

The Perforator Pedicled Propeller (PPP) Flap Method: A Report of Two Cases

Hiko Hyakusoku, Rei Ogawa, Koichiro Oki and Nobuaki Ishii

Department of Plastic, Reconstructive and Regenerative Surgery, Graduate School of Medicine, Nippon Medical School

Abstract

Background: Perforator flaps are thin free-tissue transfers consisting of skin and subcutaneous tissue which have the advantage of decreasing donor site morbidity. We have reconstructed postburn scar contractures using “propeller flaps” of the remaining healthy skin around the recipient sites. In this paper, we report on two cases and describe the concept of using “perforator flaps” and “propeller flaps” together as what are called “perforator pedicled propeller (PPP) flaps.”

Cases: Patient 1 was an 18-year-old man with a sacral pressure ulcer. The soft tissue defect was reconstructed with a rotated superior gluteal artery PPP flap. Patient 2 was a 53-year-old woman who presented with an open fracture of the right elbow. The skin defect over the fracture was covered with a rotated deep brachial artery PPP flap raised on the lateral upper arm.

Conclusion: The PPP flaps are useful for burn reconstruction and repairing various types of wound. Moreover, microsurgery is unnecessary. The PPP flap may be classified into two types: the central axis type and the acentric axis type. The central axis PPP flap is significant when used as a 90-degree-rotation island flap, and the acentric axis PPP flap is significant when used as a 180-degree-rotation island flap. Both types are easy to harvest and useful for repairing various kinds of wound.

(J Nippon Med Sch 2007; 74: 367–371)

Key words: propeller flap, perforator flap, free flap

Introduction

Perforator flaps have the advantages of minimizing donor site morbidity and being versatile owing to their thinness. Perforator flaps are usually used as free flaps but may also be used as pedicled flaps for reconstructing contiguous recipient sites^{1–3}. We have reconstructed postburn scar contractures

using “propeller flaps” of the remaining healthy skin around the scar and wound⁴. The flaps were elevated as island flaps, and recipient sites were covered with the rotated flap or skin grafts. The subcutaneous pedicle under the center of the flaps allows these methods to be characterized as “central axis flap methods⁵.” These methods are easily adapted to restore function and improve the appearance of scar contractures. In this report, we

Correspondence to Rei Ogawa, MD, PhD, Department of Plastic and Reconstructive Surgery, Nippon Medical School, 1–1–5 Sendagi Bunkyo-ku, Tokyo 113–8603, Japan
E-mail: r.ogawa@nms.ac.jp
Journal Website (<http://www.nms.ac.jp/jnms/>)

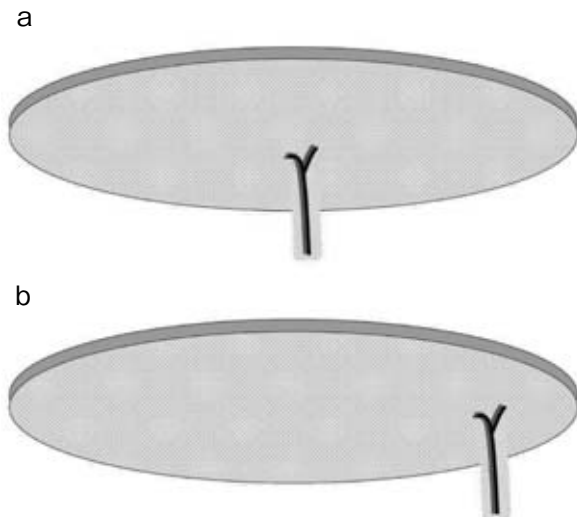


Fig. 1 The scheme of the PPP flap

a: Central axis type

The pedicle is located in the center of the flap. This type of flap can rotate 90 degrees to release contractures or cover skin defects.

b: Acentric axis type

The pedicle is located on an acentric portion of the flap. This type of flap can rotate 180 degrees and cover skin defects at some distance.

describe the concept of simultaneously using “perforator flaps” and “propeller flaps” called “perforator pedicled propeller (PPP) flaps”. These PPP flaps are useful for burn reconstruction and for repairing various types of wound. Moreover, microsurgery is not necessary because the flaps are the same size as free perforator flaps. In this report, we discuss the usefulness of and indications for PPP flaps.

