Treatment of Breast-Cancer-related Lymphedema With or Without Manual Lymphatic Drainage

A Randomized Study

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A prospective randomized study was carried out to investigate whether the addition of manual lymphatic drainage (MLD) to the standard therapy could improve treatment outcome in women with lymphedema of the ipsilateral arm after breast cancer treatment. Forty-two patients were randomly assigned to receive standard therapy or standard therapy plus MLD 8 times in 2 weeks and training in self-massage. The standard therapy consisted of use of a compression garment, exercises and information about lymphedema and skin care. The efficacy of treatment was evaluated by reduction in lymphedema volume during treatment and by improvement in symptoms potentially related to lymphedema. The patients were followed-up for a total of 12 months. The study showed that both groups obtained a significant reduction in edema and that MLD did not contribute significantly to reduce edema volume.

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One of the complications of breast cancer treatment is lymphedema of the ipsilateral arm (1, 2). Lymphedema is defined as a swelling of the arm caused by insufficient lymph drainage (3). It may result in cosmetic deformity, loss of functional ability, physical discomfort, recurrent episodes of erysipelas and psychological distress (4, 5). The incidence of lymphedema after treatment for breast cancer ranges between 6% and 38%, depending on the extent of axillary surgery and the use of radiotherapy (5–7). Lymphedema can be divided into 3 stages. During the first 'reversible' stage a protein-rich edema is present. Stage 2, designated as 'spontaneously irreversible', presents fibrosclerotic alterations and an increase in the number of ceratinocytes and connective tissue cells. Stage 3, 'elephantiasis', is characterized by massive hyperceratosis and by a tremendous increase in the volume of the limb (8). Lymphedema may arise immediately after treatment or show up after several years.

Decongestive lymphatic therapy (DLT) can be effective in reducing lymphedema (9, 10). DLT is a combination of intensive treatment using compression by bandages, manual lymphatic drainage (MLD), exercises enhancing the lymphatic flow, and skin care. This is usually followed by daily use of compression garments, exercises, and skin care (8). Intensive treatment is mainly used for severely swollen or misshapen limbs, where an elastic garment cannot be fitted (3, 11). MLD is a gentle massage technique, which stimulates the lymphangiomotoric activity, as demonstrated by Mislin (12). This directs the lymphatic flow away from the edematous part of the trunk and arm and thereby decreases the edema and fibrous changes in the arm. MLD is a part of DLT and should be adjusted to the individual patient, but MLD alone has been found inadequate (13) (14). The main constituent of DLT is compression by elastic sleeves. The patient's own contribution includes skin care, exercises and if necessary in combination with MLD. The intensity of application of the individual components of DLT depends on the stage of lymphedema at the time of treatment starts (13, 14). Uncomplicated cases of lymphedema can be treated in an outpatient setting (8) (13). In a study using DLT, Oliver Leduc et al. found that the most important reduction of the edema was obtained in the first week. During the second week, the results obtained were stabilized (14). In our experience, women treated for breast cancer with an uncomplicated edema in stage 1 or 2 have a notable reduction effect with a standard therapy consisting of daily use of compression sleeves, exercises, skin care and precautions.

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The aim of the present study was to investigate whether addition of MLD to our standard therapy improved the outcome in women with modest lymphedema stage 1 or 2 after treatment for breast cancer. As the most important reduction of the edema is obtained in the first two weeks (14), we chose to add MLD, given 8 times in 2 weeks.

MATERIAL AND METHODS

Patients

This study included 42 women who after treatment for early breast cancer had developed unilateral lymphedema of the arm. The patients were seen in the outpatient lymphedema clinic at the department of oncology, if lymphedema was found at a routine follow-up visit or if the patients referred themselves to the department because of a swollen arm. Prior to enrolment in the study, each patient was examined to exclude lymphedema caused by recurrence of breast cancer. The women underwent a physical examination, ultrasound of the axillary and periclavicular regions and x-ray of the shoulder. All the women were outpatients.

