

RELIABILITY OF FUNCTIONAL COMPRESSIVE BANDAGING IN THE TREATMENT OF LYMPHEDEMA SECONDARY TO THE TREATMENT OF BREAST CANCER

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ABSTRACT

Functional compressive bandaging (FCB) is a therapeutic resource used to control lymphedema resulting from the treatment of breast cancer. However, the reliability of the technique is unknown. We evaluated intra- and inter-rater reliability of the spiral technique in the four-layer FCB of the arm and forearm in breast cancer survivors with lymphedema. Forty-five breast cancer survivors with a mean age of 64.88 ± 10.01 years participated in the study. Evaluations were performed by two examiners at different times analyzing the pressure exerted (mmHg) by the spiral FCB in the arm and forearm of the upper limb affected by lymphedema. The intraclass correlation coefficient (ICC_{2,1}) was used to determine intra- and inter-examiner reliability, with a 95% confidence interval, minimum detectable change, and standard error of the measurement. Intra-rater reliability was considered low to high in the arm and forearm region. Inter-rater reliability in the arm region was considered low and in the forearm region low to moderate. Our results indicate that spiral FCB has low to moderate intra-examiner and inter-examiner reliability.

Keywords: lymphedema, breast cancer, compressive bandaging, rater reliability

Lymphedema is a chronic condition often found in women who have undergone treatment for breast cancer and a common treatment is combined with complex physical therapy (CPT) (1,2). Components of CPT management for lymphedema include skin care, manual lymphatic drainage, physical exercises, and functional compressive bandaging (FCB) (3,4). There are a variety of investigations using different compression techniques to obtain changes in limb volume. These studies have shown a main outcome of changes in limb volume. However, it is necessary to determine the standardization of the technique with an emphasis on pressure (5,6) and the number of layers of bandages (7-11). Yet, there is no consensus on the intra-examiner and inter-examiner reliability related to the spiral or spica technique in the treatment of lymphedema in women surviving breast cancer.

Different approaches to FCB have produced similar results in reducing the volume of the affected limb (12-14). Compression with lower pressures (20-30mmHg) is considered the most appropriate practice in the treatment

of lymphedema compared to higher pressures (44-58mmHg) which are less tolerated by patients (12,15). Randomized clinical trials would shed light on support issues related to FCB in lymphedema. However, such studies are challenging due to the wide variety of treatment modalities and measured outcome parameters (16,17).

The application of FCB by different professionals can generate different results in the pressure exerted by the layers of the bandaging. The literature is scarce regarding the intra-examiner and inter-examiner reliability related to FCB treatment for lymphedema in women survivors of breast cancer. Thus, the aim of the study was to assess the intra- and inter-rater reliability of FCB using a spiral technique with four layers of bandages on the forearm and arm of breast cancer survivors with lymphedema.

MATERIAL AND METHODS

Ethical Aspects

The study was approved by the Research Ethics Committee of the Clinical Hospital, Ribeirão Preto Medical School, University of São Paulo, CAAE: 90238218.7.0000.5440, and patient participation was confirmed by signing an Informed Consent Form.

Study Design

In this intra-examiner and inter-examiner reliability study of FCB, we used two physiotherapists at different times with an interval of one week (18). The physiotherapists were previously trained and experienced in the technique. One physiotherapist was responsible for recruitment and two physiotherapists were in charge of performing the FCB in a spiral with four layers. The first physiotherapist performed FCB, then a second physiotherapist performed the same procedure. The sequence was repeated after a seven-day interval, while another evaluator was responsible for recording the FCB pressure variation measures, processing, and analyzing the collected data (*Fig. 1*).

