

# Long-term benefit of liposuction in patients with lipoedema: a follow-up study after an average of 4 and 8 years

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## Summary

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### Accepted for publication

2 November 2015

### Funding sources

None.

### Conflicts of interest

None declared.

DOI 10.1111/bjd.14289

**Background** Long-term results following liposuction in patients with lipoedema are available only for an average period of 4 years.

**Objective** To find out whether the improvement of complaints persists for a further 4 years.

**Methods** In a single-centre study, 85 patients with lipoedema had already been examined after 4 years. A mail questionnaire – often in combination with clinical controls – was repeated after another 4 years (8 years after liposuction).

**Results** Compared with the results after 4 years, the improvement in spontaneous pain, sensitivity to pressure, oedema, bruising and restriction of movement persisted. The same held true for patient self-assessment of cosmetic appearance, quality of life and overall impairment. Eight years after surgery, the reduction in the amount of conservative treatment (combined decongestive therapy, compression garments) was similar to that observed 4 years earlier.

**Conclusion** These results demonstrate for the first time the long-lasting positive effects of liposuction in patients with lipoedema.

### What's already known about this topic?

- The longest follow-up studies after liposuction performed in patients with lipoedema were performed over an average period of 4 years.

### What does this study add?

- This study adds new information concerning specific complaints after an average period of 8 years following liposuction in patients with lipoedema.
- These complaints include oedema, spontaneous pain, sensitivity to pressure, bruising, restriction of movement, cosmetic impairment and reduction in quality of life.

Lipoedema, a disease seen mainly by dermatologists, phlebologists and lymphologists, occurs only in women and is characterized by a circumscribed increase of subcutaneous fatty tissue accompanied by oedema, pain and bruising. Apart from conservative treatment to reduce oedema [combined decongestive therapy (CDT) comprising manual lymphatic drainage (MLD) and compression garments or bandages], the guidelines for lipoedema of the German Society of Phlebology<sup>1</sup> include surgical treatment (liposuction) to reduce fatty tissue.

Despite convincing short-term results,<sup>2–5</sup> only one long-term study on liposuction for lipoedema treatment has been

conducted to date. A follow-up study conducted by our working group in 2010 showed that in 112 patients who had undergone liposuction, the circumscribed accumulations of subcutaneous fatty tissue, which in many cases were disfiguring, had disappeared an average of 3 years and 8 months after liposuction (range 1 year and 1 month to 7 years and 4 months). Furthermore, a distinct reduction in oedema typical of lipoedema was observed, along with a reduction in spontaneous pain, sensitivity to pressure and bruising. This in turn improved restriction of movement, cosmetic impairment and quality of life, as well as the

summary score of all seven parameters, representing 'overall impairment'.<sup>6</sup>

The objective of the study presented here was to test the continued long-lasting treatment success of this patient group, which was studied again in 2014 after an average of 8 years, using the same questionnaire. The objective was to find out whether the improvement in complaints described in 2010 had changed in the course of the subsequent 4 years. The study focused particularly again on the type and number of conservative treatment measures (MLD, CDT) still required after liposuction.

## Patients and methods

This study was approved by the ethics committee of the University of Schleswig-Holstein, Campus Luebeck, Germany. All of the 112 female patients evaluated in 2010 by means of a questionnaire at the Hanse-Klinik, a specialized clinic in Luebeck, Germany, were written to again in March 2014. Twenty-seven of these patients could no longer be reached or did not respond. The remaining patients returned questionnaires that could be evaluated, which corresponds to a return rate of 76%. In some of the cases, the patients were also examined or submitted photos that were evaluated.

In 2014, the average age of this population was 47.4 years (range 28–75). In 2014, their average age at the time of the first liposuction was 40.1 years (range 22–68). With respect to the time period after surgery, the follow-up observation took place an average of 8 years and 3 months (range 5 years and 1 month to 11 years and 4 months) after the first liposuction and 7 years and 6 months (range 4 years and 8 months to 10 years and 10 months) after the last liposuction.

With respect to the severity of lipoedema, in 2010, 35 of the 112 patients (31%) had stage I lipoedema, 75 (67%) had stage II lipoedema and two (2%) had stage III lipoedema. The patient cohort studied in 2014 included 24 patients (28%) with stage I lipoedema and 61 patients (72%) with stage II lipoedema. Of the two patients with stage III lipoedema studied in 2010, one could no longer be reached in 2014. The other patient explained by telephone that other health-related problems (affecting the vertebral discs and lungs) were so pressing that the evaluation of the parameters listed in the

questionnaire would not reflect the (only very slight) lipoedema-related complaints.

