

The pectoralis major myocutaneous flap

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KEYWORDS

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The pectoralis major myocutaneous flap has enjoyed a long history of over 40 years utilization to reconstruct a variety of head and neck defects. Despite the attractiveness, feasibility and success rates of free tissue transfer, the role of the pectoralis major myocutaneous flap is irreplaceable in the setting of high-risk patients, the vessel-depleted neck, and in overall poor free tissue transfer surgical candidates. This chapter reviews the pertinent surgical anatomy, flap design and harvest with emphasis on mitigation of donor site morbidity when mobilizing the pectoralis major myocutaneous flap.

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Introduction

The first reports of pectoralis major myocutaneous flap (PMMF) appeared in the literature in 1968 by Dr Hueston, a surgeon from Melbourne Australia, where he described incorporating the pectoralis muscle with the overlying skin to reconstruct chest wall defects.¹ Approximately a decade later, in 1979, descriptions of the PMMF for head and neck reconstruction were described separately by Ariyan and Baek, and at least partially derived from the previous work of Conley who introduced the laterally based deltopectoral flap for reconstruction of head and neck defects.¹ While, microvascular free tissue transfer for complex reconstruction of the head and neck is the mainstay approach for these complicated patients, no surgical armamentarium is complete without a working understanding of the PMMF for both primary reconstruction, salvage and emergency procedures. As a matter of historical perspective, the first successful free tissue transfer was performed in 1957 to reconstruct the cervical esophagus with wide spread use of free tissue transfer for head and neck defects

emerging in the 1980s.^{2,3} In high-volume surgical settings, the success rate for free tissue transfer is as high as 98% and others have even shown in low resource areas and the developing world, these surgeries are feasible and successful.³⁻⁵ Despite the attractiveness, feasibility, and success rates of free tissue transfer, the role of the PMMF is irreplaceable especially in the setting of high-risk patients, the vessel-depleted neck, and in overall poor free tissue transfer surgical candidates.

Recently, Liu et al reviewed their outcomes using the PMMF in the era of free tissue transfer and utilized pedicled flaps in ~20% of their cases.⁶ The PMMF was selected as a primary reconstruction option in 74% of patients primarily due to poor vascular status and history of previous radiation >60 Gy.⁶ Donor site morbidity is often cited as one of drawbacks following PMMF harvest; however, no patients reported severe shoulder pain or dysfunction and cosmetic outcomes were deemed excellent in follow-up questionnaires.⁶ As with any surgical option, patient selection is paramount to achieve excellent results with minimal morbidity, of which 40 years since its initial description the PMMF remains a workhorse flap in modern day head and neck reconstruction.

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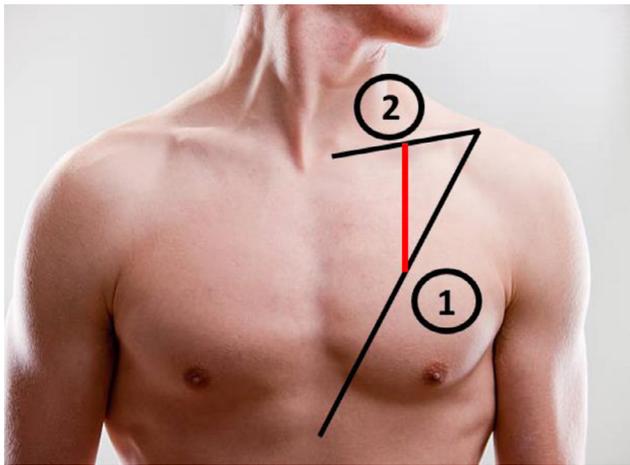


Figure 1 Vascular pedicle. To identify the pectoral branch of the thoracoacromial artery: 1 – draw a line from the xyphoid to the acromion; 2 – mark the course of the clavicle and identify the mid-point of the clavicle. From the mid-point of the clavicle draw a second line perpendicular. This perpendicular line marks the course of the artery. Consideration of the vascular pedicle early allows for effective design of the skin paddle when needed.

