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Original Article

Effect of complete decongestive therapy and a home program for patients with post mastectomy lymphedema

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Abstract. [Purpose] Post mastectomy lymphedema is common among breast cancer survivors. It leads to physical discomfort and functional impairment. Rehabilitation forms the mainstay of treatment and is multidisciplinary. [Subjects and Methods] Sixty post mastectomy patients were allocated randomly and assigned to either a conventional treatment group (n=30) or a complete decongestive therapy (CDT) group (n=30). The conventional treatment group received manual lymphatic drainage, wore a low elastic compression garment, received glenohumeral mobilization, and performed deep breathing exercises, and the complete decongestive therapy group received CDT from a trained physiotherapist and a daily home program along with the conventional treatment, 5 days a week for 6 weeks. [Results] Arm circumference measurements were taken at five levels: the wrist, mid forearm, elbow, mid-upper arm, and axilla. The upper extremity function was evaluated using the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, and pain was assessed using the visual analogue scale. Measurements were taken at baseline, and at 4th and 6th weeks after the start of intervention. Within and between group comparisons showed significant improvements in the CDT group. [Conclusion] Complete decongestive therapy and a home program assists breast cancer related lymphedema survivors in regaining their lost functions. It also helps to improve their independence in daily activities, reduce their need for caregivers, and thereby improving their quality of life. Therefore, the results of this study showed that the CDT with a home program is an effective treatment for reducing post mastectomy lymphedema.

Key words: Breast cancer, Manual lymphatic drainage, Post mastectomy lymphedema

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INTRODUCTION

Post mastectomy lymphedema (PML) is a condition that can develop early or years after mastectomy. It develops due to the physical trauma of surgery and radiotherapy, which can interrupt the lymphatic system to varying degrees[1)]. Secondary lymphedema can cause disfigurement, physical discomfort, and functional impairment, and results in poor functional recovery, chronic disability and, impaired quality of life[2, 3)]. Anxiety, depression, and emotional distress are more common among patients with secondary lymphedema[3, 4)]. The incidence of breast cancer has increased globally, and the greatest increases are being in Asian countries with a very wide range from 2% to 40% of women[5, 6)]. Different factors such as the level of nodal dissection, the number of nodes removed, the number of involved nodes, the presence of extra capsular spread, the size and grade of the primary tumor, co-morbid conditions, chemotherapy, axillary irradiation, experience of the surgeon, dominant limb and body mass index can influence the incidence of lymphedema[7–9)]. Unfortunately, some survivors experience long-term complications that include physical impairments, psychological distress and suboptimal health-related quality of life[10, 11)]. Consequently appropriate measures are important for reducing complications that can impair the function and quality of life. The treatment of post mastectomy lymphedema is multidisciplinary, and includes medical, surgical, palliative and physical therapy approaches. The physical therapy treatment for post mastectomy lymphedema involves upper limb elevation and exercises, a compression sleeve, massage therapy, complete decongestive therapy (CDT), manual lymphatic drainage (MLD) and pneumatic compression pump[12)]. Rehabilitation interventions are considered the mainstay of treatment for the post mastectomy lymphedema[12–15)]. Manual lymph drainage is a specialized manual (hands-on) technique designed to improve fluid removal from congested areas and helps to drain the lymph into functioning lymph vessels and lymph nodes[16–24)]. CDT is considered as

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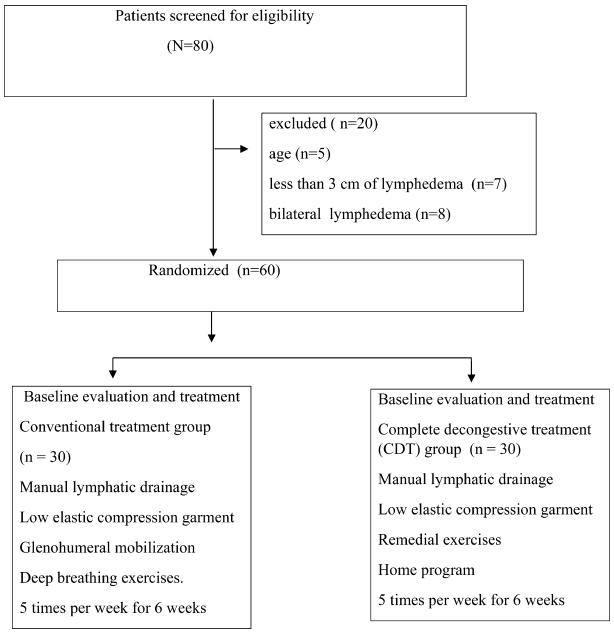