## Results

### Postoperative changes in complaints

The seven items were evaluated quantitatively. They are spontaneous pain, sensitivity to pressure, oedema, bruising, restriction of movement, cosmetic impairment and reduction in quality of life. As in 2010, the following scale was used for evaluation: 0, none; 1, minor; 2, medium; 3, strong; 4, very strong. For all items there were highly significant differences between the presurgical and postsurgical responses. Table 1 presents the values of the respective parameters at the times of the initial presurgical examination (between 2003 and 2009), the second examination (2010) and the present examination (2014). Figures 1–7 present these values graphically.

In addition to these seven impairment scores, the overall score (overall impairment, which is the mean value of all seven parameters) was also re-evaluated. Figure 8 presents the changes in this overall impairment. Overall impairment is considered to be an especially reliable value for treatment success. The reliability determinations according to Cronbach's alpha (internal consistency) are as follows: before liposuction,  $r_{tt} = 0.78$ ; after liposuction in 2010,  $r_{tt} = 0.79$  and after liposuction in 2014,  $r_{tt} = 0.77$ . This means that the reliability of the test of overall impairment for the group analyses is good.

The single-factor variance analysis with measurement repetition shows highly significant differences over time for all seven parameters and for overall impairment. All changes tended to be successful compared with the preoperative starting situation, with the scores for all impairment parameters being significantly lower in both 2010 and 2014 than before liposuction.

Apart from the scale 'spontaneous pain', between 2010 and 2014 there was a slight increase in impairments in all scales and for overall impairment (Table 1). For the items bruising, restricted movement, cosmetic impairment and impaired quality of life and the overall impairment, the increase is statistically significant, but the level is very low (all effect sizes are  $< 0.5$ ) and therefore not clinically relevant.

**Table 1** Changes in complaints after an average of 4 years (2010) and 8 years (2014) in 85 patients

	Before liposuction	2010	2014	P-value (ANOVA)
Spontaneous pain	1.86 ± 1.33	0.37 ± 0.61	0.37 ± 0.57	< 0.001
Sensitivity to pressure	2.88 ± 1.01	0.85 ± 0.86	0.94 ± 0.95	< 0.001
Oedema	3.07 ± 0.06	1.28 ± 0.88	1.34 ± 0.92	< 0.001
Bruising	2.91 ± 1.10	1.12 ± 1.02	1.46 ± 1.17	< 0.001
Restriction of movement	2.11 ± 1.30	0.24 ± 0.58	0.53 ± 0.69	< 0.001
Cosmetic impairment	3.32 ± 0.89	1.04 ± 0.89	1.40 ± 1.07	< 0.001
Reduction in quality of life	3.35 ± 0.84	0.73 ± 0.87	0.94 ± 1.00	< 0.001
Overall impairment	2.78 ± 0.72	0.81 ± 0.56	1.00 ± 0.66	< 0.001

Values are mean ± SD. Scale: 0, none; 1, minor; 2, medium; 3, strong; 4, very strong.

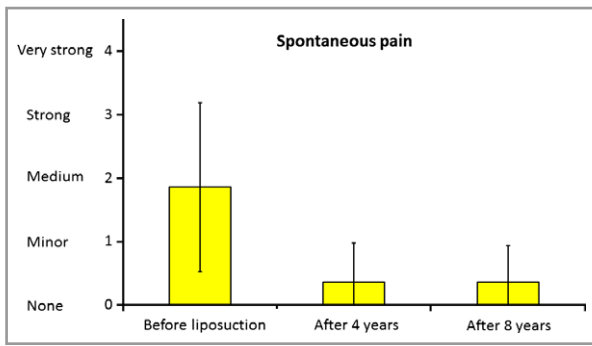


Fig 1. Spontaneous pain before and after an average of 4 and 8 years following liposuction in 85 patients with lipoedema.

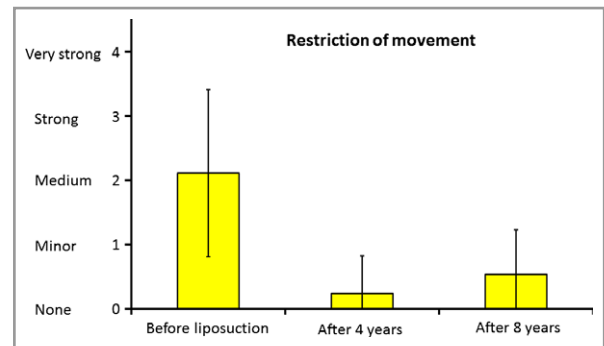


Fig 5. Restriction of movement.

