Original Article

Mango-shaped Bi-paddled pectoralis major myocutaneous flap reconstruction for large full-thickness defects post resection of squamous cell carcinoma of oral cavity: An analysis of 232 cases

ABSTRACT

Objectives: The objective of the study was to examine the feasibility of bi-paddled pectoralis major myocutaneous (PMMC) flap reconstruction in patient undergoing full thickness composite resection.

Materials and Methods: Inclusion criteria: The subjects chosen were patients with clinically T4A squamous cell carcinoma of buccal mucosa, lower alveolus, and maxilla in with skin involvement. Patients required a full-thickness composite resection of intraoral lesion, bone (mandibular segment and/or maxilla), and overlying involved skin and had modified radical neck dissection. Exclusion criteria: Patients not requiring full thickness composite resection including skin. Patients were observed postoperatively for early and late postoperative complications, starting of oral feeding, post-operative trismus, and dysphagia during subsequent follow-up and cosmetic outcome.

Results: Overall, the complication rate was 33.8% out of which only 7.8% required major re-surgery with second flap reconstruction. This is comparable with other large series of PMMC flap. Clavien-Dindo Grade I complications were seen in 9.5%, Grade II in 69.7%, Grade IIIA in 13.4%, and Grade IIIB in 7.45% of patients. Full-thickness partial flap necrosis included necrosis of either the external or the internal skin paddle. There were 15 cases – 6.5% of full thickness external paddle necrosis. These were mostly in patients with bite composite resections and having a larger random fasciocutaneous distal component of the flap without underlying muscle. Furthermore, 40% of these patients were females. In females, the flap necrosis comprised 4 of the 12 patients (33.33%).

Conclusion: Pectoralis major mycocutaneous flap has been a boon to reconstruction of the oral cavity post its inception. In case of locally advanced squamous cell carcinomas of the oral cavity, in many instances, there is a clinically significant cervical lymph nodal spread vessels post mandating a comprehensive lymph node dissection. PMMC flap provides a robust well vascularized muscular cover to the cervical vessels poststernocleidomastoid excision.

Keywords: Bi-paddled pectoralis major myocutaneous flap, oral cavity, squamous cell carcinoma

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INTRODUCTION

Large post full-thickness (composite resection) defects in patients of squamous cell carcinoma of the oral cavity are a reconstruction challenge for the surgical oncologist. These defects need both a good intraoral defect closure and external skin coverage. The skin cover must be cosmetically acceptable and robust enough to sustain adjuvant radiotherapy.

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Free flap microvascular reconstruction is the gold standard for full-thickness composite resection defects. Microvascular reconstructive surgical expertise may not be always available at high volume cancer centers in resource-limited developing countries. Since its inception by Ariyan in 1979,[1] pectoralis major myocutaneous (PMMC) flap has been the backbone of reconstruction of postresection defects in head-and-neck cancers. Even in the era of microvascular surgery and various free flap reconstructions, the folded (also called bi-paddled) PMMC flap remains a robust viable option which can be performed in resource-limited centers by the surgical oncologist. In this study, we are presenting a series of 232 patients with mango pattern bi-paddled PMMC flap was used for the reconstruction of postresection full-thickness defects in patients operated for squamous cell carcinoma of the oral cavity. The advantages of mango pattern being that it allows a large size flap utilizing maximum surface area of skin overlying the pectoralis major muscle with adjacent skin with random blood supply which can be used to reconstruct large defects.

MATERIALS AND METHODS

This was a retrospective study done at the Department of Surgical Oncology; Institute of Medical Sciences, Banaras Hindu University, Varanasi, India; between January 2016 and December 2020. The study was approved by the institutional ethical committee (Dean/2021/EC/2654).

Inclusion criteria
The subjects chosen were patients with clinically T4A squamous cell carcinoma of buccal mucosa, lower alveolus, and maxilla in with skin involvement. Patients required a full-thickness composite resection of intraoral lesion, bone (mandibular segment and/or maxilla), and overlying involved skin and had modified radical neck dissection. Patients treated with upfront surgery, patients treated post neoadjuvant chemotherapy (NACT) and that recurring post earlier definitive treatment; were included in this study.

Exclusion criteria
Patients not requiring full thickness composite resection including skin were excluded from the study.

