Infrared thermography imaging in evaluation of the safety of liposuction-assisted abdominoplasty versus traditional abdominoplasty

Ahmed Elfiqi, Karim El-Lamie, AbdelRahman Mohamed, Niveen Al Mahmoudy

Department of Plastic Surgery, Faculty of Medicine, Ain Shams University, Cairo, Egypt

Correspondence to Ahmed Elfiqi, MSC, Department of Plastic Surgery, Faculty of Medicine, Ain Shams University, Cairo 11511, Egypt
Tel: 01009186539;
e-mail: fiqi_ba@hotmail.com

Received: 16 May 2022
Revised: 06 June 2022
Accepted: 21 June 2022
Published: 05 April 2023

The Egyptian Journal of Surgery 2023, 41:1185–1191

Background
Liposuction-assisted abdominoplasty is a powerful operation to maintain a good physique for aging people and to improve body contouring for massive weight loss patients. However, it is controversial to combine abdominoplasty and liposuction because of the possibility for vascular damage of the abdominal flap and increased perfusion complications. The aim of this study was to determine the complication rates of lipoabdominoplasty compared with traditional abdominoplasty using infrared thermal imaging.
Patients and methods
A total of 40 patients were enrolled in this study and were divided into two groups: group A (20 patients) for lipoabdominoplasty and group B (20 patients) for traditional abdominoplasty. Assessment of the vascularity of the flap was done in each group by infrared thermography imaging for a month.
Results
There was no statistically significant difference between the temperature of the center and the sides of the flap in group A and group B during the first 30 days postoperatively, with *P* value of 0.809.
Conclusion
Infrared thermal imaging is a quick, easy way of assessing cutaneous perforators. It should be considered as a useful method to evaluate its best role among the established cutaneous perforator imaging methods. Lipoabdominoplasty is not associated with a statistically significant increase in vascularity perfusion complication rates as compared with traditional abdominoplasty, despite the fact that it involves potential trauma to the vascularity of the abdominoplasty flap.

Keywords:
abdominoplasty, lipoabdominoplasty, thermal imaging

Egyptian J Surgery 2023, 41:1185–1191

1110-1121

Introduction

The dramatic increase in the number of body-contouring surgeries being performed is likely due to the rise of bariatric procedures and increased attention given to aesthetic surgery. Abdominoplasty is among the most popular procedures in aesthetic surgery with good patient satisfaction. It is, however, associated with a significant incidence of complications. These, however, do not seem to affect patient satisfaction. Traditional abdominal surgery has been limited to the standard technique performed through a variety of incisions and with minimal variations in technique for long time. It is usually associated with a relatively high complication rate because of the large scale of dissection required. It also involves the affection of the lymphatic and neurovascular supply to the flap [1]. In 1957, Vernon published a modern version of abdominoplasty, including an umbilical transposition and plication of the musculoaponeurotic layer. Pitanguy reported in 1967 of 300 abdominal lipectomies, and Regnault published the W-technique for abdominoplasty in 1972 [2].

In 1995, Lockwood also reported the utility of liposuction undermining during abdominoplasty, and its ability to preserve perforators of the abdominal wall. Regardless of the technique used when performing abdominoplasty, vascular territories are interrupted and should be taken into account. Lipoabdominoplasty is based on the selective undermining of the abdominal flap on the superior medial line, preserving the great majority of the arteries, lymphatic vessels, veins, and nerves, which reduces the incidence of complications. As liposuction has become routine, the surgical approach to abdominoplasty has changed. It is no longer conceivable to aesthetically improve an abdomen without it. However, several problems were encountered in abdominoplasties, for example, the residual fat in the superior flap was responsible for a

difference in thickness above and below the suture line. This discrepancy caused the residual scar to be 'buried' in the resulting fold with a hangover of the upper flap or a curtain fold effect and the pot belly deformity owing to the presence of unexcised fat, which is responsible for an apparent recurrence if the patient regains weight [3].

