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QUALITY OF LIFE FOLLOWING LIPOSUCTION AND CONSERVATIVE TREATMENT OF ARM LYMPHEDEMA

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ABSTRACT

Arm lymphedema can produce an additional burden from a psychosocial point of view. Although edema reduction through treatment can be an advantage in terms of reduced weight of the arm and simplified clothing needs, the purpose of the present study was to register changes in psychosocial parameters during one year after treatment. Thirty-five patients underwent liposuction combined with postoperative CCT (Controlled Compression Therapy), while 14 received CCT alone. Edema volume and range of motion in the shoulder joint were measured and effects on quality of life were assessed with various questionnaires. Liposuction+CCT removed the arm lymphedema completely, whereas CCT alone reduced it by half. The treatments improved range of motion in the shoulder joint and patients' quality of life in relationship to the volume reduction. Liposuction+CCT improves patients' quality of life, particularly qualities related to the volume reduction and hence qualities associated with everyday activities. CCT is beneficial too, but the effect is less obvious than when combined with surgery, probably because the edema reduction is less. The consequences of arm lymphedema for more psychologically oriented qualities and social life in general seem to be less serious and we found few notable effects of treatment in these domains.

Keywords: quality of life, arm lymphedema, breast cancer, liposuction, controlled compression therapy

About one-third of all women treated for breast cancer develop arm lymphedema (1) when excision of lymph nodes and supplementary radiotherapy interrupts normal lymph drainage from the arm. Interstitial fluid increases with accumulation of lipids, proteins, and macrophages. The normal turnover of tissue fluid is impaired and the microcirculatory steady state disturbed. A slow flow rate further accelerates lipogenesis and deposition of fat (2). This process is enhanced by the transformation of macrophages into adipocytes (3-6). Subsequently, subcutaneous lymphedema becomes firm due to pinocytosis of white blood cells and activation of fibrocytes, which increase the connective tissue component of the primordial subcutaneous fat (7,8) Thus, in early stages the fluid component may dominate the lymphedema, whereas in late stages excess adipose tissue and fibrosis may be striking.

We have shown that liposuction followed by rigorous Controlled Compression Therapy (CCT) can remove the edema completely (9,10). CCT alone is also effective, but reduces the edema by only half (11). It could be argued that the procedure of liposuction may be hazardous for the soft tissues of the arm. We have found, however, that liposuction does not further restrict the already

impaired lymph transport capacity (12), and the microcirculation of the skin rather shows an increase. This in combination with the removal of adipose tissue and proteinaceous fluid, which may potentiate bacterial overgrowth, may explain the reduced incidence of erysipelas postoperatively (13).

The cancer itself is troublesome, but the swollen and heavy arm introduces an additional burden for the patients from a physical, psychosocial and psychological point of view (14-24). Physical problems include pain, limited limb movement and physical mobility and problems with clothing, thus interfering with everyday activities. Also, the heavy and swollen arm is hindering and cosmetically unappealing, altogether contributing to emotional distress (25-30).

The edema reduction itself is naturally a great advantage for the patient in terms of reduced weight and simplified clothing. But the perceived impact of the treatment on the general health profile (health-related quality of life) is a factor that also has to be analyzed when evaluating the overall outcome of treatment (24).

Consequently, the aim of the present study was to register changes in such parameters following treatment by liposuction combined with CCT. Results were compared with the effects of CCT alone. Possible correlations between the edema volume reduction and outcome parameters were also investigated.

SUBJECTS AND METHODS

Subjects

Women with arm lymphedema following breast cancer treatment are regularly referred to our lymphedema team, mostly by general surgeons, oncologists and general practitioners. Forty-nine such consecutive patients during a three-and-a-half year period participated in the present prospective study. The indication for further intervention was based on subjective discomfort due to the heavy arm. Furthermore, previous treatment in all cases with manual lymph therapy and/or pneumatic compression therapy had not afforded the desired results. None of the patients had, however, received any manual lymph or pneumatic therapy for the last three months before the trial. The lymphedema was hypertrophic and firm in all cases due to adipose tissue formation, and showed clinical signs of fibrosis, i.e., grade II. None had generalized disease or local wound complaints. All patients, except one in the CCT group, had undergone radiotherapy immediately following the breast cancer operation, which included excision of lymph nodes in all cases. Radiotherapy was started 4-6 weeks after mastectomy. The patient profile is shown in *Table 1.* A detailed analysis of the edema volume reduction in 44 of these patients has been reported separately (11).

The study compares two established treatment regimes, and under these circumstances approval from the local ethics committee is not needed for standard hospital procedures. The study was approved by the institutional board at the Department of Plastic and Reconstructive Surgery, Malmö University Hospital, Malmö, Sweden and all patients signed an informed consent.

Methods

The same staff, one physiotherapist and one occupational therapist, measured the parameters before, and after 0.5, 1, 3 and 12 months.

Liposuction

35 of the patients had no contraindications for surgery and chose operation. They were thus suitable for surgical treatment with liposuction, which was performed by the first author. Treatment was instituted as long as 10 years (mean, range 1-43) after mastectomy and radiotherapy.

