

# Treatment of lipoedema using liposuction

## Results of our own surveys

S. Rapprich<sup>1</sup>; S. Baum<sup>2</sup>; I. Kaak<sup>3</sup>; T. Kottmann<sup>4</sup>; M. Podda<sup>5</sup>

<sup>1</sup>Dermatology Bad Soden, Bad Soden am Taunus/Germany; <sup>2</sup>Dematological practiseim Vorderen Westen, Kassel/Germany; <sup>3</sup>General Medicine Westerrönfeld/Germany; <sup>4</sup>Medical Statistics Hamm/Germany; <sup>5</sup>Dermatology Department, Darmstadt Hospital/Germany

### Keywords

Lipedema, liposuction, lipolymphedema, life quality, decongestive lymphatic therapy, sports, epidemiology

### Summary

**Background:** Lipedema is a painful, genetically induced, abnormal deposition of subcutaneous fat in the extremities of women. The pathogenesis is unknown. Also unknown is the number of women affected in Germany. This study presents the epidemiology of the disease. There are currently two treatment options available: Complex physical decongestive therapy and liposuction. Liposuction is the only method that removes fat permanently. An additional study proves its effectiveness and highlights its vital role as part of a comprehensive treatment concept.

**Patients and methods:** As part of the epidemiological research, all patients of a general practitioner were examined for leg problems. The liposuction study included the pre- and postoperative examination of 85 patients, which was carried out using a questionnaire.

**Results:** Lipedema were diagnosed in 5% of all patients of the GP practice. In all 85 pa-

tients liposuction significantly reduced pain, bruising and the tendency of swelling in the extremities. It therefore led to a significant improvement in the quality of life of the patients.

**Conclusion:** Lipedema is a relatively common disorder among women. Liposuction forms part of an effective treatment plan, when it is used in conjunction with pre- and postoperative complex physical decongestive therapy, a sports program, treatment of concomitant obesity, as well as psychological support, if needed. Therefore a comprehensive treatment plan should be aimed at for a successful result.

### Schlüsselwörter

Lipödem, Liposuktion, Lipolymphödem, Lebensqualität, konservative Therapie, Sport, Epidemiologie

### Zusammenfassung

**Hintergrund:** Beim Lipödem handelt es sich um eine schmerzhafte, anlagebedingt übermäßige Fettgewebsvermehrung der Extremitäten bei Frauen. Die Ursache ist unbekannt. Ebenso unbekannt ist die Zahl der betroffenen Frauen in Deutschland. Eine eigene Untersuchung zur

Epidemiologie wird vorgestellt. Als Therapiemöglichkeit stehen die Komplexe Physikalische Entstauungstherapie und die Liposuktion zur Verfügung. Nur durch die Liposuktion ist eine dauerhafte Entfernung des Fettgewebes möglich. Ihre Wirksamkeit wird in einer weiteren Untersuchung aufgezeigt und die Bedeutung als Teil eines umfassenden Behandlungskonzeptes dargelegt.

**Patienten und Methodik:** Für die epidemiologische Untersuchung wurden in einer ländlichen Hausarztpraxis sämtliche Patientinnen bezüglich Beinleiden untersucht. Die Studie zur Liposuktion umfasste die prä- und postoperative Untersuchung von 85 Patientinnen mittels Beschwerdefragebogen.

**Ergebnisse:** Bei 5% aller Patientinnen einer Hausarztpraxis wurde ein Lipödem festgestellt. Mittels Liposuktion konnten bei 85 Patientinnen Schmerzen, Druckschmerz, Hämatomneigung und Schwellungsneigung signifikant vermindert und die Lebensqualität verbessert werden.

**Schlussfolgerung:** Das Lipödem ist eine relativ häufige Erkrankung der weiblichen Bevölkerung. Die Liposuktion stellt zusammen mit der prä- und postoperativen komplexen physikalischen Entstauungstherapie, einem Sportprogramm und der Behandlung einer begleitenden Adipositas sowie bedarfsweise einer psychologischen Unterstützung ein wirksames Behandlungskonzept dar.

Sie kann nur im Zusammenwirken mit diesen anderen Therapien erfolgreich sein und daher ist ein umfassender Therapieplan anzustreben.

### Correspondence to:

Dr. med. Stefan Rapprich  
Hautmedizin Bad Soden  
Kronberger Straße 2, 65812 Bad Soden, Germany  
Tel. +49-6196/651550  
E-Mail: s.rapprich@hautmedizin-badsoden.de

### Therapie des Lipödems mittels Liposuktion im Rahmen eines umfassenden Behandlungskonzeptes

#### Ergebnisse eigener Studien

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Lipoedema is a constitutional, disproportionate accumulation of fat in the female extremities (1–2). Pain at rest and on pressure, a tendency for bruising to occur after minimal trauma and an increase in oedema over the course of the day are characteristic. The disease shows a chronic, progressive course.

The disproportionality between the trunk and the affected extremities is even obvious in case of the frequently concomitant obesity. The disease is diagnosed clinically and should be differentiated from lipohypertrophy and lymphoedema in particular.

The recommended treatment is complex physical decongestion therapy (CPDT), consisting of manual lymphatic drainage (MLD) and compression, exercise during compression and skincare. This treatment is only effective against the oedema component and the compression, in particular, must be used long-term. MLD is required for oedema that occurs despite compression garments. The effects of MLD on pain are unclear. For many patients,

CPDT can bring relief for a short time, but this relief is not permanent and has no influence on the course of the disease.

