

EFFECTS OF COMPRESSION BANDAGING WITH OR WITHOUT MANUAL LYMPH DRAINAGE TREATMENT IN PATIENTS WITH POSTOPERATIVE ARM LYMPHEDEMA

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ABSTRACT

We examined the effects of low stretch compression bandaging (CB) alone or in combination with manual lymph drainage (MLD) in 38 female patients with arm lymphedema after treatment for breast cancer. After CB therapy for 2 weeks (Part I), the patients were allocated to either CB or CB+MLD for 1 week (Part II). Arm volume and subjective assessments of pain, heaviness and tension were measured. The mean lymphedema volume reduction for the total group during Part I was 188 ml ($p<0.001$), a mean reduction of 26% ($p<0.001$). During Part II the volume reduction in the CB+MLD group was 47 ml ($p<0.001$) and in CB group 20 ml. These differences were not significant ($p=0.07$). A percentage reduction of 11% ($p<0.001$) in the CB+MLD group and 4% in the CB group was significantly different ($p=0.04$). In both the CB and the CB+MLD group, a decrease of feeling of heaviness ($p<0.006$ and $p<0.001$, respectively) and tension ($p<0.001$ for both) in the arm was found, but only the CB+MLD group showed decreased pain ($p<0.03$).

Low stretch compression bandaging is an effective treatment giving volume reduction of slight or moderate arm lymphedema in women treated for breast cancer. Manual lymph drainage adds a positive effect.

Arm lymphedema secondary to breast cancer treatment most often develops gradually as a chronic disease (1) giving an increase of adipose tissue in subcutis with a later ingrowth of fibrosis probably due to the high protein concentration in the lymph stimulating the fibroblasts (2). Secondary lymphedema is a recognized complication of axillary node dissection, especially in combination with radiotherapy. Patients with arm lymphedema experience functional impairment, psychosocial maladjustment, and increased psychological morbidity (3), the condition being lifestyle-compromising (4).

The assumption that untreated lymphedema gradually increases in amount and grade (5) with time has been documented by Casley-Smith (1). It was also found that the amount of arm lymphedema increased more rapidly than that of lower extremity lymphedema and the grades of secondary lymphedema increased more rapidly than primary ones. Accordingly, the purposes of treatment should aim to limit the increase of volume and to treat mild lymphedema as soon as possible to avoid more serious sequelae and a chronic irreversible disorder.

Continuous compression using elastic sleeves is considered an important part of treatment (6). Compression raises the interstitial pressure, limits blood capillary filtration and increases lymph flow (7,8). The