Our surgical technique has been described in detail in a previously (9). Briefly, liposuc-

TABLE 1
Patient Profile

Number of patients	Liposuction+CCT 35			CCT 14		
	Mean	SD	range	Mean	SD	range
Age at cancer operation (yr)	54	12	39-79	56	12	28-72
Duration of lymphedema (yr)	8.4	7.4	1-27	7.9	5.1	1-19
Age at treatment start (yr)	65	11	46-89	66	13	30-89
Interval between breast cancer operation and treatment start (yr)	10	9.2	1-43	9.9	5.4	1-19
Edema volume before treatment (ml)	1840	788	570-3915	1680	628	670-3320

tion was effected via 20–30 incisions, 3-mm long and the hypertrophied and edematous fat was removed by vacuum aspiration as completely as possible. During the subsequent postoperative course, CCT was maintained exactly as described below for the non-surgery group.

Controlled Compression Therapy

Fourteen patients chose treatment with CCT alone. Treatment was instituted 9.9 years (mean, range 1-19) after primary cancer treatment. The compression therapy is crucial for patients of both groups. Its application was therefore described in detail and discussed with the patient at the first clinical evaluation. If she had any doubts about undergoing continuous CCT, she was not enrolled for participation in the study. All patients complied with our concept. During the trial we did not find any sudden increase of the edema volume, which we have found to be associated with poor compliance. Otherwise, neither specific instructions regarding daily life, nor any exercise programs were given, except the recommendation to use protective gloves when gardening. Indeed, we encouraged the patient to lead a life as normal as possible, i.e., continue with activities that she did before the breast cancer operation.

CCT was instituted with a custom-made compression sleeve-and-glove garment (Jobst®-Elvarex BSN Medical, Smith & Nephew, Mölndal, Sweden) that gave compression in the range 32 to 40 mmHg (compression classes 2 and 3). It was taken in at each visit, using a sewing machine, to compensate for reduced elasticity and wear and tear of the garment. The take in was determined by the degree of the volume reduction quantified by the water displacement technique, described below. This was most important during the first 3 months when the most notable changes in volume occurred, particularly in the surgery group. At the 3-month visit, the arms were measured for new custom-made compression garments (Jobst®-Elvarex BSN). This procedure was repeated at 6 and 12 months. It was important however, to take in the garment continuously to compensate for wear and tear. This required additional visits in some

instances, although the patient could often make such adjustments herself. When the edema volume had decreased as much as possible and a steady state was achieved, new garments could be prescribed, using the latest measurements. In this way, the garments were renewed three or four times during the first year. Two sets of sleeve-and-glove garments were always at the patients' disposal; one being worn while the other was being washed. Thus, a garment was worn permanently, and treatment was interrupted only briefly when showering and, possibly, for formal social occasions. The patient was informed about the importance of hygienic measures and skin care.

Volume measurements

Arm volumes were recorded using the water displacement technique in connection with visits to our out patient clinic. A container with a faucet was filled with water. The whole arm was then submerged until the fingertip reached the bottom of the container. In cases of short arms a fixed ruler was used to define the arm position. The displaced water was collected and weighed on a balance to the nearest 5 g, corresponding to 5 ml. Both arms were always measured at each visit, and the difference in volume between the two was designated 'the edema volume' (31-34). Besides absolute values in each patient, the decrease in the edema volume was also calculated.

Range of motion (ROM) in shoulder joint

ROM of the shoulder joint was measured in degrees with a standard goniometer. Tests were performed in the standing position with care to prevent compensatory movements of the torso. Without passive movements, ROM was determined for the following six active movements of the arm. Flexion: The arm was moved in the sagittal plane, from 0° (neutral position) towards 180° (normal maximum). Abduction: The arm was moved away from the side of the body in the coronal plane, from 0° (neutral position) towards 180° (normal maximum). External rotation: From 0° (neutral position) towards 90° (normal maximum) with the arm abducted 90° in the coronal plane and the elbow flexed 90°. Internal rotation: From 0° (neutral position) towards 90° (normal maximum) with the arm abducted 90° in the coronal plane and the elbow flexed 90°. If the patient could not abduct to 90°, the arm was held passively at 90° whereafter the patient actively performed the rotation challenge. Extension: The arm was moved in the sagittal plane, from 0° (neutral position) and backward towards 90° (normal maximum). No physiotherapy instructions or physiotherapy was given before or after treatment in order to better evaluate the outcome of the treatment per se.

Patient-based outcome measures

Health-related quality of life is defined as the subjective perception of the impact of disease and treatment on the health status including physical, psychological and social functioning, and well-being (35). In order to capture the constructs of relevance to study questions a battery of outcome instruments were used ranging from specific pain and disability measures to a broad generic questionnaire. All questionnaires were self-administered, i.e., completed by the patients themselves.

Visual Analogue Scale (VAS) measurements of symptoms and of activities of daily living (ADL).

'Yes' and 'No' questions of symptoms. VAS is widely used as an easy, reliable and sensitive means with which to evaluate patients' subjective opinion of the outcome of various treatments in clinical studies, particularly on pain (36-38). The scale is graded from 0 (no difficulty) to 100 (extreme difficulty). There are no established 'normal values', but a healthy patient without edema would conceivably rate '0' in all instances.

