

**Versatility of Pectoralis Major Myocutaneous Flap in the  
Reconstruction of Various Sites of Oral Cavity**

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## **Introduction**

Reconstruction of head and neck region following ablative tumor surgery is a herculean task for the surgeon. Various modalities of treatment have been tried to reconstruct the functional as well as cosmetic appearance of the resected site.

Various reconstructive techniques like local and distant flaps like myocutaneous, fasciocutaneous osseomyocutaneous and also vascularized free flaps have been used in reconstruction and rehabilitation.

One such flap, the pectoralis major myocutaneous flap designed by Aryan nearly 30 years back offers a lot of advantages and versatility. Therefore it is aptly called as “work horse” of head and neck reconstruction.

This study is performed to analyse the versatility of pectoralis major myocutaneous flap in the reconstruction of defects in oral & maxillo facial region after ablative cancer surgery.

## **Review of Literature**

Picrell (1947) described the pectoralis major muscle as a local transposition flap. Sission described it as a rotation muscle flap for sternum in 1962. It was first used as a myocutaneous unit by Heuston and Arnold in 1979 described it as an island flap.

Ariyan S in (1979) was the first person who applied the principles of pectoralis major muscle for the reconstruction of head and neck defects. In his study with 14 cases of PMMC he found that the flap is reliable for repair of defects after ablative surgery in head and neck region. He also identified that flaps could be transferred immediately.

Baek S, Biller HF, Kreipi Y, Lawson W (1979) conducted a study by using this flap for reconstruction of head and neck defect and found effective and technically easy.

William P, Magee Jr, Charles E. Horton, John B. McCraw, W. David Melnnis in 1980 used pectoralis paddle myocutaneous flap for the head and neck reconstruction.

Ariyan S (1980) used this flap extensively and found that its technical ease, reliability and availability of the flap have made it very attractive for its widespread use. Advantage of PMMC is that it

will provide a covering for the vital structures of the neck without extensive bulk.

Hugh F Biller, Se-Min Baek, William Lawson, Stanley, Blang Rind (1981) did an analysis of complications in 42 cases. They found that only 3 cases had minor necrosis. There were no major necroses in any of the cases.

Baek SM, Lawson W, Biller HF (1982) did an analysis of 133 PMMC flaps. Only 11 flaps failed and required secondary repair. They found that this muscle with its excellent blood supply and anatomic proximity, provide a very reliable flap in the head and neck defects.

Cho HT, Baray K, Mignogna and Bliteer A (1983) studied the delayed failure of these flaps in head and neck reconstruction. The predisposing factors to failure seem related, more to be of technical errors rather than to general factors.

Daroff RH, Warsten CF, Berktold RE, Krespi YP and Sesson GA (1983) analyzed 95 PMMC flaps. Incidence of complication was very similar to those reported in previous series. Hidden recurrences appeared in 3 cases and may be unique in

myocutaneous flaps. With the exception of hidden recurrence, PMMC flap is a valuable flap in head and neck reconstruction.

Sareeno GA, Santim H, Endicott JN, Shah C and Martin C (1983) conducted a study to analyze the vascular supply of PMMC. Their angiographic study revealed important factors critical to the technique of surgery used to protect the blood supply of the flap.

Another study was conducted by Peter J. Moloy and Felix E. Gonsalvis on vascular anatomy and they stated that the lateral thoracic artery (LTA) can nourish Pectoralis major muscle by itself and retain the flaps that may otherwise develop necrosis.

Austin Meherhof, Arthur Rosenstock, James Neilfield and Dawsan S (1983) made analysis of complications in 73 PMMC flaps and they found complication rate of 54%. But most complications were minor and did not require a second procedure for correction.

Marsel R.H, Liston S.L, Adams G.L conducted a study on complications of PMMC flaps in 14 patients used for head and neck reconstruction. Complications like neck abscess, fistula, flap necrosis, chest wall hematoma or abscess occurred in 4 cases.

Schuller (1993) did a review of 50 consecutive PMMC flaps and assessed the flap. He concluded that the technical ease, versatility and reliability as a one stage reconstructive procedure strongly outweigh the minor disadvantages of the flap.

Wilson, Viacomettis AM, Oneil T in (1984) observed 112 PMMC flaps used alone or in combination with other flaps. They found the flap very valuable in reconstruction of head and neck defects.

