments with BCRL. Although several articles have been published on the effect of compression garments on BCRL, the quality of these publications has not been assessed.

2. PICO

Hence, to find relevant evidence, the author presents an answerable clinical question: In adult breast cancer patients (p), does compression garment (I) have an effect on changes in the volume of breast cancer lymphedema (O)? In addition, the control group could be different compression therapies or usual care. Because for patients with BCRL, the researchers' treatment options without any lymphatic drainage were shown to be unethical [17].

3. Search Strategy

Six databases were searched in accordance with the Preferred Reporting Items for Systemic Reviews and Meta-Analyses (PRISMA) [14] guidelines (Figure 1. Prisma 2009 Flow Diagram), including MEDLINE, PubMed, Psych Articles, Academic Search Complete, CINAHL, and Cochrane Library. The keywords in the search strategy (Table 2. The search strategy) were breast cancer, Breast cancer lymphedema, and compression garment. The limits used were: (1) The English language, (2) Articles from the year 2017 to 2022, (3) Peer-reviewed, (4) Participants were being 18 years old or older, and (5) The article describing the effectiveness of compression garments in treating BCRL. As a result, 903 studies were obtained, including seven studies through other sources. After removing the duplicates, there were 657 studies. Then, through screening the titles, read abstracts and full-text articles. Finally, only five articles fulfilled the inclusion criteria (Table 3. Table of Studies), all of which were RCTs. Because RCT is suitable for exploring and comparing the effect of a new nursing, preventive or other intervention on disease recovery and prevention, it can provide a scientific basis for correct clinical decision-making. Therefore, it is most appropriate to choose RCTs to explore this topic.

4. Appraisal

Critically appraisal of the original research literature is an important part of evidence-based nursing, including validity, impact, and applicability. RCTs were the highest-quality evidence in the original study, but not every RCT was of high quality. Because causal inferences in randomized trials can be undermined by flaws in design, implementation, analysis, and reporting, leading to underestimation or overestimation of the true effects of interventions (biases) [9]. Therefore, the five included studies will be critically appraised below, and use the Cochrane Collaboration's tool for assessing the risk of bias in randomized trials [9]. The bias risk assessment tool addresses six types of bias: selection bias, performance bias, detection bias, attrition bias, reporting bias, and other biases. Assessments are made for one or more items within each domain, which may cover different aspects of the domain or different outcomes. Each item will be judged to be low risk of bias, high risk of bias, or unclear risk of bias. Details of the specific evaluation results of the five studies are in Table 1. Cochrane Collaboration's tool for assessing risk of bias. Then, the literature was classified by the quality of evidence according to the GRADE [8] grading system, and all five RCTs were of moderate quality. Because each trial has at least one bias.

Table 1. *Cochrane Collaboration's tool for assessing risk of bias.*

	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias
(Ozsoy-Unubol et al., 2019)	+	+	-	+	+	+	+
(Pajero Otero et al., 2019)	+	+	-	-	+	+	+
(Tantawy et al., 2019)	+	+	-	+	-	+	-
(McNeely et al., 2022)	+	+	-	+	+	+	+
(Ochalek, Gradalski and Partsch, 2017)	?	?	-	+	+	+	+

Key: + Low risk of bias; - High risk of bias; ? Unclear risk of bias

In the main results, compression garments were effective on arm lymphedema volumes in all trials compared to baseline, both in the early phase of BCRL or in the maintenance phase of CDT. Of the three trials comparing the Kinesio taping, two showed that the Kinesio taping was superior to the compression garment [18, 23]. Another study showed that both modalities had similar effects in early BCAL treatment, although the difference in arm circumference was reduced in both groups after the intervention [17]. One trial demonstrated that the use of a lightweight arm compression sleeve within one year after surgery not only reduced the volume of arm lymphedema but also prevented secondary lymphedema [16]. One trial demonstrated that increased nighttime compression was more effective in reducing the volume of excess lymphedema in the arm than daytime compression garments alone [13]. Additionally, in these studies, adherence to compression garment wear was found to be poor. For example, Pajero Otero et al. [18] reported that participants wore only 6.7 hours per day, which may have contributed to the poor efficacy of compression garment therapy.

