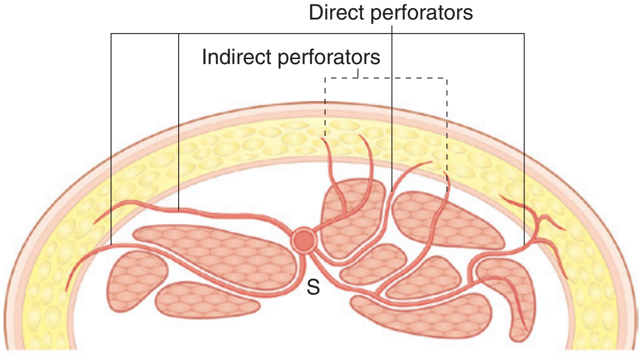

Figure 2.5 The deep fascia perforators of Nakajima et al.[14] (see Fig. 2.4) can be more simply considered to be either "direct" or "indirect" perforators. All perforators arise from the same source vessel (S) but only "indirect" perforators (dotted lines) first pass through another tissue intermediary (here depicted as muscle) before piercing the deep fascia.

an underlying source vessel. Taylor has repeatedly argued that the direct vessels are the primary cutaneous supply, and it is irrelevant if they have first traversed intermuscular or intramuscular septa, as their main destination always is to the skin.[27,28,37,38] The indirect vessels emerge above the deep fascia as terminal, spent branches whose main purpose was to supply the deeper tissues, so they are in reality only a secondary means of cutaneous blood supply.[39] It can be further argued that all deep fascia perforators would be *"direct"* if they coursed from the source vessel to perforate the fascia without first passing through some other tissue intermediary, or otherwise they would be *"indirect"* perforators (Fig. 2.5).[28,40] All corresponding cutaneous flaps would then be either direct perforator flaps or indirect perforator flaps.

Because the perforator supplying a muscle perforator flap, by definition,[35] must have first traveled through the substance of that muscle, in this classification system, these would be indirect perforator flaps. Neurocutaneous flaps would be an excellent example of indirect non-muscle perforator flaps. These flaps rely on an intrinsic and extrinsic neurocutaneous or venocutaneous vascular supply that accompanies a peripheral cutaneous nerve.[41–44] The extrinsic vascular supply can often be a true artery, and, depending on the nerve, both structures can simultaneously pierce the deep fascia before proceeding within the subcutaneous tissues.[41–44] The major purpose of this accompanying vascular system is to provide circulation to the nerve, and only secondarily (or indirectly) are cutaneous branches given off that will support an overlying cutaneous flap. Niranjan et al.[33] pointed out that perforators similar to those accompanying the cutaneous nerves can also arise independently from fascioperiosteal or tenosynovial branches, which in turn also can supply indirect non-muscle perforator flaps. Thus, indirect perforator flaps, more than any other cutaneous flap, deserve a separate categorization to ensure the appropriate dissection of whatever are the intermediary structures, while protecting the requisite vascular supply.

MUSCLE FLAPS

In the 1980s, muscle flaps became very popular, since it was a reliable method to transfer large skin flaps. Over the decades, the use of muscle flaps has evolved so that muscle function is rarely sacrificed simply to supply skin blood supply but rather, muscle flaps are used when a large volume of flap is required to fill dead space or muscle function is required, as, for example, with facial reanimation. It remains important that the pattern of vascularity of muscles will determine muscle flap survival and must be respected.

MATHES AND NAHAI MUSCLE FLAP CLASSIFICATION

Mathes and Nahai[45] (1981) categorized muscles into Types I–V, based on their vascular supply (Fig. 2.6). On the other hand, it is not just a coincidence that the majority of musculocutaneous perforators arise near where the dominant pedicle enters the hilum of that muscle. The astute student of muscle perforator flaps must be fully aware of the most reliable muscle types, which pedicle is dominant, and where they are typically located to better predict the presence of musculocutaneous perforators. This is essential for skilful elevation of these flaps, even though the muscle itself is not to be included.

TAYLOR CLASSIFICATION

Taylor et al.[46] have also divided muscles into four groups (Types I–IV) that differ by their mode of motor innervation (Fig. 2.7). This classification becomes important when a dynamic muscle transfer is considered, to ensure capture of an appropriately functioning muscle unit.

OTHER FLAPS

Vascularized bone flaps are used less frequently than soft tissue flaps. Again, as for all other flaps, a good system would categorize these primarily on the basis of their circulatory patterns.

SERAFIN CLASSIFICATION

Serafin has divided osseous flaps according to whether the flap has a direct (endosteal) or indirect (periosteal) circulation (Fig. 2.8).[47] Vascularized joint transfers could similarly be subclassified according to the source of vascularization of their bony constituents.

COMBINED FLAPS

In extraordinary circumstances, the creative combination of flaps from a single donor site is used to repair challenging defects where multiple tissue islands are required. The sporadic introduction of variations of combined flaps has created much confusion in terminology, since minor modifications of technique often have been called different names or given eponyms, but the basic flap composition has remained unaltered. There are two major subtypes of combined flaps that are distinctly different in regards to the physical relationship of their component parts, yet both are similar in that each anatomic territory that is part of that combination always retains an independent blood supply.