We studied the following parameters: pain, difficulties with activities of daily living (ADL), and swelling of the back of the hand. The questions were:

— Do you have pain in the lymphedematous arm?
— Do you have problems with swelling of the hand of the lymphedematous arm?
— Do you have problems with activities of living in your daily life?

We added the following symptom questions to the protocol in an attempt to further assess the subjective perception of the impact of the disease, although no data on reliability and validity for obvious reasons are available. They were answered with 'yes' or 'no':
— Is there reduced mobility in the shoulder joint?
— Do you feel that the arm is swollen?
— Does the arm feel heavy?
— Do you feel fatigue or weakness in the arm?
— Do you feel numbness or pricking sensation in the arm?

Nottingham Health Profile (NHP)

NHP is a two-part, self-administered questionnaire designed to provide a standardized measure of perceived health problems (39,40). Both reliability and validity of the test have been verified for Swedish circumstances (41). The 38 'yes' or 'no' items of part I reflect degrees of distress within the domains of emotions, sleep, lack of energy, pain, physical mobility, and social isolation. Weights in each section total 100, indicating the presence of all possible problems, whereas 0 denotes no problems whatsoever (42,43). Part II has 7 'yes' or 'no' statements concerning the frequency of health-related problems such as gainful employment, housework, social life, family life, sex life, hobbies, and holidays. Because of the high mean age in the present material, questions about gainful employment and sex life were excluded. Findings in the NHP were related to mean values of a normal female Swedish population, taking age and sex into consideration (44).

The Psychological General Well-Being index (PGWB)

PGWB is a psychometrically well documented test that is used to detect differences in clinical studies (45). The PGWB index has been translated into Swedish and psychometrically verified according to standard principles (46). The test consists of 22 questions, which in addition to providing a total score, cover six subscales depicting anxiety, depressed mood, well-being, self-control, general health, and vitality. Patients rate each question on a six-point scale with 1 as the most negative and 6 as the most positive option. Findings in PGWB were related to mean values of a normal Swedish population (47)

The Hospital Anxiety Depression Scale (HAD)

The HAD scale has been validated and is a reliable instrument for screening of anxiety and depression among patients attending a regular unit for medical care (48). The test has been shown to provide a valid measure of the severity of disorders related to mood, and repeated application of the test provides the physician with useful information concerning any emotional aberrations. The original HAD scale is available in Swedish. The test consists of 14 questions, 7 representing anxiety and 7 depression. Patients rate each question on a four-point scale, graded 0-3, corresponding to increasing degree of anxiety or depression, giving a maximum of 21.

Calculations and statistical analysis

Non-parametric methods were consistently used as observed data of some variables were not statistically normal distributed. Hodges-Lehmann estimates of medians, including 95% confidence intervals (49), by

TABLE 2
Edema Volumes*

	Before (baseline)	6 months	1 year	Change from baseline at 6 months	at 1 year
LS+CCT	1781 (1528-2080)	98 (-30-230)	-21 (-118-113)	p<0.0001	0.0001
CCT	1625 (1350-1968)	903 (673-1273)	730 (550-1308)	p<0.0001	0.0002
LS+CCT vs CCT				p<0.0001	0.0001

LS=liposuction, CCT=Controlled Compression Therapy. *Values are edema volumes (ml) [median (CI-95)].

group and time of assessment are presented for all data except binary variables ('yes' or 'no' questions of symptoms, and NHP part II), where the proportion of responses is used. Additionally, the following tests of significance were applied:

Analysis of differences within group, continuous variables

Changes over the first 6 months were analyzed using the Friedman test. The difference between one year and baseline assessment was analyzed using the Wilcoxon signed rank test.

Analysis of differences between groups, continuous variables

Differences of baseline values, values over the first 6 months derived as area under the curve (AUC), and changes after one year were analyzed using the Wilcoxon rank sum test.

Analysis of differences within group, binary variables

Changes over the first 6 months were analyzed using Cochran's Q test. The difference between one year and baseline assessment was analyzed using McNemar test (50).

Analysis of differences between groups, binary variables

Differences of baseline values were analyzed with Fischer's exact test, values over the first 6 months derived as area under the curve (AUC) were compared using Wilcoxon rank sum test, and outcome values after one year were analyzed using Cochran-Mantel-Haentzel test with adjustment for the baseline assessment (50).

Analysis of correlation between edema volume reduction and outcome parameters

The Spearman correlation coefficient was used to analyze any correlation between edema volume reduction in all patients and of quality of life parameters (continuous variables).

The outcome of the significance tests was considered as exploratory results, and therefore nominal p-values are presented without any adjustment for multiple comparisons. A p-value of 0.05 or less is presented as statistically significant.

