Outcome Analysis of Combined Lipoabdominoplasty versus Conventional Abdominoplasty

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Background: Abdominoplasty and liposuction have traditionally been separate procedures. The authors performed a retrospective cohort study to evaluate the outcomes of a novel single-stage approach combining extensive lipoplasty with a modified transverse abdominoplasty.

Methods: One hundred fourteen patients were evaluated for abdominal contouring. Patients were categorized into four groups: group I ($n = 20$) received abdominal liposuction only, group II ($n = 33$) traditional W-pattern incision line abdominoplasty, group III ($n = 30$) modified transverse incision abdominoplasty, and group IV ($n = 31$) combined procedure involving widely distributed abdominal liposuction accompanied by inverted V-pattern dissection abdominoplasty. Wound complications, patient satisfaction, and revision rates were compared statistically.

Results: Group I (liposuction alone) experienced an overall complication rate of 5 percent; two patients were dissatisfied (10 percent) and underwent further revision with full abdominoplasties. Group II (traditional W-pattern abdominoplasty) had a complication rate of 42 percent, a dissatisfaction rate of 42 percent, and a revision rate of 39 percent. By comparison, group III (modified low transverse abdominoplasty) had a complication rate of 17 percent, a dissatisfaction rate of 37 percent, and a revision rate of 33 percent. Group IV (combined liposuction plus abdominoplasty) had significantly lower complication, dissatisfaction, and revision rates (9, 3, and 3 percent, respectively).

Conclusions: Modified transverse abdominoplasty combined with extensive liposuction and limited paramedian supraumbilical dissection produced fewer complications and less dissatisfaction than did traditional abdominoplasty. This may be attributable to a reduced tension midline closure in the suprapubic region, less lateral undermining in the upper abdomen, and greater preservation of intercostal artery blood flow to the flap. (*Plast. Reconstr. Surg.* 121: 1821, 2008.)

Functional abdominoplasty was first described by Kelly in 1899[1] and popularized for cosmetic purposes in 1967 by Pitanguy,[2] who introduced the low transverse (i.e., bikini line) incision that could remove lower abdominal scars. Since this time, abdominoplasty procedures have rapidly gained popularity, with 102,497 being performed in 2004, an increase of 510 percent from 1992 levels and an increase of 24 percent from 2002 levels.[3,4]

During this period, surgeons focused increased attention on reducing complications. Local complications such as hematoma, seroma, wound dehiscence, and skin necrosis occur in up to 32 percent of nonsmokers and as many as 52 percent of smokers.[5] As such, greater effort has been set forth to define the vasculature of the abdomen to limit these complications. Huger[6] de-

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Received for publication August 5, 2006; accepted November 29, 2006.
The first two authors contributed equally to the production of this article.

DOI: 10.1097/PRS.0b013e31816b1350

Disclosure: *None of the authors has any financial interests in the companies producing or distributing products used for this study.*

scribed three vascular territories of the abdominal wall: zone 1 ranges from the xiphoid to the pubis between the lateral borders of the rectus abdominis and is supplied by the superior and inferior epigastric arteries; zone 2 is the trapezoidal area defined by anterosuperior iliac spine superiorly and by the groin inferiorly—its blood supply is from the superficial inferior epigastric, superficial circumflex iliac, and external pudendal arteries (superficial system) and from the deep inferior epigastric vessels (deep system); zone 3 is the area of the lateral abdomen and flanks and is supplied by the segmental lumbar, subcostal, and intercostal arteries. Traditional formal abdominoplasty with its low transverse incision and wide undermining to the costal margin sacrifices zone 1, zone 2, and to a limited extent zone 3. Furthermore, the skin of zone 1 experiences additional vascular compromise caused by tension on the suture line and thinning of the abdominal flap. Thus, many surgeons have proposed less extensive approaches to abdominoplasty in an attempt to maintain adequate vascularity,[7–11] but the best aesthetic outcomes remain with the classic abdominoplasty.