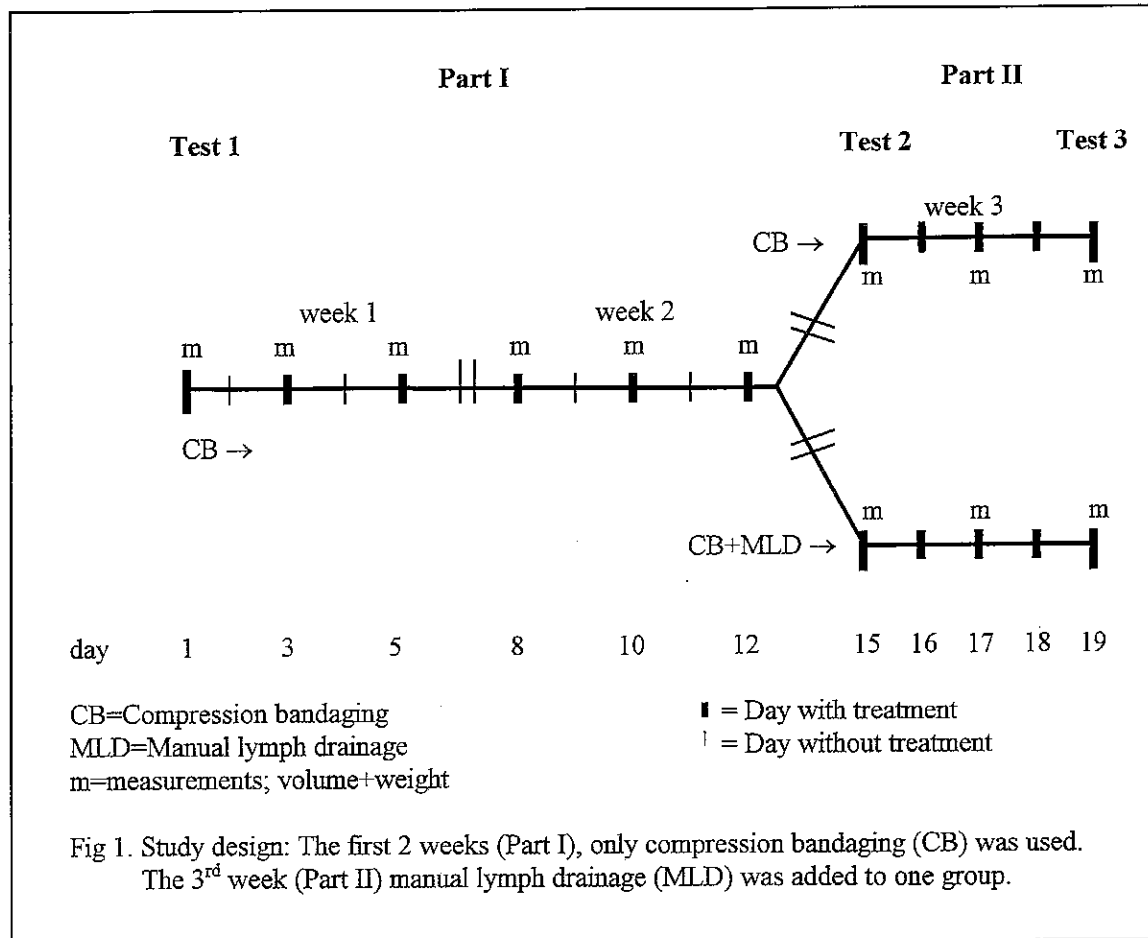


Fig. 1. Study design: The first 2 weeks (Part I), only compression bandaging (CB) was used. The 3rd week (Part III) manual lymph drainage (MLD) was added to one group.

effect of an elastic sleeve without other treatment has been evaluated in breast cancer patients undergoing mastectomy and has shown a decrease of 7-17% of the arm lymphedema, depending on how long the sleeve was administered (2 weeks-6 months) (9-11).

Manual lymph drainage (MLD) (12) combined with compression therapy is an effective treatment for lymphedema resulting in normalization of microlymphatic hypertension and an improvement of clinical appearance (13). Hutzschenreuter et al (14) showed that MLD combined with low stretch compression bandaging decreased arm lymphedema volume by 20%, and Johansson

et al (9) found that MLD on its own reduced arm volume by 15%. Complex lymphedema therapy (CLT), a combination of MLD, compression bandaging, exercises and skin care, results in lymphedema reduction of about 60% (15,16). The volume-reducing effect of low stretch bandaging alone has not previously been evaluated, although the clinical impression is that bandaging is the most effective volume-reducing factor in CLT. There is lack of agreement, however, whether the time-consuming MLD treatment adds any volume-reducing effect.

The purpose of this study was to examine the effect of CB alone or when combined with

TABLE 1
Patient Characteristics

Characteristics	CB group n=18	CB+MLD group n=20
	median (q ¹ -q ³)	median (q ¹ -q ³)
Edema beginning after op, months	19 (3.8-69)	10 (6-21)
Edema duration, months	6 (1-27.3)	4 (3-42.8)
	number	number
Right/left arm lymphedema	11/7	13/7
Dominant arm lymphedema	12	12
Partial mastectomy/mastectomy	4/14	5/15
Radiotherapy	15	18

CB=compression bandaging; MLD>manual lymph drainage.

MLD on limb volume and the subjective feeling of heaviness, tension and pain in women with secondary arm lymphedema after previous treatment for breast cancer.