Flap design
Surgical defect dimensions including the intraoral mucosal defect and the skin defect externally were measured (medio-laterally and supero-inferiorly). Additional 2 cm length was added for de-epithelization at site of folding between the two paddles. While measurement of the flap, an additional 2 cm was taken for length and width to account for flap shrinkage post designing [Figures 1-4].

Marking
The flap was designed as a mango or bean shape, overlying maximally the skin overlying the 5th, 6th, and 7th intercostals space, with the concavity toward the nipple so as to avoid it if possible. The medial most extent of the flap was 2 cm lateral to the sternal border. The distal most point of the flap curved laterally to include skin beyond the lateral margin of the extent of the pectoralis major muscle, thus forming the random part of the flap. The distal most extent of the random pattern that could be achieved was till the anterior axillary line [Figure 3].

In case of very large skin defect, requiring a wide external (skin) cover, the nipple was included to form a large wide flap.

After marking the flap dimensions, the flap was harvested as per the technique first used by Freeman[2] so as to spare the deltopectoral skin cover for a deltopectoral flap if needed later on [Figure 4]. Tunnel underlying the deltopectoral area skin was made four fingers wide so as to allow easy transfer of the flap. The flap was harvested by first taking an oblique incision from the apex of the axilla to the skin paddle so as to identify the lateral edge of the pectoralis major muscle. Subsequently, the skin paddle was demarcated and an extra area of the underlying pectoralis major muscle was taken beyond the flap.

The skin paddle was fixed to the muscle by vicryl 3.0 sutures to minimize shear between the skin paddle and the underlying muscle. The random portion of the flap was elevated the last, with underlying fascia of serratus anterior and rectus abdominis muscle.

Figure 1: Pre operative photos of a patient having Squamous cell carcinoma of Right Gingivo-Buccal Sulcus from angle of mouth to Retromolar trigone region with overlying skin involvement (Post NACT 3 cycles). Note that patient is having trismus due to involvement of masticator spaces

The nipple was spared in most cases. In cases of very large defect, a broad flap with the nipple included in the skin paddle was used.

Flap suturing

The flap was brought through the neck to the defect in the oral cavity. The proximal edge of the flap was sutured to the proximal most point of the defect. The flap was then inset with simultaneously suturing the upper and lower edge of the mucosal defect and the flap from posterior to anterior. The flap was then de-epithelialized at the site of the commissure and folded so as to fill the external skin defect. The upper and lower lips were sutured at the site of de-epithelialization; so as to form the oral commissure [Figure 5].

Plating

In cases of segmental mandibulectomy and resection of mandible going to mandibular arch, titanium reconstruction plating (2.5 mm) was used for the reconstruction of the mandibular continuity.

Care taken during flap suturing:
1. Reconstruction of the proximal portion of the flap allowed the part of the skin paddle overlying the muscle to form the intraoral cover. This well-vascularized portion of the flap ensured better healing and thus prevention of wound dehiscence and formation of orocutaneous fistula
2. In cases of defects involving the oral commissure and beyond 2 cm of the adjacent upper and lower lip, the commissure was not reconstructed and the middle portion of the folded paddle was not de-epithelialized. Although this created an incompetent stoma, it allowed the prevention of microstomia and also allowed healing of the suture lines. The oral stoma was then reconstructed postadjuvant treatment using local tissue advancement [Figure 6].

Evaluation

Patients were observed postoperatively for early and late postoperative complications, starting of oral feeding, postoperative trismus, and dysphagia during subsequent follow-up and cosmetic outcome [Figure 7].

Figure 3: Marking for Bi-paddled PMMC flap based on the perforators of pectoral branch of Thoracoacromial artery with preservation of nipple; the random pattern of the flap is marked with asterisk

Figure 2: Pre operative marking for Wide excision with Bite Composite Resection for the same patient shown in figure 1, Post resection defect following MRND and measurement of the defect size

Figure 4: PMMC flap marking preserving the blood supply for delto-pectoral flap, which can be utilized for secondary surgery if needed
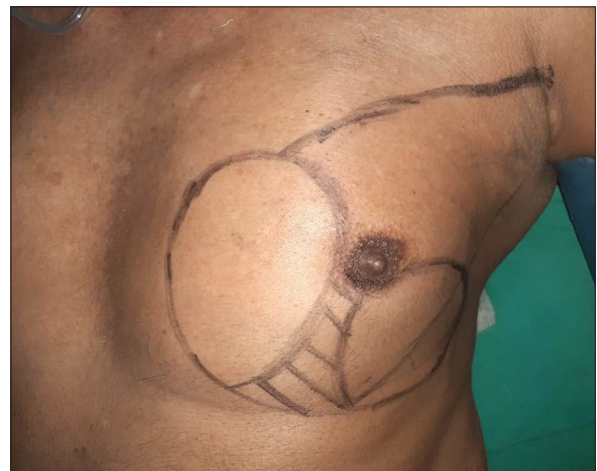

