

# Indications, Selection, and Use of Distant Pedicled Flap for Upper Limb Reconstruction

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## KEYWORDS

- Pedicled flap • Soft tissue cover upper limb • Groin flap • Abdominal flap
- Hand injury reconstruction

## KEY POINTS

- Pedicled flaps are easy to raise, are reliable, and do not need microsurgical expertise.
- Many of the disadvantages of pedicled flaps can be offset by properly planning the flap.
- Narrowing the base of the flap around the axial vessels, keeping just adequate length to allow comfortable mobility and primary thinning of the critical end of the flap are important steps.
- Good radical debridement before inseting of the flap facilitates primary reconstruction of tendons and bones.
- Secondary thinning can be aggressively performed in pedicled flaps.
- When vessels are not available for free flaps, or when free flaps fail, pedicled flaps can be a lifeboat.
- Pedicled flaps can also be used in preparation for a major microsurgical procedure, such as toe transfer or microsurgical bone reconstruction.

## INTRODUCTION

The description of the pedicled groin flap by McGregor and Jackson<sup>1</sup> was a milestone in the journey of reconstruction of soft tissue defects of the hand. Understanding of the axial pattern of blood supply in that flap led to further identification of flaps based on various cutaneous vessels. Subsequent introduction of microsurgical free flaps enormously extended the reconstructive capability, to an extent that the option of a pedicled flap to cover soft tissue defects in the hand was often relegated to the background. Free flaps have the advantage of being a single-stage procedure, involve fewer hospital inpatient days, encourage the primary reconstruction of other injured structures, and patients do not have to go

through the discomfort and the period of “attachment” to the abdomen.<sup>2</sup>

Despite these advantages, pedicled flaps have survived as a valuable part of the reconstructive surgeon’s armamentarium. Furthermore, refinements in techniques can offset most of the presumed disadvantages associated with pedicled flaps.<sup>3</sup> When well done, the outcome of pedicled flaps can be as good as and in certain aspects even better than what a free flap can achieve in the long term. In circumstances when free flaps cannot be done because of paucity of recipient vessels or infrastructural inadequacies or when they fail, pedicled flaps serve as lifeboats.<sup>4</sup>

In the reconstruction of complex defects, pedicled flaps can serve as a foundation for the subsequent microsurgical procedure. Groin flaps are

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used to cover the amputation stumps of the fingers and thumb before toe transfers.<sup>5</sup> In major injuries and single vessel limbs, pedicled flaps are used to cover the soft tissue defect and subsequently the bone defect can be reconstructed with a free fibula transfer. In this way pedicled flaps are complementary to the success of microsurgery. Hence, it is mandatory on the part of an upper limb reconstructive surgeon to be well versed in the techniques of performing pedicled flaps. In most parts of the world they still serve as the workhorse in the management of upper limb injuries and will likely never be entirely supplanted by free tissue transfer.<sup>6</sup>

The anatomic basis of the commonly performed flaps, general principles that govern their use, site-specific technical considerations that influence the outcome, and complications and their avoidance are discussed in this article.

## ANATOMIC CONSIDERATIONS

The infraumbilical part of the abdomen and the lateral aspect of the trunk serve as common donors of pedicled flaps. The lower part of the abdomen is supplied by three vessel branches that arise from the femoral artery and the paraumbilical perforators (Fig. 1).

The superficial circumflex iliac artery (SCIA) arises from the femoral artery 2 cm below the

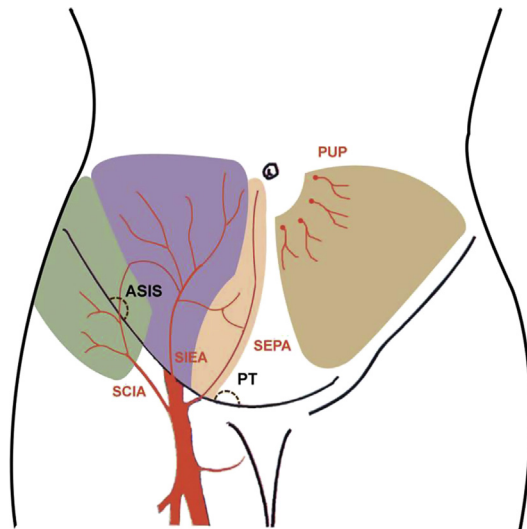
inguinal ligament or from a common trunk along with the superficial inferior epigastric artery (SIEA). It then passes laterally and gives a deep branch at the medial border of Sartorius. The cutaneous branch becomes superficial at the lateral border of the Sartorius and runs into the tissue that is raised as the groin flap. The vessel runs parallel to the inguinal ligament, about 2 cm below it toward the anterior superior iliac spine. A simple "rule of two finger widths" has been recommended by Chuang and colleagues.<sup>7</sup>

The SIEA arises from the femoral artery 1 cm distal to the inguinal ligament and passes vertically upward superficial to the inguinal ligament within 2.5 cm of the midinguinal point. It soon becomes superficial by piercing the Scarpa fascia and runs superolaterally with the final branches traced up to the umbilicus.<sup>8</sup>

The superficial external pudental artery (SEPA) arises from the femoral artery close to the preceding branches and passes medially deep to the great saphenous vein toward the pubic tubercle.<sup>9</sup> It gives off branches at this point, and one of the branches ascends toward the umbilicus.

The deep inferior epigastric artery arises from the external iliac artery just proximal to the inguinal ligament, passes beneath the rectus abdominis muscle, and anastomoses with the superior epigastric artery within the rectus sheath. They give rise to perforators along their course that pierce the anterior rectus sheath to supply the skin. The highest concentration of these perforators is near the umbilicus and they feed into a subcutaneous vascular network that radiates like the spokes of a wheel.<sup>10</sup> These paraumbilical perforators are useful to raise flaps that are used for the reconstruction of the volar defects of the forearm.<sup>11</sup>

These are the main vessels on which pedicled flaps used for the upper limb are based. The branches of these vessels anastomose freely with each other in the anterior abdominal wall. Choke vessels exist between the territories and most often the dimensions exceeding the primary territory of a particular vessel can be raised by incorporating an adjacent territory. A flap of large dimension can be raised by incorporating these vessels in the base. The distance between the site of emergence of the SCIA and the SIEA into the subcutaneous tissue is only 6 to 8 cm in an adult, irrespective of the thickness of the abdominal wall (Fig. 2). By planning the base to include both the vessels, a flap of large dimensions involving the entire infraumbilical part of the lower abdominal wall up to the midline can be raised. This could also be raised as a bilobed flap to simultaneously cover the volar and the dorsal defects of the hand.<sup>12,13</sup>



**Fig. 1.** A schematic diagram showing the commonly used flaps from the lower part of the abdomen for upper limb reconstruction and the vessels on which they are based. ASIS, anterior superior iliac spine; PUP, para umbilical perforators; SCIA, superficial circumflex iliac artery; SEPA, superficial external pudental artery; SIEA, superficial inferior epigastric artery.

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