

Tumescent liposuction in lipoedema yields good long-term results

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Summary

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Background Lipoedema is a painful disease in women with circumscribed increased subcutaneous fatty tissue, oedema, pain and bruising. Whereas conservative methods with combined decongestive therapy (manual lymphatic drainage, compression garments) have been well established over the past 50 years, surgical therapy with tumescent liposuction has only been used for about 10 years and long-term results are unknown.

Objectives To determine the efficacy of liposuction concerning appearance (body shape) and associated complaints after a long-term period.

Methods A total of 164 patients who had undergone conservative therapy over a period of years, were treated by liposuction under tumescent local anaesthesia with vibrating microcannulas. In a monocentric study, 112 could be re-evaluated with a standardized questionnaire after a mean of 3 years and 8 months (range 1 year and 1 month to 7 years and 4 months) following the initial surgery and a mean of 2 years and 11 months (8 months to 6 years and 10 months) following the last surgery.

Results All patients showed a distinct reduction of subcutaneous fatty tissue (average 9846 mL per person) with improvement of shape and normalization of body proportions. Additionally, they reported either a marked improvement or a complete disappearance of spontaneous pain, sensitivity to pressure, oedema, bruising, restriction of movement and cosmetic impairment, resulting in a tremendous increase in quality of life; all these complaints were reduced significantly ($P < 0.001$). Patients with lipoedema stage II and III showed better improvement compared with patients with stage I. Physical decongestive therapy could be either omitted (22.4% of cases) or continued to a much lower degree. No serious complications (wound infection rate 1.4%, bleeding rate 0.3%) were observed following surgery.

Conclusions Tumescent liposuction is a highly effective treatment for lipoedema with good morphological and functional long-term results.

Lipoedema, first described in the 1940s in the U.S.A.,^{1,2} is characterized by bilateral symmetric enlargement mainly of the legs as a result of abnormal deposition of subcutaneous fatty tissue in combination with oedema. Despite being a specified clinical entity, epidemiological data are still unknown.

The disease occurs exclusively in women; it is probably attributable to an autosomal dominant inheritance with sex limitation.³ In most cases, hips, thighs ('jodhpur-like riding breeches'), knees and lower legs, sometimes with a fatty cuff at the ankles (Turkish-pants phenomenon, inverse shouldering effect) are affected; arms are rarely affected and hands and feet

are never involved. The accumulation of fluid in the form of orthostatic oedema results in pain, tenderness and sensitivity to pressure; this is expressed in synonyms such as lipalgia, adiposalgia, adipopalgesia, adiposis dolorosa, lipomatosis dolorosa or painful column leg. Together with easy bruising, it causes significant physical morbidity.

Whereas lipoedema may appear in women with generalized obesity, body weight is normal in many patients. The obvious disproportion between a slim upper half of the body and large lower extremities cannot be eliminated by weight loss brought about by diet or physical exercise; this often results in considerable frustration and psychological problems.^{2,4}

In the majority of patients, the disease starts almost imperceptibly after puberty but may also develop at other periods of hormonal change, such as pregnancy or menopause; it persists lifelong and progresses gradually. At the beginning, the skin is smooth and the subcutaneous layer is thickened, soft and with an even structure (stage I); the skin might be cool in certain areas as a result of functional vascular dysbalance. Over time, subcutaneous nodules develop and the skin surface becomes uneven (stage II). After several decades, patients may present with huge amounts of tender subcutaneous tissue and bulging protrusions of fat, mainly at the inner side of the thighs or knees (stage III), which lead to an impairment of gait.

Although the number of textbooks and publications dealing with lipoedema is extensive in Germany,⁵ literature is sparse in English.⁶ Many clinicians are still unaware of this disease, with lipoedema being frequently unrecognized or misdiagnosed.^{7,8} Confusion often exists concerning the differential diagnosis of lipohypertrophy (similar disproportion, symmetric, but no oedema and no pain), primary lymphoedema (asymmetric, decreased lymphatic flow, positive Kaposi–Stemmer skin fold sign, no pain, no bruising), phleboedema (pathological vein function tests, typical skin changes), obesity (increased volume on the trunk, increased weight, body mass index $> 30 \text{ kg m}^{-2}$, often no obvious disproportion, no oedema, no pain), Dercum disease (increased volume, pain, but no oedema) and Launois–Bensaude benign symmetric lipomatosis [increased accumulation of fatty tissue with typical disproportion, mostly localized in the neck (type I), shoulders and upper arms (type II) or pelvic region (type III), no pain, no oedema]. The diagnosis of lipoedema can be made only on the basis of the patient's clinical signs and symptoms;⁹ ultrasound or magnetic resonance imaging has been used for the exact localization and quantification of fatty tissue.⁸

