Pre-expanded Internal Mammary Artery Perforator Flap

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KEYWORDS

• Internal mammary artery perforator flap • IMAP • Pre-expansion • Tissue expansion

KEY POINTS

- Advantages of the pre-expanded internal mammary artery perforator (IMAP) flap include increased vascularity from delay phenomenon, primary closure of donor site, decreased donor site morbidity, local tissue use, and no need for microsurgery.
- Disadvantages include staged reconstruction, protracted timeline for serial expansion, and risks/complications associated with tissue expansion.
- During pre-expansion, make the incision according to final flap design, fixate the tissue expander in the subcutaneous plane, and wait a minimum of 4 weeks between final expansion and flap harvest.
- A pinch test should be performed to ensure that direct primary closure can be obtained for the donor site.
- Confirm internal mammary perforator integrity, and adequate flow (visible pulse, loud audible venous, and arterial signals) before making a complete circumferential incision of the flap.

INTRODUCTION

Historically a mainstay of head and neck reconstruction, the deltopectoral flap[1–3] is perfused by multiple perforators of the internal mammary artery (IMA). Potential pitfalls of this flap, however, included high rate of flap necrosis, donor site skin grafting, and inability to island the flap leading to dog-earing.[4–6] Refinement of the original deltopectoral flap, based on the same perforator vessels, resulted in the IMAP flap, which was first described by Yu and colleagues.[7] Initially described for tracheostomy reconstruction, the IMAP flap is applicable toward various defects of the head, neck, and chest. Perforator flaps throughout the body have become essential tools for plastic surgery reconstruction. Recent advances in the vascular anatomy knowledge and dominant perforator location have increased flap selection options.

Perforator mapping and anatomic studies have elucidated the perforasome theory, which was outlined by Saint-Cyr and colleagues.[8] The perforasome describes the arterial vascular territory of a single perforator. Its characteristics and relationship to neighboring vascular territories were studied, revealing general principles pertaining to surgical vasculature.[8] Clinical application of this knowledge allows for more predictable and dependable results in perforator flap surgery (**Fig. 1**).

Tissue expansion has been used throughout the body to increase skin and cutaneous tissue. It has the added benefit of improving vascularity and allowing for primary donor site closure. Tissue expansion is commonly performed with traditional

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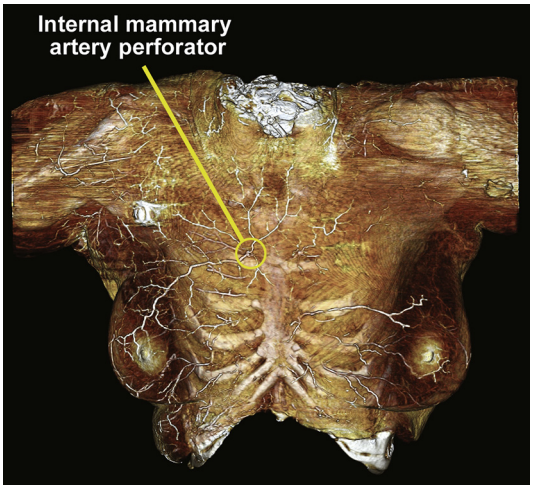

Fig. 1. CT angiography demonstrating IMAP perforator.

flaps, and it has only more recently been applied to perforator flaps. Pre-expansion of the pedicled IMAP flap is an excellent choice for reconstruction in select cases that require a large flap for the head, neck, or chest region—often in patients who have limited other options.

ANATOMY OF INTERNAL MAMMARY ARTERY PERFORATORS

The IMA runs 1 cm to 2 cm lateral to the edge of the sternum and divides into the deep superior epigastric artery and musculophrenic artery between the sixth costal cartilage and intercostal space. There are 2 venae comitantes distally, which merge between the third and fourth intercostal spaces to form 1 internal mammary vein.[9–11] The internal mammary vessels tend to be larger on the right side.

The perforating branches of the IMA pass through the intercostal muscles and medial pectoralis major. These cutaneous perforating branches are given off by the IMA in the first 5 to 6 intercostal spaces. The second perforator is generally the largest (usually >0.8 mm).[11,12] In an anatomic study conducted by Wong and colleagues,[13] the mean perforator diameter among IMA perforators was 1.50 mm in the first intercostal space, 1.83 mm in the second intercostal space, and 1.47 mm in the third intercostal space. The IMAPs have been demonstrated to vary in size and dominance between patients and chest side.[14–16] The IMAP flap is based on a single or double perforator of the IMA, and it can generally extend from the midline of the chest to the anterior axillary line.

The arterial territory, the perforasome, of the IMA perforators explains the characteristics of the IMAP flap. The foundation of the perforasome theory[8] consists of the following 4 principles:

1. Direct and indirect linking vessels (**Fig. 2**). Direct linking vessels are large vessels that communicate directly from one perforator to the next, and indirect linking vessels maintain perfusion between perforators through recurrent flow from the subdermal plexus.
2. Flap design and skin paddle orientation are dependent on linking vessel direction. Orientation of the linking vessels demonstrates direction of maximal blood flow. For the IMAP flap, this is perpendicular to the midline. The IMAP flap has a fairly large perforasome, which allows for greater customization for flap planning, including horizontal, vertical, and oblique designs.[11]

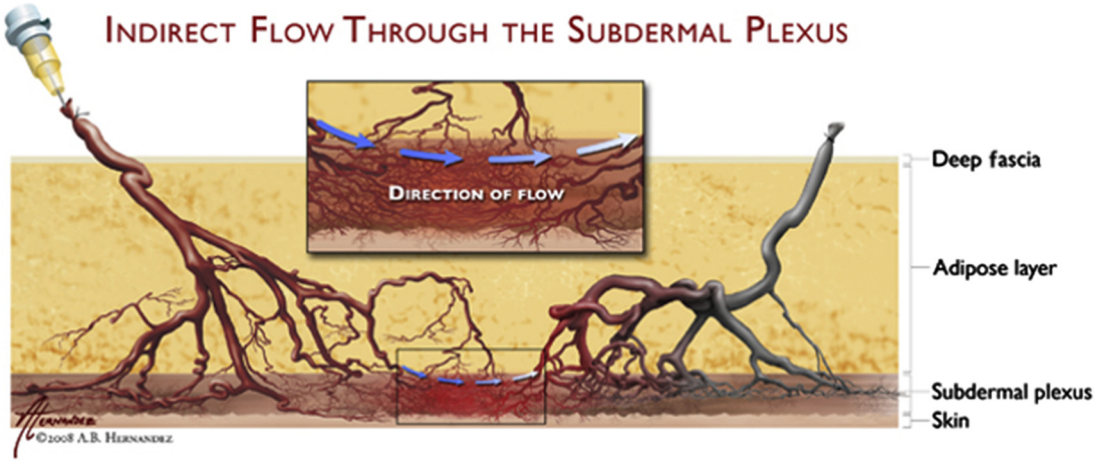

Fig. 2. Indirect linking vessels. (Printed with permission from A.B. Hernandez of Gory Details Illustration, Grapevine, TX.)