The limited undermining of the abdominal flap in lipoabdominoplasty reduces distal flap ischemia and necrosis by preserving most of the periumbilical and supraumbilical perforator vessels to the abdominal skin. The reduction in the incidence and volume of seromas was also attributed to the same factor [4].

Infrared thermal imaging is a quick, easy tool for evaluating cutaneous perforators. It should be considered a useful way to determine its best role among the established cutaneous perforator imaging methods [5]. The FLIR ONE PRO is a smartphone-compatible miniature thermal imaging camera. It uses a long-wave (8–14 μm) infrared sensor that has a working temperature range of −20 to 400°C with a sensitivity that detects temperature difference down to 70 mK. It requires minimal training and is a simple 'point-and-shoot' technology. To assist with the image display and interpretation, a visible light camera takes a photograph, which is digitally merged with the thermal image [5].

Patients and methods

This clinical prospective study was approved by the Research Ethics Committee of the Ain Shams University and carried out in Demerdash hospitals from August 2019 to August 2021. The sample consisted of 40 female patients who attended the Plastic Surgery Outpatient Clinic at Al-Demerdash Hospital (Ain Shams University in Egypt). The patients were divided into two groups according to their order of arrival and underwent one of the following procedures: the first 20 patients (group A) underwent lipoabdominoplasty and the following 20 patients (group B) underwent traditional abdominoplasty. The inclusion criteria were female patients ranging in age from 20 to 60 years who presented with abdominal deformities marked by excess abdominal skin and adipose tissue with muscle laxity and BMI less than or equal to 35 kg/m^2. The exclusion criteria were BMI above 35 kg/m^2, chronic systemic disease like diabetes mellitus or heart disease with impaired performance, alcoholic consumption, regular drug intake (especially aspirin, NSAIDs, and anticoagulants), huge ventral hernia, subcostal scars, redo abdominoplasty, unrealistic patient expectation, and psychologically disturbed patients. Before taking consent to participate, all patients were informed about the procedure, type of anesthesia, risks, and possible complications.

Statistical analysis

All data were collected, tabulated, and statistically analyzed using SPSS 22.0 for Windows (SPSS Inc., Chicago, Illinois, USA). Data were analyzed for normal distribution using the Shapiro–Wilk test. Qualitative data were presented as frequencies and relative percentages. χ^2 test and Fisher exact were done to calculate the difference between qualitative variables as indicated. All statistical comparisons were two tailed, with significance level of P value less than or equal to 0.05 indicating significant difference, P value less than 0.001 indicating highly significant difference, and P value more than 0.05 indicating nonsignificant difference. All surgeries were done by the same plastic surgeon (first author). Group A (n=20) received lipoabdominoplasty. The marked abdominal flap was infiltrated with a 1 : 500 000 adrenaline and saline solutions in an amount equal to the amount of fat aspirated (super wet technique with a 1 : 1 ratio of total infiltrate to total aspirate). Liposuction was infiltrated in the supraumbilical and flank regions, using a 4-mm liposuction cannula, followed by the infraumbilical region, using a 5-mm diameter liposuction cannula. Next, a suprapubic incision was done, extending to the iliac crest. The dermal-fat flap was detached and extended to the umbilical region. In the supraumbilical region, the detachment continued 1 cm lateral to the medial edges of the rectus muscle to the xiphoid process. Plication of the anterior rectus sheath was performed in one plane. The umbilicus was fixed to the muscular aponeurosis with simple vicryl sutures. Suction drains were used in all groups. Vacuum drain was placed under the abdominal flap, exteriorized in the suprapubic area. The patients were advised to wear an elastic garment for a month and stay with the abdomen in a slightly flexed position for 2 weeks. The length of hospital stay was 1 : 2 days in all cases, and early walking was encouraged at the first postoperative day. Group B (n=20) underwent traditional abdominoplasty. The surgical procedure was performed similarly to group A with only liposuction in flanks below umbilicus. Follow-up was done by the infrared thermal camera the FLIR ONE PRO (FLIR Systems Inc., Wilsonville, Oregon, USA). We assessed the vascularity of the flap in the center and compared the temperature with the sides of the flap for 30 days postoperatively. The mean ages of the patients were 33.9 years in the lipoabdominoplasty patients and 35.9 years in the traditional abdominoplasty patients. The average BMI for those going lipoabdominoplasty was 29.45. For patients who underwent traditional abdominoplasty, the average BMI was 29.05. The