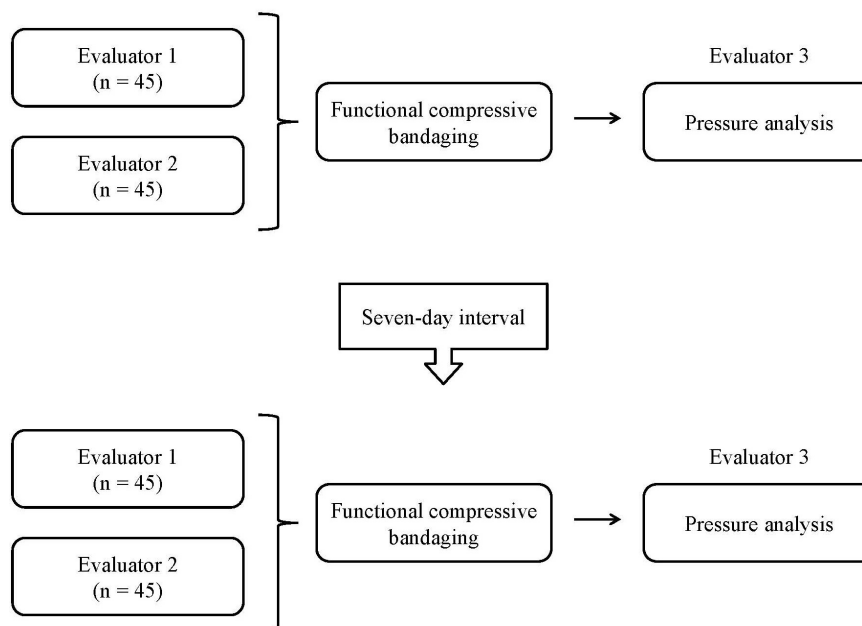


Fig. 1. Diagram of the study flow. Two different physiotherapists (Evaluators 1 and 2) performed functional compression bandaging on all 45 subjects and the pressure was measured by a different physiotherapist (Evaluator 3). The whole process was repeated 7 days later. (n = 45 subjects).

TABLE 1
General Characteristics of Study
Participants and
Their Breast Cancer Treatment. (n=45)

Variables	Mean ± Standard deviation
Age (years)	64.88±10.01
BMI (Kg/m ²)	31.94±6.05
Diagnosis time (months)	112.40±85.75
Absolute difference in limb volume (mL)	602.34±442.28
Coefficient of difference in limb volume (%)	35±11
Limb affected by lymphedema	22 Right – 23 Left
Axillary lymphadenectomy	28
Sentinel lymph node	13
Chemotherapy	33
Radiotherapy	31

BMI: body mass index.

Power Analysis and Study Population

The processing of sample calculations was performed using the Ene® software, version 3.0 (Autonomous University of Barcelona, Barcelona, Spain), based on the study conducted by Terwee et al (19), considering 80% statistical power and alpha of 0.05 and totaling 45 women.

Participated in the study included forty-five women with a mean age of 64.88 (SD = 10.01) years, average BMI of 31.94 (SD = 6.05) kg/cm², with lymphedema secondary to the treatment of breast cancer of 602.34 (SD = 442.28) mL, and with no ongoing adjuvant treatment, preexisting upper limb dysfunction, or associated diseases. Regarding the treatment of breast cancer, the average time of surgery was 112.40 (SD = 85.75) months. Prior general characteristics of the women are shown in *Table 1*.

Upper Limb Volume

Lymphedema was documented by measuring the indirect volume of the upper limbs determined by calculating the sum of the volume of truncated cones using seven-point circumferences of the arm and forearm. The method has good intra- and inter-examiner reliability levels, with intraclass correlation coefficient (ICC) values of 0.99 (20,21). Lymphedema was confirmed with the difference between limbs equal to or greater than to 200 mL by means of criteria established by Andersen et al. (22). Calculation of the volume difference coefficient was performed to identify the percentage of asymmetry of the upper limb affected by lymphedema compared to the unaffected upper limb. The positive value indicates an increase, and the negative value indicates a reduction in volume between body segments.

Manometry

The pressure exerted by the bandage (sub-bandage) was evaluated by an instrument composed of an inflatable rubber bag connected to a properly calibrated manometer, positioned in the arm and forearm regions as developed based on studies by Damstra et al (12) and Kang et al (23). Accuracy and precision of measurements was evaluated according to criteria established by Partsch (24). The same instrument was used to assess the degree of pressure exerted by the bandaging in another study by Rezende et al (25).

The recording of the pressure exerted by the compression bandage was performed immediately after the procedure, while the patient was seated and the instrument positioned and stabilized in the central portion of the anterior region of the arm and forearm.

Functional Compressive Bandaging

Functional compressive bandaging was performed on the upper limb same side as the surgery, from the fingers to the axillary region, with spiral technique and distribution of four layers of bandages (26). No therapeutic procedure was performed before FCB.

TABLE 2
Pressure Measurement of Functional Compression Bandaging
by Two Different Physiotherapists (n=45)

		Mean ± Standard deviation	
	Measurements	PT _A	PT _B
Arm	First	32.44±7.65	29.22±8.56
	Second	31.84±6.65	28.95±6.97
Forearm	First	33.88±7.83	33.66±5.71
	Second	34.00±7.57	32.66±5.92

Abbreviations: PT, physiotherapist.

