




High-Definition Liposculpture: What are the Complications and How to Manage Them?

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Abstract

Background High-definition liposculpture is a novel surgical technique widely accepted among plastic surgeons. The aim of this article is to describe surgical outcomes with a special emphasis on complications in high-definition liposculpture patients.

Methods An historical cohort of patients who underwent high-definition liposculpture from two senior surgeons was reviewed. Technique, patient selection criteria, preoperative marks and surgical outcomes are described. Postoperative complications are discussed.

Results A total of 417 patients underwent high-definition liposculpture between 2015 and 2018. Primary liposuction and secondary liposuction were performed in 308 (74%) and 109 (26%), respectively. Combined surgeries were performed in 121 cases (29%). There were no systemic complications. Local complications included hyperpigmentation ($n = 276$), seroma ($n = 125$), nodular fibrosis ($n = 83$), unsatisfactory definition in superficial liposuction areas ($n = 16$), unnatural appearance of body contour ($n = 17$), VASER-related burns ($n = 3$) and Mondor's syndrome ($n = 2$). Most patients (94%) were satisfied with the results.

Conclusion High-definition liposculpture is a body contouring technique that has shown excellent results. Despite non-serious complications were frequent, most complications were local and safely treated without affecting surgical outcome. To know these complications will help to recognize them earlier and to adjust patient expectation about the postoperative period.

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Keywords Body contouring · Liposculpture · Aesthetic surgery · High-definition liposculpture · Liposuction

Introduction

Liposuction is one of the most frequently performed aesthetic procedures worldwide [1]. It has the advantages of improving body contours with inconspicuous scars and low risks if it is executed by a properly trained plastic surgeon.

Traditionally, the aspiration of subcutaneous fat is performed in a deep plane adjacent to Scarpa's fascia, given the concerns that superficial liposuction is associated with higher rates of complications, such as contour irregularity, seroma, hyperpigmentation, chronic induration and fibrosis [2, 3]. The interest in removing subdermal fat began in the 1980s, when Illouz et al. [4] described the use of superficial liposuction to define the infragluteal fold. Gasperoni [5] described subdermal liposuction as a method to treat flaccidity of the skin after conventional liposuction, which would allow retraction of the skin; nevertheless, other authors have reported that the procedure can produce

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abnormal retractions and irregularities [2]. The first report of using liposuction to enhance the musculature, also known as “muscle etching,” came from Mentz [6]; later, Hoyos [7, 8] systematized and expanded the technique, establishing the concept of high-definition liposculpture (HiDef Lipo) by adding the systematic use of ultrasound to achieve better tissue retraction and later replicating the technique in the gluteus, arms and lower limbs [9–12].

In our experience, HiDef Lipo provides excellent outcomes in selected patients, but it is not exempt from local and systemic complications. The aim of this article was to describe surgical outcomes with a special emphasis on complications with the use of this technique.

Patients and Methods

After obtaining institutional review board approval, a historical cohort of patients who underwent HiDef Lipo, performed by two senior surgeons, was reviewed. Clinical data were obtained by examining clinical records, discharge summaries and clinical notes. The authors collected data on demographic information, including age, and body mass index, the types of surgery performed and postoperative complications. The follow-up data included photographs and medical assessments over 2 years.

The outcomes included the patient satisfaction rate and complications. The patient satisfaction rate was evaluated with a non-structured interview regarding patient satisfaction.

Complications were classified as local or systemic. Local complications were defined as hyperpigmentation, nodular fibrosis, Mondor’s syndrome, seroma, localized infections, persistent sensitive alterations, unnatural appearance and poor definition body contouring. The incidence and severity of complications were evaluated. Medical and surgical treatment was evaluated and discussed.

Systemic complications were defined as systemic infections, thromboembolic events, septic shock and death.

Patient Selection Criteria

The patients selected for this technique were ASA I or II. A maximum body mass index (BMI) of 26 kg/m² for women and 28 kg/m² for men was selected; because HiDef Lipo aims to be a sculpting procedure, appropriate patients without an excessive amount of fat or skin laxity were chosen to obtain good results (8). Patients with a higher weight were referred to a nutritionist for diet-related treatment until an adequate weight was obtained. Supraumbilical, flank and back skin laxity were evaluated. In cases of low and moderate skin laxity, HiDef Lipo combined with other skin resection procedures (e.g.,

abdominoplasty or mini abdominoplasty) to treat the excess skin was planned [12]. HiDef Lipo was not performed in patients over 60 years of age given the high risk of complications. Patients with massive weight loss were not included because of severe skin laxity.