The criteria for entry in the study were: one or more symptoms of lymphedema (numbness, tightness, stiffness, pain, aching, heaviness or other kinds of discomfort), a difference in volume between the two arms of at least 200 ml (measured to a level 15 cm above the elbow), and/or a difference between the circumference of the two arms of at least 2 cm (measured 15 cm above or 10 cm below the elbow). Eligible patients had to be at least four months after surgery, because some cases of lymphedema accompanying operation and radiotherapy can resolve spontaneously. Women were not eligible for enrolment to the study if they showed evidence of recurrence, had bilateral breast cancer, or if they had received treatment for lymphedema during the preceding three months. Patients with severe lymphedema, defined as a difference in arm volume exceeding 30%, were not included in the study but were offered DLT, including compression bandaging. However, if they declined to receive this more extensive treatment, they were allowed to participate in the study.

Assessments

At the time of enrolment, a complete history was obtained from each woman on type and side of operation, the number of excised axillary lymph nodes, the number of tumor-positive lymph nodes, radiotherapy technique, adjuvant systemic treatment, duration of lymphedema, previous episodes of infections, and injuries to the arm. The circumference of both arms was measured starting at the wrist and repeated for every 5 cm proximally for a total of 40 cm. The volume of each arm was calculated from these measurements using numerical integration by piecewise quadratic approximation, known as Simpson's rule of integration. Shoulder function was measured as the active mobility in two plans, i.e. extension–flexion and adduction–abduction. The patients completed a questionnaire on symptoms possibly related to lymphedema, which they graded from 1 to 7. In addition, the patients were asked to what extent they complied with the treatment instructions given.

The women also completed the EORTC QLQ-C30 questionnaire for breast cancer, but these data are not reported in the present study.

Study design

The patients were randomly assigned to receive standard therapy or standard therapy plus MLD and training in self-massage. The standard therapy consisted of a custom-made sleeve-and-glove garment providing 32–40 mmHg compression (Jobst-Elvarex, compression class 2, Beiersdorf, Sweden), educational information and recommendations about lymphedema, instruction in physical exercises to enhance the lymph flow, education in skin care and safety precautions. In the experimental arm, MLD was given 8 times in 2 weeks, and the patients were furthermore educated in daily self-massage using a simple form of MLD. One hour was reserved for each visit.

Patients randomized to standard therapy alone were allowed to crossover after three months, if they found that the treatment response up until then was unsatisfactory.

Assessments including objective measurements and questionnaires about symptoms related to lymphedema and compliance with the use of compression sleeves, exercises, and self-massage were performed after 1, 3, 6, 9 and 12 months. A further follow-up visit after 4 months was arranged for women randomized to standard therapy alone who in addition chose to have the MLD and education in self-massage. The social circumstances were appraised and patients could be referred to a social welfare officer. The study participants were encouraged to contact the lymphedema clinic whenever any unexpected problems arose, in order to tackle these without delay.

The endpoints of the study were the change in volume of the ipsilateral arm compared to the contralateral arm, and patient-reported symptoms potentially related to lymphedema.

Statistical methods

The study was designed to detect a percentage reduction in absolute edema volume of 20% after 3 months compared to the baseline absolute edema volume with a significance level of 5% and a type II error of 10% (power of 90%). (For example, a reduction in absolute edema volume from 30% to 50%.) The absolute edema volume is defined as the difference in volume of the lymphedema arm compared to the contralateral arm. This required inclusion of 42 patients. The effect of treatment was analyzed by intention to treat. The level of statistical significance was set to 5%. All the estimated p-values are two-tailed.

For assessment of differences in baseline characteristics between groups, Fisher's exact test was used if the data were categorical and the Wilcoxon test was used for continuous variables.

Analysis of volume changes.

Comparison of the treatment effects of the groups was performed as a two-way analysis of variance with repeated measurements over time. The natural logarithm to the ratio of the volume of the lymphedema arm compared to the contralateral arm was chosen as the response variable in order to fulfil the statistical assumptions for such an analysis. This implies that the estimated levels at each time point correspond to relative changes in volume of the lymphedema arm compared to the contralateral arm. The model included three variance components: (a) inter-individual, (b) intra-individual and (c) residual variation (measurement error). The intra-individual variation is modeled as a random change in level 6 months after the first measurement. This model gave a substantially better fit than the more simple compound symmetry model, which includes only the variance components (a) and (c) above and is often used to analyze repeated measurements. The model also included an extra variable to indicate whether the lymphedema arm was identical to the dominant arm or not. And finally, the duration of lymphedema was examined by adding this variable as a linear regressor. The analyses were performed by means of Proc Mixed in SAS (version 6.12).