Correlation Analysis

The comparison of the FCB pressure between Physiotherapist A and Physiotherapist B was performed using t-test. The analysis of intra- and inter-examiner reliability was tested by the intraclass correlation coefficient (ICC) with a 95% confidence interval, minimum detectable difference (DMD), and standard error of measurement (SEM). The interpretation of the ICC value was based on the study by Fleiss (1986) (27): for values below 0.40, reliability was considered low; between 0.40 and 0.75, moderate; between 0.75 and 0.90, high; and values greater than 0.90, reliability was considered excellent. Data processing was performed using SPSS® software, version 13.0 (Chicago, IL, USA), considering a significance level of 0.05.

RESULTS

Table 2 shows the results of pressures produced by FCB on the upper limb with physiotherapists A and B at both time points. Overall, the FCB produced pressures that were not significantly different ($p > 0.05$) from each physiotherapist at each point and time.

Table 3 reveals the results of inter-rater reliability in the arm and forearm region. In the arm region, reliability was low for both the first measurement (ICC: 0.2) and the second measurement (ICC: -0.3). In the forearm region, reliability was moderate in the first measurement (ICC: 0.6) and low in the second

measurement (ICC: -0.2).

Table 4 shows the results of intra-examiner reliability in the arm and forearm region. Physiotherapist A revealed low reliability for both the arm (ICC: -0.04) and forearm (ICC: -0.3) regions. Physiotherapist B showed high reliability (ICC: 0.8) for the arm and moderate (ICC: 0.7) for the forearm regions.

TABLE 3
Interrater Reliability of the Arm and Forearm
for the Measurements by Two Different
Physiotherapists (n=45)

	Measurements	ICC (95% CI)
Arm	First	0.2 (-0.4; 0.6)
	Second	-0.3 (-1.4; 0.2)
Forearm	First	0.6 (0.2; 0.8)
	Second	-0.2 (-1.1; 0.4)

Abbreviations: CI, confidence interval.

TABLE 4
Intrarater Reliability of the Arm and
Forearm of the Two Physiotherapists (n=45)

ICC (95% CI)		
	PT _A	PT _B
Arm	-0.04 (-0.9; 0.4)	0.8 (0.7; 0.9)
Forearm	-0.3 (-1.5; 0.3)	0.7 (0.4; 0.8)

Abbreviations: CI, confidence interval, PT, physiotherapist.

DISCUSSION

The objective of the present study was to evaluate inter- and intra-examiner reliability of FCB with spiral technique in the treatment of secondary lymphedema related to breast cancer. Intra-examiner reliability was low to high while inter-examiner reliability was low to moderate. These results reflect the difficulty in standardizing the FCB technique. The criteria established for carrying out the procedure are contestable by Laplace's Law. Components of the system influence the proportion of pressure as described by Muldoon (28) and Hegarty-Craver et al (29) and establish that the heterogeneity of body segment circumference, the number of layers, and the elastic property of the material determine the interface of the therapeutic compression system. The gold standard for the treatment of lymphedema is complex decongestive therapy and involves manual lymphatic drainage, physical exercises, compression, and skin care (30). The application of inelastic bandages, regardless of the pressure level, trigger a significant reduction of lymphedema (31) due to the negative pressure gradient passively facilitating lymphatic flow (32-35). It is known that low to moderate pressure levels are successful due to increased tolerance and consequently the possibility of prolonged use. However, there is a need for daily reapplication of the functional compressive bandaging (2,12).

This study confirms an applicator-dependent character to this secondary lymphedema treatment approach. The study of Protz et al (36) identified difficulty in uniformly applying inelastic bandages to lower limbs and highlighted the need for professional training. Hara et al (37) emphasized the need for standardization of technique due to divergence in application of pressure among health professionals trained in methods of FCB. In addition, Karakashian et al (38) highlighted challenges in elastic bandages due to the distinct behavior of subcutaneous structures which trigger pressure variability in body segments.

There is a lack of evidence regarding the different methods of FCB. Benigni et al (39) evaluated the pressure and stiffness interface

for the spiral and spica techniques in lower limb lymphedema and attributed clinical effectiveness to the spica technique. Likewise, Oh et al (26) claimed significant benefits for the spica technique in reducing volume and improving functionality but pointed out the possibility of low adherence due to performance characteristics and consequent discomfort in the upper limb. In the present study, the spiral technique approach was selected because of the ease of reproduction among physiotherapists.

The present study was the first to perform reliability measures of FCB using a spiral technique in women undergoing breast cancer treatment, therefore, comparisons are not possible. Challenges to the execution of the procedure are highlighted related to the issue of standardization among health professionals. Therefore, further studies are needed with an emphasis on adequate reproducibility and efficiency for FCB to control lymphedema secondary to the treatment of breast cancer.

CONFLICT OF INTEREST AND DISCLOSURE

The authors declare no competing financial interests exist.

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