Mango-shaped Bi-padded 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-padded 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 myocutaneous 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-padded pectoralis major myocutaneous flap, oral cavity, squamous cell carcinoma

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.
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

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].
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 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.[9]

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                             | 49.5 yr (+/-5.36) | NA |
| Median                           | 49 (38-69) yrs | NA |
| Stage                            |        |            |
| IVA                              | 231    | 100        |
| Preoperative treatment group     |        |            |
| Upright 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 excision with marginal mandibulectomy was done in only 1 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.

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) |
CONCLUSION

Pectoralis major myocutaneous 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 5: Overall complications/morbidity across various studies

| Author          | Overall complications with PMMC flap |
|-----------------|--------------------------------------|
| Patidar H et al. | 23.07                                 |
| Jacob et al.    | 48.33                                 |
| Tripathi et al. | 40%                                   |
| Ahmad GQ et al. | 34.04                                 |
| Bhola et al.    | 20.96                                 |
| Chaturvedi et al.| 40.5%                                 |
| Sahu et al.     | 33.3%                                 |
| Mehta et al.    | 40.5%                                 |
| Our study       | 33.8%                                 |
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.[14] | Shah et al.[17] | Vartanian et al.[14] |
|------------------------------------|-----------|------------------|---------------------|------------------|-----------------|---------------------|
| 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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