In accordance with the original study design, the reduction in absolute edema volume after 3 months compared with the baseline absolute edema volume was assessed as well. Student's unpaired *t*-test was used to compare the treatment groups.

The change in absolute edema volume compared with the baseline absolute edema volume was calculated as follows: change in absolute edema $= ((V_o - V_c)_B - (V_o - V_c)_T))/(V_o - V_c)_B$. Where V_o is the volume of the lymphedema arm and V_c is the volume of the contralateral arm. T is the time of treatment assessment and B is baseline (pretreatment) assessment. The changes in the natural logarithm to the ratio of the volume of the lymphedema arm compared with the volume of the contralateral arm were calculated as follows: change in ln ratio $= \ln (V_o / V_c)_B - \ln (V_o/V_c)_T$.

Analysis of such longitudinal studies has to take into account that each individual is measured several times during the study (repeated measurements), causing correlation between observations on the same individual. For statistical reasons it is not a good idea to base the analysis on the changes in absolute difference, since for a given individual the same set of baseline values are used in the computation on each of the changes. In this study the diagnostic checking of the statistical model (inspection of residuals) led us to conclude that the analysis should be based on the differences in natural logarithm to the ratio instead of the absolute differences. The differences between the two methods are illustrated in Table 1, in three selected patients. Subjective inspection of the raw data (baseline and 3 months) suggests that the reduction in lymphedema volume is most pronounced for patient no. 15, followed by patient 39 and least for patient 34. In patient 15, both methods agree and give a large reduction. In patient 34, the reduction in absolute difference compared with the baseline gives the impression of a marked reduction, whereas the reduction in the natural logarithm to the ratio of the volumes is only modest. In patient 39, the changes are somewhat reversed compared with those for patient 34. Thus evaluation of treatment results by calculating the change in the natural logarithm to the ratio of the volumes is in closer agreement with the subjective impression than by calculating the change in absolute edema volume compared with the baseline absolute edema volume.

Analysis of subjective measures.

Although the measures are scores on an ordinal and not a continuous scale, we have analyzed this data in the same way as the volume changes described above. Since the

Table 1

Comparison of the estimated treatement outcome in 3 selected patients by calculation of the change in absolute edema and by calculation of the change in the natural logarithm to the ratio

Patient number	Baseline (B)		3 months (3 mths)		Absolute difference[3]		Change %	Ln (ratio) difference[4]		Change
	V_0^1 (ml)	V_c^2 (ml)	V_0 (ml)	V_c (ml)	Baseline ml	3 months ml		Baseline	3 months	
15	2 871	1 687	1 972	1 628	1 184	344	70.0	0.532	0.192	0.340
34	1 866	1 647	1 684	1 590	219	94	57.1	0.125	0.057	0.067
39	2 749	1 451	2 263	1 519	1 298	744	42.7	0.639	0.399	0.240

[1] V_0 is the volume of the lymphedema arm.
[2] V_c is the volume of the contralateral arm.
[3] Change in absolute edema $= (V_0 - V_c)_B - (V_0 - V_c)_{3\ months}/(V_0 - V_c)_B$
[4] Change in ln ratio $= \ln (V_0/V_c)_B - \ln (V_0/V_c)_{3\ months}$.

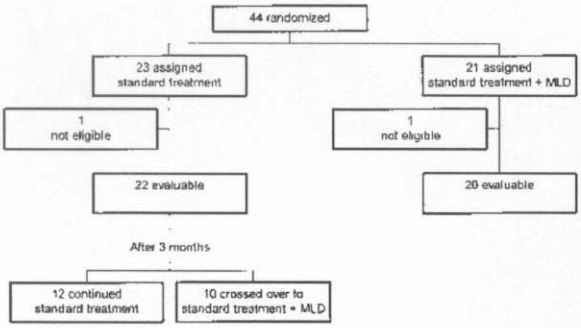

Fig. 1. Trial profile.

scale includes 7 points and the data do not seem to be concentrated on a smaller subset, we do not believe that this will have major impact on the results. This avoids the use of more specialized software to analyze ordinal data with repeated measurements. The data have also been examined for a possible time trend by means of a linear regression, which, apart from the variance components mentioned above, includes three terms: (a) a baseline value, (b) a level change to describe the new baseline value after one month of treatment and (c) a possible linear trend over time.

