

Research Paper

Synergic Effect of Compression Therapy and Controlled Active Exercises Using a Facilitating Device in the Treatment of Arm Lymphedema

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Abstract

Trial design: A randomized controlled trial was performed to evaluate the effect of the combination of compression therapy with active exercising using a facilitating apparatus on arm lymphedema. **Method:** Twenty women with a mean age of 63.3 years were evaluated; all had lymphedema resulting from breast cancer treatment. The inclusion criterion was a difference of 200 mL in size between arms. The apparatus used, called 'pulley system', is a vertical iron wheel fixed on a support at a distance of 10 cm from the patient's body. Participants were submitted to two series of active exercises using this facilitating device, one series using a compression sleeve and the other without. Each series consisted of four 12-minute sessions of exercises separated by 3-minute rest intervals. Volumetry was performed before and after each series of exercises. The paired t-test was utilized for statistical analysis (p -value < 0.05). **Results:** A significant mean reduction (p -value < 0.007) and non-significant mean increase (p -value < 0.2) in volumes were observed during exercising with and without compression, respectively. **Conclusion:** Controlled active exercising utilizing a facilitating apparatus while wearing a compression sleeve reduces the size of lymphedematous arms.

Key words: lymphedema, exercising, equipment.

Introduction

In recent years, due to the increase in the incidence of breast cancer, research on the physical and psychosocial sequels of treatment has intensified.¹ Functional changes associated to breast cancer treatment include reductions in muscle force and in the amplitude of movement of the shoulder and increases in the body segment volume, frequently involving pain⁵ and consequently alterations in the quality of life and difficulties in performing everyday activities²⁻⁴.

Lymphedema is one complication of breast cancer treatment. A 10-year follow up reported an incidence of 38.7% for lymphedema⁶ and identified axillary dissection and radiotherapy as important risk factors;⁷ the hypothesis of the authors was that these procedures damage the lymphatic system and impair drainage of proteins and macromolecules from the cell interstice.⁸ Other publications place the prevalence between 9% and 45% depending on risk factors which include the type of surgery, radiotherapy, obe-

sity and infections.⁹⁻¹¹

There is no consensus on one single specific treatment for lymphedema but an association of therapies is recommended. These therapies include manual and mechanical lymph drainage,¹²⁻¹⁴ exercising and myolymphokinetic activities,^{15,16} compression garments and bandages,^{17,18} care with hygiene and with daily tasks,¹⁹ and psychological support.²⁰

Of the different forms of lymphedema treatment, myolymphokinetic exercises, lymph drainage and compression mechanisms seem to constitute the three most important. Myolymphokinetic exercises cause muscle movements that increase veno-lymphatic return which, in turn, leads to a reduction in the volume of the lymphedema⁸ however for these exercises to be effective they must comply with biomechanical principles.²¹ Frequently the increase in volume of the affected limb reduces the amplitude of movements, increases the body mass index and makes exercising, and consequently rehabilitation of the limb, more difficult. Thus exercising is a technique that potentially can be used in the treatment of lymphedema.²² Apparatuses can be used to control movements in the rehabilitation of limbs thereby improving the amplitude of joint movement and posture of the spine and reducing limb size.

The aim of the current study was to evaluate the effect of active exercising using a facilitating apparatus associated with compression on arm lymphedema resulting from breast cancer treatment.

Method

Twenty female patients with a clinical diagnosis of lymphedema resulting from the surgical treatment of breast cancer and subsequent radiotherapy and chemotherapy were enrolled in this study. Lymphedema was defined as a difference in volume of more than 200 mL compared to the contralateral arm. The ages of the patients varied between 49 and

82 years old with a mean age of 63.3 years.

The effect of compression on volume changes was evaluated in lymphedematous arms of patients exercising using a facilitating apparatus. The patients were submitted to two sessions of four 12-minute stints of exercising with intervals of three minutes between each stint to rest. They were required to sit with the spinal column properly aligned during the exercising. A short-stretch 'home-made' compression sleeve made of a cotton-polyester textile was used during one of the sessions of exercises^{8,23}. The order of the sessions (with the compression sleeve and without compression) was decided by simple randomization using a table from a statistics book. Evaluation before and immediately each one-hour session of exercising was achieved by volumetry using the water displacement technique²⁴. An active exercise apparatus denominated 'pulley system' was used. This device consists in a vertical iron wheel fixed to a 30 cm-high support on a metal bench placed at a distance of 10 cm from the patient's body. The patient revolves the wheel thereby elevating the shoulder and stretching the arm.

Statistical analysis

The paired t-test was employed for statistical analysis with an alpha error of 5% (p-value < 0.05) being considered acceptable.

Results

A reduction in arm volume of 24.6 mL (standard deviation = 25.6 mL) was seen during the one-hour exercising session while wearing a compression sleeve (p-value = 0.0004). However, a non-significant mean increase in arm volume of 9.7 mL (standard deviation = 33.3 mL - p-value = 0.2) was observed in patients exercising without the compression sleeve (Table 1).

Table 1: Mean and standard deviation of volume before and after one hour exercising using the apparatus with and without compression.