Preoperative Markings

Preoperative markings were made focusing on the patient’s superficial anatomy to achieve natural results. Different colors were used to reinforce preoperative planning. Debulking (deep liposuction), definition (superficial liposuction) and addition (fat grafting) areas were marked separately [7, 8, 12] (Fig. 1 and video 1).

To facilitate preoperative marking, patients were requested to perform isotonic and isometric body movements. Arm contraction, back hypertension, abdominal flexion and knee flexion–extension are activated state maneuvers. In cases of incorrect abdominal wall contraction, the patient was requested to perform abdominal crunches to adequately palpate the rectus abdominis muscle borders and metamers [14, 15].

Technique

All patients were operated on by two senior surgeons under general anesthesia, thermic blankets and intermittent pneumatic compression. Superficial and deep tumescent infiltration was performed using a solution composed of 1000 mL of normal saline, 1 mg of epinephrine 1:1000 and 250 mg of tranexamic acid [16].

Emulsification was performed with an ultrasound lipoplasty system (VASER) [17] in the same order as the infiltration at 70% power in pulse mode in areas of very thin skin, such as the inner arms and thighs. Fifty percent power was used in selected patients. Seventy percent power in pulse mode was used in the superficial and deep layers of the back and abdomen. As an alternative to VASER, a 980-nm laser (700 J/15 cm²) was used to reinforce retraction along the definition lines (e.g., the infraumbilical area). This technology was used instead of VASER not as a coadjuvant therapy. Skin retraction was observed in the early postoperative period.

Debulking areas were treated using 3.4- to 4-mm Mercedes cannulas. In definition areas, 3.0–4.0 cannulas were used according to the surgeon’s preference. Pieces of 1-inch-thick sponge (Reston, 3M) were placed on the definition areas (Fig. 2). Pressure garment therapy was used in all patients for 3 weeks, day and night, followed by 3 weeks only during the day.

Gluteal augmentation with autologous fat transfer was performed according to Mendieta’s technique [18]. Closed drains were inserted through pubic incisions to drain the