Liposuction is the only way to achieve long-lasting removal of the fatty tissue. Since the development of techniques that protect lymphatic vessels using vibrating microcannulas and local tumescence anaesthesia and water jet-assisted liposuction, it has become possible to treat lipoedema surgically. More than 20 years' experience of the method has now accumulated and its effectiveness has been confirmed scientifically (3–5).

However, experience also shows that, in addition to the surgeon's expertise, the quality of the compression treatment and of the pre- and post-operative lymphatic drainage, as well as diet and physical activity for overweight patients are also crucial for the success of treatment. Psychological support is sometimes also important.

Thus the treatment concept is multifaceted and is based on several mainstays. These will now be described and supported with new study data.

## Fundamentals of lipoedema

In the beginning of the 1940s, Hines and Allen described lipoedema for the first time (1). Since then, numerous synonyms have appeared in the literature, but knowledge about this still really unknown disease is sparse (6–7).

Depending on the source, the following names for lipoedema can be found: lipalgia, adiposalgia, Adipositas dolorosa (Dercum's disease), Lipomatosis dolorosa, Lipohypertrophia dolorosa, painful column leg and painful lipoedema syndrome (2).

## Definition and staging

Lipoedema is a disease that almost exclusively affects women (8). It is characterized by a painful symmetrical increase in fatty tissue in the lower extremities. In about 1/3 cases the arms are also affected (9–10). The result is a characteristic disproportionality of the body's silhouette between extremities and the trunk (► Fig. 1).



**Fig. 1**  
Lipoedema of whole leg and upper arm type.

Orthostatic oedema, sensitivity to pressure and touch and a tendency to bruise easily are typical of the disease picture (1–2, 9, 11–12)

Based on its morphology, lipoedema is divided into three clinical stages or degrees of severity. In the first stage, the finding on palpation is still of a soft consistency and the structure is finely nodular and homogeneous; the surface of the skin is smooth and the subcutis thickened. In the second stage, the subcutis is harder on palpation, the fatty tissue feels more nodular and the first signs of unevenness appear on the skin surface. In the third stage, the palpation finding is hard and the fat lobes grossly deformed (12).

The course is always progressive, but varies widely among individuals in time and cannot be predicted.

### Localisation

Lipoedema is always symmetrical and occurs in different forms in the lower extremities. The figures quoted in the literature for involvement of the arms range from 30–80% (13–14). There are three types that affect the legs: whole leg, thigh type and calf type. In the same way, lipoedema affecting the arms is classified as whole arm, upper arm and lower arm type (4, 12, 15).

In our own population, the whole leg type was the most common at 62.4%, then the thigh type at 30.6% followed by the calf type at 6%.

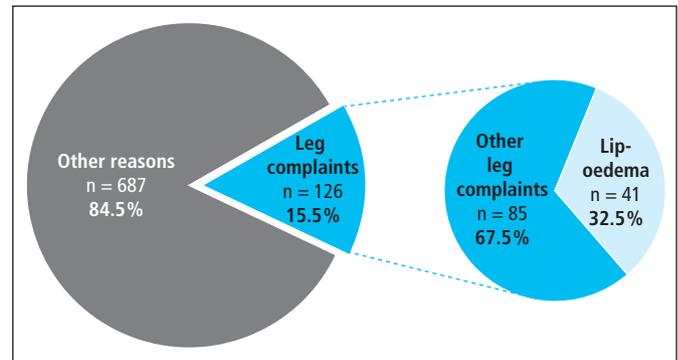
### Epidemiology

There are no exact figures for the prevalence of lipoedema. It is estimated that approx. 7–9.7% of the female population are affected (16). The frequency of lipoedema in specialist lymphology clinics is reported as 8–17% (2, 12, 17–18).

Over a period of one year (July 2011 to July 2012) our own study on prevalence investigated 813 female patients who were at least 15 years old and who had presented for a wide variety of diseases at a rural general practice in Schleswig-Holstein with a catchment area of 15,000 inhabitants (► Fig. 2).

Leg complaints were the reason for the consultation in 126 (15.5%) of the 815 pa-

**Fig. 2** Reason for consultation of 813 female patients in a rural general practice (own investigation).



tients. Of these 126 patients, lipoedema was diagnosed as the cause of the symptoms in 41 (32.5%). Lipoedema had been previously diagnosed in only 4 patients; for all the remaining women this was the first time. 5% (41 of 813) of the patients who attended the practice suffered from lipoedema. It is not possible to extrapolate to the proportion in the total population, but the proportion we found is close to the figure reported by Marshall and Schwahn-Schreiber (16).

### Symptoms

The disproportion between the slim upper body and the sturdy extremities is characteristic. Sensitivity to touch and pain on



**Fig. 3** Lipolympoedema with liposclerosis

pressure is present, as well as a tendency to develop haematoma after the slightest trauma.

Spontaneous pain in the affected areas is reported, as well as feelings of tightness and swelling (2). There is no correlation between the morphological stages and the extent of the clinical symptoms. Any concomitant obesity aggravates the symptoms.

“Fat cuffs” above the ankle or knee develop and can cause difficulties when walking. The fat bulges in the thighs lead, via the adduction movement, to a pseudo X leg position with abnormal joint load, or even arthritis and mechanical stress on the skin with chafing (19).

