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Reconstruction Flaps Post Oro-Mandibular Tumor Resection to Maintain Function and Cosmetic Outcomes: A Prospective Study

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ABSTRACT

Objective: *The aims of study to evaluate the functional and aesthetic outcomes of various local and regional flaps used for immediate reconstruction of oro-mandibular defects following tumor resection in Hadhramout National Oncology Center.*

Methods: *This prospective study of 156 patients with Stage I–III oral, mandibular, or oro-mandibular tumors, predominantly squamous cell carcinoma (91.7%), underwent immediate reconstruction at Hadhramout National Oncology Center from January 2013 to March 2025. Flaps included local tongue and buccal flaps, pectoralis major myocutaneous (PMMC), submental, nasolabial, temporal, deltopectoral, forehead, and bilateral Karapandzic flaps. Functional and cosmetic outcomes were assessed preoperatively and six months postoperatively using the University of Washington Questionnaire. Statistical analysis (Chi-square test, Cramer's V) was performed to evaluate associations between flap type and postoperative outcomes.*

Results: *Among 156 patients (96 males, 60 females; mean age: 52 years), squamous cell carcinoma predominated (91.7%). Soft tissue defects were most common (62.2%), and local flaps were the most frequently used (34.6%). The overall flap success rate was 98.1%. Functional outcomes were significantly associated with flap type ($\chi^2(7)=105.026$, $p<0.001$; Cramer's $V=0.82$). Submental, PMMC, and local flaps yielded the highest rates of excellent functional outcomes. Aesthetic outcome was also significantly associated with flap type ($\chi^2(9)=18.863$, $p=0.026$; Cramer's $V=0.35$), with nasolabial and local flaps performing best. Complications, including partial flap loss (1.3%) and orocutaneous fistula (1.3%), were minimal. Statistical analysis revealed significant associations between flap type and outcomes, with local and submental flaps excelling in both function ($p < 0.001$) and aesthetics ($p = 0.026$).*

Conclusion: *This study underscores the viability of pedicled flaps particularly PMMC and submental flaps in settings lacking microsurgical infrastructure, offering reliable functional and cosmetic reconstruction of oro-mandibular defects while maintaining acceptable morbidity and quality-of-life outcomes. These techniques provide viable alternatives to free flap reconstruction and support extensive oncologic resection without compromising postoperative quality of life.*

Keywords

Oro-mandibular reconstruction, Pectoralis major myocutaneous flap, Submental flap, Functional outcomes, Aesthetic outcomes, Head and neck cancer, Yemen.

Introduction

Squamous cell carcinoma (SCC) of the oro-mandibular region remains prevalent in Yemen due to socioeconomic factors, including widespread use of smokeless tobacco and limited access to early diagnostics [1]. Reconstruction post-resection

aims to restore form and function, adhering to the principle of replacing "what is removed" [2]. Reconstructive methods in head and neck surgery adhere to the fundamental principle that any structure removed during oncologic resection must be adequately repaired or replaced. This concept is particularly critical in the management of oro-mandibular defects following tumor resection. Effective reconstruction not only restores form and function but also empowers surgeons to pursue extensive resections without hesitation, knowing that even large composite defects can be reliably reconstructed [3,4].

While free flaps are considered the gold standard for complex defects [5,6], local and regional flaps remain critical in settings with limited microsurgical infrastructure. This study evaluates outcomes of local, nasolabial, deltopectoral, submental, and pectoralis major myocutaneous (PMMC) flaps in a cohort of Yemeni patients, emphasizing their role in cosmetic and functional restoration.

Patients and Methods

Aims of the work

To evaluate the aesthetic and functional outcome of different techniques of flaps in reconstruction of oromandibular Defects after tumors resection by either local and regional flaps.

Study Design and Ethical Considerations

This prospective study conducted on 156 patients of Hadhramout National Oncology Center, those treated at Al Arab University Hospital and Al Burj Consultant Hospital for the period from January 2013 to March 2025, with oral, mandibular or oro-mandibular cancer that need reconstructions flaps after tumor resection, whom admitted to Al arab University Hospital and alburj consultant Hospital, Hadhramout, Yemen.