Figure 5: Marking showing Bi –paddled PMMC flap to be harvested with marked central area that has to be de-epithelised before inset

Figure 6: Post operative photograph of patient showing Closure of Bi-paddled PMMC flap sutured to the defect with minimal tension

Detailed written and informed consent for the surgery and also for the reconstruction in vernacular language was obtained from each patient before start of the treatment. Institutional ethics committee approval for the study was obtained. The study was in concordance with theHelsinki guidelines. The study was approved by institutional ethics committee letter number: Dean/2021/EC/2654.-ECR/526/Inst/UP/2014/RR-20 Dt 19/05/2021.

Observations

Observations are summarized in the form of Tables 1-4.

DISCUSSION

Reconstruction postcomposite full-thickness resection is one of the most important parts of treatment of locally advanced squamous cell carcinomas of the oral cavity. An adequate reconstruction must help in quick healing so that the patient can receive adjuvant treatment without delay. Further, the reconstruction must achieve its primary aims of reformation of the oral competence, acceptable function – swallowing, speech, and cosmesis in that order of importance.

Our study examined the feasibility of bi-paddled PMMC flap reconstruction in patient undergoing full thickness composite resection.

All were stage IVA diseases, and in all patients, bone was resected whether it involved mandible as in most cases or maxilla in 5.59% of cases.

There were 94.8% males and 5.2% females. The reason for this gender disproportion is that only females with less bulky breasts and comparatively smaller full-thickness defects

Figure 7: Primary closure of the donor site following harvest of Bi-paddled PMMC flap, Closure resembling the shape of tongue

were chosen for the study. In females, bi-paddled PMMC is generally not preferred due to bulkiness of the breast tissue and consequently very high chances of shearing and epithelial necrosis.[3]

Nearly 57.6% of patients were operated upfront and 34.2% of patients were operated post 3 cycles of NACT consisting of paclitaxel and carboplatin. The purpose of chemotherapy is an attempt to downsize the lesion and obtain negative surgical margins.[4] This was done especially in patients with extensive soft-tissue involvement and edema as these were deemed to have poor prognosis and higher chances of margin positivity. 8.2% were recurrent cases post earlier surgery and adjuvant radiotherapy.

Nearly 62.8% of patients had primary of the lower alveolus subsequently involving the gingivobuccal sulcus (GBS) and buccal mucosa. Around 33.8% of patients had primarily buccal mucosa disease with paramandibular extension without gross mandibular cortical erosion. Nearly 3.5% of patients had disease involving the lower alveolus and crossing the midline, thus involving arch of mandible. GBS and lower alveolus is the most common site of squamous cell carcinoma of the oral cavity in the Indian subcontinent due to habit of tobacco intake and placing tobacco in the GBS.[5] All patients had skin involvement; either gross ulceration or tethering with clinically suspected dermal infiltration, edema, and redness.

Nearly 83.18% of patients had a habit of tobacco chewing and 48.27% of patients were smokers. Around 12.1% patients had diabetes mellitus, while 28.1% of patients were hypertensive.

Surgery

All patients had composite resection of the primary tumor, involved bone, and overlying involved skin.

Full-thickness wide excision with segmental mandibulectomy was done in 84% of patients. Extended segmental

Table 1: Demographic data

Patient characteristics	Number	Percentage
Total no of patients	231	100
Gender		
Male	219	94.8
Female	12	5.2
Age (years)		
Mean	49.5yr(+/-5.36)	NA
Median	49 (38-69) yrs	NA
Stage		
IVA	231	100
Preoperative treatment group		
Upfront cases	133	57.6
Post NACT cases	79	34.2
Recurrent cases	19	8.2
Site of disease		
Lower Alveolus	145	62.8
Buccal Mucosa	78	33.8
Lower alveolus extending beyond midline	8	3.5
Addiction		
Tobacco chewing	193	83.18
Smoking	112	48.27
Co morbidities		
Diabetes	28	12.1
Hypertension	65	28.1
Surgery done		
FTWE + SM	194	84
FTWE + MM	1	4
BCR	28	12.1
FTWE + SM + AM	8	3.5
Titanium Plating	70	30.17
Hb (g/dl)		
Mean	12.28(+/-0.86)	
Median	12.400 (10.9-13.9)	
Albumin (g/dl)		
Mean	3.85(+/-0.47)	
Median	3.7 (2.6-4.6)	