Patients suffer massively from their appearance with not inconsiderable psychosocial consequences (1–2, 20–21). Depending on the severity of the findings, a secondary lymphatic drainage problem can result and a lipo-lymphoedema develops, sometimes with liposclerosis (Fig. 3).

Lipoedema does not only occur in a pure form, but also as a mixed form in combination with other diseases, particularly lipolympoedema, lipophleboedema and lipolympophleboedema (9).

► Table 1 summarises the clinical criteria.

### Aetiology

The causal pathogenesis is unknown. In view of the familial accumulation in 60% of cases, genetic factors are assumed (22). The fact that it most commonly manifests itself in puberty, but also during pregnancy and the menopause, is suggestive of hormonal influences.

No diagnostically relevant characteristics can be identified by histology. There is an unspecific hypertrophy and hyperplasia of fat cells (23–25).

In pathophysiological terms, it is assumed that capillary permeability and fragility are increased (26). Due to the abnormal capillary permeability and fragility, large amounts of tissue fluid are formed in the interstitial spaces that have to be transported away via the lymphatic vessels. Initially, the lymphatic system compensates for the large volumes, but the reserve capacity is quickly exhausted, so that congestion of lymph occurs.

High-volume insufficiency exists in this case (27) and lymphatic flow is not obstructed. The excessively large volumes of interstitial fluid cause the pressure in the system to rise and lymphatic microaneurysms to form (28). This is reflected clinically in a sensitivity to touch and pressure and a tendency to bruise. The skin and subcutis thicknesses subsequently increase (29). Over the years, tissue fibrosis with lymphangiosclerosis and perilymphovascular fibrosis can develop. This reduces the transport capacity. If the lymphatic system is decompensated, the picture of lipolymphoedema develops and possibly also dermatoliposclerosis (30).

## Clinical diagnostics

Diagnosis of lipoedema is based on a detailed history, inspection and palpation (31). In the vast majority of cases, lipoedema can be diagnosed by the clinical examination, without the aid of instrumental procedures (30).

In terms of history-taking, the time of occurrence and family history are an important guide. Patients often report feelings of tightness and swelling.

The disproportion between the upper body and the extremities and the bulges of fat above the ankles or knees are characteristic. There is a sensitivity to touch and pressure and an increased tendency to bruise. Stemmer's sign is negative. Findings on palpation change from Stage I to Stage II, from soft and finely nodular to hard and grossly nodular (12).

A widened subcutis with homogeneous and increased echogenicity can be demon-

**Tab. 1** Clinical criteria for the diagnosis of lipoedema (after 12).

- Onset in puberty, pregnancy or menopause
- Disproportional adipose tissue accumulation (extremities – trunk)
- Cuff or bulge formation in joint regions
- Hands and feet unaffected
- Feeling of heaviness and tightness of the affected extremities
- Pain on palpation or spontaneously – increases during the day
- Oedema – increases during the day
- Tendency to bruise easily
- Stemmer's sign negative

strated by high resolution sonography (32). Hypochoic fissures are present in oedema. In clinically difficult cases, this investigative method, coupled with compression sonography, provides a non-invasive differentiation of lipoedema and lymphoedema; it is also suitable for objective follow-up (33–34).

In some circumstances, a CT or MRI scan can be used for diagnosis. Such methods will show a thickening of the skin and subcutis in the case of lipoedema. Unlike lymphoedema, there is no “honeycomb-like” structure of the subcutis or a collection of oedema fluid (29, 35–36).

Indirect lymphangiography enables convoluted lymph collectors and pinnate or flame-like contrast medium depots to be demonstrated, but these are also seen in lymphoedema and obesity (26).

Functional lymphoscintigraphy is used for the diagnosis of lymph drainage disorders. In pure lipoedema, there is no change or only small changes in lymph transport (37). At an early stage before the occurrence of high-volume insufficiency, elevated lymph node uptake values can be measured with lymphoscintigraphy (38). This technique can detect early signs of lymphatic stasis with the onset of high-volume insufficiency (26).

## Differential diagnostics

Lipoedema is frequently not diagnosed at all, or misdiagnosed (6). It must be distinguished from other disorders of fat distribution. The most important differential

diagnoses are lipohypertrophy, lymphoedema, phleboedema, Dercum's disease, Madelung's disease and obesity (2, 12) (► Table 2).

The connection between lipoedema and weight is a subject that is repeatedly discussed in the literature. On the one hand, lipoedema must be differentiated from obesity (6), on the other – according to Bosman and Greer – lipoedema is overproportionally frequently associated with obesity (39–40). In his 1974 investigation, Greer found more than 50% obesity in lipoedema patients; in his publication of 2007, Bosman reported that approx. 80% of his lipoedema patients were also obese (40). Using the body-mass index (BMI), in 2012 Schmeller et al. classified 73.3% of their 112 patients as overweight or obese and 17% as markedly obese, with a BMI over 35 kg/m<sup>2</sup> (3).

In our own investigation at the Dermatology Clinic in Darmstadt, almost 30% of 85 patients were of normal weight with a BMI of 20–25 kg/m<sup>2</sup>. Approx. 26 were pre-obese with a BMI of 25–30 kg/m<sup>2</sup> and 20% of those investigated were obese with a BMI of over 30 kg/m<sup>2</sup>. Thus about 50% of the patients studied were overweight and obese.