Patients Selection

Inclusion/Exclusion Criteria

- **Included**: Stage I–III:(cancer lip, tongue, flour of the mouth, check and alveolar ridge, mandible) and benign mandibular tumors, and select recurrences post-chemo-radiotherapy.
- **Excluded**: Metastatic disease, surgically unfit patients, Patients refuse

Ethical Considerations

Ethical approval (HUCOM-2012-11) and informed consent were obtained and the post-operative score obtained by independent person.

Preoperative Workup

All patients were submitted for the following:

Thorough History Taking

Patients' details, Epidemiological data, Associated co-morbidity as Diabetes mellitus (D.M.), vascular disease (i.e., arteritis), Medication as chronic steroid usage, Previous neck irradiation or surgery, History of cerebrovascular incidents and Bleeding disorder.

General Examination

- All subjected patients were submitted to meticulous clinical examination including chest, heart, liver with special attention to hypertension and peripheral vascular disorder.
- Donor site examination to exclude the possibility of prior trauma to the intended flap tissues or vascular pedicle.

Local Examination

- Inspection for facial asymmetry, swelling, discoloration or ulceration and palpation particularly noting asymmetry or masses.
- Inspection of different intraoral areas (lip - buccal mucosa – tongue - floor of mouth – retromolar trigone) with palpation of ulcer, mass or nodule if present.
- Examination for missing, loosening teeth or caries.
- Examination of the lesion (Direct visualization of the neoplasm, along with bimanual palpation).
- TNM-staging of the malignant neoplasm according to American Joint Committee on Cancer
- Neck examination for palpable lymph node.

Defect Classification and Flap Selection

Defects were classified using Boyd's system, which stratifies defects based on involvement of mucosa, mandible, and skin [7]. For lateral defects <6 cm, submental or nasolabial flaps were prioritized, while PMMC flaps addressed larger defects involving bone or through-and-through involvement [8,9]. Free flaps were excluded due to limited microsurgical infrastructure, contrasting with high-resource studies favoring fibula or iliac crest flaps [10,11].

– Photographic records of the tumor to provide a baseline for comparison on later occasions.

Laboratory Investigations Including

Complete blood picture, Erythrocyte sedimentation rate, Prothrombin time and concentration, bleeding time, clotting time, Liver and kidney functions, Fasting blood sugar, Serum albumin, Blood group for possible blood transfusion.

ECG and Echocardiography for Cardiac Patient

Radiological Examination

A. Orthopantomogram (panoramic scanning dental X-ray of the upper and lower jaw) was done in for assessment of mandibular involvement, exclusion of dental infection and assessment of integrity of mandibular plate in case of 2ry reconstruction.
B. Computed tomography and 3-Dimensional CT for assessment of primary lesion, mandibular involvement and neck lymph node.
C. MRI for soft tissue assessment.

Biopsy Taking

Representative True-cut or incisional biopsy was taken under local

or general anesthesia, FNAC of neck lymph node if present and histopathological examination of the biopsy.

Metastatic Work Up in Malignant Cases: Including CT scan head, neck, chest, abdominopelvic and bone scan.

Postoperative Workup

- Postoperative flap monitoring, clinically by (Color, Temperature, Tissue turgor, Capillary refill time and Pinprick bleeding) and by Doppler ultrasound.
- Postoperative photos will be used to assess the final aesthetic results.
- Functional and aesthetic appearance were independently and subjectively evaluated to assess the final outcome of the reconstruction.
- Consultation of medical oncology for starting post-operative Radiotherapy and/or chemotherapy.

The data was collected including the age and gender of patients, the side and site of the lesion, radiological findings and tumor pathology, the treatment modalities used, type of surgery performed, the flap used for reconstruction, complication of the donor and recipient site, subjective outcome result, all were recorded and the data were statistically analyzed.

Surgical Techniques

The local, regional, and pedicled oro-mandibular reconstruction operations had been done under general anesthesia.

- The operating room was equipped with the usual surgical instrument.
- The patient is positioned supine with the head supported on a ring and neck extended by a sandbag under the shoulder. The head is turned to the opposite side of lesion.
- The surgical site and the donor site are sterilized with betadine, spirit and draped with towel.
- Same surgical team, operated simultaneously in all the studied cases.
- The selection of the flap is according to the expected defect after tumor resection (bone, soft tissue or bone and soft tissue).