Ethics

The study was carried out in accordance with the Helsinki-II declaration and was approved by the regional Scientific Committee of Aarhus. All patients received verbal and written information, and gave informed consent before inclusion.

RESULTS

The trial profile is presented in Fig. 1. Forty-four patients were randomized, but 2 patients, one in each treatment group, were subsequently found not to be eligible (one was found to have lymphedema caused by a local recurrence and one was randomized less than 4 months after surgery). Of the 42 women included in the analysis, 22 were randomized to standard therapy alone, and 20 were randomized to standard therapy plus MLD. Ten patients randomized to standard therapy crossed over to standard treatment plus MLD after 3 months. One woman randomized to standard therapy plus MLD died of a heart attack before the 12-month evaluation. Two patients randomized to standard therapy withdrew from the study after the 1- and 4-month evaluations, respectively, because of breast cancer recurrence. One woman withdrew from the study after the 3-month evaluation because of her husband's terminal disease. One woman did not return for her 12-month evaluation because of depression. This allowed data to be obtained on 42 patients at 1 month, on 41 patients at 3 months, on 39 patients at 6 and 9 months and 38 patients at 12 months.

The median age of the patients was 53 years (range: 25–77 years) and the median edema volume at baseline was 346 ml (range: 78 ml–1297 ml). Significantly more patients randomized to standard therapy had received endocrine treatment compared with patients in the standard therapy plus MLD group, but apart from this, the characteristics of the patients in the two groups were similar (Table 2), as were their answers to the baseline questionnaire on arm discomfort, tightness, heaviness, aching, pain, function and loss of shoulder mobility (data not shown).

Analysis on an intention-to-treat basis showed no significant differences in the estimated reduction in lymphedema over time between the two randomization groups ($p = 0.66$) (Fig. 2). The analysis was repeated, dividing the patients into 3 groups: one group randomized to standard therapy plus MLD right from the start, one group randomized to standard therapy and continuing on standard therapy and the last group consisting of the patients randomized to standard therapy but with the addition of MLD after 3 months (Fig. 3). There was no

Table 2

Characteristics of patients by treatment

	Standard treatment (n = 22) Median (range)	Standard treatment plus MLD (n = 20) Median (range)	p-value
Age (years)	56 (29–77)	53 (25–73)	0.41
Edema volume (ml)	361 (78–1184)	340 (161–1297)	0.71
Duration of lymphedema (months)	12 (4–126)	15 (5–183)	0.26
Lymph nodes removed	11 (5–21)	15 (3–30)	0.10
	Number	Number	
Endocrine therapy	10	2	0.02
Chemotherapy	6	9	0.19
Radiotherapy (RT)			0.93
No RT	11	8	–
RT without including the axillae	7	10	–
RT including the axillae	4	2	–

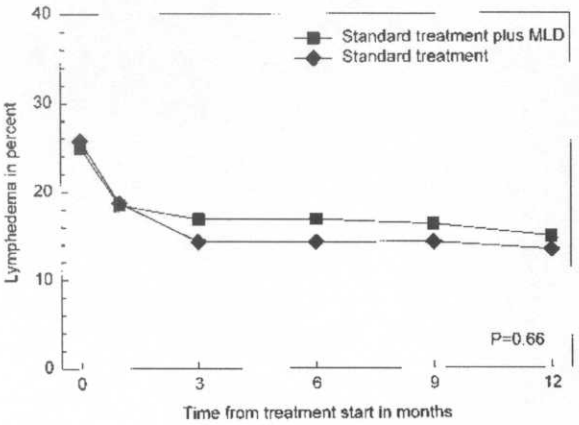

Fig. 2. Treatment outcome according to randomization group. The estimated increase in the ratio of the arm volume between the lymphedema arm and the contralateral arm according to the time since treatment start. MDL = manual lymphatic drainage.

evidence of an improved effect of adding MLD to the treatment ($p = 0.86$).

The mean percentage reduction in absolute edema volume after 3 months compared with the baseline absolute edema volume was 60% (95% CI: 43%–78%) among patients assigned to standard treatment alone versus 48% (95% CI: 32%–65%) among patients assigned to standard treatment plus MLD.