Table 1 Thermal imaging results at first 3 days postoperatively and next month in the two groups

Temperature difference	Lipoabdominoplasty (*N*=20)	Abdominoplasty (*N*=20)	*t*	*P*
1–3 day				
Mean±SD	0.745±0.465	1.09±0.566	2.11	0.042
4–30 day				
Mean±SD	0.480±0.304	0.510±0.459	0.243	0.809

complication rates were determined for the following: DVT, pulmonary embolism, seroma, hematoma, necrosis, infection, scar widening, wound dehiscence, and need for surgical revision. Perfusion-related complications are defined as those involving skin necrosis, wound infection, or wound dehiscence. Complication rates were compared between patients undergoing lipoabdominoplasty versus traditional abdominoplasty, and the results of the temperature with the infrared thermal camera were compared.

Results

Among the 40 patients, 20 patients did lipoabdominoplasty and 20 patients did traditional abdominoplasty. Patients undergoing lipoabdominoplasty had an average age of 33.95 years, whereas for those undergoing traditional abdominoplasty, the average age was 35.95 years. Patients undergoing lipoabdominoplasty had an average of 1355 ml of lipoaspirate, whereas in traditional abdominoplasty, 607.5 ml of lipoaspirate. Among the drains for the lipoabdominoplasty, patients had an average volume of 307 ml and average of 3.35 days for removal, whereas in traditional abdominoplasty, patients' average drain volume was 193 ml, with an average of 2.65 days for removal.

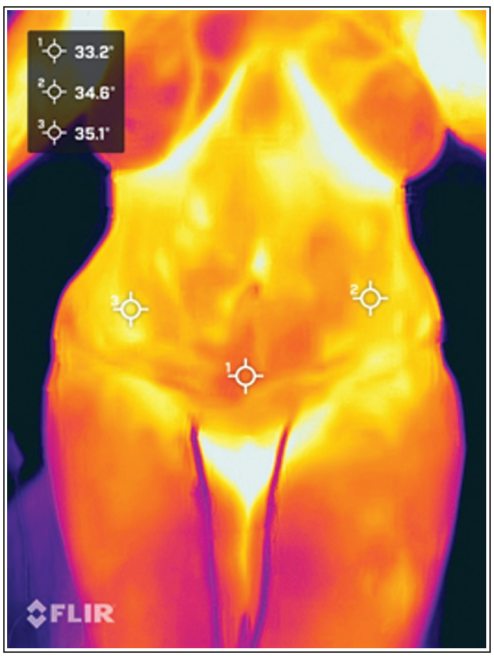
Among the infrared thermography imaging results (Table 1), we measured the temperature of the raised flap in the center and we compared it with the temperature in the sides in the first 3 days and the next 30 days. We found that there was a significant difference in the first 3 days, with *P* value of 0.042, with average in lipoabdominoplasty of 0.745°C and 1.09 in traditional abdominoplasty; however, we found no statistically significant difference in the next 30 days, with *P* value of 0.809.

We think that the perfusion complications start to appear when the difference in temperature from the sides and the center becomes more than one degree as the complicated cases show a difference of more than one degree. So, the cutoff point that demonstrate the critical drop in temperature is more than one degree in the next 30 days postoperatively.