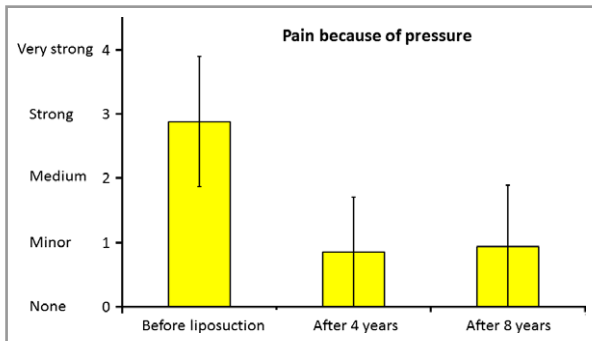


Fig 2. Sensitivity to pressure.

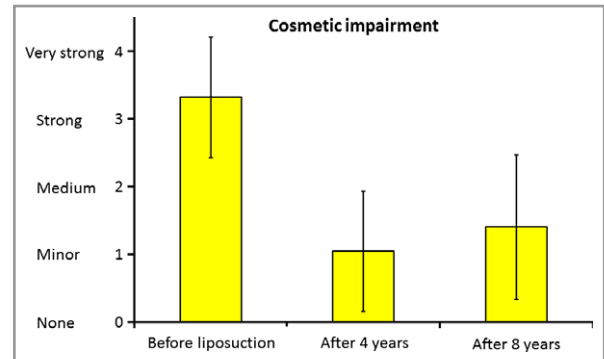


Fig 6. Cosmetic impairment.

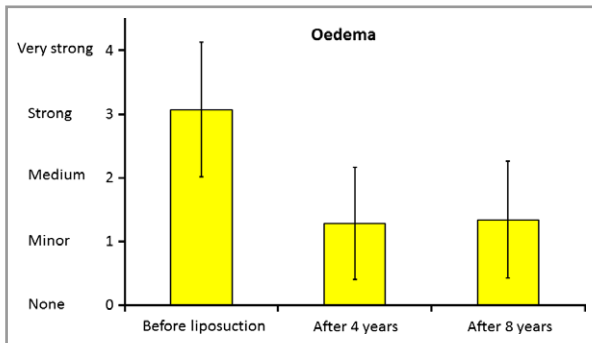


Fig 3. Oedema.

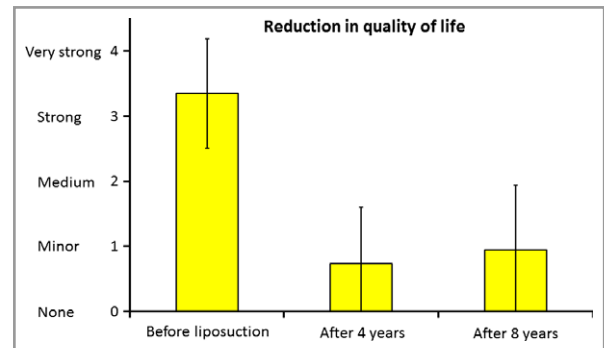


Fig 7. Reduction in quality of life.

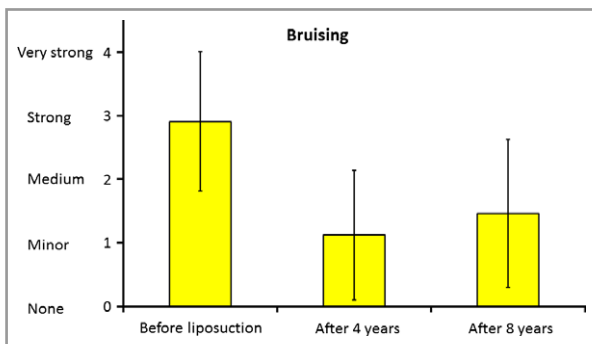


Fig 4. Bruising.

The magnitude of the changes between the measurement time points is expressed by effect size, a measurement related to the SD. It is a dimensionless number that has no upper limit and indicates the extent of the effect of an intervention and, in contrast to the significance, is of great clinical relevance. An effect size of 0.5 is evaluated as average and an effect size of  $\geq 0.8$  as high.