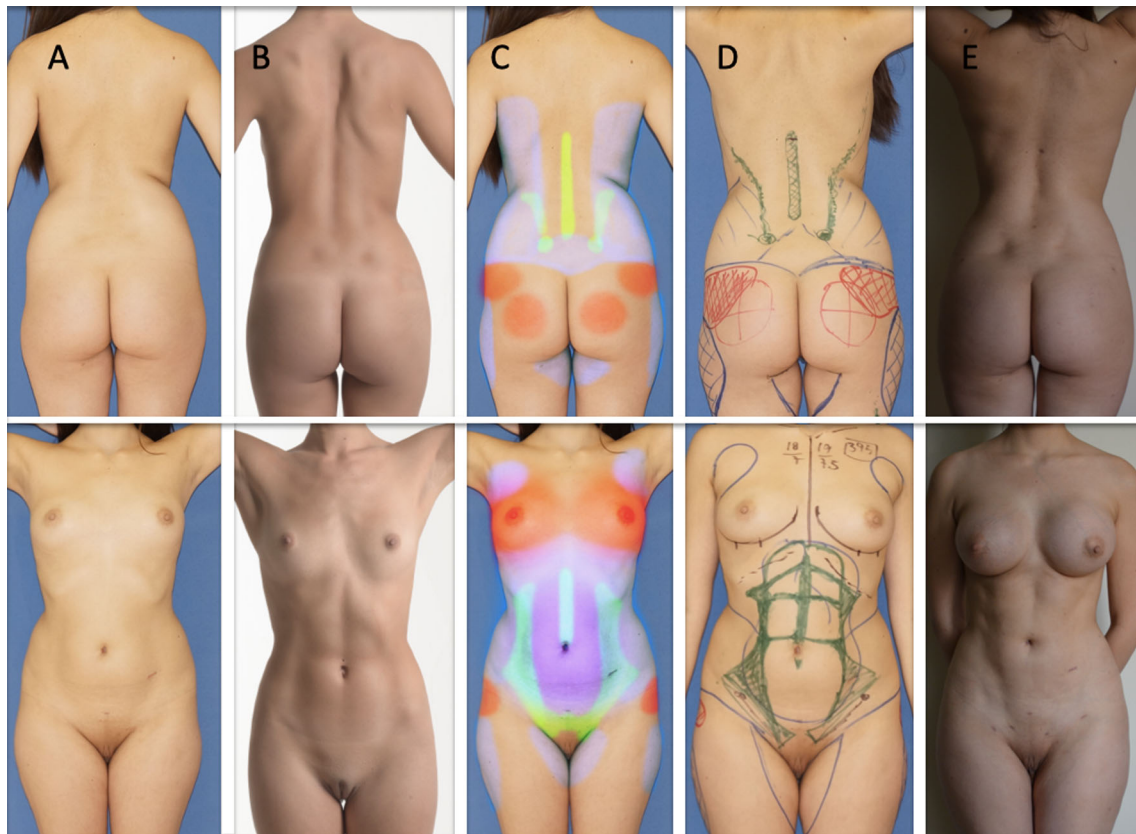


Fig. 1 In (a), a typical patient is shown. In (b), a young athletic female model is shown as a control to highlight the surgical endpoints that should be pursued in a typical patient (a). Preoperative digital planning (c) and markings (d). To “transform” the patient (a) to the model (b), deep fat must be extracted from the blue areas (c). In the green areas, superficial liposuction must be performed to highlight

muscle impressions. In the red areas, volume can be added to improve the body contour. (e) shows the results at 1.5 years after HiDef liposuction of 4000 cc of fat and gluteal augmentation with 600 cc of fat grafting per side combined with breast augmentation surgery using 350 cc anatomical high-profile polyurethane implants



Fig. 2 Soft foams (Reston[®], 3M) were placed on definition lines to improve the effective pressure and decrease the seroma rate

semilunaris and inguinal regions. Umbilical ports were sutured loosely to achieve fluid output. Drains were removed when the output was less than 30 mL/day (3–7 days after surgery). Thromboprophylaxis with elastic stockings and intermittent pneumatic compression were used intraoperatively in all patients.

Postoperative Method

Forty milligrams per day of enoxaparin sodium was administered 12 h after surgery and maintained for 5–6 days to prevent thromboembolic events.

A trimodal analgesic therapy based on acetaminophen at 1 g three times a day, celecoxib at 200 mg twice a day and pregabalin at 75 mg twice a day was used. Tramadol or ketorolac was used as rescue treatment. Lymphatic drainage (Vodder and Leduc techniques) and external ultrasound (moderate intensity, 3 MHz) were initiated on the first postoperative day and continued for 10 days.

Results

Demographics

A total of 417 high-definition liposculpture procedures were performed. Overall, 83 (20%) patients were women and 333 (80%) were men. The average age at surgery was

38 years. The body mass index at the time of high-definition liposculpture was 25, with an average height of 1.75 m and a weight of 75 kg. The average follow-up duration was 2 years. Primary liposuction and secondary liposuction were performed in 308 (74%) and 109 (26%) patients, respectively. Combined surgeries were performed in 121 (29%) patients. Details of the surgical procedures are shown in Table 1.

The mean surgical time was 1.5 h in cases of anterior abdominal liposuction. In patients who required definition of the whole trunk, arms and thighs, the average time was 4 h. Six hours was the average time in combined surgeries.

Outcomes and Complications

In the 417 operated patients, the most frequent complication was hyperpigmentation ($n = 276$, 66.18%), followed by seroma ($n = 125$, 29.97%) and nodular fibrosis ($n = 83$, 19.9%) (Figs. 3, 4). No systemic complications were recorded. A list of complications is shown in Table 2.

Seroma was present in 125 (29.97%) patients. All seromas responded to percutaneous drainage without the need for surgical treatment. The average aspiration volume was 30–40 mL, and 3 aspirations were needed to resolve each case. The suprasternal and interpectoral areas were the most commonly affected body parts for males, while the lower abdomen and sacral areas were the most commonly affected body parts for females.

Transient nodular fibrosis was present in 81 (19.42%) patients. It usually appeared during the 4th–6th week postoperatively and resolved spontaneously after 2 or 3 months. None of the patients presented with localized infections or permanent sensitivity alterations.

Poor definition with superficial liposuction (Fig. 5) was observed in 16 (3.83%) patients, and an unnatural body contour appearance was observed in 17 (4.07%) patients. Two patients required secondary liposuction to correct irregularities. Secondary procedures were performed during the postoperative consultation, under local anesthesia.