Methods

The PPP flap can be obtained from every part of the body, enabling the harvesting of larger flaps if required. Doppler flowmetry is useful for identifying perforators preoperatively. The PPP flap is classified into two types on the basis of the position of the perforator pedicle (**Fig. 1a**). The first type is the “central axis type,” which is similar to our original propeller flap (**Fig. 2**)⁴. The pedicle is in the center of the flap, and recipient sites may be covered by 90-degree rotation of the flap (**Fig. 3a, b and c**). These flaps are especially useful for simultaneous release of

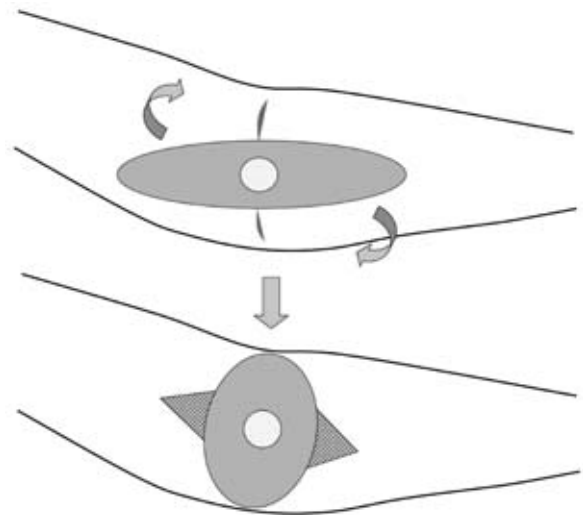


Fig. 2 The scheme of the conventional “propeller flap” method

The flaps are elevated as island flaps, and recipient sites are covered with a rotated flap and skin grafts. The subcutaneous pedicle under the center of the flaps allows these methods to be characterized as “central axis flap methods.”

bilateral side band contractures, and the wound next to the flap may be covered with the flap (**Fig. 3c**). However, covering the donor sites proved to be somewhat difficult, and skin grafts were sometimes required. This problem was overcome by small lobules attached to the sides of the propeller flaps, thus reducing the necessity of free skin grafts⁵.

In the second type of flap, the pedicle is located on an acentric portion of the flap (acentric axis type) (**Fig. 1b**). This type was reported by Teo at the first Propeller Flap Workshop in India⁶. The flap can cover a wound on an extension of the longitudinal axis of the flap by 180-degree rotation (**Fig. 3d**) and is useful for treating wounds of the limbs because long flaps can be designed on the longitudinal axis of limbs. Moreover, the donor site can sometimes be closed primarily.

Pedicles of both types of flap do not need to be refined as complete vascular pedicles if perforators are present. However, in the “acentric axis type,” the pedicle should be refined wherever possible to allow 180-degree rotation.