Lam KH, WI Wei, KF. Sia in (1984) used pectoralis major osteomyocutaneous flap for mandibular reconstruction in 14 patients who underwent mandibulectomy for oral tumors. They encountered three failures, which were probably due to technical errors.

Smith PG, Collins S.L (1984) used thin and double lined PMMC flap for the repair of head and neck defects. The technique of segmentally splitting flaps provides a method both for leaving innervated muscle segments in situ to preserve donor motor function and for deriving two independent flaps from one muscle.

Morgan R.F, Sargent LA, Hoopes JE did mid facial and total nasal reconstruction with bilateral PMMC flap. The advantage

of the method was the distant donor site that avoids additional facial scarring.

Donegon JO, Glickman JL (1984) found an unusual complication of PMMC flap. 2 patients developed osteomyelitis of the rib in the donor area.

Gordon R, Tobin (1985) conducted a study on pectoralis major segmental anatomy and segmentally split pectoralis major flaps.

William D, Morain, Lawrence B, Colen, James C. Hatchings (1985) used segmental PMM flap on six cases with five successful outcomes. The segmental terminal nerve distribution of medial and lateral pectoral nerves permit preservation of the muscle in situ.

Robertson HS and Robertson JM (1986) used PMMC in head and neck reconstruction and opined that it is a valuable alternative to the more bulky myocutaneous flaps.

In another study, conducted by Coleman M.F and Zemplyny J, the design of incisions for pectoralis major myocutaneous flaps in women, where the defect could be hid below the inframammary area and obtained excellent results.

Adekeye ED, Lauvery KM, (1986) Nasser treated defects produced by cancrum oris in children and adolescents with PMMC flaps.

Ellison DE, Hover LA, Ward PH (1987), studied the recurrence of tumor within the myocutaneous flaps.

Cueva R, Thomas JR, Davidson TH (1988) conducted a study on liposuction to debulk PMMC flap since excess bulk intense flaps due to subcutaneous fat is a disadvantage. The study was on fresh cadaver to determine what effect this procedure might have on blood supply to skin overlying the pectoralis major muscle. Gross as well as histologic observation suggested that liposuction would not significantly affect the vascularity of flap.

Kusuma M, Ono T, Eujibayashi, Nagure, Enomotto (1988) did a study on 44 PMMC flaps which was used for immediate reconstruction following resection of oral cancer. Out of it, 30 flaps resulted in complete survival, 13 resulted in partial necrosis and in one flap complete necrosis occurred.

Bhathena HM, Kavarana NM (1989) reported their experience with bipaddled PMMC in 53 patients, with oral cancer. In one patient, this flap was used as a free composite tissue

transfer in bipaddled fashion. They said that the flap can be used either before or after radiotherapy in oral cancer and provides both lining mucosa and skin cover.

Kroll SS, Geofort H, Jones H, Schusterman M (1990) analyzed complications in 168 PMMC flaps for head and neck reconstruction. The rate of complication was 63% however, most of these complications were self limiting and the rate of total flap loss was only 2.4%.

Robert E Marx and Brian R Smith (1990) adopted an improved technique for the PMMC flap, where the whole muscle was used and the LTA was included as an integral part of the flap. Data from 54 consecutive cases using this approach showed reduction in complications, a greater range of use and consistent healing in irradiated and non-irradiated tissues.

Robert E Marx, Robert Johnson, Pairot Tayapongsale (1990) derived the 'walk-up flap'. It originates from the existing myocutaneous flap to provide vascular soft tissue in difficult areas or obliterating dead space during bony reconstruction of the jaws.

Shan R Baker (1990) analyzed regional flaps in facial reconstruction and found that PMMC is the author's preferred

choice of a regional flap for reconstruction of large defects of oral cavity and oral pharynx. The proximity of the flap to oral cavity and oropharynx, bulk of the muscle provides coverage to carotid artery, when neck dissection is also accomplished and better vascularity are the factors which favoured PMMC over other regional flaps. Other advantages are (a) one stage reconstruction without the need for a controlled salivary fistula and also (b) can be used when patients are cachectic.

