

# Active exercises utilizing a facilitating device in the treatment of lymphedema resulting from breast cancer therapy

## Aktive Übungen zur Reduzierung des Lymphoedems nach Brustkrebsbehandlung

### Abstract

The aim of this study was to evaluate the reduction in volume of arm lymphedema secondary to breast cancer therapy utilizing an exercise facilitating device. Twenty-one women with arm lymphedema resulting from the surgical and radiotherapeutic treatment of breast cancer were randomly selected. Evaluation was made by water-displacement volumetry before and after each session. The patients were submitted to a series of active exercises using a facilitating device for four 12-minute sessions with intervals of 3 minutes between sessions in the sitting position with alignment of the spinal column. The lymphedematous arm was maintained under compression using a cotton-polyester sleeve. The active exercising device used was a mobile flexion bar fixed on a metal base at a height of 30 cm from the tabletop and at a distance of 10 cm from the patient's body. The paired t-test was utilized for statistical analysis with an alpha error of 5% ( $p\text{-value} \leq 0.05$ ) being considered significant. The initial mean volume of the arms was 2,089.9 and the final volume was 2,023.0 mL with a mean loss of 66.9 mL ( $p\text{-value} < 0.001$ ). In conclusion, active exercises utilizing facilitating devices can contribute to a reduction in size of lymphedematous limbs.

**Keywords:** lymphedema, mamma carcinoma, active exercises, devices

### Zusammenfassung

Ziel der Studie war es, die Wirkung eines Übungsgerätes zur Volumenreduzierung von Lymphoedemen, die infolge einer Brustkrebsbehandlung entstanden waren, zu prüfen. 21 Frauen mit Lymphoedem der Arme resultierend aus der chirurgischen und Strahlentherapie des Mamma-Karzinoms wurden in die Studie einbezogen. Die Evaluierung erfolgte durch Erfassung der Flüssigkeitsverdrängung vor und nach der Behandlung. Die Patientinnen führten Bewegungsübungen mit Hilfe eines Gerätes für die Dauer von 4 x 12 Min. durch mit jeweils einer Unterbrechung von 3 Min. Die Übungen wurden in sitzender Position und aufrechter Haltung durchgeführt. Der betroffene Arm wurde mit einem Baumwoll-Polyester-Ärmel komprimiert. Das verwendete Übungsgerät war eine bewegliche Stange, die über ein Drehgelenk mit einem Metallständer verbunden war (Höhe über dem Übungstisch: 30 cm, Abstand vom Körper der Patientin: 10 cm).

Die statistische Auswertung erfolgte mit dem gepaarten t-Test mit einer Irrtumswahrscheinlichkeit von 5% ( $p \leq 0,05$ ). Das mittlere Flüssigkeitsvolumen der Arme war initial 2.089,9 ml und nach Therapie 2.023,0 ml mit einer mittleren Flüssigkeitsverdrängung von 66,9 ml ( $p \leq 0,001$ ).

Die aktive Übung mit einem einfachen Gerät kann eine signifikante Reduktion des Lymphoedems der Arme bewirken.

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**Schlüsselwörter:** Lymphoedem, Mamma-Karzinom, aktive Übungen, Hilfsgerät

## Introduction

Lymphedema is a type of edema that occurs due to an abnormal accumulation of fluids and other substances in the tissues resulting from a failure of the lymphatic system associated with insufficiency of extralymphatic proteolysis of proteins in the cell interstice and mobilization of macromolecules [1], for example hyaluronic acid [2].

The treatment recommended for lymphedema is a combination of therapies including: lymph drainage [3], [4], exercising [5], [6], [7], hygienic care [8], psychological support [9] and more recently the association of occupational activities [10] with compression mechanisms and cervical stimuli [2], [11].

The exercises used to treat lymphedema should be programmed controlled muscle activities to improve the physical condition without competitive objectives [6], [9]. Even so, it is very important to consider the principles of biomechanics, velocity, duration and positioning with this approach to therapy [12].

However, one of the difficulties related to exercising is controlling how they are carried out: the development of facilitating devices may assist in this aspect and establish a specific plan of exercises for the patient. The objective of the present study was to evaluate the reduction in volume of arm lymphedema resulting from cancer treatment utilizing a specific exercise facilitating device.

## Methods

A total of 21 women with clinical diagnosis of arm lymphedema were randomly selected by order of arrival in a rehabilitation group. All participants reported that they had been submitted to radiotherapy after surgery for breast cancer. The time from surgery until this study varied between 2 and 12 years and none of the patients had been submitted to any type of physical rehabilitation within this period.