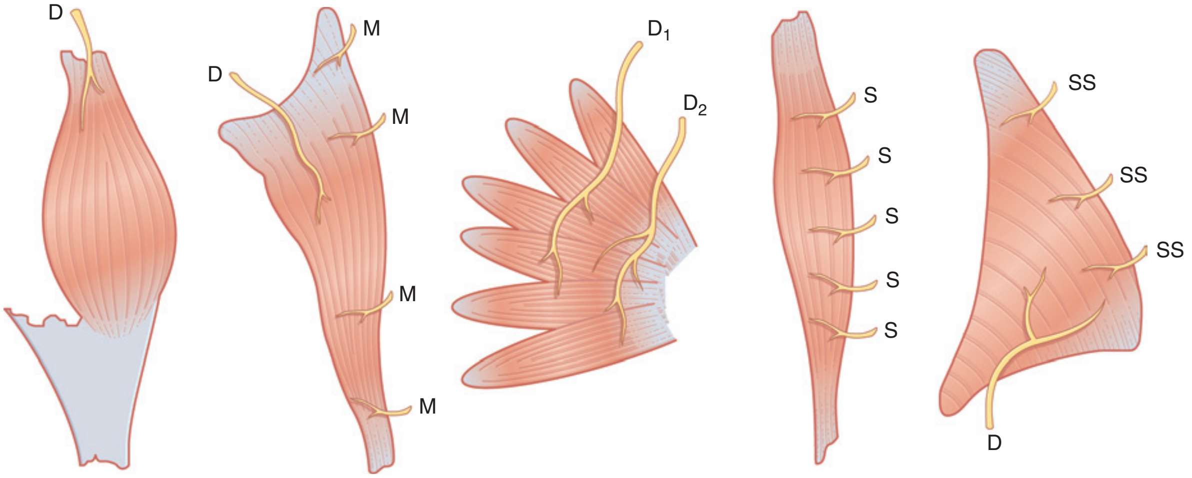

Figure 2.6 The classic classification schema for muscle flaps by Mathes and Nahai[45] is divided into five types, according to the predominant vascular pattern for that type muscle. D, dominant pedicle; M, minor; SS, secondary segmental; S, segmental.

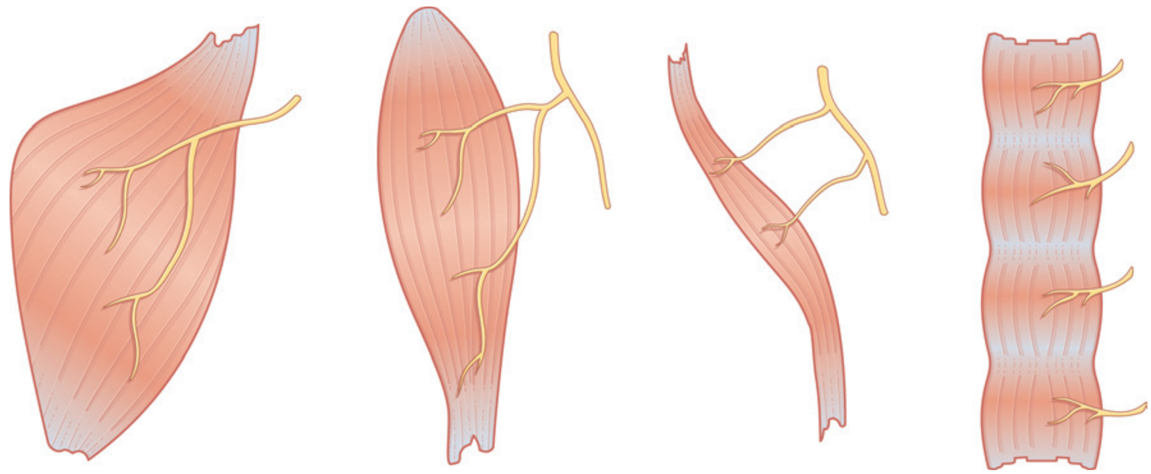

Figure 2.7 Taylor's[46] alternative schema classified muscles according to the increasing complexity of their innervation, and concomitant diminished suitability for use as a dynamic muscle transfer. (A) Type I: single unbranched nerve entering muscle. (B) Type II: single nerve that branches just before entering muscle. (C) Type III: multiple branches from same nerve trunk. (D) Type IV: multiple branches from different nerve trunks.

CONJOINED FLAPS

Harii et al.[25,48] first introduced the concept of combined flaps when they described a "combined myocutaneous flap and microvascular free flap." This captured the skin territories of the latissimus dorsi musculocutaneous flap and groin flap, where both remained connected together to essentially form a bipedicled flap with the thoracodorsal and superficial circumflex iliac vessels remaining as pedicles at opposite ends, respectively.[25] Such a conjoined flap or Siamese flap (named after the conjoined Siamese twins, Chang and Eng, 1811–1874)[49] will have multiple flap territories that remain dependent due to some common physical junction, yet each territory retains its intrinsic and independent vascular supply (Fig. 2.9).

Any direct or indirect perforator flap[40] that has more than a single perforator could also be considered to be a "conjoined" flap, as each perforator retains its specific vascular territory that, for example, Tsai et al.[50] have used to advantage as the basis for "splitting" the flap. These would be called "perforator-based conjoined flaps" in contradistinction to Harii et al.'s[25,48] flap that retained independent branches of the source vessel to each territory, hence being an example of a "branch-based (independent) conjoined flap." If the independent branches had a common "mother" vessel, as in a conjoined parascapular and latissimus dorsi muscle flap as theorized by Nassif et al.,[51] this would be an example of a "branch-based (common) conjoined flap."