



CT analysis of fat distribution superficial and deep to the Scarpa's fascial layer in the mid and lower abdomen

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KEYWORDS

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Summary *Introduction:* Mismatches in the thickness of subcutaneous fat at the level of the umbilicus and suprapubic region can result in an unsightly bulge and an unfavourable result following standard abdominoplasty. This problem can be avoided by thinning the abdominoplasty flap. This study was carried out to assess the thickness of the subcutaneous fat layer at the level of the umbilicus and the supra-pubic region. Measurements of full thickness fat and the depth of Scarpa's fascia separating superficial and sub-Scarpa fat layers were taken from the CT scans in 69 women; mean age 52 years (range 30–79).

Results: The thickness of the skin and abdominal wall fat was an average of 7 mm thicker (max 22 mm; $p < 0.05$). The thickness of the fat layer superficial to Scarpa's fascia was an average of 19 mm at mid abdomen and 22 mm in the lower abdomen ($p < 0.05$). The thickness of the fat layer deep to Scarpa's fascia was 14 mm in the mid abdomen and 5 mm in the lower abdomen ($p < 0.05$). In 55% of patients the difference in thickness of the mid abdominal and lower abdominal fat was greater than 5 mm, a difference that could lead to a noticeable mismatch and therefore an unfavourable outcome.

Conclusions: Results of this study suggest that selectively thinning the fat layer deep to Scarpa's fascia would address potential mismatches and preserve the Scarpa's fascia layer in more than 50% of cases, therefore allowing wounds to be closed with an effective deep tension layer.

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Introduction

Differences in the subcutaneous fat layer thickness at the level of the mid abdomen and in the suprapubic area are

frequently observed during standard abdominoplasty. These become apparent when closing an abdominoplasty. Mismatches in thickness between the two wound edges may result in a poor cosmetic outcome from a bulge above the

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Figure 1 Transverse section on contrast CT scan showing Scarpa's fascia which shows as a thin vascularised layer and measurement of superficial fat layer thickness to this layer. Scarpa's was less well defined near to the midline by the CT scans, an observation which is corroborated by typical surgical findings. This scan also demonstrates the rich network of small arteries in the superficial layer and a paucity of such vessels in the sub-Scarpa layer.

suture line. One way to address this problem and to preserve the opportunity to repair the wound edge in anatomical layers, including Scarpa's fascia, is to resect sub-Scarpal fat from the upper abdominal flap. This could allow the thickness of the upper and lower abdominal skin flaps to be matched during closure of abdominoplasty and DIEP flap donor wounds with effective placement of deep tension sutures.

This manoeuvre can be considered safe since the circulation of the anterior abdominal skin and fat is distributed by subdermal and suprafascial plexuses.^{1,2} Thinning the abdominoplasty flap is technically feasible and was first advocated in the plastic surgical literature by Grazer³ and this approach also supported by Grading⁴ and Wood.⁵ Brink et al. have published a series of 151 patients in which the deep (sub-Scarpal) fat layer was removed from the entire undersurface of the abdominoplasty flap; there was only 1 instance of wound necrosis.⁶ In order to gain further information about the suitability of this technique this study aims to gain a clearer understanding of the fat thickness in the upper and lower abdomen and the relative thicknesses of superficial and sub-Scarpal layers. CT scans were used to measure the differences in fat thickness

immediately above the umbilicus ('mid' abdomen) and at the upper margin of the mons ('lower' abdomen) – the levels at which the abdominoplasty incisions would be made. The study was carried out to obtain data on the thickness of fat in the mid abdomen and supra public regions of the abdomen and to understand more clearly the distribution of fat in the layers above and deep to Scarpa's fascia in these two regions. CT angiograms that had been performed for the routine pre-operative evaluation of patients who are candidates for breast reconstruction using DIEP flaps form the basis of the study group for evaluation of fat distribution in the anterior abdominal wall.