Conservative treatment with manual lymphatic drainage and compression hosiery or bandages (combined physical therapy, decongestive physiotherapy, known as CDT) is used as a standard regime worldwide to eliminate oedema.⁴ In 2002, the first results concerning the surgical therapy of lipoedema by tumescant liposuction to reduce the subcutaneous fatty tissue were reported during the 20th World Congress of Dermatology in Paris.^{10,11} Since 2005, liposuction has become an integrated part of therapy in the guidelines of lipoedema of the German Society of Phlebology.⁴

Our aim was to determine the efficacy of liposuction concerning appearance and associated complaints over a long-term period and to clarify whether decongestive conservative therapy (manual lymphatic drainage, compression treatment) can be reduced in the years following surgery.

Patients and methods

From January 2003 to December 2009, a total of 255 female patients with lipoedema were treated with tumescant liposuction in the Hanse-Klinik, a specialized clinic in Lübeck, Germany. One hundred and sixty-five patients who had completed treatment for at least 6 months, received standardized

questionnaires. Of the 114 questionnaires returned, 112 (68%) could be evaluated. In addition, many patients were seen clinically, or photographs could be analysed.

The patients' mean age was 38.8 years (range 20–68); the average weight was 79.3 kg (range 50–123). Thirty-five patients presented with lipoedema stage I, 75 patients with stage II and two patients with stage III. Nearly all had undergone conservative therapy for many years and either had experienced no obvious improvement of complaints or had noticed a progression of subcutaneous fatty volume.

Following informed consent from each patient, liposuction was performed on legs, hips and arms under pure tumescant local anaesthesia (TLA) with blunt vibrating microcannulas of 3 and 4 mm in diameter (power-assisted liposuction).^{5,12}

The average amount of TLA solution infiltrated was 7707 mL (range 2564–13 450), the average time of surgery was 2 h (40 min to 3 h 35 min). Of 112 patients, 12 patients were operated on once, 29 patients twice, 28 patients three times, 23 patients four times, 12 patients five times, four patients six times and four patients seven times. The minimum time between the operations was 1 month, the maximum about 1 year. Because in most cases the German health insurance system refused to pay for this treatment, the financial situation of the patients often determined the intervals between the liposuctions. The average amount of fat removed was 9846 mL per person (range 1000–25 600) or 3077 mL per session (range 450–7000), depending on the size and number of operated areas (hips, outer thighs, inner thighs, front thighs, back thighs, knees, outer lower legs, inner lower legs, upper arms, lower arms, buttocks). The patients could be re-evaluated after a mean of 3 years and 8 months (1 year 1 month to 7 years 4 months) after the first liposuction and a mean of 2 years and 11 months (8 months to 6 years and 10 months) after the last liposuction.

Prior to the first surgery and after the last surgery, physical measurements and patient-reported symptoms/complaints were assessed. Physical measurements were limb circumference and weight; in addition patients reported their clothing size.

Because of a lack of validated questionnaires for the assessment of lipoedema-related complaints we used a new questionnaire including items with high face validity. By means of seven items, patients reported the intensity of spontaneous pain, pain upon pressure, oedema, bruising, restriction of movement, cosmetic impairment and reduction in quality of life. The quantification of these items was performed on five-point-scales: 0, none; 1, minor; 2, medium; 3, strong; 4, very strong. In addition these items were summarized to a total score named 'general impairment'.

For these seven parameters (complaints) and the total score (general impairment) statistical analysis was conducted by using t-tests for dependent samples to compare the intensity of complaints prior to surgery with their intensity after the last operation. Analyses of variances were conducted to determine differential effects of the patient's age, stage and time since last liposuction. Statistics were performed with SPSS 16.0

for Windows (SPSS, Chicago, IL, U.S.A.). The statistical analysis was performed without alpha adjustments; therefore, the results are considered mainly explorative.¹³ According to this, the term 'significant' (used for P-values < 0.05) is given as a description of differences.

