INTRODUCTION

Several patients who present sagging skin and localized fat deposits in the abdomen, resulting from age or previous pregnancy, follow a regular routine of physical exercises and dieting. However, even under this strict routine, they do not manage to obtain an abdominal contour definition. These individuals demonstrate a certain limitation in revealing muscle outlines, mainly due to disproportion or disconnection between the skin and subcutaneous elements and the muscle components of the abdominal wall. Therefore, definition liposuction alone will not achieve an ideal result in these patients, due to the fact that the skin may remain lax and may not shrink properly over time.

In this context, many devices have been used to promote and enhance skin retraction after liposuction, including ultrasound-assisted liposuction, power-assisted liposuction, and laser-assisted liposuction. These technologies, which use external sources of energy and allow skin retraction, may increase the chances of local complications when compared with regular suction-assisted liposuction (SAL),1–3 and are insufficient to meet these patients’ expected results.

In 2001, Saldanha et al,4,5 using the term “lipoabdominoplasty” for the first time, standardized a selective undermining and combination of both procedures. This procedure combines two traditional techniques, abdominoplasty and liposuction, with the advantage of removing excess fat using liposuction, while promoting adequate skin tension through its traction and removal. It also has the advantage of correcting any existing hernia or rectus diastasis in the same procedure.4,5

However, in this kind of patient, the classic Saldanha’s lipoabdominoplasty may not be enough to achieve the desired athletic look, since the amount of liposuction is limited, as is the flap thickness, detachment, and advancement. The medium definition abdominoplasty could be considered a version of this procedure, based on creation of thinner flaps with a wider subcutaneous undermining not limited by the central tunnel as described by Saldanha. The purpose of this article is to evaluate the results using a validated objective grading system for aesthetic outcomes proposed by Strasser and the safety of the medium definition abdominoplasty.

METHODS

This was an interventional, retrospective study from a single center, carried out over 36 months (September

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Three hundred fifty-one patients underwent medium definition SAL and abdominoplasty. The body fat index (BFI) was chosen for evaluating this population, rather than body mass index (BMI), because it defines the ideal candidates for medium definition liposuction. Patients with low BFI usually exercise regularly, at least three times a week. Therefore, these patients have high levels of muscular mass, which may increase the BMI due to the high lean body mass, without necessarily reflecting the percentage of body fat.

The BFI was calculated using a skinfold caliper in seven locations: the triceps (the back of the upper arm); pectoral region (the mid-chest); subscapular region (beneath the edge of the shoulder blade); midaxillary regions (midline of the side of the torso); abdomen (next to the belly button); suprailiac region (just above the iliac crest of the hip bone); and quadriceps (middle of the upper thigh). Two measurements of each site were taken and averaged.

Inclusion Criteria
1. Patients with hypertrophic and palpable rectus abdominis muscle.
2. BFI of 22.5% or less.

Surgical Technique: Medium Definition Liposuction and Abdominoplasty
The goal of medium definition liposuction is to outline the abdominal muscles in patients by removing the fat in the muscle transition zones (the tendinous intersections of the linea alba, linea semilunaris, and rectus abdominis muscle), revealing and enhancing the deep anatomy and muscular topography, with no need for the use of any external energy device. The approach is based on near total fat removal and continuous compression of key areas of the skin by customized handcrafted pads placed in strategic areas of the abdomen, producing well-controlled fibrosis between the muscle transition zones and the skin over the course of 30 days.

This guided fibrosis will create a smooth and long-lasting muscle definition. Without the use of energy devices for skin tightening, patient selection for medium definition liposuction is limited to fit patients with mild fatty deposits and good skin quality, which is needed for the desired aesthetic final result.

Skin Markings
Skin markings were guided by palpation of the muscular tendinous intersections of the rectus abdominis muscle, linea alba, and linea semilunaris.

Suction-assisted Liposuction
SAL/superficial liposuction was performed under regional anesthesia (epidural block) and sedation. The tumescent technique was performed with a 3-mm cannula at a concentration of 1:300,000 epinephrine to achieve adequate vasoconstriction. Four hundred eighty milliliters were injected in the dorsum and 400 ml were injected in the abdomen. The waiting time before starting the liposuction was 15 minutes.

A regular perforated liposuction cannula with three holes in line, one side of the tube (sizes 3, 3.5, and 4 mm) was used to perform liposuction. This cannula design is very important to spare the subdermal plexus during the superficial liposuction (Fig. 1).

