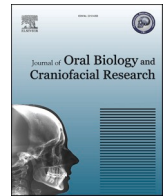




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PMMC flaps for reconstruction of oral defects in the age of microvascular flaps: A developing nation perspective

Karan Padha^{a,*}, Amit Dhawan^b, Prahlad Duggal^c, Vikas Kakkar^d, Ramandeep Bhullar^b,
Tejinder Kaur^b

^a Oral & Maxillofacial Surgeon, 2075 Fd Hospital, Bhuj, India

^b Department of Oral and Maxillofacial Surgery, SGRD Institute of Dental Sciences and Research, Amritsar, India

^c Chief ENT & Head Neck Surgeon, Swift Hospital, Amritsar, India

^d Department of Surgery, Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar, India

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ABSTRACT

Purpose: The purpose of this study was to compare Pectoralis major myocutaneous flap (PMMC) and Free flaps for reconstruction of post ablative defects in patients undergoing treatment for oral squamous cell carcinoma and to understand the reasons for choosing each from a developing nation perspective.

Material and methods: In the present study, a retrospective study was conducted of the patients treated by either free flaps or PMMC flaps for reconstructive procedures over a five year period in the Department of Oral and Maxillofacial Surgery, Shri Guru Ram Das Institute of Dental Sciences and Research.

Results: Out of 90 PMMC flaps, 44 patients (48.8%) had reconstruction due to lack of micro vascular facility at the center, in 39 patients (43.3%) due to financial constraints and in 7 patients (7%) due to associated comorbidities. The overall complication rate in PMMC group was 30% as compared to 28% in Free Flap group. Total flap loss was seen in 3 flaps (2 microvascular and 1 PMMC) while marginal necrosis of skin paddle was seen in 12 patients (13%) in the PMMC group.

Conclusion: Though, the selection of PMMC flap over free flap was influenced by many factors, results of this study suggest that PMMC flap still has a major role in post-ablative defect reconstruction even in this era of free flaps, especially in developing countries like India.

1. Introduction

Cancer of the oral cavity is estimated to be the third most common malignancy after cancer of the cervix and stomach in developing countries like India. Surgical excision remains a mainstay of treatment in patients having oral squamous cell carcinoma (OSCC). Significant soft tissue, bone, and skin defects are anticipated after tumor extirpation in loco regionally advanced OSCC. Therefore, reconstruction is mandatory to promote wound healing and optimize function along with cosmetic appearance. Due to the development of surgical techniques in reconstruction, there has been a marked improvement in therapeutic results. Of all the reconstructive options available, pedicled pectoralis major myocutaneous flap (PMMC) and microvascular free tissue transfer remain the cornerstone of reconstruction in defects created by extirpation of OSCC. The concept of use of PMMC flap for the purpose of

reconstruction was originally proposed by the Polish surgeon Ludwik Rydygier at the XII World Congress of Medicine in Moscow in 1897 but it was not until 1979 that the pectoralis major flap was finally introduced into modern reconstructive surgery by Ariyan who based the flap on the thoracoacromial artery.^{1,2} The use of PMMC flap was widespread due to its simple technical aspects, versatility, and proximity to the head and neck region. PMMC flap has multiple advantages including: easy accessibility in the same surgical field; technically simple; robust and reliable vascular anatomy; and minimal requirement for specialized instruments and training.³

Although microvascular free flaps to the head and neck region were introduced much earlier than the pedicled flap, they did not achieve immediate popularity, due to lack of training facilities, infrastructure and technically demanding surgical procedures with greater risk of post-operative complications and failure. The advent of modern techniques in

* Corresponding author. House no 90/2, Sainik Colony, Jammu, 180011, India.

E-mail addresses: kmpadha@gmail.com (K. Padha), surg.amit@gmail.com (A. Dhawan), duggalprahlad@yahoo.co.in (P. Duggal), kakkarvikasdr13@yahoo.co.in (V. Kakkar), drbhullar07@gmail.com (R. Bhullar), tkgumber@gmail.com (T. Kaur).

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head and neck reconstructive surgery during the past decade resulted in an increase in microvascular free flaps being performed more frequently in an attempt to enhance the functional and esthetic results in head and neck surgery especially for OSCC patients. Hence the use of PMMC flap for reconstruction of post ablative defects in OSCC patients has fallen out of favor at most centers. The aim of this study was to evaluate the reasons behind their usage in developing countries and to understand if they still justify being an alternative to free flaps in this day and age.