Among the general German population, 36% of people have a BMI that is within the overweight region and 15% within the obese. A little over 50% of Germans have BMI values of over 25 kg/m<sup>2</sup> (41–44). With almost 50% of patients overweight or obese, our population of patients roughly corresponds to the German average and our values are similar to those found by Greer in 1972. However we had considerably fewer obese patients than Schmeller and Bosman.

In contrast to the group in Lübeck where the prevalence of obese and overweight patients was elevated, the rate of overweight and obese patients in our Darmstadt population was roughly the same as in the population at large. Although several studies have reported an increased occurrence of overweight and obese patients, this cannot be confirmed by our own investigation. No increased prevalence of overweight and obesity in lipoedema compared to the general German population can be deduced from our data.

Tab. 2 Differential diagnostics in lipoedema (after 2, 12).

	♂/♀	Onset	Location	Symmetry	Fat more	Tender-ness	Oedem-a	Feet af-fected	Diets success-ful	Other
<b>Lipoedema</b>	♀	Puberty, pregnancy, menopause	Legs, arms	Yes	Yes	Yes	Yes	No	No	Tendency to bruise
<b>Lipohyper-trophy</b>	♀	Puberty, pregnancy, menopause	Legs, arms	Yes	Yes	No	No	No	No	
<b>Lymph-oedema</b>	♂/♀	Inherited or acquired	Legs, arms, trunk	Sometimes	Fatty de-generation possible	No	Yes	Yes	No (except: pro-tein-rich diet in primary lip-oedema with in-testinal involve-ment)	Lymph drainage scintigraphy patho-logical. Stemmer's sign positive, lympho-cytes, pachy-dermia, papillo-matosis cutis
<b>Phleb-oede-ma</b>	♂/♀	Adulthood	Legs	No	No	No	Yes	No	No	Venous status pathological
<b>Dercum's disease</b>	♀	Postmeno-pausal	Legs	No	Yes	Yes	No	No	No	Pain, muscle weakness, C2 abuse, depression
<b>Madelung disease</b>	♂	Adulthood	Neck, shoulder, pel-vis	Yes	Yes	Yes	No	No	No	Liver cirrhosis, C2 abuse
<b>Obesity</b>	♂/♀	Any age	Body	Yes	Yes	No	No/Yes	No	Yes	BMI increased

## Therapy

Therapeutic measures, conservative or surgical, can stop or at least slow progress. There is no causal treatment, because the pathogenesis is not known.

The aims of treatment are, in the first instance, to improve the symptoms and prevent complications. Dermatological complications range from congestive dermatitis, oedema sclerosis, congestive dermatosis or even venous leg ulcers. Orthopaedic complications can occur primarily at the knee joints through a Genu valgum (knock-knee) position caused by a fat pad (19).

Concomitant obesity should be treated according to the Obesity Guidelines (73). Sadly, female lipoedema patients are repeatedly given treatment recommendations that apply from a medical viewpoint, to overweight patients (45). They are generally advised to adopt diets, physical training or even use diuretics or laxatives. These recommendations can even have fatal consequences, since the disproportionality between the upper body, which becomes slimmer, and the lower half of the body, whose circumference remains unchanged, is potentiated (2).

Sport and a healthy diet are certainly sensible and part of the treatment concept. However there is a consensus in the literature that the inherited fat distribution disorder in lipoedema cannot be “slimmed away” by sport or other weight-reducing measures (32, 46–48). This is strikingly illustrated by the case of a woman patient who reduced her weight from 99 to 62 kg, i.e. achieved a weight loss of 37 kg. It is clear that the lipoedema on the calves was not affected (► Fig. 4a).

The conservative treatment is complex physical decongestion therapy (CPDT). This consists of two phases. In the first, the patient is given intensive anti-oedema treatment. Manual lymphatic drainage

## Conservative treatment of lipoedema (CPDT)

(MLD) followed by a lymphological compression bandage is applied daily on an outpatient basis or as inpatient therapy in severe cases. In lipoedema, this can reduce the circumference by a maximum of 10%.

In the second phase of treatment, if the oedema cannot be prevented by the compression garments, oedema-dependent MLD is used. In this treatment phase, the aim is to conserve the result of the first phase and to improve it, if possible. In addition to MLD and compression therapy, CPDT includes good skincare, exercises and, in the ideal case, regular decongesting self-treatments (49).

Alongside MLD, instrument-based intermittent compression (IIC) can be used as adjuvant therapy. This consists of a leg sleeve with overlapping air compartments that fill and empty in a wave-like manner. Presumably through the change in pressure, the lymphangiomotor system is stimulated. This effect is utilised to maintain the effect of treatment after MLD.

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**Fig. 4** a. Patient after weight reduction of 37 kg and resistant lipoedema of the calf type that was b. treated by liposuction.



**Fig. 5** Infiltration of tumescence local anaesthesia

The IIC can be used as a supplement to MLD and is generally reported as pleasant and helpful by lipoedema patients (50–51).

Consistent MLD and compression garments are recommended in the literature (2, 52–59) even though the therapeutic effect, with a 10% reduction in circumference per leg, was rated as modest by Deri and Weisleder (14, 60). The maximum reduction in circumference of 10% could only be achieved under frequently repeated treatment and only improved the symptoms for a short time (2, 4, 48, 61, 62). This means a high therapeutic effort, which is difficult to achieve under normal conditions of life. Moreover, in everyday practice, the therapeutic effect of CPDT did not meet patient expectations.

