

Abdominal Etching: Surgical Technique and Outcomes

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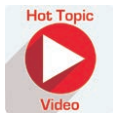
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Background: The ideal body is characterized by a muscular physique and defined anterior abdominal wall. Despite diet and exercise, many are unable to achieve this desired result. Liposuction with abdominal etching is used to achieve high-definition abdominal aesthetics. The etching technique is performed with liposuction in a superficial plane, to create indentures consistent with “six-pack abs,” or definition of vertical abdominal lines.

Methods: The authors’ abdominal etching preoperative markings, surgical technique, and postoperative care are discussed. The surgeons’ experience with abdominal etching in 50 consecutive patients is reviewed, including rate of complications and patient satisfaction.

Results: The average patient age was 36.4 years. We had an almost equal number of men ($n = 26$) and women ($n = 24$), with an average body mass index of 26.7 kg/m^2 . The average blood loss was 275 ml, the average tumescence was 6 liters, and the average lipoaspirate was 5 liters. There were no major complications such as fat embolus, deep venous thrombosis, or intraabdominal injury. The most common minor postoperative complications were contour irregularities (12 percent), seromas (10 percent), and hyperpigmentation (2 percent). The majority of patients were satisfied (98 percent). The average length of postoperative follow-up was 27 months.

Conclusions: Abdominal etching is a safe and effective method of creating a defined anterior abdominal wall for patients who desire the muscular definition of vertical abdominal lines. Almost all of our patients reviewed were satisfied with this procedure, maintained long-term results, and had an acceptable rate of complications. (*Plast. Reconstr. Surg.* 143: 1051, 2019.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

In Western culture, the well-toned body with muscular definition is considered highly desirable. Among desired features, men and women often strive for defined, anterior abdominal wall musculature, or “six-pack abs.” Vigorous exercise and tightly controlled diets, however, are not always enough to provide men and women with the desired appearance of their abdominal muscles. Plastic surgery has become a readily available option for those seeking improvement of their abdominal musculature appearance. Liposuction “abdominal etching”—the removal of fat through lipoaspiration from specific and defined subcutaneous planes with the goal of improving body

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contour and appearance—has become increasingly popular among patients seeking a more muscular-appearing, well-defined abdomen and trunk.

The notion of removing fat from localized body sites is not a new idea. Charles Dujarrier performed the first known attempt to remove subcutaneous fat through a small incision using a uterine curettage of a dancer from the Folies Bergere.¹ Unfortunately, Dujarrier injured the femoral artery, leading to the amputation of one of the dancer's legs. Schrudde reported curetting subcutaneous fat from the lower leg through a small incision in 1972.^{1,2} However, blind aggressive undermining using a sharp curette resulted in lymphatic leaks, hematomas, and skin necrosis.^{1,2}

Modern liposuction began with the techniques of Arpad and Giorgio Fischer in the 1970s.^{1,2} Although they were the first to add suction to facilitate fat extraction, their instruments were sharp, resulting in complications.¹ Ulrich Kesselring introduced the idea of working in the deep fat compartment above the muscle fascia. Kesselring still used sharp instrumentation with suction, but achieved better outcomes than previously presented because of his restrictive patient selection: young female patients with a small amount of localized fat and elastic skin.¹

In 1980, Yves Gerard Illouz introduced the use of blunt instrumentation to remove fat while preserving other structures between the dermis and muscle fascia. He also started using a wet technique, infiltrating 200 to 300 ml of hypotonic saline and hyaluronidase solution before aspiration.^{1,2} By the 1980s to 1990s, an increasing number of residency programs included training courses and live operations, popularizing the procedure.

Modern liposuction relies on small, blunt-tip cannulas, often with multiple side ports to allow for efficient removal of adipose tissue, and aspiration units to provide effective suction. Power-assisted liposuction provides benefits from the standpoints of manual labor and surgeon fatigue. Such advancements in instrumentation decrease injury to the blood vessels, therefore decreasing bleeding. The use of tumescence, a diluted solution of lidocaine with epinephrine, revolutionized liposuction, because of decreased blood loss and less pain postoperatively. The common complications previously associated with liposuction, including bleeding, wound infection, and seroma/hematoma formation, became less common.^{2,3}