2. Aims and objectives

The purpose of this study was to analyze the microvascular free flap versus PMMC flap for reconstruction of post surgical defects in patients undergoing treatment for oral squamous cell carcinoma and to evaluate the indications, limitations and complications of both the reconstructive techniques to understand the factors leading to selection especially in developing countries.

3. Material and methods

Data of patients who underwent PMMC reconstruction or Microvascular free flap reconstruction after post ablative head and neck defects were analyzed retrospectively. A total of 115 patients, over a five year period, who underwent reconstructive procedures were included in this study. All patients were staged according to the guidelines of the American Joint Committee on Cancer (AJCC).⁴ This study followed the Declaration of Helsinki on Medical Protocol and Ethics and the Regional Ethical Review Board of the Institute approved the study. The reconstructive procedures were divided into two groups. Group 1 included reconstruction with PMMC flap and Group 2 included microvascular free flap reconstructions. The selection of microvascular free flap or PMMC flap was not randomized. All PMMC flaps were done by the same operating team of surgeons who did primary resection and neck dissection. Basic demographic data, tumor-related features and type of surgical intervention and relevant data were recorded. Complications related to the flap used including total flap loss, partial and marginal necrosis of flap, wound dehiscence, donor site morbidity were noted and compared between groups. Average hospital stay was also recorded for both the groups and compared. Data was reviewed to determine the reasons for selecting PMMC flap over free flap. Data was statistically analyzed using SPSS for Windows (Version 16.0). Results were compared between groups using Chi square and Student–T test.

4. Results

A total of 115 patients with cancer of the oral cavity underwent ablation surgery followed by either PMMC or free flap reconstruction. Out of these 115 patients, 110 were males and 5 were female patients

Table 1
Epidemiological data of Group 1 and Group 2.

| | GROUP-1 PMMC | GROUP-2 FREE FLAP |
|----------------------|-----------------------------|-------------------------|
| Gender | M-87; F-3 | M-23; F-2 |
| Mean age | 54.1Yr | 47.6 Yr |
| T-stage | T3-11(12.2%); T4-79(87.7%) | T3-4(16%); T4-21(84%) |
| N-stage | N0-25(27.7%) N+65(72.2%) | N0-10(40%) N+15(60%) |
| Primary site of OSCC | | |
| Retromolar trigone | 47(52.2%) | – |
| Buccal mucosa | 16(17.7%) | 2(8%) |
| Mandibular alveolus | 16(17.7%) | 11(44%) |
| Gingivobuccal sulcus | 11(12.2%) | 2(8%) |
| Tongue | – | 2(8%) |
| Soft palate | – | 2(8%) |
| Floor of mouth | – | 2(8%) |
| Hard palate | – | 2(8%) |
| Maxilla | – | 2(8%) |

with the mean age of 54.1 years (Table 1). Out of the reconstructions carried out, 90 were PMMC flap reconstructions (Group 1) and 25 were microvascular free flap reconstructions (Group 2).

In group 1, 70 were PMMC skin island flaps which were used for intraoral lining after resection of the primary tumor and 20 were bipaddled PMMC flaps which were used to reconstruct both the intraoral as well as extraoral skin cover (Figs. 1 and 2). Carcinoma of retromolar trigone (40 patients) was the most common site to be reconstructed with PMMC skin island flaps followed by carcinoma of buccal mucosa (11 patients). Carcinoma involving the upper and lower gingivobuccal sulcus along with skin of cheek (8 patients) was most commonly reconstructed with bipaddled PMMC flaps. In these patients, three-dimensional bite resection was performed which required reconstruction of full thickness cheek defect. No osteomyocutaneous PMMC flap (with a part of rib attached) was used for reconstruction in our series. The patients reconstructed in group 1 were Stage III and Stage IV OSCC patients. In 71 reconstructions with PMMC, modified radical neck dissection type II was performed and there was a significant relationship of PMMC reconstruction with MRND II (*statistically significant p < 0.05*). This type of neck dissection was invariably performed to sacrifice sternomastoid muscle in order to make space for pectoralis muscle. Marginal necrosis of the flap was the most common complication encountered in Group-1 (12 out of 90 patients). Out of these 12 patients with marginal flap necrosis, 7 were bipaddled PMMC flaps. Total flap loss occurred in 1 patient for which contralateral PMMC muscle island flap was used for secondary reconstruction. None of the other complications required any active surgical intervention and were managed conservatively.