RESULTS

Only statistically significant outcomes are described. The more important findings can be summarized as follows:

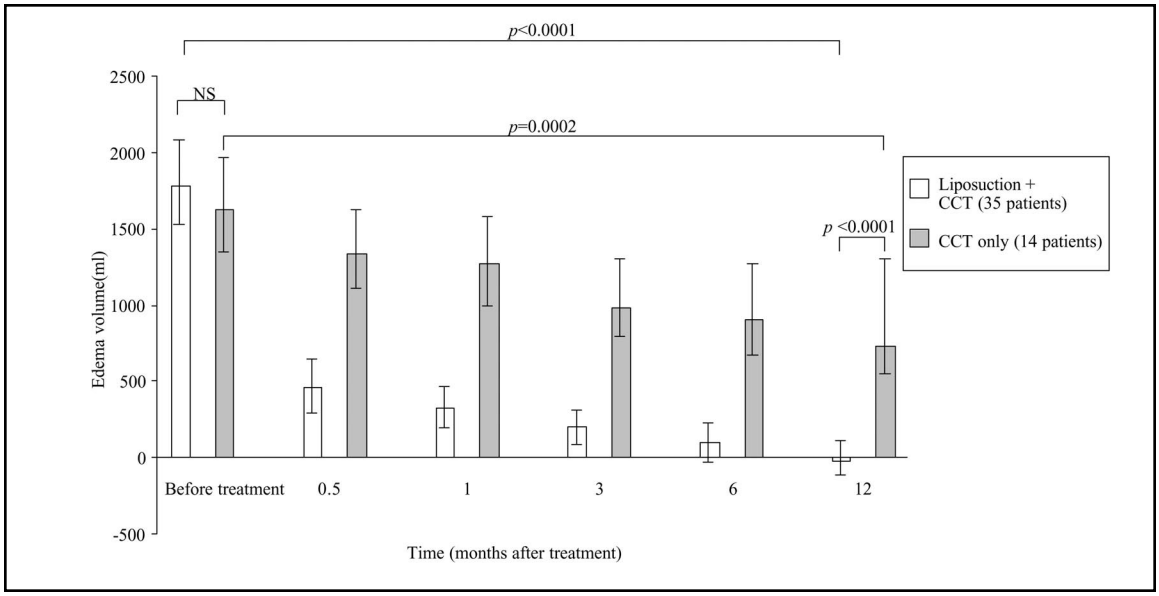

Fig.1. Median (CI- 95%) edema volumes before and after treatment. Note the pronounced effect of surgery and that significant improvement continued during the subsequent postoperative course.

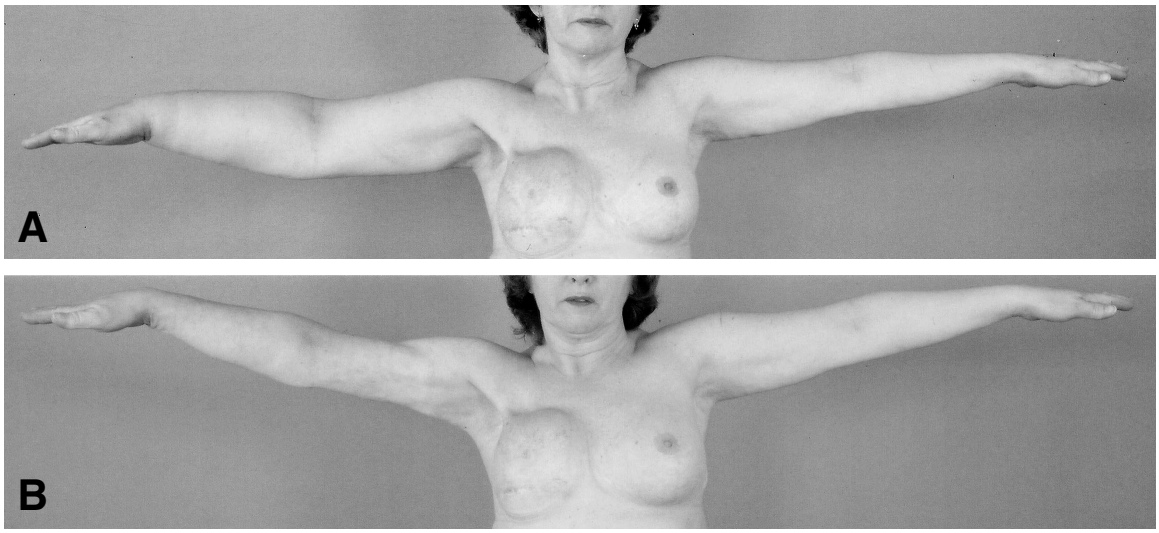

Fig. 2. (a) A 52-year-old woman with a preoperative edema volume of 1335 ml in the right arm. (b) Clinical result one year after liposuction.

Volumes (Table 2)

In both groups, the pretreatment edema volume decreased during one year. There were differences between the groups both over 6 months, and at 12 months.

Liposuction+CCT was found to be better than CCT alone for reducing the arm lymphedema with a relative reduction of 103% in the liposuction+CCT group compared to 50% in the CCT group after one year (*Fig. 1*). *Figure 2* shows a typical result in the liposuction+CCT group after one year.