Mark Gilliland first described abdominal etching by liposuction along the linea semilunaris, linea alba, and transverse inscriptions of the rectus abdominis muscle while preserving the fat over the central muscle body of the individual

rectus abdominis muscles, bordered by the muscular inscriptions, to accentuate the appearance of this musculature.⁴⁻⁶ This high-definition liposculpture technique involves differential liposuction to create desirable details of the abdominal musculature of the abdomen, trunk, and pelvis.^{5,7,8} Our technique describes the abdominal, pelvic, and serratus anterior detail. Hoyos and Millard described generalized deep liposuction that debulks the deeper fatty tissues, whereas more superficial liposuction highlights natural grooves.⁸ Adequate liposuction of the flanks contributes to abdominal aesthetics by creating a V-shaped trunk, leading to a well-defined waist. Steinbrech and Sinno provide a detailed account of their use of selective lipocontouring with fat grafting in men to create a more natural-appearing muscular abdomen.⁹ Overall, this article provides a comprehensive overview of our abdominal etching technique with the use of power-assisted liposuction and a case series highlighting surgical outcomes and postoperative management.

PATIENTS AND METHODS

Surgical Technique

Patient Selection and Preoperative Counseling

This article conforms to the Declaration of Helsinki. The best results are achieved on patients who have a relatively healthy diet and who exercise regularly. However, the patient may have certain resistant areas of fat that hides the desired muscular definition. The patient's height, weight, and body mass index should be taken into consideration. A previous history of liposuction must be discussed during the consultation, as the resultant fibrosis can negatively impact results. Etching combined with abdominoplasty should be avoided because of an increased risk of skin necrosis and wound complications. In contrast, abdominal etching can be safely performed in conjunction with other procedures such as gynecomastia and autologous buttock fat transfer operations.

Once it is established that abdominal etching is the best surgical option for the patient, a detailed physical examination and careful evaluation of the patient's anatomy should be performed.¹⁰ This identifies differences in intrinsic anatomy, such as deviation from ideal contour, scars, asymmetry, dimpling, and cellulitis. Skin tone and elasticity are especially important to note, including identification of striae and any stretched or excess skin. These can sometimes be a contraindication to liposuction and may be better suited for a skin

excisional procedure. A key part of the examination is a pinch test that can be used to differentiate how much fat is subcutaneous versus intraabdominal. The patient should be counseled that only subcutaneous fat will be improved, and any resultant protuberance is usually the result of intraabdominal fat. The surgeon should also examine for any external scars and/or hernias. Imaging on primary cases has not typically been indicated, because the procedure remains superficial within the subcutaneous plane. If there is any question of abdominal wall fascial deformity or hernias, a computed tomographic scan of the abdomen and pelvis with oral contrast should be obtained. This will determine the presence and location of any abdominal wall hernias, in addition to any previous mesh placements because of prior operations. Ultrasound can be used but lacks the anatomical detail compared to a computed tomographic scan. Ultimately, computed tomographic scans are not operator dependent, in comparison with ultrasound imaging. Before obtaining informed consent, patients should be counseled on potential risks of seroma, hematoma, bruising, pigmentation changes (mostly temporary), deep venous thrombosis, pulmonary or fat embolus, contour irregularity, and intraabdominal injury or perforation.

It is integral to discuss with the patient beforehand that the incisions will be left open to drain serosanguineous fluid for 1 to 2 days after the procedure. Jackson-Pratt drains are also an option, and have been used on a few patients in our case series. The prevention of seroma complication is a key technical issue, as even small seromas can obliterate the sought-after muscular definition, and lead

to poor results. The patient is counseled that most of the swelling resolves in the first 2 weeks, but the final aesthetic appearance continues to improve gradually over the course of 2 to 3 months.

Indications

The indications for abdominal etching include lipodystrophy of the abdomen and flanks, and poor definition of the abdominal aesthetic “lines.”

Preoperative Markings

Begin by standing the patient up in the preoperative holding area (Fig. 1). Ask the patient to tense his or her abdomen while you identify and mark semilunar lines on either side of the abdomen, and the midline linea alba. Palpate for the location of transverse inscriptions of the rectus abdominis muscle and mark them with horizontal lines. Typically, the lowest line is at the level of the umbilicus, with two other more superior horizontal lines. Mark the iliac crest to create iliac crest indentation lines. Mark any excessive flank lipodystrophy that needs to be addressed to enhance overall trunk contour and a narrowed waist. Serratus anterior lines may also be marked out for patients desiring ultra high definition. (See Video 1, Supplemental Digital Content 1, which demonstrates how to draw preoperative markings for six-pack abdominal etching, <http://links.lww.com/PRS/D354>.)