To improve contour, liposuction has been offered to abdominoplasty patients, but as two independent procedures separated in time by at least 6 months.[12–14] Caution concerning the advisability of such an approach was based on the belief that the traumatic forces of liposuction would limit the vascularity of the flap and thereby increase complications. Matarasso[15,16] studied the safety areas for lipoplasty combined with abdominoplasty and recommended limited and cautious liposuction of the epigastric and mesogastric areas (zone 1) with full type 4 abdominoplasty. With advances in superficial liposuction,[17] Saldanha et al.[18] performed lipoplasty of the abdomen, sparing the epigastric and mesogastric areas, followed by an abdominoplasty with rectus muscle plicature, and found a complication rate no higher than that of a formal abdominoplasty. In a study performed by Lockwood,[19] patients who underwent high lateral tension abdominoplasty and superficial fascial system repair with and without liposuction experienced complications that did not exceed historical controls. In 2006, the most recent survey of 497 surgeons reveals that 56 percent of surgeons perform some sort of liposuction with a full abdominoplasty but also stresses the need to differentiate complication rates in patients who received liposuction with their abdominoplasty versus those who did not.[20]

In this study, we performed a retrospective cohort study comparing outcomes among four groups: group I, abdominal liposuction alone; group II, traditional W-pattern abdominoplasty; group III, modified transverse abdominoplasty; and group IV, combined liposuction and abdominoplasty. The combined approach is a novel procedure in which liposuction is performed throughout the entire abdomen including the epigastric and mesogastric areas, followed by a modified transverse abdominoplasty.

PATIENTS AND METHODS

Between September of 1998 and May of 2005, 114 patients seeking abdominal contouring were evaluated and operated on at Yale University Cosmetic Clinic by one senior author (J.P.). Data were taken from charts of patients with mean follow-up of 9 months postoperatively. Those patients with good skin and muscle tone or those who refused formal abdominoplasty were categorized into group I (n = 20) and received abdominal liposuction alone. Patients in the remaining groups were indistinguishable preoperatively (i.e., they all had excess fat in the upper and lower abdomen and excess skin laxity in the supraumbilical and infraumbilical regions, and typically had poor muscle tone of the abdominal wall). Patients were categorized based on the procedure performed: group II patients (n = 33) underwent a W-pattern abdominoplasty, group III patients (n = 30) underwent a modified transverse incision (i.e., non–W-pattern) abdominoplasty, and group IV patients (n = 31) underwent a combined procedure with abdominal liposuction and inverted V-pattern abdominoplasty. The maximum hip flexion allowed at operation was 30 degrees in all patients undergoing abdominoplasty.

Outcomes

Complications were recorded either as local wound complications or as generalized complications after surgery. Wound complications included wound infection, partial wound dehiscence, seroma, hematoma, and skin edge necrosis. Generalized complications included deep vein thrombosis, pulmonary embolus, ileus, sensation disorder of the skin of the thighs, nerve palsies of the upper extremities, and death. Patient satisfaction was assessed based on a binary yes/no scale at the longest postoperative follow-up point within 0.5 to 1.5 years. Revision rates were coded by whether patients subsequently underwent an additional abdominal contouring procedure to improve results from the prior operation.

Surgical Procedures

For all procedures, preoperative markings were made with the patient standing.

Group I: Lipoplasty

Lipoplasty was performed using a superwet technique with stab incisions along the lower abdomen, injection of tumescent Klein's solution (1 liter of lactated Ringer's solution, 50 cc of 1% lidocaine, and 1 cc of 1:100,000 epinephrine solution), and 3.7-mm Mercedes tip cannulas. Attention was given to the epigastric and flank regions for improved contouring, and incisions were closed with 5-0 monofilament resorbable suture. Postoperative compression garments were worn for 6 weeks.

Group II: W-Pattern Abdominoplasty

Traditional lower abdominal W-pattern abdominoplasty[21,22] was performed by incising along the inferior border of the skin flap to be removed and then undermining superiorly to the sternal (xiphoid) margin and overlapping the costal margins for a distance of approximately 5 cm. Rectus plication was performed if indicated. The umbilicus was transposed and overlapping, excess skin removed. The wound was closed symmetrically using 2-0 and 3-0 monofilament resorbable suture with two Jackson-Pratt drains in place. No compression garments were worn until drains were removed 10 to 14 days after surgery, when serum drainage was less than 15 cc per 24 hours.