TABLE 3
Range of Motion

	Before (baseline)	6 months	1 year	Change from baseline at 6 months	at 1 year
Flexion (180°)					
LS+CCT	145 (130-158)	160 (150-168)	163 (153-168)	p<0.0001	0.0001
CCT	140 (120-160)	155 (140-170)	155 (130-173)	p<0.0001	0.0001
Extension (90°)					
LS+CCT	45 (43-50)	58 (53-60)	60 (55-63)	p<0.0001	0.0001
CCT	48 (40-55)	58 (53-65)	58 (53-65)	p<0.0001	0.002
Abduction (180°)					
LS+CCT	150 (130-165)	165 (153-175)	170 (160-173)	p<0.0001	0.0001
CCT	138 (108-160)	155 (135-178)	158 (128-178)	p<0.0001	0.02
Internal rotation (90°)					
LS+CCT	70 (63-78)	85 (80-88)	85 (80-90)	p<0.0001	0.0001
CCT	75 (65-90)	85 (80-90)	85 (78-90)	NS	NS
External rotation (90°)					
LS+CCT	70 (63-78)	80 (75-85)	80 (75-88)	p<0.0001	0.0001
CCT	75 (65-85)	85 (80-90)	85 (80-90)	p<0.002	0.04

LS=liposuction, CCT=Controlled Compression Therapy; NS=not significant. Values are given in degrees [median (CI-95)]. Normal values of ROM are given in parentheses.

ROM (Table 3)

Flexion, extension, abduction and external rotation increased in both groups during one year. Internal rotation increased during one year in the liposuction+CCT group, whereas in the CCT group no change was seen. There were no differences between the groups.

Visual Analogue Scale (VAS) measurements of symptoms and of activities of daily living (ADL) and 'yes' or 'no' questions of symptoms (Table 4)

The VAS score decreased regarding pain, swelling of the hand, and difficulties with ADL during one year in the liposuction+CCT group, whereas in the CCT group no change was seen. Between the groups, differences were seen during the one year follow-up, except regarding swelling of the hand after one year.

In the liposuction+CCT group positive changes were seen during the whole year regarding reduced mobility, swollen arm, heavy arm, fatigue/weakness, and numbness/ pricking sensation, except at one year for numbness/pricking sensation. In the CCT group favorable changes were seen to a lesser extent especially regarding swollen arm and heavy arm during 6 months. Notable changes between the groups were seen regarding swollen arm and heavy arm during one year.

TABLE 4
Visual Analogue Scale and 'Yes' or 'No' Questions of Symptoms

	Before (baseline)	6 months	1 year	Change from baseline at 6 months	at 1 year
Pain					
LS+CCT	25 (9-35)	5 (3-9)	3 (2-5)	p<0.0002	0.0003
CCT	26 (3-48)	31 (18-47)	40 (21-59)	NS	NS
LS+CCT vs CCT				p<0.009	0.002
Swelling of hand					
LS+CCT	39 (27-48)	11 (6-18)	13 (8-22)	p<0.0002	0.0001
CCT	46 (24-66)	45 (22-65)	45 (27-65)	NS	NS
LS+CCT vs CCT				p<0.03	NS
ADL (difficulties)					
LS+CCT	41 (31-51)	6 (3-12)	4 (2-8)	p<0.0001	0.0001
CCT	51 (37-66)	48 (37-57)	41 (24-58)	NS	NS
LS+CCT vs CCT				p<0.0001	0.02
Reduced mobility					
LS+CCT	63	20	20	p<0.0001	0.0001
CCT	64	36	36	NS	NS
LS+CCT vs CCT				NS	NS
Swollen arm					
LS+CCT	94	26	14	p<0.0001	0.0001
CCT	100	79	86	p<0.0001	NS
LS+CCT vs CCT				p<0.0001	0.0001
Heavy arm					
LS+CCT	89	9	11	p<0.0001	0.0001
CCT	93		50	p<0.004	0.04
LS+CCT vs CCT				p<0.0001	0.005
Fatigue/weakness					
LS+CCT	51	11	14	p<0.0001	0.003
CCT	50	21	29	NS	NS
LS+CCT vs CCT				NS	NS
Numbness/prick. sens.					
LS+CCT	37	26	23	p<0.0007	NS
CCT	57	43	57	NS	NS
LS+CCT vs CCT				NS	NS

LS=liposuction, CCT=Controlled Compression Therapy; NS=not significant. Values are VAS scores (0-100) [median (CI-95)] for pain, swelling of hand and ADL. Value for remaining symptoms are "yes" answers in percent.

