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The History of Body Contouring Surgery

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Abstract

Body contouring surgery is a rapidly evolving field in plastic surgery. In accordance with improvements in abdominal contour surgery, procedures to improve redundant skin elsewhere on the body were being devised. Initial attempts to correct the anomalies were made in the 1920s by Thorek and his contemporaries and consisted primarily of elliptical excisions of skin. All of the advances made in body contouring, from the original work of Kelly and his contemporaries to the modifications seen every decade, have contributed to a dynamic and evolving specialty. Currently, there is no field within the domain of plastic surgery growing with the same rapidity, and with worldwide obesity continually on the rise, the growth of this field is unlikely to abate in the near future. The contributions of Thorek, Passot, Pitanguy, Baroudi, Grazer, Wise, Regnault, Lassus, Illouz, Klein, Lockwood, and others have provided the necessary armamentarium to approach the post-weight loss patient knowingly, intently, and adequately equipped to restore pleasing contour to the patients we as surgeons care for. The combination of regional dermolipectomies, lifts, and suction lipoplasty has the potential to restore the elegant human form, to recreate gesture, and to restore appropriate structure.

Keywords: history, body contouring, surgery

1. History of body contouring

Physical look has always been very important to majority of people [1]. Unaesthetic fat deposits or loose skin, especially the ones without response to diet or physical exercise, has always been some of the major issues of modern age aesthetic surgery patients [2]. There are, however, differences in the distribution of the body fat between male and female patients. Men have less body fat around the waist, especially in the abdominal area; women generally have a higher percentage of body fat than men, especially around their thighs and buttocks, which is called gynoid fat. In overweight women, normally, the deposition of fat is mainly

found below the waist. Patients with the extra amount of fat can feel uneasy, anxious, or embarrassed. Plastic and aesthetic surgery, through abdominoplasty and liposuction, has solved this problem, in order to achieve pleasant cosmetic results, i.e., to deliver an improved aesthetical image to the patients [2].

Evolving together with weight loss surgery, the field of body contouring surgery has assayed to sculpt a satisfying form surgically. Operative interventions of this type, where surgeons remove large amounts of fat and excess skin, are not something new, although they are growing rapidly with quite accessible treatment.

2. History of abdominal procedures

First, there were functional panniculectomies with various approaches concerning the scar shape and its location [2]. Over a century ago, in 1880, in France, Demars and Marx reported a large resection of skin and fat from the abdominal wall. In 1899, Dr. Kelly performed a panniculectomy with an elliptical transversal incision around the umbilicus [3]. In 1901, Peters described a similar surgery extracting 7450 g from a patient, including the umbilicus, without the undermining [4]. Gaudet and Morestin extracted fat and skin with correction of an umbilical hernia while preserving the umbilicus. Eventually, Babcock in 1916 described dermolipectomies using vertical incision [5].

Most authors would agree that the earliest work by these pioneers and others generally represented truly functional panniculectomies. There was tremendous variation in scar location and morphology, but the basic approach was exactly the same, simple dermolipectomy [6].

Thorek is the one to be praised for the contour surgery's first major aesthetic accomplishment. He performed the first umbilicus-preserving abdominoplasty in 1924 [7]. The significant contribution of Passot would need to be mentioned here—he used undermining as a modification of Kelly's technique [8]. Vernon in the 1950s developed a novel concept by combining extensive undermining with the umbilical transposition and relocation, which is a procedure still in use today. Callia described aponeurotic suturing as an important piece of his procedure in 1967, which involved an infrainguinal incision [9]. The famous Pitanguy in the same year published a series of 300 abdominal lipectomies with infrainguinal incision [10]. Previously, the published literature consisted mostly of case reports or a few number of patients. In the 1970s, Regnault modified the Pitanguy's incision into the “W” incision [11]. In 1973, Grazer championed the “bikini line” incision used frequently today [9]. An observation in 1977 by Grazer and Goldwyn that abdominoplasty decreased anterior projection of the abdomen but did little to change waist diameter led to Psillakis' assertion in 1978 that muscular aponeurotic suturing was an underutilized tool to decrease waistline dimensions [12]. Pregnancy produces changes in the body contours due to skeletal modification and flaccidity of the cutaneous and musculoaponeurotic tissues. There is now a new technique to face the musculoaponeurotic flaccidity and in this way achieve acceptable abdominal contour. The major oblique muscle is sutured to the rectus fasciae.