Pectoralis myocutaneous muscle flap anatomy

The pectoralis major is a large superficial muscle that fans out from the median half of the clavicle extending to the second to seventh costal cartilages and the aponeurosis of the external oblique muscle. The muscle fibers then laterally converge to insert into the greater tubercle of the humerus. The vascular pedicle, comprised of the pectoralis branch of the thoracoacromial artery and accompanying vein, lies on the undersurface of the muscle, with the pectoralis minor and costal cartilages just deep to these structures. The lateral thoracic artery serves as a secondary blood supply to the pectoralis major muscle and is often ligated (see surgical approach) to achieve greater rotation and length. The motor innervation of the pectoralis major is primarily derived from the lateral branch of the pectoral nerve which arises from the brachial plexus (C5-C7). The vascular pedicle is readily identified on the undersurface of the pectoralis major muscle and is easily predicted using the following well-established technique (Figure 1). Use of this technique is helpful in designing the skin flap to ensure the vascular pedicle is well incorporated into the design.⁷ It is advisable to identify the vascular pedicle before the lateral muscle cuts are made as the deltopectoral branch of the thoracoacromial artery is most reliably identified laterally where the fascial planes and the pectoralis minor are found.⁶

Skin flap design and elevation

Size and design of the skin paddle for the PMMC flap is entirely dependent on the defect requiring reconstruction and any skin overlying the pectoralis muscle remains useful in the flap design. The medial aspect of the pectoralis major inserts onto the second thru sixth costal cartilages.

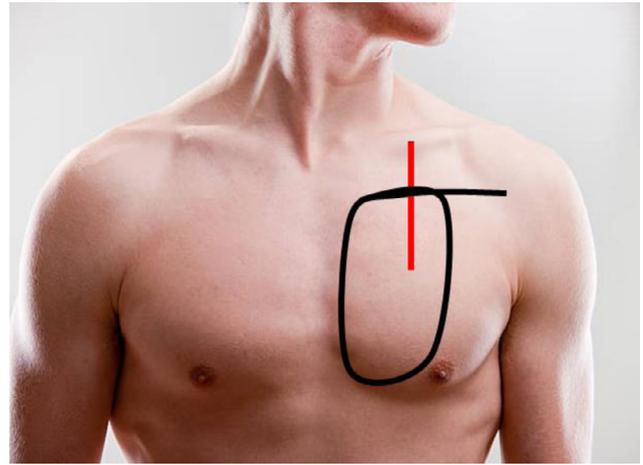


Figure 2 Skin flap elevation and design. A curvilinear incision is placed medial to the head of the humerus and extended medially arching toward the second intercostal cartilage. Next the incision is extended laterally to the desired length needed to fill the defect and carried laterally and superiorly as needed with care taken to avoid violation of the nipple areolar complex.

Beyond the sixth costal cartilage blood supply to the skin is based on a random pattern but this does not preclude further skin paddle harvest beyond the inferior edge of the muscle.

With these anatomical considerations in mind, there are countless ways to layout the incisions for the PMMC flap. The following concept allows for early identification of the pectoralis major muscle, identification of the pedicle, and allows the surgeon to make intraoperative modifications in design, if necessary (Figure 2). Pedicle length is approximated by measuring the distance between the superior extent of the skin paddle and the inferior edge of the clavicle and this distance should approximate the distance between the defect and the inferior edge of the clavicle. In women, the inframammary crease is an ideal location to incorporate the use of skin, avoids excess bulky breast tissue, and provides excellent scar camouflage. Once the vascular pedicle is marked out on the chest wall, a curvilinear incision is made from the humerus to the second costal cartilage. The medial aspect of the skin paddle can extend as inferiorly as needed, recognizing the inferior portion of the pectoralis major is at the level of the sixth intercostal cartilage and blood supply is random inferior to this point. If possible, the lateral and superior aspects of skin flap design take into consideration the nipple areolar complex for both men and women and do not violate these important aesthetic structures.

