

A Modified Design of the Pectoralis Major Myocutaneous Flap for Reconstruction of Head and Neck Defect

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Abstract: Even though the pectoralis major myocutaneous flap (PMMF) still has an important role in the free flaps era, it is reported to have drawbacks such as the limited cephalad extension and high incidence of total or partial flap necrosis. Various modifications have been attempted to augment the limited cephalad extension and a stable blood supply.

The aim of this study is to describe a modified design of the skin paddle and preparation of the PMMF, to achieve stable blood circulation and sufficient pedicle length. The priority skin paddle is the medial part for its stable blood supply, and the lateral margin should be adjusted as needed. During the harvesting, the lateral thoracic artery (LTA) is preserved to protect the perforating branches, and the anterior sheath of the rectus abdominis muscle is used as a suture margin to prevent damage of the thin muscle of the PMMF. The skin paddles in this study are larger than those previously reported. All of the 21 patients in our study, the skin paddles show complete survival with no partial necrosis of skin paddle, fistula, or wound dehiscence.

It is worthwhile to consider and preserve the LTA as a major contributor to a lateral and distal PMMF. This study would be useful in future and preparation of the PMMF in head and neck reconstruction.

Key Words: Head and neck, lateral thoracic artery, pectoralis major myocutaneous flap, pedicle flap, reconstruction

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Reconstruction of the head and neck defects continues to pose a challenge for surgeons. Cancer, trauma, and congenital anomalies are the primary reasons for patients to seek surgical reconstruction of

these areas. Since the first description by Ariyan in the 1970s, the pectoralis major myocutaneous flap (PMMF) has been recognized as an excellent reconstructive choice for large soft tissue defects in the head and neck.^{1–4} With the development of microsurgical techniques, reconstruction with free flaps has been widely used: free flaps can reconstruct larger head and neck defects with significantly lower morbidity and complication rates to the donor and receptor sites, and can typically achieve better functional and cosmetic outcome than pedicled flaps.^{5–8} But the PMMF plays a valuable role in the management of head and neck defects in the following situations: when recipient vessels are not available for anastomosis, in regions with limited access to microsurgery, following free flap failure, and when requiring protection of vital vascular structures.^{9–11} In some of these cases, the PMMF is a better choice that presents less risk to the patient than other reconstruction options.¹²

The PMMF still has an important role in the free flaps era; unfortunately, it is reported to have drawbacks such as the limited cephalad extension and high incidence of total or partial flap necrosis. Several reports have highlighted the need to address the limited cephalad extension of the PMMF and the unstable blood circulation of the skin paddle.^{4,13–20} In anatomical research and clinical trials concerning the PMMF, the contribution of the lateral thoracic artery (LTA) has received considerable attention (Figs. 1 and 2).

However, it is a challenge to preserve the LTA without sacrificing the length of the pedicle. Therefore, the aim of this study is to describe a modified design of the skin paddle and preparation of the PMMF in the reconstruction of head and neck defects, to achieve stable blood circulation and sufficient pedicle length.

MATERIALS AND METHODS

The study evaluates patients who underwent radical resection for primary and recurrent, oral and oropharyngeal squamous cell

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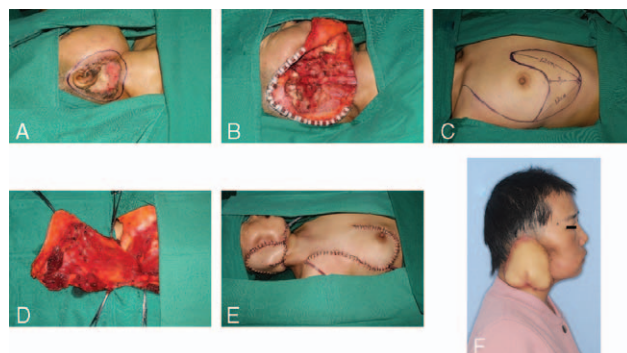


FIGURE 1. A 44-year-old woman with parotid region squamous cell carcinoma. (No. 6 from the table 1). A, The tumor is located in the right parotid region involving the upper neck. B, The skin defect after tumor resection and the exposed carotid artery. C, Design of the skin paddle and skin incision. D, The thoracoacromial artery and lateral thoracic artery were preserved. E, The flap transferred to the defect, and the donor site sutured. F, Three months postoperatively: the appearance of the face and neck recipient sites.