Method

Abdominal CT scans from a cohort of patients having CT angiogram work-up for DIEP flap breast reconstruction were analysed. The thickness of skin and subcutaneous fat immediately superior to the umbilical dimple and at the superior margin of the mons was measured. The 'mid' abdominal measurement (the usual level of the superior abdominoplasty incision) was taken immediately superior to the umbilical dimple: CT scan cuts were scrolled superiorly from the umbilicus until the dimple of the umbilical os was no longer visible. The 'lower' abdominal measurement (the usual level of the inferior abdominoplasty incision) was identified as the upper limit of the mons pubis by scrolling inferiorly to find the level at which the lower abdominal skin and subcutaneous tissue was thinnest. This level was readily determined and, when scrolling more inferior to this level, the thickness increased again in the mons.

At both levels, the 'full' thickness of abdominal skin and fat (from skin surface to musculoaponeurotic layer) and the 'superficial' thickness (from skin surface to Scarpa's fascia) were measured. Measurements were taken to the nearest 0.1 mm; for the purposes of clarity and practicality, results are shown rounded to the nearest millimetre.

Because Scarpa's fascia was not readily seen in the midline measurements at both levels were taken from a paramedian position at the most medial point where Scarpa's fascia was discernible (**Figure 1**). Measurements were abandoned if Scarpa's fascia was not discernible medial to the linea semilunaris at the 'mid' or 'lower' level.

Statistics and graphs were calculated with Microsoft Excel statistical package.

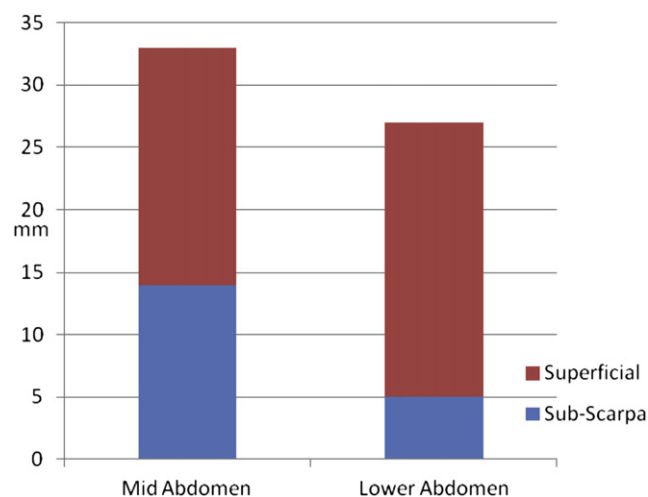
Results

98 consecutive abdominal CT angiograms were analysed. All patients were female and the mean age was 52 years (range 30–79). Scarpa's fascia was discernible over the anterior

Table 1 Measurements of upper and lower anterior abdominal fat thickness.

n = 69	Mid abdomen			Lower abdomen		
	Full thickness	Superficial	Sub-Scarpa	Full thickness	Superficial	Sub-Scarpa
Mean (mm)	34 ^a	19	14	27	22	5
Range	55–23	30–13	22–3	60–15	45–12	18–0

^a This is a rounding anomaly – true values: full thickness 33.8; superficial 19.4; sub-scarpa 14.4.



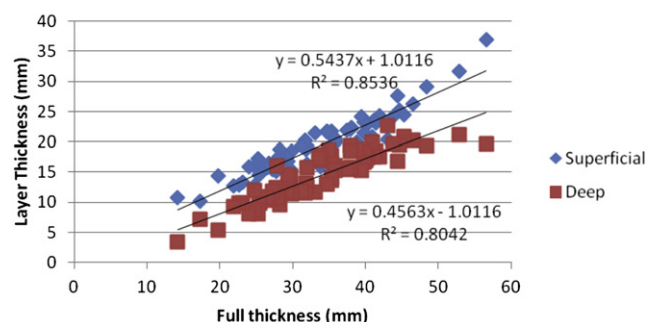
Graph 1 Representation of mean abdominal wall thickness and the relative contribution of superficial and sub-Scarpa fat layers in the upper and lower abdomen.

abdomen at the upper and lower abdominal level in 69 patients. The average distance between these two levels (achieved by counting CT cuts of 0.625 mm) was 14.9 cm (18.9–11.3). In 29 patients it was indistinct at one or other level. These cases were excluded. Full thickness of fat and the superficial thickness (surface to Scarpa's fascia) were measured at each level (Table 1 and Graph 1).