Fig. 1. Flow chart for the sample recruitment

standard care for lymphedema management but the level of evidence for each component used to improve hand function and quality of life needs to be established[25–28]. Commonly used patient reported outcome measures for breast cancer survivors have been identified and validated. Measures such as the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Breast Cancer Module (EORTC QLQ BR23), FACT-B, and the BREAST-Q have been designed to measure overall function[29]. A number of reported outcome measures have been developed to assess the effects of cancer disease on upper limb function. Kwan's Arm Problem Scale (KAPS) was developed to identify arm problems such as arm stiffness, pain and function during breast cancer treatment[30]. The Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire[31] and the Upper Extremity Functional Index (UEFI) are also commonly used to measure the general upper extremity function of breast cancer survivors[32]. The Visual Analogue Scale (VAS) is a reliable and valid scale for the evaluation of pain intensity. It is a 10 cm line marked with 0 at one end, representing no pain, and 10 at the other end, representing the worst pain imaginable. The patient is asked to mark a point on the scale representing their intensity of pain[33]. The literature available concerning CDT and the results of randomized controlled trials conducted are limited and contradictory[17, 34–40]. Therefore this study investigated the effect of complex decongestive therapy (CDT) and a home program for post mastectomy lymphedema on pain and arm function.

SUBJECTS AND METHODS

Subjects

Recruitment conducted at the Physiotherapy Department of Maharishi Markendeshwar University hospital. The participants were aged between 50 and 70 years, and had unilateral mastectomy for stage I and II breast cancer. They had completed the radiotherapy and chemotherapy sessions. Subjects who developed lymphedema of more than 3 cm compared to the contralateral extremity were included. Participants' with primary lymphedema, bilateral lymphedema, pulmonary edema, congestive heart failure or any contraindications limiting therapy were excluded. For the sample size calculation, a power analysis was done with an alpha risk of 0.05 and a power of 0.80. The sample required was 27 patients in each group. Anticipating a 10% dropout rate in each group, the corrected sample size was increased to 60. This sample size estimation formula was adapted by Zhong B[41]. Eighty subjects were screened and 20 individuals were excluded as they did not meet the inclusion criteria. The sixty participants were divided into two groups: a conventional treatment (CT) group and a complete decongestive therapy (CDT) group. Each group comprised of 30 participants and their mean ages were 56.3±3.3 years and 56±3.5 years, respectively (Fig. 1).

Table 1. Descriptive statistics of the sample

Variables		Group A	Group B
Age (years)		56.3±3.3	56±3.5
Educational level	Literate	25 (42%)	27 (45%)
	Illiterate	5 (8%)	3 (5%)
Marital status	Single	4 (7%)	5 (8%)
	Married	26 (43%)	25 (42%)
Type of surgery	Radical Mastectomy	17 (43%)	18 (45%)
	Modified Radical Mastectomy	3 (8%)	2 (5%)
Affected Arm	Dominant	15 (38%)	14 (35%)
	Non Dominant	5 (13%)	6 (15%)

All the participants were made aware of the purpose and procedure of the study. A signed informed consent was obtained from each participant. Maharishi Markendeshwar University Ethical Committee approved the study. The demographic characteristics such as education level, marital status, type of surgery and affected arm are presented in Table 1. The Majority of the participants was literates and married. Lymphedema was observed in both the dominant and non-dominant upper limbs. There were no significant differences in the demographic characteristics between the groups ($p > 0.05$).

Methods

This study had pretest-posttest design and all the measurements were taken at baseline, and at the 4th and 6th week of treatment. CT group participants received manual lymphatic drainage, low elastic compression garment, gleno-humeral mobilization and deep breathing exercises. Massage strokes were applied to the side of the edematous limb, starting at the base of the neck and progressing to the affected limb. Massage was always directed proximally from the upper arm to the axilla, and then from the hand to the elbow. Finally, the whole limb was massaged from the distal to the proximal portion[37].