Furthermore, conservative measures have to be undertaken for life and, according to Cornely, do not stop the further progress of the disease (14). Szolnoký et al. reported that MLD reduced the oedema component of lipoedema and the pain induced by oedema, as well as having a positive effect on the increased capillary permeability and reducing the bruising tendency (56–57).

MLD is seen as symptomatic treatment in disorders of lymph drainage, which has no causal effect on the disease. Little is found in the literature about the therapeutic benefits of pure compression garments treatment in lipoedema. In their study, Reiche et al. reported that compression garments reduced oedema in the initial phase of treatment, without differentiating between lipoedema, lymphoedema and lipolymphoedema when drawing this conclusion (63).

In summary, there is a consensus in the literature that CPDT, consisting of MLD for marked oedema components and compression garments, should be recommended in lipoedema as conservative treatment (31). The basic treatment primarily consists of compression garments in this case.

In their paper entitled “Tumescence liposuction in lipoedema yields good long-term results”, Schmeller et al. reported on a group of patients similar to those of our

own study, where out of 112 patients, 67 had received CPDT preoperatively, 18 compression garments, 8 MLD and 19 none of the above.

Over 60% of the patients who presented at the Dermatology Clinic in Darmstadt had previously undergone lymph drainage. Enquiry as to its efficacy showed that this had achieved a positive therapeutic effect in approx. half of the patients, of which approximately one quarter of the women treated showed a satisfactory result. On the other hand, MLD had had no effect in almost half of the patients.

The second conservative measure that was enquired about, was compression garments. Almost 80% of the patients had worn compression stockings preoperatively; more than half of them (57.7%) on a regular basis. 22.5% of the women used no compression garments. Thus more than half of the patients reported a positive therapeutic effect from MLD and/or compression garments.

One reason why only half of the patients benefitted from conservative treatment is possibly that such treatment can only be effective if a relevant oedema component is present.

In our own investigation, almost all patients had pain and symptoms of congestion after all conservative treatments had been exhausted.

## Surgical treatment of lipoedema – liposuction

To date, there is no alternative to liposuction for the permanent removal of fat cells. This procedure has become possible for lipoedema in the last 20 years through the development of tissue-friendly techniques.

So far, in the case of two techniques it has been proved that lymphatic vessels in particular are not injured:

- Liposuction under local tumescence anaesthesia with vibrating microcannulas (power-assisted liposuction)
- Water jet-assisted liposuction (64–65).

Several studies have demonstrated the effectiveness in terms of symptom improve-



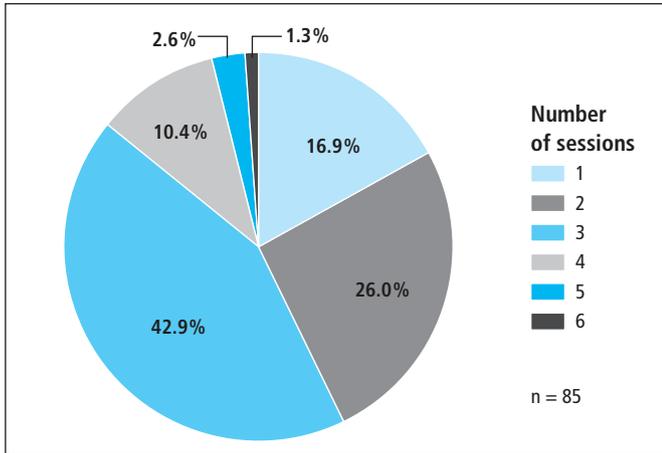
**Fig. 6**  
Liposuction using vibration microcannulas



**Fig. 7**  
Check in the standing position and removal of the residual tumescence fluid at the end of liposuction



**Fig. 8**  
Compression bandage postoperatively



**Fig. 9** Number of sessions per patient

ment (3–5). The rate of complications is very low (66, 67), while there is a very great gain in quality of life for the patient which is not achievable with any other method.

gard to the change in various symptom parameters after liposuction. All the patients in this study had been operated on by the first author using tumescence anaesthesia and the vibration technique in sometimes several sessions.

### Own investigations

In our own study, 85 patients were surveyed between 4/2003 and 2/2011 with re-

### Material and methods

Where required, the patients were given 5–10 mg diazepam i.v. as premedication.

**Tab. 3** Questionnaire

Questions	Results		
	VAS-mean values		
	Pre OP	6 months post-OP	Significance
Do you have pain in the affected regions?	6.5	2.1	p<0.001
Is sensitivity to touch or tenderness present?	6.5	2.4	p<0.001
Do you bruise easily?	8.1	4.3	p<0.001
Do your legs feel tight?	6.9	2.6	p<0.001
Do your legs feel hot?	2.8	1.2	p<0.001
Do your legs feel cold?	3.4	1.6	p<0.001
Do you have muscle cramps?	2.7	1.3	p<0.001
Do your legs feel heavy?	7.8	3.1	p<0.001
Do your legs feel tired?	7.4	3.1	p<0.001
Do your legs swell?	6.3	3.2	p<0.001
Are there skin complications?	3.2	1.1	p<0.001
Do your legs itch?	2.8	1.3	p<0.001
Is your walking restricted?	4.1	1.2	p<0.001
How would you assess the reduction in your quality of life?	8.5	3.3	p<0.001
Are you satisfied with the appearance of your legs?	9.2	5.0	p<0.001
<b>Total</b>	<b>86.2</b>	<b>36.8</b>	<b>p&lt;0.001</b>

The tumescence solution was infiltrated using Sattler’s method with a continuously operating roll pump system. Infiltration continued until the skin developed a hard elastic turgor; the tissue was blanched by the tissue pressure and the proportion of adrenaline in the tumescence solution (“blanching effect”) (68) (► Fig. 5).