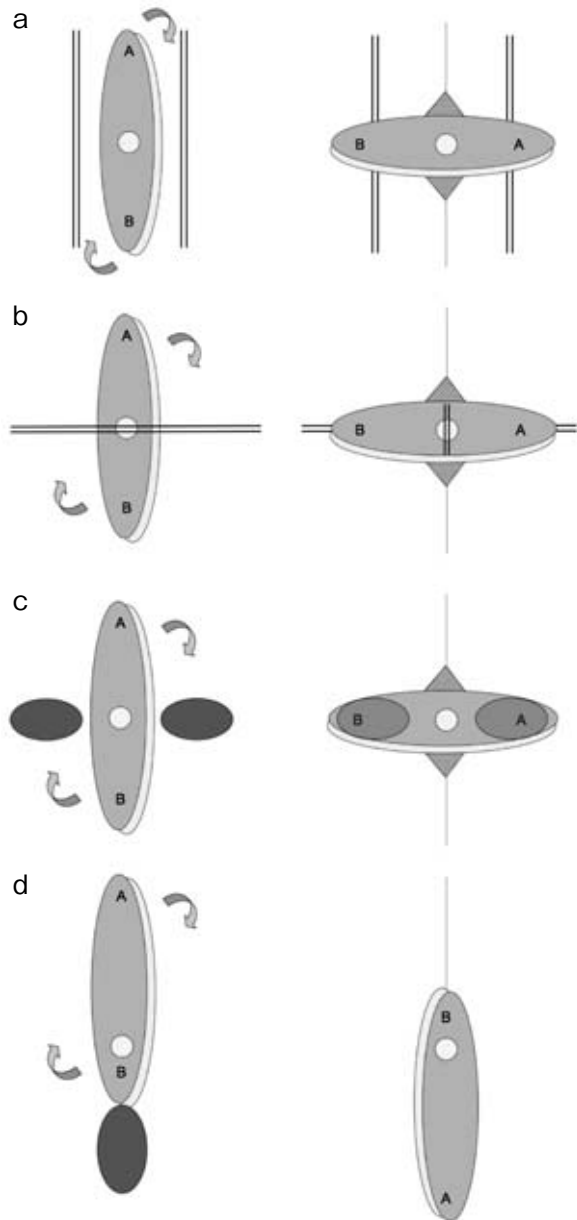


Fig. 3 The scheme of PPP flap rotation

The figures show typical uses of the central axis (a, b, and c) and acentric axis flaps (d). Usually, the central axis PPP flap is indicated for simultaneous bilateral band contracture release (a), in the vertical direction (b), and simultaneous bilateral wound closure (c). These central axis PPP flaps sometimes require small skin grafts to close the donor sites. The acentric axis PPP flap is useful for covering a wound on a line extending along the longitudinal axis of the flap by a 180-degree rotation (d). This type of flap is useful for wounds of the limbs because flaps can be designed on the longitudinal axis of limbs and the donor site can sometimes be closed primarily.

a, b: Contracture release using a central axis PPP flap
c: Covering a skin defect with a central axis PPP flap
d: Covering a skin defect with an acentric axis PPP flap

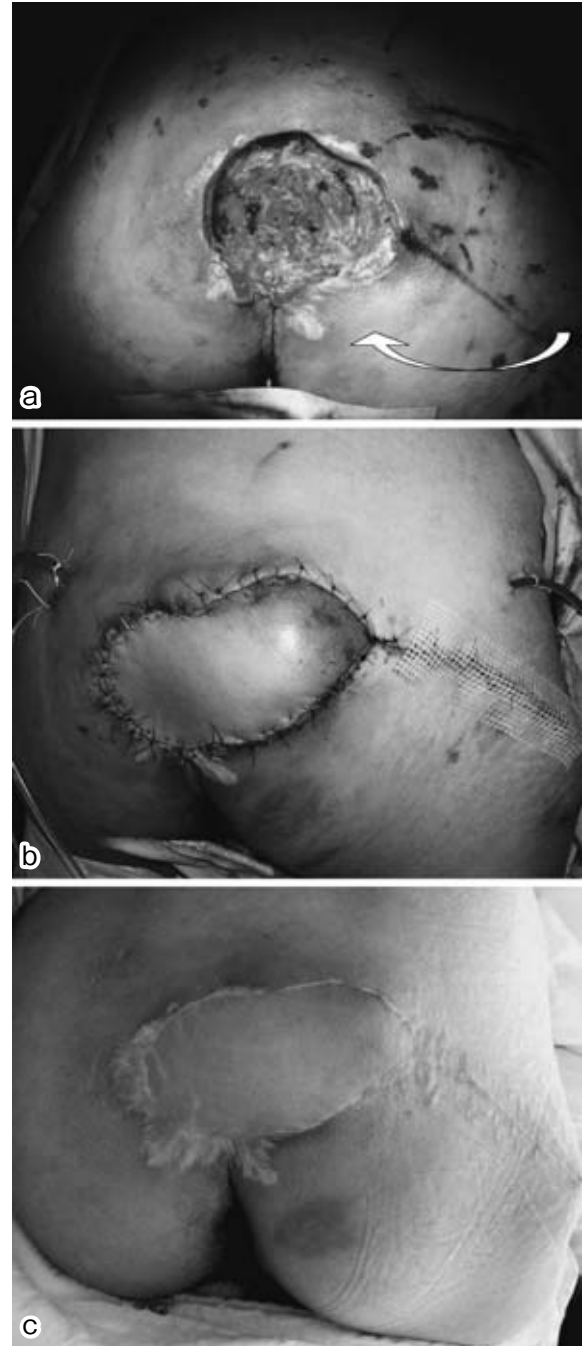


Fig. 4 Patient 1

An 18-year-old man with a sacral pressure ulcer that was repaired with a rotated superior gluteal artery PPP flap. The perforator pedicle was located on an acentric portion of the flap, and the pedicle was refined to a complete vascular pedicle. The donor site could be closed easily. The flap survived, and the pressure ulcer did not recur.