Surgical Methods

Pectoralis Major Myocutaneous PMMC Flap (24 patients)

All patients should be examined before raising the flap. Any scar over the chest wall which might interfere with the design of the flap should be noted and the incision for the skin island modified accordingly. The skin island should be marked and at least half of skin island should place over the lower border of pectoralis major, and you should preserve the deltopectoral flap as the pectoralis flap will pass under it.

Then incision is deepened through the skin and preserving the subcutaneous tissue to improve the blood supply and therefore the reliability of the flap, elevation of skin and subcutaneous tissue to expose the muscle.

Then identification of the lateral border of the pectoralis major muscle, the lateral portion of the muscle is dissected off the chest wall and dissected from sternal origin from lateral border of the sternum. As there is an avascular plane between the pectoralis major and minor muscles, it is easy to separate these two muscles.

The neurovascular pedicle of the pectoralis major muscle flap (arterial: The pectoral artery which is dominant branch of the thoracoacromial artery and The pectoral branch of the lateral thoracic artery, venous: one or two venules accompany the pectoral branch of the thoracoacromial arterial trunk, nerves: lateral and medial pectoral nerves) this pedicle is attached to the undersurface of the muscle and comes up from the chest wall medial to the medial border of the pectoralis minor. It can be identified both visually and by palpation of its pulsation and we cut the nerve supply of muscle to induce atrophy of bulky muscle. The skin island then taken to reconstruct the oromandibular defect either direct or it will be supported with titanium plate and screws and wrapping of the plate by flap and stitches between plate and pectoralis muscle to hold it in place, then suturing skin island to the defect. The skin defect over the chest wall can be closed primarily with a subcutaneous drain in all cases.

Submental Flap (21 patients)

The flap is raised as an elliptical-shaped musculocutaneous flap with a skin island ranging from 4-5 up to 10-16 cm that can used to reconstruct buccal mucosa, tongue defect and floor of mouth defects. The arterial blood supply to the submental flap is axial and provided directly by the submental branch of the facial artery, the pedicle consists of the submental artery and vein. Mobilization of the flap is achieved by dissecting its arterial supply to the origin of the facial artery. The length of the submental vein is the limiting factor in pedicle length, so Removal of the submandibular gland lengthen the pedicle and facilitates passage of the widely based flap into the oral cavity.

The facial artery will require proximal dissection through the submandibular gland to provide adequate pedicle length and mobilization. Superiorly, the border lies at least 1 cm behind the mandible to keep the scar hidden. The lateral extent lies just beneath the angles of the mandible. The inferior limit is determined by the amount of skin needed. In addition to the skin, subcutaneous tissue, and platysma that included in the flap, the ipsilateral anterior belly of the digastric muscle is taken with the flap because it is closely associated with the submental artery. Take Care to identify and preserve the marginal mandibular nerve, the donor site is closed primarily.

Temporal Myocutaneous Flap (14 patients): is a regional pedicled flap based on the deep temporal arteries, mark the flap, before incision made 2cm superior to helix at hairline then curved anteriorly parallel to temporal hairline, and terminated medial brow (preserve supratrochlear vessels), skin, subcutaneous tissues are elevated in a subgaleal plane.

DISSECTION PLANES: Superficial: Above temporoparietal fascia (protect frontal nerve). Deep: Subperiosteal elevation from temporal fossa

Flap Harvesting: The temporalis muscle is dissected from the temporal fossa. It is detached inferiorly from the coronoid process of the mandible if increased mobility is needed. Care is taken to preserve the deep temporal vessels. The harvested flap was rotated inferomedially to reach the oral cavity and A tunnel was created through the zygomatic arch or the flap passed around it.

Donor Site Closure: Scalp is closed in layers with care to preserve the frontal branch of the facial nerve.

INCISION: Start: 2cm superior to helix at hairline Curve: Anteriorly parallel to temporal hairline, terminate: Medial brow (preserve supratrochlear vessels).

DISSECTION PLANES: Superficial: Above temporoparietal fascia (protect frontal nerve), Deep: Subperiosteal elevation from temporal fossa.

PEDICLE ISOLATION: Identify deep temporal arteries 2cm below temporal line and preserve vascular cuff at coronoid insertion. Tunneling Flap passage to midface/orbit with or without osteotomy of zygomatic arch.