Results

Changes of body shape

The reduction of subcutaneous fatty tissue caused a decrease in the circumference of hips, legs and/or arms, resulting in a proportionate body at the end of surgery; mean reductions of 8 cm (range 1–23) in the thighs (inguinal region) and of 4 cm (1–11) in the middle of the lower legs (calves) were achieved.

The average weight before surgery was 79.3 kg (range 50–123) and before the last liposuction 78.9 kg (49.5–118); in the questionnaire, an actual average weight of 75 kg (48.5–113) was mentioned.

With respect to off-the-peg clothing (trousers), 38% of the patients mentioned a reduction of one size, 25% of two sizes and 11% of three sizes; 23% of the patients did not notice any change and 2% experienced an increase of one size.

Improvement of complaints

The score values (minimum: 0; maximum: 4) of spontaneous pain, pain attributable to pressure, amount of oedema, bruising, reduction of movement, cosmetic impairment and reduction in quality of life showed significant differences pre- and postoperatively. Table 1 shows the mean improvement of all these complaints typical for lipoedema. An improvement was also seen in the summary score (overall severity score) (Fig. 1). This summary score, including all seven values in one figure, represented the 'general impairment'; with values from 2.81 preoperative to 0.86 postoperative, its difference was also significant. The clinical effect of all these differences is repre-

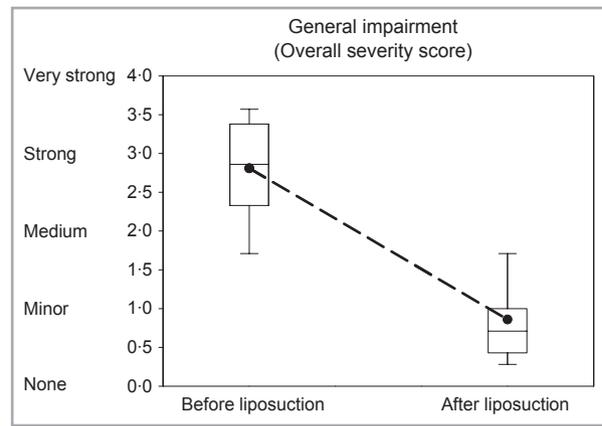


Fig 1. Improvement of general impairment in lipoedema after liposuction (mean values).

sented by the effect size, which describes the magnitude of a change. A value > 0.50 is classified as medium, a value > 0.80 may be classified as a strong effect. The highest scores of the effect size were seen in cosmetic appearance and reduction of quality of life. These two items also had the highest values (3.33 and 3.36) of all parameters before surgery.

In addition, the general impairment was examined by analysis of variances according to age groups, stage of lipoedema and time after the last liposuction. Table 2 demonstrates no difference in the amount of improvement between the various age groups. For severity of lipoedema, stage II (75 patients) and stage III (two patients) were pooled into one group; in comparison with stage I (35 patients), this group showed a higher improvement (P = 0.02). No significant differences in improvement could be seen with regard to time after liposuction (1–24, 25–36, 37–48 or 49–82 months).

Reduction of conservative therapy

Of 112 patients, 67 had combined physical therapy (manual lymphatic drainage and compression) before the operation(s).

Table 1 Changes of complaints

| Complaint ^a | Preoperative | | Postoperative | | P-value (t-test) | Effect-size |
|---------------------------------|--------------|------|---------------|------|------------------|-------------|
| | Mean | SD | Mean | SD | | |
| Spontaneous pain | 1.88 | 1.33 | 0.37 | 0.60 | < 0.001* | 1.36 |
| Pain because of pressure | 2.91 | 1.06 | 0.91 | 0.92 | < 0.001* | 2.01 |
| Oedema | 3.06 | 1.02 | 1.27 | 0.88 | < 0.001* | 1.88 |
| Bruising | 3.01 | 1.03 | 1.26 | 1.11 | < 0.001* | 1.63 |
| Restriction of movement | 2.03 | 1.36 | 0.28 | 0.68 | < 0.001* | 1.58 |
| Cosmetic impairment | 3.33 | 0.88 | 1.08 | 0.91 | < 0.001* | 2.52 |
| Reduction in quality of life | 3.36 | 0.86 | 0.76 | 0.91 | < 0.001* | 2.95 |
| General impairment ^b | 2.81 | 0.70 | 0.86 | 0.63 | < 0.001* | 2.93 |

^aScale: 0, none; 1, minor; 2, medium; 3, strong; 4, very strong. *P < 0.001. ^bReliability (internal consistency) of the total score 'general impairment' is 0.77 (preoperative) and 0.76 (postoperative) (= good reliability).

