TEXTBOOK OF LIPOSUCTION

Edited by

C William Hanke
Gerhard Sattler
Boris Sommer
Textbook of Liposuction
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Textbook of Liposuction

Edited by

C William Hanke MD MPH FACP
Director, Laser and Skin Surgery Center of Indiana, Indianapolis, IN, USA
Past-President, International Society for Dermatologic Surgery
Past-President, American Society for Dermatologic Surgery
Past-President, American Academy of Cosmetic Surgery
Past-President, International Society of Cosmetic and Laser Surgeons

Gerhard Sattler MD
Director, Rosenparkklinik, Center for Cosmetic Dermatologic Surgery and Plastic Surgery, Darmstadt, Germany
Founder/Director, Live Surgery Symposium, Darmstadt, Germany
President, International Society for Dermatologic Surgery
President, German Society for Dermatologic Surgery and Aesthetics
Treasurer, Society for Cosmetic Surgery of Germany

Boris Sommer MD
Private practice, Frankfurt, Germany
Board of Directors, International Society for Dermatologic Surgery
President, German Society for Cosmetic Botulinum Toxin Therapy

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Contributors

Mattias Augustin MD
Department of Dermatology
Freiburg University Hospital
Freiburg
Germany

Dorothee Bergfeld MD
Private Practice
Frankfurt
Germany

Guillermo Blugerman MD
B&SCentro de Excelencia en Cirugía Plástica
Buenos Aires
Argentina

Birgit Buxmeyer MD
Rosenparkklinik Center for Cosmetic Dermatologic Surgery Plastic Surgery
Darmstadt
Germany

Loek Habbema MD
Medisch Centrum’t Gooi
Busum
The Netherlands

C William Hanke MD FACP
Director, Laser and Skin Surgery Center of Indiana
Indianapolis, IN
USA

Thomas Hübner MD
Rosenparkklinik Center for Cosmetic Dermatologic Surgery and Plastic Surgery
Darmstadt
Germany

Rainer Jokisch MD
Rosenparkklinik Center for Cosmetic Dermatologic Surgery and Plastic Surgery
Darmstadt
Germany

Roland Kaufmann MD
Department of Dermatology
Johann-Wolfgang-Goethe University
Frankfurt
Germany

Aimee L Leonard MD
Laser and Skin Surgery Center
Carmel, IN
USA

Kristina Maier MD
Department of Dermatology
Freiburg University Hospital
Freiburg
Germany

Maurizio Podda MD
Department of Dermatology
Johann-Wolfgang-Goethe University
Frankfurt
Germany
List of Contributors

**Gerhard Sattler MD**  
Director, Rosenparkklinik Center for  
Cosmetic Dermatologic Surgery  
and Plastic Surgery  
Darmstadt  
Germany

**Boris Sommer MD**  
Private Practice  
Frankfurt  
Germany

**Sonja Sattler MD**  
Rosenparkklinik Center for Cosmetic  
Dermatologic Surgery and Plastic Surgery  
Darmstadt  
Germany
The first written description of the tumescent technique was published by Klein in 1987. The first book on *Tumescent Local Anesthesia* was published in German by Sattler, Sommer, and Hanke in 1999, and in English in 2000. Klein’s comprehensive book *Tumescent Technique* was also published in 2000. Liposuction using tumescent local anesthesia is performed on patients who are totally conscious; general anesthesia or intravenous sedation is unnecessary; patients are awake and comfortable intraoperatively and postoperatively. Multiple large studies have reported complications to be minor and uncommon; no fatalities have been documented. Patients prefer the simplicity of liposuction using tumescent local anesthesia to the complexities of liposuction using general anesthesia. A number of books have been written on liposuction, but this one is different and unique in many ways.

First, it is the product of the German–American experience in performing liposuction using tumescent local anesthesia. Although invented in the United States, liposuction using tumescent local anesthesia has undergone significant development and refinement by Gerhard Sattler and his colleagues in Germany. Sattler initially learned about liposuction using tumescent local anesthesia at the ISDS Congress in Barcelona in 1987. He began treating patients with the new technique in 1989. Liposuction has been the centerpiece of the Live Surgery Symposium, an international postgraduate course held in Germany in 1992, 1994, 1996, 1998, 2000, 2002, 2004, and 2006. Tumescent local anesthesia has been applied to many new procedures by German physicians from various specialties.