The rate of infusion was adjusted according to the pain felt by the patient and amounted to between 120 and 200 ml/min. After adequate contact time of the tumescence solution, the subcutaneous fat was suctioned off in a longitudinal direction to avoid damage to the lymphatic tract. A criss-cross technique was avoided. In a longitudinal direction, lymph vessels are comparatively robust against shear forces, whereas they are vulnerable transversally (4, 69–70). A blunt, 4 mm thick vibrating microcannula with three blunt openings in a Mercedes star arrangement was used as aspiration instrument (► Fig. 6).

Tumescence local anaesthesia enables the results to be checked in the standing position (► Fig. 7). Residual fluid can be massaged away. Finally, compression stockings, absorbent dressings and a compression bandage on the top are applied (► Fig. 8).

Patients received postoperative antibiotic prophylaxis for 3 days with ciprofloxacin 2 x 250 mg or cefuroxime 2 x 250 mg, together with enoxaparin 1 x 40 mg s.c. for 5 or 10 days as thrombosis prophylaxis depending on the risk profile. Compression treatment was prescribed postoperatively. The patients were to wear compression stockings 24 hours a day for 1 week and only during the daytime for a further 4 to 6 weeks. MLD sessions were prescribed as further follow-up treatment, two to three times a week over a period of at least 6 weeks.

The treatment of the legs was done in at least 3 sessions. The regions were generally treated in the following order:

1. Inner surfaces of thigh and knee,
2. outer surface of thigh, with hip if necessary,
3. lower leg.

### Results

The required number of liposuctions per patient is shown in ► Fig. 9; this ranged

from one to six. Almost half (42.9%) of patients were treated with three sessions. Another 42.9% of patients were treated with either one (16.9%) or two (26.0%) liposuctions. More than three sessions were needed in only a small proportion of the women (14.3%). The median number of sessions needed to treat lipoedema with liposuction was three, with a mean of  $2.61 \pm 1$  sessions.

To evaluate the results, the patients were given a questionnaire of 15 questions pre- and 6 months postoperatively (► Table 3). The intensity of symptoms could be reported on a visual analogue scale (VAS) from 0 (absent) to 10 (very severely pronounced). Spontaneous pain, tenderness, bruising tendency, swelling tendency, restriction when walking and quality of life were some of the parameters measured.

Prior to surgery, the patients rated their pain with a median score of 7 points (mean  $6.5 \pm 3$  points) (► Fig. 10). Six months postoperatively, the median pain score had reduced to 1 (mean  $2.12 \pm 2$  points). Overall, a significant improvement in leg pain could be achieved (Wilcoxon test,  $p < 0.001$ ).

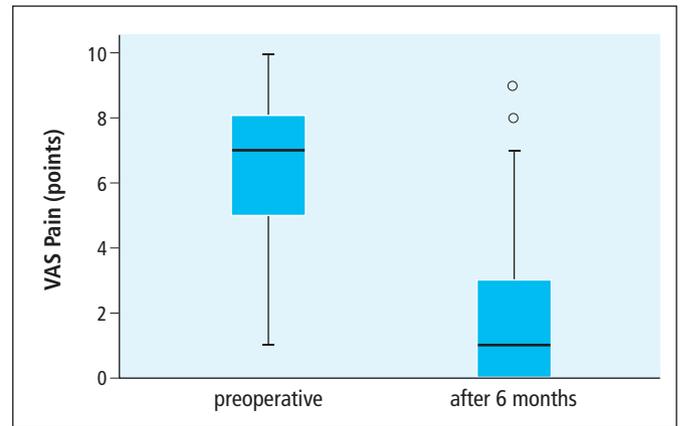
The sensitivity to touch and tenderness of the areas affected by lipoedema was rated preoperatively with a median score of 8 points (mean  $6.5 \pm 3.0$ ). Fig. 11 shows that liposuction significantly reduced the sensitivity to touch (Wilcoxon test  $p < 0.001$ ) by  $\frac{3}{4}$  to 2 points (mean  $2.4 \pm 2.4$  points).

The patients were asked to assess the tendency of the legs to bruise before and after surgery. Pre-operative values were high, with a median score of 8 points and a mean of  $8.1 \pm 2.2$  points. The bruising tendency improved significantly postoperatively (Fig. 12), with a reduction of more than 50% in the symptoms to a median score of 3 points and a mean of  $4.3 \pm 31.1$  (Wilcoxon test  $p < 0.001$ ).