However, whether to include the nipple areolar complex requires careful consideration because of the very personal nature loss of these structures may impose upon the patient. Using fresh cadavers to study the contribution of the nipple areolar complex on blood supply to the PMMC flap, Rikimaru et al concluded a skin island flap encompassing the nipple areolar complex may stabilize the blood circulation of the skin paddle of the PMMC.⁸ To extend upon these findings, Coruh performed 11 PMMC in men encompassing the nipple areolar complex and reported neither

partial nor total skin flap loss in their study.⁹ Partial or total skin flap loss in harvest of the PMMC is not negligible and ranges between 7% and 27%.⁹ Complications associated with flap harvest and inset require consideration and appropriate surgical planning. Whether the surgeon chooses to incorporate the nipple areolar complex necessitates discussion with the patient during the perioperative appointment and a discussion to re-graft the nipple areolar complex in the future also considered in these patients. It is worth noting that in the Coruh study, encompassing the nipple areolar complex was only performed in men.⁹

PMMC flap elevation

Based on the incision planning outlined in [Figure 2](#), an initial approach working lateral to medial from the humerus to the second costal cartilage is performed using bovie electrocautery on cutting setting through the skin taking care to identify the pectoralis major muscle lying below. Next, the incision is carried medially along the sternum and inferiorly as dictated by the reconstruction needs of the patient, taking care not to prematurely incise the pectoralis muscle. At this point the, the superior, medial and inferior outline of the PMMC flap has been delineated and the pectoralis major muscle is freed medially from the sternum and inferiorly from the chest wall. The internal mammary perforators adjacent to the sternum that supply the deltopectoral flap are encountered and care to avoid inadvertent ligation of these vessels is important for the patient who may require a deltopectoral flap in the future. Retaining sutures to prevent shearing are sometimes placed at this point or after the completion of all the skin incisions. The muscle flap is then elevated off the chest wall beneath the deep pectoralis major muscle fascia.

Bleeding from the chest wall perforators is common and is controlled with vascular clips (personal preference), bipolar, or bovie electrocautery. Vessel ligation is critically important as these vessels will retract and can lead to hemothorax if not addressed when they are initially encountered. Once the intermuscular plane is identified between the pectoralis major and minor muscles, one can readily free the pectoralis major and its vascular pedicle (running on the undersurface) from the pectoralis minor using blunt dissection. At this point, the lateral incision on the skin paddle is made if not done so already. The advantage of waiting to incise the lateral skin paddle at this point in the operation allows for modifications in skin flap design to ensure the vascular pedicle is well incorporated. Once the skin paddle is completely incised, the skin is sutured to the muscle and fascia to prevent shearing of the skin paddle from the anterior surface of the muscle.

With the PMMC flap in the nondominant hand, the pectoralis muscle is freed laterally taking care to keep the pedicle in view. Branches from the lateral thoracic artery and medial pectoral nerve are divided using vascular clips as to avoid thermal injury to the pedicle. The dissection is carried laterally and superiorly where the pectoralis muscle is then freed from the humerus. At this point, attention

is to turn toward creating a tunnel between the neck and chest. Wide undermining between the skin and superior aspect of the pectoralis muscle is performed to create a skin/fascia tunnel between the chest and neck, taking care to preserve the perforators to the overlying deltopectoral flap. A large retractor is placed in the neck over the clavicle to facilitate entry from the chest into the neck. At least 3-4 fingers should easily pass through the tunnel to ensure the opening is wide enough to encompass the PMMC flap which is then be passed through the tunnel into the neck. If additional length is required, incision of the clavicular portion of the pectoralis major muscle, taking care to keep the pedicle in view at all times, may provide increased mobility.

PMMC flap inset, closure, and monitoring

The demands of the resection will dictate inset, however, the following principles are key. Sutures to secure both the muscle fascia and skin should be incorporated in the inset to help distribute the weight of this flap and prevent tugging on the skin paddle alone. Remember to remove the sutures placed initially to prevent shearing as these may interfere with inset, especially in the setting of pharyngeal reconstruction following total laryngectomy.

Irrigation of the chest donor site is performed, and the area inspected to ensure there is meticulous hemostasis. Two closed suction drains ideally are placed within the chest, which is then closed in 2 layers according to surgeon preference. Additional undermining may facilitate chest wall closure. It is not uncommon to experience some tension of the chest wall closure.

As with most head and neck reconstruction patients, care is taken to avoid snug ties around the neck and placing unwarranted pressure on the pedicle. It may prove advantageous to mark the site on the chest wall where the PMMC flap is rotated on itself, so the nursing staff does not mistake the bulge as an expanding hematoma.

Disclosure

The author reports no proprietary or commercial interest in any product mentioned or concept discussed in this article.

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