Nasolabial Flap (6 patients)
The flap inferiorly based pedicle flap used to reconstruct intermediate-size intraoral defects of the medial cheek, upper lip, palate, and anterior floor of the mouth up to5 cm in diameter. Classically, the nasolabial flap is a fasciocutaneous flap can be used as a random pattern flap based on the subcutaneous blood supply from the transverse facial and angular vessels and the incision is placed to provide a 2–3 cm base and a length-to-width ratio between 2:1 and 3:1. or it can raised as axial pedicaled Nasolabial musculocutaneous island flap preserve the underlying angular artery and its muscle perforators (superiorly based flap) or the facial artery with it perforators branches (inferiorly based flap) which lies deep to the facial muscles, so dissection of this flap necessitates severing the zygomaticus major, zygomaticus minor, and levator labii superioris muscles.

The base of the flap should be maintained at just above the level of the mouth angle because just below this level several branches of the facial artery and inferior labial artery pass into the nasolabial skin and subcutaneous tissue and superiorly, the flap extends to no closer than 5–7mm inferior to the medial canthus to avoid ectropion of the lower lid.

The flap transfer to the oral cavity, through a wide transbuccal tunnel which created posterior to the orbicularis oris and flap sutured to the defect site and the donor site is reapproximated and closed primarily.

Deltopectoral Flap (11 patients)
This fasciocutaneous flap is based on the first four anterior cutaneous perforator branches of the internal mammary artery with the primary supply being the second and third perforators that perforate the intercostal muscles and the pectoralis muscle to reach the skin and Venous drainage is accomplished by the venae comitantes that accompany the arteries in this region.

The flap is marked with a line parallel to the clavicle and centered over the second or third intercostal space or both, depending on the width necessary. The flap can extend in the direction of the acromion to the deltopectoral groove and beyond if needed (Figure 1).

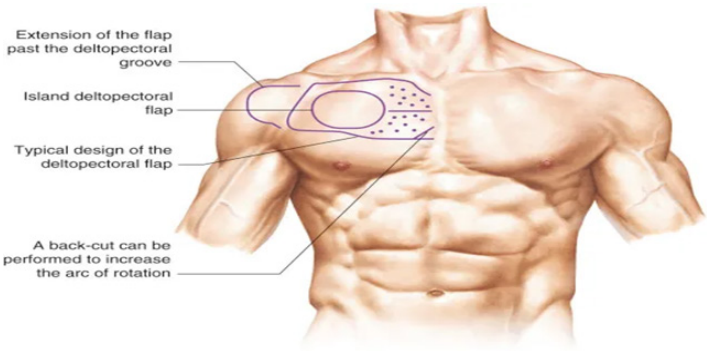

Figure 1: Flap anatomic landmarks.

The flap is harvested by sharply incising the skin and subcutaneous layers to the pectoralis fascia that incorporated into the flap to preserve the perforating blood vessels that travel above this fascial layer. The flap elevated in this plane from a lateral to medial direction, with extreme care taken to stay at least 2 cm from the lateral border of the sternum.

We cover the intraoral defect by the DPF that can pass to oral cavity through a tunnel in the floor of mouth and we underwent de- epithelization of that part that passed through the tunnel and we suture the outer and inner edges of the flap to close the tunnel and prevent orocutaneous fistula that may develop on top of it. As any pedicaled flap we separate it after 2-3weeks after the intraoral part get its neovascularization and we return the remaining proximal part of the flap to cover the raw area on the chest wall.

Bilateral Karapandzic Flap (3 patient's)
It is an axial musculomucocutaneous flap based on the superior or inferior labial arteries It is designed around the melolabial and labiomandibular creases, which divide the facial subunit borders between the upper and lower lips and the cheek.

Technique

1. Incisions are made bilaterally along the nasolabial folds and down around the oral commissures, connecting to the defect.
2. The flaps, containing skin, subcutaneous tissue, and the *intact* orbicularis oris muscle with its neurovascular bundles,

are **rotated medially and advanced** towards the midline.
3. The flaps are sutured together centrally and to the remaining lip/commissures.
4. Functionally, the Karapandzic flap preserves lip mobility, oral competence, articulation, and emotional expression.

Forehead Flap (1 patient)
A pedicled axial-pattern flap harvested from the forehead skin and subcutaneous tissue, based on the supratrochlear artery (and sometimes the supraorbital artery).