The average temperature in the center of the flap in the first 3 days in the lipoabdominoplasty patients was 31.95°C and in the traditional abdominoplasty group was 31.76°C, with no significant difference (Figs 1, 2). Among the temperature in the next 30 days, the average was 33.02°C in the lipoabdominoplasty patients, whereas the average temperature was 33.83°C in the traditional abdominoplasty patients, with *P* value of 0.191.

Among the hospital stay, there was no significant difference between the two groups of patients, with *P* value of 0.687, with an average of 2.2 days in the lipoabdominoplasty and 2.15 days in the traditional abdominoplasty patients. Regarding the hemoglobin preoperatively and postoperatively, there was no significant difference between the two groups, with an average of 11.35 g in the lipoabdominoplasty patients and 11.13 g in the traditional abdominoplasty patients. On examining all patients and comparing the two techniques (lipoabdominoplasty and traditional abdominoplasty), the complication rates (Table 2) were

Figure 1



Thermography images postoperatively. Figure 1, shows the first day postoperatively of lipoabdominoplasty, showing the difference in temperature between the center (33.2°C) of the raised flap and the sides (~34.8°C), with a difference of ~1.5.

comparable but with no significant difference, with *P* value 0.327. There were two patients who developed seroma after 2 weeks in the lipoabdominoplasty patients; however, it was treated only by syringe aspiration in the epigastric area.

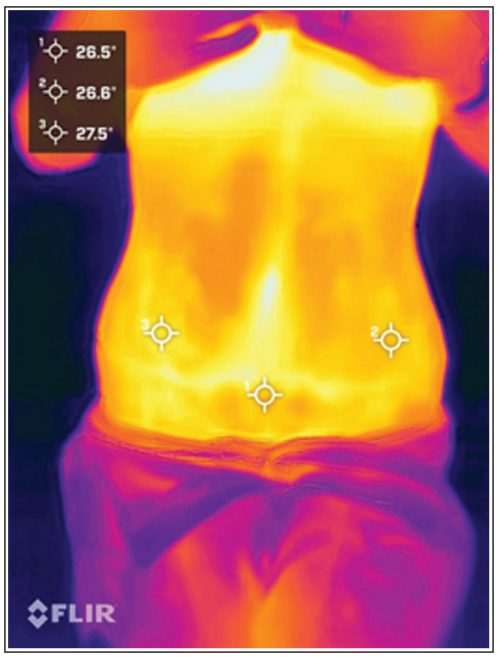
The rate of wound dehiscence was three patients, two (10%) of them in the lipoabdominoplasty group and one (5%) patient in the traditional abdominoplasty group, with no statistically significant difference, with *P* value 0.327. One (5%) patient complained of scar widening in the traditional abdominoplasty patients (Figs 3 and 4).

Discussion

The combination of abdominoplasty and liposuction is still controversial because of possible vascular damage of the flap and increased rate of complications. Moreover, complications after lipoabdominoplasty are uncommon and transient in clinical practice [6,7]. As a common operation in plastic surgery, it is necessary to systematically evaluate its safety. Lipoabdominoplasty has been performed with a significant decrease of complications such as seroma, hematoma, and flap necrosis. This technique avoids two-staged procedures (abdominoplasty and isolated liposuction) in most of the abdominoplasty procedure indications [6–8].