Comparing full thickness of mid to full thickness of lower abdominal fat

Mean full thickness upper abdominal fat was 7 mm thicker than the mean for the lower abdomen (paired t test: $p < 0.05$). In 41 cases (59%) this difference was greater than 5 mm (max 22 mm). The difference in thicknesses was 5 mm or less in 24 (35%). Nine patients (13%) had an 'inverse' relationship where the lower fat was thicker than

Mid abdomen



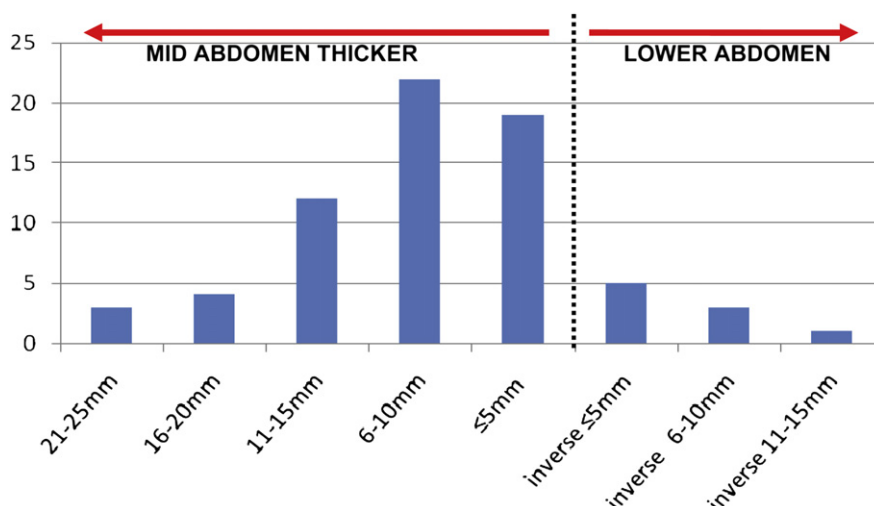
Graph 3 Scatter plot of individual layer thickness against overall thickness in the mid abdomen.

the upper and this difference was greater than 5 mm in four (6%) (See Graph 2).

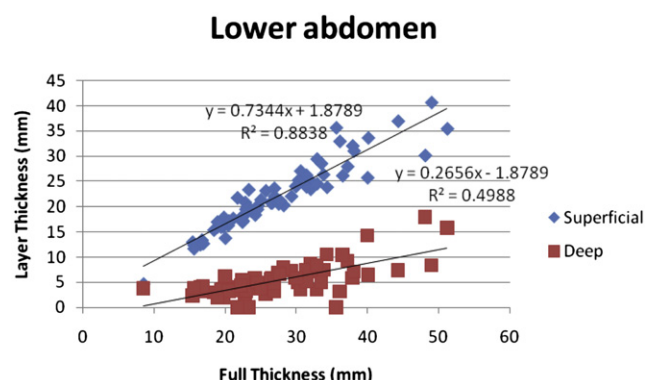
Superficial and sub-Scarpa fat layers at mid and lower abdominal levels

The sub-Scarpal fat layer of the mid abdomen was 9 mm thicker than the same layer for the lower abdomen ($p < 0.05$). The superficial layer was thinner by 3 mm at the mid abdominal level ($p < 0.05$). The superficial layer at the mid abdominal level was 7 mm thinner than the full thickness of the lower abdominal skin. In 38 cases (55%) this difference was greater than 5 mm (max 25 mm) and the difference was less than 5 mm in 31 (45%) cases.

The fat of the typical female abdomen is therefore thicker just superior to the umbilicus than it is at its most inferior level (87% of cases). At mid and lower levels, the superficial layer is thicker than the sub-Scarpa layer but a greater contribution from the sub-Scarpa layer is seen in the mid abdomen (43% of total thickness) than in the lower (19%). With increasing overall abdominal wall thickness, additional fat appears to be distributed evenly between the



Graph 2 Distribution of mid to lower abdominal wall thickness.