The liposuction starts with the patient in a prone position and it is performed using a 360 lipo approach. After the dorsum liposuction is complete, the patient is positioned in a supine position and the surgeon starts debulking the deep layers of fat with 4-mm cannulas and then continues toward the mid-lamellar layer and between the muscle groups with 3.5-mm cannulas. Additional superficial liposuction was then performed to define the relevant anatomy for the abdominal muscle groups by using a 3-mm cannula facing the deep subcutaneous tissue. It is very important to not use the canullas with the holes facing up to the dermis. Otherwise, there could be subdermal plexus damage. In this approach, there was no need for specific protection of the subcostal vessels. The result is a quite thin flap (around 0.6 cm), covering the deeper muscle anatomy.

To create natural and delicate transition zones between the abdominal muscles, a 3.5-mm cannula was used to

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**Takeaways**

**Question**: How to create abdominal definition without sculpt fat.

**Findings**: It is possible to create abdominal definition based on muscle volume combined with thin flaps.

**Meaning**: The medium definition abdominoplasty is capable of exposing the muscle anatomy, creating thinner flaps than the conventional techniques.
create smooth surfaces and to clean the eventually sharp edges, preventing hard lines.

Abdominoplasty

Abdominoplasty was performed, after liposuction, by an incision at the suprapubic area (6 cm from the furcula vaginalis) and tissue detachment up to the xiphoid process, through a tunnel beyond lateral edges of the rectus muscle whenever necessary to achieve adequate tissue release with no tension nor rejections. It is a primary difference from Saldanha’s approach, since there’s no need to get stuck to a central “tunnel” to spare the fasciocutaneous perforator vessels (Fig. 2). It is important to highlight the importance of the subdermal plexus preservation, during the liposuction, given the flap thickness, because it is the main source of tissue perfusion. After the abdominal flap undermining, a vertical plication was performed on the anterior rectus sheath, bringing the medial edges of the recti muscle together. An additional horizontal plication was made on the suprapubic region, at the end of the vertical plication. This results in a plication with the aspect of an inverted “T.” Plication was made in two layers (the first with 2.0 nylon with separated stitches, and the second with continued suture with Vicryl 1). After the plication, progressive tension sutures were done (around 20 separated Vicryl 0 stitches) from the flap into the muscular wall.

Customized Abdominal Pads

Compression is one of the main points of medium definition liposuction. Right after the procedure, customized handcrafted cotton and gauze pads were prepared in the operating room and placed on specific sites of the abdomen to produce localized pressure areas of contact between the skin and the underlying fascia. These customized pads were covered with semi rigid cardboard, which was placed over the anterior abdomen. A traditional liposuction compression garment was placed over the cotton pads and cardboard.

After 48 hours, patients removed the original compression pads and received a removable custom compression pad. This second compression pad/second compression garment could be removed in order for the patient to bathe normally and then was repositioned. It was recommended to be used by the patient for at least 1 month after surgery. The use of these shaping pads is critical for achieving the best long-term aesthetic results.

Cosmetic Evaluation

All patients have been evaluated through digital photograph, by two independent senior board certified plastic surgeons, using a validated objective grading system for aesthetic outcomes proposed by Strasser, at least 12 months after the operation.

THE GRADING SYSTEM

This system is based on the concept that perfection is the lack of imperfection. The result is graded based on the identification of imperfections or flaws that deviate from the ideal. All potential flaws can be classified under one of the five possible flaw categories: malposition, distortion, asymmetry, contour deformity, and scar. Each flaw category is graded for serious variety: perfect, noticeable, obvious, and obvious and deforming. Each severity level is assigned a value: perfect, 0 points; noticeable, 1 point; obvious, 5 points; and obvious and deforming, 15 points. The total points under the flaw categories are added for the total score. A perfect result has 0 flaws and gets a score of 0. Scores of 1 to 4 are good results, 5 to 14 are moderate, and 15 or greater are poor.

RESULTS

Three hundred fifty-one patients who underwent medium definition SAL and abdominoplasty were evaluated through digital photograph analysis by Strasser scale. (See table, Supplemental Digital Content 1, for patient profiles. http://links.lww.com/PRSGO/C69.)