The CDT group received manual lymphatic drainage,

Table 2. Arm circumference measurements of the groups

Outcome	Baseline (cm) (M±SD)	95% CI	4th week (cm)	95% CI	6th week (cm)	95% CI
Conventional treatment group (n=30)						
Wrist	17.9±1.1	16–22	16.7±1.1	14–19	15.7±1.1	13–17
Mid forearm	20.9±1.2	18–24.5	19.7±1.3	16–23	18.8±1.4	15–22
Elbow	23.3±1.5	20–28	22.5±2.6	19–27	21.1±1.6	17–26
Mid-arm	25.1±1.5	21–31	23.7±1.8	19–31	22.8±1.8	17–30
Axilla	27.0±1.8	23–32	25.7±1.9	21–30	24.6±1.9	20–30
CDT group (n=30)						
Wrist	18.7±1.2	15.5–20.3	16.6±1.3	14.2–19.4	15.1±1.1	13.3–18.6
Mid forearm	20.9±1.4	18.5–23.2	18.9±1.5	16.3–22.4	17.2±1.5	15.2–21.5
Elbow	23.1±1.7	19.3–26.6	21.2±1.83	17.8–34.1	19.5±1.9	16.5–24.8
Mid-arm	24.8±1.96	21.4–28.7	22.87±2.3	18.2–27.2	21.2±2.3	17.4–26.5
Axilla	26.5±2.3	23.3–33	24.7±2.3	21.2–32.2	23±2.6	19.3–30.1

Values are mean± SD; CI: confidence interval; cm: centimeters

wore a compression garment for 23 hrs daily, and performed remedial exercises and a home program. Both groups received treatment 5 times a week for 6 weeks. CDT group individuals and occasionally family members received training in self-massage. They were encouraged to perform self-lymph drainage by themselves at least once daily. Remedial exercises were given with diaphragmatic breathing exercises in between. The patients sat comfortably, relaxed, place their hands over their abdominal muscles and took deep breaths through the nose followed by prolonged expiration through the mouth without any strenuous effort. The following order was adopted for remedial exercises were conducted by a trained physiotherapist: 1) warm up activity of active mobilization of the large joints at a moderate pace for 5 min; 2) shoulder girdle mobilization-scapular retraction, protraction, depression, shoulder extension, elbow flexion and extension, wrist flexion and extension and ball squeeze; and 3) pectorals and trapezius muscles stretching[17, 42]. The one-hour home program involved self lymphatic drainage, skin care and remedial exercises. Participants received initial education and training about the home exercises, and once their understanding was found to be satisfactory they were given the booklets on the home program.

Arm circumferences were measured using a cloth measuring tape at four levels: the metacarpophalangeal joints, wrist joint, 15 cm distal to the lateral epicondyle, and 10 cm proximal to the lateral epicondyle. The patients were positioned prone with their upper limbs at their sides and their elbows straight while the circumference measurements were taken. Two measurements were taken and their mean was used. The calculated difference between each circumference (in centimeters) was calculated at all four levels. The final volume was determined by adding the separate volumes of the sections together. Every calculation was squared, and then all measurements for that arm were totaled and divided by π (3.1416). The recorded values were used to calculate arm volume using the following formula:

$$V= h\ (C1^2+C1C2-C2^2)/12\pi^2$$

Where V is the volume of the segment, C1 and C2 are the circumferences at the ends of the segment, and h is the distance between them[43, 50]. The DASH questionnaire was used to measure upper limb function. The questionnaire is a self-administered region specific outcome instrument. It consists of 30 core items and 8 optional items, which generate a disability score, ranging from 0 (no disability) to 100 (the most severe disability)[31, 49]. Pain was measured using a VAS.

RESULTS

The data were analyzed using the SPSS 16 software package and a 95% confidence interval. Descriptive statistics were used for subject's demographic characteristics. The level of significance used was 0.05. Repeated measures of ANOVA was used for within and between group comparisons. For post Hoc analysis, Tukey's test was used to test for significant interactions between groups. Table 2 shows the arm circumference measurements at the five levels: wrist, mid-forearm, elbow, mid-arm and axilla. Mean and standard deviations were calculated. The within and between groups comparison revealed there were significant improvement in the circumferences. The circumference of the proximal part of the arm at post-test was significantly reduced compared to its value at pre-test. The CDT group showed significant improvements in pain, DASH scores and arm volume ($p \leq 0.05$ (Table 3).