a: Intraoperative view
b: Immediate postoperative view
c: One-year postoperative view

Case Reports

Case 1

A sacral pressure ulcer developed in an 18-year-old man who had sustained a C5-C6 spinal cord injury after diving into a swimming pool and hitting his head against the bottom. After the debridement of necrotic tissue in the sacral ulcer, the skin and soft tissue defects were reconstructed with a rotated superior gluteal artery PPP flap (**Fig. 4a**). The perforator pedicle was located on an acentric portion of the flap, and the pedicle was refined as a complete vascular pedicle. After 180-degree rotation, no kinking of the perforator was observed, and the flap was sutured (**Fig. 4b**). The donor site could also be closed primarily. The flap survived completely, and pressure ulcer did not recur (**Fig. 4c**).

Case 2

A 53-year-old woman presented with an open fracture of the right elbow. Her right elbow had struck the door during an automobile accident. There was a bone defect of the right olecranon and a 6 × 4-cm skin defect. A bone tip harvested from ilium was grafted to the right olecranon using stainless steel wire. The skin defect over the fracture was covered with a rotated PPP flap raised on the lateral upper arm (**Fig. 5a**). The perforator was derived from the deep brachial artery; thus, this flap can be called a “deep brachial artery PPP flap.” The perforator pedicle was located on an acentric portion of the flap, and the pedicle was refined as a complete vascular pedicle (**Fig. 5b**). After 180-degree rotation, no kinking of the perforator was observed, and then the flap was sutured (**Fig. 5c**). The donor site could be closed primarily, and the flap survived completely.

Discussion

In the original propeller flap method, 90-degree rotation of the flap with a small subcutaneous pedicle in the center portion could be used to release contractures⁴. Recently, a similar rotation-flap method was described by Suzuki et al. as a kind of

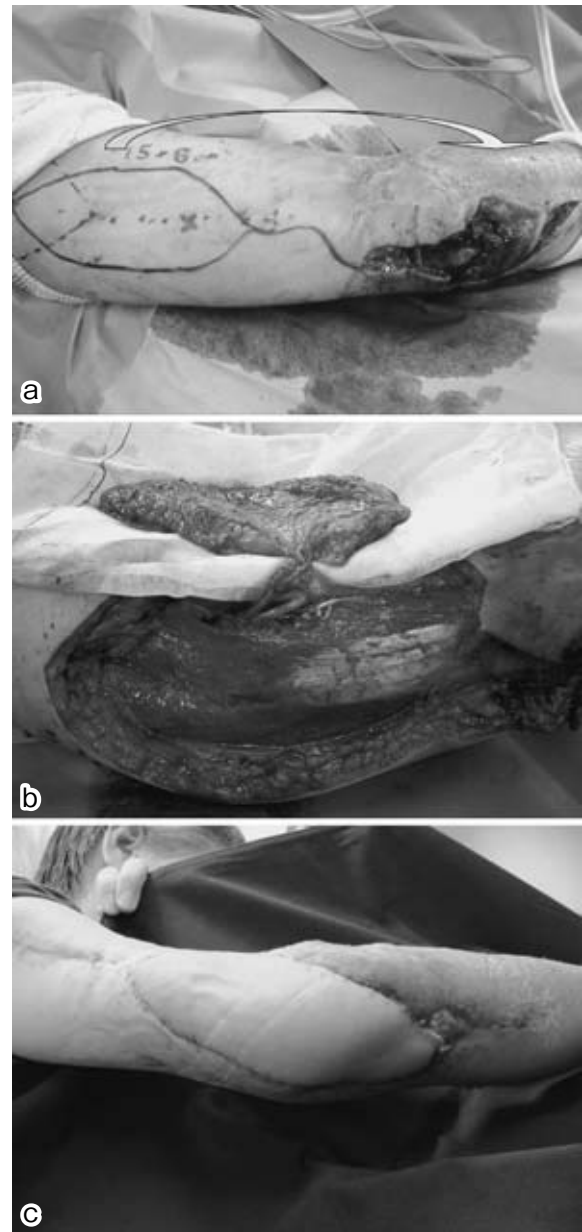


Fig. 5 Patient 2

A 53-year-old woman had an open fracture of the right elbow. After free bone grafting, a skin defect over the fractures was covered with a rotated PPP flap raised on the lateral upper arm. The perforator was derived from the deep brachial artery. Thus, we could call this flap a “deep brachial artery PPP flap.” The flap survived completely, and the donor site could be closed primarily.

