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# Abdominoplasty in patients with and without pre-existing scars: A retrospective comparison<sup>☆</sup>

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## KEYWORDS

Abdominoplasty;  
Abdominal scars;  
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**Summary Background:** Over the past decade, abdominoplasty has become an increasingly popular aesthetic procedure both in improving anterior abdominal contour and scar revisions. The associated post-operative complications have been widely reported. Many factors such as obesity, smoking and pre-existing abdominal wall scars are hypothesised to increase the risk of these problems. However, there are no published data analysing the effect of segmental interruption to the blood supply that may have been caused by pre-existing scars. This study attempted to quantify the effect of pre-existing scars on the incidence of complications after abdominoplasty. **Methods:** All 123 abdominoplasties under the care of a single surgeon (2000–2007) were reviewed retrospectively with respect to indications, presence of abdominal scars, and post-operative complications. Patients with pre-existing scars were compared with unmatched 'controls' (no scars) by univariate analysis using the Student's t-tests, Mann–Whitney U, and Fisher's Exact tests and by multivariate analysis employing a simple logistic regression.

**Results:** One hundred and twenty-three patients (97% female, median age = 40 years) underwent abdominoplasties for abdominal laxity (46%), multiple scars (22%) and 'diastasis recti' (11%). Seventy per cent (87/123) had pre-existing scars (29% single, 71% multiple) of which 32 patients have supraumbilical scars, fifty-five patients with infraumbilical scars and 36 patients with no pre-existing scar. A quarter of patients developed complications such as: infection (14.6%), delayed wound healing (8.1%) and wound dehiscence (4.9%). Smoking and diabetes were the only independent risk factors for complications following an abdominoplasty.

**Conclusion:** Our study suggests that pre-existing scars, both supra-umbilical and infraumbilical, did not significantly predispose to abdominoplasty complications. Smoking and diabetes were independent risk factors, a finding of clinical importance.

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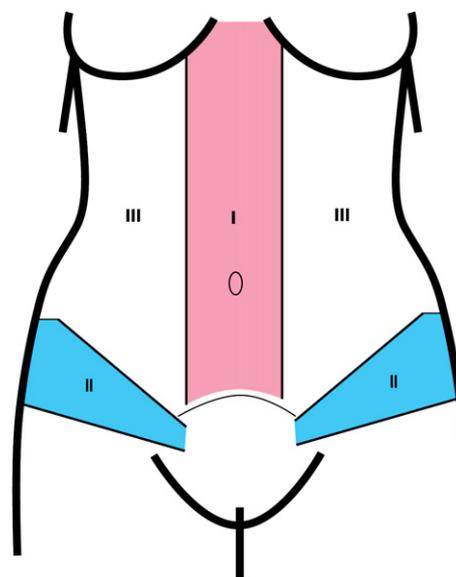
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Abdominoplasty is becoming an increasingly popular plastic surgery procedure,<sup>1</sup> and a 30% rise from 2007 to 2008 renders it the fifth most common aesthetic operation in the UK.<sup>2</sup> It is a relatively major procedure, which may be associated with a high risk of early post-operative complications. The rate of haematomas, seromas, wound infection, skin necrosis and dehiscence has been reported as high as 35%.<sup>3–5</sup> Abdominal hernia may present as a late complication. Many factors are hypothesised to increase the risk of these complications including smoking, obesity, diabetes, male gender and previous scarring.<sup>3–9</sup> The limited publications which have systematically analysed the effect of pre-existing scars on the rate of complications following abdominoplasty are contradictory.<sup>7,9,10</sup> The presence of pre-existing abdominal scars in these patients, therefore, remains a challenge to plastic surgeons.

De Castro et al, in a retrospective observational review<sup>7</sup> of 150 abdominoplasties in which 72% had pre-existing scars, concluded that a pre-existing midline scar was a limitation to abdominoplasty. In contrast El-Khatib and Bener, in a prospective cohort study<sup>9</sup> of 76 abdominoplasties, found that previous abdominal scarring was not a contraindication. Surprisingly, a recent study by Momeni et al<sup>10</sup> showed a significantly lower complication rate in patients with previous abdominal surgery. To our knowledge, there has been no published data examining the influence of the interruption to local blood supply of the abdominal wall caused by pre-existing scarring on post-operative outcomes. In addition to the mechanical effects of scars, this is likely to be a key aetiological factor in local post-operative morbidity and therefore merits a focused analysis. The contribution of pre-existing abdominal wall scarring to wound healing problems following abdominoplasty remains unclear. We therefore reviewed the effect of pre-existing scars on the rate of complications, based on the interruption of regional blood supply determined by the vascular zone in which scars were located. Only patients under the care of a single surgeon were included in the study to eliminate the contribution of inter-operator variability.