TABLE 5
Nottingham Health Profile

	Before (baseline)	6 months	1 year	Change from baseline at 6 months	at 1 year
Total score (12.5)					
LS+CCT	9 (5-23)	6 (2-10)	8 (2-14)	p<0.0007	0.02
CCT	14 (8-33)	11 (2-36)	15 (6-36)	p<0.02	NS
LS+CCT vs CCT				NS	NS
Emotions (11.7)					
LS+CCT	5 (0-14)	0 (0-0)	0 (0-8)	p<0.02	NS
CCT	0 (0-23)	0 (0-27)	4(0-34)	NS	NS
LS+CCT vs CCT				NS	NS
Sleep (16.9)					
LS+CCT	17 (6-28)	11 (6-26)	11 (6-21)	NS	NS
CCT	39 (17-61)	34 (11-56)	38 (10-60)	NS	NS
LS+CCT vs CCT				NS	NS
Lack of energy (17.6)					
LS+CCT	0 (0-30)	0 (0-0)	0 (0-12)	NS	NS
CCT	0 (0-38)	0 (0-50)	0 (0-50)	NS	NS
LS+CCT vs CCT				NS	NS
Pain (13.4)					
LS+CCT	11 (5-26)	0 (0-8)	0 (0-13)	p<0.02	0.02
CCT	23 (5-45)	16 (4-38)	22 (0-41)	NS	NS
LS+CCT vs CCT				NS	NS
Physical mobility (8.6)					
LS+CCT	7 (4-14)	5 (0-10)	5 (0-10)	p<0.02	0.05
CCT	14 (5-37)	11 (0-41)	14 (4-30)	NS	NS
LS+CCT vs CCT				NS	NS
Social isolation (6.7)					
LS+CCT	0 (0-13)	0 (0-0)	0 (0-0)	NS	NS
CCT	0 (0-0)	0 (0-13)	0 (0-21)	NS	NS
LS+CCT vs CCT				NS	NS
House work (20.0%)					
LS+CCT	51	23	29	p<0.002	0.03
CCT	57	50	57	NS	NS
LS+CCT vs CCT				NS	NS
Social life (10.7%)					
LS+CCT	9	6	9	NS	NS
CCT	7	14	14	NS	NS
LS+CCT vs CCT				NS	NS
Family life (7.0%)					
LS+CCT	3	3	6	NS	NS
CCT	0	0	0	NS	NS
LS+CCT vs CCT				NS	NS
Hobbies (12.6%)					
LS+CCT	31	20	34	NS	NS
CCT	43	43	43	NS	NS
LS+CCT vs CCT				NS	NS
Holidays (10.2%)					
LS+CCT	26	17	29	NS	NS
CCT	29	29	29	NS	NS
LS+CCT vs CCT				NS	NS

LS=liposuction, CCT=Controlled Compression Therapy; NS=not significant. Values are given in NHP scores [median (CI-95)] for total score, sleep, lack of energy, pain, physical mobility, and social isolation. Value for remaining symptoms are "yes" answers in percent. Normal mean values are given in parentheses.

TABLE 6
Psychological General Well-Being Index

	Before (baseline)	6 months	1 year	Change from baseline at 6 months	at 1 year
Total score (101.4)					
LS+CCT	107 (100-113)	110 (105-116)	109 (100-118)	p<0.05	NS
CCT	101 (89-113)	110 (93-116)	106 (90-114)	NS	NS
LS+CCT vs CCT				NS	NS
Anxiety(23.6)					
LS+CCT	26 (24-27)	26 (25-28)	26 (24-28)	NS	NS
CCT	25 (21-28)	26 (23-28)	25 (22-27)	NS	NS
LS+CCT vs CCT				NS	NS
Depressed mood (23.6)					
LS+CCT	16 (16-17)	16 (16-17)	16 (15-17)	NS	NS
CCT	16 (13-18)	16 (14-17)	16 (12-17)	NS	NS
LS+CCT vs CCT				NS	NS
Well-being (16.0)					
LS+CCT	17 (16-18)	18 (16-20)	17 (16-19)	NS	NS
CCT	16 (13-18)	18 (15-19)	18 (15-19)	NS	NS
LS+CCT vs CCT				NS	NS
Self-control (15.1)					
LS+CCT	17 (16-17)	17 (16-17)	17 (15-17)	NS	NS
CCT	15 (14-17)	16 (15-17)	16 (15-17)	NS	NS
LS+CCT vs CCT				NS	NS
General health (14.4)					
LS+CCT	15 (13-16)	16 (15-16)	16 (14-17)	p<0.04	NS
CCT	12 (9-15)	14 (12-16)	13 (12-15)	NS	NS
Vitality (17.0)					
LS+CCT	18 (17-20)	19 (18-20)	20 (17-21)	NS	NS
CCT	18 (15-20)	20 (16-21)	18 (15-20)	NS	NS

LS=liposuction, CCT=Controlled Compression Therapy; NS=not significant. Values are PGWB scores [median (CI-95)]. Normal mean values are given in parentheses.

NHP (Table 5)

In the liposuction+CCT group total score, pain, physical mobility, and housework decreased during one year, whereas emotions only during 6 months. In the CCT group only total score changed during the first 6 months. No changes were seen between the groups at any time.

PGWB (Table 6)

In the liposuction+CCT group, only the total score and general health changed during 6 months. No other changes were seen.