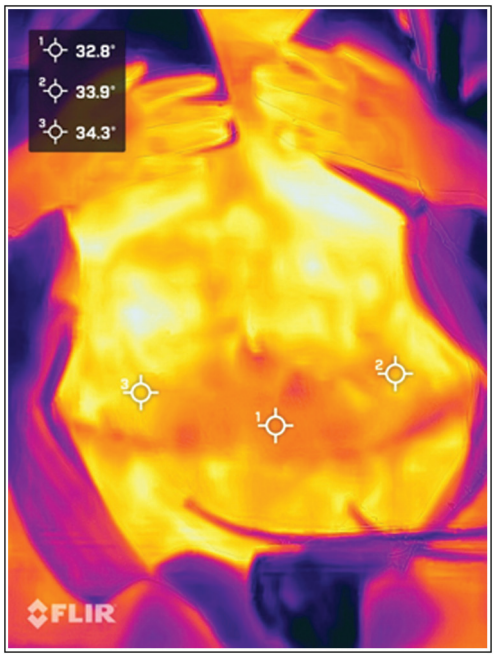
The main aim of this study was to assess the value of liposuction-assisted abdominoplasty versus traditional abdominoplasty focusing on the safety of lipoabdominoplasty on the vascularity of the flap using the infrared thermal imaging. This comparative study was conducted in plastic and Reconstructive Surgery Department of Ain Shams University hospital for a period of 2 years. This study was conducted on 40 female patients with abdominal deformities marked by excess abdominal skin and adipose tissue with muscle laxity. The patients were divided into two equal groups:

Figure 2



Thermography images postoperatively. Figure 2, left one, shows the first day postoperatively of lipoabdominoplasty, showing the difference in temperature between the center (33.2°C) of the raised flap and the sides (~34.8°C), with a difference of ~1.5°, whereas figure 2, the right one, shows after a week postoperatively of traditional abdominoplasty, where the temperature in the center was 26.5°C and in the sides was ~27°C, with a difference of ~0.5°.

Figure 3

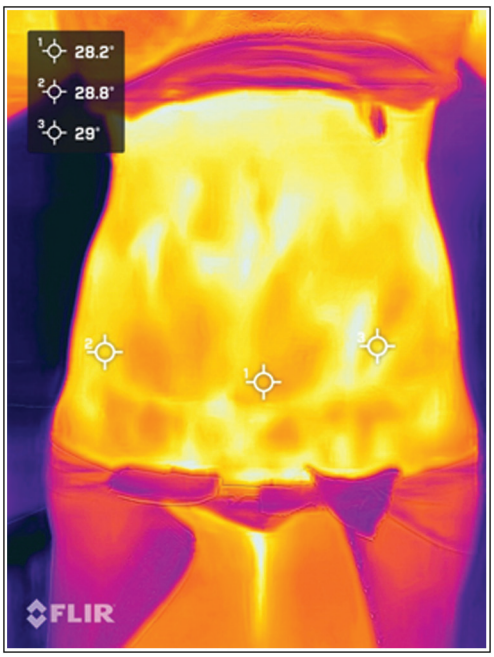


Thermography images postoperatively. Figure 3, left one, shows a postoperative photograph at day 1 after lipoabdominoplasty operation, showing temperature in the center was 32.8°C and in the sides was ~34.1°C, with a difference of ~1.3°. Figure 3, the right one, shows a postoperative photograph at day 4 after traditional abdominoplasty operation, showing temperature in the center was 28.2°C and in the sides ~28.9°C, with a difference of ~0.7°.

Table 2 Rate of complications of the two groups

Variables	Liposuction (*N*=20) [*n* (%)]	Abdominoplasty (*N*=20) [*n* (%)]	χ^2	*P*
No complications	16 (80)	18 (90)	3.45	0.327
Scar widening	0	1 (5)		
Seroma	2 (10)	0		
Wound dehiscence	2 (10)	1 (5)		

Figure 4



Thermography images postoperatively. Figure 4, the left one, shows a postoperative photograph at day 1 after lipoabdominoplasty operation, showing temperature in the center was 32.8°C and in the sides was ~34.1°C, with a difference of ~1.3°. Figure 4, the right one, shows a postoperative photograph at day 4 after traditional abdominoplasty operation, showing temperature in the center was 28.2°C and in the sides was ~28.9°C, with a difference of ~0.7°.

the first group included 20 patients who underwent liposuction-assisted abdominoplasty, and the second group included 20 patients who underwent traditional abdominoplasty.

