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Effect of exercise while utilizing a device with an arm compression sleeve to reduce lymphedema

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Summary

Background: Lymphedema is one complication of breast cancer treatment and there is no consensus that identified one single therapy in the treatment of lymphedema; therfore an association of methods is recommended and one of these is exercising. The aim of this study was to evaluate the utilization of exercising with a facilitating device along with an arm compression sleeve to reduce the size of lymphedematous arms. *Materials and Methods:* Thirty women from a rehabilitation group with arm lymphedema resulting from the surgical, chemotherapeutic, and radiotherapeutic treatment of breast cancer were enrolled sequentially on arriving in the clinic. While sitting in an upright position and wearing an arm compression sleeve, patients were submitted to a one-hour session of active exercising consisting of four 12-minute stints with three-minute intervals to rest. The change in lymphedema was evaluated by water volumetry before and immediately after the session. The active exercising device is similar to the pedaling system of a bicycle. The paired *t*-test was employed for statistical analysis. An alpha error of 5% (p-value < 0.05) was considered acceptable. *Results:* A statistically significant reduction (p-value < 0.004) was noted in the size of the arm. *Conclusion:* Active exercising using a facilitating device and under supervision may reduce the size of lymphedematous arms.

Key words: Arm compression; Exercise; Lymphedema; Breast cancer.

Introduction

In recent years due to the increased incidence of breast cancer, research on the physical and psychosocial sequelae of mastectomy combined with chemotherapy and radiotherapy has been intensified [1]. In these cases the functional impairment of arms, which frequently includes pain, reductions in the amplitude of shoulder movement and in muscle force, and increases in the body segment volume with consequent alterations in the quality of life and difficulties in performing daily activities [2-4] are linked to the treatment of breast cancer [5].

Lymphedema is one complication of breast cancer treatment. A ten-year follow-up study reported an incidence of lymphedema of 38.7% [6]. Another study identified the degree of axillary dissection and radiotherapy as important risk factors [7]. The hypothesis of the authors is that these procedures damage the lymphatic system and complicate drainage of proteins and macromolecules from the cell interstice [8].

There is no consensus that identified one single therapy in the treatment of lymphedema; therefore an association of methods is recommended. One of these treatments is exercising [9, 10]. Additionally, recent studies suggest that the use of lymphokinetic activities associated to compression mechanisms may be a form of treatment [11].

Lymphokinetic activities are structured muscle activities without being competitive that improve the patient's fitness and health [12]. Myolymphokinetic activities, another form of lymphedema treatment, consist of randomly non-programmed muscle exercises which include the day-to-day movements used to perform domestic and professional activities [13]. Even so, biomechanical principles, such as the speed and duration of the movements and posture, should be considered in this treatment method. Hence, one of the difficulties is to control exercising; thus, the development of facilitating devices may facilitate this and allow the establishment of specific exercising programs for each patient. The aim of this study was to evaluate the reduction in the size of arms affected by lymphedema following breast cancer treatment by exercising using a facilitating device.

Materials and Methods

Thirty women from rehabilitation group for patients with arm lymphedema resulting from the surgical, chemotherapeutic, and radiotherapeutic treatment of breast cancer, ranging from 43 to 80 years of age with a mean of 61.5 years, were enrolled sequentially on arriving in the clinic. While sitting in an upright position, the participants were submitted to a one-hour session of active exercises. This session consisted of four 12-minute stints with intervals of three minutes to rest. The active exercising device, similar to the pedaling system of a bicycle, was fixed on a

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Figure 1. — Active exercising device similar to the pedal system of a bicycle fixed on a table at a height of 30 cm from the floor and at a distance of ten cm from the patient's body.

table at a height of 30 cm with the table at a distance of ten cm from the patient's body as demonstrated in Figure 1. The device was developed by the authors from low-cost (junk) material with the design taking into account the physiology and pathophysiology of the lymphatic system. The device was made from cheap materials so that the patients themselves could have the device in their homes to perform daily exercises. The exercising was controlled by a physiotherapist at an intensity of about ten movements per minute.

An arm compression sleeve, made from a low-stretch cotton-polyester textile by a seamstress [14], was worn during exercising [15, 16]. The arm sleeve was adjusted for each individual patient before starting the activity. The patient was warned that exercising should be ceased and the physiotherapist immediately informed if they felt any joint pain or discomfort of the shoulder or arm. In these cases, this was considered an adverse event.

The change in lymphedema was evaluated by water volumetry before and immediately after the session. The displaced water was weighed on calibrated weighing scales (grams) as one gram of water as the equivalent of one ml in volume. Arms were diagnosed as lymphedematous when the volume was at least 200 ml greater than the contralateral arm.