HAD (Table 7)

In the liposuction+CCT group only

TABLE 7
Hospital Anxiety Depression Test

	Before (baseline)	6 months	1 year	Change from baseline at 6 months	at 1 year
Anxiety (≤7)					
LS+CCT	5 (4-6)	4 (3-6)	4 (3-6)	p<0.05	NS
CCT	5 (3-7)	5 (3-8)	7 (5-9)	NS	p<0.04
LS+CCT vs CCT				NS	p<0.02
Depression (≤7)					
LS+CCT	3 (2-4)	3 (1-4)	3 (1-4)	NS	NS
CCT	3 (1-5)	3 (1-6)	3 (1-7)	NS	NS
LS+CCT vs CCT				NS	NS

LS=liposuction, CCT=Controlled Compression Therapy; NS=not significant. Values are HAD scores [median (CI-95)]. Normal mean values are given in parentheses.

anxiety decreased during 6 months, while in the CCT group it increased at one year, where also a difference was seen between the groups. No changes regarding depression were seen.

Correlation between edema volume reduction and outcome parameters (Table 8)

ROM showed negative correlation at baseline – i.e., the less edema volume the better ROM – in aspects of flexion, extension, abduction, and internal rotation. Baseline positive correlations – i.e., the larger edema volume, the more pronounced symptoms – were found regarding VAS parameters (swelling of hand, ADL), and all scales of NHP (part I). After one year there was a negative correlation regarding abduction and internal and external rotation, i.e the less edema volume, the better ROM. Positive correlations were seen after one year in VAS parameters (pain, swelling of hand, ADL) and NHP (total score, lack of energy and social isolation), i.e., the less edema volume the fewer symptoms. Neither PGWB index nor HAD showed any correlations.

DISCUSSION

Conservative therapy with complex physical therapy (CPT) and compression pumping are feasible primarily for pitting edemas, where the swelling is dominated by accumulated lymph. In the long run accumulation of adipose tissue and fibrosis occur and a surgical approach is rational in patients with non-pitting edema. Older methods with split skin grafting turned out to be mutilating for the patient. Microsurgery is an inventive method with the intention to reduce edema but does not reduce the swelling completely as excessively formed adipose tissue is not removed (51-54). The microsurgical technique also requires postoperative wearing of garments. Liposuction+CCT is a new approach with promising results based on the immediate volume reduction, where also excess adipose tissue is removed. With this technique we encountered no surgical complications. Postoperative dysestesia in the skin in some patients disappeared within 2-3 months.

In general, patients with breast cancer-related symptomatic arm lymphedema after

TABLE 8
Correlation Between Edema Volume Reduction and Outcome Parameters

	Before (baseline)	Change from baseline to 1 year
Range of motion		
Flexion	-0.47*	-0.22
Extension	-0.48*	-0.18
Abduction	-0.39*	-0.32*
Internal rotation	-0.52*	-0.43*
Outward rotation	-0.28	0.35*
Visual Analogue Scale		
Pain	0.14	0.39*
Swelling of hand	0.35*	0.34*
ADL	0.38*	0.47*
Nottingham Health Profile (Part I)		
Total score	0.45*	0.31*
Emotions	0.33*	0.25
Sleep	0.39*	0.20
Lack of energy	0.41*	0.33*
Pain	0.41*	0.20
Physical mobility	0.48*	0.21
Social isolation	0.46*	0.28*
Psychological General Well-Being Index		
Total score	-0.16	0.09
Anxiety	-0.08	0.10
Depressed mood	-0.10	0.03
Well-being	0.02	0.27
Self-control	-0.11	0.19
General health	-0.21	0.04
Vitality	-0.09	-0.03
Hospital Anxiety Depression Test		
Anxiety	0.02	0.18
Depression	0.16	0.07

*=$p<0.05$.

treatment who would consider therapy is not often encountered. Although a regional center for lymphedema treatment, only 49 patients could be recruited for this prospective study during a three-and-a-half year period. A prospective study with matched pairs would be optimal, but for ethical reasons we could not postpone treatment.

In this series of patients, we found that liposuction+CCT reduced arm lymphedema by 103%, i.e., the treated arm was somewhat smaller than the healthy one. CCT is beneficial as well, but the effect is less pronounced at 50%. Reduction in arm lymphedema volume had significant consequences for the patients. As could be expected from the

volume measurements, more favorable additional effects were mostly recorded in the liposuction+CCT group.

The subjective sensation of pain, heaviness, weakness and paresthesia after breast cancer treatment have been clearly documented previously (25,27,28,30,55), as well as reduced mobility of the shoulder after irradiation (14). In the present study, the subjective sensation of swelling of the hand and arm decreased, as did heaviness and fatigue/weakness particularly in the liposuction+CCT group. Benzen et al (56) found that postoperative irradiation decreased shoulder performance, but presence of arm edema had no significant influence. In contrast, the mobility of the shoulder joint in this study was considered better after treatment and this was confirmed by the ROM measurements. Regarding the subjective sensation of pain (VAS and NHP subscale) and numbness or pricking sensation (VAS), the results indicate an improvement in the liposuction+CCT group. Carroll and Rose (57) also recorded reduced pain after conservative treatment with CPT using categorical verbal ration scores and McGill Pain Questionnaire, but the study did not correlate pain scores with volume data. Sitzia and Sobrido (58) also found improved NHP (part 1) scores regarding pain, energy and physical mobility after conservative treatment, but there was no association between change in limb volume and change in subscales. In our CCT group, however, VAS score for pain was rather increased, and NHP pain score was unchanged.