Somalo and Gonzalez-Ulloa extended the transverse abdominal incision circumferentially and introduced the belt lipectomy. This concept would provide the stepping stone for many subsequent “radical” lifting procedures [13, 14].

3. History of upper body contouring procedures

Similarly as with the improvements in abdominal contour surgery, procedures to ameliorate redundant skin on other parts of the body were being devised. The arms of a weight loss patient often manifest sagging deflated skin, downward descent of the posterior axillary fold, and redundant axillary skin. Initial attempts to correct these anomalies were performed in the 1920s by Thorek and his contemporaries and involved primarily elliptical excisions of skin [15]. The procedure did not change significantly and was pretty exotic until 1973. Here, Lewis carried the resection into the patients’ axilla and performed a Z-plasty to reduce the effects of scar contracture. Soon after, Pitanguy again developed alternative solution for patients with excessive lateral axillary skin tissue, in which he continued the arm scar into the inframammary fold. Afterward, he developed a method of a so-called bat-wing torsoplasty in the 1970s. This technique combined brachioplasty with vertical axilloplasty in a single scar bilaterally [16]. Another big contribution was made by Regnault, who created a fishtail version of the arm reduction that is still used with small modifications by many surgeons [17].

4. History of lower body contouring procedures

The lower extremities have also suffered the unwanted effects of massive weight loss as well as effects of gravitational forces. In the beginning of the twentieth century, Dr. Kelly and Dr. Noel realized the aesthetic impact of thigh morphologic abnormalities and performed local excisions of the thigh tissue in combination with abdominal lipectomy [18, 19]. They managed to achieve success with elliptical excisions of skin and fat. This method was brought to life at the moment when Lewis created the notion of a thigh lift in 1957, using a circular resection with vertical components, in order to minimize overall circumference; thus thigh contour was altered greatly in a most positive way [20]. Pitanguy’s contribution to trochanteric lipodystrophy in the 1960s [21] has inspired Farina to devise “riding trousers” resection type [22]. It differs from obesity because, according to Pasqualini [23] the latter is a state in which an excess of fat accumulate, predominantly in subcutaneous cellular tissues, and a remarkable change in the shaping of the body occurs as a consequence. From a clinical standpoint, trochanteric lipomatosis is like a real lipoma, since, according to Bergmann and his coworkers [24], it remains unaltered even when the patient loses significant weight. The incision must be fusiform and deep to the aponeurotic layer, from the iliac crest up to the mediocrural level. The upper end of this incision has to be lengthened backward, following the iliac crest to about 15 or 10 cm from the posterior midline [32]. Fusiform excision of the dermofat together with undermining of the crural flaps is carried out after that. Large undermining of the incision’s lower end is carried out in parallel to the iliac crest in a way to expose the aponeurosis of the

gluteus maximus. By pulling upward and forward, the angle of this large pelvicrural flap, a right-angled triangular part is achieved for the excision. Next, a cutaneous suture is carried out with simple interrupted stitches, and a few Donati's stitches are tied upon rollers of gauze. A pressure dressing of gauze that has been impregnated with Vaseline petroleum jelly is applied and fixed with adhesive tape [22].

The fusiform excision, which continues from the iliac crest, up to a quite high point on the lateral face of the thigh, needs to be done towards the posterior side, in order to be hidden from the front side [22]. Schrocher advised to leave one or two centimeters of fat on the aponeurosis because, in his opinion, when the aponeurosis is exposed there is excess exudation [25]. In Farina's opinion this is caused by lipolysis, a natural phenomenon when fat tissues are handled, so we must not hesitate to undermine at the fascial plane.

Abundant lipolysis can modify the aesthetics by changing the general volume of the limbs. The upper end of the abovementioned incision, when it gets near the iliac crest, needs to follow the line in an anteroposterior direction until the middle to the posterior midline. Farina not only removed the disfigurement but also succeeded in improving the aesthetic aspect of the buttocks by making them look higher using this method. The patient must stay absolutely stable for a week, when we start to remove alternate stitches [22].

This method eventually ended up with scars in a position which was neither desired nor expected.

