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Review

A journey through liposuction and liposculture: Review

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ABSTRACT

Introduction: Nowadays, liposuction is the most frequently performed aesthetic surgery procedure in Western Countries. This technique has had rapid development since the 1970s, when it was experimented for the first time by A. and G. Fischer. It is currently widely used in clinical practice for many different situations in aesthetic, reconstructive and functional fields.

Materials and methods: This review aims to describe the historical evolution of liposuction by analyzing the transformation of the method in function of the introduction of innovative ideas or instruments. We have also focused on reporting the major clinical applications of this surgical technique, applicable to almost the entire body surface. We finally analyzed the complications, both major and minor, associated with this surgical technique.

Results: Liposuction is mainly used to correct deep and superficial fat accumulations and remodel the body contour. It has become an essential complementary technique to enhance the aesthetic result of many other aesthetic procedures such as reduction mammoplasty, abdominoplasty, brachioplasty, thigh lift and post bariatric body contouring. However, it can be largely used for the treatment of innumerable pathologies in reconstructive surgery such as lipomas, lipedema, lipodystrophies, pneudogynecomastia and gynecomastia, macromastia e gigantomastia, lymphedema and many others. The complication rate is very low, especially when compared with conventional excisional surgery and the major, complications are generally associated with improper performance of the technique and poor patient management before and after surgery.

Conclusion: Liposuction is a safe, simple and effective method of body contouring. It has enormous potential for its application in ablative and reconstructive surgery, far from the most common aesthetic processes with a very low complication rate.

1. History

Liposuction is a very common cosmetic procedure: a safe, simple and effective method of body contouring. The first attempt to remodel the body silhouette dates back to 1921, when Dr. Charles Dujarrier wanted to improve the shape of the ankles and knees to a dancer patient. He removed a large part of skin and soft tissue, with a broad subcutaneous dissection and long skin incision. The result was tragic because of an excessive removal of tissue and suture too tight and live. This caused necrosis and amputation [1,2].

After that, many other attempts are followed with less tragic results, with *en bloc* resection of both fat and skin to recontour outer thigh adiposity. Several complications such as hematoma, long-term seroma, necrosis, infections, and many post-operative body deformities burdened this technique [3,4].

In 1972, the German physician Schrudde published a new less invasive technique to remove subcutaneous fat, using a uterine curette in a “sharp” technique of subcutaneous surgery. Several other surgeons used this technique through the mid 1970's: Kesserling and Meyer [5], in 1976, used a large, double blade cutting curette connected to a low-power aspirator to suck the fat, previously separated from the deep plane by scissors. This “sharp” technique restricts its use only to poorly vascular regions to limit the complications, which are already high [6,7].

In 1975, Arpad and Giorgio Fischer [8], father and son cosmetic surgeons, developed the modern technique of liposuction. They was the first to introduce blunt hollow cannula attached to a suction source and the criss-cross suctioning technique from multiple incision sites. This “blunt” method allowed obtaining better and more predictable aesthetic results with much less complications. The Fischer applied their method only to outer thigh adiposity [9].

Illouz and Fournier, two Parisian surgeons, modified and popularized the Fischer's technique. In 1977, Illouz [10] developed modified equipment for performing liposuction and extended technique to the

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whole body. He introduced blunt cannulas of smaller diameter to reduce the section of nerves, lymphatic vessels and blood vessels. He used three different size of blunt-tipped cannulas depending on the area to be aspirated: the larger (10 mm) for the flanks, hips and buttocks, the middle one for knees, ankles, abdomen and the smaller for the face.

To make the technique less traumatic and reduce hemorrhagic risk, he gradually developed the “wet technique”, based on the injection of saline solution and hyaluronidase into the fat performing a hydrodissection before the liposuction procedure.

The hydrotomy allowed preserving the neurovascular bundles, the enlargement of the deep adipose layer that needs to be aspirated. This make easer for the surgeon preserving the superficial flap and removing only the deep layer [11].

Fournier, who also worked in Paris, was initially a supporter of the “dry technique”, in which no fluid was injected before the procedure, considering it more precise and accurate. However, experience has led it to abandon this approach in favor of local lidocaine infiltration and eventually the tumescent technique, recognizing the bleeding advantages.

He has also strongly supported the need for taped compression to support and shape the suctioned tissue, during the post-operative period.

However, the greatest merit of Fournier was to travel the world teaching others this technique and inspiring those [12].

Lawrence Field, a Californian based dermatological surgeon, visited and studied this evolving technique in 1977. He was probably the first American to visit France and learn the new technique of liposuction from the Italian and French pioneers [13,14].

After that, in the early 1980s, many other surgeons traveled to France to study this procedure. The blunt cannula technique came to be the accepted liposurgical method in this country and around the world, and in 1982, the American Society of Lipo-Suction was formed to bring surgeons from both the United States and foreign countries into one group to establish a teaching program [15,16].

Furthermore, by 1984, liposuction training was available in some dermatology and plastic surgery residency program [17,18].