All patients were female, and the mean age of the patients was 34.7 (28–43). The follow-up evaluation was performed at 12 months, postoperatively, for all of the patients. The average BFI was 19.9% (18%–22%). Three hundred forty-one patients were postpartum (97.1%).

Aesthetic Surgery Outcomes

According to the Strasser Scale, 326 patients (93%) had good and excellent results. Twenty-two patients

Fig. 2. Transilluminated abdominal flap, to show the undermining.
had moderate results, and three patients (0.8%) had poor results.

The most frequent complications (n = 17, 4.8%) are listed in Table 1. There was one case (0.2%) of partial flap necrosis, which was treated in a hyperbaric chamber for 20 sessions, presenting a favorable outcome and no need of surgical revision. There were no infections.

Results can be seen in Figures 3–6: Figure 3 for case 1, Figure 4 for case 2, Figure 5 for case 3, and Figure 6 for case 4, all with a 12-month follow-up.

## DISCUSSION

Several patients, even following a strict routine of physical exercises and dieting, do not manage to acquire a well-defined and athletic abdomen. This limitation occurs mainly due to the disproportion and disconnection between the skin, subcutaneous and muscle elements of the abdomen wall. In such cases, even when there is localized muscle hypertrophy obtained with regular exercising, the contours are not perceived, since the saggy skin and the fat that cover the region hinder this perception. This characteristic also prevents the patient from obtaining the benefits of definition liposuction alone, since it would worsen skin sagging.

For this specific population, medium definition liposuction combined with abdominoplasty is indicated, which is an evolution of the technique described by Saldanha. A better connection between the elements that cover the abdominal wall is provided. Removal of skin excess followed by plication of the myo-aponeurotic layer generates the necessary tension on skin that allows visualization of the edges of the muscles of the abdomen. The conventional lipoabdominoplasty can create pleasant results, but has limitations in fat removal when compared to medium definition liposuction abdominoplasty. The author believes that the medium definition liposuction can produce thinner flaps capable of revealing the deeper muscle layers more efficiently than the traditional technique.

There are several liposuction techniques combined with abdominoplasty that promote muscle definition, with variable results. “High-definition liposuction” has become synonymous with any type of etching during liposuction, regardless of the use of external energy devices and definition grading. However, VASER-assisted high-definition liposculpture (VAHDL) is a specific technique that was created by Hoyos. Not all high-definition liposuction procedures follow the original technique, nor do they create a high level of definition.

The surgical use of ultrasound or LASER has been advocated for boosting skin tightening during liposuction, facilitating the creation of variable degrees of muscle definition. Both technologies have shown a great capacity for eliminating fat and are a good indication for secondary cases, facilitating fat removal and potentially decreasing bleeding and causing less swelling and bruising. On the other hand, a higher rate of thermal injury, dyschromia, and seroma occur, as well as a prolonged procedural time when compared to regular SAL. These rates may be even higher when these external energy sources are combined with undermining, thinning and traction of skin flaps in abdominoplasty. Laser lipolysis is related to an overall complication rate of 0.93%, mostly dyschromias and skin burns. The other complications such as edema, ecchymosis, and pain can be compared to SAL. Hoyos suggests, even recommends, delayed neo umbilicoplasty when there is 1, high flap tension; 2, flap discoloration or congestion; 3, a thick flap with more liposuction required; 4, additional definition is performed, or planned for a second procedure; 5, inverted T flap closure or inadequate flap descent; 6, high scar positioning; 7, secondary or revision

### Table 1. Complications List

| Complications          | n = 17 (4.8%) |
|------------------------|--------------|
| Seroma                 | 8 (2.2%)     |
| Dyschromia             | 1 (0.2%)     |
| Skin irregularities    | 2 (0.5%)     |
| Hypertrophic scar      | 3 (0.8%)     |
| Hematoma               | 2 (0.5%)     |
| Partial flap necrosis  | 1 (0.2%)     |

![Fig. 3. Abdominal definition obtained with the medium definition technique. A 34-year-old female patient, BFI 15%, preoperatively (A), B, Twelve months postoperatively.](image)
Fig. 4. Abdominal definition obtained with the medium definition technique. A 37-year-old female patient, BFI 19.8%, preoperatively (A). B, Twenty-four months postoperatively.

Fig. 5. Abdominal definition obtained with the medium definition technique. A 39-year-old female patient, BFI 21.8%, preoperatively (A). B, Twelve months postoperatively.