This study assumed that interruption to blood supply of the anterior abdominal wall due to prior surgery would be of interest. Since the interruption to blood supply varies according to scar location, it was decided to group scars for analysis into three vascular zones first described by Huger<sup>11</sup> in 1979 and since regarded as important prognostic considerations in abdominoplasty.<sup>12</sup> In particular, we expected that the location of scars in relation to the horizontal plane of the umbilicus would be significant.



**Figure 1** Line diagram to demonstrate zonal blood supply to the anterior abdominal wall. Zone 1 extends from the xiphoid to the pubis between the lateral borders of rectus abdominis, and is supplied by superior and inferior epigastric arteries. Zone 2 extends superiorly to the anterior superior iliac spines and inferiorly to the groin crease, supplied by the superficial epigastric, superficial circumflex iliac, external pudendal and inferior epigastric arteries. Zone 3 includes the flanks and is supplied segmentally by lumbar, subcostal and intercostal arteries.

Supraumbilical scars have the potential to compromise the blood supply of the remaining abdominoplasty flap; therefore the hypothesis of the study was that pre-existing supra-umbilical scars would represent an independent risk factor for wound complications after abdominoplasty. Scars below the umbilicus are generally included in resection and thus should not have a noticeable impact on blood supply. However, an infra-umbilical scar location can sometimes make the dissection difficult, extend above umbilical level and contribute to hernias. In addition, occasionally the Pfannestiel scars are not removed because they are too low than ideal location of the incision.

## Methods

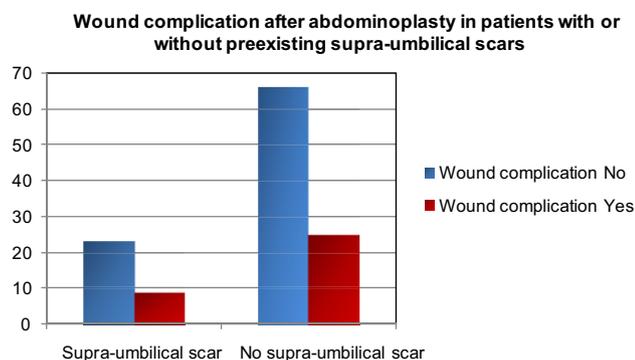
All 123 abdominoplasties under the care of a single surgeon (2000–2007) were reviewed retrospectively with respect to indications, presence of abdominal scars, post-operative

**Table 1** Wound complication after abdominoplasty in patients with or without pre-existing supra-umbilical scars

Presence of pre-existing supra-umbilical scar	Wound complication		Total
	No	Yes	
Supra-umbilical scar <sup>a</sup>	23	9	32
No supra-umbilical scar <sup>b</sup>	66	25	91
Total	89	34	123

<sup>a</sup> with or without concomitant infra-umbilical scar.

<sup>b</sup> no scars ( $n = 36$ ) or with infra-umbilical scars only ( $n = 55$ ).



