

Future Perspectives of Pre-Expanded Perforator Flaps

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KEYWORDS

- Pre-expansion • Pre-fabrication • Pre-expanded perforator flaps • Perforator flaps • Skin flaps
- Future perspectives

KEY POINTS

- Future perspectives of pre-expanded perforator flap from 2 editors are summarized in this review.
- Pre-expanded perforator flaps will be acknowledged and used more by worldwide plastic surgeons to reconstruct large skin defects.
- Pre-expander super-thin perforator flap may become a work horse for resurfacing if surgeons can improve and master the technique of performing these 2-staged reconstructions.
- With a better understanding of the improved blood supply to the flap and prefabrication of blood supply within the flap, pre-expanded perforator flap will play a more important role in reconstructive surgery.

INTRODUCTION

Although it may still not be fully understood how blood supply to the flap can be enhanced by pre-expansion of a perforator flap, the readers can see from this special issue that the pre-expanded perforator flap has been innovatively used by many reconstructive surgeons worldwide to solve some of the most difficult and challenging problems in our specialty. Although the clinical application of a pre-expanded perforator flap is primarily focused on head and neck reconstructions such a flap has also been used to reconstruct defects in the trunk, extremities or hands. There are considerable good clinical experiences presented in this special issue; therefore, pre-expanded perforator flaps can be used to reconstruct relatively large skin and soft tissue defects with improved functional and cosmetic outcomes.

ADVANTAGES AND DISADVANTAGES OF PRE-EXPANDED PERFORATOR FLAP

The advantages of a pre-expanded perforator flap are started with the concept that such a technique combines the application of a perforator flap with tissue expansion so that more flap tissue with improved blood supply can be available for reconstruction.¹ A pre-expanded perforator flap, in general, may be more reliable than a nonexpanded conventional perforator flap because of the pre-fabricated blood supply within the flap during targeted tissue expansion based on perforator flaps. Such a flap can provide “like-for-like tissue” for resurfacing large skin and soft tissue defects in any area of the body. It is especially true that such a flap can also provide not only large, but also a relatively thin flap to reconstructing large skin defects, especially in the face, neck, hand, or foot

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and other parts of the body with essentially no donor site morbidity but without the need for a subsequent skin graft or additional flap for donor site closure.²⁻⁴ Such a flap can be performed primarily as a pedicled flap without the need for more complex microsurgical procedures.

The disadvantages of pre-expanded perforator flap include inherent problems associated with the use of a tissue expander such as infection or expander extrusion. Such a reconstruction would require staged and multiple procedures for completion. It obviously may require prolonged hospital stay for the patient and, as with any other flaps, distal ischemia of the flap may still occur and would compromise the overall outcome of the reconstruction. In addition, owing to variations of perforator anatomy in each patient, some expertise would be required for preoperative mapping of the perforators so that during a preoperative design the expanders can be accurately placed for maximum effect of the prefabricated blood supply within the flap.⁵

UNDERSTANDING OF IMPROVED BLOOD SUPPLY TO PRE-EXPANDED PERFORATOR FLAP

Although the current understanding on how the vascular supply to the flap can be improved after pre-expansion of a perforator flap has been focused on the delayed phenomena, it is very true that the overall mechanisms on prefabrication of blood supply within a pre-expanded perforator flap would be more than just a delayed phenomenon but still less clearly understood. However, static 3-dimensional computed tomographic (CT) and dynamic 4-dimensional CT angiographies have been introduced to plastic surgery by Saint-Cyr and colleagues⁶ to investigate vascular anatomy and perfusion of a perforator flap. The static 3-dimensional CT angiography can assess vascular anatomy in the coronal axial and sagittal planes and the dynamic 4-dimensional CT angiography can evaluate the perfusion of a perforator flap by visualizing the actual filling of flap circulation over a short time interval in 3 dimensions.⁶ With these 3-dimensional or 4-dimensional CT angiographies, we are confident that prefabrication of blood supply within a pre-expanded perforator flap can be assessed live in patients that can provide extremely valuable information on what has happened in terms of how the blood supply within the flap could be enhanced after pre-expansion. In addition, large animal studies can also be performed with the use of these innovative techniques to determine and understand how the prefabrication of blood supply within

pre-expanded perforator flaps. With a better understanding of the mechanism on prefabrication of blood supply to a pre-expanded perforator flap, plastic surgeons will be able to have much clever use of such a flap for various reconstructions and to minimize complications through a better preoperative design for such a flap reconstruction.

IMPROVEMENT OF TISSUE EXPANSION AND ITS RELATED ISSUES

Because the creation of a pre-expanded perforator flap requires the placement of a tissue expander, any improvement of the tissue expander and its expansion process would definitely improve the outcome of such a flap reconstruction. This would include designing a different size, shape, or contoured expander similar to expanders used in breast reconstruction. Surgical techniques to minimize the trauma of expander placement such as endoscopic placement of expander may also improve the outcome of such a flap reconstruction. Could the expander be controlled by the patient for subsequent tissue expansion with a newly designed gas generated expansion used in breast reconstruction?⁷ Any of these refinements or innovations could definitely improve the overall outcome of tissue expansion for creation of a pre-expanded perforator flap.

Improvement of the expansion process may also contribute to the final outcome of a pre-expanded perforator flap. Can the expansion process be performed in a more speedy fashion but minimizing the complication rate of flap ischemia or expander extrusion? Some of the innovative therapies such as the application of the patient's own stem cells could enhance the tissue regeneration and improve ischemia during the tissue expansion that may essentially speed the expansion process and have more and better flap tissue available for reconstruction.⁸ In addition, topical administration of an angiogenic growth factor may also improve or minimize flap ischemia during tissue expansion for a pre-expanded perforator flap.⁹

MORE ACCURATE PRE-EXPANSION OR POST-EXPANSION PERFORATOR MAPPING

More accurate mapping of the perforator(s) before or after expansion of a pre-expanded perforator flap can be critical for the success of such a flap reconstruction. Because multidetector row computed tomography angiography is a novel imaging technology that can acquire both static and dynamic 3-dimensional or even 4-dimensional

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