Clinical Population

In this prospective study, 40 consecutive women, with unilateral arm lymphedema after breast cancer operation with axillary nodal dissection (level I and II) (17), were included over a 3 year period. They were all referred to the Lymphedema Unit, University Hospital, Lund, Sweden. Lymphedema was defined as >10% difference in volume between the abnormal and normal (contralateral) arm (18) as measured by volumetry (19). After written and oral information and approval by the patients, they were allocated to either CB treatment alone (CB group) or to CB in combination with MLD (CB+MLD group). The series was determined so that the patients were consecutively numbered and the patients with even numbers were included in the CB group and those with odd numbers in the CB+MLD group.

The study design (*Fig. 1*) included three weeks of treatment with low stretch compression bandage for all patients. The bandage was changed every second day. After 2 weeks (Part I) MLD was added to the CB treatment in 17 of the patients for 5 days for another week (Part II), whereas the other 18 patients continued with CB alone.

Exclusion criteria were: previous contralateral breast diseases or intercurrent disease affecting the swollen arm or difficulties in participating in the study such as dementia. Also patients who had received any lymphedema treatment within six months prior to the study were excluded, except for those who wore elastic sleeves not renewed during the six-month period. Only those patients from Part I who still had an arm lymphedema by definition >10% volume difference between the abnormal and normal arm (18) were included in Part II. Two patients in the CB group were dropped during Part I; one because of feelings of numbness and weakness in the arm during bandaging and one who was unable to participate in serial measurements. The

mean±SD (range) age of the remaining 38 women was 64±12 (37-83) years in the CB group (n=18) and 58±12 (41-80) years in the CB+MLD group (n=20). Other characteristics of which there was no difference between the groups are presented in *Table 1*. Sixteen patients had received different kinds of lymphedema treatment, but not within 6 months of the study, and 9 of them wore elastic sleeves. Three patients from the CB+MLD group were not included in Part II because of complete resolution of the arm edema after CB treatment during Part I.

The study was approved by the Lund University Research Ethics Committee.

Physiotherapeutic Treatment

CB treatment was accomplished with low stretch bandages (20) to ensure continuous pressure during work as well as during rest periods. The bandage was wrapped in proximal direction, beginning at the hand and ending at the extremity root with pressure gradually decreasing. The bandage was kept on until the next measurement was performed.

The CB+MLD treatment during Part II was performed at approximately the same time of the day for 45 min/day during 5 days. The CB and MLD treatments were performed mainly by one experienced physiotherapist specially trained in bandaging and in the MLD technique of Vodder (12). The MLD involves gentle massage starting over the contralateral quadrant of the trunk free of lymphostasis followed by massage over the ipsilateral trunk and extremity in a proximal direction ending with the hand.

Measurements And Assessments

The study design is illustrated in *Fig. 1*. During Part II with daily MLD treatments, all measurements were performed before treatment at Test 2 and 3.

Volume of the arm. Each arm was submerged in a container with water and the

volume displacement was measured in ml. The method has been described by Kettle (19), who found a standard deviation of 1.5% from the mean volume. Bednarczyk et al (21) carried out a validity test for the water displacement method compared with a computerized limb volume measurement system (CLEMS) and found a high correlation coefficient ($r=0.992$). They also showed that measuring plaster figures, CLEMS had a high test-retest correlation ($r=0.999$). The changes in lymphedema volume were obtained by comparing the difference in volume between the affected and unaffected arm. The changes were expressed both in ml and as percentage reduction in lymphedema. Percentage lymphedema reduction was calculated as follows:

$$\frac{\text{diff test A} - \text{diff test B}}{\text{diff test A}}$$

where diff = affected arm volume minus unaffected arm volume (22).

Body weight was registered at each volume assessment.

Subjective assessment: The experiences of pain, heaviness and tension of the affected arm were each scored by the patient on a 100 mm horizontal visual analogue scale (VAS). The endpoints were "worst imaginable" (0 mm) and "no discomfort" (100 mm) (23). Each patient was asked to consider her subjective sensations before and after the three-week period of study. The initial scores at test 1 were made available to the patient at test 3 at the end of the study (24).

Statistics

Student's t-test for paired samples was used to calculate differences within the total group during Part I and within the groups CB and CB+MLD in Part II. t-tests for independent samples were performed to calculate differences between the two groups CB and CB+MLD.