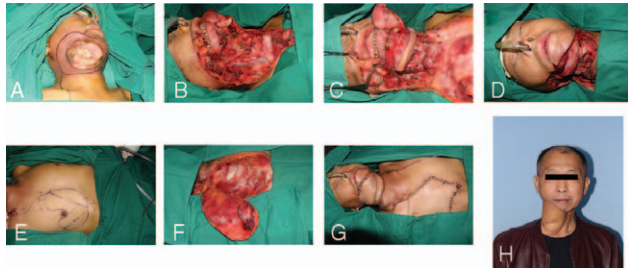


FIGURE 2. A 59-year-old man with the right submandibular region squamous cell carcinoma. (No. 4 from the table 1). A, The tumor is located in the right submandibular region. B, The defect after tumor resection. C and D, Reconstruction of the free fibular flap, and skin defect in the neck remained. E and F, Design of the skin paddle and skin incision, and pectoralis major myocutaneous flap (PMMF) is harvested. G, The PMMF is transferred to the defect and wound is closed. H, Twelve months postoperatively: the appearance of the neck recipient site.

carcinoma and osteoradionecrosis (ORN), followed by placement of PMMF for reconstructive purposes between October 2018 and December 2019 at the Peking University Hospital of Stomatology. This study is approved by the Ethics Committee of Peking University School and Hospital of Stomatology. The details of the demographics and clinical characteristics refer to the supplemental Table 1, <http://links.lww.com/SCS/C111>.

Modified Design

The basic flap design, as well as the shape and size of the skin paddle, is finalized after the recipient site was completely prepared.

The skin paddle is located inferior and medial to the nipple and generally extends inferior to the border of the pectoralis major muscle and slightly over the rectus abdominis muscle and its fascia. For female patients, the incision could be modified around the breast that blends into the inframammary crease.

The incision extends down to the pectoral fascia, it is important to preserve the fascia and adipose tissue on the muscle near the incision, at least 2 cm from the skin paddle. The elevation of the pectoralis major muscle from the chest wall starts inferiorly by making an incision through the rectus fascia, 2 cm below the skin paddle. The dissection is performed superiorly between the pectoral fascia and the origins of the muscle on the ribs and sternum, with frequent shifts from medial to lateral position to maintain perspective and avoid splitting the pectoralis major muscle. The vasculature usually becomes visible through the areolar pectoral fascia at the inferior extent of the pectoralis minor muscle. At this point, the LTA can be seen coming out from underneath the lateral border of the pectoralis minor muscle. The muscle attachments from the sternum are detached up to the clavicle, along with divided muscle insertion on the humerus. With this technique, the pectoral branch of the thoracoacromial artery (TAA), LTA, and veins are preserved. The length of the PMMF pedicle is measured, which is from the clavicle to the lowest of the skin paddle.

A tunnel is prepared in the neck through which the flap is passed to reach the head and neck by supraclavicular route. It is critical for the neck tunnel to be wide enough to provide adequate space for the flap without compression.

The flap is passed through the neck tunnel, and then placed in the recipient site.

RESULTS

The study includes 16 men and 5 women ranging in age from 34 to 82 years (median: 59 years). According to the 2010 American Joint Committee on Cancer staging guidelines, 4 patients suffer primary tumor with clinical stage IVa, 14 patients with recurrent tumors, and

3 patients with ORN. The follow-up time is ranged from 8 to 22 months.

The PMMF is the first choice in 18 patients, and works as the salvage flap in the remaining three patients after the initial free flaps failed. The skin paddle dimensions are 6 × 10 – 8 × 24 cm (median: 6 × 21 cm). The lengths of the PMMF pedicles ranged from 15 to 22 cm (median: 19 cm).

The PMMF survive in all 21 cases: 19 patients show primary healing without complications, 1 patient (No. 7) has buccal skin partial necrosis in the receptor site and is healed after 1 month, 1 patient (No. 15) with effusion between the flap, acquires an infection 2 weeks after the operation, is healed after 5 weeks. There are no cases of partial necrosis of skin paddle, fistula, or wound dehiscence in this study.