Five studies had a total of 296 participants. All participants were adult breast cancer patients, but the staging of BCRL was different. Each study was also approved by the relevant ethics committee, but one of the studies did not mention whether patients had signed informed consent [16]. Ochalek,

Gradalski and Partsch [16] and Ozsoy-Unubol et al. [17] were in early stage BCRL. The remaining participants were in the maintenance phase of the CDT phase [13, 18, 23]. These participants came from different countries, including Turkey, Spain, Egypt, Canada, and Poland. The demographic and baseline clinical features of the control and intervention groups were comparable in four studies [13, 17, 18, 23]. The baseline clinical features of the patients in another study were comparable, but the age of the patients calculated using the Wilcoxon rank-sum test was P=0.001 [16]. In addition, the study had a small sample size, a significant number of dropouts (16.7%; in NCG), and no intent-to-treat analysis. In contrast, McNeely et al. [13] designed a multicenter randomized controlled trial with a sufficient sample size, minimal follow-up loss, and an intent-to-treat analysis. However, McNeely et al. [13] also mentioned the limitation that the participants in the study were predominantly white. Tantawy et al. [23] and Pajero Otero et al. [18] mentioned that although their study had reached the recommended sample size, the limitations of the small sample size existed.

Although the included studies were all RCTs, their method designs were different. Ozsoy-Unubol et al. [17] designed a prospective randomized single-blinded study. Tantawy et al. [23] designed a randomized controlled trial study, as well as Ochalek, Gradalski and Partsch [16]. However, Tantawy et al. [23] pointed out that their study randomization was not standardized. Pajero Otero et al. [18] used a randomized, crossover, clinical trial. A crossover trial is one in which participants receive two or more consecutive interventions in a randomized order in different treatment periods, usually separated by washout periods, to avoid "carry-over" intervention effects from one treatment period to the next [21]. In this crossover experiment [18], two 4-week washout periods were set, which saved the number of samples and made the two groups more balanced and comparable [15]. McNeely et al. [13] used a parallel 3-arm, multicenter, randomized, fast-track trial (with the delayed assignment to the experimental group for both comparison groups), and the study published the full research protocol ahead of the experiment [12]. A randomized fast-track trial is a more patient-friendly design and can optimize the recruitment and retention of control group participants in the trial [12]. Furthermore, McNeely et al. [13] and Ochalek, Gradalski and Partsch [16] both conducted a pilot study.

In experimental research, the researcher imposes on the research subjects the treatment factors that cause direct or indirect effects according to different research purposes, which is called intervention. To verify the effectiveness of compression garments in the treatment of BCRL, of the five studies, three compared the efficacy of Kinesio Taping and compression garments for BCRL [17, 18, 23], one study compared the efficacy of adding nighttime compression for BCRL [13], and one study assessed the efficacy of light compression sleeves for BCRL [16]. The study [13] was the only study with three control groups, the other four studies have only control and intervention groups. Three groups include Group 1 (daytime compression garments only [standard care]), group 2 (daytime compression garments plus nighttime compression bandages), and group 3 (daytime compression garments plus garments using a nighttime compression system). In the study [16], while the intervention group consisted of patients with a light compression sleeve and the control group of patients without compression sleeves, both groups received a standardized physical exercise program that was both ethical and reduced other bias. Similarly, in another four studies, patients in the intervention and control groups both received basic education, preventive measures, and exercise.

In addition, the duration and pressure of compression garment use varied widely across studies. Although Executive Committee [5] recommended that the highest stress a patient can handle was the one most likely to benefit them, the question of the optimal pressure range for compression garments to prevent lymphedema remains unresolved [16]. Ozsoy-Unubol et al. [17] did not mention usage time and the pressure of compression garments. The remaining four studies had compression garment pressures ranging from 15mmHg to 60mmHg, and the time range for using the compression garment was 6.7h/day to at least 20h/day [13, 16, 18, 23]. Increased time in compression garments showed better for lymphedema [13].

As for the result measurement tool, four studies used different tapes [16, 17, 18, 23], just one study used the Perometer which is an optoelectric limb volumeter that uses infrared technology [13]. The tapes include nonelastic tape at five levels [17], standard 1cm-wide, retractable, tailor's tape [18], and normal tape [16, 23]. Although these four studies used tapes to measure differences in the circumference of the upper extremities, they were measured in different ways. The circumference difference between the five parts of the upper limb was measured [17]. The circumference difference between the four parts was measured with the tape measure [18, 23]. The tape measure was measured every 4 cm from the wrist [16]. In contrast, McNeely et al. [13] used the Perometer more objectively quantified limb volume and identified inter-limb differences. Moreover, although the measurers were outsiders and blinded, Pajero Otero et al. [18] mentioned that it was not possible to completely blind the raters due to significant differences between treatments, such as skin imprinting after treatment. However, this will not have an impact on the project results as the results are objective facts.