This method has been further improved by Pitanguy using a semicircular excision technique, which at once took care of trochanteric adiposity and medial and lateral thigh laxity. Baroudi, Regnault, and Grazer came up with further modifications in this method. In the end, the semicircular thigh reduction has been completely revised by Regnault and we got the circular thigh reduction [26]. One of the unwanted side effects of these methods was known as gluteal depression. It is a contour shape loss between the iliac crest and femoral trochanter. Agris, Aston, and many others rectified this by filling up this area with excess deepithelized skin [27]. Agris J. Use of dermal-fat suspension flaps for thigh and buttock lifts..

In the early 1990s, Dr. Lockwood would further revolutionize the rejuvenation of the lower extremity and move onto entire thigh-abdomen-trunk aesthetic unit by describing the anatomic features and making use of the superficial fascial system (SFS) to anchor tissues after excisional lifting procedures [28, 29]. His precise description of the medial thigh anchoring technique in 1988 allowed a more durable lift of the inner thigh with less scar migration [30]. The introduction of the high-lateral-tension abdominoplasty and the lower body lift expanded upon the earlier belt lipectomy concept of Somalo and Gonzalez-Ulloa to fix and perfect the entire thigh-trunk-abdomen aesthetic unit [13, 14].

5. History of breast reduction

Male and female breast tissue would also experience unpleasant and significant conformational changes as a result of massive weight loss. The female breast is one of the most attractive

aesthetic areas in female anatomy. There are numerous testimonies to the crucial and often devastating role that feminine beauty and figure of breasts had in many different cultures. Depending on the cultures and the era, vision of what makes beautiful and sensuous breasts have more or less stayed the same for the past 2500 years. First of all their size, but also shape, and maybe the breasts' symmetry can have a greater effect on the women's self-esteem and/or confidence. Reduction mammoplasty is certainly one of the frequently asked surgeries—plastic surgeons can make a crucial effect to a woman's quality of both physical and social life. Plastic surgery has seen quite high satisfaction rate of the patients constantly, although there are not always success stories to be told [33].

Majority of women with extremely large breasts might suffer from poor self-esteem, altered self-image, and other psychological effects. Women, whose breasts are abnormally large relative to their body built, are often limited in their choice of clothing and even lifestyle. Exercise, sports, and participation in other daily activities might be very difficult for them. Breast sizes are a powerful factor in woman's attitudes, career choices, as well as personal life in so many ways.

Urgent medical conditions, such as skin lacerations and intertrigo, chest tightness, or for example, chronic headaches as well as pains in the breast, neck, back, or shoulder are well known complaints of women with breasts larger than usual. These symptoms are either eliminated or significantly improved by reduction mammoplasty. After surgery, majority of these women enjoy a positive new outlook, cured from their medical complaints and engage in activities that were previously impossible for them.

Breast reduction surgery continues to develop, improve and is being refined constantly with a large number of procedures. Each procedure presents particular advantages in terms of symptoms, vascular preservation, technique design, ease of realization, minimum scarring, maintenance of innervation, and long-term results.

Usually seen anomalies are asymmetric volume loss, or for instance loose inelastic and redundant skin, or medialized nipple-areola complex (NAC) position in women. There is also lateral outward migration of tissue, which results with axillary skin excess. Rejuvenation of chest is still one of the most challenging areas in body contouring surgery.

Long time ago, in the 6th ct. AD, Paulus Aegineta described a technique of reduction mammoplasty in order to correct the gynecomastia. Furthermore, in 1561 Hans Schaller has successfully performed a reduction mammoplasty by breast amputation [31]. Dieffenbach [32] was the first surgeon to make a reduction mammoplasty in a female patient, leaving the scar in the inframammary fold. Thomas [33] and Guinard [34] underlined the inframammary fold as an entrance site for the operative treatment of surplus breast tissue.

Most of the surgical treatments made during the 1800s and the early 1900s were aiming at correcting ptosis. Different skin types, as well as glandular excisions were involved, attaching or sometimes suspending the breasts on a higher position at the chest wall, however, without the true nipple-areola complex (NAC) transposition. The whole idea of nipple-areola complex transposition has been improved in between 1909 and 1925. Morestin in 1909 [35] was the first

surgeon who transposed the nipple-areola. He was followed by Villandre, cited in 1925. He referred to a surgery that he performed in 1911 [36]; and later Lexer continued the work [37].