Group III: Modified Transverse Abdominoplasty

The modified low transverse procedure was performed by incising along the superior border of the skin flap to be removed and undermining superiorly and inferiorly with this incision as described by Matarasso.[15,16] Modifications were made such that undermining in the superior direction extended to the xiphoid, with limited dissection over the medial ribs. Dissection in the inferolateral groin region was carried out in a plane slightly superficial to Scarpa's fascia to preserve lymphatic drainage. The superior flap was then pulled inferiorly, overlapping the inferior section, and trimmed to ensure low-tension closure of the skin flap. Rectus plication was performed if indicated. The umbilicus was transposed and the wound closed symmetrically using resorbable monofilament sutures with two Jackson-Pratt drains in place. Drain removal and compression garment use are described above (group II).

Group IV: Combined Lipoabdominoplasty

The combined procedure was performed starting with liposuction followed by inverted V-pattern abdominoplasty. Stab incisions were made in the skin flap to be removed. Tumescent Klein's solution (1 liter of lactated Ringer's solution, 50 cc of 1% lidocaine, and 1 cc of 1:1000 epinephrine solution) was infused to adequate skin turgor (superwet technique). Suction lipectomy was performed with Mercedes tip 3.7-mm cannula in all areas of the abdomen and flanks including the epigastric and mesogastric areas until adequate contouring and removal of fat and liquid was achieved (fat thickness, approximately 1 cm). The abdominoplasty was performed by incising along the superior border of the skin flap to be removed and dissecting down to the fascial layer. The umbilicus was defined, preserving a small cuff of periumbilical rectus stalk fat. Dissection was carried superiorly through the transverse incision up to the xiphoid, but importantly, with limited lateral dissection, to 7.5 cm from the midline, to preserve perfusion from the lateral flanks (zone 3). Dissection was then carried inferiorly in a suprafascial plane into the superomedial groin, where dissection is shifted superficial to Scarpa's fascia, thereby preserving lymphatic channels in this region. The superior flap was overlaid above the inferior flap (with maximum flexion at the hips of 30 degrees) to determine placement of the inferior incision for resection and low-tension closure. The umbilicus was transposed to the superficial flap as in groups II and III. The wound was then closed with the same postoperative care as in groups II and III.

Statistical Analysis

The patient demographics of the four groups were compared using analysis of variance for age, body mass index, and infusion; chi-square analysis was used for smoking and surgical history. The summarized data are listed in Table 1. There were no statistically significant differences among the four groups in terms of mean age, mean body mass index, mean tumescent used (when applicable), presence of abdominal scars, and smoking history (Table 1). Fisher's exact test was used to compare the complication rates and dissatisfaction rates among the groups (Table 2). All statistical tests were performed with a two-tailed significance level set at $p < 0.05$.

RESULTS

The complications experienced for each group are listed in Table 1. No generalized complications occurred for any of the groups. Significant differences for wound complications, however, were

Table 1. Demographic Information, Medical History, and Complication, Dissatisfaction, and Revision Rates of the Four Groups*

	Group I, Liposuction Alone ($n = 20$)	Group II, W-Pattern Incision Abdominoplasty ($n = 33$)	Group III, Modified Low Transverse Abdominoplasty ($n = 30$)	Group IV, Combined Lipoabdominoplasty ($n = 31$)
Age, years				
Mean ± SD	38.5 ± 9.5	40.6 ± 9.7	37.8 ± 9.1	35.2 ± 8
Range	31–55	24–67	25–58	19–62
BMI				
Mean ± SD	27.7 ± 2.5	28.3 ± 3.7	27.2 ± 4.1	28.2 ± 6.1
Range	24.1–31.9	22.5–38.3	22.3–35.7	19.9–39.3
Smoking	2 (10%)	7 (21%)	6 (20%)	8 (28%)
Prior surgery	10 (50%)	17 (52%)	15 (50%)	14 (45%)
Infusion fluid (Klein's), cc				
Mean ± SD	2015 ± 924	N/A	N/A	1655 ± 505
Range	800–4500	N/A	N/A	1001 ± 3000
Aspirate, cc		N/A	N/A	
Mean ± SD	917 ± 660	N/A	N/A	974 ± 562
Range	200–2700	N/A	N/A	150–2500
Wound complications	1 (5%) (sterile stitch abscess, $n = 1$)	14 (42%) (dehiscence, $n = 6$; seroma, $n = 5$; abscess infection, $n = 2$; scar hypertrophy, $n = 2$; cellulitis, $n = 1$; hematoma, $n = 1$)	5 (17%) (seroma, $n = 2$; marginal necrosis, $n = 1$; severe pain, $n = 1$; umbilical deformity, $n = 1$)	3 (9%) (cellulitis, $n = 1$; dehiscence and slough, $n = 1$; seroma, $n = 1$)
General complication	0%	0%	0%	0%
Dissatisfaction	2 (10%)	14 (42%)	11 (37%)	1 (3%)
Revision	N/A	13 (39%)	10 (33%)	1 (3%)