Further, every liposuction surgeon knows that the most difficult aspects of the procedure to learn are the preoperative planning, patient positioning, incision placement, and cannula direction. A great strength of this book is the multitude of high-quality photographs which demonstrate these key concepts. It should be noted that the majority of the tunnels are made in the long axis of the body to avoid unnecessary injury to the lymphatics and neurovascular structures which lie within the fat septa. This minimizes postoperative morbidity and allows patients to return to normal activities within a few days.

Third, many new concepts and discoveries are presented. These include new indications for liposuction, new information on the science of tumescent local anesthesia, and a major advance, powered liposuction using reciprocating cannulas. With powered liposuction, patients can be treated more rapidly without discomfort. Patient and surgeon fatigue is reduced, and the results are better. However, a learning curve is required for the liposuction surgeon to make the transition from standard cannulas to powered cannulas. Another major
advance has been the manually assisted skin stabilization technique (MASST). This technique is carried out by the nurse or first surgical assistant who applies manual circumferential pressure to the skin during suctioning. The MASST helps to minimize tissue trauma and encourages precise, uniform fat removal.

The editors and authors of this book hope that physicians will utilize the information presented to maximize patient safety and satisfaction with the tumescent liposuction technique.

CWH, GS, BS
Reports of operative attempts to remove unwanted fat appeared sporadically even before the beginning of the 20th century, but always referred to extensive surgical procedures with *en bloc* removal of adipose tissue via large incisions.

The first attempt to remove fat via small incisions was described in 1929. The French surgeon Dujarrier removed accumulations of fat from the calves of a dancer using a curette. Tragically, damage to larger blood vessels resulted in the amputation of one leg.

The next documented attempts to remove fat via small incisions were performed in 1968 by the American physician Wilkinson and in 1972 by the German surgeon Schrudde, who first described the use of an aspiration curette. However, in both cases the treatment method was soon abandoned because of extensive side-effects.

The generally accepted pioneers of the modern form of liposuction are Georgio Fischer and his father Arpad Fischer. In the mid-1970s, they developed an instrument (the ‘cellusuctiotome’) consisting of a hollow curette with a blade, attached to a suction pump. The curette detached the fat to be aspirated by severing it with a motor-driven blade. The fat was then transported away through a system of tubes. This method had a high complication rate in the form of bleeding, postoperative hematoma, seroma, and formation of indentations. In 1976, Kesselring and Meyer developed a large, sharp curette with which they aspirated fat from the lateral thigh (‘saddlebags’) after detaching it from the fascia lata with a pair of long scissors. They too achieved unsatisfactory surgical results, despite the use of modified operating techniques and equipment. The method introduced by Teimourian *et al.* in 1981 using a fascia stripper also used the basic principle of large-scale detachment of subcutaneous adipose tissue from the muscles, and had similar complications.

Yves-Gerard Illouz from Paris made major advances in the development of liposuction, turning it into a safe, routine procedure. Illouz replaced the sharp-edged curette with a blunt, less traumatizing cannula. In fact, he used a suction system which had until then only been used in the gynecological field for pregnancy terminations: the Karman aspirator with uterine cannulas. This equipment was much easier for interested colleagues to obtain than the prototype designed by the Fischers, resulting in the popularization of this method. Illouz further developed the concept of treating the tissue in several layers, using what is known as the ‘wet technique’. This involved injecting saline mixed with hyaluronidase into the adipose tissue prior to treatment. Through these improvements, it
was possible to reduce the complication rate considerably\textsuperscript{5,6}.

Another pioneer in the field of liposuction was Pierre Fournier, who gave considerable momentum to the development of the liposuction technique. To avoid non-uniform operating results, he recommended use of the ‘criss-cross’ technique, which consisted of overlapping treatment of the area to be aspirated at various levels, from various incisions, and from various angles. In order to achieve a cryoanesthetic effect he injected cooled saline solution after adoption of the ‘wet technique’. In the mid-1980s Fournier published his work on the technique of fat transfer as a means of tissue augmentation. This involved extraction of the fat, first with microcannulas and later with cannulas of larger diameter, attached to a syringe. Fournier also advocated the manual aspiration of fat, using syringes, for body-shaping (syringe-assisted liposculpturing)\textsuperscript{7}. Together with Illouz, Fournier played a major role in making liposuction internationally known.