DISCUSSION

The findings of the present study indicated that the subjects in both the groups had showed significant improvements in the arm function and there were decreases in the pain and lymphedema as measured by a VAS and the modified truncated cone method respectively. Moreover, greater improvements were seen in the subjects receiving the home program. In the examination of the effectiveness of the above treatment strategies in subjects with post mastectomy lymphedema (PML), the CDT group had showed an

Table 3. Volume, DASH and pain scores of the groups

Outcome	Baseline (M±SD)	95% CI	4th week	95% CI	6th week	95% CI
Conventional treatment group (n=30)						
Pain	6.9±1.1	4.2–8.2	4.5± 0.9	2.1–4.8	2.9± 0.6	1–1.9
DASH score	32.6±1.5	30–36	7.9±0.8	5.8–9.3	5.±1.1	1.6–3.3
Lymphedema	1,974±171.3	1,596–2,553	1,757.6±186.71	1,302–2,201	1,599.7±191.4	1,031–2,102
Complete decongestive therapy group (n=30)						
Pain	6.8 ± 0.9	4.2–8.5	3.2 ± 0.7	3.1–6.3	1.4 ± 0.2	2–4.7
DASH score	32.6 ± 1.4	30–35	6.7 ± 0.7	6.6–10	2 ± 0.5	3.3–7.5
Lymphedema (cm^3)	1,996.4± 279.3	1,311–2,502	1,657.2±254.1	1,278–2,105	1,412.5±219.2	1,065–1,904

Values are mean± SD; CI: confidence interval; cm: centimeters

effective reduction in lymphedema, pain, and a significant improvement in function. In this study we found that CDT and remedial exercises in combination with a one hour home program can reduce the volume of lymphedema decreased pain and improved hand function.

The two groups had equal numbers of subjects and there was no significant difference with respect in their ages, which could have affected the results of the study. Manual lymphatic drainage (MLD) resulted in a significant reduction in lymph volume and improvement in arm parameters and symptoms related to edema. Williams et al. conducted a randomized control crossover study and found that MLD significantly reduced the limb volume and dermal thickness. Subject's quality of life and emotional status were also improved by this technique[20, 51]. Anderson et al. in a prospective randomized study compared MLD and the use of a compression garment and exercise. Their data suggested that MLD did not contribute significantly to the reduction in edema. Compression bandaging alone can sometimes yield good results[17].

The results of the present study are supported by the study of Devoogdt et al., which concluded that the MLD in addition to conventional treatment after axillary lymph node dissection for breast cancer has a medium to large short term effect in reducing the extent of arm lymphedema[18]. However the significant improvement in regard to lymphedema seen in the present study may be attributable to the CDT together with the home program. Literature specifying the region specific reduction in lymphedema using conservative approaches is limited. The present study provides region specific lymphedema reduction for the CDT and home program. However, the reductions obtained in the different regions did not occur at the same time and edema decreased in all the regions, but to a lesser extent in the axilla and mid-arm at the end of the 4th week. This may be due to the fact that stimulated anatomical regions produce increased their lymphatic uptake[17]. Between 4 to 6 weeks, edema was significantly reduced in the axilla as compared to the other regions. This indicates that lymphedema reduction in axilla takes around 6 weeks.

In the present study, lymphedema was improved significantly in the experimental group; the mean improvement of lymphedema in the experimental group was 34.25 % with an effect size of 2. This result is supported by a previous study performed by Haghighat[38] where they showed 16.9 % of mean improvement in lymphedema with an effect size of 1.05. The mean improvement of the DASH score in the present study was 175.9 % with an effect size of 27.25; this result was supported by a previous study done by Raven where they showed 170.5 % of mean improvement with an effect size of 2.28[46–48]. Current lymphedema treatment involves using passive forces such as manual lymphatic drainage, compression bandaging, and limb elevation. Recent literature suggests that active forces from skeletal muscle contractions and thoracic movement can also be utilized to pump venous and lymphatic fluid[44–47]. The CDT group showed more improvement in the volume, pain and upper limb function than did the conventional group, because the remedial exercises and home program resulted in greater reduction of limb volume, allowing the subjects to gain confidence and to move the limb without fear. In conclusion the CDT in combination with a home exercise program was effective at reducing post mastectomy lymphedema. Potential benefits were gained by the persons participating in this study, who showed there was improvements in pain, volume and upper extremity function. The study assisted breast cancer related lymphedema survivors in regaining their lost functions restored, gain their confidence, and improved their physical functioning.