BMI, body mass index; N/A, not applicable.
*The revision rates are closely related to the dissatisfaction rate.

Table 2. Complication and Dissatisfaction Rates Using Pairwise Comparisons of Fisher's Exact Tests

	Complication Rate (%)	Group	*p*	Dissatisfaction Rate (%)	Group	*p*
Group I, liposuction ($n = 20$)	5	I	—	10	I	—
		II	0.004*		II	0.015*
		III	0.381		III	0.0497*
		IV	0.6464		IV	0.5534
Group II, W-pattern incision ($n = 33$)	42	I	0.004	42	I	0.015*
		II	—		II	—
		III	0.0313*		III	0.7971
		IV	0.0042*		IV	0.0002*
Group III, modified transverse incision ($n = 30$)	17	I	0.381	37	I	0.0497*
		II	0.0313*		II	0.7971
		III	—		III	—
		IV	0.4729		IV	0.0011*
Group IV, lipoabdominoplasty ($n = 31$)	9	I	0.6464	3	I	0.5534
		II	0.0042*		II	0.0002*
		III	0.4729		III	0.0011*
		IV	—		IV	—

*Significant differences. Group IV had a significantly lower complication rate compared with group II and a lower dissatisfaction rate compared with groups II and III.

found (Table 2). The transverse incision group (group III, 17 percent) had fewer complications compared with the W-pattern group (group II, 42 percent; $p = 0.0313$). The complication rate for the combined procedure (group IV, 3 percent) was significantly less than the rate for the W-pattern incision group (group II, 42 percent; $p = 0.0042$) but no different from that of the transverse incision group (group III, 17 percent).

Dissatisfaction rates were also compared and found to have significant differences (Table 2). The revision rates were closely related to dissatisfaction rate and not included in Table 2 for redundancy reasons. The combined procedure (group IV, 3 percent) had less dissatisfaction compared with the transverse incision (group III, 37 percent; $p = 0.0011$) and W-pattern (group II, 42 percent; $p = 0.0002$). Two patients from group I had revision abdominoplasties because of uncorrectable skin laxity. In group II, 13 patients (39 percent) underwent additional revision surgery including 10 lipoplasty recontouring procedures, five repeat abdominoplasties, and five scar revisions. In group III, 10 patients (33 percent) underwent additional surgery, including nine cases of liposuction recontouring, four scar revisions, and one repeat abdominoplasty procedure. In contrast, only one patient from group IV underwent correction using liposuction because of epigastric fat prominence.

DISCUSSION

This study evaluated one surgeon's (J.P.) experience with four surgical approaches for patients seeking abdominal contouring. The selection of procedures represents an evolution of technique developed sequentially based on surgeon perception of results. The patients with W-pattern incisions (group II) were operated on first, but because of tip necrosis at the distal ends of the W advancement flap and bulging soft tissue of the advanced flap, subsequent patients underwent modified low transverse abdominoplasty (group III). Although there were fewer episodes of skin necrosis, patients complained of persistent fullness of the abdominal profile, particularly in the supraumbilical region. As a result, the patients underwent a single-stage lipoabdominoplasty procedure (group IV), where extensive liposuction was added to the modified transverse technique used in group III, the key distinction being limited paramedian supraumbilical dissection, 7.5 cm from the midline and 15 cm wide overall (Fig. 1). The aim of this study was to compare statistically the outcomes among liposuction alone (group I), W-pattern (group II), modified transverse (group III), and lipoabdominoplasty (group IV).