**Figure 2** Complications after abdominoplasty in patients with and without pre-existing supra-umbilical scars.

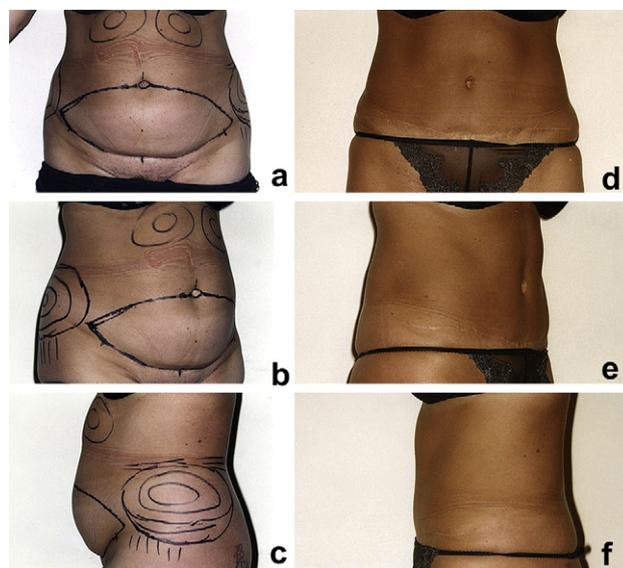
wound complications and herniation. Wound complications were identified from hospital notes, and were defined as any wound problem requiring medical intervention. This composite outcome measure included: infection requiring antibiotics, skin necrosis, fat necrosis or dehiscence requiring further surgery, or wound healing taking longer than two weeks and requiring unexpected early follow up. Herniation was considered as a second outcome measure, defined by a requirement for medical intervention such as use of a binder after eight weeks of operative intervention.

Scars were considered in relation to the Huger zones of abdominal blood supply<sup>11</sup> (Figure 1), divided into groups for analysis: zone 1 only, zone 2 only, zone 3 only, zones 1 and 2 only, zones 1 and 3 only, zones 2 and 3 only, or scars in all 3 zones. These groups of patients with pre-existing scars were compared with unmatched 'controls' (no scars). As infra-umbilical scars are discarded during the abdominoplasty procedure, scars were defined in relation to the umbilicus as either 'supraumbilical' or 'infraumbilical' for analysis. This enabled a focussed analysis of the rate of complications in patients with or without supra-umbilical scars.

For univariate analysis, dichotomous data were analysed using the Fisher's exact or Chi Squared ( $\chi^2$ ) tests; parametric continuous data were analysed using the Student's t-test. To exclude confounding effects of demographic and other variables, multivariate analysis was performed using a binary logit regression analysis. A forward variable selection procedure was used, incorporating variables significant in univariate analysis. Inclusion in the model required a significance level of  $\alpha = 0.1$ . Significant results were reported from the model at a significance level of  $\alpha = 0.05$ .

## Results

Over the 8-year period (2000–2007) 123 patients (97% female, median age 40 years, range 21–70 years) underwent abdominoplasties, predominantly for abdominal laxity (46%), multiple scars (22%) and 'diastasis recti' (11%). Seventy percent (87/123) had pre-existing scars (29% single, 71% multiple). Forty-five per cent of patients (55/123) have infraumbilical scars and a quarter of all patients (32/123) had supra-umbilical scars with or without infra-umbilical scars (Table 1 and Figure 2). Of these 32 patients with one or more supraumbilical scars, the distribution of



**Figure 3** Pre-operative (a–c) and post-operative (d–f) photographs of a 30-year-old patient with single Pfannenstiel incision scar.

scar extent was as follows: 8 subcostal or Kocher's, 3 transverse upper, and 22 long midline. The rate of complications in this group was 28% (9/32); the rate of complications in patients without supra-umbilical scars was 27% (25/91). Representative clinical outcomes are shown in patients with one scar (Figure 3), previous multiple incisions through one scar (Figure 4), one scar with incisional herniation (Figure 5) and multiple scars (Figure 6). Twenty-eight per cent of patients developed complications such as: infection (14.6%), delayed wound healing (8.1%) and wound dehiscence (4.9%). Three patients developed herniation, an insufficient number to support statistical analysis. There was no inadvertent entry into the peritoneum or damage to intraperitoneal structures.

## Univariate analysis

There was no significant effect of supra-umbilical scars, with or without infra-umbilical scars, on the rate of complications ( $p = 0.943$ , Chi-Square test). Similarly the number of scars did not influence the rate of complications ( $p = 0.374$ ,  $\chi^2$  test). Analysis of each zone in isolation and in combination revealed no statistically significant increase in complications following pre-existing scars in Zone 1 ( $p = 0.2116$ ), Zone 2 ( $p = 0.4431$ ), Zone 3 ( $p = 0.7435$ ), Zones 1 + 2 ( $p = 0.6168$ ), Zones 1 + 3 ( $p = 0.4038$ ), or Zones 1 + 2 + 3 ( $p = 0.5$ ) [Fisher's Exact Tests]. (Figures 7 and 8). Age ( $p = 0.368$ , 2-tailed student's t-test), body mass index ( $p = 0.105$ , 2-tailed student's t-test), number of children ( $p = 0.056$ , 2-tailed student's t-test) and steroid use ( $p = 0.075$ , Fisher's Exact test) were not significant in univariate analysis.

