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time the incidence of problems such as late seroma requiring surgery and contracture of a double capsule will increase. I can only hope that someday the U.S. Food and Drug Administration (and Canadian Health Protection Branch) will approve an implant that allows true tissue ingrowth (without separation of the coating) such as the newer polyurethane implants that these authors have available in Italy.

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A Combined Anatomical and Clinical Study for Quantitative Analysis of the Microcirculation in the Classic Perfusion Zones of the Deep Inferior Epigastric Artery Perforator Flap

Sir:

We read with interest the article by Rahmanian-Schwarz et al., “A Combined Anatomical and Clinical Study for Quantitative Analysis of the Microcirculation in the Classic Perfusion Zones of the Deep Inferior Epigastric Artery Perforator Flap.” Although the study itself is well designed and well reported, and certainly adds some valuable anatomical and physiologic information to our understanding of deep inferior epigastric artery (DIEA) perforator (DIEP) flaps, we would like to comment on the terminology used in the mapping of perfusion zones of the lower abdominal wall.

The authors make the statement that “since the description of the vascular territories of the DIEP flap was published in 1983, many surgeons have used it for the selection of well-perfused tissue in microvascular autologous breast reconstruction. Our study disputes a generally accepted definition of the classic perfusion zones of the DIEP flap.” In making this statement, the authors appear to have confused the previously described perfusion zones of the transverse rectus abdominis myocutaneous (TRAM) flap with the DIEP flap. The TRAM flap perfusion zones are based on skin perfusion by means of all the cutaneous perforators of the DIEA, whereas a DIEP flap is necessarily perfused by only one or several perforators. The terminology in the recent literature has thus changed from the TRAM perfusion zones (or the angiosome of the DIEA) to the DIEP perfusion zones (or the perforator angiosome of DIEA perforators), based on a range of cadaveric and clinical studies performed by both ourselves and by Wong et al. and Saint-Cyr et al. When describing the perfusion of the abdominal wall based on one or several perforators, the perfusion zones are markedly different from the TRAM perfusion zones.

In our clinical and cadaveric studies, in which we looked at 200 hemiabdominal walls from both cadavers and patients, analyzing over 1500 DIEA perforators, we found that there is a specific “perforator” angiosome for each individual perforator, and that these differ between medial and lateral row perforators. “Perforator angiosomes” mirror the angiosome patterns described by Taylor and Palmer; however, the subangiosomes of individual perforators present some unique features. We found that each DIEA perforator has its own territory of supply, independent of the zone of supply by the source vessel. Of these, lateral row perforators and medial row perforators have fundamental differences in their zones of perfusion. Figure 1 demonstrates the perforator angiosomes of the DIEP flap, with several key features evident:

1. Zone I of medial row perforators is larger, has more extensive branching, and has larger caliber vessels than lateral row perforators.
2. Zone I of medial row perforators is centered over the position of perforators as they emerge from the anterior rectus sheath, as they have a relatively direct course to the Scarpa fascia, at which...
point branching occurs; whereas zone I of lateral row perforators is centered lateral to the location of the perforator at the anterior rectus sheath, as there is a lengthy lateral course traversed by lateral row perforators before reaching the Scarpa fascia and branching.

3. The primary zones (zones I and II) of medial row perforators routinely cross the midline to perfuse the medial parts of the contralateral hemiabdominal wall, whereas lateral row perforators do not primarily communicate with branches that cross the midline.

4. Zones I and II (the territories of maximal perfusion within a perforator flap) comprise more than the entire ipsilateral hemiabdomen for a medial row perforator, but are more limited for a lateral row perforator.

These findings match similar studies by Wong et al., and a close look at the results of the current study demonstrate that Rahmanian-Schwarz et al. have similar findings themselves: the perfusion studies in their Figure 6 demonstrate very nicely the “perforator angiosome” of a single perforator—shown nicely to not fill an entire TRAM flap zone.

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Reply: A Combined Anatomical and Clinical Study for Quantitative Analysis of the Microcirculation in the Classic Perfusion Zones of the Deep Inferior Epigastric Artery Perforator Flap

Sir:

It is with great honor that we reply to such interesting commentary and insightful observations made by our esteemed colleagues, Drs. Rozen, Whitaker, and Ashton. We appreciate their ongoing productive assessment and work in the field of plastic and reconstructive surgery.

The aim of our study was not necessarily to redefine the zones of the deep inferior epigastric artery perforator (DIEP) flap but rather to combine a clinical and cadaveric study and to assess the perfusion dynamics and vascular anatomy of these two distinct study types. The authors intentionally chose to use Hartrampf’s zones, as these are familiar to most plastic and reconstructive surgeons. Furthermore, this has been the standard for research and has been used by Wong et al., Holm et al., and Baily et al. to compare their results.

Our study showed that there is a difference between cadaveric and clinical perfusion of the DIEP flap. We speculate that the differences between anatomical and clinical results could be attributable to systemic and local mediator processes that are only found in living tissue or may even be released after circumcision and raising of a flap. As discussed in our publication, we further hypothesize that the cause of such dynamic perfusion phenomena is related to the choke vessels mentioned by de Weerd et al. They describe choke vessels between the angiosomes on each side of the midline that form a greater resistance for circulation than the choke vessels between the ipsilateral angiosomes.

Wong et al. demonstrated in their ex vivo study “Perforasomes of the DIEP Flap: Vascular Anatomy of the Lateral versus Medial Row Perforators and Clinical Implications” that the medial row perforators demonstrated a regular perfusion across the midline and rarely any perfusion across the midline from lateral row perforators. There is a vast difference in results when this is compared with our clinical (i.e., in vivo) measurements. Our intraoperative measurements, using the O2C device, show no significant differences in the perfusion of zones II and III (Fig. 1).

We acknowledge similarities with the results of Rozen et al. and Holm et al. Nonetheless, we would like to point out the major differences in the carrying out of the clinical studies. Our measurements were carried out preoperatively and intraoperatively, that is, after the circumcision and raising of the flap on a...