Pedicled: Remains attached to its vascular pedicle during transfer (usually 2-3 weeks), ensuring blood supply.

Axial-Pattern: Based on a named artery, allowing large size and length.

Excellent Tissue Match: Provides abundant, well-vascularized skin with similar color, texture, and thickness to native nasal skin.

Two-Stage Procedure: Stage 1: Flap elevation, inset into nasal defect. Stage 2 (2-3 weeks later): Pedicle division and final inset.

Donor Site: Primarily closed (resulting in a vertical midline forehead scar) or skin grafted.

Postoperative Functional Assessment

Functional and aesthetic assessments were performed of those patients who had undergone successful flap performed and who could be observed for at least 6 months. Functional outcome was based on the University of Washington Questionnaire (UWQ). The following points was addressed (pain, speech, chewing, swallowing and cosmetic appearance). For evaluation each point was categorized as excellent, good, fair and poor. Preoperative and postoperative evaluation was done. Data of this questionnaire at preoperative and 6 months postoperative were compared and statistically analyzed.

Results

This study conducted on 156 patients of Hadhramout National Oncology center, were presented with oral, mandibular or oro-mandibular tumor that need immediate reconstructions flaps after tumor resection were admitted to Al arab university Hospital and Al burj Consultant Hospital, Yemen, during the period from January 20013 until March 2025. The reconstruction was performed immediate in all patients (100%) with the same surgical team.

Gender and Age Distribution

The 156 patients enrolled in this study were 96 males (61.54%) and 60 females (38.46%). The male: female ratio was 1.6:1 .and their distribution as in the Table 1 and Figure 2 histogram below. Majority of patients age were (77.6%) were ≥34 years old, with the largest group being 51-67 years (40.4%). Younger patients (17-33 years) were underrepresented (5.1%).

Table 1: Age Group).

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	17 - 33	8	5.1	5.1	5.1
	34 - 50	58	37.2	37.2	42.3
	51 - 67	63	40.4	40.4	82.7
	68+	27	17.3	17.3	100.0
	Total	156	100.0	100.0	

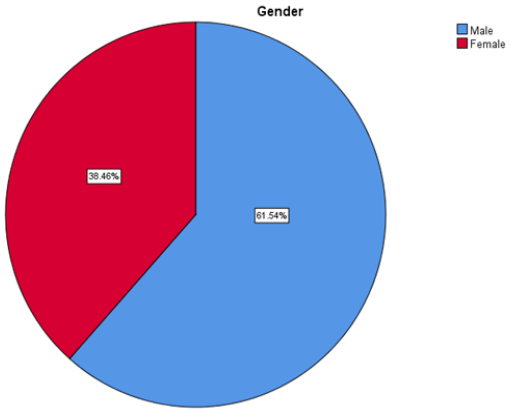

Figure 2: Histogram sex distribution.

Tumor Characteristics

Squamous cell carcinoma accounted for 91.7% of cases, indicating it is the primary pathology in this cohort, the bad oral hygiene with single denture that make friction with tongue or gingiva or unfit denture in old age patient was the main risk factor of SCC in addition to smoking, showing Kate and Shammah tombac, ameloblastoma (3.8%), Adenoid cystic carcinoma (3.2%), Ewing sarcoma (0.6) and malignant melanoma (0.6), see Table 2 below.

Table 2: Histopathological Tumor type.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	squamous cell carcinoma	143	91.7	91.7	91.7
	Ameloblastoma	6	3.8	3.8	95.5
	Adenoid cystic carcinoma	5	3.2	3.2	98.7
	Ewing sarcoma	1	.6	.6	99.4
	malignant melanoma	1	.6	.6	100.0
	Total	156	100.0	100.0	

Type of Surgical Defect after Resection

Surgical resection of the oro-mandibular tumors led to a defect which was soft tissue defect only in 97 patients (62.2%), bony mandibular defect only in 6 patients (3.8%) and soft tissue with bone defect in 53 patients (34%). Oro-mandibular defects were classified according to Boyd's classification [12]. This classification is based on three upper case characters (H, C, L) and three lower case characters (o, m, s). H defects are lateral defects on any length, including the condyle but not significantly crossing

the midline, L defects are the same but exclude the condyle; C defects consist of the entire central segment containing the four incisors and the two canines. These letters may be combined (e.g., LCL would represent an angle-to-angle defect). The letter o represents the absence of mucosa and skin component, s represents skin deficit, and m represents mucosa deficit.