Except for appraisal evidence, patients' needs, values, and expectations should be considered. Although compression garments can reduce the volume of lymphedema in the arms, it also has some shortcomings to be aware. The first is the price of compression garments. Compression garments are much more expensive than compression bandages because they need to be customized. The high price may deter some BCRL patients from using them. The second is that the time required for daily use is very long. Some clinicians even recommended using a compression garment for up to 24 hours a day [10]. This is difficult for patients with poor adherence. But McNeely et al. [13] mentioned that compression garments were easier to apply than compression

bandages and can facilitate long-term patient self-management. The third is side-effects. Previous studies have reported that compression garments can cause blistering, rashes, and discomfort [3, 20]. It is not friendly to patients with sensitive skin. However, in one included study, skin peeling occurred in 20% of participants (n=6) with Kinesio taping, but not in the compression garments group [18].

Despite the fact that the search strategy aimed to include all relevant literature, it was only limited to publications in English. It might overlook articles that add value to the comment. There is currently no standard compression garment application pressure and duration. Criteria for inclusion in BCRL status vary from study to study. Because the intervention was obvious, blinding of participants and raters was difficult to achieve, resulting in a high risk of bias for these RCTs. In addition, although the assessments were reviewed by two independent assessors, including the author and another classmate, different assessors may have their judgments on each factor, so results may vary.

5. Conclusion

Based on the current evidence, compression garments appear to have a positive effect on BCRL, significantly reducing lymphedema volume. Compression garments combined with general health education and exercise programs also could prevent secondary lymphedema after surgery. Therefore, compression garments are recommended as an intervention for early prevention and as part of a treatment strategy during the maintenance phase of CDT. Compression garments also could reduce skin damage compared to the Kinesio Taping. Healthcare professionals should promote patient adherence with compression garments and increase patient wear time. It will benefit the effectiveness of compression garments for lymphedema. In future studies, the author recommends the use of the Perometer as an outcome tool to quantify limb volume and more objectively identify differences between limbs, and future RCTs could focus on determining the optimal compression garment pressures. At the same time, more rigorous, standardized, and comprehensive systematic reviews or meta-analyses in related fields are needed to provide stronger evidence.

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Appendix

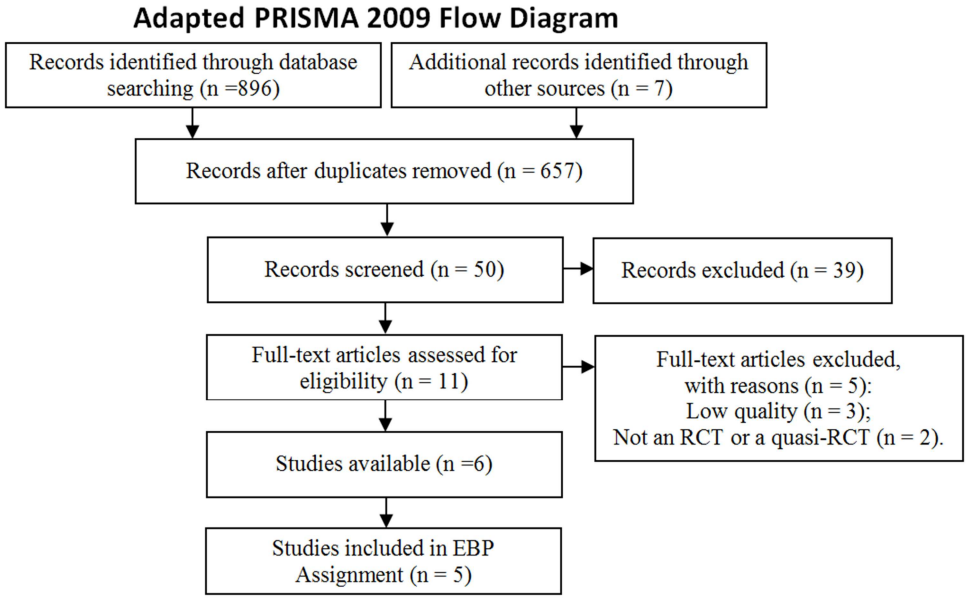

Figure 1. *Prisma 2009 Flow Diagram.*

Table 2. *The search strategy.*

Date	**10th April 2022**	
Research Topic	**In adult breast cancer patients, the effect of compression garments on changes in the volume of breast cancer lymphedema**	
Search Strategy	Keywords/concepts	Synonyms/alternative terminology
	Breast Cancer	Breast Cancer OR Breast Tumors OR Breast Tumor OR Breast Neoplasm OR Mammary Cancer OR Mammary Cancers OR Malignant Neoplasm of Breast OR Breast Malignant Neoplasm OR Breast Malignant Neoplasms OR Malignant Tumor of Breast OR Breast Malignant Tumor OR Breast Malignant Tumors OR Cancer of Breast OR Cancer of the Breast OR Human Mammary Carcinomas OR Human Mammary Carcinoma OR Human Mammary Neoplasm OR Human Mammary Neoplasms OR Breast Carcinoma OR Breast Carcinomas