At the end of the 1970s, numerous US physicians visited the French pioneers, who were also invited to the USA to teach physicians there\textsuperscript{2}. In 1982, Illouz introduced his operating procedure at a meeting of the American Academy of Cosmetic Surgery. Also in 1982, the first workshops for liposuction surgery were held initially in Paris and then in the USA\textsuperscript{1}. In 1983, the American Society of Liposuction Surgery was founded\textsuperscript{5}. The 50 founding members included not only plastic surgeons, but also ENT specialists and ten dermatologists. Another milestone in the development of modern liposuction surgery was the introduction in 1985 of tumescent anesthesia by Jeffrey Klein, who first published the procedure in 1987\textsuperscript{8} (see below). The tumescent technique enabled the performance of more extensive liposuction procedures under local anesthesia on an outpatient basis. At the same time, because of the specific pharmacological and physical interaction with the tissue to be treated, it rendered liposuction considerably safer, and enabled further development.

Because of the low complication rate and excellent cosmetic results, liposuction by tumescent local anesthesia is currently the method of choice\textsuperscript{9}.

In the mid-1980s, a range of developments were initiated with the aim of making the aspiration of fat even easier, particularly in difficult areas such as the male breast and flanks, and in the case of repeat procedures.

In 1987, Italian physician groups first described a new technique utilizing ultrasound waves to remove homogenized fat\textsuperscript{10–13}. The cannulas were attached to an ultrasound generator in order to cause the adipocytes to burst. However, this method soon showed some significant disadvantages: it required relatively large cannulas, and relatively high rates of seroma and skin burns were recorded\textsuperscript{14}. Recently, there have been increased reports of persistent postoperative hypesthesia and hyperesthesia as a result of damage to the lipoproteins of the neural sheaths.

In 1995, Charles Gross, an ENT surgeon at the University of Virginia, first described the use of motor-driven cannulas with an internal rotating blade to destroy fat cells, and referred to this method, which was used in neck liposuction under direct endoscopic control, as ‘liposhaving’\textsuperscript{15}. Based on this idea, cannulas with rotating blades were developed, and later, better-suited oscillating blades emerged. The latest developments are cannulas without oscillating blades which are made to vibrate via a handpiece.
These vibrating cannulas take advantage of the different oscillating characteristics of the metallic cannulas and the more torpid adipose tissue. The vibrating cannula glides past the tissue structures, with only the fat homogenized by the tumescent solution being sucked into the cannulas (vibration-assisted liposuction)\textsuperscript{16}.

Vibrating cannulas facilitate the procedure for the surgeon even in fibrous or previously operated sites. Vibrating cannulas also appeal to patients, since they glide through the tissue more easily and rarely catch on the connective tissue. So far, no serious complications have been observed. Development of the cannulas and handpieces is not yet complete, but it is expected that the advantages of these systems in both handling and the achievement of good operating results will result in widespread use\textsuperscript{15,16}.

**THE ROLE OF DERMATOLOGISTS IN THE HISTORY OF LIPOSUCTION**

Because of dermatologists’ increasing interest in liposuction, symposia and courses on the subject were offered at the congresses of major American associations (American Academy of Dermatology and American Society for Dermatologic Surgery). In 1983, Stegman and Tromovitch gave the first presentation on liposuction at the American Academy of Dermatology\textsuperscript{17}. In numerous hospitals, liposuction surgery was added to the specialty training programs for dermatologists. However, increasing rivalry between specialty groups made it progressively more difficult for dermatologists to use the operating facilities.

Influenced by the development, and following reports of deaths during liposuction conducted under general anesthesia, Jeff Klein, a pharmacologist and dermatologist from San Juan Capistrano, California, developed a specific form of local anesthesia for liposuction known as the tumescent technique\textsuperscript{18}.

In this method, large quantities of physiological saline are mixed with a local anesthetic to achieve a concentration of local anesthetic between 0.05 and 0.1\%. Injection of the tumescent solution, besides ensuring sufficient anesthesia while avoiding the risks of general anesthesia, offers a large range of other advantages (see Chapter 4).

The introduction of the tumescent technique enabled liposuction to be carried out on an outpatient basis. Dermatologists, who were the first to adopt this new anesthetic technique, became one of the driving forces behind the further development of liposuction. The unusually low-risk profile of this method of liposuction was confirmed in a study conducted by Hanke \textit{et al.} in 1994\textsuperscript{9}. Of 15,336 patients who underwent fat removal using the tumescent technique, none required a blood transfusion or hospitalization due to complications. Moreover, the tumescent technique was also adapted for other dermatological indications: Field \textit{et al.} demonstrated the possibility of mobilizing repositioned flaps\textsuperscript{19}, and Roenigk and others utilized this technique to operate on multiple or giant lipoma\textsuperscript{20} (see Chapter 9).