The following phase in the evolution of breast reduction surgery was mainly focused on the knowledge of the blood supply of the skin, mammary glands, and nipple-areola itself. The subdermal blood supply to the breast skin and glands was object of many detailed considerations.

In 1937, Schwarzmann [38] proposed to leave a periareolar dermal ring in order to improve arterial and venous blood supply directly to the nipple-areola. This has improved viability of the nipple-areola complex and improved its transfer. It is a beginning of methods involving deepithelized nipple pedicle flaps.

The extreme significance of incisions' marking beforehand the operation was well presented by Bames in 1948 [39]. The following year, Aufricht [40] remarked that ultimate breast form is determined by the postsurgical "skin brassiere". Wise in 1956 [41] described a pattern for preoperative marking of the breast that resulted an aided in accurate and reproducible resection of parenchymal tissue while minimizing complications and resulting in satisfactory breast shape.

Resulting and following refinements in breast reduction surgery evolved around pedicle designs to preserve vascularity and place the scars in more aesthetic area. Different orientations of the breast dermal and parenchymal pedicles were described. Strombeck [42] described a horizontal dermal bipedicle flap that helped maintain innervation to the nipple-areola complex. McKissock [43] described a vertical bipedicle flap; Weiner et al. [44] a superiorly based flap; finally, Courtiss and Goldwyn [45] along with Georgiade et al. [46] used inferiorly based flaps.

A few authors described substantial innervation of the breasts. Marchac and de Olarte [47], Góes [48], Lejour [49], and Lassus [50] implemented vertical as well as short-scar reduction methods. Most of the methods developed during the 1960s and 1970s. However, during the last decade or more, they achieved common popularity, acceptance, as well as regular utilization.

However, Beisenberger's dermoglandular separation [51] as well as nipple transposition at the unilateral vascular pedicle which Skoog did in 1963 [52], Regnault's B type reduction [53], Lassus's vertical mammaplasty [54], or Benelli's periareolar reduction [55] have helped discovering new methods and techniques to recreate satisfactory breast shape in both women and men. Various authors described in detail glandular reshaping and dermal suspension.

6. History of liposuction

Removing excess fat from localized body sites is not a new idea [56]. In 1921, in France, Charles Dujarrier tried to remove subcutaneous fat using a uterine curette on a dancer's calves and knees [57]. Unfortunately, he damaged the femoral artery, and the patient has lost her leg as a

result. One of the original and creative initiatives came from Schrudde in 1964, when he extracted fat from lower areas of the limb, through a visibly small incision, utilizing a curette. The unfortunate results from this surgical initiative were unpleasant hematomas and seromas [34, 58]. Pitanguy, on the other hand, was in favor of a removal of both fat and skin in a block, in order to remove excess thigh adiposities in one act. However, significant visible incisions made this method quite unpopular [20].

The field of modern liposuction began with the technique and new instruments developed by Arpad and Fischer [59, 60]. During their work in Rome, Italy, they managed to develop a blunt hollow cannula, with additional function of suction. Some of the previous cannula designs contained a cutting blade also. They made their results public in 1976 [61]. Fischers also started the crisscross tunnel formation method, from several incision sites. The new instruments have brought very promising results. The abovementioned complications were avoided using these instruments. Kesselring and Meyer [62] published their surgery results of sharp curettage aided by a suction device in 1978, but their method did not receive a wide acceptance.

Fournier, in Paris, showed an early interest in the Fischer's liposculpture technique [63]. He was an initial enthusiasts of the "dry technique" in which no fluids were infiltrated into the patient prior to liposuction. Fournier would become a world leader in liposuction and fat transplantation, eventually insisting on the benefits of tumescent anesthesia and making a great contribution in opening new horizons and ideas to surgeons from different parts of the world.

Illouz, a Parisienne, was quite attracted by the Fishers' work. His preferred method was a "*wet technique*", where they implemented a solution of hypotonic saline together with hyaluronidase inserted into the adipose tissue before the aspiration. Illouz thought that the solution itself was a "*dissecting hydrotomy*" which would catalyze the removal of fat and thus reduce trauma, as there was smaller amount of bleeding. Illouz received worldwide publicity and promoted this method.

The first US surgeon to visit France to learn the new area of liposuction was Lawrence Field in 1977, a Californian dermatology surgeon [64]. Other surgeons from the States, coming to conferences and educating themselves about new methods in the literature, also showed an interest in the area. One of them was Norman Martin, an otolaryngologist. He visited to Illouz in 1980 and quickly started with liposuction surgeries in Los Angeles in 1981 [65].

