Perforator flap terminology: update 2002
Phillip N. Blondeel, MD, PhD*, Koenraad Van Landuyt, MD, Moustapha Hamdi, MD, Stan J. Monstrey, MD, PhD

Department of Plastic and Reconstructive Surgery, University Hospital Gent, De Pintelaan 185, 2K12C, B-9000 Gent, Belgium

Over the last decade, the number of different perforator flaps has increased rapidly. Confusion arose in the absence of clear definitions and agreements concerning definition, classification and nomenclature of perforator flaps. This led to certain misunderstandings among surgeons who perform perforator flap surgery and growing criticism from its antagonists. During the Fifth International Course on Perforator Flaps in Gent, Belgium in 2001, the pioneers in this area sat together to come up with clear rules and definitions on the terminology of perforator flaps. Although the opinions of the surgeons differed on certain points, a consensus was reached on six preliminary definitions. Those definitions are listed in Box 1. In addition to the definitions on vessels, flaps, and nomenclature, an attempt was made to classify the different perforator vessels (Fig. 1A). Here, a distinction was made between direct and indirect perforators as well as (indirect-) muscle and septal perforators. The general opinion and conclusions reflected in the first consensus was to distinguish between muscle (or myocutaneous) perforator flaps and septal (or septocutaneous) perforator flaps. The need to differentiate between the muscle and septal perforator flaps was important to identify the different surgical techniques that are involved for either one of these flaps. Therefore, the attention of the surgeon would be focused on the anatomy of the perforator and the source vessel following the angiosome principles of Taylor and Palmer [1]. Unfortunately, at that time, it was unclear where the direct perforator flaps with pedicles running through other structures than septum or muscle (eg, nerve or bone), would be classified.

Modifications to the 2001 consensus

During the Sixth International Course on Perforator Flaps that was held from October 23 until October 26, 2002 in Taipei, Taiwan, a roundtable was held concerning the terminology. The general feeling was that the terminology, definitions, classifications, and nomenclature should be as simple as possible. The need for a distinction between a septal perforator flap and a muscle perforator flap was reconfirmed. In agreement with the authors of the first article on terminology consensus, the different types of perforator vessels were further simplified (Fig. 1B). In the first consensus, a distinction was made between indirect muscle perforators that predominantly supply subcutaneous tissue and those that predominantly supply the muscle with secondary branches to the subcutaneous tissue. A third type of muscle perforators is the indirect perimysial perforators that travel within the perimysium between the muscle fibers before piercing the deep fascia. To simplify the classification, it is easier to classify those three subtypes of muscle perforators as one group, “indirect muscle perforators.” All of these types of muscle perforators have branches to the overlying subcutaneous tissue after piercing the deep fascia. The structures through which the perforators run within the muscle and the size of the branches can be variable, but the type of surgical technique that is used to dissect all three of these perforators is identical.

Conversely, type 1, direct perforators, and type 5, indirect septal perforators, of the previous consensus...
Box 1. Preliminary definitions as agreed upon at the Fifth International Course on Perforator Flaps in 2001

A perforator flap is a flap that consists of skin or subcutaneous fat. The vessels that supply blood to the flap are isolated perforator(s). These perforators may pass either through or in between the deep tissues (mostly muscle).

A “‘muscle’” perforator is a blood vessel that traverses through muscle to supply the overlying skin.

A “‘septal’” perforator is a blood vessel that traverses only through septum to supply the overlying skin.

A flap that is vascularized by a muscle perforator is called a muscle perforator flap.

A flap that is vascularized by a septal perforator is called a septal perforator flap.

A perforator flap should be named after the nutrient artery or vessels and not after the underlying muscle. If there is a potential to harvest multiple perforator flaps from one vessel, the name of each flap should be based upon its anatomical region or muscle.

