The “Gent” Consensus on Perforator Flap Terminology: Preliminary Definitions

Discussion by G. Ian Taylor, M.D.

It is often said that what goes around comes around, and it is pleasing that perforator flaps have focused us once again on the fundamental basis of all good surgery: the applied anatomy of the region. It is timely that instead of endless descriptions of flaps that focus on the tissue components or the various surgical gymnastics to raise them, we are now revisiting at last one of the most important factors that determine flap survival: the anatomy of the blood supply and venous drainage of the transplant.

In this important article, Phillip Blondeel and his coworkers have made a major contribution with their attempt to clarify and simplify, by consensus, the terminology that often has been confusing when different authors have described their various “perforator flaps.” This confusion has come about for several reasons: (1) because of the surgical technique used when raising the flap; (2) because of new terminology introduced by individuals; and (3) because of variations in the basic anatomy of the vessels and tissues of the region in question. For instance, the use of the word “perforator” by some of the pioneers in this field, which implies cutaneous perforator, was often quarantined to represent only musculocutaneous perforators, dissected through muscle to the underlying source artery. This was done, with good intentions, to indicate an often difficult dissection, but one with the potential benefit of a less bulky flap and reduced donor-site morbidity.

However, as Geoff Hallock has reaffirmed, a cutaneous perforator, by definition, is any vessel that perforates the outer layer of the deep fascia to supply the overlying skin and subcutaneous tissues, regardless of its pathway from the underlying source vessel. The term perforator, therefore, cannot be reserved for only musculocutaneous vessels, especially because for more than a century this all-embracing definition has been used by the pioneers in our specialty, including Manchot, Spalteholz, and Salmon, reconfirmed later by Daniel and Williams, and reviewed more recently by Timmons in 1985.

Most surgeons, when dissecting and defining various perforator flaps, have traced the cutaneous vessels from “the leaves to the roots” rather than the reverse direction. This can be confusing, as illustrated in the next two points. First, the same cutaneous perforator may have a constant destination but a variable origin. For example, Daniel and I found the superficial circumflex iliac artery arose in common with the superficial inferior epigastric artery in 83 percent of our dissections and separately from the common femoral artery or one of its branches, such as the profunda artery, in 17 percent of cases. Second, the same source artery may send, to the same site in the outer layer of the deep fascia, a musculocutaneous perforator in some patients and a septocutaneous vessel in others. For example, the variable perforators of the descending branch of the lateral circumflex femoral artery in the thigh are usually musculocutaneous but may be septocutaneous; the same can be said of the perforators of the ulnar artery in the forearm; and the perforators of the peroneal artery in the leg.

All vessels, including the cutaneous perforators, follow the connective tissue framework of the superficial and the deep fascia either between the specialized deep tissues (i.e., the direct cutaneous vessels) or through the deep tissues.
(i.e., the indirect vessels) as defined by Spalteholz and Salmon and recently reaffirmed by Hallock (Fig. 1). The latter group may pierce tissues other than muscle en route to the skin. Indeed, there are indirect vessels that course through glands, bone, and periosteum before emerging from the outer layer of the deep fascia. For example, the superficial temporal artery, from its origin at the neck of the mandible, passes for several centimeters through the parotid gland, supplying “glandulocutaneous” perforators to the skin over the parotid via its transverse facial branch, before piercing the deep fascia at the lower border of the arch of the zygoma to supply the scalp and forehead. The internal maxillary artery, which emerges from the infraorbital and mental foramina to supply the skin, provides osteocutaneous perforators, and periosteocutaneous perforators supply the skin over the tibia from the posterior tibial and peroneal arteries.

The dominant (primary) supply to the integument (skin and subcutaneous tissues) from the underlying source arteries varies from region to region. In the torso, the dominant supply is usually by indirect vessels. They are musculocutaneous perforators, with some notable exceptions, especially those direct cutaneous vessels that arise from the groin and the axilla. In the extremities, the dominant supply is usually by direct septocutaneous vessels, although once again there are large indirect musculocutaneous vessels in the buttock, thigh, and proximal calf (Fig. 2).

**FIG. 1.** Radiograph (above, left) and tracing (above, right) of a cross-section of the midtong of a cadaver injected with lead oxide. The vessels follow the intermuscular and intramuscular septa, and the direct septocutaneous vessels provide branches to the muscles en route to the skin from their source femoral or profunda arteries. The small indirect perforators in this study emerge from the muscles (small arrows). (Below) A schematic diagram shows a single direct septocutaneous perforator (b) and various indirect musculocutaneous perforators of varying sizes that pierce the muscle (or other specialized deep tissues) early (c) or late (a and d) to supply the overlying integument. In each case, the perforator supplies all adjacent tissues between the source artery and the skin.
The composition of the subcutaneous tissues may vary at different sites. Although fat is the only tissue present in most regions, the subcutaneous layer may include, in addition to fat, the muscles of the panniculus carnosus in other regions, for example, the muscles of facial expression in the head, the platysma in the neck, the palmaris brevis in the hand, and the dartos muscle in the scrotum.

All cutaneous perforators, whether direct or indirect, supply adjacent tissues before piercing the outer layer of the deep fascia. It is obvious that this is the case for the indirect cutaneous perforators that pierce and supply muscle and other tissues, but it is also true for the direct perforators, whether they arise from their source artery close to the surface or from a deeper location. For example, the superficial circumflex iliac artery supplies the sartorius before it pierces the deep fascia; the perforators of the radial artery supply the superficial radial nerve; the lateral thoracic artery supplies the pectoral and serratus anterior muscles before supplying the skin and the breast; and the perforator of the circumflex scapular artery supplies twigs to the adjacent triceps and teres major muscles as it emerges from the triangular space to supply the integument.

Therefore, with the definition of direct and indirect perforators in mind, direct cutaneous and septocutaneous vessels are synonymous. This is in accordance with the original definitions provided by Spalteholz and Salmon, and it answers one of the questions posed by Blondeel et al., as to whether direct cutaneous vessels should be included in the septal perforator group: they should.

Subsequent definitions by the authors follow logically, so that for practical purposes the perforator flaps fall into the two groups as described: the muscle (musculocutaneous or indirect) perforator flaps and the septal (septocutaneous or direct) perforator flaps. If Figure 1 in the article by Blondeel et al. is examined, their five categories of cutaneous perforators can be simplified. Type 1 and type 5 perforators are both direct septocutaneous vessels coursing between the deep tissues. This is so regardless of whether these tissues are

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![Schematic diagram showing the sites of the dominant cutaneous perforators of 0.5 mm or greater as they emerge from the outer layer of the deep fascia from their source vessels. The majority of perforators are musculocutaneous on the torso, piercing the muscles near their fixed attachments, whereas they are most often septocutaneous in the limbs, piercing the deep fascia between muscles, tendons, or bone.](image-url)

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muscle, tendon, or bone, whether their source vessel is close to the undersurface of the outer layer of the deep fascia or is more deeply situated, and whether the cutaneous vessel travels in a loose areolar tissue partition or adjacent to a thin fibrous septum. Furthermore, a type 4 perforator as shown in their Figure 1 does not exist. All vessels that pierce muscle supply that tissue as they pass through; hence, their type 3 and 4 perforators are the same.

I commend the definitions put forward by Blondeel and his coauthors, with the above recommendations, but I would make a plea for sanity regarding nomenclature. Personally, I hate abbreviations, and if we start talking about PIP, POP, PUP, PAP, or POOP flaps, this will end up looking like a Morse code dictionary. About the only abbreviation I like is KISS, and you all know what that stands for: keep it simple, surgeons.

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REFERENCES