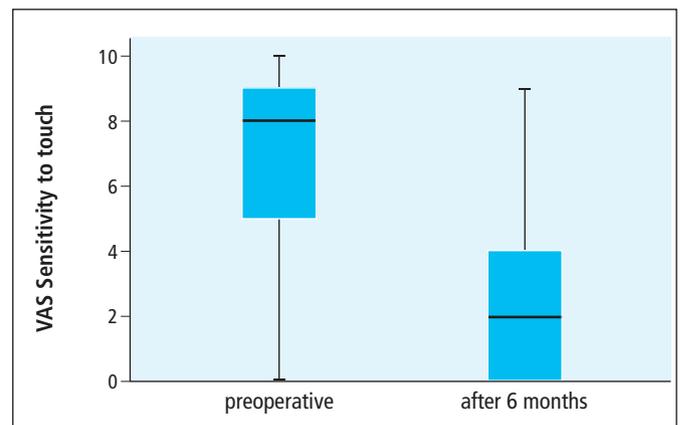
► Figures 10 and 14 show that the tendency of the legs to swell was rated on the VAS preoperatively at a median of 7 points and a mean of  $6.33 \pm 3.2$ . When questioned 6 months after liposuction, the median score was given as 3 points and the mean as  $3.2 \pm 2.5$ . The operation significantly reduced leg swelling by almost half (Wilcoxon test  $p < 0.001$ ).

Symptoms when walking were surveyed in a general way using the VAS. The mean

**Fig. 10**  
Pain preoperatively and after 6 months



**Fig. 11**  
Contact sensitivity preoperatively and after 6 months

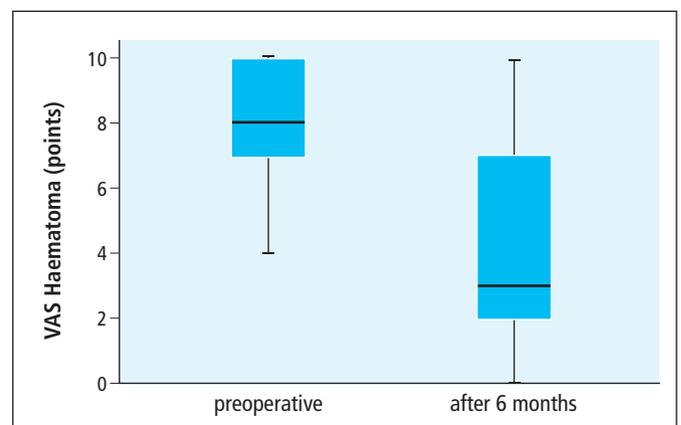


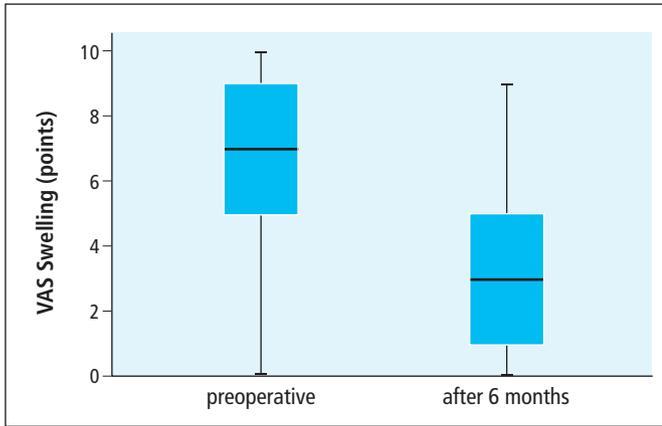
initial score of  $4.1 \pm 3.5$  points was significantly reduced (Wilcoxon test  $p < 0.001$ ) after the operation to  $1.2 \pm 1.9$  points (► Fig. 14). The median preoperative value fell from 4 to 0 postoperatively. The score of 0 signifies that the majority of patients became free of symptoms after liposuction.

The reduction in quality of life of lipoedema patients before and six months

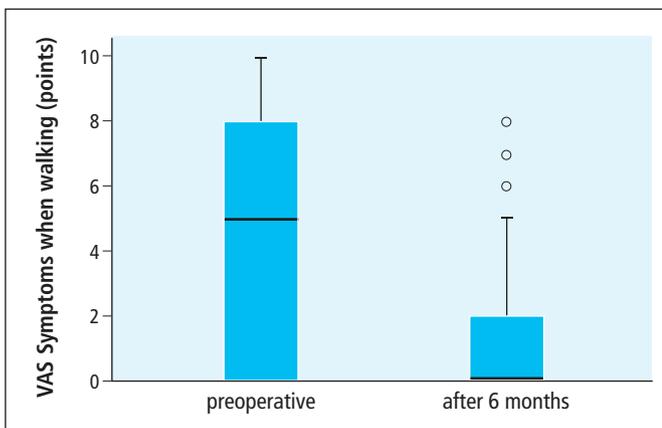
after liposuction is shown in Fig. 15. The preoperative median score of 9 points was the highest of any of the questions measured by the VAS. The high burden of suffering of the patients is also reflected in the mean value, which, at  $8.5 \pm 2.0$  points, was also the highest of all mean VAS scores. Quality of life was improved by  $\frac{2}{3}$  after liposuction, with the median score

**Fig. 12**  
Haematoma preoperatively and after 6 months





**Fig. 13** Leg swelling preoperatively and after 6 months



**Fig. 14** Walking complaints preoperatively and after 6 months

Thus the scores for the symptoms of heavy legs, pain, tightness and satisfaction with the appearance improved significantly postoperatively. Analogous to the report by Rapprich, Dingler and Schmeller et al. (3–4), the greatest improvement was observed in the quality of life. The main symptoms of lipoedema were once again in this study those which responded best to the surgical therapy, namely tired legs, followed by sensitivity to touch, with a mean of up to 4.7 points. The bruising tendency was likewise greatly improved by a mean of 3.8 points.