In Group-2, 14 microvascular free flap reconstructions were performed after primary resection of stage III, stage IV OSCC patients. Free fibula osteomyocutaneous flap was used in 20 patients (Figs. 3 and 4) while 1 patient received free fibula osseous flap without the skin paddle. Carcinoma alveolus was the most common site to be reconstructed with free fibula-9 out of 21 patients. Radial forearm free flap was performed in 4 patients-1 carcinoma buccal mucosa, 1 posterolateral border tongue, 1 hard palate and 1 soft palate. 7 out of 25 patients in group 2 encountered flap related complications postoperatively. Total flap loss in 2 patients (Figs. 5 and 6) and partial skin flap necrosis in 4 patients who also had an infection at the donor site. Post op exploration was required in 3 patients in Group-2 and out of which 1 was salvaged. The cause was ascertained to be venous thrombosis. The total flap loss percentage was 1.3% in Group-1 as compared to 14.2% in Group-2.

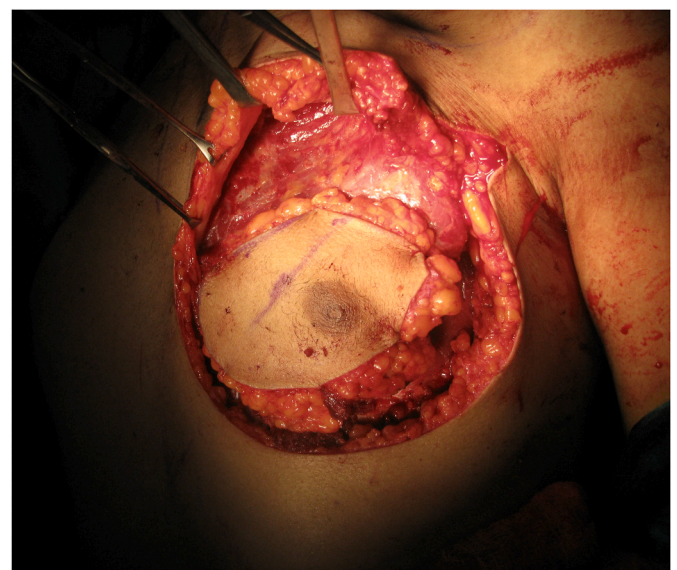


Fig. 1. Raising Pectoralis Major Myocutaneous (PMMC) flap.

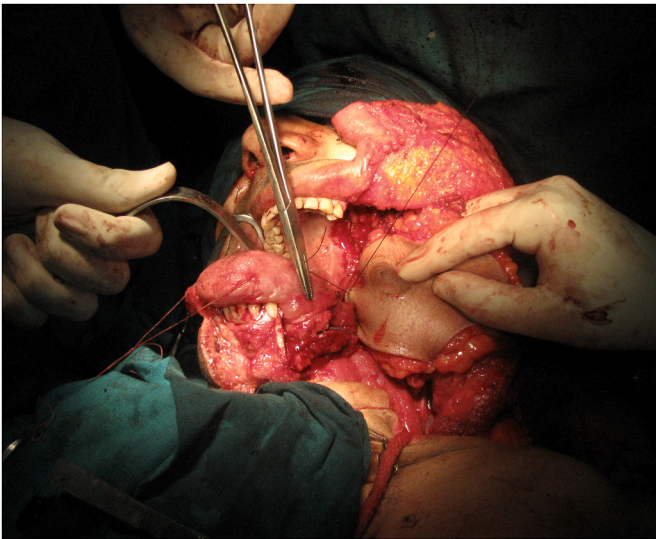


Fig. 2. Insetting Pectoralis Major Myocutaneous (PMMC) flap.



Fig. 3. Free fibula osteomyocutaneous flap.



Fig. 4. Free fibula osteotomized to mimic the shape of mandible.