As no evidence of a treatment effect from MLD could be demonstrated, the results were pooled to estimate the overall extent of treatment effect. To allow direct comparison with treatment results from other studies, these results are given on the untransformed data and as the reduction in absolute edema volume. The mean percentage reductions in absolute edema volume after 1 and 12 months in relation to the baseline absolute edema volume were 43% and 66%, respectively. The lymphedema reduction after one month was statistically significant compared to the baseline ($p < 0.001$). The mean residual lymphedema after 12 months was 166 ml (median residual volume = 119 ml; range: −99 ml–938 ml).

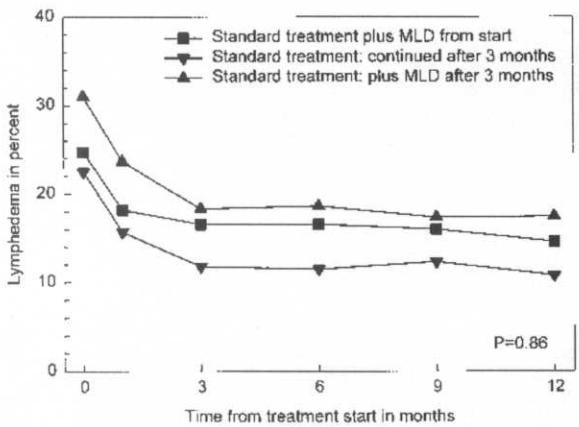

Fig. 3. Treatment outcome according to the treatment received. The estimated increase in the ratio of the arm volume between the lymphedema arm and the contralateral arm according to the time since treatment start. MDL = manual lymphatic drainage.

The percentages for patients reporting improvement or no change in symptom score after 3 months compared to baseline according to treatment group are given in Fig. 4. Only patients reporting the symptom in question at baseline are included in the description. Analysis of the symptom scores did not suggest any differences between the groups, and the results for each treatment were consequently pooled. The analysis revealed that, after one month, the patients experienced a significant reduction in all the symptoms. Over time, there was a further slight improvement, but this was not significant (data not shown).

There was no difference between groups in the compliance of the patients concerning use of compression sleeves or performance of arm exercise. The analysis showed that the effect of treatment on lymphedema was significantly related to the use of compression sleeves in both groups ($p < 0.001$). This effect was constant over time.

DISCUSSION

Lymphedema can be a serious and disabling complication of breast cancer treatment. There is no cure for this condition, and the aim of the treatment is to reduce the swelling, increase joint mobility and to decrease discomfort. Management with DLT is currently a popular and widespread treatment approach, and was recently recommended by a workgroup of the American Cancer Society Lymphedema Workshop (15). DLT is a combined method of treatment, and the relative efficacy of each of the components of this comprehensive treatment program has not previously been investigated in randomized studies.

One person (LA), an experienced and certified lymphotherapist according to the Vodder School of practice, carried out all treatments in the present study. Our intention was to study only the majority of patients with minor lymphedema, defined as a difference in arm volume of less than 30% (absolute difference), and for this reason we found it justifiable to omit the bandages usually used as an integrated part of the DLT. This is in accordance with the approach used by others (3).

MLD is generally believed to be an important part of DLT, though inadequate as the sole treatment (13, 14). Our study showed a lack of effect of MLD as a supplement to standard therapy for management of minor lymphedema. Our findings suggest, that the standard therapy approach without MLD is a sufficient and adequate treatment for this patient category. Both groups obtained a significant reduction in limb volume, a decrease in discomfort and an increased joint mobility during treat-