Date	**10th April 2022**	
Research Topic	**In adult breast cancer patients, the effect of compression garments on changes in the volume of breast cancer lymphedema**	
	Compression garment	Compression garment OR Compression garments OR Compression therapy OR Pressure garment OR Pressure garments OR Compression Sleeve OR Compression Sleeves
	Breast cancer lymphedema	Breast cancer lymphedema OR Breast Cancer Lymphedemas OR Breast Cancer Treatment-Related Lymphedema OR Breast Cancer Treatment Related Lymphedema OR Breast Cancer-Related Arm Lymphedema OR Breast Cancer Related Arm Lymphedema OR Breast Cancer Related Lymphedema OR Postmastectomy Lymphedema OR Postmastectomy Lymphedemas OR Post-mastectomy Lymphedema OR Post mastectomy Lymphedema OR Post-mastectomy Lymphedemas
Limits and Type of material required	2017 -2022 English language Peer review Participants were being 18 years old or older	
Databases and Resources to be searched (incl. relevant organisations)	CINAHL MEDLINE/complete PsychArticles PubMed Cochrane Library Academic Search Complete	

Table 3. *Table of Studies.*

#	Reference as per guidelines	Aim/Purpose	Methodology	Sample
1	Ozsoy-Unubol, T., Sanal-Toprak, C., Bahar-Ozdemir, Y. and Akyuz, G. /Efficacy of kinesio taping in early stage breast cancer associated lymphedema: A randomized single blinded study/2019	To evaluate the effectiveness of kinesio taping (KT) compared to compression garment (CG) in treatment of early stage breast cancer-associated lymphedema (BCAL).	A randomized single blinded study	35 patients between 18-70-years old who had unilateral stage 1 BCAL and had not received any lymphedema treatment, Turkey
2	Pajero Otero, V., García Delgado, E., Martín Cortijo, C., Romay Barrero, H. M., de Carlos Iriarte, E. and Avendaño-Coy, J. /Kinesio taping versus compression garments for treating breast cancer-related lymphedema: a randomized, cross-over, controlled trial/2019	To determine the effectiveness of Kinesio taping compared to compression garments during maintenance phase of complex decongestive therapy for breast cancer-related lymphedema.	A randomized, cross-over, controlled trial	30 women with breast cancer-related lymphedema during maintenance phase of complex decongestive therapy, Spain
3	Tantawy, S. A., Abdelbasset, W. K., Nambi, G. and Kamel, D. M. /Comparative Study Between the Effects of Kinesio Taping and Pressure Garment on Secondary Upper Extremity Lymphedema and Quality of Life Following Mastectomy: A Randomized Controlled Trial/2019	To compare the effects of Kinesio taping and the application of the pressure garment on secondary lymphedema of the upper extremity.	A Randomized Controlled Trial	66 women with unilateral BCRL (stages II and III) for at least 6 months and who completed phase I of complex decongestive therapy were invited, Egypt
4	McNeely, M. L., Dolgoy, N. D., Rafn, B. S., Ghosh, S., Ospina, P. A., Al Onazi, M. M., Radke, L., Shular, M., Kuusk, U., Webster, M., Campbell, K. L. and Mackey, J. R. /Nighttime compression supports improved self-management of breast cancer–related lymphedema: A multicenter randomized controlled trial/2022	To determine the efficacy of nighttime compression on arm lymphedema volume maintenance and quality-of-life outcomes in women with BCRL who were in the maintenance phase of treatment for lymphedema.	A Multicenter Randomized Controlled Trial	120 women with a diagnosis of BCRL in the ipsilateral arm and being in the lymphedema maintenance phase, Canada
5	Ochalek, K., Gradalski, T. and Partsch, H. /Preventing Early Postoperative Arm Swelling and Lymphedema Manifestation by Compression Sleeves After Axillary Lymph Node Interventions in Breast Cancer Patients: A Randomized Controlled Trial/2017	To evaluate the potential role of light arm compression sleeves in reducing the incidence of early postoperative swelling and of breast cancer-related arm LE up to one year after the intervention.	A Randomized Controlled Trial	45 women with a diagnosis of breast cancer, Poland