Intraoperative Description

This procedure is performed under general anesthesia (Fig. 2). Prophylactic intravenous antibiotics are given, and standard tumescence (30 ml of 1% lidocaine plus 1000 ml of normal saline plus 1 ml of 1:1000 epinephrine) is infiltrated into the areas to be liposuctioned after the patient

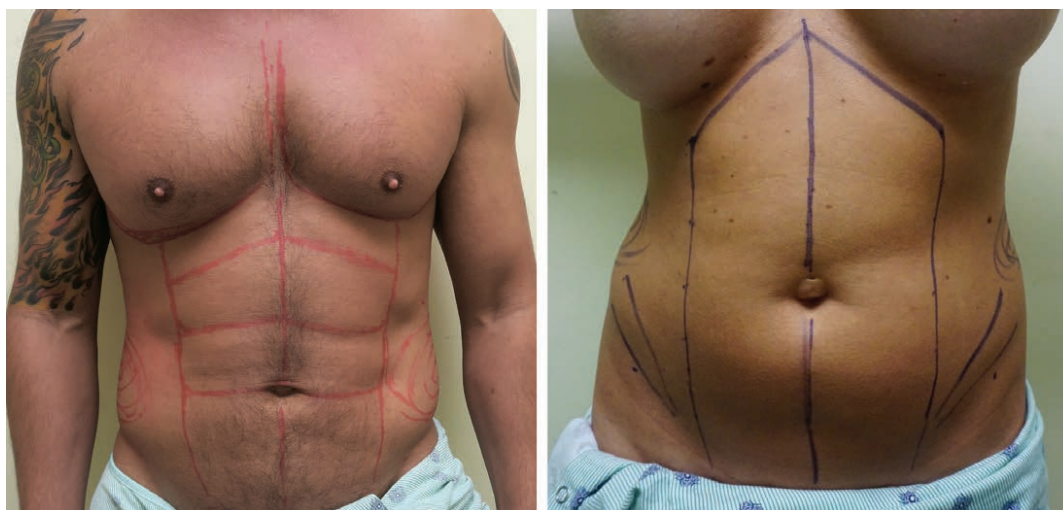
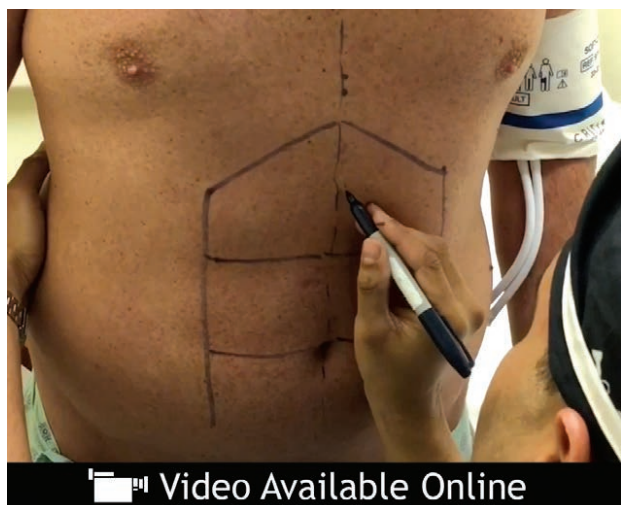


Fig. 1. (Left) Frontal view of preoperative markings in a male patient. (Right) Frontal view of preoperative markings in a female patient.



Video 1. Supplemental Digital Content 1 demonstrates how to draw preoperative markings for six-pack abdominal etching, <http://links.lww.com/PRS/D354>.

is prepared and draped in a sterile manner. If needed, the liposuction is started in the prone position to address flank lipodystrophy. Midline incisions in the area of the bra line at the thoracic level in women and above the gluteal cleft are used when prone. Then, the patient is placed in the supine position for liposuction of the anterior flanks and abdomen. (See **Video, Supplemental Digital Content 2**, which demonstrates the surgical technique in bringing the liposuction cannula superficially to the dermis level, to create an “etching,” or indenture accentuating the patient’s native six-pack lines in the abdomen, <http://links.lww.com/PRS/D355>.)