There was a statistically significant increase in complications in diabetic patients ( $p = 0.020$ , Fisher's Exact Test) and smokers ( $p = 0.0001$ , Chi-Square test). Hypertension did not affect the rate of complications although this tended towards significance ( $p = 0.070$ , Fisher's Exact Test) (Figure 9). The two groups of patients with or without



**Figure 4** Pre-operative (a–c) and post-operative (d–f) photographs of a 39-year-old lady with 1 scar: multiple previous caesarean sections through a single Pfannenstiel incision.

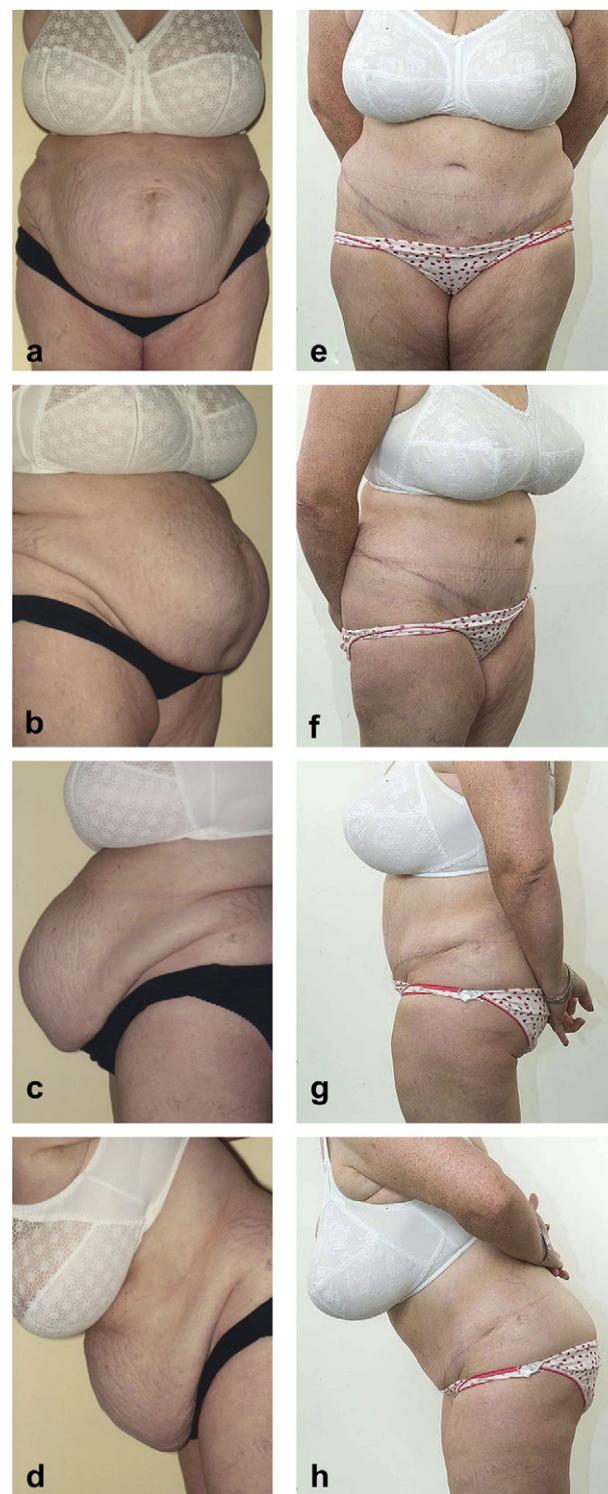
supraumbilical scars displayed no significant difference in their distributions of smokers ( $p = 0.388$ ,  $\chi^2$  test) or diabetics ( $p = 0.098$ ,  $\chi^2$  test).

### Multivariate analysis

Smoking (odds ratio 5.41, standard error 0.464,  $p = 0.0001$ ) and diabetes (odds ratio 11.287, standard error 1.19,  $p = 0.041$ ) were the only independent risk factors for complications after abdominoplasty.