In the present study, regarding the demographic characteristics between the studied groups, we found that there was no significant difference between the two studied groups regarding age and BMI. In line with the current study, Di Martino *et al.* [8] aimed to compare the rate of seroma formation in patients who underwent either abdominoplasty and lipoabdominoplasty. The study enrolled 58 female patients, who were divided into three groups and underwent one of the following procedures: group A (n=21), abdominoplasty without quilting sutures; group B (n=17), abdominoplasty with quilting sutures; and group C (n=20), lipoabdominoplasty. There was no significant difference between abdominoplasty and lipoabdominoplasty groups regarding age and BMI. Moreover, the study by Roostaeian *et al.* [9] was done to compare flap perfusion and overall complication rates for traditional technique and limited dissection lipoabdominoplasty. The study enrolled 18 patients. The control group (n=9) underwent traditional abdominoplasty. The study group (n=9) underwent abdominoplasty with liposuction of the abdominal flap. Of the 18 patients, 17 (94.4%) were women. The average age was 41 years (range, 28–65 years) for the control patient group and 51 years (range, 32–60 years) for the study group (P=0.065). The average BMI was 26.1 kg/m^2 (range, 21.1–33.7 kg/m^2) for the control group and 25.3 kg/m^2 (range, 21.9–31.3 kg/m^2) for the study group (P=0.650). Mean age and BMI did not differ significantly between the two groups.

In addition, Samra *et al.* [10] aimed to assess the complication rates of lipoabdominoplasty versus traditional abdominoplasty. The study enrolled two groups treated with lipoabdominoplasty (n=93) and traditional abdominoplasty (n=68). There was no significant difference between the two studied groups regarding age and BMI. In the present study regarding the operative time and hospital stay between the two studied groups, we found that there was a significant difference between the studied groups regarding operative time. However, there was no significant difference found between the studied groups regarding hospital stay.

Operative time is another important factor that has recently received very special attention in aesthetic surgery, considering the time of the procedures and the possibility of combining multiple operations at the same time. In a retrospective review of 1753 plastic surgery operations, operative time was associated with higher complication rates [11].

The study by Swanson [12] reported that the mean operative time was significantly longer in the lipoabdominoplasty operation. The study by Roostaeian *et al.* [9] reported that the mean operating times for the abdominoplasty and lipoabdominoplasty groups, respectively, were 136 min (range, 96–189 min) and 139 min (range, 101–172 min) (P=0.883). They stated that they performed the liposuction simultaneously with abdominoplasty so that the operating time was not changed significantly.

However, the study by Di Martino *et al.* [8] reported that the length of hospital stay was 24 h in all cases in the studied groups, and early walking was encouraged at the first postoperative day. Moreover, the study by Azzam *et al.* [13] evaluated the efficacy of combined liposuction and surgical resection of deep fat of the anterior abdominal wall in abdominoplasty. The study enrolled 20 females and found that the mean hospital stay was 3.75 ± 0.91 days (range, 3–6 days).

Furthermore, Saldanha *et al.* [2] reported that the lipoabdominoplasty operation takes ~2 h and the patient stays in the hospital for 1 day.

In the present study regarding the hemoglobin levels preoperatively and postoperatively between the two studied groups, we found that there was no significant difference between the groups regarding preoperative and postoperative hemoglobin. Meanwhile, there was a significant decrease in hemoglobin in both groups.

In line with our results, the study by Azzam *et al.* [13] reported that in lipoabdominoplasty operation, the mean hemoglobin level was 12.28 ± 0.78 g/dl preoperatively and 10.45 ± 0.61 g/dl postoperatively, and the average decrease was ±2.06 (no patient required a blood transfusion).

Moreover, the study by Vendramin and Ferreira [14] aimed to analyze the decrease in hemoglobin and the clinical and laboratory results throughout the recovery of patients undergoing body liposuction associated with lipoabdominoplasty.

Hemoglobin required nearly 1 month normalizing in most patients. These patients were treated only with oral iron tablets and did not require blood transfusion.