Box 2. Modified definitions from the Sixth International Course on Perforator Flaps in 2002

A perforator flap is a flap consisting of skin or subcutaneous fat. The vessels that supply blood to the flap are isolated perforator(s). These perforators may pass from their source vessel origin either through or in between the deep tissues (mostly muscle).

A “‘muscle’” or myocutaneous perforator is a blood vessel that traverses through muscle to pierce the outer layer of the deep fascia and to supply the overlying skin.

A “‘septal’” or septocutaneous perforator is a blood vessel that traverses only through septum to supply the overlying skin after piercing the outer layer of the deep fascia.

A skin flap that is vascularized by a muscle perforator is called a muscle perforator flap or musculocutaneous perforator flap.

A skin flap that is vascularized by a septal perforator is called a septal perforator flap or septocutaneous perforator flap.

(see Fig. 1A) make up different groups. This reduced the classification from five different perforators to three different perforators:

1. Indirect muscle perforators (including perimysial perforators) that travel through muscle before piercing the deep fascia
2. Indirect septal perforators that travel through the intermuscular septum before piercing the deep fascia
3. Direct perforators that perforate the deep fascia only.

The different definitions were maintained and only a few adjustments were made (changes are shown in italics) (Box 2).

The terms “myocutaneous” and “septocutaneous” were introduced during the last perforator course meeting and indicate clearly the course of the perforator through the deeper structures. This would have some analogy to the older terms “musculocutaneous or myocutaneous flaps” and “septocutaneous flaps.” The modified definitions also clearly state the distinction between the two main types of perforator flaps, namely muscle and septal perforator flaps.

No consensus was reached for flaps that are vascularized by a direct perforator or if they should be included in the septocutaneous perforator flaps. The protagonists argue that the dissection of a septocutaneous perforator and a flap that is vascularized by a direct perforator is similar and that it would simplify the classification. From a semantic point of view, the antagonists argue that septocutaneous perforator flaps are not the same as a flap that is vascularized by a direct perforator, and, therefore, should be distinguished. For example, the groin flap, although its nourishing vessels perforate the deep fascia, could hardly be called a perforator flap.

The following facts were reconfirmed: the vessels of a muscle perforator flap can pierce any muscle independent of the donor morbidity created, inde-
ependent of the muscle fiber direction in relation to the
course and direction of the perforator, and also
independent of the length of the pedicle.

The consensus on perforator flap nomenclature has
not been rediscussed. For that reason, the original
definition still must be applied if a perforator flap is
described or if a new perforator flap is being given
a name.

Discussion

Although all authors of the first terminology
consensus agreed that the first definitions were tem-
porary, it soon became clear that further simplification
of the terminology and definitions were necessary.
Classification of the perforator vessels was espe-
cially confusing. Therefore, we propose a more sim-
plicity way to classify the perforating vessels and the
perforator flaps.

Three main subgroups of vessels were defined: (1) the
(indirect) “muscle” perforators or “myocutane-
ous” perforators (for the musculocutaneous perforator
flap), (2) the (indirect) “septal” or “septocutaneous”
perforators (for the septocutaneous perforator flaps),
and (3) the direct perforators. Musculocutaneous and
septocutaneous perforators are indirect perforator ves-
sels. Nevertheless, there is a small group of perforator

Fig. 1. (A) Schematic drawing of the different types of direct and indirect perforator vessels with regard to their surgical
importance conform to the first consensus in 2001. (1) “Direct perforators” perforate the deep fascia only. (2) “Indirect muscle
perforators” predominantly supply the subcutaneous tissues. (3) “Indirect muscle perforators” predominantly supply the muscle,
but with secondary branches to the subcutaneous tissues. (4) “Indirect perimysial perforators” travel within the perimysium
between muscle fibers before piercing the deep fascia. (5) “Indirect septal perforators” travel through the intermuscular septum
before piercing the deep fascia. (B) Simplification by the 2002 consensus into three types of perforator vessels: (1) Indirect
“muscle” or myocutaneous perforators traverse through muscle to pierce the outer layer of the deep fascia and supply the
overlying skin. (2) Indirect “septal” or septocutaneous perforators traverse only through septum and supply the overlying skin
after piercing the outer layer of the deep fascia. (3) “Direct” perforators perforate the deep fascia only.
vessels that perforate structures other than muscle and septum. For example, in the head and neck area, many osteocutaneous perforators can be found, such as the mental, infraorbital, and supraorbital vessels. Although it is unlikely that osteocutaneous perforator flaps will be harvested from that area, one should be aware of their presence. Small blood vessels can perforate other tissues, as well (e.g., the parotid gland, nerve, or periosteum).