### Discussion

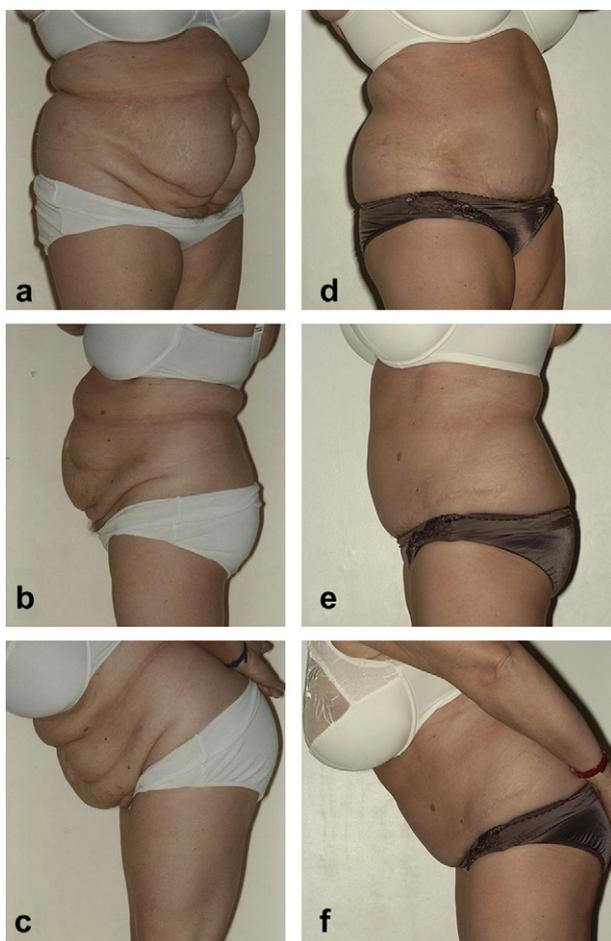
This study comprised predominantly female patients, similar to other published series. Almost half of the patients presented with abdominal laxity. It is interesting to note that the proportion of patients with pre-existing scars in our study was 70% (87/123). This was double the rate found in our series on the use of abdominal flaps for breast reconstruction in patients with pre-existing scars,<sup>13</sup> perhaps because the resected tissue in abdominoplasty is



**Figure 5** Pre-operative (a–d) and post-operative (e–h) photographs of a 59-year-old lady with previous Pfannenstiel incision and incisional hernia.

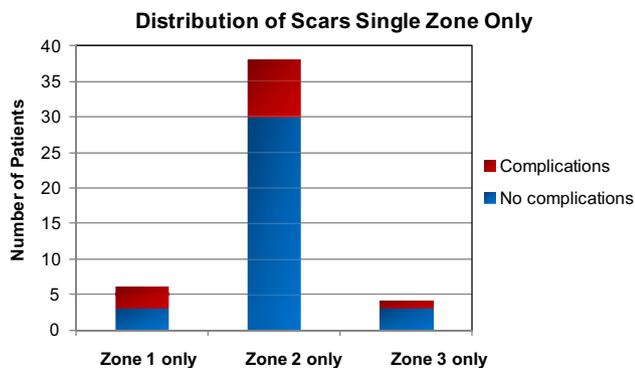
discarded and not intended for microsurgery or reconstructive use.

No published studies have considered the impact of scars according to their effect on abdominal wall blood supply, or accounted for heterogeneity in operative technique by examining a case series under the overall care of a single

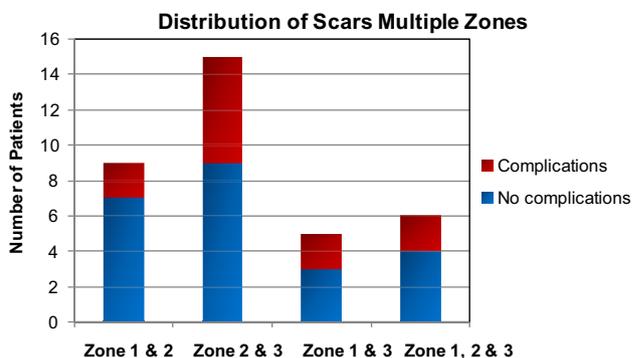


**Figure 6** Pre-operative (a–c) and post-operative (d–f) photographs of a 56 year old lady with multiple abdominal scars following road traffic accident requiring splenectomy, bowel resection and appendectomy.