As Table 2 shows, the effect sizes for the changes in all items compared with the starting levels are significantly above 0.8 in comparison and are therefore 'strong'. The strongest improvement is demonstrated – unchanged – in the evaluation of the patient's own quality of life (improvement by nearly 3 SDs). The reduction in overall impairment is also at this level.

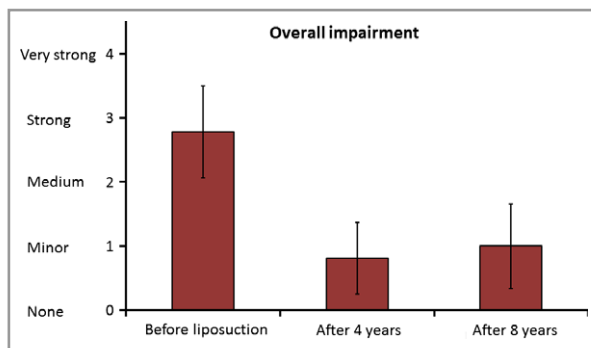


Fig 8. Overall impairment (overall severity score).

Table 2 Effect size for comparison of complaints between various measurement times

	Preoperative to 2010	Preoperative to 2014	2010–2014
Spontaneous pain	1.38***	1.50***	0.02
Sensitivity to pressure	2.04***	1.92***	0.11
Oedema	1.85***	1.73***	0.08
Bruising	1.72***	1.28***	0.31***
Restriction of movement	1.86***	1.51***	0.46***
Cosmetic impairment	2.54***	1.96***	0.33***
Reduction in quality of life	2.89***	2.59***	0.22*
Overall impairment	3.05***	2.58***	0.31**

\*\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$  (t-test).

In addition, the reduction in overall impairment was also evaluated differentially (Table 3), broken down by age, stage of disease and time period (months) after the last liposuction. For these group variables, two-way ANOVAS were calculated for the outcome variable 'overall impairment', with the group

Table 3 Differential analysis of 'overall impairment' using age, stage and months following liposuction as factors in addition to time effects

	n	Preoperative <sup>a</sup>	Postoperative 2010 <sup>a</sup>	Postoperative 2014 <sup>a</sup>	Source	P-value (ANOVA)
Age (years)						
22–32	21	2.6 ± 0.8	0.7 ± 0.5	0.9 ± 0.6	Group (g)	0.40
33–46	42	2.8 ± 0.7	0.9 ± 0.6	1.0 ± 0.7	Time (t)	< 0.001
47–68	22	2.9 ± 0.6	0.8 ± 0.5	1.1 ± 0.7	g × t	0.91
		P = 0.51	P = 0.62	P = 0.61		
Stage						
I	24	2.5 ± 0.7	0.9 ± 0.7	0.9 ± 0.7	Group (g)	0.44
II	61	2.9 ± 0.7	0.8 ± 0.5	1.0 ± 0.6	Time (t)	< 0.001
		P = 0.06	P = 0.25	P = 0.56	g × t	0.053
2014: months following last liposuction						
52–79	20	2.8 ± 0.7	0.7 ± 0.4	1.1 ± 0.6	Group (g)	0.61
80–89	22	3.1 ± 0.6	0.8 ± 0.5	0.9 ± 0.7	Time (t)	< 0.001
90–99	21	2.6 ± 0.8	0.6 ± 0.4	1.0 ± 0.8	g × t	0.053
100–134	22	2.6 ± 0.7	1.0 ± 0.7	1.0 ± 0.6		
		P = 0.12	P = 0.09	P = 0.90		

Values are the mean ± SD. <sup>a</sup>P-values in these columns refer to a comparison at this point of measurement.

factor as an independent factor and time (three level) as a measurement repetition factor. In so doing, it was shown that age is insignificant for the success of the intervention. The interaction between the measurement and the age group is not significant.

With regard to the disease stage, overall impairment prior to surgery was greater in stage II lipoedema (value of 2.9) than in stage I (value of 2.5). After liposuction, there was no longer any difference between the groups in the measurements taken in 2010 and 2014 (values of 0.8 vs. 0.9 and 1.0 vs. 0.9, respectively). The tendency of an interaction between group and time was significant ( $P = 0.053$ ). These results indicate that patients with stage II lipoedema have greater success and feel similar to the patients with stage I lipoedema after treatment.