It was 1982 when a group of physicians from various specialty disciplines received lectures from Illouz and Fournier. Among them, dermatologists Claude Caver and Arthur Sumrall attended these classes. Rhoda Narins, a dermatologist from New York, also visited France in 1982 to learn the techniques. At the same time, a task group formed by the American Society of Plastic and Reconstructive Surgeons visit to Europe to learn and form opinions about this new procedure. Recognizing its potential, the abovementioned attempted to monopolize the whole field by having Illouz sign a contract with them to exclusively teach plastic surgeons worldwide. Fournier in turn refused to sign that kind of contract, and in spite continued to teach physicians from various fields [65]. Julius Newman, otolaryngologist and cosmetic surgeon, together with his associate Richard Dolsky, who was a plastic surgeon, together

taught the first American course on liposuction, held in Philadelphia in 1982. The five live surgery workshops were held in Hollywood, California, in June 1983, under the authority of the American Society of Cosmetic Surgeons and the American Society of Liposuction Surgery. There were altogether 10 dermatologists in attendance.

Interest in liposuction has been on the upward spiral since and continued to expand in the United States. In 1983 and 1984, several interspecialty courses were sponsored by the American Academy of Cosmetic Surgery. “Lipo Suction” term was coined by Newman and soon he eventually established the ASLS—American Society of Liposuction Surgery. Some of the first publications about liposuction were noted in the dermatological literature, back in July 1984 [66, 67].

Already in 1984, liposuction training was ongoing in some residency programs. For instance, the dermatology section at the Tulane University School of Medicine was one of the first ones to teach residents about liposuction on a regular basis. Liposuction was soon a part of the “Core Surgical Curriculum in Dermatology” in 1987. Dermatologic surgeons also had a greater role in postgraduate education in liposuction, and established special training courses. Doctors Patrick Lillis, Rhoda Narins, and Jeffery Klein organized many workshops that gained much interest.

The dermatological literature of the 1980s is filled with numerous interesting and important articles describing liposuction methods [67–71]. Klein designed the tumescent technique, showcasing almost entirely bloodless session of liposuction with application of just local anesthesia [72]. This creative innovation was a turning point and dramatically altered the future of liposuction. The first dermatological textbook to contain a chapter on liposuction was *Cosmetic Dermatologic Surgery*, published by Year Book in 1984, authored by Samuel Stegman and Theodore Tromovitch.

In 1987, Klein’s description of the tumescent technique and subsequent demonstration of its safety and efficacy revolutionized the art and practice of suction lipectomy [31].

The American Academy of Dermatology (AAD), the American Society for Dermatologic Surgery (ASDS), and the International Society of Dermatologic Surgery (ISDS), all practiced extensive educational program on liposuction subject at their annual gatherings starting in 1984. Coleman and Fournier were guest editors of a special liposuction issue in *Journal of Dermatologic Surgery and Oncology* in 1988. Lillis and Coleman were guest editors for a special issue of *Dermatology Clinics* on liposuction in 1990 and again in 1999. William Coleman and Naomi Lawrence were guest editors for a special issue of *Dermatologic Surgery* in 1997.

The first detailed instructions on care [73] for liposuction procedures have been approved by the American Academy of Dermatology in 1989 and published in 1991. The Tumescent Liposuction Council has been formed in 1992, with the aim of increasing level of awareness about the advancing tumescent method for liposuction treatment. Their newsletter was first published in 1993. Many postgraduate courses were organized to help teaching dermatologists how to master this method.

During the 1980s, dermatologists were major contributors to this field. Some of the contributions were the use of liposuction for the face alone or in combination with microlipoinjection,

face-lifting [74, 75], and liposuction for axillary hyperhidrosis, lipomas, gynecomastia, and reconstructive surgery [76, 77].