Also in more global parameters related to ADL (VAS, NHP total score part I) some beneficial effects were recorded, particularly in the liposuction+CCT group. Some important subscale parameters in NHP actually indicated an improvement, e.g., physical mobility and housework, whereas other subscale parameters remained fairly constant, such as qualities related to emotions, sleep, energy, social life in general, family life, hobbies, and holidays. Starting values for these parameters were in most instances compatible with or even better than those obtained from the normal age-matched population indicating that the lymphedema situation hardly limits these functions (44). Consequently, no improvement after treatment could be expected in either group. Also Sitzia and Sobrido (58) found that the NHP (part 1) was less useful with regard to psychological and emotional domains. They also found that a large percent of the subscale scores, both before and after intensive treatment, were better than the published norms. It may be that these dimensions are not relevant to this patient group, that the treatment has little effect on these dimensions, or that the NHP (part 1) questions lacked the sensitivity needed in this context (58).

Regarding psychological health, findings in the HAD subscales showed that the women in our particular series were compatible with the normal population for anxiety and depressive disorders. This is supported by a study by Tobin et al (18), who also found no differences in HAD scores between patients with and without lymphedema after breast cancer treatment. The PGWB index indeed showed high values compared with a normal population, indicating normal general health (47). Despite this, there was a tendency for an even better total PGWB score following treatment with liposuction+CCT, and this recorded improvement is of a magnitude that has previously been shown to be of clinical relevance in a population with PGWB scores in the normal range (59). Although there is a ceiling effect for this instrument under such circumstances, it has shown to be useful in the evaluation also of asymptomatic patients, for instance with hypertension (60). Zanolla et al (61) reported an improvement in patients' 'mood' after treatment using both visual analogue and ordinal scales, but found no significant correlation between limb size and mood state. Mirolo at al (20) used the Functional Living Index-Cancer (FLIC) and the Wesley Clinic Lymphoedema Scale (WCLS) and found better scores after

treatment, but found no correlation between them and reduction of the edema. Another study by Woods (19) using the PAIS (Psychological Adjustment to Illness Scale) suggested that lower post-treatment scores can be influenced by appropriate management, but no statistical correlation was made to evaluate the influence of the edema volume reduction per se or comparison to a normal population. Regarding psychological health, in summary, there are some data indicating essentially normal health. Despite this, a possible slight effect of treatment has been found.

Sitzia and Sobrido reviewed the literature and found that to date there has been no examination of the relationship of edema volume reduction to health related quality of life (24, 58). We found a significant correlation between reduced edema volume and improved quality of life parameters like ROM, VAS, and NHP, but none regarding qualities related to psychological well-being (PGWB and HAD).

It may be considered surprising that qualities related to social life in general and psychological well-being were undisturbed, as qualities related to everyday activities were clearly impaired by the lymphedema. Maunsell et al (16) indeed found psychological distress in patients at 3 months after breast cancer treatment. Also Tobin at al (18) found that patients, without treatment, showed significant differences in most of the scores of PAIS achieved by the patients with arm swelling and those without. The patients with lymphedema had had their lymphedema for 4.2 years. On the other hand, Goldberg et al found a significant decrease in anxiety and depression one year after breast cancer treatment compared to pretreatment values (62). A tentative explanation for the high scores in our study is that the emotional consequences of the stigma are gradually alleviated once the breast cancer turned out to be properly treated, as in our series of patients where treatment for lymphedema was started after about 10 years. Since the baseline or 'before treatment' values were compatible with or better than values observed in a normal healthy population, there was little scope for improvement. Hence, no major changes after treatment, or differences between the groups, were likely to appear. Furthermore, groups were comparatively small and the tests used may be too blunt to reveal small alterations in this particular patient category. From this point of view, complementary investigations with larger materials and alternative tests would seem warranted.

Findings reported here on the beneficial effects of liposuction and CCT on quality of life are based on observations during one year. A longer period of observation would be desirable for definitive conclusions. However, we have shown that the already deteriorated lymph transport is not further impaired by liposuction (12), and regarding the edema volumes, the effect is maintained for at least four years (10). Therefore the prospect of a long-term favorable effect on quality of life parameters seems reasonable.

In summary, arm lymphedema entails subjective discomfort in terms of pain, swelling, heaviness, fatigue/weakness and restricted mobility of the arm. These impairments are reflected primarily in difficulties in accomplishing activities related to everyday life. Treatment with CCT alleviates these problems, but combined with liposuction the effects are even more conspicuous. The consequences of the arm lymphedema regarding more psychologically oriented qualities seem so far to be less serious.

CONCLUSIONS

Liposuction+CCT improves patients' quality of life, particularly qualities associated with everyday activities, hence qualities that can be directly related to the complete arm edema reduction. CCT is beneficial too, but the effect is less obvious than when combined with surgery, probably because the edema reduction is less. The consequences of the

arm lymphedema for more psychologically oriented qualities and social life in general seem to be less serious, and only marginal effects of treatment can be expected in these domains.

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