With respect to the period of time after the last liposuction procedure, the obtained success was maintained. The evaluation of patient groups with a range of different times between the last liposuction procedure and the quality-of-life measurement yields only a time effect ( $P < 0.001$ ). In the survey performed in 2014, the values of the patients who had undergone liposuction at various times in the past were very comparable. The visible reduction in complaints in the postoperative period from 52 to 79 months could also be observed in patients whose liposuction had taken place 100–134 months earlier.

#### Changes in conservative treatment after liposuction

Of the 85 patients surveyed in 2014, 19 (23%) did not undergo CDT (MLD plus compression garments). Eleven of the patients (13%) were treated only with compression garments and eight (9%) underwent only MLD without compression garments. Forty-seven patients (55%) underwent CDT prior to liposuction. This subgroup was additionally evaluated separately.

Figure 9(a) shows the group preoperatively; all 47 patients (100%) had undergone CDT. Figure 9(b) shows the changes in 2010. At this time, 23% no longer required CDT, 57% were undergoing CPD less frequently and only 20% required CDT to the same extent as before. Figure 9(c) presents the changes in 2014, an average of 8 years postoperatively. Fourteen of the patients (30%) reported that they no longer needed to undergo treatment. Nine patients only wore compression stockings postoperatively. Four patients had only

occasional MLD and 15 patients continued to undergo CDT with MLD and compression garments, although they required both of these treatments significantly less often than before. These latter three study groups with a total of 28 patients (60%) thus had fewer conservative therapy interventions postoperatively than before liposuction. Five patients (10%) continued with the same extent and number of MLD treatments as before. However, they reported greater and, in particular, more rapid success of the decongestive measures with fewer overall complaints.

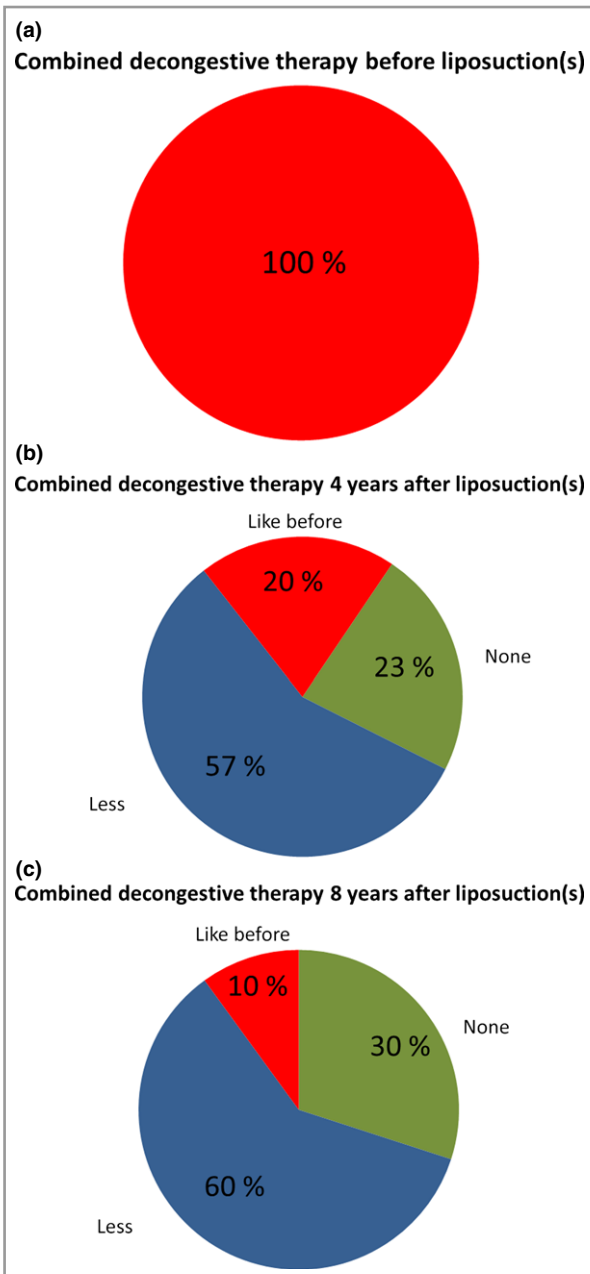


Fig 9. (a) Combined decongestive therapy before liposuction(s) (n = 47). (b) Use of combined decongestive therapy an average of 4 years following liposuction(s). (c) Use of combined decongestive therapy an average of 8 years following liposuction(s).