surgeon. The findings of the present study supported the null hypothesis that pre-existing scars would not influence the rate of wound healing complications following abdominoplasty. There is no evidence in our study that wound healing is related to the zone of blood supply interrupted by previous surgery, perhaps due to the excision of these territories in the operative process although this holds true only for infra-umbilical scars. Previous observational studies have suggested that the presence of pre-existing



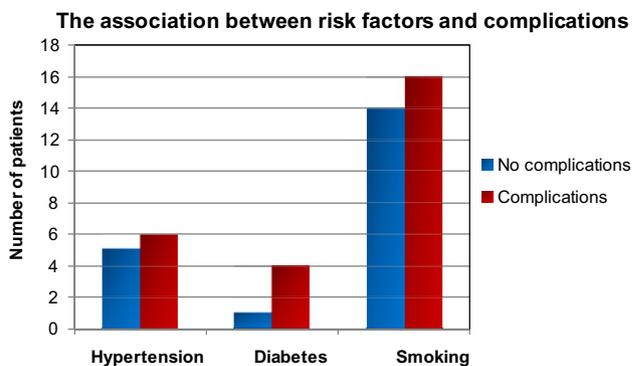
**Figure 7** Distribution of scars in single zones only.



**Figure 8** Distribution of scars in multiple zones.

scars may increase the rate of complications following abdominoplasty,<sup>7,8</sup> although the evidence base for this is equivocal as no statistical analysis was performed to support this conclusion. El-Khatib and Bener<sup>9</sup> have proposed that scars do not increase complication rate in abdominoplasty, although this study lacked a control group of patients without pre-existing scars to facilitate comparative statistical analysis. Indeed, abdominoplasty has been reported as a useful technique to aid the management of complex defects in patients with multiple scars.<sup>8,14</sup> Momeni et al<sup>10</sup> recently reported that pre-existing scars had a 'beneficial' effect on outcomes following abdominoplasty, and acknowledged that inter-operator variability may have led to methodological bias affecting this result. They suggested that this surprising finding warranted further research. For patients similar to our sample, pre-existing scars do not represent a contra-indication to this commonly requested aesthetic procedure. The technical challenge of abdominoplasty in patients with pre-existing scars may be overcome through a logical, algorithmic approach to abdominal reconstruction previously published by the senior author.<sup>13</sup> Surprisingly, location of scars relative to the umbilicus was not a significant predictor of complications and specifically the supra-umbilical scar location did not increase the risk of complications on both univariate or multivariate analysis.

Limitations to our study include the inability to perform statistical analysis of herniation, which was a rare event not amenable to analysis in this sample size. The study was underpowered to detect an effect of pre-existing scars on herniation, which could have resulted in type 2 error.



**Figure 9** The Association between the risk factors and complications.

Further larger-scale studies are required to determine specifically if pre-existing scars predispose to abdominal wall herniation.

Although this study focussed on the effects of pre-existing scars on abdominoplasty outcomes, the multivariate analysis required to study their influence revealed that smoking and diabetes represent important risk factors for wound complications after abdominoplasty. This finding is of significant clinical value; hence both aesthetic and reconstructive plastic surgeons must ensure that these independent risk factors are treated aggressively both pre- and post-operatively to ensure optimal post-operative outcomes.

The evidence for pre-existing abdominal scarring as a contra-indication to abdominoplasty is equivocal. Our study, focussed on the segmental interruption of anterior abdominal wall blood supply caused by pre-existing scars, revealed no significant effect of scars on the rate of complications following abdominoplasty. There was no significant effect of supra-umbilical scars in particular. Smoking and diabetes represented significant independent risk factors for wound complications in both univariate and multivariate analysis, providing confirmation of a finding with significant clinical value. Therefore, for patients similar to the sample in the present study, pre-existing scars did not significantly predispose to abdominoplasty complications. Plastic surgeons pre-operatively must optimise treatment of diabetes and strongly advise patients against smoking to minimise wound complications following abdominoplasty.

### Sources of funding

None required.

### Conflicts of interest

None declared.

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