FTWE: Full thickness wide excision involving skin + soft tissue + mucosa.
SM – Segmental Mandibulectomy. BCR – Bite-Composite Resection. MM –Marginal Mandibulectomy

Table 2: Flap dimensions

Site	Average dimensions (length × width) in cm
Average -oral defect/mucosal defect	5.9×4.2
Average External skin defect	6.1×4.2
Average flap dimensions	15.5×6.4
Largest flap dimension	21.5×7.5
No of Cases where Nipple incorporation in flap	14
Average size of the random portion of the flap	4.5×5.2
Largest size of the random portion of the flap	8×5.5

mandibulectomy involving the mandibular arch; for disease crossing midline; was done in 3.5% patients. Bite composite resection was done in 12.1% of patients while full-thickness

Table 3: Early post-operative flap related complications

Complications	number	percentage
Full thickness total flap necrosis	2	0.9
Full thickness Inner partial flap necrosis	0	0.00
Full thickness outer partial flap necrosis	15	6.5
Epithelial necrosis	35	15.2
Minor suture dehiscence	32	13.9
Major suture dehiscence with OCF	21	9.1
Wound infection	26	11.3
Flap debridement & re-suturing	17	7.4
Hematoma	8	3.45
Re-surgery with second flap used	18	7.8
Total flap related morbidity	78	33.8
ClavienDindo grade I	22	9.5
II	161	69.7
IIIA	31	13.4
IIIB	17	7.4

Table 4: Late post operative data

	Number of patients	Percentage
Grade 1 dysphagia	136	58.87
Grade 2 dysphagia	74	32.03
Grade 3 dysphagia	21	9.09
Post operative average mouth opening	Mean	3.85cm(+/-0.8)
	Median	3.5cm (2.8-4.2)
Day of starting oral feed	Mean	23.3 (0.43)
	Median	21 (16-51)
Day of adjuvant RT	Mean	36.8(+/- 5.3)
	Median	36 (30-70)

excision with marginal mandibulectomy was done in only one patient.

The average flap dimensions were 13.5 cm length × 6.4 cm width. The largest flap dimension was 21.5 cm length × 7.5 cm width. 6.03% flaps had incorporation of the nipple. The average dimensions of random portion of the flap were 4.5 cm length × 5.2 cm width. This was the portion of the flap beyond the lateral margin of pectoralis major. The largest dimensions of the random portion were 8 cm length × 5.5 cm width. This was possible due to the lateral curvature in the flap design, such that the random portion is oriented obliquely and finally horizontally till the anterior axillary line. The random portion is composed of area supplied by the superior epigastric artery and perforators from the serratus anterior muscle. These are in connection with branches from the thoracoacromial artery via choke vessels. These choke vessels provide blood supply from the thoracoacromial artery; once the flap is harvested. This is shown in a study of vasculature for the pectoralis major muscle and PMMC flap by Rikimaru *et al*.[6]

Overall, the complication rate was 33.8% out of which only 7.8% required major re-surgery with second flap

reconstruction. This is comparable with other large series of PMMC flap by various authors such as Pradhan *et al.*,[7] Ahmad GQ *et al.*,[8] Bhola *et al.*,[9], Konduru *et al.*,[10] Sahu *et al.*,[11] Deo *et al.*,[12] Jacob *et al.*,[13] Tripathi *et al.*,[14] Chaturvedi *et al.*[15] and Mehta *et al.*[16] [Table 5].

Clavien-Dindo Grade I complications were seen in 9.5%, Grade II in 69.7%, grade IIIA in 13.4% and grade IIIB in 7.45% patients.

Early postoperative complications

Full thickness total flap necrosis of the entire myocutaneous flap was seen in only two patients (0.86%). One patient had undergone bite composite resection while the other person had undergone segmental mandibulectomy. One was a male and the other female. Both were patients treated post NACT. On debridement, thrombosis was observed at the thoracoacromial artery pedicle.