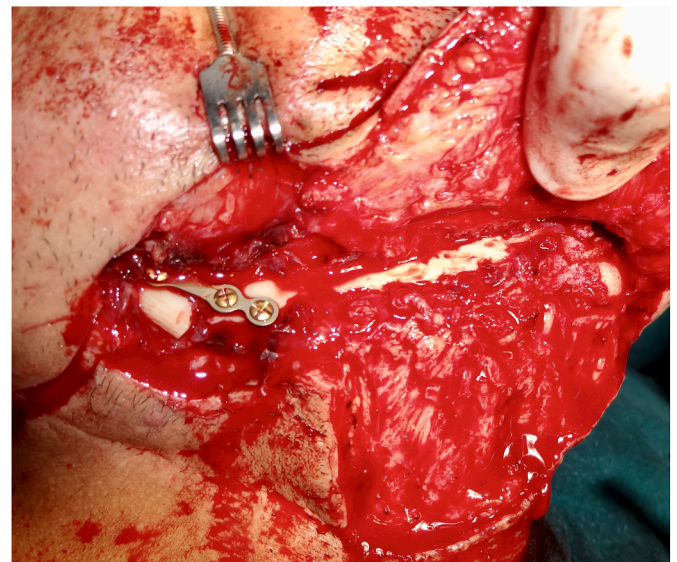


Fig. 5. Total loss of free fibula flap and the avascular fibular bone.

The overall complication rate in Group-1 was 30% as compared to 28% in Group-2 (Table 2). 11 patients out of 90 patients in Group 1 required tracheostomy as compared to 8 patients in Group-2. In rest of the patients keeping the endotracheal tube overnight was preferred and found adequate for management of immediate post-operative course of reconstruction. The operative duration was found to be higher in Group-2 than Group-1 (Table 3). The median hospital stay in Group 1 was 12 days as compared to 10 days in Group 2 (Table 4). The reasons for choosing PMMC flap over free flap were analyzed. Limitation of the availability of microvascular facility in the initial period of this study at the institute was one factor in favor of PMMC reconstruction in 44 patients. 39 patients opted out of microvascular free flap reconstruction due to financial restrictions while associated comorbidities in 7 patients prevented its use (Table 5).

5. Discussion

Reconstruction of the post ablative defect after extirpation of oral squamous cell carcinoma (OSCC) is a surgical challenge even in this

modern era of advanced esthetics and cosmetics. Out of the reconstructive options currently available to treat post ablative defects of OSCC, free tissue transfer with micro-vascular anastomosis is the favored method for reconstruction after major head and neck cancer surgery. The aim of this study was to evaluate the role of PMMC flaps in head and neck reconstruction in the present day and age. In the primary sites of OSCC like tongue, soft palate, floor of mouth, hard palate and maxilla, reconstruction with free flaps was performed with the primary reason being that the mucosal lining of these structures is relatively thinner than other sites of oral cavity and thus reconstruction with bulky PMMC flap is not a practical option. Difficult arc of rotation of the PMMC flap to areas like hard palate and maxilla without compromising the blood supply of the flap is another reason for choosing Free flaps over PMMC flaps in these regions. Another factor is the pliability of the flap required for the reconstruction of areas like the tongue which cannot be achieved with the PMMC flap.⁴ The patients who underwent



Fig. 6. The avascular fibular bone.

Table 2
Flap related complications.

| COMPLICATION | GROUP-1 PMMC | GROUP-2 FREE FLAPS |
|--------------------------------|--------------------|--------------------|
| Total flap loss | 1/90 (1%) | 2/25 (8%) |
| Marginal flap necrosis | 12/90 (13%) | – |
| Partial flap necrosis | 3/90 (3%) | 4/25 (16%) |
| Wound dehiscence at donor site | 11/90 (12%) | 1/25 (4%) |
| Total | 27/90 (30%) | 7/25 (28%) |

Table 3
Operative duration (in minutes).

| AUTHORS | PMMC group | Free flap group |
|----------------------|----------------------|----------------------|
| Mallet et al. | 259 ± 57 min | 420 ± 79 min |
| Hsing CY et al. | 593 ± 138 min | 793 ± 248 min |
| Present study | 510 ± 130 min | 807 ± 210 min |

Table 4
Hospital stay (in days).