Three (0.71%) patients had VASER-related burns in the dorsal area (Fig. 6). They were treated conservatively with dimethyl sulfoxide ointment (to improve local circulation) and depigmentation ointment.

Mondor's syndrome occurred in 2 (0.47%) patients (Fig. 7). Both patients underwent HDL and mastopexy with a prosthesis, and the syndrome solved spontaneously.

The patient was satisfied with the surgical outcome in 392 (94%) cases.

Discussion

HDL is a reproducible, safe and effective method for body contouring [7–13]. Current reports support HiDef Lipo as a precision body contouring technique that enhances aesthetic results through improving body definition. Combined procedures have been previously described. Hoyos et al. [9, 10, 12] reported natural results with a dynamic definition approach to liposculpting and fat grafting for arm and body contouring. The same group [13] described a successful combined technique consisting of ultrasound-assisted liposuction with abdominal definition, abdominoplasty and neoumbilicoplasty to avoid the stigmata of lipectomy. In our experience, no systemic complications were observed, and the most frequent complications were local and not serious.

Sixty-six percent of patients had hyperpigmentation. Of them, transient hyperpigmentation was predominant (59.95%) and presented during 6–8 months after surgery. It was treated with topical 4% hydroquinone and recovered completely. Twenty-six patients had permanent hyperpigmentation, most likely due to hemosiderin deposits. Cutaneous hyperpigmentation was observed in definition lines. Permanent hyperpigmentation presenting in definition lines can be explained by hemosiderin deposits [19], friction exerted on the incision by the cannula and pressure induced by the compression garments. This complication has been reported by other authors [2, 8, 20]. Kim et al. [2] performed an analysis of postoperative complications of

Table 1 Description of surgeries performed in a total of 417 patients

Procedure	No. of procedures	Percent of patients
Primary liposuction	308	74
Secondary liposuction	109	26
Combined surgeries	121	29
Abdominoplasty	67	16
Abdominoplasty and mastopexy with implants	26	6
Breast augmentation with implants	16	4
Abdominoplasty and breast augmentation with implants	9	2
Gluteal implants	2	0.5
Gluteal implants and breast augmentation with implants	1	0.2

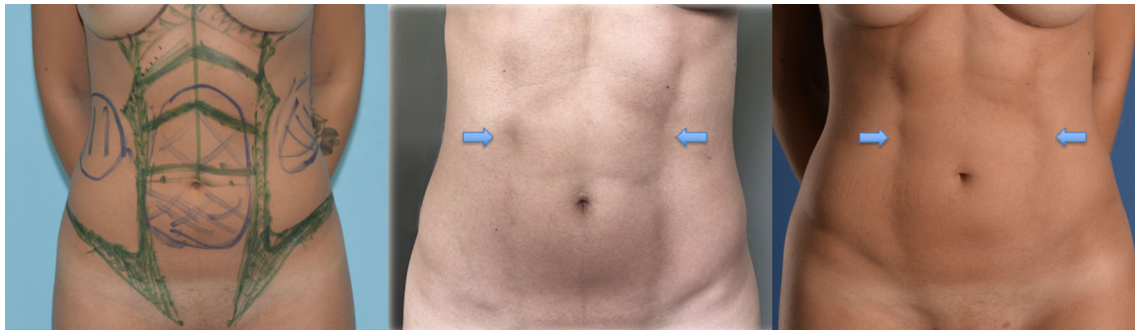


Fig. 3 Hyperpigmentation. **a** Preoperative markings of a patient undergoing HiDef liposuction. The green marks correspond to areas in which superficial liposuction must be performed. **b** Transient hyperpigmentation (blue arrows) at 2 months after surgery that was

treated with hydroquinone. Notice that hyperpigmentation is present along all definition lines where superficial liposuction was performed. **c** Long-term results at 12 months showing the absence of hyperpigmentation and good aesthetic results