Fig. 6. Abdominal definition obtained with the medium definition technique. A 36-year-old female patient, BFI 19%, preoperatively (A). B, Twelve months postoperatively.
lipectomy is performed. This approach, suggested by Hoyos, demonstrates clearly that the use of external energy in abdominoplasty can improve the complication rates and demands extra care.

The medium definition liposuction abdominoplasty is different from VAHDL, as it is based on a near total fat removal, with SAL, in key areas, and on continuous post-operative compression by customized handcrafted pads, producing well-controlled fibrosis between the muscle transitions. This guided fibrosis will create muscle definition, replacing the role of external energy devices in skin retraction. The authors observed that this type of approach produced predictable and reproducible results in the selected population.

Furthermore, not using external energy allows for an even more superficial liposuction, with the creation of thinner flaps than those obtained from technologies that use energy, in a safer way. These flaps, being quite thin, contribute to an intense reshape of these patients’ body contours, creating athletic and natural results (Fig. 7). In 2017, Danila described a technique to improve results in standard lipoabdominoplasties, using fat transfer directly to the rectus abdominis muscle. This approach shares the same principles of the medium definition liposuction, which means, revealing the deeper muscle wall anatomy through a thinner subcutaneous layer created by SAL. The authors believe this to be one of the main reasons to favor medium definition liposuction in cases of definition abdominoplasty (Fig. 8). Besides that, there is no need for the surgeon to use expensive devices, depending on disposables, software upgrades, and maintenance fees.

The creation of these “super-thin” flaps is just possible given the use of a specifically designed liposuction cannula, as described before. This way, the surgeon can go quite superficially, removing the fat and sparing the subdermal plexus. The subdermal or cutaneous plexus is considered to be the junction between the deep reticular portion of the dermis and the underlying subcutaneous fat tissue. The subdermal vessels have a kind of axialiarity that plays an important role in the development of a thin flap. Several thin flaps in the abdominal region have been
reported since Imanishi et al.\textsuperscript{14} proposed the concept of thin flap in 1988. Knowledge of the characteristics of the subdermal plexus, particularly of the direction of blood flow, may be critical for designing thin flaps, since this plexus is the remaining and the main source of flap vascular nutrition in the medium definition abdominoplasty. Furthermore, the authors do not recommend the use of any type of external energy in these types of flaps, at the risk of tissue damage and safety issues.

Proper patient selection is key for consistent results of medium definition abdominal etching liposuction.\textsuperscript{1} Patients with a regular exercise routine, muscular hypertrophy, and a low BFI are ideal candidates for medium definition liposuction abdominoplasty. The more fat that is removed, the larger the imbalance between continent (skin) and content (fat). The challenge is to obtain the optimal proportion between fat and skin removal.

The Strasser Scale was used to validate overall aesthetic results. The end result is based on the identification of imperfections or flaws that deviate from the ideal. All potential postsurgical flaws can be classified under one of five possible flaw categories: malposition, distortion, asymmetry, contour deformity, and scar.

The benefits of this grading system include the easy identification of deficiencies and result in easy implementation of a plan to eliminate the flaw in the future. It increases the critical observational acumen of the surgeon. It helps in the evaluation of the surgical procedure it relates to the end result. It improves as a result and it improves our ability to communicate results within our profession in a meaningful way.

According to the scale, most results were considered good or excellent, which means that the medium definition liposuction approach is a safe technique with few undesirable fibrosis, retractions, or distortions. The authors believe that this low incidence of complications in thin flaps is due to the nonuse of external energy devices combined with liposuction and the use of postoperative compression pads.

The authors consider that the level of definition obtained after surgery can vary from patient to patient, directly depending on their abdominal muscle hypertrophy, since the variable elements that priorly covered the muscle contours (skin and fat) have been partially removed or corrected. Some patients have shown a low grade of muscle definition after the procedure, due to their lack of local muscle hypertrophy. Even so, this occurrence did not compromise the overall aesthetic outcome, given the fact that the overall abdominal look appeared more athletic with less palpable and visible fat. This finding was very important, demonstrating that a high degree of abdominal definition is not mandatory for a pleasant, athletic and natural result. This study has limitations in evaluating long-term results and how the thinner flaps behave after weight gain and pregnancies.

CONCLUSIONS

The approach has been successful in a selected population of athletic patients. Medium definition liposuction combined with abdominoplasty has shown to be effective, safe, and reproducible for most patients.

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