The PMMC Flap-Is the Subclavicular Route Safe? – in this study by Cyrus J. Kerawala, Jian Sun, Zhi-Ynan Zhang, Zhou Guoyu, 100 patients were randomly allocated into two groups and after harvesting the flap, the pedicle was passed in either a supraclavicular or subclavicular plane. The survival rate and complications of each flap were assessed at 1 month. They found that in 3 of the (7%) subclavicular flaps and 2 (3.5%) of the supraclavicular flaps total flap necrosis occurred. They concluded that the subclavicular route addresses the problem of PMMC flap bulk and may increase the arc of rotation of the flap without significantly compromising its vascular supply.

Carlson FR, Layne JM (1997) conducted a study on PMMC for reconstruction of soft tissue oncologic defects. A paper presented by Demir Kan F, Unal M, Arslan E, Unal S, Aksoy A describes the case of a 38 year old patient presented with squamous cell carcinoma of right retrotrigonal region. He was treated with various flaps following radiotherapy of which PMMC was complicated by partial necrosis resulting in large orocutaneous fistula and oral commissure incontinence.

Vendrell Marques JB, Zapater Latorre E, Ferrandis Pereperez E, Estelles Ferriol E, Brotons Durban S in 2002 conducted a retrospective study of 76 pedicled pectoralis major musculocutaneous flaps. They analyzed the presence of complications at the donor and receiver sites and its correlation with difference parameters.

Keidan RD, Kusiak JF (1992) studied complications following reconstruction with PMMC flap, in previously irradiated patients. They found that PMMC flap for head and neck reconstruction is well tolerated following radiation therapy and has shown comparable morbidity in patients who have not undergone prior irradiation.

Shindo ML, Constantino PD, Friedman CD, Pelzer HJ, Sisson GA Sr, Bressler FJ (1992) reported that pectoralis major myocutaneous flap has been widely used for reconstruction of oral cavity and pharyngeal defects. However it has several disadvantages such as chest distortion, hair growth at the reconstructed site and excessive bulk, all of which can be avoided by the use of the pectoralis myofascial flap. Oral cavities and pharyngeal defects, ranging in size from 4–9cm in largest dimension in 26 patients were reconstructed with the pectoralis myofascial flap. The surface of the flap was covered by squamous epithelium in one mouth. The flap remained healthy during and after radiotherapy. The pectoralis myofascial flap is ideal for soft tissue coverage of small to medium size oral cavity and pharyngeal defects. Its major advantages over the pectoralis myocutaneous flap are decreased bulk and improved cosmesis.

Cheema MA (1993) reported his experience with 11 PMMC flaps, used for reconstruction of head and neck area. His brief experience confirms the reliability and efficiency of PMMC flap for head and neck reconstruction.

Candiani P, Campiglio GL, Saccheri S, Roviato GC (1994) reported their 5 years clinical experience in the reconstruction of oral cavity and chest wall defects using the pectoralis major as muscle or musculocutaneous flap. The short and long term results confirm the excellent viability and versatility of the PMMC and muscle flap.

David E Schuller, Robert L, Daniels, Mark King, Steve Houser (1994) analyzed the frequency of pulmonary atelectasis in patients undergoing PMMC reconstruction. The study supports the results of others that there is no increased incidence of pulmonary atelectasis with PMMC flap.

Haers PE, Gratz KW, Sailer HF, (1994) had done a study on bilobed musculocutaneous pectoralis major flap in closure of combined intra and extra oral defects. They emphasized the versatility of this flap in reconstructive surgery.

Von Biberstein SE, Spiro JD (1994) reviewed 24 PMMC flaps retrospectively. They concluded that despite the recent shift to microvascular free-tissue transfer, PMMC remains an excellent option for repair defects resulting from head and neck cancer resection.

Grevers G (1994) studied PMMC flap for intra-oral reconstruction in 14 patients with squamous cell carcinoma. In 1993, Talavera J, Crespo C, Paya L, Gomez M, Domenech E studied general features of PMMC reconstruction in 31 cases after ablative surgery for carcinoma. In the whole, cosmetically and functionally, the end-condition was favorable and hopeful.

Jacob OJ (1994) conducted a study on one stage reconstruction of large oral mucocutaneous defects with double paddled PMMC flaps. He opines that the double paddled pectoralis major flap allows a one stage operation that provides bulk for large defects in the cheek with two epithelial surfaces. He also comments that oral feeds can normally be started from the third day and it is particularly important where sophisticated nutritional support is not available.

Schadel A, Bergler W, Seifert E (1994) commented about the alternative method for a muscle fascia flap from pectoralis major muscle described by Robertson et al in 1985. They opined that the pectoralis muscle fascia flap is associated with a lesser incidence of complications.