Table 2 Differential analysis of 'general impairment' using age, stage and months following last liposuction as factors in addition to time effects

| | Groups | n | Preoperative, mean (SD) | Postoperative, mean (SD) | Source | Analysis of variance P-value |
|--------------------------------------|--------|----|----------------------------|-----------------------------|-------------------|------------------------------------|
| Age (years) | 20–29 | 27 | 2.7 (0.8) | 0.7 (0.5) | Group (g) | 0.07 |
| | 30–39 | 41 | 2.9 (0.7) | 1.1 (0.9) | Time (t) | < 0.001** |
| | 40–49 | 25 | 2.7 (0.7) | 0.7 (0.3) | Interaction g × t | 0.85 |
| | 50–68 | 19 | 2.9 (0.5) | 0.8 (0.5) | | |
| | | | P = 0.46 | P = 0.07 | | |
| Stage | I | 35 | 2.6 (0.7) | 0.9 (0.7) | Group (g) | 0.20 |
| | II/III | 77 | 2.9 (0.7) | 0.8 (0.6) | Time (t) | < 0.001** |
| | | | P = 0.02* | P = 0.66 | Interaction g × t | 0.02* |
| Months following last liposuction | 1–24 | 33 | 2.9 (0.6) | 0.8 (0.6) | Group (g) | 0.66 |
| | 25–36 | 33 | 3.0 (0.7) | 0.8 (0.7) | Time (t) | < 0.001** |
| | 37–48 | 19 | 2.5 (0.9) | 0.9 (0.4) | Interaction g × t | 0.11 |
| | 49–82 | 27 | 2.7 (0.6) | 1.0 (0.7) | | |
| | | | P = 0.19 | P = 0.69 | | |

P-values in the columns headed preoperative and postoperative are related to a comparison at this point of measurement. **P < 0.001. The results demonstrate a decrease of general impairment without an influence of age and months following last liposuction. The significant interaction between stage and time (*P = 0.02) shows that the decrease of general impairment is greater in patients with higher stages of lipoedema.

Another 18 patients only had compression garments and eight patients exclusively used decongestive physical therapy. In 19 patients, no conservative treatment before surgery was performed.

Table 3 shows the changes in conservative treatment (in percentages) in the 67 patients who had previously undergone combined physical therapy. Of these, 13 patients (19.4%) needed manual lymphatic drainage and compression as often as before; 20 patients (29.9%) also continued with physical decongestive therapy, but less often; 13 patients (19.4%) still used compression garments; six patients (9%) declared that they only needed manual lymphatic drainage from time to time; 15 patients (22.4%) reported that they no longer required conservative therapy.

Side-effects and complications

Out of the 112 patients who had 349 liposuctions in total, postoperative wound infections occurred in five cases, representing an infection rate of 1.4%. All patients had received prophylactic oral antibiotics (cefepodoxime proxetil) for 3 days after surgery. In four women, postoperative erysipelas could be treated at home with further oral antibiotics; one patient with an abscess of the lower leg was treated in hospital in her home town.

In one case (0.3%), postoperative bleeding on one side occurred on the evening of surgery after removal of 5400 mL fatty tissue from hips and outer thighs. The haemoglobin level dropped from 13.2 to 8 g/dL; following oral therapy with iron and folic acid, normal values were reached again within 4 weeks. The following three liposuctions (removal of, in total, 16 700 mL of fatty tissue) in this woman were performed without any problems.

In some patients, orthostatic reactions occurred on the day of operation; these were resolved without further treatment

Table 3 Changes of conservative therapy postoperatively in four subgroups

| | n | % |
|---|----|------|
| (a) | | |
| Before | | |
| Lymphatic drainage and compression | 67 | 100 |
| After | | |
| Lymphatic drainage and compression (as before) | 13 | 19.4 |
| Lymphatic drainage and compression (less than before) | 20 | 29.9 |
| Only compression | 13 | 19.4 |
| Only lymphatic drainage | 6 | 9 |
| No lymphatic drainage, no compression | 15 | 22.4 |
| (b) | | |
| Before | | |
| Only compression | 18 | 100 |
| After | | |
| No compression | 5 | 27.8 |
| (c) | | |
| Before | | |
| Only lymphatic drainage | 8 | 100 |
| After | | |
| No lymphatic drainage | 4 | 50 |
| (d) | | |
| Before | | |
| No lymphatic drainage, no compression | 19 | 100 |
| After | | |
| Lymphatic drainage, compression | 3 | 15.8 |
| Only compression | 3 | 15.8 |
| Only lymphatic drainage | 2 | 10.5 |
| No lymphatic drainage, no compression | 11 | 57.9 |