The results of the present study suggest the use of CDT and a home exercise program in post-mastectomy lymphedema in order to achieve the significant improvement and hasten the recovery of the breast cancer survival patients. Follow up should be performed to see the long term effects of the treatment. Region specific lymphedema reduction and quality of life should be explored in the future studies. A first limitation of the study is the volume measurement which was measured indirectly using arm circumference. Another limitation was that there was no follow up to observe the long term effects of this technique.

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REFERENCES

1) Bulley C, Coutts F, Blyth C, et al.: A Morbidity Screening Tool for identifying fatigue, pain, upper limb dysfunction and lymphedema after breast cancer treatment: a validity study. Eur J Oncol Nurs, 2014, 18: 218–227. [Medline] [CrossRef]
2) Bulley C, Gaal S, Coutts F, et al.: Comparison of breast cancer-related lymphedema (upper limb swelling) prevalence estimated using objective and subjective criteria and relationship with quality of life. Biomed Res Int, 2013, 807569.
3) Torres Lacomba M, Yuste Sánchez MJ, Zapico Goñi A, et al.: Effectiveness of early physiotherapy to prevent lymphoedema after surgery for breast cancer: randomised, single blinded, clinical trial. BMJ, 2010, 340: b5396. [Medline] [CrossRef]
4) Beaulac SM, McNair LA, Scott TE, et al.: Lymphedema and quality of life in survivors of early-stage breast cancer. Arch Surg, 2002, 137: 1253–1257. [Medline] [CrossRef]
5) Khokhar A: Breast cancer in India: where do we stand and where do we go? Asian Pac J Cancer Prev, 2012, 13: 4861–4866. [Medline] [CrossRef]
6) Pillai PR, Sharma S, Ahmed SZ, et al.: Study of incidence of lymphedema in Indian patients undergoing axillary dissection for breast cancer. Indian J Surg Oncol, 2010, 1: 263–269. [Medline] [CrossRef]
7) Deo SV, Ray S, Rath GK, et al.: Prevalence and risk factors for development of lymphedema following breast cancer treatment. Indian J Cancer, 2004, 41: 8–12. [Medline]
8) Logan V: Incidence and prevalence of lymphoedema: a literature review. J Clin Nurs, 1995, 4: 213–219. [Medline] [CrossRef]
9) Segerström K, Bjerle P, Graffman S, et al.: Factors that influence the incidence of brachial oedema after treatment of breast cancer. Scand J Plast Reconstr Surg Hand Surg, 1992, 26: 223–227. [Medline] [CrossRef]
10) Dawes DJ, Meterissian S, Goldberg M, et al.: Impact of lymphoedema on arm function and health-related quality of life in women following breast cancer surgery. J Rehabil Med, 2008, 40: 651–658. [Medline] [CrossRef]
11) Kim SJ, Yi CH, Kwon OY: Effect of complex decongestive therapy on edema and the quality of life in breast cancer patients with unilateral leymphedema. Lymphology, 2007, 40: 143–151. [Medline]
12) Gautam AP, Maiya AG, Vidyasagar MS: Effect of home-based exercise program on lymphedema and quality of life in female postmastectomy patients: pre-post intervention study. J Rehabil Res Dev, 2011, 48: 1261–1268. [Medline] [CrossRef]
13) McKenzie DC, Kalda AL: Effect of upper extremity exercise on secondary lymphedema in breast cancer patients: a pilot study. J Clin Oncol, 2003, 21: 463–466. [Medline] [CrossRef]
14) Box RC, Reul-Hirche HM, Bullock-Saxton JE, et al.: Physiotherapy after breast cancer surgery: results of a randomised controlled study to minimise lymphoedema. Breast Cancer Res Treat, 2002, 75: 51–64. [Medline] [CrossRef]
15) Johansson K, Tibe K, Weibull A, et al.: Low intensity resistance exercise for breast cancer patients with arm lymphedema with or without compression sleeve. Lymphology, 2005, 38: 167–180. [Medline]