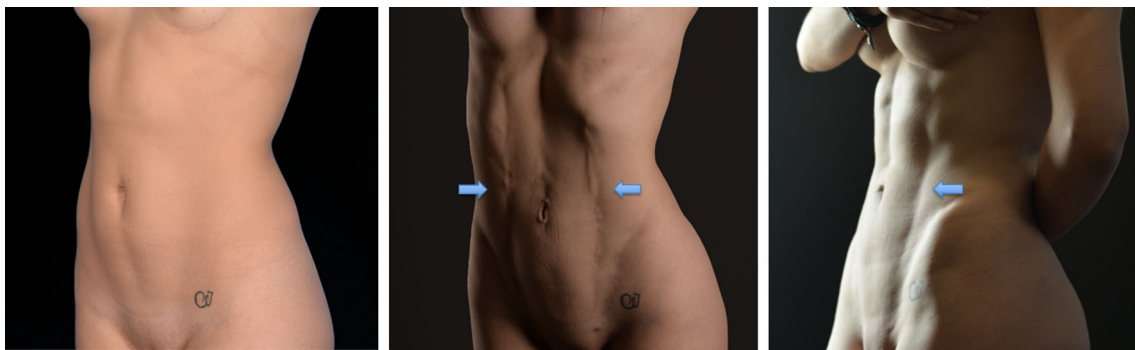


Fig. 4 Nodular fibrosis. Different lighting was used to highlight the fibrosis and final result. **a** Preoperative photograph. **b** Postoperative results at 2 months showing nodular fibrosis on the anterior abdominal wall (blue arrows). **c** Final results at 1 year with nodular fibrosis resolved

Table 2 Complications associated with high-definition liposculpture

Complications	<i>n</i> (%)
Systemic complications:	0 (0%)
Local complications	
Hyperpigmentation	
Transient:	250 (59.95%)
Permanent:	26 (6.23%)
Seroma:	125 (29.97%)
Nodular fibrosis	
Transient:	81 (19.42%)
Permanent:	2 (0.47%)
Localized infections:	0 (0%)
Permanent sensitive alterations:	0 (0%)
Lack of definition:	16 (3.83%)
Unnatural appearance:	17 (4.07%)
VASER-related burns:	3 (0.71%)
Mondor's syndrome:	2 (0.47%)

superficial liposuction in 2398 patients and observed 36 (1.5%) cases of hyperpigmentation without providing

details regarding the time or location of occurrence. Hoyos et al. [8] reported two cases of skin pigmentation secondary to superficial liposuction in the inner thighs, most likely due to over resection. We think that hyperpigmentation is a consequence of superficial liposuction and energy and should therefore be expected in most of the patients in this series. We believe that patients with Fitzpatrick skin type II–IV are more likely to present hyperpigmentation. This potential complication could be detrimental for the doctor–patient relationship if not properly discussed in the preoperative consultation. Special care and prompt treatment are mandatory in these cases. We use mild ointments, such as 2–3% hydroquinone, to prevent hyperpigmentation in high-risk cases (Fitzpatrick II–III) and treat hyperpigmentation with custom blends of commercially available creams, such as Tri-Luma (fluocinolone acetonide 0.01%, hydroquinone 4%, tretinoin 0.05%, Galderma).

In our study, postoperative seroma was the second most frequent complication and occurred at a higher incidence than that in other reports [2, 8, 13]. Postoperative seroma in HiDef Lipo patients may be due to aggressive liposuction in high-definition areas, transection of the fibrous septum in the superficial fat layer or lymphatic system damage during liposuction, and heat produced by energy-based liposuction