Reconstruction Flap Usage

Common Flaps: Local flaps were most frequent (34.6%), followed by pectoralis major flaps (15.4%) and submental flaps (13.5%). Rare Flaps: Bilateral Karpazadic (1.9%) and forehead flaps (0.6%) were least used. see Table 3.

Table 3: Type of Reconstruction flaps according to defect.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Local tongue flap	6	3.8	3.8	3.8
	Local Buccal flap	16	10.3	10.3	14.1
	Pectoralis major myocutaneous flap	24	15.4	15.4	29.5
	Nasolabial Flap	6	3.8	3.8	33.3
	Submental flap	21	13.5	13.5	46.8
	Deltopectoral flap	11	7.1	7.1	53.8
	Temporal flap	14	9.0	9.0	62.8
	Local Flap	54	34.6	34.6	97.4
	Bilateral Karpazadic flap	3	1.9	1.9	99.4
	forehead flap	1	.6	.6	100.0
	Total	156	100.0	100.0	

Pectoralis major myocutaneous PMMC Flap:

24 patients their post-oncological defects reconstructed by **PMMC flap** alone or with titanium plate and screws, 14 patients have both bone and soft tissue defects and 10 patients with only bone defect and some steps of tumor resection and reconstruction are shown in (Figures 3A, B, C) and (Figures 4A, B).

Figure 3A, B, C: A. Marking the incision of resection big ulcerating SCC of RT check and buccal mucosa B. Bilobal elevation of PMM flap and skin paddle oriented to cover defect. C. Closer the wound.

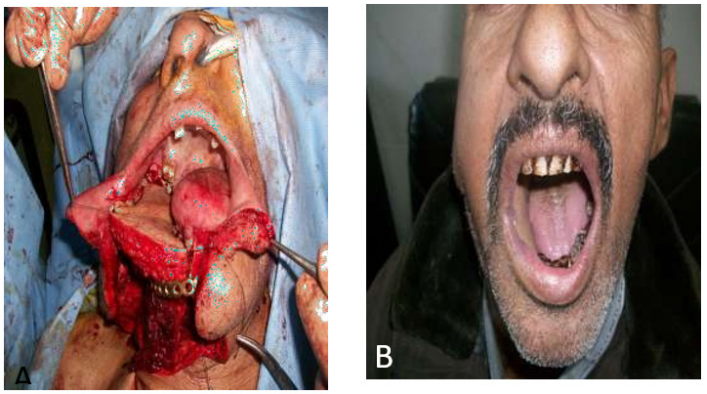

Figure 4A, B: A. fixation of the reconstruction plate by screws and the PMM flap fixed to it and cover the defect B. postoperative photo show good appearance and coverage of the flap.

Nasolabial Flap: 6 patients have soft tissue defects only after wide lip or tongue tumor resection were reconstructed by nasolabial Flap, (Figures 5A, B) and (Figures 6A, B).

Figure 5A, B: S.C.C. of the anterior floor of mouth, (B)Design of nasolabial flap and collar incision for neck dissection.

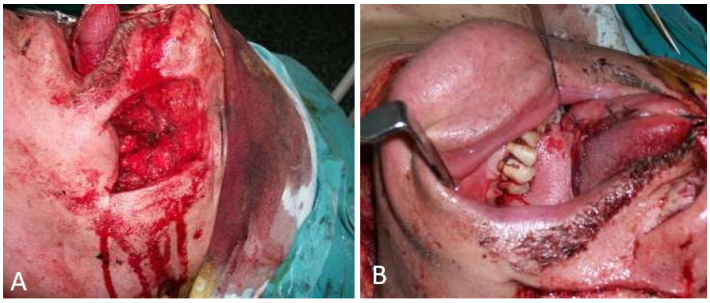

Figure 6A, B: A. Nasolabial flap tunneling, (B) Nasolabial flap suturing to resected receipt tongue site.

Submental Flap: 21 patients have soft tissue defects and some with bony and soft tissue only and reconstructed by submental flap and their defects were mucosal defect either in anterior floor of mouth or tongue or in buccal mucosa and cheek as in (Figure 7A,B,C,D) and (Figure 8A,B).