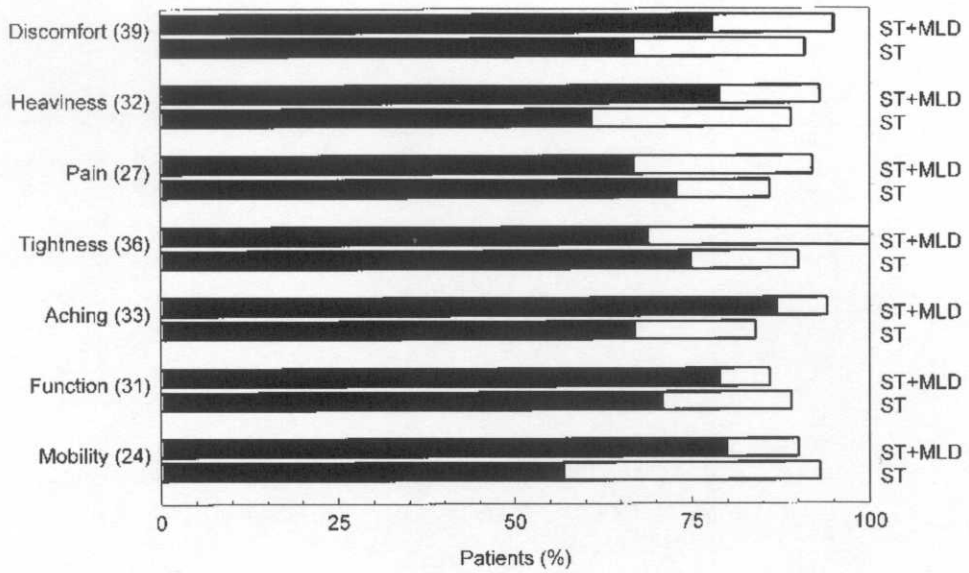

Fig. 4. Change in symptom scores after 3 months. Percentage of patients reporting improvement or no change in symptom score after 3 months compared with baseline according to treatment group. Black columns: improvement in symptoms. White columns: unchanged symptoms.The number of patients reporting the symptom in question at baseline is given in parentheses and only these patients are included in the description. ST = standard treatment; MDL = manual lymphatic drainage.

ment. Less than half of the patients randomized to the standard therapy chose the addition of MLD, indicating that they did not have additional treatment requirement, and furthermore the addition of MLD at crossover did not further improve edema reduction. After 3 months, 27 out of 41 patients had an edema volume of less than the 200 ml, usually regarded as a threshold for clinically significant edema.

In the present study the mean reduction in absolute lymphedema in the whole treatment group was 43% after one month. This is in accordance with the absolute lymphedema reduction of 47% found in a Swedish study by Brorson et al. using 'controlled compression therapy' (16). Controlled compression therapy is similar to the standard therapy used in the present study, with the exception that our patients wore compression garments during daytime only, while patients in the Swedish study used compression garments both day and night. Even though the two studies yielded approximately the same results in the percentage of reduction of lymphedema, there are considerable differences in the treatment results when comparing the mean volumes of edema remaining after treatment. In our patient group the mean lymphedema left after 12 months was 166 ml (range: −99 ml–938 ml) compared with 873 ml (range: 340 ml–2 275 ml) in the Swedish study. This difference in treatment outcome is most likely due to differences in patient characteristics rather than in the treatment given. The patients in the Swedish study had a much larger and more severe lymphedema. The mean volume of edema at baseline was 1 680 ml and the mean duration of lymphedema was 7.2 years compared with a mean volume of 350 ml and a mean duration of 1.2 years in our study. Comparison of the respective outcomes of the treatment in the two studies suggests that, to obtain the best results, it is important to start compression treatment in the early stage of lymphedema.

The outcome of the randomized study by Brorson et al. indicates that standard therapy/controlled compression therapy might not be sufficient in larger lymphedema. A better treatment for larger lymphedema (greater than 1 000 ml) could be liposuction combined with controlled compression therapy, which in the above study was shown to reduce the lymphedema significantly more effectively than compression therapy alone, and resulted in a reduction in absolute edema volume of more than 100% (16).

The effect of DLT has to our knowledge been assessed in non-randomized studies only. In a study by Boris et al. comprising 16 patients with a mean lymphedema before treatment of 690 ml, the edema reduction was 73% (9) and in a study from the Adelaide Lymphedema Clinic an average reduction of 64% after one month was described for the first 78 consecutive arm lymphedemas treated in the clinic (17). Long-term results of DLT have been published by Boris et al. (18), who reported an initial arm lymphedema reduction after DLT averaging 62.6% in 56 consecutive patients. After 36 months' follow-up, this reduction was maintained.

It is possible that DLT including MLD has a place in the treatment of larger lymphedema, but randomized stud-

ies evaluating the efficacy of the different components of this combined treatment should be performed in this patient category. Further studies should include objective measurements of both arms as well as some kind of subjective assessment. The patients should be followed-up for at least one year, to allow evaluation of long-term treatment outcome.