	With compression			Without compression		
	Initial (vol)	After 1 hour	Difference	Initial (vol)	After 1 hour	Difference
N	20	20	20	20	20	20
Mean	1988.3	1963.7	24.650*	2015.1	2024.9	-9750
Std deviation	396.50	398.50	25.656	439.44	448.55	33.312
Std error	88.660	89.106	5.737	98.262	100.30	7.449
Median	2023.0	2010.5	16.000	2004.0	2003.0	-11.500
	p<0.0004 *			p<0.2		

Discussion

The current work is part of an initial study to standardize exercising using a facilitating apparatus to treat lymphedema resulting from breast cancer therapies. There are few publications that determine the types, objectives and how exercises should be utilized in the treatment of lymphedema. Additionally, few studies have reported on the criteria used to prescribe exercising. However in the daily practice we observe that the same exercises can increase or decrease the size of lymphedematous limbs due to difficulties inherent in controlling these activities. The utilization of apparatuses is one option that allows the standardization of activities and to define in which way patients should perform specific activities.

Pilot studies have shown that there is a necessity to evaluate each patient to check if prescribed exercises achieve treatment goals. In lymphedema, the main objectives are to reduce the limb volume, control muscle trophism and maintain joint mobility. Thus, muscle work and joint movement are used to attain these objectives.

However exercising requires higher or lower blood flows depending on the force. To achieve reductions in limb volume, it is necessary to drain more fluids from the tissues than are filtered by the capillary membrane and so myolymphokinetic activities that lead to a reduction in the size of the limb should be used. A high blood flow is required to strengthen the musculature and lymph drainage does not always accompany this flow rate and so increases in limb volume can result from activities.

Pilot studies have also shown that employing an exercising facilitating apparatus for a particular length of time can either increase or decrease the limb volume depending on the speed at which exercises are performed, the patient's fitness and the size of the limb. From these observations we identified the best type of apparatus and time of exercising, and also the necessities of each patient. For some patients the limb volume needs to be reduced, for others, the muscles need to be strengthened and joint mobility needs to be improved and for others an association of these aspects is necessary. However doubts remain about the effectiveness of compression during exercising which led us to evaluate this association.

Preliminary studies evaluating muscle activities as therapy for lymphedema resulting from breast cancer treatment demonstrated that inelastic or short-stretch compression mechanisms help to reduce limb volume^{16,18}. Hence, we chose a compression garment made from a cotton-polyester material, that is, the same material used in an earlier study that

evaluated exercising²³.

An understanding of the physiology of exercising and of the lymphatic system, in particular related to the necessity of controlling the speed of movements and the correct alignment of the spinal column, was used to develop these facilitating devices. The exercising program was split in 12-minute exercising sessions followed by rest intervals so that the capillary filtration rate remained relatively low. With greater effort or longer exercising sessions, the supply of blood to the muscles increases and this may increase the edema.

The first part of this study was to develop an apparatus from simple materials (metal) that would facilitate specific controlled active movements with the objectives of reducing the limb volume, increasing the amplitude of movements and of strengthening the muscles. Thus, the proposed exercising program had several different goals.

Exercising may constitute a treatment method or it can aggravate the lymphedema depending on how it is performed. This observation is seen every day; patients report that the edema worsened after performing specific activities as more effort was exerted than the maximum allowed by limitations imposed by the lymphedema. Hence daily clinical practice shows us that a balanced is fundamental to maintain the limb within or close to normality. Without activity, muscles become atrophic and excessive and repetitive activities can lead to increased edema.

Faced with these difficulties, it is important to identify synergic mechanisms that allow the patient to perform exercises or muscle activities without aggravating the edema. Hence, compression mechanisms together with controlled activities have a synergic effect in the treatment of lymphedema. The current study shows that exercising without a compression garment may improve joint mobility and strengthen the musculature but it does not reduce the volume of the limb. However, when associated to compression therapy, the synergic effect leads to a reduction in size. The mechanism of inelastic or low-stretch compression does not reduce the volume of the limb without muscle activity. So it is the working pressure caused by muscle activity acting within an inelastic or low-stretch compression mechanism that causes a reduction in limb volume.

For this study, we performed pilot studies to assess the best way to perform activities over a one-hour period, that is, with or without rest intervals. This rest interval proved to be synergic in respect to the loss in volume. Hence an exercising program to treat lymphedema should be well planned and the results careful assessed.

One study demonstrated the effect of the application of a new technique, lymphoscintigraphy, after an intradermal injection of contrast, as a functional evaluation of the lymphatic system. The technique showed acceleration in drainage and several compensation mechanisms both during resting and with exercising in a group of patients with late or absent lymph drainage²².

The use of low-stretch or inelastic compression in the treatment of lymphedema is indicated because working pressures caused by the muscle activity favor drainage and seem to be tolerable to patients^{13,25}. One study concluded that there was no risk of aggravating lymphedema with the use of compression during light exercising as, in the day-to-day life, compression is frequently utilized²⁶.

It is important to stress that any mechanism used must be correctly adjusted in a way to avoid the development of strangling because of badly adjusted compression. This is frequently observed and thus healthcare professionals and patients should be aware about the necessity to adjust compression mechanisms during exercising and during daily activities.

Conclusions

Low-stretch compression mechanisms have a synergic effect in the reduction of volume of lymphedematous limbs during active exercising controlled by the use of a facilitating apparatus.

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Registration Trial

Patients that fulfilled the inclusion criteria were informed about the objectives of the study and, if they accepted to participate, were required to sign an informed consent form. The study was approved by the Research Ethics Committee (Instituto de Biociências Letras e Ciências Exatas, Campus de São José do Rio Preto, SP, Brazil - # 11/2007) and registered in a trial ACTRN12610000763044. Web address of the trial: <http://www.ANZCTR.org.au/ACTRN12610000763044.aspx>.

Competing Interests

The authors have declared that no competing interest exists.

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