| AUTHORS | PMMC GROUP | FREE FLAP GROUP |
|----------------------|------------|-----------------|
| Hsing CY et al. | 25 | 23 |
| Kekatpure VD et al. | 14 | 14 |
| Mallet et al. | 23 | 18 |
| Present study | 12 | 10 |

reconstruction with free flap had a longer operative duration when compared with those who underwent PMMC flap reconstruction, which is concurrent with the study conducted by Mallet et al.⁵ Microvascular anastomosis is likely the main reason for the longer duration of procedure. Analyzing the PMMC group, the overall complication rate encountered was 30%. The complication rates reported by other studies were as follows: Milenovic A et al–33%, Liu et al–35%, Ijsselstein et al. –53%, Shah et al– 63% and Kroll et al- 63%.^{6–10} The authors reported a

Table 5
Factors affecting selection of PMMC flap over free flap.

| AUTHORS | LACK OF MICROVASCULAR FACILITY | FINANCIAL CONSTRAINTS | ASSOCIATED COMOBIDITIES | SALVAGE PROCEDURE |
|----------------------|--------------------------------|-----------------------|-------------------------|-------------------|
| Avery CME et al. | – | – | 23 | 4 |
| Kekatpure VD et al. | – | 21 | 12 | 5 |
| Present study | 38 | 33 | 4 | - |

marginal flap necrosis rate of 13% in this study compared with 29% by Shah et al. and 25% by Mehta et al. while total flap loss occurred in 1% patients as compared to 2.4% reported by Shah et al. and 2% by Kroll et al. The average hospital stay in this study for the PMMC group was 12 days which compared favorably with 14 days as reported by Kekatpure VD et al. but was still higher compared with the free flap group which averaged 10 days hospital stay.

In this study, 44 patients underwent reconstruction with PMMC flap due to lack of microvascular facility in the initial period at the institute, 39 patients due to financial restraints and 7 patients due to associated major comorbidities. This compares favorably with the study reported by Kekatpure VD et al. in which PMMC flap was preferred over free flap in 21 patients due to financial constraints and in 12 patients due to associated medical comorbidities.¹¹ A large number of head and neck cancer patients in India come from the lower socio-economic strata. These patients have limited resources and insurance support. In a study conducted by Kroll et al., mean cost of surgery was found to be higher for the free flap group as compared to the PMMC group. The result of our study corroborate these observations and add that financial constraints play a significant role especially in developing countries like India. Associated comorbidities and non-availability of microvascular facilities at most maxillofacial centers providing head and neck oncology services may further limit the use of microvascular reconstruction.

Analyzing the 25 patient who underwent free flap reconstruction, 7 out of 25 patients encountered flap related complications post-operatively. Total flap loss in 2 patients and partial skin flap necrosis in 4 patients with the overall complication rate being 30%.The partial flap necrosis rate of 16% was higher than the rate of 4% reported by Mallet et al. However, the overall complication rate of 28% was lesser than the rate of 40% reported by the same study. The postoperative stay of 10 days was significantly less than 18 days reported by Mallet et al. and 23 days reported by Hsing et al. The operative duration of 807 ± 210 min was comparable to 793 ± 248 min reported by Hsing et al. however was higher than 420 ± 79 min reported by Mallet et al.^{4,5}

Main limitation of the current study is unequal sample size between two groups due to non-availability of microvascular facility in the initial period at the institute when we relied upon PMMC flap for most of the reconstructions. This is not a randomized study thus selection bias invariably existed. This study is first of its kind evaluating the financial implications affecting patient decisions as well as associated factors like lack of adequate access to modern medical infrastructure especially prevalent in developing nations. It aims to bridge the knowledge gap till a more widespread adoption and infrastructure availability especially in peripheral centers widespread in developing nations like India.

6. Conclusion

A pragmatic approach is advocated to head and neck reconstruction in this modern era, despite the increasing application and popularity of microvascular reconstruction. The PMMC flap once a workhorse flap for head and neck reconstruction still has many applications and may be the preferred option of reconstruction for post ablative head and neck defects in a variety of circumstances especially in developing countries like India where financial constraints and lack of specialized infrastructure play a compelling role in the decision process.

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Ethical approval

All procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from the individuals included in the study.

Declaration of competing interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.

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