Regarding the drainage characteristics between the two studied groups, our results showed that the drainage volume and time were significantly higher in the liposuction group compared with the abdominoplasty group. We also found that there was a highly significant difference between the two studied groups regarding aspirate.

The study by Di Martino *et al.* [8] reported that the mean aspirate volume in lipoabdominoplasty group was 1327 ml (600–2700 ml). However, the study by Roostaeian *et al.* [9] reported that in the abdominoplasty group, the mean abdominal infiltrate fluid, total infiltrate fluid, abdominal fat aspirate, and total fat aspirate volumes were 0, 862, 0, and 792 ml, respectively. The corresponding values for the lipoabdominoplasty group were 609, 1163, 474, and 1028 ml. The difference in mean aspirate volumes relates to the addition of abdominal flap liposuction in the study group. The study by Swanson [12] reported that the mean aspirate volume was 1998 ± 1024 ml (100–5350 ml) in the lipoabdominoplasty group. Moreover, Samra *et al.* [10] reported that patients undergoing lipoabdominoplasty had an average of 2100.60 ± 736.8 ml of lipoaspirate removed, with an average tumescent infiltrate of 2335.71 ± 578.04 ml.

Regarding the postoperative complications between the two studied groups, our results showed that the complication frequencies were comparable in the two groups without statistical significance found.

The systematic review and meta-analysis by Xia *et al.* [6] included an overall 17 trials enrolling 14 061 adult patients. Of these patients, 577 (4.1%) developed seroma; 113 (0.8%) experienced hematomata; 783 (5.6%) experienced wound infection, dehiscence, or fat necrosis; 35 (0.2%) developed deep venous thrombosis; and 110 (0.7%) experienced scar deformity.

In agreement with our results, Roostaeian *et al.* [9] reported that there was no significant difference in complications between the studied groups. Neither group had major complications or revisions. Minor complications included an exposed suture, resulting in delayed wound healing, in the abdominoplasty group. A patient in the lipoabdominoplasty group had a small area of fat necrosis and a small seroma, neither of which required further treatment.

Moreover, the study by Swanson [12] reported that there was no significant difference in complications between the abdominoplasty and lipoabdominoplasty groups. However, the liposuction only group had a highly significantly lower incidence of complications when compared with abdominoplasty and lipoabdominoplasty groups.

In agreement with our results, Samra *et al.* [10] reported that there was no statistically significant difference for perfusion-related complications, including skin necrosis, wound infection, and wound dehiscence.

The known tool to assess the vascularity of the flaps is the computed tomography angiography, which was commonly used in assessing deep inferior epigastric perforator flap patency in patients before doing any flap harvesting. However, computed tomography is more expensive than thermal camera and needs many preparations for doing a single scan, but the thermal camera is a handheld easy-to-use tool and is easily used as a bedside test with no preparations [15, 16].

Moreover, Raghuram *et al.* [17] concluded that combining liposuction with abdominoplasty has the potential to improve patient satisfaction, self-esteem, and quality-of-life. The study by Farid *et al.* [18] reported that ~43.3% considered the results of lipoabdominoplasty operation to be excellent, 30% considered the results of the operation to be very good, 20% considered the results of the operation to be good, and 6.7% considered the results of the operation were not satisfying.

Conclusion

Infrared thermal imaging is a quick and easy tool for evaluating cutaneous perforators. It should be considered a useful tool to assess the established cutaneous perforator imaging methods. Lipoabdominoplasty is not associated with a statistically significant increase in vascularity perfusion complication rates as compared with traditional abdominoplasty, despite the fact that it involves potential trauma to the vascularity of the elevated abdominoplasty flap.

Financial support and sponsorship

Nil.

Conflicts of interest

No conflict of interest.