16) Huang TW, Tseng SH, Lin CC, et al.: Effects of manual lymphatic drainage on breast cancer-related lymphedema: a systematic review and meta-analysis of randomized controlled trials. World J Surg Oncol, 2013, 11: 15. [Medline] [CrossRef]
17) Andersen L, Højris I, Erlandsen M, et al.: Treatment of breast-cancer-related lymphedema with or without manual lymphatic drainage—a randomized study. Acta Oncol, 2000, 39: 399–405. [Medline] [CrossRef]
18) Devoogdt N, Christiaens MR, Van Kampen M: Efficacy of manual lymphatic drainage in preventing secondary lymphedema after breast cancer surgery. Lymphology, 2012, 45: 188–189, author reply 189. [Medline]
19) Szuba A: Literature watch. The addition of manual lymph drainage to compression therapy for breast cancer related lymphedema: a randomized controlled trial. Lymphat Res Biol, 2005, 3: 36–41. [Medline] [CrossRef]
20) Williams AF, Vadgama A, Franks PJ, et al.: A randomized controlled crossover study of manual lymphatic drainage therapy in women with breast cancer-related lymphoedema. Eur J Cancer Care (Engl), 2002, 11: 254–261. [Medline] [CrossRef]
21) Szolnoky G, Lakatos B, Keskeny T, et al.: Intermittent pneumatic compression acts synergistically with manual lymphatic drainage in complex decongestive physiotherapy for breast cancer treatment-related lymphedema. Lymphology, 2009, 42: 188–194. [Medline]
22) Devoogdt N, Van Kampen M, Geraerts I, et al.: Different physical treatment modalities for lymphoedema developing after axillary lymph node dissection for breast cancer: a review. Eur J Obstet Gynecol Reprod Biol, 2010, 149: 3–9. [Medline] [CrossRef]
23) Devoogdt N, Christiaens MR, Geraerts I, et al.: Effect of manual lymph drainage in addition to guidelines and exercise therapy on arm lymphoedema related to breast cancer: randomised controlled trial. BMJ, 2011, 343: d5326. [Medline] [CrossRef]
24) Karadibak D, Yavuzsen T, Saydam S: Prospective trial of intensive decongestive physiotherapy for upper extremity lymphedema. J Surg Oncol, 2008, 97: 572–577. [Medline] [CrossRef]
25) Poage E, Singer M, Armer J, et al.: Demystifying lymphedema: development of the lymphedema putting evidence into practice card. Clin J Oncol Nurs, 2008, 12: 951–964. [Medline] [CrossRef]
26) International Society of Lymphology: The diagnosis and treatment of peripheral lymphedema. 2009 concensus document of the International Society of Lymphology. Lymphology, 2009, 42: 51–60. [Medline]
27) Hwang JH, Kwon JY, Lee KW, et al.: Changes in lymphatic function after complex physical therapy for lymphedema. Lymphology, 1999, 32: 15–21. [Medline]
28) Cheville AL, McGarvey CL, Petrek JA, et al.: Lymphedema management. Semin Radiat Oncol, 2003, 13: 290–301. [Medline] [CrossRef]
29) Campbell KL, Pusic AL, Zucker DS, et al.: A prospective model of care for breast cancer rehabilitation: function. Cancer, 2012, 118: 2300–2311. [Medline] [CrossRef]
30) Kwan W, Jackson J, Weir LM, et al.: Chronic arm morbidity after curative breast cancer treatment: prevalence and impact on quality of life. J Clin Oncol, 2002, 20: 4242–4248. [Medline] [CrossRef]
31) Beaton DE, Katz JN, Fossel AH, et al.: Measuring the whole or the parts? Validity, reliability, and responsiveness of the Disabilities of the Arm, Shoulder and Hand outcome measure in different regions of the upper extremity. J Hand Ther, 2001, 14: 128–146. [Medline] [CrossRef]
32) Razmjou H, Bean A, van Osnabrugge V, et al.: Cross-sectional and longitudinal construct validity of two rotator cuff disease-specific outcome measures. BMC Musculoskelet Disord, 2006, 7: 26. [Medline] [CrossRef]
33) Ferreira-Valente MA, Pais-Ribeiro JL, Jensen MP: Validity of four pain intensity rating scales. Pain, 2011, 152: 2399–2404. [Medline] [CrossRef]
