Tumescent Liposuction in Germany: History and New Trends and Techniques

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In 1989, inspired by American and European pioneers of tumescent liposuction such as Jeff Klein, Bill Coleman, William Hanke, and Pierre Fournier, we started to perform this procedure at the Department of Dermatology in Darmstadt, Germany, as an outpatient procedure. From 1991 tumescent liposuctions were performed regularly in increasing numbers. Looking back, the introduction of this new technique for liposuction in Germany required several new approaches due to language difficulties, problems in communication, and a complete lack of instrumental equipment and infrastructure at that time. Therefore much had to be invented twice. The following article describes our personal experiences in the development of tumescent liposuction in Germany which led to new trends and techniques in this surgical procedure.

History

The first tumescent liposuctions were performed using the standard Klein formula for preparation of the tumescent solution. Not knowing the technique of tumescent fluid infiltration, we found the procedure difficult to perform due to the patient’s pain. So the concentration of xylocaine was elevated to 0.1–0.2%. Due to this higher concentration, the volume of tumescent solution that could be infiltrated in one session was decreased significantly to about 1.0–2.5 l. Infiltration was done manually with a 2-cc percutaneous stick. Therefore only small areas could be treated at one session (eg, outer or inner thigh or abdomen) and the tumescent effect achieved was still rather small, considering the obvious traumatic effects on the tissue. This was reflected in a more painful procedure, a prolonged downtime after the operation and a moderate cosmetic result.

Aspiration was performed with 5–6-mm diameter Fournier cannulas (Lab. Sebbin, Paris, France) using the syringe technique.

The introduction of the Klein cannulas (Wells/Johnson, Tucson, AZ) in 1993 meant to be a great improvement. Although comparatively small, the suction effect of the Klein cannulas was superior to other cannulas we knew at that time and the patient felt less pain during the procedure due to the small diameter of the cannulas. The production of cannulas designed after our recommendations meant another step in the development of easier liposuction. Parallel to the introduction of the Klein cannulas, an aspirator pump was established making the procedure more effective and faster.

All these changes offered a great benefit for patients and reduction of bleeding but still tumescent liposuction was comparatively tiring for the surgeon, allowing only the treatment of small areas with much effort. By reducing the lidocaine concentration to 0.08%, we were able to raise tumescent volumes and therefore slightly improve the suction characteristics. The patients felt better and suffered from less pain.

As an experiment we started to use infiltration cannulas as aspiration cannulas in 1994, following the idea that smaller holes in the cannula would cause less tissue trauma. This was possible as a result of an improved infiltration technique. Surprisingly the small cannulas proved to be more effective during aspiration and additionally even less blood loss was observed as usual.

After many patients reported little or no pain, we reduced the concentrations of xylocaine added to the tumescent solution from 0.08 to 0.05% allowing the instillation of greater volumes. Patients tolerated this change without any problems. In the same year we substituted prilocaine for xylocaine as local anesthetic. The lower pH of prilocaine (6.8) allowed reduction of the sodium bicarbonate in the tumescent solution from 12.5 to 6 ml and painless infiltration was still possible. No additional premedication was given except for 2 mg diazepam intravenously at the very start of the operation.

In a study about the pharmacokinetics of prilocaine performed in 1995 we showed that serum levels of prilocaine stayed substantially below those that were recorded for xylocaine, thus providing a better safety profile for prilocaine. As a consequence greater amounts of tumescent solution ranging from 4–6 l could be used. Patients showed no side effects or other problems. The liposuction could still be performed as an outpatient procedure.
At the same time, we started to use the Klein pump for easier and faster infiltration. Using the pump for a short time we noticed uneven distribution of the tumescent fluid in the tissue compared to the hand-operated percutaneous stick. The faster infiltration of the tumescent solution led to an uneven distribution with penetration mainly along the septae instead of infiltrating directly into the fat tissue. In order to provide complete anesthesia we therefore left the operation site to soak for 30–40 min instead of starting the operation immediately after infiltration. At the end of this penetration time, we noticed that the tumescent effect had been diminished and that reinfiltration was necessary.