For our standard technique, a total of six incisions are commonly used: one at the superior umbilicus, and three in the lower abdominal crease along the linea alba and semilunaris lines. Two far lateral incisions are also used to assist in etching the horizontal lines. These are typically at a lower thoracic/upper lumbar level. The flanks or “love handle” areas are accessed from a supine position by means of the lower lateral abdominal incisions if significant posterior flank liposuction is indicated, and a decision is made not to start the patient in the prone position. As our technique progressed, we have adopted the use of a bent cannula to access the inscriptions from our umbilical incision, thereby avoiding the need for the two lateral incisions. In female abdominal etching, we have been also able to access the upper abdominal inscriptions from inframammary breast augmentation incisions. The use of longer cannulas allows us to place the abdominal incisions below

the belt or the bikini line, thus making them even more inconspicuous.

Power-assisted liposuction of the deep layers of the abdomen and flanks is performed using a no. 5 Mercedes cannula. Curved long cannulas are helpful for liposuction of the flanks. Long cannulas are also helpful for accessing the superior abdomen from the lower abdominal incisions. Power-assisted liposuction with a blunt-tip cannula (no. 4 or 5) is used to create the linea alba, semilunaris, and iliac crest lines using the lower abdominal incisions by bringing the cannula superficially next to the dermis. To perform this controlled contour irregularity to “etch” the abdomen, it is necessary to perform liposuction right under the dermis in the superficial fat layer. As liposuction in this layer can theoretically cause thermal injury, we limit the cannula passes to a maximum of 10 passes before we move on to another inscription or vertical line before returning to etch this area again. We also use power-assisted liposuction, and avoid VASER (vibration amplification of sound energy at resonance), to minimize thermal injury.

It is useful to use two fingers to pinch the area to be suctioned, followed by guidance of the cannula into the pinched area. In men, the six-pack effect is created by using the two far lateral incisions or bent cannulas to “etch” the horizontal lines. Depending on the patient’s particular desires, the degree of etching can be adjusted. If the patient desires a softer appearance, we perform shallow indentures. In contrast, for a “harder” and more defined etch, a deeper indenture or grooves can be created. There are typically three rows of horizontal lines, with one far right and one far left incision to etch the upper two lines. The umbilical incision is used to etch the lowest (third) horizontal line. The definition of the iliac crest lines is achieved by suctioning in a triangular area in the region of the anterior superior iliac spines of the pelvis. Our technique does not include rectus abdominis fat grafting, as most of our patients did not desire a fat-grafted appearance in their abdominal wall. We feel that with our etching technique, fat grafting of the rectus muscle would not be necessary for added definition. Lastly, the incisions are left open (1 to 1.5 cm) to allow for drainage and prevent seroma/hematoma formation. However, when expecting excessive drainage, drains are sometimes used. Dry gauze and abdominal pads may be placed over the incisions.

The etched lines are maintained by placing compression over the etched areas. TopiFoam (Mentor-Aesthetics, Irvine, Calif.) is cut to size over the etched areas into thin strips 1 cm in width



Fig. 2. (Above, left) Frontal intraoperative view of incisions in a male patient. (Above, right) Frontal intraoperative view of incisions in a female patient. (Below, left) Intraoperative view with TopiFoam in place for a male patient. (Below, right) Intraoperative view with TopiFoam in place for a female patient.

to ensure the skin sticks down to the abdominal wall (Fig. 2, below). Larger pieces of TopiFoam are placed on top of the existing ones for more uniform compression. An abdominal binder is used to secure the TopiFoam compression.

Postoperative Care

As with any liposuction patient, we encourage early ambulation (ideally, on the day of surgery) and adequate oral intake of fluids. The abdominal

binder with TopiFoam is worn for 2 to 3 days until initial drainage has stopped. After that point, a compression garment is worn at all times for 2 weeks and part-time (approximately 12 hours/day) for an additional 2 weeks.