From the end of the 1980s onward there was a ‘reimport’ of liposuction into Europe. The technique of fat transfer was developed by both American and German physician groups\textsuperscript{21–23}.

**DEVELOPMENT IN GERMANY**

In 1989, Gerhard Sattler was the first German dermatologist to perform liposuction using the tumescent technique at the Darmstadt...
Dermatology Clinic (Hautklinik des Klinikums Darmstadt)22. The introduction of this method, new to the German-speaking countries, was marked by various difficulties, in part due to the lack of an established infrastructure for obtaining the appropriate instruments. Many developments had to be ‘reinvented’. Beginning in 1991, fat aspirations using tumescent local anesthesia were performed regularly and in steadily increasing numbers. The technique was used initially in the dermatology department at the Rosenpark Clinic in 1997, as well as at other centers.

The method was introduced to an ever-increasing circle of interested German practitioners from a wide range of disciplines in the form of workshops and numerous congress presentations by the major German specialty associations. Also, the Darmstadt Live Symposium has been held regularly since 1992. As a result of the international exchange that takes place here and in the course of numerous other events, this method is now performed at a high and internationally comparable standard.

German physician groups working with Sattler and others have increasingly introduced new developments and ideas. These include extension of the surgical spectrum to cover non-cosmetic indications24, further developments in and studies of the tumescent solution25 and technical improvements (see Chapters 4 and 10).

DEVELOPMENTS IN RECENT YEARS

In the 1990s there were several technical innovations, including the development of better cannulas and new liposuction-assisting procedures (see Chapter 10)24,25. There were also developments in the composition and dosing quantities of the tumescent solution (see Chapter 4). Moreover, the volume of clinical use and experience resulted in changes in the concepts of physiodynamics and wound healing, which were applied to the planning and performance of liposuction procedures (see Chapters 6 and 7).

STATISTICS ON THE DEVELOPMENT OF LIPOSUCTION

The statistics of major American specialty associations clearly show the enormous increase in liposuction, which is now the most commonly performed cosmetic procedure worldwide.

According to the American Academy of Cosmetic Surgery (www.cosmeticsurgery.org), the number of liposuction procedures performed in the USA was 71,632 in 1990, 599,430 in 1999, and 672,793 in 2000. Between 1999 and 2000, an increase of 12.2% was observed in the number of procedures performed. Of the patients treated in the year 2000, 114,375 were male, which represents a proportion of 17%. The average treatment age was 40 years.

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4. Teimourian B, Adham MN, Guin S, Shapiro C. Suction lipectomy – a review of 200 patients over a six-year period and a study
Liposuction is one of the most frequently performed cosmetic surgery procedures worldwide. The number of procedures has risen steadily over the past 15 years (statistics of the American Academy of Cosmetic Surgery, www.cosmeticsurgery.org).

Liposuction via tumescent local anesthesia is currently the method of choice. The high safety standard using this technique has been confirmed during the past 15 years in large numbers of patients (see Chapter 18)\(^1^,\(^2\).

The central role that the tumescent technique has assumed in liposuction surgery is based, in part, on the ability to perform the procedure on an outpatient basis, avoiding the risks of general anesthesia (see Chapter 4)\(^3^,\(^4\). It has also been shown that the tumescent technique has a significant positive impact on wound healing (see Chapters 6 and 7).

The safety of the tumescent solution has been enhanced by improvements in composition and application (e.g. ‘super tumescence’) (see Chapter 4). In the future, further optimization of the tumescent solution composition can be expected.

Liposuction should not be viewed purely as a fat-removing procedure. Its role is more in the harmonization of body contours through liposculpture or ‘body-shaping’, which has brought about a considerable change in the meaning and understanding of liposuction since the beginning of modern liposuction surgery.

The ideal patient for corrective esthetic use of liposuction is a patient of normal weight with localized, diet-resistant pockets of fat due to genetic–hormonal factors. This is the real domain of liposuction surgery as a body-shaping method; however, other patients can benefit from fat aspiration in cases of specific indications (see section below on ‘What can liposuction achieve?’ and Chapter 9).

Postoperative complications often seen in the early stages of the development of liposuction surgery, such as dimpling or seroma development, baggy skin, and excessive fat removal with skeletization or asymmetry, can now, for the most part, be avoided by using the appropriate operating techniques (Figures 2.1 and 2.2). At the same time, efficient procedures have been developed to optimize aesthetically displeasing results by means of specific touch-ups or corrective surgery (see Chapters 13 and 18).