At the end of 1995 the first generation of our own multi-hole-cannulas were produced. The cannulas had a diameter of 2.7 mm equipped with 10 round holes each with a diameter of 1 mm arranged in a circular or semicircular fashion, comparable to the known infiltration cannulas. The semicircular arrangement of holes allows a unilateral aspiration. A variety of different lengths of cannulas enabled us to treat large areas by fewer incisions. Volumes of up to 6 l of tumescent solution were used with prilocaine in a concentration of 0.05%.

By using a two-pump infiltration technique, infiltration speed could be reduced by half without jeopardizing time. We observed a nearly complete lack of intraoperative distress for the patients. Before starting liposuction we wait one hour for penetration of the solution. Due to absorption and leakage of the anesthetic solution, the tumescent effect of swelling and firmness of the tissue is decreased during that time. To achieve full tumescence, reinjection with either tumescent solution or plain physiologic saline is then performed.

The relatively large amount of tumescent solution that can be instilled without side effects enables us to treat far bigger areas in one session, eg, upper and lower abdomen, hips, waist or outer and inner thighs, knees, gluteal region/hips.

Latest Technical Developments
In early 1997, we introduced blunt-tipped cannulas of 3 and 4 mm diameter with 24 circular arranged holes of 1.0 to 1.2 mm diameter. This hole size provided better mechanical features due to a higher stability and more distinguished penetration characteristics, combined with very effective suction.

New Physiodynamical Tumescent Concept
All the experiences gained in the past have led to a new understanding of the physiologic process during tumescent liposuction, explaining the good results achieved with new infiltrating techniques and cannulas. The ultimate aim of the procedure is pure fat removal in the subcutaneous layer. It is essential to preserve all other structures, such as the connective fibrous tissue, lymphatic and blood vessels, and nerves. If these anatomic identities are respected and remain uninjured, postoperative problems with lymphedema or bleeding are reduced markedly.

The connective tissue stabilizes the overlying skin, providing the vector for a wound contraction in the postoperative period. The subcutaneous connective tissue comprises a framework for subcutaneous skin suspension. Small vessels run along connective tissue fibers, which serve as guiding structures. The empty, honeycomb-like spaces between the connective tissue fibers are filled with fat lobules. A partial or complete destruction of this framework will lead to the elimination of the inner suspension of our skin which may show in clinically more or less pronounced skin irregularities.

At the start of the infiltration the tumescent fluid will spread primarily in areas with the lowest resistance, mainly along the bigger connective tissue septae. Allowing the solution to penetrate for one hour or more will allow fluid penetration into the fat lobules due to tissue pressure and osmotic diffusion. This can be experienced impressively when a lipoma is infiltrated with tumescent solution. While the solid tumor can still be felt 5 minutes after infiltration, it is no longer distinguishable from the surrounding fat tissue after one hour. Once a homogenous change of the consistency of the fatty tissue has been achieved, the suction of a liposuction cannula will remove fat in a unique and uniform fashion. If penetration is irregular, a suction cannula will show different suction characteristics and so will lead to irregular fat removal.

Another important factor is the shearing force and shearing strength of the operation site and the type of cannula being used. The inner stability of the operation site builds up a force counter to the penetration force of the surgical instrument, eg, the cannula. In order not to damage any of the connective fibers, a cannula for tumescent liposuction must be blunt. The force for surgical action is directed from the suction machine which produces approximately -0.9 bar, following the tubing to the holes of the cannula. If a cannula has one hole, all suction force is concentrated on one spot. If we have a three-hole cannula, the force working on each hole is divided by three. Using a 24-hole-cannula, suction pressure of -0.9 bar is divided by 24 holes, suction on each single hole has minimal strength. We have found that this low suction pressure is too low to traumatize the fibrous fibers, resulting in an intact fibrous framework for better postoperative wound contraction.
At the same time, harvesting of pure fat with only minimal fibrous tissue makes the reuse of the gained material for augmentation in other areas possible.\(^6\) In this process, which we call liporecycling, the reinjection of the autologous material can be done through a 30-gauge needle, eg, to treat mimic folds or atrophic scars.

**Summary**

Due to the developments and changes of tumescent solution, infiltration technique, and cannulas, we perform tumescent liposuction today using up to 6–8 l tumescent solution. Total aspirate measures up to 9 l, pure fat aspired up to 5 l. Tumescent liposuction of extended areas can still be done as an outpatient procedure. The condition of patients intra- and postoperatively as well as results has improved and the predictability of outcome is more certain.

**References**