The compression garment is extremely important in the abdominal etching patient, as even minor seromas can have a disastrous consequence with regard to the desired results. Patients are followed postoperatively by a multidisciplinary team,



Video 2. Supplemental Digital Content 2 demonstrates the surgical technique in bringing the liposuction cannula superficially to the dermis level, to create an “etching,” or indenture accentuating the patient’s native six-pack lines in the abdomen, <http://links.lww.com/PRS/D355>.

including a registered dietician, with an emphasis on sports nutrition and a personal trainer to maintain long-term results. The following figures demonstrate our high-definition results that can be maintained in the long term with adherence to our postoperative regimen (Figs. 3 through 6). Light exercise such as upper body weights and lower body weights can be started after 2 weeks, because many of the patients already work out and are eager to do so postoperatively. Heavy exercise (which involves core and/or trunk) and running are delayed until 4 weeks postoperatively. Basic

laboratory values are obtained that include endocrine and hormonal blood levels. Furthermore, genetic markers, anthropometrics of the patient, and exercise data are obtained. A metabolic cart performance test is then performed to obtain the resting energy expenditure. This helps determine calories expended in a day and substrate use (e.g., fat, carbohydrate), breathing patterns, resting heart rate, and respiratory rate. The performance component of the test evaluates specific heart rate zones to help prevent high levels of stress and promote fat oxidation during aerobic exercise. Based



Fig. 3. Preoperative frontal view (*left*) compared to image obtained 1-year postoperatively of a male patient with abdominal etching plus concomitant gynecomastia correction and deltoid/biceps augmentation (*right*).



Fig. 4. (Above) Preoperative frontal view (*above, left*) compared to image obtained 4 years postoperatively of a male patient with six-pack abdominal etching (*above, right*). (Below) Preoperative oblique view (*below, left*) compared to image obtained 4 years postoperatively in a male patient with six-pack abdominal etching (*below, right*).

on these results in combination with patient goals, a customized nutrition and exercise plan is created to maintain long-term results, up to 6 years postoperatively in our series.

RESULTS

Fifty consecutive patients who underwent abdominal etching performed by the surgeons were included in the case series. The average age of patients was 36.4 years (range, 21 to 55 years). We

had an almost equal number of men and women (26 men and 24 women), with a nonobese, average body mass index of 26.7 kg/m² (range, 18.8 to 38.0 kg/m²). Intraoperatively, the average estimated blood loss of patients was 275 ml (range, 50 to 900 ml); 6 liters (range, 2.7 to 11 liters) of tumescence solution was used on average in each case. The average lipoaspirate from patients was 5 liters (range, 0.5 to 9 liters). Of our 50 abdominal etching patients, there were four with concomitant correction of gynecomastia, eight cases



Fig. 5. Preoperative frontal view (*left*) compared to a photograph obtained 1 year postoperatively of a male patient with six-pack abdominal etching with well-defined hip lines (*right*).



Fig. 6. Preoperative frontal view (*left*) compared to a photograph obtained 6 months postoperatively of a female patient with vertical line etching and defined hip lines (*right*).

of autologous buttock fat transfer (Brazilian butt lift), five cases of secondary/tertiary breast reconstruction, and two cases of fat grafting to the deltoids and biceps. Other areas of liposuction performed outside of the central abdomen during the abdominal etching procedure included the back, flanks, and thighs. Patient satisfaction was determined objectively during follow-up clinic visits. The majority of patients were satisfied [49 of 50 (98.0 percent satisfaction rate)] and would have the procedure performed again. Average length of follow-up was 27 months, with the longest follow-up being 65 months with maintained aesthetic result.

We defined a major complication as a return to the operating room or a major systemic event requiring inpatient admission. This would include hematoma, deep venous thrombosis, pulmonary embolism, fat embolus, or intraabdominal entry. Our series of patients had a 0 percent major complication rate.

In addition, we defined a minor complication as an event that could be managed in an outpatient setting. Of our 50 consecutive patients, 11 (22 percent) demonstrated a minor complication. Our series had six contour irregularities, all minor, as 98 percent of our patients were overall happy with their results. Of the six contour irregularities, three improved over time to the point that patients did not request any further treatment. One of the female patients requested a long-term filler for softening of an overetched linea alba and was happy with that result. Another patient was initially happy with her result, but gained weight 1 year later. She complained of “puffiness” in between her vertical lines. Revision minor liposuction was performed in the office and she was happy with that result. The last contour irregularity, requiring further treatment, was a male patient who had a seroma that, after resolution, resulted in a “crooked” horizontal line. This was improved with revision minor liposuction in the office, followed by small-volume fat

grafting (<10 cc). Five patients (10 percent) had seromas, all of which were managed conservatively in the office by aspiration or percutaneous drain placement, without a return to the operating room. Only one patient had a seroma that led to a contour irregularity; the remainder of the complications occurred independent of each other. We also had one case (2 percent) of hyperpigmentation, which improved over time. It should be noted that all of these minor complications were managed in an outpatient setting that did not require a return to the operating room or an inpatient admission. We had no thermal injuries or full-thickness burns (although one may consider hyperpigmentation a minor burn).