**WHAT CAN LIPOSUCTION ACHIEVE?**

Liposuction is not a procedure for overall weight reduction in obese patients (body mass index (BMI) > 30–40). Nevertheless, it can be useful in
this patient group as a reduction treatment for the removal of mechanically troublesome fat deposits. Experience with these patients has often shown that, after the removal of localized fat deposits, a further general weight loss ensues. To what extent this is due to psychological changes (increased motivation for dietary change and exercise) or even hormonal changes in metabolism is still being investigated (see Chapter 3). Obese patients seeking help must also be offered other methods of weight reduction that will not further aggravate their physical condition through yo-yo dieting or “quackery”. Sensible measures for weight reduction and nutritional education can be offered across a range of specialty disciplines. Good results have been reported, for instance, with the use of stomach balloons, which enable lasting weight reduction. Thus, specific medically supported weight reduction can precede liposuction in the treatment of persistent fat deposits.

Liposuction via the tumescent technique is also used in a range of adipose tissue disorders, for the mobilization of skin transplants in tumor surgery, and also for the treatment of lipolymphedema (see Chapter 9).5

**MAJOR DEVELOPMENTS IN RECENT YEARS**

In the 1990s, numerous technical innovations emerged as a result of the development of new cannulas and liposuction-assisting procedures (see Chapters 10 and 12). In the field of cannula
technology, refinement of the tumescent technique enabled the use of small-caliber can-
nulas, which led to more uniform postoperative results. The introduction of blunt cannulas with
multiple suction openings (24-hole cannulas) enabled tissue trauma to be considerably
reduced, with significantly improved wound healing and postoperative results. Distribution
of the suction force over multiple openings reduces the suction force and consequent dam-
age to supportive connective-tissue apparatus.

In 1995, Charles Gross, an ENT specialist at
the University of Virginia, first described the
use of motor-driven cannulas, which destroyed
fat cells by means of an internal rotating blade.
This method, which was used for neck liposuc-
tion under direct and indirect endoscopic con-
trol, was referred to as 'liposhaving'. Based on
this idea, the development of what became
known as powered liposuction continued, first
via cannulas with oscillating blades, then using
vibrating cannulas in which a blunt cannula is
made to vibrate using a handpiece.

Vibration-assisted liposuction (VAL) makes
use of the varying physical torpidity of human
tissue: only the adipose tissue homogenized by
tumescence can respond to the suction force of
the metal cannulas vibrating at high frequency,
whereas connective-tissue structures are not
drawn in because of their greater torpidity. The
oscillation frequency of the cannulas is so high
that the suction force that develops at a localized
site cannot affect firm structures. As a result, the
cannula glides smoothly past tissue structures.
Vibrating cannulas also facilitate the surgical
procedure in previously operated fibrous areas.
Since they do not get caught in the connective
tissue, the procedure is comfortable for patients.
No severe complications have been observed.
Development of the cannulas and handpieces is
not yet complete, but it is expected that these
systems will become widely accepted due to
their advantages in handling and their achieve-
ment of good operating results.

Ultrasound-assisted liposuction (UAL),
developed in Italy in the mid-1980s, aimed
to homogenize the adipose tissue using ultra-
sound waves. The handpiece, containing piezo-
electric crystals, is controlled by an electrical
generator. This causes the crystals to oscillate
rhythmically at a defined frequency. Mechanical
energy is transferred from this piezoelectric
transducer to the actual suction cannulas
(sonotrodes). The oscillation energy applied to
the tissue leads to the rupture of fat cells due to
what are known as cavitation processes.

Due to the frequently observed side-effects
in the form of seroma and skin burns, as well as
hypesthesia and hyperesthesia as a result of dam-
age to lipoproteins in the nerve sheaths, this
method has not become widely used. Discussion
about a possible carcinogenic risk caused the
American Society for Dermatologic Surgery to
term this procedure experimental. Another
method which must also be considered experi-
mental is the procedure known as lipopulsing or
high-frequency pulsing, used to soften adipose
tissue by the application of low-energy, high-
frequency electrical impulses, because the pos-
tulated effect of softening of the adipose tissue is
contested.

Another method is fat aspiration using the
water-jet technique developed by Taufig. Here,
the fat is fragmented and immediately aspirated
by a high-pressure jet of physiological saline solu-
tion with added adrenaline (epinephrine). Advantages are a rapid effect and the ability to
assess the results immediately. The surgeon work-
ing with the tumescent technique is able to assess
the results accurately only with experience,
because of tissue swelling. Disadvantages are the
need for general anesthetic with all the attendant

The status of liposuction today

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