TABLE 2
Arm Volume (mean±SD) in ml at the Three Test Occasions

	CB n=18	CB+MLD n=20
Test 1	3073±602	3027±363
Test 2	2841±479	2882±386
Test 3	2823±474	2832±393*

CB=compression bandaging; MLD>manual lymph drainage; *= n=17.

TABLE 3
Arm Lymphedema Volume (mean±SD) in ml (Affected Minus Unaffected Arm) at the Three Test Occasions

	CB n=18	CB+MLD n=20
Test 1	770±455	626±217
Test 2	565±311	503±146
Test 3	545±311	455±157*

CB=compression bandaging; MLD>manual lymph drainage; *= n=17.

Corresponding analyses employing Wilcoxon signed rank tests and Wilcoxon rank sum tests for paired and independent samples respectively were also performed. The $p < 0.05$ significance level was chosen.

RESULTS

Volume of the arm: In the total group, the mean±SD arm volume was 3049±484 ml on the affected side and 2355±355 ml on the unaffected side at test 1. The difference was significant ($p < 0.001$). The mean percentage volume difference between the abnormal and normal arm was 22±9%. The mean lymph-

dema volumes for the total group was 694±353 ml at test 1 and 507±247 ml at test 2. The mean arm volumes and the mean lymphedema volumes for the CB group and the CB+MLD group on the different test occasions are shown in *Table II* and *Table III*, respectively. There were no significant differences between the two groups at test 2.

The mean lymphedema volume reduction during Part I when the whole group was wearing CB was 188±155 ml ($p < 0.001$) and a percentage reduction of 26±15% ($p < 0.001$) was seen. The percentage reduction in Part I was 21±13% ($p < 0.001$) for the first week (7 days) and 6±14% ($p = 0.006$) for the second week (7 days). During Part II (4 days) the volume reduction in the CB group was 20±46 ml ($p = 0.8$) and in the CB+MLD group 47±42 ml ($p < 0.001$). There was no significant difference ($p < 0.07$) between the two groups. A percentage reduction of 4±10% (n.s.) in the CB group and 11±9% ($p < 0.001$) in the CB+MLD group was obtained, revealing a significant difference ($p < 0.04$) between the groups.

The mean percentage reduction in the 9 patients who wore elastic sleeves before the start of Part I was 25±11% with no difference between the groups.

Body weight: The mean±SD of the body weight for the whole group was 71.9±11 kg in test 1 and 71.6±11 in Test 2 (not significantly different).

Subjective assessment: There were no differences in mean score between the two groups at test 1. From test 1 to test 3, a decreased feeling of pain ($p = 0.03$) heaviness and tension (both $p < 0.001$) was found in the CB+MLD group. In the CB group, the feeling of heaviness ($p = 0.006$) and tension ($p < 0.001$) was decreased. There were no significant differences between the two groups at test 3.

DISCUSSION

Continuous CB with a low stretch bandage is effective treatment for volume reduction of secondary arm lymphedema in

women previously treated for breast cancer especially during the first week of therapy. The period of 2 weeks (Part I) for CB treatment was chosen according to the outcome of a previous study (25) with a treatment period of four weeks including massage, isometric exercises and wearing of elastic sleeve. The results of that study (25) showed that the greatest edema volume reduction occurred during the first week and gradually diminished over the course of the next three weeks. Similarly, in another study (9) with 2 weeks of MLD treatment, the most significant decrease of volume occurred during the first week. In the present study, a further small edema reduction was noted during the second week, but by the third week, no further edema reduction was forthcoming suggesting that bandaging was most effective when administered daily for two weeks. This outcome is also supported by Ko et al (16) in a study of 149 patients with upper-extremity lymphedema using CLT. They found a volume reduction of 59% after an average of 16 days of treatment, whereas in another study, Boris et al (15), also using CLT in 56 patients, found a similar edema reduction (62.6%) over a 30-day period.