Table 3. *Continued.*

#	Intervention/ Tool	Findings	Limitations
1	Patients randomized to the KT (n= 16) and CG (n= 19) groups. KT was applied with a lymphatic correction technique in three-four day intervals for four weeks. At the end of the fourth week, patients were suggested to wear CGs. Patients in CG group were treated daily for 23-hours in CGs. Education, preventive measures, and exercises were given to both groups. /A nonelastic tape at five levels.	1) Both modalities had similar effects in the treatment of early stage BCAL. 2) KT can be an alternative treatment to CG for patients who have difficulties in obtaining and wearing CGs. 3) Both groups had reductions in all levels of arm circumference differences at immediate post-treatment and three months after treatment.	1) It did not test the combined treatment of KT with CGs.
2	Participants received two interventions, Kinesio taping and compression garment, both lasting four weeks, whose	1) The decrease in the Relative Volume Change were greater in the Kinesio taping intervention	1) The sample size was small. 2) The patients were not blinded to

#	Intervention/ Tool	Findings	Limitations
	order was randomized by blocks. A four-week washout period was established prior to the interventions and between them. Group A (n=15) received the intervention with Kinesio taping first which was followed by therapy with compression garments, and Group B (n=15) received the same interventions in the reverse order. /A standard 1cm-wide, retractable, tailor's tape (Medi, Germany).	(-5.7%, SD=2.0) compared to that observed using compression garments (-3.4%, SD=2.9) (p<0.001). 2) Taping was perceived as more comfortable by patients and further reduced lymphedema-related symptoms compared to compression. 3) The average daily hours of usage (6.7 hours) of compression garments by the participants.	the treatment. 3) There was no record of whether participants were at stage IIa or IIb of lymphedema and no registration of whether there were changes in the lymphedema stage of each participant. 4) It was not evaluated if the changes with the therapies were maintained over time.
3	Participants were randomly allocated to the Kinesio taping (KT) group (n=33) and pressure garment (PG) group (n=33). The KT group received Kinesio taping application (2 times per week for 3 weeks), while the PG group received pressure garment (20- 60 mmHg) for at least 15-18 hours per day for 3 weeks. / A tape.	1) The sum of limb circumferences, SPADI, hand grip strength, and quality of life significantly improved after treatment in the KT group (P<0.05). 2) While the PG group showed no significant improvement in SPADI, hand grip strength, physical, role, pain, and fatigue score p>0.05, while the sum of limb circumferences significantly decreased (P<0.05). 3. Significant differences were observed between the KT and PG groups at the end of the intervention (P<0.05).	1) The sample size was small and lacked regular follow-up period. 2) The pressure difference between the manufacturer prescription and actual delivery of PGs. 3) KT and PG treatment after the first phase of lymphedema, which may bias the study. 4) There was absence of objective measurement of limb size in the outcome. 5) Intention-to-treat statistical analysis was not performed.
4	Participants were randomized to group 1 (daytime compression garment alone, n=39), group 2 (daytime compression garment plus nighttime compression bandaging, n=44), or group 3 (daytime compression garment plus the use of a nighttime compression system garment, n=37). Participants from all groups used a nighttime compression system garment from weeks 13 to 24. /The Perometer (Pero-Systems, Wipputal, Germany), is an optoelectric limb volumeter that uses infrared technology.	1) The rates of adherence to nighttime compression were 95% ± 15% and 96% ± 11% in the compression bandaging and nighttime compression system groups, respectively. 2) After the intervention, the addition of nighttime compression was found to be superior to standard care for both absolute milliliter reductions (P =.006) and percentage reductions (P =.002) in excess arm lymphedema volume.	1) A primarily White population and high baseline quality of life and self-efficacy. 2) The use of a randomized fast-track design precluded our ability to analyze trial findings by original group allocation at the 24-week follow-up.
5	Participants were pre-operatively randomly assigned to a group with compression of circular-knit sleeves in compression class I (15-21 mm Hg) for daily wearing (compression group [CG]; n = 23) or to a control group without compression (no CG, n = 22). Both groups underwent a standardized physical exercise program. /A tape.	1) At one month, postoperative swelling was reduced only in CG. 2) After 12 months, the average change of excess volumes (edema) reached 67.6 mL in the CG vs. þ114.5 mL in the no CG (P < 0.001). 3) Significantly less edema was seen in the CG after 3, 6, 9, and 12 months.	1) The sample size was small, which did not allow to evaluate subgroups concerning the risk for the development of LE. 2) It was the noticeable number of drop-outs (16.7%; in NCG) and that an intention-to treat analysis could not be performed.

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