Throughout this period, liposuction surgery was mostly performed under general anesthesia.

Dermatologists were very interested in performing the process in local anesthesia. Therefore, they started to combine a slight preoperative sedation with local lidocaine infiltration. However, the possible applications were limited by the maximum recommended local anesthetic dosage to few cases with small areas to be treated.

In 1987 Jeffrey Klein, a Californian dermatologist, first reported on the use of large volumes of very dilute anesthesia which allowed liposuction to be performed in larger volumes completely under local anesthesia without the need of sedation or general anesthesia. Klein invented a recipe consisting of 0.05% lidocaine, 1:1,000,000 epinephrine, and 10 mL sodium bicarbonate per liter of saline, which could be infused into tissue prior to liposuction [19].Klein also demonstrated that the same dosage of lidocaine diluted in a large volume of fluid allowed obtaining a good degree of anesthesia even on large areas, without evidence of systemic toxicity.

Moreover, the presence of epinephrine produced an important vasoconstriction which greatly reduces bleeding during the procedure, which was a major liposuction problem prior to Klein's development [20,21].

Lillis demonstrated that the Klein's tumescent technique offered significant reduction in blood loss, even in suction case of over 3L. He verified, also, that Klein's work demonstrating minimal plasma absorption of lidocaine when low concentration solutions were infused [22,23].

Furthermore, performing liposuction without general anesthesia offered other different advantages like reduction of hospitalization, costs and risks of anesthesia.

The main disadvantage of this method is that infiltration of the anesthetic takes a significant length of time. In addition, the cannulas used to extract the fat need to be somewhat finer in diameter to be tolerated by the patient and hence the time to remove a given volume of fat is lengthened compared with general anesthesia [24].

Liposuction was born as a suction technique by means a vacuum pump [25]. However, the Brazilian Luiz Toledo, in 1988 [26], experienced the use of disposable syringes of different gauges and size for aspiration of adipose tissue. The main advantage was a wider freedom of movement for the operator during the procedure, making surgery simpler and easier. In addition, the syringes allow you to know precisely the amount of local anesthetic that has been infiltrated before the procedure and the exact amount of fat removed from each area, all data which are just approximate with the use of the lipoaspirator. Toledo also proposed creating a patient's body map to ensure symmetry as much as possible. A nurse marked exactly the amount of injected local anesthetic and fat tissue removed from each body area to improve as much as possible the aesthetic result and symmetry [27].

The main advantage of syringe liposuction is, therefore, the precision and accuracy in measurement of adipose harvested volumes, in addition to the possibility of injecting fat. The vacuum-pump assisted liposuction makes the surgical procedure more comfortable and less tiring for the surgeon, especially in case of large amounts of fat to be removed. Therefore, the vacuum pump assisted liposuction was usually chosen for major lipoplasty procedures, in which quantity of fat to be removed is a priority over the topographic, symmetric, precise distribution of fat harvest [28].

Ultrasonic liposuction was introduced by Zocchi, in Italy, in 1992 [29] as an alternative to conventional blunt cannula suction. Zocchi credits Scuderi for the original concept of lipo-exeresis [30].

This technique is based on the application of ultrasounds to the fatty tissue to be aspirated, resulting in both thermal effects and mechanical effects to the surrounding adipocytes. These mechanical oscillations pass through the cannula that emits the waves from its tip. The thermal effects play a role in fat dissolution and must be dissipated by tissue infiltration [31,32].

In this way, Zucchi tried to make aspiration easier and to preserve the neurovascular structures, which can be destroyed by the cannulas.

Zocchi detailed what he believed were the advantages of Ultrasonic technique over traditional liposuction: a more selective destruction of the undesired tissue while preserving surrounding higher-density structures; elimination of the “fluid part” of the adipose tissue (fatty acids), leaving the adipocyte wall and intercellular substance to create a smooth skin surface; skin contraction secondary to stimulation of the dermis by ultrasonic energy; correction of cellulite; once the fat is dissolved with ultrasound, the procedure requires less physical exertion on the part of the surgeon [29,33].

Ultrasonic liposuction was embraced initially in South American and Europe and then largely rejected after experience with skin sloughs, burns, and seromas [34].

Laser-lipolysis began to spread after the publication of the studies about the interaction between laser and adipose tissue, conducted by Apfelberg [35] and Apfelberg et al. [36,37] in 1992.

Laser-assisted liposuction represents a relatively recent advancement in the treatment of lipodystrophies and irregularities of adipose tissue. The laser beam is directly propagated to adipose tissue with which it keeps a direct contact. The action of the laser causes the rupture of the adipocyte membrane and consequent release of oily content into the extracellular fluid. Complications and results of laser-assisted liposuction are similar to those obtained with the majority of liposuction techniques. In addition to the cytolitic effects on adipocytes, the laser can cause neoformations and remodeling of the collagen and reorganization of the reticular dermis. It is particularly indicated for localized areas of lipodystrophy in the body or face [2,38].