Ideally, liposuction dissects between free fibrous/neurovascular mesenteries during the process of fat removal. Subsequent to fat removal, a more pliable sliding flap is created wherein perforator vessels are usually left intact, as demonstrated by direct histology, microangiography, and endoscopy.[22–25] The application of tumescent technique and use of small blunt-tipped cannulas (3.7-mm diameter) over the past decade has further improved liposuction safety. Hoffman et al.[26] demonstrated that tumescent technique produces little lymphatic injury among patients as compared with a 50 percent rate of injury in patients who were operated on using dry technique. However, despite the known safety of liposuction, the effectiveness of this procedure is directly

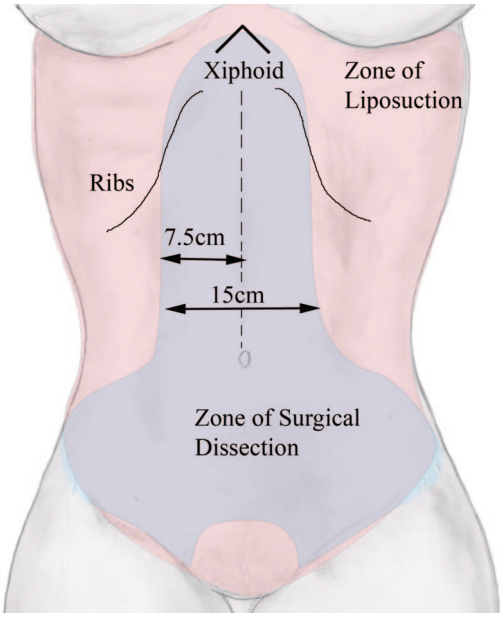

Fig. 1. Zones of liposuction and zones of dissection for the lipoabdominoplasty technique used in group IV. Liposuction was performed throughout the abdomen, including the epigastric and mesogastric areas. Dissection was limited laterally to 7.5 cm from the midline with an inverted V-pattern at the xiphoid to spare the intercostal arteries.

limited by skin tone. In those individuals with skin laxity (i.e., candidates for abdominoplasty), the creation of a sliding flap by means of liposuction would increase laxity and result in skin folding and redundancy. In 10 percent of our patients seeking contouring by liposuction alone, an abdominoplasty was later performed to correct the redundancy created by liposuction.

One of the first major reports about the incidence of complications after abdominoplasty stems from a physicians' survey performed by Grazer and Goldwyn in 1977.[27] In our study, we found that the W-pattern (group II) and modified transverse (group III) abdominoplasty had overall complication rates of 42 percent and 17 percent, respectively. Group III had a significantly lower complication rate compared with group II ($p = 0.0313$). Smokers constituted 21 percent of group II and 20 percent of group III. When smokers were excluded, the complication rate was 33 percent for the W-pattern and 15 percent for the transverse modified pattern. As such, the overall complication rate for the W-pattern abdominoplasty (group II) corresponds to previously published reports of Floro and Davis[28] (34.6 percent) and Uchelen et al. (29.4 percent).[29] However, the transverse modified abdominoplasty (group III) complication rate (17 percent) was less than that expected based on published values by Chaouat et al.[30] (32 percent) and Hensel et al.[31] (32 percent).

This reduction is probably a result of modifications made to the original procedure, taking into account the vascular territories of Huger.[32] First, the abdominal flap is tailored such that closure could be performed without excessive tension, thereby optimizing vascular flow. This was accomplished by making an incision along the superior border of the skin to be excised as suggested by Matarasso,[15,16] then undermining the abdominal flap and the segment to be excised by means of this incision, and finally overlapping the two to determine placement of the inferior incision for "tension-free" closure. This method of tailoring was performed easily with the transverse abdominoplasty (group III) but was more difficult to duplicate with the W-pattern (group II). Second, when undermining the abdominal flap superiorly along the rectus fascia, an inverted V-pattern of dissection was used toward the xiphoid process, with sparing of the lateralmost costal margins, to optimize lateral intercostal artery blood flow. Finally, dissection in the inferior direction was carried out in a suprafascial plane into the medial groin region, where a more superficial dissection plane above Scarpa's facia was entered to preserve lymphatics perforate abdominal vessels and the neural chain in this region. None of these modifications was performed for our group II (W-pattern) abdominoplasties.