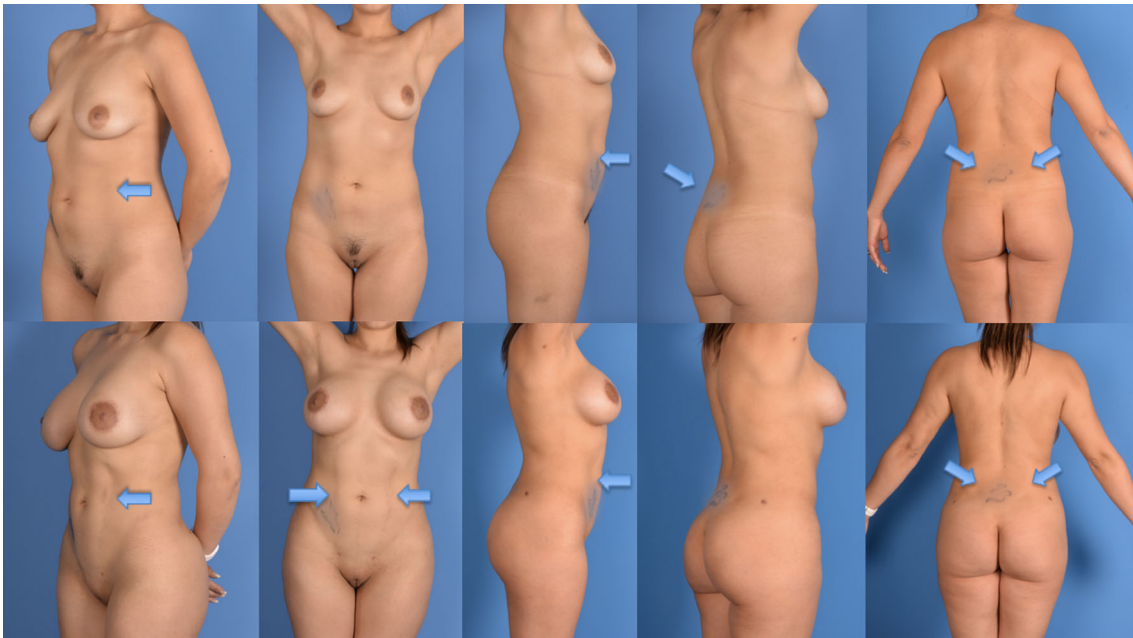


Fig. 5 Poor definition despite VASER use and overall good liposuction results (blue arrows)

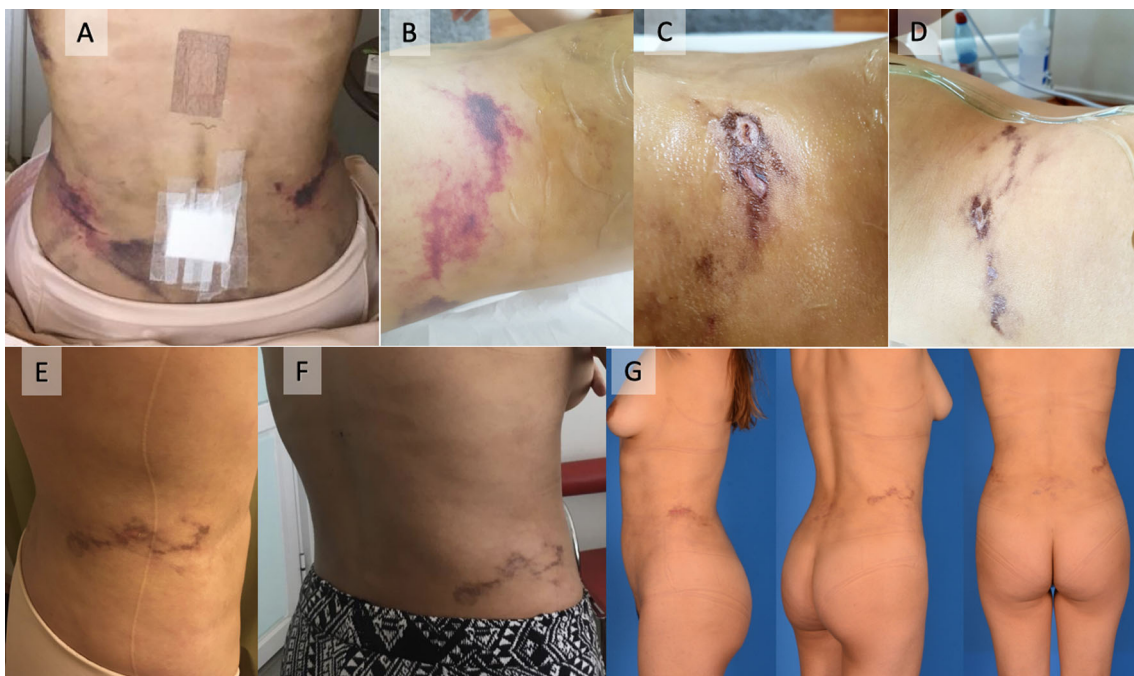


Fig. 6 VASER-related burns despite it being used according to the protocol: 70% power in pulse (VASER) mode, 60 s/100 mL of fluid. From left to right and top to bottom: photographs at 48 h (a), 1 week

(b), 2 weeks (c), 3 weeks (d), 2 months (e), 4 months (f), 6 months (g), postoperatively are presented. Photographs (a) to (f) were submitted by the patient. The scars completely resolved after 1 year

[7, 8, 13, 21, 22]. Furthermore, in this series, 24% of the patients underwent abdominoplasty and HDL; therefore, the seroma rate could be overestimated. To prevent postoperative seroma, all patients underwent treatment with lymphatic drainage and external ultrasound. Based on our clinical experience, we believe that the early initiation of

these therapies in the postoperative period may improve patient recovery and decrease pain and edema.