A patient survey was created based on Salles et al. for generation of a clinical score scale to objectively measure outcomes of aesthetic surgery of the abdomen.¹¹ This outcomes assessment scale was developed as a tool striving for standardization of outcomes following aesthetic surgery. The five parameters in the scale include abdominal volume, contour, skin excess, appearance of the navel, and scar quality of the abdominal wall. The authors found the scale to be sensitive for identifying different anatomical abnormalities in the abdomen and an effective tool for various surgical techniques of abdominoplasty and liposuction. Qualtrics software (Qualtrics, Provo, Utah) was used to create the survey. Patients were asked to complete the survey by means of an online link or over the phone. Twenty-eight patients (56.0 percent) completed the survey following their procedure. A majority of patients reported no bulging of abdomen [20 of 28 (71.4 percent)], a well-defined waist [23 of 28 (82.1 percent)], no skin excess or sagging [19 of 28 (68.0 percent)], nearly imperceptible scar [22 of 28 (78.6 percent)], and a natural appearing umbilicus [24 of 28 (85.7 percent)]. Most were satisfied with the procedure [27 of 28 (96 percent)].

DISCUSSION

The objective of this study was to provide a comprehensive overview of the current state of abdominal etching; describe surgical technique, postoperative management, and evaluation of postoperative outcomes; and discuss complications in 50 consecutive patients who have undergone abdominal etching. Our technique describes synergized detailed knowledge of anatomy, with meticulous markings and precise liposuction in varying planes to create desired results. This case series profiles 50 consecutive patients

who underwent abdominal etching. The patients exemplify that the procedure can be performed with optimal aesthetic results and minimal postoperative complications. Common complications of liposuction include seromas, bruising/pigmentation changes, and contour deformities. Seromas are managed with aggressive aspiration and compression, to prevent obliteration of the sculpted indentures. More serious complications include infection, lidocaine toxicity caused by tumescent solution, anemia, hypovolemic shock, thromboembolism, and death.¹² However, these secondary risks were not encountered in our series, highlighting the relative safety of performing this procedure. Illouz evaluated postoperative complications in over 3000 cases performed over 5 years, and found surgical complications to be minimal bleeding, and rare occurrences of hematoma, seroma formation, and infections.¹³ In a later article, Illouz describes contour irregularities as another potential complication.¹⁴ Kim et al. evaluated postoperative complications of 2398 patients who underwent superficial liposuction between 1995 and 2008. The average age of patients was 42.8 years, the average body mass index was 27.9 kg/m², and the mean volume of aspiration was 5045 cc. The authors found an overall complication rate of 8.6 percent (206 patients). The most common complications were contour irregularities (71 patients), seroma formation (54 patients), hyperpigmentation (36 patients), asymmetry (18 patients), hypertrophic scar (15 patients), chronic induration (six patients), skin necrosis (four patients), and infection (two patients).¹⁵

These authors experienced similar minor postoperative complications, namely seroma formation, contour irregularities, and pigmentation changes. All patients were managed in an outpatient office setting. The seromas were managed either with aspiration or reopening of an incision with insertion of a Penrose drain. The authors were very aggressive in identifying seromas to avoid separation of the dermis from the underlying abdominal wall, which would distort the etched lines and create contour irregularities. The contour irregularities were corrected in the office with small-volume liposuction and/or fat grafting.

CONCLUSIONS

Our article presents a surgical abdominal etching technique that will possibly guide other plastic surgeons who are interested in replicating this relatively new procedure. Furthermore, the case series is integral to understanding the safety

of the procedure, and useful for fellow surgeons who may use these data to appropriately counsel patients on the potential risks and complications during the consent process. We also highlight our extensive postoperative management, with the addition of a multidisciplinary nutrition and personal training team with the goal of maintaining long-term results and retaining their newly etched abdominal muscles. Abdominal etching challenges certain traditional plastic surgery principles, such as liposuction in the superficial layer. However, this study shows that liposuction can be performed in a safe and effective method with desirable aesthetic results in both male and female patients.

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