### Morphology

This study did not re-examine the changes in morphology. However, to demonstrate the long-lasting effects, one series of photos is presented that depicts an unchanged leg shape – despite changes in weight (with subjectively unchanged improvement in complaints) – over a period of 11 years (Fig. 10).

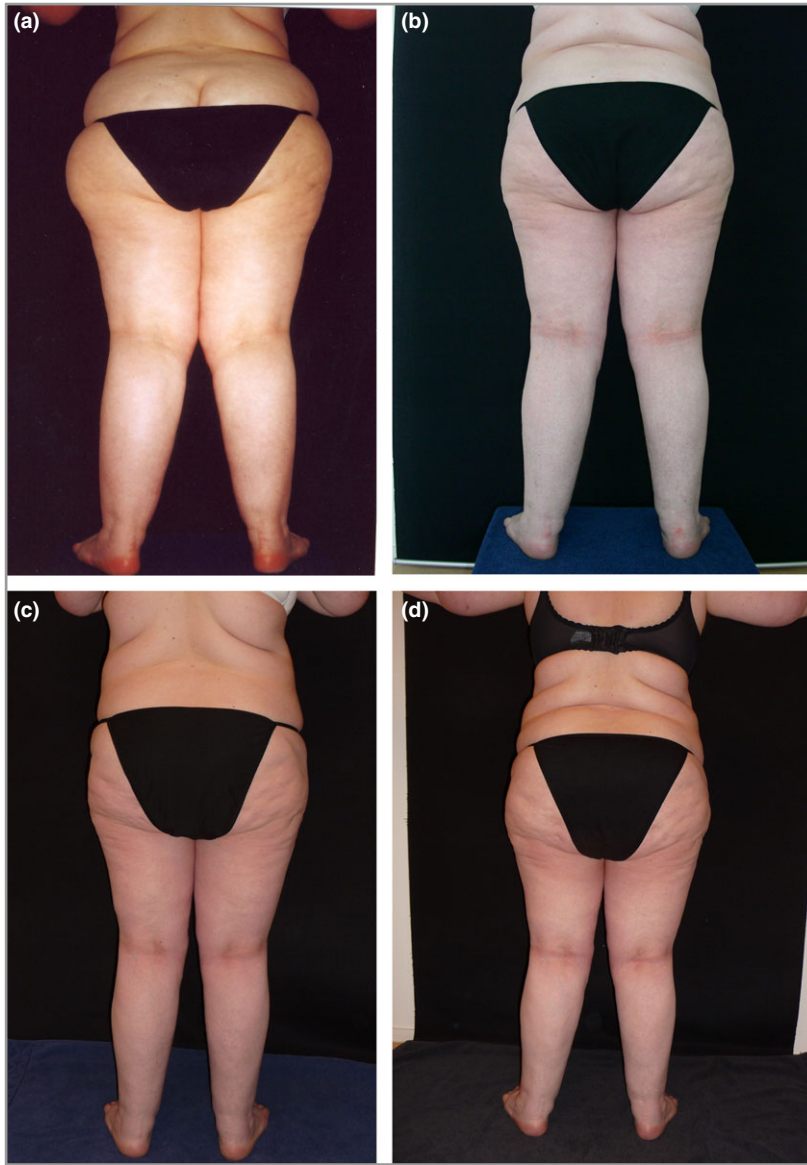
### Discussion

The goal of this study was to test the long-lasting effects of the reduction in complaints in patients with lipoedema after liposuction. Among the cohort of 112 patients with lipoedema written to in 2014, 85 patients were evaluated. With a response or return rate of 76%, which is considered to be very good in the literature,<sup>7</sup> the data collected for the surveyed group are representative. The study also represents an investigation of complaints typical for lipoedema over an unusually long period.

In general, the improvements achieved after an average of 4 years (in 2010) were still in place after an average of 8 years postoperatively (in 2014). For all individual parameters, as well as for overall impairment, highly significant differences between the initial and end findings were maintained. The decreases in the severity scores on a five-point scale reported 4 years earlier were practically identical for all seven parameters after an average of 8 years.

This long-lasting effect over so many years is even more remarkable when it is compared with the effects of CDT. The effect of this conservative treatment, which for decades has been established as a standard treatment for lipoedema, is known to be quite brief. For MLD the effect lasts in the range of hours, and once compression garments have been removed it is in the range of hours to days. Although CDT has been used routinely for over 50 years, we are not aware of any long-term studies during or after this treatment that we could have used for comparison during the course of lipoedema.