Twenty percent of patients had nodular fibrosis. All cases were in the semilunar line and linea alba of the abdomen. In our study, the incidence was higher than that in previous reports [23]. Nodular fibrosis usually appears as



Fig. 7 **a** Photograph submitted by the patient showing right Mondor's syndrome. **b** Long-term postoperative results without Mondor's syndrome

a fibrous string in the linea alba and semilunaris between the 4th and 5th postoperative weeks and spontaneously resolves after 3–6 months in most cases. This complication can greatly decrease patient satisfaction and raise deep concerns about the surgical results. It is crucial that the surgeon inform patients prior to surgery that this complication could occur and will likely resolve without any significant intervention.

Two patients had permanent nodular fibrosis and required corticoid treatment to reduce the degree of scar inflammation [24]. A solution was prepared with 20 mg of triamcinolone (Atrinat, Laboratory Ever Pharma GmbH, Jena, Germany), 3 mg of betamethasone sodium phosphate and 3 mg of betamethasone acetate (Cidoten Rapilento, Laboratory MSD, NJ, USA) in 10 mL of saline. Each fibrotic line was treated 2 times 4 weeks apart. After the intervention, the fibrosis was significantly reduced, and good postoperative results were achieved. We believe that permanent nodular fibrosis is produced by the aggressive resection of all fat layers, causing adhesions from the dermis to the aponeurosis muscle layer.

Based on our experience, we believe that nodular fibrosis can be prevented by avoiding aggressive cannula use, performing liposuction 1 or 2 mm deep into the dermis, and avoiding scratching the deep dermis with the cannula. Early compression, massage and thorough drainage of seromas in that area also could prevent this complication. If the fibrosis does not resolve within 6 months, steroid treatment should be initiated promptly.

Thirty-three patients had poor definition or unnatural results. All of them had been overweight and/or had skin laxity, causing a negative effect on the surgical outcome. We strongly discourage operating on this type of patient unless another skin resection procedure is performed (e.g., tummy tuck or RAFT lipoabdominoplasty) [12–14].

In this large series, the patient satisfaction rate was very high. However, patient satisfaction was not measured in a standardized fashion using patient-reported outcomes (PROs), such as the Body-QoL[®] or others [25–28], because the present study is a retrospective review. Nevertheless,

we consider HiDef Lipo to be the current high-end surgery for body contouring.

Conclusion

HiDef Lipo is a safe, reliable and successful body contouring technique. The complication rate may be high, but most complications can be adequately resolved.

Transient nodular fibrosis is an underestimated complication that may compromise the short- and midterm aesthetic results and therefore must be clearly disclosed to patients, especially patients who work with their bodies (e.g., models and body builders).

In summary, we recommend the following considerations to obtain optimal results with HiDef Lipo:

1. Select patients carefully. Patients with abdominal wall flaccidity will have poor results unless a skin resection procedure is also performed. In HiDef Lipo surgery, the surgeon chooses the patient, not vice versa.
2. Inform patients about the high probability of skin changes (fibrosis and/or hyperpigmentation) after liposuction and the delay in achieving definitive results. Patients seeking short-term results (less than 3 months) should be warned about this potential complication. This is especially important in patients who work with their bodies, such as models or dancers.
3. Perform anatomical marking through static and dynamic palpation of the musculature. Predefined patterns are highly discouraged. If it is not possible to palpate a muscle group, it is better not to define it. There is no linea alba below the umbilicus, and there is no semilunaris above the costal margin.
4. Monitor blood loss during surgery, avoid hypothermia and perform thromboprophylaxis.
5. Avoid over resecting fat in the anterior abdomen since the area is very prone to fibrosis and seroma and therefore unnatural results. In general, a flap of 8–10 mm and 5–10 mm is left over the rectus abdominis and flanks, respectively.
6. Initiate early compression, lymphatic drainage, ultrasound and rigorous drainage of seromas in definition lines.
7. Use local compression of the linea alba and semilunaris lines for 2 weeks after surgery to reinforce definition areas.
8. If hyperpigmentation or fibrosis is diagnosed, we recommend early treatment with depigmentation ointment and compression massage, respectively.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed Consent For this type of study, formal consent is not required.

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