Dissatisfaction rates for W-pattern abdominoplasties (group II) and transverse modified abdominoplasties (group III) were 47 percent and 37 percent, respectively. Revisions were performed on 39 percent and 33 percent of all patients, respectively. Although the modified transverse abdominoplasty resulted in fewer complications compared with W-pattern abdominoplasty, revision rates were similar. Patients undergoing revision were given the option of continuing management with diet and exercise or undergoing secondary liposuction to reduce fat-related convexity of the upper and lower abdomen. If liposuction was undertaken, anticipated skin laxity following the procedure was addressed with minor revision of lower abdominal skin without umbilical transposition. Patients were informed preoperatively that this two-stage approach would be performed at their expense.

In an effort to reduce this need for abdominoplasty revision, the recommendation against combining liposuction and abdominoplasty

(group IV) was challenged. Previously, Chaouat et al.[30] did not note any increase in complications compared with abdominoplasty alone among eight patients who underwent limited lipoaspiration (outside of the epigastric and mesogastric areas) combined with transverse abdominoplasty. Hensel et al.[31] reported similar findings. Our data support and add to the findings generated by Lockwood[19]; however, Lockwood's procedure emphasized high lateral tension with superficial fascial system repair using liposuction as an adjunct immediately before closure. The areas of liposuction performed in Lockwood's study included extensive liposuction of the hips and back and less often of the costal margins and epigastrium. Although complication rates were only compared with historic controls, the study lent credence to the use of liposuction for safe undermining and creation of a sliding flap.

The present study used a different combined approach and compares the complication and dissatisfaction rates to a cohort population of patients who underwent abdominoplasty alone. In our retrospective study, the modified transverse abdominoplasty technique was combined with liposuction using a superwet technique. Contrary to the current precautions, extensive liposuction was performed throughout the entire epigastric and mesogastric regions but resulted in decreased overall complications compared with abdominoplasty alone. The key step was our limited undermining of the abdominal flap (arbitrarily chosen to be 7.5 cm from the midline) over the medial ribs, thereby preserving lateral intercostal artery perforators. Suction lipectomy also achieves discontinuous undermining of the abdominal flap and maintains vascular perforators, creating a more mobile flap that can be easily closed, with less tension. Furthermore, tumescent infiltration with epinephrine in the mixture reduces blood vessel caliber and decreases vascular and lymphatic

Fig. 2. A representative patient from group II (W-pattern abdominoplasty–alone procedure), a 42-year old woman showing before (*left*) and after (*right*) results on the anteroposterior (*above*) and lateral views (*below*). Although contour is improved postoperatively, significant superior abdominal and periumbilical subcutaneous fat remains to distort the normal abdominal profile.

damage during the liposuction procedure. In combination, the abdominal flap is created with less undermining, decreased suture line tension, and preserved abdominal flap vasculature. The complication rate for the combined group was 9 percent, which was lower than groups II and III, although a significant difference was found only when compared with group II. The added benefits are improved aesthetic results (Figs. 2 and 3) and high patient satisfaction. The dissatisfaction rate (3 percent) and revision rate (3 percent) were lower than those in groups II and III.

A limitation of this study was the lack of quantified measurement of vascular flow among groups I through IV at preoperative, postoperative, and follow-up time points. We are currently conducting these studies. Another limitation includes a more extensive evaluation of patient satisfaction using established questionnaires. Our study evaluated patient satisfaction on a binary scale, but more extensive assessment would be useful in establishing the benefit of a combined procedure.