Full-thickness partial flap necrosis included necrosis of either the external or the internal skin paddle. There were 15 cases – 6.5% of full thickness external paddle necrosis. These were mostly in patients with bite composite resections and having a larger random fasciocutaneous distal component of the flap without underlying muscle. Furthermore, 40% of these patients were females. In females, the flap necrosis comprised 4 of the 12 patients (33.33%). There was no case of full-thickness partial necrosis of the internally sutured component of flap in any patient. The necrotic areas were debrided and salvage surgery in form of deltopectoral flap, contra-lateral PMMC flap, and micro-vascular free flap were used.

Minor suture dehiscence was seen in 13.3% of patients, mostly in whom bite composite resection were done and mostly in the females. Major wound dehiscence with oro-cutaneous fistulae (OCF) occurred in 21 patients (9.1%). Out of these 7 were at the anterior portion of the lower suture line at the site of suturing with the mandibular stump. The rest 14 incidences were on the superior suture line – all in patients who underwent bite composite resection. We interpret that

Table 5: Overall complications/morbidity across various studies

Author	Overall complications with PMMC flap
Patidar H *et al.*[7]	23.07
Jacob *et al.*[13]	48.33
Tripathi *et al.*[14]	40%
Ahmad GQ *et al.*[8]	34.04
Bhola *et al.*[9]	20.96
Chaturvedi *et al.*[15]	40.5%
Sahu *et al.*[11]	33.3%
Mehta *et al.*[16]	40.5%
Our study	33.8%

the mucosa of the hard palate; which is nonpliable; was unable to hold the weight of the bi-paddled flap.

Most of these cases of suture dehiscence healed with secondary intention, regular wound cleaning and irrigation. Re-suturing was required in 11 patients. OCF due to flap necrosis was treated with debridement, wound dressing and re-suturing wherever feasible.

Flap related hematomas as seen in 3.45% of patients at the donor site. With careful hemostasis and overrunning the lateral remnant of the Pectoralis major with interlocking silk sutures; prevented further incidence of donor site hematomas was prevented. Re-surgery with second flap was needed in 7.4% cases. These results are comparable with other studies Jacob *et al.*,[13] Tripathi *et al.*,[14] Mehta *et al.*,[16] Shah *et al.*[17] and Vartanian *et al.*[18] [Table 6].

Oral feeding was started on 21st day (16–51 days). Patients were provided with guide flange prosthesis to prevent postoperative mandibular deviation. Exercises for mouth opening were taught to the patients.

Grade 1 dysphagia was observed in 58.87%, grade 2 dysphagia in 32.03% and grade 3 dysphagia was seen in 9.09% patients. Median mouth opening was 3.5 cm. None of the patients suffered from microstomia. In patients at risk of microstomia due to the involvement of the oral commissure and adjacent lips, the de-epithelization at the edge of folding of the bi-paddled PMMC flap was done. Most patients received adjuvant treatment within 6 weeks. Median time of receiving adjuvant treatment was at 36 days (30–70 days).

There was no incidence of late flap necrosis.

CONCLUSION

Pectoralis major mycocutaneous flap has been a boon to reconstruction of the oral cavity post its inception. It has a lower learning curve, does not require specialized instruments, and can be easily mastered by the surgical oncologist. In case of locally advanced squamous cell carcinomas of the oral cavity; in many instances, there is a clinically significant cervical lymph nodal spread vessels post mandating a comprehensive lymph node dissection. PMMC flap provides a robust well-vascularized muscular cover to the cervical vessels post sternocleidomastoid excision.

Limitations of the flap included the absence of bony reconstruction and also initial bulging defect and poorer cosmesis as compared to microvascular free flap.

Table 6: Comparison of early post operative complications in various studies.

Complications	Our study	Jacob *et al*.[13]	Tripathi *et al*.[14]	Mehta *et al*.[16]	Shah *et al*.[17]	Vartanian *et al*.[18]
Full thickness total flap necrosis	0.9	1.66	0	2.7	3	2.4%
Full thickness partial flap necrosis	6.5	3.32	6.31	24.54	2	11.4%
Major suture dehiscence with OCF	9.1	10	12.63	14.5	26	11.8%
Wound infection	11.3	3.32	33.68	12.7	29	8.3%
Hematoma	3.45	-	7.36	12.7	-	-

Declaration of patient consent

The authors declare that they have obtained consent from patients. Patients have given their consent for their images and other clinical information to be reported in the journal. Patients understand that their names will not be published and due efforts will be made to conceal their identity but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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