Due to their rather low initial scores, the symptoms of feelings of hotness, coldness, muscle cramps, skin itching and symptoms on walking showed only a moderate degree of suffering. They also improved after liposuction, although the improvements were not as great as with the more prominent symptoms.

After completion of the liposuction for lipoedema, a significant improvement in symptoms could be demonstrated for all 15 questions in the survey. The improvement in quality of life was the most impressive. In this investigation, liposuction was found to be an overwhelmingly effective treatment for lipoedema, with an improvement in symptoms that lasted at least 6 months (► Fig. 16).

## Discussion

Further studies with a one-year follow-up period should subsequently be undertaken. An attempt should also be made to record the quality of life in a standardised manner, which has not been done to date. In this respect, it is remarkable that up till now there is no specific questionnaire for recording quality of life for lipoedema, so that at present a validation is still pending.

## Accompanying aspects

### Diet

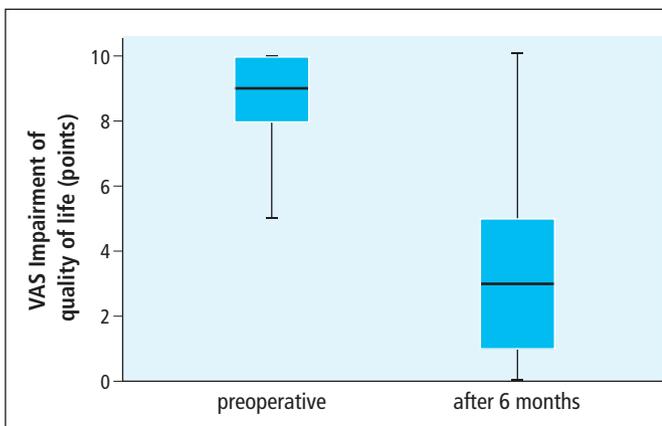
So far there is no lipoedema-specific diet. If obesity is also present, then dietary recommendations should be based on the German Obesity Guidelines (73).

now 3 points and the mean  $3.3 \pm 2.8$ . The increase in quality of life is significant (Wilcoxon test  $p < 0.001$ ). The improvement in quality of life postoperatively is the highest of all changes recorded using the VAS.

Postoperative bruising occurred in 12 patients in a total of 168 operations (7.1%). In 5 of these patients, the haematoma was mild, in 4 moderate and in 2 the haemato-

ma after liposuction required revision. After one liposuction a seroma that required treatment occurred and one patient suffered thrombophlebitis.

On average, liposuction produced significant improvements in all symptoms. The overall symptom score was more than halved.



**Fig. 15** Impairment of quality of life preoperatively and after 6 months



Fig. 16 Lipoedema patient before and after liposuction (3 sessions)

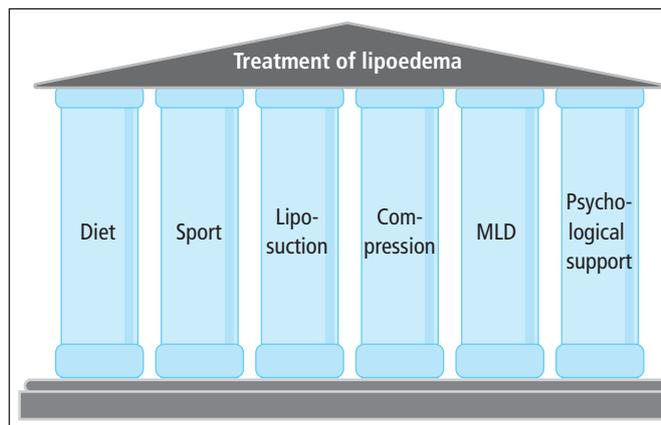


Fig. 17 Lipoedema treatment concept

### Physical activity

Inactivity and obesity potentiate the formation of oedema and have negative effects on the course of the lipoedema. Exercise is an important part of the treatment concept of lipoedema and obesity.

Water sports (aqua jogging, aqua cycling) are especially recommended, because here the buoyancy relieves the load on the joints, the water pressure causes a lymph drainage effect and calories are consumed by the exercise against the water resistance.

In addition, the water has a massaging effect on the skin and subcutis. Studies on the effectiveness of aqua cycling in lipoedema have not yet been conducted.

### Psychological aspects

Patients suffer massively from their appearance, with considerable psychosocial consequences (1–2, 20, 71–72). Depression and eating disorders are also common.

### Treatment concept

A comprehensive treatment concept includes diet, sport, liposuction, compression, MLD and if necessary, psychotherapy (► Fig. 17). However, liposuction can only be successful if effective CPDT is carried out pre- and postoperatively and an accompanying exercise and dietary programme, especially in the case of obesity, is carried out.

Liposuction should be undertaken as part of the overall concept if, despite intensive conservative treatment, progression occurs in terms of findings and symptoms. The above-mentioned questionnaire is offered as an instrument to measure this progression.

After successful liposuction, further conservative treatment can be avoided in the majority of patients. However, appropriate dietary management and physical activity should be continued.

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