The results from two independent studies (15,16) emphasize the clinical impression that CLT is an effective combination of treatment for lymphedema encompassing MLD, CB, exercises and skin care. When CLT is administered for at least a two-week period, a volume reduction of about 60% can be expected. The efficiency of a treatment, however, also needs to be related to the economic resources available. MLD is time-consuming whereas CB takes comparatively little time to perform and can even, with some training, be left to the patients to do on their own. Therefore, the purpose of this study was to examine whether MLD had additive volume-reducing effect. The results obtained support this assumption, although the amount of added edema reduction was small. Thus, an edema decrease of 26% in 14 days occurred with CB alone but when MLD

was added for 5 days a further edema reduction of 11% was obtained for a total reduction of 37%. An unanswered question is whether the difference (approx. 20%) between the two treatment programs, CLT and CB+MLD, may have been less if MLD had been added from the outset or if the difference observed are attributable to exercises and skin care. Another consideration is that the percentage decrease during Part I may have been greater if the 9 patients who wore elastic sleeves before the start of Part I had been excluded as having already been "treated." On the other hand, separate analysis showed a similar reduction of arm edema for patients who had worn elastic sleeves compared with those who had not before inclusion in the trial study.

Continuous compression with elastic sleeves is considered an important part of edema treatment (6) especially to maintain an arm volume reduction for a longer period after intensive daily therapy has ceased. With an average follow-up of 9 months, Ko et al (16) found that edema improvement was maintained within 95% of the initial volume in 84% of the patients wearing compression sleeves during the day combined with bandaging at night and a daily exercise program. The volume-reducing effect of an elastic sleeve without other treatment has been evaluated for a longer period by Swedborg (10) and Bertelli et al (11). They showed a volume reduction of 8% and 18% respectively after 6 months. With gradual decrease of the size of the sleeve over a one-year period, Brorson et al obtained a reduction of 47% (26). However, Casley-Smith found that lymphedema increased with time (1). Thus, it is important when lymphedema is first detected to offer effective treatment over a short period, and CB alone seems to have the largest volume-reducing effect over a short period. If MLD is added, the effect is only slightly greater.

In the present study, CB+MLD was administered to patients with slight and moderate lymphedema (18). Whereas there

was no planned exclusion of severe edema, no such patients were referred to the Lymphedema Unit during the study. This might be due to the close follow-up program of breast cancer patients in Sweden, resulting in early detection of lymphedema. It might also be due to the possibility of treating severe lymphedema, often with a high degree of fat deposition, by liposuction with complete reduction of the edema (27). However, considering the physical and psychosocial ill effects for lymphedema patients, the first goal for treatment is to keep the lymphedema volume as low as possible and thereby avert reaching the stage of severe lymphedema (18).

The patients in this study were allocated consecutively (i.e., not randomly but alternatively) to the two treatment groups when they were referred to the Lymphedema Unit. The patients were referred from many different clinics and the severity or the incoming order sequence was not influenced by any referring doctor.

Normally there is a small change in arm volume over time, approximately 5%, documented by Swedborg et al (28). In this study, the mean±SD percentage volume variation of the unaffected arm was 1±2%. Concerning this low variation, together with the steady body weight, we conclude that the reduction of the arm volume on the affected side after treatment represented a true reduction of lymphedema.

Asymmetry of arm volume occurs because the dominant arm is usually larger than the non-dominant one (29). However, in our study there were no significant differences between the groups regarding the side of operation or the dominant arm. Thus, no correction for asymmetry was made.

We used the visual analogue scale (VAS) to evaluate changes in feelings of pain, heaviness and tension in the affected arm during the treatment period. There was no correlation between edema volume reduction and feelings of heaviness and tension, perhaps because the patient population was small. However, such a correlation was

previously demonstrated by Swedborg et al (30) using a Borgscale (31). The correlation between VAS and Borgscale was found to be good by Wilson et al (32), measuring dyspnea during exercise. However, the validity of the correlation between edema volume reduction and reduction of feelings of heaviness and tension has not yet been verified using VAS.

In this study, we determined that compression wrapping with a low stretch bandage is an effective treatment regarding volume reduction of slight or moderate arm lymphedema in women previously treated for breast cancer. This response is improved when manual lymph drainage is added. Patients subjective feelings of heaviness and tension in the swollen arm were similarly decreased by either CB alone or CB combined with MLD.

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