a: Preoperative view

b: Intraoperative view

c: One-month postoperative view

subcutaneous pedicled flap for scar contracture repair in the nasal root, although the flap was extremely small⁷. These flaps have improved and are widely used for postburn reconstruction^{5,8-10}.

They are also useful for revision of mild, localized scar contractures. Tension of the recipient sites may be turned 90 degrees with flap rotation, allowing dramatic improvements to be achieved through only simple manipulations.

Teo⁶ has extended this technique and reported his flap at the first Propeller Flap Workshop in India in 2006 (this workshop was established by Balakrishnan at the Right Hospital in Chennai). This flap is a perforator pedicled island flap capable of covering a wound at some distance by 180-degree rotation (**Fig. 1b**). The flap may be designed for limbs and for every part of the body where perforators exist¹¹. This type of flap is quite useful for wounds of limbs because flaps may be designed on the longitudinal axis of limbs and donor sites can sometimes be closed primarily. In our two cases, donor sites could be closed primarily. The perforator pedicle on the acentric axis flap should be identified with Doppler flowmetry preoperatively and should be refined wherever possible for ease of 180-degree flap rotation.

The most important advantage of the PPP flap is easy manipulation, which eliminates the need for microsurgery. The flap may be harvested at an appropriate size, even as large as large free perforator flaps. Lastly, the definition of the "propeller flap method" must be determined. If a propeller-shaped island flap with a narrow subcutaneous pedicle or a perforator pedicle, in spite of its location, is not always in the central portion of the flap, conventional local flap methods, including the advancement flap method and the transposition flap method, should also be included in the "propeller flap method."

References

1. Zeng A, Xu J, Yan X, You L, Yang H: Pedicled deep inferior epigastric perforator flap: an alternative method to repair groin and scrotal defects. *Ann Plast Surg* 2006; 57: 285-288.
2. Eo S, Kim D, Jones NF: Microdissection thinning of a pedicled deep inferior epigastric perforator flap for burn scar contracture of the groin: case report. *J Reconstr Microsurg* 2005; 21: 447-450; discussion 451-452.
3. Yilmaz S, Saydam M, Seven E, Ercocen AR: Paraumbilical perforator-based pedicled abdominal flap for extensive soft-tissue deficiencies of the forearm and hand. *Ann Plast Surg* 2005; 54: 365-368.
4. Hyakusoku H, Yamamoto T, Fumiiri M: The propeller flap method. *Br J Plast Surg* 1991; 44: 53-54.
5. Hyakusoku H, Iwakiri I, Murakami M, Ogawa R: Central axis flap methods. *Burns* 2006; 32: 891-896.
6. Teo TC: Propeller flaps for upper limb reconstruction, 2006; The 1st Propeller Flap Workshop, India.
7. Suzuki S, Isshiki N, Ishikawa K, Ogawa Y: The use of subcutaneous pedicle flaps in the treatment of postburn scar contractures. *Plast Reconstr Surg* 1987; 80: 792-798.
8. Murakami M, Hyakusoku H, Ogawa R: The multi-lobed propeller flap method. *Plast Reconstr Surg* 2005; 116: 599-604.
9. Murakami M, Hyakusoku H, Ogawa R: The scar band rotation flap. *Burns* 2005; 31: 220-222.
10. Aslan G, Tuncali D, Cigsar B, Barutcu AY, Terzioğlu A: The propeller flap for postburn elbow contractures. *Burns* 2006; 32: 112-115.
11. Hallock GG: The propeller flap version of the adductor muscle perforator flap for coverage of ischial or trochanteric pressure sores. *Ann Plast Surg* 2006; 56: 540-542.

(Received, March 1, 2007)

(Accepted, June 27, 2007)