Graph 4 Scatter plot of individual layer thickness against overall thickness in the lower abdomen.

Table 2 Classification of abdominoplasty flap thickness mismatch and treatment suggestion.

Upper flap thicker	87%	Type A	Mismatch >5 mm	59%	Thin the abdominoplasty flap
Lower flap thicker	13%	Type B	Mismatch <5 mm	35%	Thinning unnecessary
		Type C	Mismatch >5 mm	6%	Thin the lower wound edge

layers in the mid abdomen (Graph 3). In the lower abdomen, however, as the overall thickness increases, the contribution from the superficial layer increases at a higher rate than that of the sub-Scarpal layer (Graph 4).

Discussion

In the majority of individuals studied the thickness of the mid abdominal fat exceeded that of the lower abdomen. A mismatch between the thickness of the superior and inferior wound edges during abdominoplasty has been observed by other authors^{7–13} (see Table 3). Heller found the need for recontouring procedures in at least 30% of patients treated with abdominoplasty alone whilst the recontouring rate was only 1% in patients who had the abdominoplasty flap thinned with liposuction.¹⁴ Thinning of the abdominoplasty flap may be performed by surgical excision of the deep fat layer,^{3–6} liposuction^{12,14–18} or by a combination of surgical thinning and liposuction.^{19,20} Increasingly, techniques which combine liposuction with minimal undermining of the upper flap are favoured¹⁸.

The results of this study indicate that the mid abdominal fat (i.e the abdominoplasty flap) is at least 5 mm thicker than that in the suprapubic region in 59% of cases (Type A) (Table 2). In these patients, thinning the flap by resection of the fat layer deep to Scarpa's fascia could be a helpful way to achieve a match in thickness of the wound edges and therefore an optimal aesthetic outcome. 35% of cases in this study had a difference of less than 5 mm in the thickness of the subcutaneous fat layer at the level of the mid abdomen compared with the supra pubic region, a difference which unlikely to be clinically apparent (Type B). The findings of this study suggest that approximately one in 20 patients might benefit from manoeuvres that are designed to thin the lower wound edge (mons) because it is thicker and may contribute to an unsightly mismatch (Type C).

In this group of patients, satisfactory thinning of the abdominoplasty flap would have been achieved with preservation of Scarpa's fascia in 100% of the Type A abdomens. In 7 cases (17% of Type A abdomens) the flap would have remained thicker but only by a maximum of 3 mm. These findings are important because they suggest that bevelling

Table 3 Abdominoplasty papers reporting thickness mismatch.

Author	Year	Study design	Procedure	n	Definition of thickness mismatch	%
Chaouat ⁷	2000	Case series	Abdominoplasty ± liposuction	118	Above scar fat folds and dog ears	41
Bragg ⁸	2007	Single unit patient questionnaire	Abdominoplasty	118	Residual overhang	35
Floros ⁹	1991	Follow up clinic	Abdominoplasty	34	Contour deformity at suture line	24
Stewart ¹⁰	2006	Case series	Abdominoplasty	278	Localised fatty excess	10
Matarasso ¹¹	2006	Multi unit surgeon questionnaire	Abdominoplasty ± liposuction	11,016	Abdominal contour deformity	5

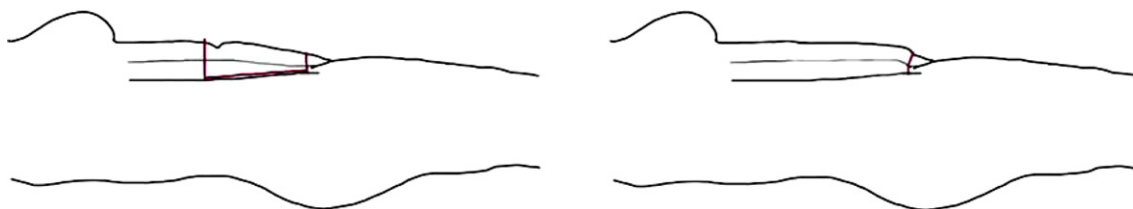


Figure 2 Abdominoplasty incision and closure (red lines) without consideration for mismatch in thickness of abdominal fat may leave a bulge at the suture line.