DISCUSSION

The PMMF is first introduced for head and neck reconstruction in 1979 by Ariyan, has been considered the most significant flap in head and neck reconstruction. The most important advantages of PMMF include relative ease of harvest, proximity to the head and neck, and coverage and protection of the vital structures of the neck by the muscle pedicle.² Despite the emergence of free tissue transfer, PMMF continues to play an important role when free tissue transfer is not feasible, or in centers without microvascular surgery support, or as a salvage procedure after failure of free flaps.^{3,10}

Even though PMMF has been widely used in reconstruction of the head and neck over the past 40 years, it is reported to have drawbacks such as the limited cephalad extension and high incidence of total or partial flap necrosis. Various modifications have been attempted to augment the limited cephalad extension. One of the most adopted modifications is the passage of the PMMF to the head and neck area through a subclavicular route. Eugene et al conducted a retrospective cohort study to compare the gain in extension that could be achieved with modified subclavicular tunnel versus supraclavicular overlay, and concluded that there was achieving an again in extension of 3.2 cm with modified subclavicular.¹⁸ Chen et al conducted a prospective study to compare the outcomes of an extensive segmental PMMF (esPMMF) and a conventional PMMF. The pedicle lengths of the esPMMF were longer than those of the conventional PMMF.¹⁹ Habal reported the use of the split clavicular technique to gain the amount of length of the PMMF.²⁰ A modified skin paddle design with subclavicular tunnel could increase the length of the vascular pedicle, but some researchers suggested that the subclavicular route would increase the potential morbidity.²¹

The pectoral branch of the TAA provides the main blood supply to the skin island overlying the upper part of the pectoris major muscle, whereas the LTA and the anterior intercostal branches of the internal mammary artery (IMA) supply the skin region overlying the lower part of the PMMF. In conventional harvesting for head and neck reconstruction, the LTA and IMA are cut to avoid compromise of the arc of flap rotation, because with only the main trunk kept intact, there is high risk of distal flap necrosis, particularly when the skin island is designed in the lower chest to gain enough pedicle length. Most large cohort series experienced a greater incidence of necrosis of the total flap (2%–4%) and partial necrosis of skin paddle (11.1%–24.5%).^{22–25} Anatomical research has confirmed the significant contribution of the LTA to PMMF, and clinical trials have shown that a greater vascular pedicle could improve blood flow.^{14–16,26} Hidetaka et al evaluated blood perfusion using intraoperative fluorescent angiography with indocyanine green and concluded that preserving the LTA in a PMMC flap can increase blood perfusion and stabilize the vascularity of the flap, making the reconstruction more effective and reliable than a conventionally harvested flap.¹⁷ Preservation of the

LTA in addition to the pectoral branch of the TAA in the PMMC flap to stabilize the blood supply is a valid choice that can result in whole flap survival.

It is a challenge to preserve the LTA without sacrificing the pedicle length. In our study, the skin paddle was designed as follows: the upper margin was located at the level of the fourth costal cartilage, the medial margin was around the outer edge of the sternum, the lower margin was up to the level of the seventh costal cartilage, and the lateral margin was 2 to 3 cm from the edge of the pectoralis major muscle, which was consistent with Hideaki's report.²⁷ The priority skin paddle is the medial part which with a stable blood supply, and adjusted the lateral margin as needed. This design is similar to the one reported by Chen et al,¹⁹ which lay the foundation for extending the pedicle length. During the harvesting, the LTA is preserved to protect the perforating branches, and the anterior sheath of the rectus abdominis muscle is used as a suture margin to prevent damage of the thin muscle of the PMMF. The length of the pedicles ranged from 15 to 22 cm, and could hence reach the external auditory and orbit by the supraclavicular route.

The skin paddles in this study are larger than those previously reported. In cases wherein the defects to the head and neck were >8 cm, a long skin paddle was designed to ensure a suture as a kiss-flap to restrict wide defect. In all 21 patients in our study, the skin paddles show complete survival with no partial necrosis of skin paddle, fistula, or wound dehiscence.

It is worthwhile to consider and preserve the LTA as a major contributor to a lateral and distal PMMF. This study would be useful in future designs and preparation of the PMMF in head and neck reconstruction.

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