The paired *t*-test was employed for statistical analysis and an alpha error of 5% (p-value < 0.05) was considered acceptable. The study was approved by the Research Ethics Committee of the Instituto de Biociências Letras e Ciências Exatas, Campus de São José do Rio Preto, SP, Brazil n^0 11/2007 and registered as a Trial ACTRN12610000758000.

Results

The mean arm volume before starting the exercises was 2,070.4 ml and after one hour of exercising using the apparatus the mean arm volume was 2,012.0 ml, thus giving a statistically significant loss of 58.43 ml (p-value < 0.004, Table 1). Figure 2 illustrates the difference in volumes with exercising. No patient complained about pain or discomfort and thus no adverse events were registered.

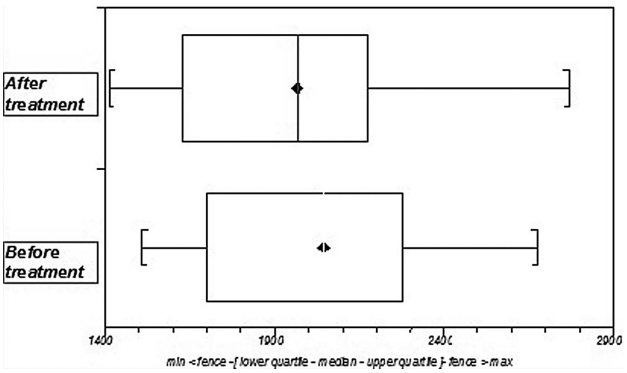

Figure 2. — Box plot of the difference in volume of lymphedematous arms before and after exercising.

Table 1. — *Mean and standard deviation of volume before and after one hour with apparatus exercise.*

	Volume before (ml), n = 30	Volume after (ml), n = 30	Difference
Mean	2,070.4	2,012.0	58.433
Standard deviation	375.44	418.12	80.491
Standard error	68.545	76.338	14.696
Median	2,043.0	1,967.0	69.000

p-value < 0.004.

Discussion

The current study showed the reduction in size of lymphedematous arms secondary to breast cancer treatment during active exercising using a facilitating device under the supervision of a physiotherapist.

There are few publications that assess the types, objectives, and how exercises should be utilized in the treatment of lymphedema. Additionally, few studies have reported on what criteria should be used to prescribe exercising. However in daily practice, we observe that the same exercises can increase or decrease the size of lymphedema limbs due to difficulties inherent to controlling these activities, which explains the need for professional supervision [17-19]. Thus, in lymphedema treatment, the therapeutic prescription of exercising or myolymphokinetic activities takes into account three major objectives in respect to patients submitted to breast cancer treatment: 1) reduction of the lymphedema, 2) improvements in the amplitude of joint movement, and 3) maintenance of muscle trophism. Hence the objective of each exercise is dynamic and dependant on the phase of treatment. When the edema is the most important aspect, the main objective is to reduce volume and the risk of injury to the tendons and muscles due to the weight of the arm. After this phase, joint mobility and trophism become important. This is a new line of research that focuses on developing facilitating devices which enable the control of exercising. Myolymphokinetic activities are ex-

ercises that cause a greater volume of drainage than capillary filtration. However, the speed, force, and duration of exercising, and the posture of the patient are some factors that affect the result. As with myolymphokinetic activities, these factors cannot be easily controlled and the development of a programmed mechanical device is necessary to improve the safety of the treatment. Pilot studies to define the design of this current study proved that the speed and duration of exercising influence the results [20]. Another aspect relates to the compression therapy of the limb. Good adjustment of arm compression sleeves is essential and any fold or irregularity may lead to a restriction in blood flow and cause an increase the size of the limb. Hence, care is of fundamental importance to the success of treatment. There is no adequate published definition of myolymphokinetic exercises or suggestions on how these exercises should be performed and thus there is a need for guidelines. Nevertheless, some studies on exercising have shown an improvement in the fitness of patients when they perform daily activities [21, 22].

The results of this study support the idea that the use of controlled active exercises to reduce arm edema is a new coadjuvant therapeutic option in the treatment of lymphedematous arms [16]. Hence an association with active exercises is necessary in the treatment of lymphedema. A passive device for lymph drainage developed for the upper limb utilizing joint mobility is very effective in reducing edema, however an association of passive and active exercises is important [16, 21-23].

Conclusion

Active exercises performed with facilitating devices and under supervision reduce the size of lymphedematous arms.

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