In the beginning, large cannulas were employed for liposuction, some up to 1 cm in diameter. These large instruments may have caused damage to neurovascular bundles and occasionally may have led to uneven contours and seromas or hematomas in some patients. Gentle touch was needed for use of local anesthesia, which was favored by dermatological surgeons. Different, smaller-diameter cannulas have been developed by dermatological surgeons [78–80]. The cannulas that are normally used at the present time are extremely small in diameter, some with an inner diameter of less than 0.6 mm. Blunt-tipped cannulas are IJOW standard, due to significantly decreased injury to blood vessels. The use of several side entry points opens the possibility for removal of adipocytes. Hand-operating instruments, combinations of syringes and cannula tips were also invented [81–84]. Many surgeons chose the usage of these quiet, disposable instruments, so they became quite popular as backup items. The aspiration units that manufacturers designed in cooperation with dermatological surgeons gradually became more powerful but more quiet as well, making surgical environment pleasant and positive experience.

In 1987, dermatologist Jeffery Klein, MD, presented his development in the field tumescent anesthesia [85]. His innovation consisted of infiltration of a dilute solution of lidocaine with epinephrine to allow for more extensive liposuction using only local anesthesia, significantly minimizing bleeding [72]. This revolutionized the field of liposuction for all specialties [86, 87]. Klein [88] and Lillis [89, 90] showed in presentation that the hematocrit of the aspirate fat was minimal. The expected complications of hematoma and seroma formation became rare. Complex calculations of fluid and blood loss or autologous transfusion were no longer needed. Peri- and postoperative monitoring was all of a sudden made much more simple.

Klein showed that diluted combinations of lidocaine together with epinephrine are really not absorbed in the same way as normally used commercial lidocaine. Klein [91] proved that when tumescent liposuction is performed in combination with previous application of 0.05% lidocaine and 1:1,000,000 epinephrine, maximal doses of 35 mg of lidocaine per kilogram of body weight were very safe and quite effective. This pharmacological discovery made possible for large volumes of fat to be removed. This development of tumescent anesthesia eventually encouraged some surgeons to progressively explore the different options and limitation of lidocaine. Lillis reported no complications what so ever in tumescent lidocaine doses of more than 70 mg/kg. Ostad et al. [92] suggested the max tumescent safe lidocaine dosage to be 55 mg/kg of the body weight. The rate of application of the tumescent anesthesia was found not to be dependent of lidocaine levels in plasma [93]. The tumescent procedure has been of utmost importance in the field and experts around the world recognize its importance.

Nowadays, some specialties still perform liposuction in the hospitals, but dermatological surgeons have clearly shown that tumescent liposuction is harmless, just as an office-based outpatient surgical treatment [94]. There were quite a low number of cases with complications, however with no fatalities, when the tumescent anesthesia method was implemented as a local anesthetic with no excess intravenous fluids or for instance general anesthesia [95, 96]. Complications and even fatalities in some cases have been reported when liposuction was

performed under total anesthesia and deep intravenous sedation, after implementation of tumescent fluids. The mentioned variations of the tumescent technique have been strongly criticized by most dermatological surgeons all over the world [97]. Dermatological surgeons have also proven without any doubt that limiting the amount of fat aspirated contributes in general to the safety of the procedure [94].

Documentation of safety in liposuction procedures that are performed by dermatological surgeons has been impeccable [95, 96]. The number of lawsuits has been shown to be significantly decreased when liposuction is performed applying the tumescent technique, in an outpatient setting by a dermatological surgeon. Hospital-based liposuction, which more often than not involves general anesthesia, have resulted in 3.5 times as many malpractice claims [94].

Liposuction, as a procedure, is practiced by several specialties, and interspecialty rivalries have formed and exist to this day. Competing personal economic interests by different branches have led to attempts to restrict who should be allowed to perform liposuction and in what setting [56, 57]. Several states have accomplished introducing negative impact legislation in order to limit the physical location in which liposuction can be carried out. Without a doubt liposuction is safest as an outpatient procedure. Demanding by law the performance of liposuction in a hospital setting may increase the risks and complications and endanger patients. These politically and economically-based restrictions on such activities will continue due to influence of wealthy medical lobbies.

At first, ultrasonic liposuction has been developed in Europe in the beginning of 1990s by Zocchi [98]. The procedure exposes fat cells to ultrasound, which acts as a fat-aspiration catalyst. Ultrasonic techniques may be cannula based (internal) and by external application. Although the American Society of Plastic and Reconstructive Surgeons promoted ultrasonic liposuction in the past, dermatological surgeons generally gave up on this technique. Use of internal ultrasound increases the risk for cutaneous burns and seroma formation, and has almost no benefits over regular liposuction. Several studies by dermatologists who were studying external ultrasonic liposuction have found almost no benefit to it, when used before, during, or after a procedure. Moreover, complications have occurred from both forms of ultrasound, and it gives the right to the above-mentioned dermatological surgeons [99–103].