As shown in our study, the results of the treatment depend on the compliance of the patients, assessed by their use of the compression garment. This is in accordance with the experience of others (10, 13, 16). To achieve the maximal compliance of the patient, two things are very important: the compression sleeve has to fit and the patient must understand why and how to use it. For the first couple of treatment weeks our patients used decreasing sizes of Jobst compression garments to reduce the edema. Then measurements were taken for a custom-made compression garment. In general, the garments were replaced every 2–6 months to maintain the proper amount of compression.

Two to three hours were reserved for each patient at the first appointment and one hour was reserved for each follow-up visit. The total time spent on each patient randomized to the standard therapy was thus eight hours. For patients randomized to MLD, a further one hour was reserved 8 times for MLD and training in self-massage. The time taken up by the standard therapy was thus only half the time used with the standard treatment plus MLD. As a consequence of the less comprehensive treatment, it might be easier for patients to continue their normal working and social lives while being treated.

Our conclusion from the present study is that standard therapy is an effective and simple way of treating minor lymphedema. MLD does not—at least in the early stage—improve the treatment outcome.

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REFERENCES

1. Brennan MJ. Lymphedema following the surgical treatment of breast cancer: a review of pathophysiology and treatment. J Pain Symptom Manage 1992; 7: 110–6.
2. Willich N, Zeschick A, Zeschick L, Wendt TH. Ergebnisse der bestrahlung nach mastectomie. In: Sauer H. Mammakarzinom Hrsg. München: Zuckschwerdt. 1989: 56–63.
3. Mortimer P, Badger C, Hall JG. Lymphoedema. In: Doyle D, Hanks G, MacDonald N, eds. Oxford textbook of palliative medicine. Oxford: Oxford University Press, 1993: 407–15.
4. Tobin MB, Lacey HJ, Meyer L, Mortimer PS. The psychological morbidity of breast cancer related arm swelling. Psychological morbidity of lymphoedema. Cancer 1993; 72: 3248–52.
5. Petrek JA, Heelan MC. Incidence of breast carcinoma-related lymphedema. Cancer 1998; 83 (Suppl 12 American): 1776–81.
6. Swedborg I, Wallgree A. The effect of pre- and postmastectomy radiotherapy on the degree of edema, shoulder-joint mobility, and gripping force. Cancer 1981; 47: 877–81.
7. Kissin MW, Querci Della Rovere G, Easton D, Westbury G. Risk of lymphoedema following the treatment of breast cancer. Br J Surg 1986; 73: 580–4.
8. Földi E. Treatment of lymphedema and patient rehabilitation. Anticancer Res 1998; 18: 2211–2.
9. Boris M, Weindorf S, Lasinski B, Boris G. Lymphedema reduction by noninvasive complex lymphedema therapy. Oncology (Huntingt) 1994; 8: 95–106.
10. Casley-Smidt JR, Boris M, Weindorf S, Lasinski B. Treatment for lymphedema of the arm—the Casley-Smidt method. A noninvasive method produces continued reduction. Cancer 1998; 83 (Suppl 12 American): 2843–60.
11. Dawn C, Rose K. Treatment leads to significant improvement. Effect of conservative treatment on pain in lymphoedema. Prof Nurse 1992; 10: 32–5.
12. Mislin H. In: Altmann HW. Handbuch der allgemeinen Pathologie. Berlin, Heidelberg, NewYork: Springer Verlag, 1972: 3. band 6. teil: 222.
13. Földi E. The treatment of lymphedema. Cancer 1998; 83 (Suppl 12 American): 2833–4.
14. Leduc O, Leduc A, Bourgeois P, Belgrado JP. The physical treatment of upper limb edema. Cancer 1998; 83 (Suppl 12 American): 2835–9.
15. Rockson SG, Miller LT, Senie R, et al. American Cancer Society Lymphedema Workshop. Workgroup III: Diagnosis and management of lymphedema. Cancer 1998; 83 (Suppl 12 American): 2882–5.
16. Brorson H, Svensson H. Liposuction combined with controlled compression therapy reduces arm lymphedema more effectively than controlled compression therapy alone. Plast Reconstr Surg 1998; 102: 1058–67.
17. Morgan RG, Casley-Smith JR, Mason MR, Casley-Smith JR. Complex physical therapy for the lymphoedematous arm. [Br] J Hand Surg 1992; 17: 437–41.
18. Boris M, Weindorf S, Lasinkski S. Persistence of lymphedema reduction after noninvasive complex lymphedema therapy. Oncology (Huntingt) 1997; 11: 99–109.