within the same day. Other than minor haematomas and postoperative swelling for a few days, no other side-effects were seen. Indurations of the subcutaneous fatty tissue as a result of

scar formation during wound healing (mainly at the inner and lower legs) disappeared completely within weeks.

Discussion

To our knowledge, this is the first long-term study concerning surgical therapy (liposuction) of lipoedema to be presented in English. For many decades, only conservative treatment with manual lymphatic drainage and compression hosiery was available. This so-called combined decongestive therapy (CDT) was introduced by the Dane, E. Vodder, in the 1930s and was modified by the German, J. Asdonk, in the 1960s. The reduction of oedema decreases tenderness and aching distress in the affected extremities, but only for a short period. Despite life-long decongestion, the amount of subcutaneous tissue increases and the disease worsens over time. Diet, physical activities such as sport, the restriction of fluid and diuretics are all without benefit.⁴

Until the end of the last century, fat removal by lipectomies or liposuction under general anaesthesia without subcutaneous infiltration ('dry technique') and large sharp cannulas caused considerable tissue damage, often in combination with unacceptable functional and cosmetic results.

The introduction of TLA in the 1990s¹⁴ with the infiltration of large amounts of fluid ('wet technique') has made liposuction a safe and effective procedure.^{15,16} With the use of blunt vibrating microcannulas of 3–4 mm in diameter (power- or water-assisted liposuction), no relevant tissue damage occurs.^{17–20} Since 2005, liposuction has been integrated into the guidelines of care for lipoedema by the German Society of Phlebology and has been further stressed in an update in 2009.⁴

Our figures demonstrate that liposuction of lipoedema under pure TLA is time-consuming. The whole operation including the infiltration of the local anaesthetic takes an average time of about 5.5 h and an average of 7.7 L of tumescent solution is needed per session. The mean duration of the liposuction itself is 2 h, a reasonable work expenditure for the surgeon. During this time, an average of about 3 L of fatty tissue is removed. This is a much larger amount than has been reported in other studies, where amounts between 1.1 and 1.9 L have been removed per session.^{16,18,21,22} Most of our patients, the majority of them with lipoedema stage II, needed two to four liposuctions but some had such extensive fatty volumes that more than five sessions were necessary. This number is much higher than that in 'standard' liposuctions performed for cosmetic reasons only.

If handled well, the results of liposuction are good with regard to morphology. The removal of fatty tissue in our patients causes an obvious reduction of circumferences in hips and extremities with a distinct improvement of body size and a minor reduction of weight. However, the most important point is the disappearance of disproportionality between the upper and lower parts of the body. Figures 2–4 show typical results before and after surgery in various body regions.

Improvements of complaints are also obvious after surgery: spontaneous pain, pain attributable to pressure, amount of oedema, bruising, reduction of movement, cosmetic impairment and reduction in quality of life showed impressive improvements with significant differences pre- and postoperatively; the same was true with the summary score termed 'general impairment'. Similar results have been reported in the literature with a smaller patient group ($n = 25$) after a shorter period (6 months after liposuction).²²