It has been the case that shaving instrument with suction to remove fat has been used in submental resection [104, 105]. Furthermore, a full-body version of this technology as well as new more powerful liposuction cannulas has been developed and used by dermatologic surgeons [106]. These devices use a rotary internal blade built into the cannula and are designed to facilitate tunneling through fibrous adipose tissue. Newer powered liposuction devices make use of a reciprocating cannula that facilitates fat removal and may decrease the physical work of the surgeon, which is in those interventions substantial [106].

Noncosmetic applications of procedures such as liposuction have been introduced or even invented by creative dermatological surgeons from all around the world [77]. They clearly showed that liposuction could be used to remove lipomas [107–109] angiolipomas [110], and improve hyperhidrosis [76, 111, 112]. Liposuction techniques can greatly assist in hematoma

situations, with successful evacuation of hematoma [113]. Klein demonstrated and performed liposuction techniques for breast reduction. The field pioneered liposuction method in order to achieve flap movement in cutaneous reconstruction [114–117]. Gynecomastia [118, 119] benign symmetrical lipomatosis (Madelung's disease) [120], Dercum's disease [121], Cushing's disease [122], and insulin-induced lipohypertrophy [123, 124] have been treated with liposuction as well. Lymphedema, most often following breast cancer treatment, has benefited from liposuction and controlled compression therapy [125, 126]. Liposuction has become a valuable technique in situations where a surgeon intends to improve stomal dysfunction [127, 128].

Liposculpture has become a proven modality that can avoid unseemly scars in patients with good skin tone and provide a significant adjunct to excisional lifting procedures. Ultrasonic liposuction techniques have the potential to improve aesthetic results.

7. Body contouring after massive weight loss

Massive weight loss (MWL) is normally defined as an excess weight loss (EWL) of 50% or more in an effort to combat morbid obesity [129]. A comprehensive and detailed preoperative evaluation is mandatory as the body-contouring procedures following MWL are often extensive with potential morbidity and even mortality [130]. Although this amount of weight loss is most commonly found in bariatric surgery settings, plastic surgeons should separate between patients who have undergone bariatric/metabolic surgery and those who have lost weight only through diet and exercise, because malabsorptive procedures produce a number of nutritional deficiencies not otherwise seen. Furthermore, they need to understand the differences between various bariatric surgical techniques and take their basic working mechanism into consideration as patients having purely restrictive procedures are less likely to suffer from many of the metabolic complications and deficiencies that may be seen after malabsorptive weight loss operations [131]. The terms, body contouring or post-MWL body contouring, can be applied to any surgical procedure used to modify the skin envelope, subcutaneous layer, and/or investing fascia, and include a wide range of operations performed to treat the MWL patient. After a rapid and massive weight loss, there is a sudden change in BMI which leads to skin and soft tissue becoming excessive and redundant with a poor tone. Surplus skin and malpositioned adipose deposits can contribute to medical conditions such as irritation, fungal infections, poor hygiene, skin breakdown, physical function impairments, and low self-esteem [131]. Therefore, excisional surgery may relieve these symptoms and, for all these reasons, it must be considered to be reconstructive rather than cosmetic [132]. However, MWL patients are also seeking an aesthetic outcome to improve their body image and self-esteem.

All of the advances made in body contouring, from the original work of Dr. Kelly and his contemporaries to the modifications seen every once in a while since, have contributed to a dynamic and evolving specialty. Currently, there is no field within the realm of plastic surgery which is growing with the same rapidity, and with worldwide obesity continually on

the rise, the growth of this field is unlikely to abate in the near future. The contributions of Thorek, Passot, Pitanguy, Baroudi, Grazer, Wise, Regnault, Lassus, Illouz, Klein, Lockwood, and others have provided the necessary armamentarium to approach the post-weight loss patient knowledgably, thoughtfully, and adequately equipped to restore pleasing contour to the patients we as surgeons care for. The combination of regional dermolipectomies, lifts, and suction lipoplasty has the potential to restore the elegant human form, to recreate gesture, and to restore appropriate structure.

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