Evaluation of the edema was achieved by water displacement volumetry immediately before and after each experiment. The patients were submitted to a one-hour session of active exercising, divided in 12-minute stints with intervals of 3 minutes, utilizing a facilitating device. The active exercises in this study were characterized by active and conscious participation of the patient with voluntary command of the muscles involved in the movements. The patient independently performed the exercises without help from the therapist: the apparatus has no type of manual or mechanical resistance. The intervention was only to control the time and rest intervals, and guidance about posture.

The patients remained sitting with alignment of the vertebral column and used a cotton-polyester compression

sleeve on the lymphedematous limb [2]. An active exercising device, denominated mobile flexion bar, was developed (Figure 1). It is fixed on a metal base at a height of 30 cm from the tabletop and at a distance of 10 cm from the body of the patient (Figure 2).



Figure 1: Apparatus mobile flexion bar



Figure 2: Demonstration of the movement and positioning of the device performed

The paired Student t-test was utilized for statistical analysis with an alpha error of 5% ( $p\text{-value} \leq 0.05$ ) being considered acceptable. The study was approved by the Research Ethics Committee (Instituto de Biociências Letras e Ciências Exatas, Campus de São José do Rio Preto, Brazil protocol No. 0002.0.229.000-07).

## Results

The initial and final mean volumes were 2,089.9 mL and 2,023.0 mL, respectively giving a mean loss of 66.9 mL ( $p\text{-value} < 0.001$ ). Table 1 illustrates the volume loss before and after the activities and the variations for each patient.

**Table 1: Volume before and after the activities of each patient**

No. of Patient	Initial vol. (mL)	Vol. after 60 minutes (mL)	Difference
1	1,926	1,813	-113
2	1,742	1,748	6
3	2,643	2,612	-31
4	2,052	2,115	63
5	1,377	1,217	-160
6	1,799	1,645	-154
7	2,031	1,987	-44
8	1,534	1,572	38
9	2,852	2,704	-148
10	2,017	2,106	89
11	2,043	1,923	-120
12	1,978	1,942	-36
13	2,189	2,065	-124
14	1,568	1,572	4
15	2,034	1,993	-41
16	1,656	1,580	-76
17	2,079	1,975	-104
18	2,387	2,210	-177
19	1,976	1,917	-59
20	3,326	3,243	-83
21	2,677	2,556	-121

Vol. = volume

## Discussion

The current study adopted a pedal arrangement with the objective of facilitating, programming and controlling exercises of patients with arm lymphedema and showed that these exercises are efficacious in reducing the volume of edema. There are no publications analyzing the use of devices with these characteristics in lymphedema treatment. The device was developed after a pilot study of lymphedematous upper limbs which evaluated the working pressures of the main muscle groups which are involved in flexion and stretching movements and cause the greatest working pressure variations.

The main difficulty in respect to myolymphokinetic exercises is the control of how they are carried out. Exercises utilize muscle contractions and these cause external compression on the blood vessels; this compression on veins and lymphatic vessels favors drainage. However, exercising demands a higher blood flow to the region and consequently increases the capillary filtration and requires greater lympho-venous drainage. Thus, exercising may lead to an increase in the volume of the limbs or a reduction depending on the filtration demand versus drainage. In the treatment of lymphedema, the main objective is the reduction in edema; hence exercises should be performed so that there is a resulting reduction [13].

Myolymphokinetic exercises and activities can, in truth, stimulate lymphovenous drainage. The authors suggest the term myolymphokinetic therapy for exercises and activities that lead to greater drainage than filtration and thus a reduction in the size of the limb.

Passive exercises are preferable to active exercises as they demand less energy [14]. However, active exercises are important to assist in maintaining the muscle trophism and maintaining the efficacy of contractions.

The development of active exercises that can be controlled will constitute an advance in the treatment of lymphedema in respect to exercising. It will be possible to establish, for each patient, an individually adapted device that leads to a reduction in the lymphedema. This is a new research line that will help to better understand exercising, a low cost therapy which is easy to perform. Another advantage is that exercises can be performed in any place giving greater independence to these patients. Exercising will not constitute the only therapy for lymphedema, but will be part of the combination of therapies.

## Conclusions

The development of myolymphokinetic apparatuses may facilitate the indication of more specific and efficacious exercises in the treatment of lymphedema of the upper limbs.

## Notes

### Competing interests

The authors declare that they have no competing interests (political, personal, religious, ideological, academic, intellectual, commercial or any other) in relation to this manuscript.

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