The simplification of the “perforator vessels” classification led to more specific definitions on musculocutaneous and septocutaneous “perforator flaps.” These two now make up the two main groups of indirect perforator flaps; the third is the group of direct perforator flaps. These three subgroups of flaps contain most of the pedicled and free axial skin flaps that are used in daily practice.

The main goal for defining a perforator flap as an entity and making a subclassification in three important groups is twofold. First, the term “perforator flap” indicates to the surgeon involved that a specific surgical technique is needed to harvest the flap. The adjective of “indirect musculocutaneous,” “indirect septocutaneous,” and “direct perforator” flap, clearly describes which surgical approach is needed for the different subtype. The surgeon will have to focus on the position and the three-dimensional course of the vessel through the deeper tissues. More specifically, muscle or myocutaneous perforator flaps will have to be raised by opening the deep fascia, splitting the donor muscle, preserving its other vascularization and motor innervation, and, eventually, exposing its source artery. For septal or septocutaneous perforator flaps, the perforator will be looked for within an intermuscular septum and followed through that septum down to the source artery.

Some microsurgeons might argue that the direct perforator flaps and the septocutaneous perforator flaps should make up one group. We believe that it is necessary to make a clear distinction between those two groups. In a direct perforator flap, like the groin flap, the perforators do not run through a specific intermuscular septum. They only pass through loose, fatty tissue in the groin area and eventually perforate the deep fascia more proximally. A specific septum is not looked for, and the surgical technique is different from the septocutaneous flap. With the septocutaneous perforator, the perforator can be localized directly within the fibers of an intermuscular septum; this makes the surgical technique different from the direct cutaneous flaps.

In the discussion of nomenclature, the definition of a source vessel is extremely important. Although everybody seems to agree with naming a perforator flap after the nutrient artery, there is some discussion about perforator flaps that are harvested from a source vessel that can give rise to multiple perforator flaps. Different orders of vessels are observed between the skin and the aorta with obviously different names. There is clearly still some debate about which order of branching should be used to name a perforator flap. For the present, the closest underlying axial source vessel that has been clearly defined anatomically is used to name the perforator flap.

Although it was agreed during the first consensus to avoid elaborate adjunctives, such as “thin” and “ultrathin,” there is a need to better define the thinning of a perforator flap. Specifically, Asian microsurgeons are more aggressive in thinning flaps in a primary phase. As described by Nakajima et al [2], the course of different branches of a perforator after perforating the deep fascia, can be variable but at the borders of the flap, the flap can be thinned considerably. Also Taylor and Palmer [1] showed that vascularization of the fat below Scarpa’s fascia is much less predominant. The difference between thin and ultrathin flaps is the amount of fat that is resected from the flap itself. A flap is “thinned” if a certain amount of fat is removed from the deepest part of the subcutaneous layer. A flap is “ultrathin” if almost all subcutaneous fat is removed and only the skin and subdermal plexus is preserved. Thinning can be done blindly or selectively by following the branches of the perforator within the subcutaneous tissues.

Because we are still in the very early phase of the development of perforator flaps, and, specifically, trying to come up with clear definitions and terminology, the definitions in this article are temporary. As mentioned in the first consensus, these definitions and terminology will be discussed at the annual forum of the International Course on Perforator Flaps.

References