I Jsselstein CB, Hovius SE, ten Have BL, Witthoff SJ, Sonneveld GJ, Meeuwis GA, Kneegt PP (1996) analyzed 224 cases of PMMC flap reconstructions in patients with carcinomas of the oral and oropharyngeal cavities. They opined that as all PMMC flaps in their series survived, it still remains a good choice in intra-oral and oropharyngeal reconstruction, when there is no necessity to reconstruct bone.

Mehta S, Sarkar S, Kavarana N, Bhathina H and Mehta A (1996) studied complications of PMMC in the oral cavity in 220 cases. They concluded that female gender, primary tongue cancer, subtotal or total glossectomy bipedicling of flaps, prior chemotherapy and presence of systemic disease (diabetes) emerged as significant risk factors for flap necrosis on multivariate analysis.

Ord RA (1996) has conducted a study on PMMC flap in Oral and Maxillofacial reconstruction. He has analyzed 50 cases retrospectively with respect to reliability and complications. He found that the complications in this study was comparable to other large series in the literature and he concluded that despite the increased use of microvascular flaps, the PMMC remains an

excellent reconstructive choice for large soft tissue defects in the oral cavity.

Pompei S, Caravelli G, Bozza F, Vigili MG, Marzetti F (1997) in their study evaluated comparatively the reconstructive approach in terms of morbidity and functional results of myocutaneous and conventional flaps. Morbidity of myocutaneous flaps was 33%.

Kiyokawa K, Tai Y, Tanabe HY, Inoue Y, Yamauchi T, Rikimaru H, Mori K, Nakashima T (1998) analyzed the circulation and haemodynamics of the PMMC flap and found that preventing injuries to the perforators by improved surgical techniques will help in alleviating the problem of flap necrosis, thus reconfirming the usefulness of this flap in head and neck reconstruction.

Xu X, Li Q, Tang P (1998) analyzed the results of the use of pectoralis major myocutaneous flap in the reconstruction of tongue in 86 patients. They concluded that reconstruction of tongue with PMMC flap meets the clinical requirement in the shape, communication and swallowing rehabilitations. It serves as a reliable material for the reconstruction of tongue with major defect following subtotal glossectomy.

Kiyokawa K, Tai Y, Inoue Y, Yanaga H, Rikimaru H, Mori K, Nakashima T, Kameyama T (2001) conducted a study where pectoralis major myocutaneous flap was grafted to the oral cavity defect by rolling and wrapping around the metal plate with the muscle of the flap. This technique shows primary reconstruction of the oral cavity and mandible in a minimally invasive manner in a short time.

Ethunandan M, Ansell M, Mellor TK, Brennan PA, (2004) reported a case of MRSA induced skin necrosis of a pectoralis major myocutaneous flap, used to reconstruct a composite mandibular defect.

## **Summary and Conclusion**

Reconstruction of maxillofacial defects following ablative cancer surgery is a challenge to the surgeon.

Various modalities of reconstruction have been tried and single stage reconstruction with myocutaneous flaps like pectoralis major myocutaneous flap has various advantages over other techniques.

Merits of pectoralis major myocutaneous flaps are that

- . It has got a hardy and easily identifiable vascular pedicle i.e. pectoral branch of thoracoacromial artery.

- . The donor site is at a distance from the tumor site, which is usually irradiated.

- . It has the advantage of covering the vital structures like carotid artery in the neck; this gives protection especially when post-operative radiotherapy is advised.

- . It provides a large area available for defect coverage.

- . It can be used as both mucosal lining and coverage of skin or combination of both.

- . Technically easy, single stage reconstruction.

- . Bulk of pectoralis major provides good cosmetic benefit after composite resection of maxillofacial tumors.

- . Short hospital stay and minimal post-operative complications.

In our 9 months period of follow-up, various complications were analyzed. We found that 34% had nil complications. 32% had infection at the flap site. Superficial flap necrosis was seen in 3 patients i.e. 6% and full thickness flap

necrosis in 2 patients (4%). Twelve patients i.e. 24% had other complications like color change, hematoma dehiscence etc.

To conclude, pectoralis major myocutaneous flap is the choice for immediate reconstruction of maxillofacial defects following cancer surgery, owing to its technical ease, reliability and versatility.

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