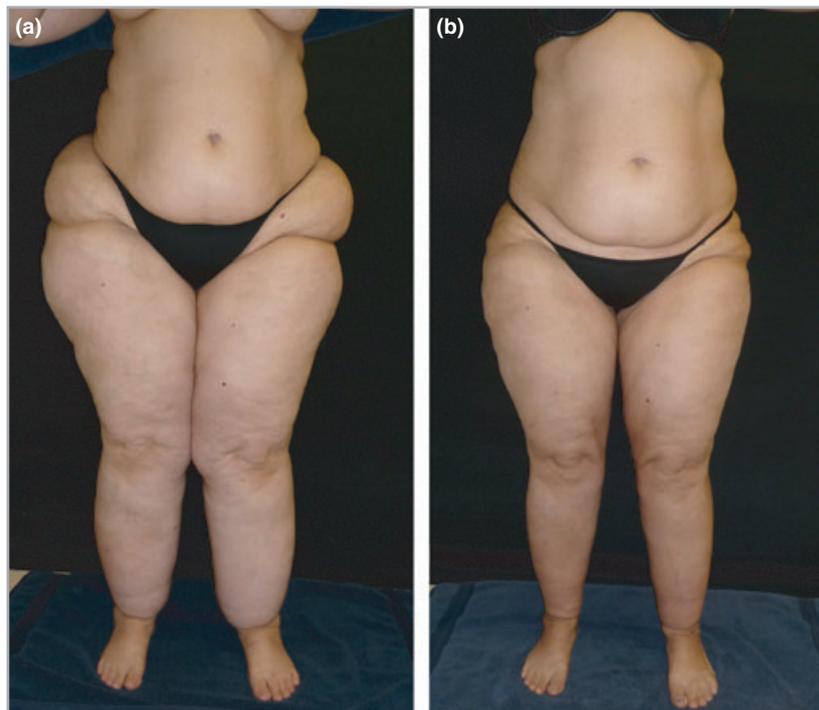


Fig 2. (a) Lipoedema in a 42-year-old woman. (b) Result 1 year and 8 months after four liposuctions (hips, thighs, buttocks, lower legs), removal of 18 300 mL of fatty tissue.

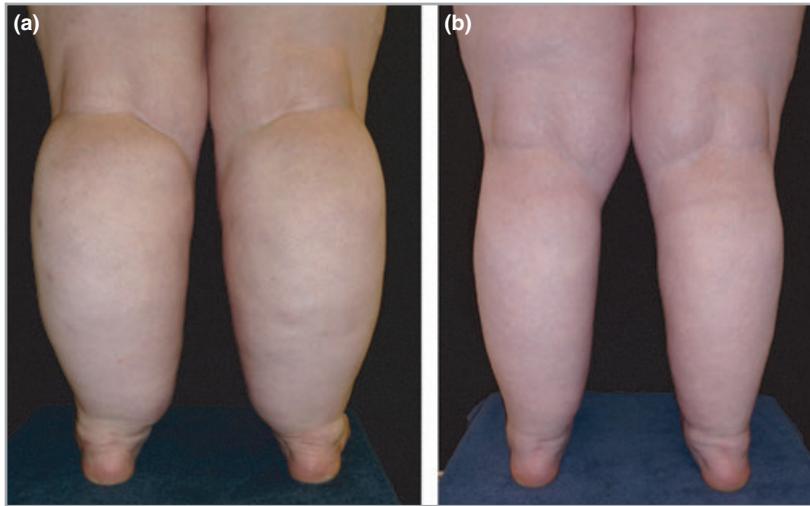


Fig 3. (a) Lipoedema in a 34-year-old woman. (b) Result 3 years and 2 months after removal of 7000 mL of fatty tissue in both lower legs in one session.

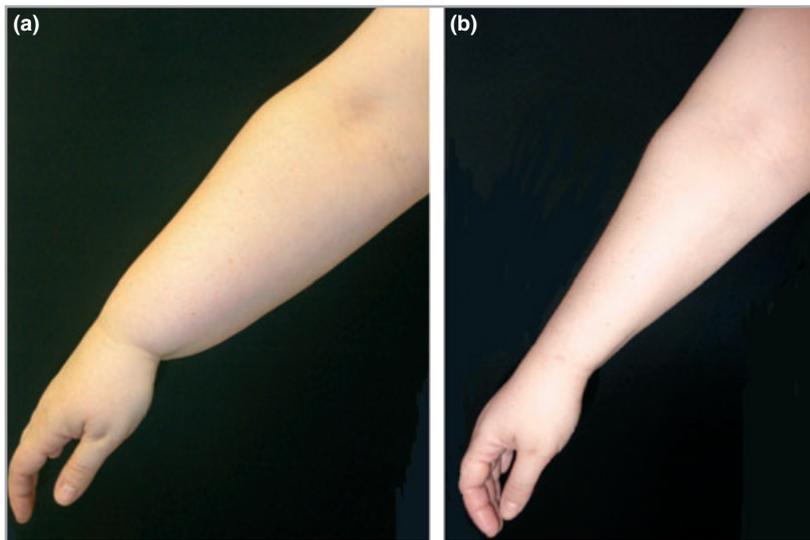


Fig 4. (a) Lipoedema in a 32-year-old woman. (b) Result 2 years and 4 months after removal of 600 mL of fatty tissue from each lower arm.