Reference

1 Saldanha OR, De Souza Pinto EB, Mattos WN, Pazetti CE, Lopes Bello EM, dos Santos MR, *et al*. Lipoabdominoplasty with selective and safe undermining. Aesthetic Plast Surg 2003;27:322–327.

2 Saldanha OR, Azevedo SF, Delboni PS, Saldanha Filho OR, Saldanha CB, Uribe LH. Lipoabdominoplasty: the Saldanha technique. Clin Plast Surg 2010:373:469–481.

3 Illouz Y-G. A new safe and aesthetic approach to suction abdominoplasty. Aesthetic Plast Surg 1992; 16:237–245.

4 Matarasso A, Swift RW, Rankin M. Abdominoplasty and abdominal contour surgery: a national plastic surgery survey. Plast Reconstr Surg 2006; 117:1797–1808.

5 Sheena Y, Jennison T, Hardwicke JT, Titley OG. Detection of perforators using thermal imaging. Plast Reconstruct Surg 2013; 132:1603–1610.

6 Xia Y, Zhao J, Cao DS. Safety of lipoabdominoplasty versus abdominoplasty: a systematic review and meta-analysis. Aesthetic Plast Surg 2019; 43:167–174.

7 Matarasso A. Abdominolipoplasty: a system of classification and treatment for combined abdominoplasty and suction assisted lipectomy. Aesthetic Plast Surg 1991; 15:111–121.

8 Di Martino M, Nahas FX, Barbosa MVJ, Montecinos Ayaviri NA, Kimura AK, Barella SM, *et al*. Seroma in lipoabdominoplasty and abdominoplasty: a comparative study using ultrasound. Plast Reconstr Surg 2010; 126:1742–1751.

9 Roostaeian J, Harris R, Farkas JP, Barton FE, Kenkel JM. Comparison of limited-undermining lipoabdominoplasty and traditional abdominoplasty using laser fluorescence imaging. Aesthet Surg J 2014; 34:741–747.

10 Samra S, Sawh-Martinez R, Barry O, Persing JA. Complicationrates of lipoabdominoplasty versus traditional abdominoplasty in high-risk patients. Plast Reconstr Surg 2010; 1252:683–690.

11 Hardy KL, Davis KE, Constantine RS, Chen M, Hein R, Jewell J. L, *et al*. The impact of operative time on complications after plastic surgery: a multivariate regression analysis of 1753 cases. Aesthet Surg J 2014; 34:614–622.

12 Swanson E. Prospective clinical study of 551 cases of liposuction and abdominoplasty performed individually and in combination. Plast Reconstr Surg Glob Open 2013; 1:5.

13 Azzam EZ, Salem IL, El Wakeel HS. The efficacy of combined liposuction and surgical resection of deep fat of the anterior abdominal wall in abdominoplasty. Egypt J Plast Reconstruct Surg 2019; 43:331–337.

14 Vendramin F, Ferreira D. Clinical and laboratory recovery of patients undergoing body liposuction associated with lipoabdominoplasty. Rev Brasil Cirurg Plást 2001; 34:468–476.

15 Razzano S, Gathura EW, Sassoon EM, Ali R, Haywood RM, Figus A. Scarpa fascia preservation in abdominoplasty: does it preserve the lymphatics? Plast Reconstr Surg 2016; 1375:898e–899e.

16 Vieira BL, Chow I, Sinno S, Dorfman RG, Hanwright P, Gutowski KA. Is there a limit? a risk assessment model of liposuction and lipoaspirate volume on complications in abdominoplasty. Plast Reconstr Surg 2018; 1414:892–901.

17 Raghuram AC, Yu RP, Gould DJ. The addition of partial or circumferential liposuction to abdominoplasty is not associated with a higher risk of skin necrosis. Aesthet Surg J 2021; 41:NP433–NP444.

18 Farid AY, Elhabbaa GI, Abdelmofeed AM, Tohamy AMK. Assisted liposuction with abdominoplasty versatility and results. Benha Med J 2018; 35(1):97.