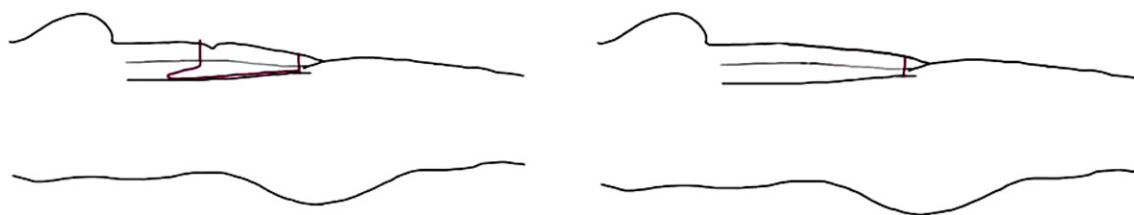


Figure 3 Beveling the upper abdominal flap deep to Scarpa's fascia allows fat thickness to be matched at the suture line.

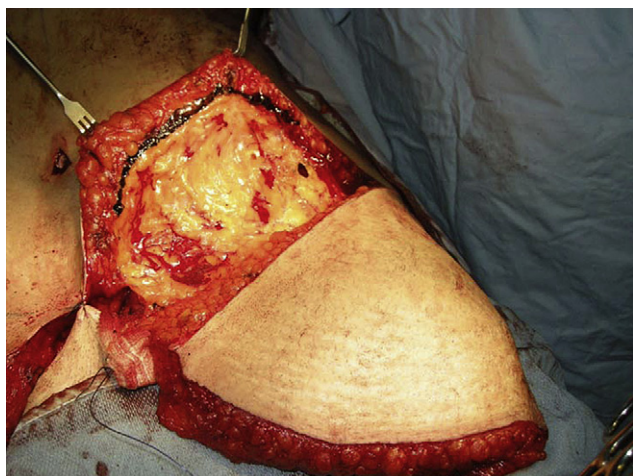


Figure 4 Removal of lower abdominal skin and fat including beveling of fat deep to Scarpa's fascia (marked with ink).

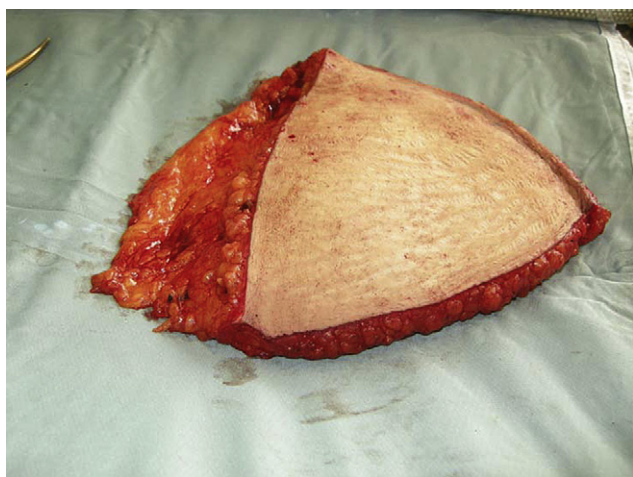


Figure 5 Excised tissue demonstrating bevel.

of the abdominoplasty flap is always achievable without infringing the superficial plane where the important vascular plexuses are located.^{1,2} Preservation of the Scarpa's fascia also facilitates wound closure using deep tension sutures.

Conclusions

Surgeons performing aesthetic abdominoplasty or involved in closure of DIEP flap donor sites will be familiar with mismatches in thickness of the upper and lower abdominal

fat. Where necessary, thinning of the abdominoplasty flap match the thickness of the suprapubic fat should be possible. This can be done with preservation of Scarpa's fascia which may be important for viability and security of wound closure. These concepts are illustrated in Figures 2–5.

Ethical approval

None required.

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Conflict of interest

None.

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