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Lateralising paraumbilical medial row perforators: Dangers and pitfalls in DIEP FLAP planning

A systematic review of 1116 DIEP flaps

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KEYWORDS

Deep inferior epigastric artery; Surgery; Perforator; Free-flap; Necrosis; Angiosome; Periumbilical; Zones of perfusion; Perforasome; Breast; Breast reconstruction

Summary *Background:* The DIEP flap remains the gold standard for autologous breast reconstruction. Recently, the ‘perforasome concept’ has advanced our understanding of DIEP flap physiology and planning. This study highlights a patient sub-population that produces anomalies to the perforasome hypothesis: those with paramedian, paraumbilical perforators.

Methods: Operation notes and pre-operative CT angiograms from 1116 consecutive DIEP flaps were reviewed retrospectively. Patients with paramedian, paraumbilical perforators ($n = 153$) were contrasted against a control group whose perforators were not paraumbilical ($n = 963$). Further subgroup analysis was performed within the study group, comparing paraumbilical perforators that held a lateral course within the flap ($n = 25$) versus those that held a medial course ($n = 128$).

Results: Rates of post-operative DIEP flap partial necrosis was greater in the study population compared with the control group (6.54% vs. 3% $p = 0.032$). When analysis was made contrasting paraumbilical perforators that held a lateral course in the flap versus perforators that held a median course, flap necrosis was significantly greater in those with a lateral course (24% vs. 3.13%).

Conclusion: The perforasome concept has improved our understanding of perfusion from perforators in DIEP flaps. However when the umbilicus presents a physical barrier to blood vessel passage resulting in lateralizing paraumbilical medial row perforators it appears an exception to the “perforasome” rule. Our experience suggests that when a paraumbilical perforator is harvested, a hemi-flap is safe but caution should be exercised when further volume is needed from the contralateral side.

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Introduction

The deep inferior epigastric artery perforator (DIEP) is the gold standard in autologous breast reconstruction post-mastectomy.^{1–4} Ideally it is based on a single perforator allowing flap elevation with little or no trauma to the rectus muscle. However, in tandem with its increased use other risks may be more prevalent including fat necrosis and partial flap failure.⁵ To minimize flap compromise, CT angiograms and other imaging modalities have been introduced to delineate the perforator anatomy, to enable pre-operative planning and subsequent increased success rates, reduced donor site morbidity and reduced operative time.^{6–11} Radiological imaging also permits, not only the identification of the optimal perforator with regard to location, but also its intra-muscular course to be mapped down to its origin and the Deep Inferior Epigastric Artery (DIEA), as well as its intra-flap course.^{12,13,20}

Recent studies have demonstrated differences in the area of perfusion according to perforator location.^{14–18,20} Studies suggested that the mean vascular territory perfused was greater when a medial row perforator was selected and furthermore, this vascularity was more likely to cross the midline.^{15,18} These findings suggested that medial row perforators perfused Hartrampf zone II^{15,16} (contralateral side) earlier and more so than Hartrampf zone III (ipsilateral side, lateral to zone 1) because single medial row perforators were more centralized resulting in their own “perforasome” or area of perfusion. The lateral row perforators travelled to Hartrampf zone III earlier and hence followed Holm’s classification who suggested reversing Hartrampf’s zones II and III.¹⁵

Whilst the perforasome or perforator angiosome concepts have advanced the understanding of DIEP flap planning, through clinical experience we have observed some anomalies that warranted further investigation. Paramedian paraumbilical perforators, located at three or nine o’clock relative to the umbilicus were observed to have limited perfusion of the contralateral hemi-flap. This paper describes our observations radiologically and clinically, after reviewing case notes and scans of over one thousand consecutive DIEP flap patients.

Methods

Our unit is a regional centre for breast reconstruction, now performing around 150 DIEP flaps a year. All patients undergoing DIEP surgery from January 2000 to October 2012 were included in the study. The operation notes from all 1116 DIEP flaps were reviewed retrospectively as were all corresponding CT angiogram images. Patient demographics, operative detail, as well as post-operative course, complications (with particular reference to vascular compromise of the flap) as well as subjective observations of the surgeon made in the patients’ charts were recorded.

All patients with paraumbilical perforators at 3 and 9 o’clock (Group 1) were identified and further analysis performed: comparisons were made of complications (rate, type, intervention) compared with the remaining DIEP flap population that was used as a control (Group 2).

Table 1 Summary of study groups. Sub-group analysis of the paraumbilical perforator group was performed, dividing group 1 into those paraumbilical perforators that held a lateral course within the flap (group 1a) and those that held a medial course within the flap (group 1b).

Group	Perforator selected	Number in population
1a	Paraumbilical, paramedian perforator with a lateral course in the flap	25
1b	Paraumbilical, paramedian perforator with a medial course in the flap	128
2	Control group, all other perforator patterns	963

Further sub-group analysis was performed on those within the paramedian paraumbilical perforator group (Group 1), dividing the group into those with perforators that coursed laterally (Group 1a), and those that coursed in a median direction within the flap (Group 1b).

Statistical comparison between the groups was made using Sigma Stat and a chi squared test was used for analysis. A *P* value of <0.05 was taken as being statistically significant. One case is described for illustrative purposes where written consent was provided by the patient to be included in the study.

Results

Demographics

Between January 2000 and October 2012 1116 DIEP flaps on 1022 patients were performed. Of these 1116 DIEP flaps included in the study, 153 were identified to have a paramedian paraumbilical perforator (Group 1 – Table 1). There was no significant difference in demographics between this



Figure 1 A CT angiogram of a Group 1a patient. Note that the medial row perforator emerges and courses laterally, particularly on the patient’s right (left in the image). This patient’s flap was harvested using her right side, and went on to partial necrosis of the contralateral side.

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