Spontaneous pain, which has previously been described in an earlier lipoedema study as being pressing and dull, sometimes as heavy, pulling or even torturing,²³ was less pronounced preoperatively (1·88) than pain attributable to pressure (2·91); both items showed a distinct improvement. Most probably, this is a result of oedema reduction (3·06 preoperative, 1·27 postoperative). Improvement of pain is well known following decongestive physical therapy. One can speculate that, following liposuction(s), oedema in the extremities is diminished because of the reduced subcutaneous space available.

The obvious reduction of bruising (3·01 before to 1·26 after surgery) has not been described before and cannot be explained. However, similar results have been published following decongestive physiotherapy of lipoedema; they have been interpreted as an improvement of the altered capillary fragility, resulting in a reduction of petechiae and thereby causing reduced haematoma formation following minor trauma.²⁴

A more physiological movement was noticed after liposuction. This was attributable to reduced skin irritation at the

inner side of the thighs, resulting in a more balanced gait. In addition, several patients have reported a reduction of chronic joint pains in the hips and/or knees, probably as a result of a more physiological strain on these joints; similar observations have just been published in another German study.²⁵

The improvement of cosmetic impairment is a direct result of the new, and now normal, body proportions of the patients. Interestingly, in spite of all the painful symptoms, the outward appearance had an enormous negative influence (3·33 before surgery) on the patients' self-esteem. This demonstrates the marked effect of body shape on the well-being of female patients. The increase in quality of life is probably attributable to the improvement of all complaints taken as a whole; it is also a result of the reduction of conservative therapy, mentioned below.

Although differential analysis showed similar good results in all age groups with every life period being well suited for surgery, differences were seen when looking at the severity of the disease. Patients with lipoedema stage II (and III) showed

a more distinct improvement compared with those at stage I. Hence, the more complaints were present before surgery, the more benefits were gained afterwards. Strikingly, this success prevailed over the following years indicating no or little deterioration of these symptoms with time. This is an obvious difference from the short-term success of oedema reduction by conservative therapy, which usually has to be repeated within days.

Decongestive physical therapy is a basic treatment in orthostatic oedema. Whereas manual lymphatic drainage reduces the actual oedema volume, compression (by stockings or bandages) is used to prevent reoccurrence. Although 19.4% of our patients needed conservative therapy to the same extent as before, the remainder required less, with 22.4% no longer needing conservative treatment over the following years.

This demonstrates the long-lasting positive 'side-effect' of liposuction on the associated complaints. Despite the treatment having no direct influence on the swelling of legs and arms (oedema itself cannot be removed by liposuction), the indirect benefit by 'space reduction' of the subcutaneous areas is obvious.

Nevertheless, surgery cannot cure lipoedema completely; according to the persisting oedema formation, physiotherapy and compression are still necessary in most patients, although at longer intervals and to a much lower degree. The postoperative infection rate of 1.4% seen here is similar to that of other studies in which rates between 1% and 3% are described.^{26,27}

The application of TLA and the usage of blunt microcannulas avoids damage to important structures, and bleeding is rare;^{16,28} a significant reduction of haemoglobin level (in our study, 0.3% of the patients) has been reported in the literature in 0.2–0.6% of cases.^{21,26} However, we should mention that the patient with postoperative bleeding in our study was the only one that we saw in a total of 1826 liposuctions within the past 10 years, representing a complication rate of 0.05%.

No serious or life-threatening events occurred during our study. In agreement with others,^{16,21} we can confirm that liposuction with exclusively TLA according to the existing guidelines is a safe procedure with no serious and only a few minor side-effects. We should finally mention that, in contrast to conservative therapy, the costs for this surgical treatment are not reimbursed in most cases by the statutory health insurance in Germany.

In conclusion, tumescent liposuction in lipoedema is a highly effective method with long-term benefit concerning body shape, together with a significant improvement of pain, oedema, bruising and restriction of movement. The obvious reduction in the need for further conservative treatment and the remarkable increase in the quality of life are important positive aspects of this therapy. Because often large amounts of TLA solution are needed and extensive volumes of subcutaneous fat have to be removed, a considerable degree of experience is required; therefore, the procedure should be performed in specialized centres only.

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