SUMMARY

The described modified transverse abdominoplasty has a lower complication rate than previously reported studies in which liposuction was used sparingly or not at all. It also yields higher patient satisfaction and lower revision rates. When the two procedures are combined, the results are counterintuitive to current dogma. A reduction in overall complications was observed when liposuction was combined with abdominoplasties compared with traditional abdominoplasties. This may be attributable to limited undermining from the midline and thus greater preservation of lateral intercostal artery vasculature of the flap. Although

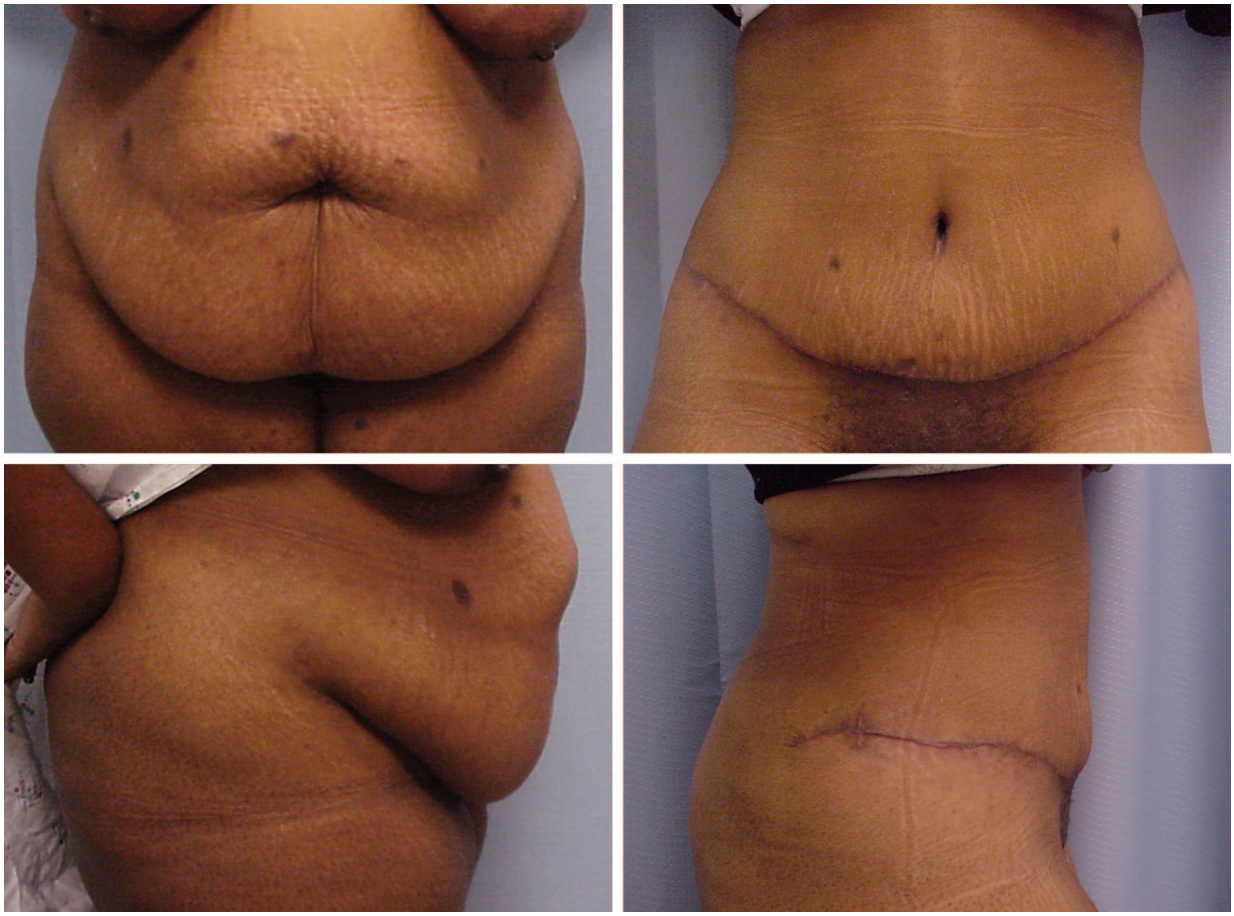

Fig. 3. A representative patient from group IV (combined lipoabdominoplasty procedure), a 35-year-old woman who underwent combined liposuction (1200 cc) and full abdominoplasty showing before (*left*) and after (*right*) results on the anteroposterior (*above*) and lateral views (*below*). Despite significant preoperative superior abdominal and periumbilical fat, the profile has been improved substantially by the addition of supplemental liposuction of the upper abdomen and periumbilical region.

a quantitative study examining preservation of flap vascularity will follow, the current results are promising and further refinements may follow.

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