Lipoedema is a disease whose pathophysiology is not understood, and for which many questions are unanswered with respect to therapeutic treatment.<sup>8–10</sup> The improvements in mobility, cosmetic appearance and quality of life observed in this study are therefore both comprehensible and logical. Compared with these improvements, the improvements in spontaneous pain and sensitivity to pressure, and a tendency



**Fig 10.** Lipoedema stage II. Course after removal of 12 600 mL of fatty tissue in the hips, thighs and lower legs in four sessions. (a) 2003, preoperative, age 38 years, 82 kg body weight; (b) 2005, postoperative, 89 kg body weight; (c) 2010, 72 kg body weight; (d) 2014, 88 kg body weight. Despite an increase in weight and in volume on the trunk, the morphology of the legs is unchanged.

towards improvement in swelling and bruising, are known but not explicable. These symptoms are the central characteristics of lipoedema.<sup>11,12</sup>

A direct influence of liposuction on nociceptors or pain mediators, or on permeability (oedema) and fragility of the capillaries (bruising), is very difficult to imagine. Our results rather indicate that the circumscribed accumulation of subcutaneous fat is the key factor for lipoedema with respect to the pathophysiology. Pain, oedema and bruising are therefore possibly only secondary phenomena, as they are reduced or eliminated after the isolated reduction of the fatty tissue. However, it should be mentioned that pain, oedema and bruising tendency can also be reduced by CDT, albeit only temporarily.<sup>13,14</sup>

Although among all patients undergoing liposuction the striking improvements in complaints compared with preoperative findings were unchanged, in the last 4 follow-up years

there was a statistically significant but not clinically relevant worsening of some of the parameters (bruising tendency, restricted movement, cosmetic impairment, reduced quality of life and overall impairment) compared with 2010. While this may be an expression of the disease progression, it could also be interpreted as a consequence of the patients' increasing age. This is true in particular for the parameters of restricted mobility and cosmetic impairment, and possibly also for quality of life. In this respect, it should be kept in mind that 12% of all patients undergoing surgery were aged 50–59 years at the time of the first liposuction and 5% were aged 60–69 years.

We did not notice any correlation between the amount of adipose tissue removed and the extent of improvement of complaints. The success of treatment is not dependent on the patient's age, the duration of the disease or the length of conservative therapy. We also could not specify an ideal time

point of fat removal, but liposuction in lipoedema is always indicated when there is a progression of symptoms in spite of conservative therapy.

Interestingly, for the parameters sensitivity to pressure, spontaneous pain and oedema tendency, this trend of clinically nonrelevant exacerbation is less pronounced and there was no detectable significance. However, these parameters are known to be the hallmark symptoms of lipoedema, and eliminating these complaints is the declared objective of conservative treatment. Therefore, if an average of 8 years postoperatively disease progression had actually occurred, it would have to be manifested specifically by these parameters. Thus the factors are more likely to be unspecific age-related factors that are unrelated to the lipoedema, such as degenerative joint diseases, chronic obstructive pulmonary disease and cardiovascular problems.

Another important result of the study is the unchanged reduced need for conservative treatment after an average of 8 years postoperatively. It is noticeable that, compared with 2010, CDT tended to be used somewhat less often in 2014. Therefore, while the proportion of patients who did not undergo CDT at all rose from 23% (11 of 47 patients) to 30% (14 of 47 patients), the differences are not significant from a clinical perspective. The proportion of patients who underwent less conservative treatment than they had prior to liposuction remained the same, with 57% in 2010 and 60% in 2014.

In conclusion, an average of 8 years (range 5 years and 1 month to 11 years and 4 months) after liposuction, a noticeable improvement in findings and complaints was seen, with unchanged highly significant differences from the initial findings. No clinically relevant worsening of complaints occurred in the past 4 years. In addition, an unchanged significant reduction in the extent of the conservative treatment (CDT) still required or used was also observed. However, it is not possible to say whether the results still in place after 8 years can be considered 'permanent'.

Based on the present data, liposuction appears to be the most effective and long-lasting treatment for lipoedema to date. While all patients' symptoms noticeably improved as a

result of the liposuction, only one-third of the patients were completely free of symptoms. For this reason, conservative treatment – as an additional treatment – continues to play a significant role in lipoedema.

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