34) Reul-Hirche H: Manual lymph drainage when added to advice and exercise may not be effective in preventing lymphoedema after surgery for breast cancer. J Physiother, 2011, 57: 258. [Medline] [CrossRef]
35) Badger C, Seers K, Preston N, et al.: Physical therapies for reducing and controlling lymphedema of the limb. In: The Cochrane Library, Oxford, 2004, 4.
36) Didem K, Ufuk YS, Serdar S, et al.: The comparison of two different physiotherapy methods in treatment of lymphedema after breast surgery. Breast Cancer Res Treat, 2005, 93: 49–54. [Medline] [CrossRef]
37) Zimmermann A, Wozniewski M, Szklarska A, et al.: Efficacy of manual lymphatic drainage in preventing secondary lymphedema after breast cancer surgery. Lymphology, 2012, 45: 103–112. [Medline]
38) Haghighat S, Lotfi-Tokaldany M, Yunesian M, et al.: Comparing two treatment methods for post mastectomy lymphedema: complex decongestive therapy alone and in combination with intermittent pneumatic compression. Lymphology, 2010, 43: 25–33. [Medline]
39) Moseley AL, Carati CJ, Piller NB: A systematic review of common conservative therapies for arm lymphoedema secondary to breast cancer treatment. Ann Oncol, 2007, 18: 639–646. [Medline] [CrossRef]
40) McNeely ML, Magee DJ, Lees AW, et al.: The addition of manual lymph drainage to compression therapy for breast cancer related lymphedema: a randomized controlled trial. Breast Cancer Res Treat, 2004, 86: 95–106. [Medline] [CrossRef]
41) Zhong B: How to calculate sample size in randomized controlled trial? J Thorac Dis, 2009, 1: 51–54. [Medline]
42) Harris SR, Hugi MR, Olivotto IA, et al. Steering Committee for Clinical Practice Guidelines for the Care and Treatment of Breast Cancer: Clinical practice guidelines for the care and treatment of breast cancer: 11. Lymphedema. CMAJ, 2001, 164: 191–199. [Medline]
43) Koul R, Dufan T, Russell C, et al.: Efficacy of complete decongestive therapy and manual lymphatic drainage on treatment-related lymphedema in breast cancer. Int J Radiat Oncol Biol Phys, 2007, 67: 841–846. [Medline] [CrossRef]
44) Schmitz KH, Ahmed RL, Troxel A, et al.: Weight lifting in women with breast-cancer-related lymphedema. N Engl J Med, 2009, 361: 664–673. [Medline] [CrossRef]
45) Kido S, Nakajima Y, Miyasaka T, et al.: Effects of combined training with breathing resistance and sustained physical exertion to improve endurance capacity and respiratory muscle function in healthy young adults. J Phys Ther Sci, 2013, 25: 605–610. [Medline] [CrossRef]
46) Seo K, Cho M: The effects on the pulmonary function of normal adults proprioceptive neuromuscular facilitation respiration pattern exercise. J Phys Ther Sci, 2014, 26: 1579–1582. [Medline] [CrossRef]
47) Ha K, Choi S: The effect of a PNF technique program aftermastectomy on

lymphedema patients' depression and anxiety. J Phys Ther Sci, 2014, 26: 1065–1067. [Medline] [CrossRef]
48) Strossenreuther RH: Guidelines for the application of MLD/CDT for primary and secondary lymphedema and other selected pathologies: treatment of secondary arm, breast and trunk lymphedema. In: Foldi M, Foldi E, Kubik S, editors. Textbook of lymphology for physicians and lymphedema therapists. München: Urban & Fischer, 2003, pp 604–613.
49) Raven EE, Haverkamp D, Sierevelt IN, et al.: Construct validity and reliability of the disability of arm, shoulder and hand questionnaire for upper extremity complaints in rheumatoid arthritis. J Rheumatol, 2008, 35: 2334–2338. [Medline] [CrossRef]
50) Taylor R, Jayasinghe UW, Koelmeyer L, et al.: Reliability and validity of arm volume measurements for assessment of lymphedema. Phys Ther, 2006, 86: 205–214. [Medline]
51) Kim SJ: The long term effects of complex decongestive physical therapy on lower extremity secondary lymphedema and quality of life. J Phys Ther Sci, 2011, 23: 155–159. [CrossRef]