14 patients have soft tissue defects after check cancer or after hemiglossectomy and floor of mouth and are reconstructed by **deltopectoral flap** as shown in (Figure 9A, B) and (Figure 10A, B).

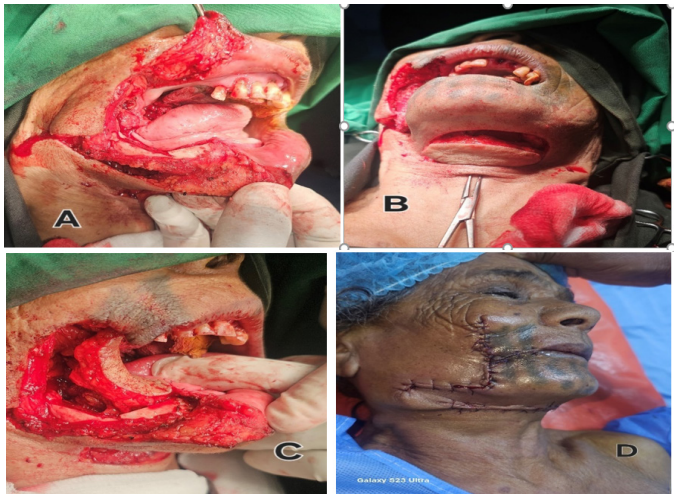

Figure 7: A: RT side Buccal resected tumor. B: Elevation of submental pedicled flap. C: Tunneling Submental flap to oral cavity (D) Close the defect and donor site.

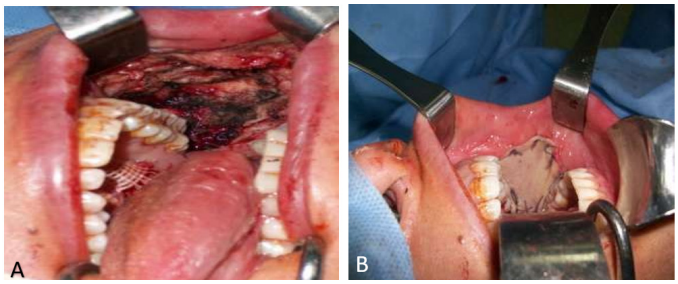

Figure 8: A: Show Buccal mucosa defect after resection of adenoid cystic carcinoma, B: The submental flap sutured to reconstruct the defect of buccal mucosa of check.

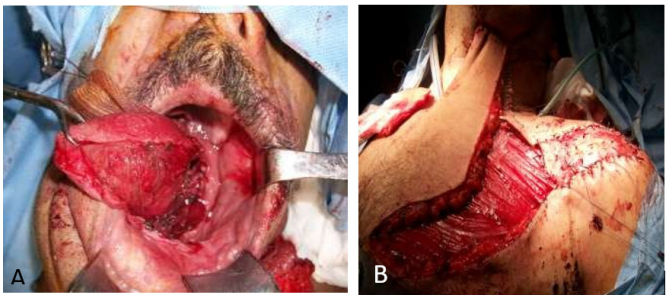

Figure 9: A: Oral defect after hemiglossectomy and part of FOM. B: Deltopectoral flap harvested and transferred to cover intraoral defect after hemiglossectomy and floor of mouth and lateral part of donor site covered by split thickness skin graft.

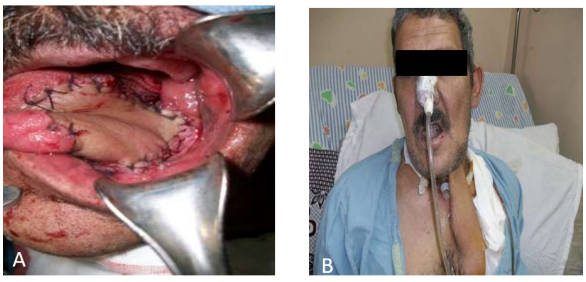

Figure 10: A: Reconstruction of intraoral defect by DPF and suturing the de-epithelized part to close the tunnel. B: One week postoperative of DPF

22 patients have soft tissue defects only after wide Local tumor resection on tongue or buccal mucosa were reconstructed by 6 cases by tongue flap and 16 cases by Local Buccal flap. 14 patients of upper jaw tumor with bone and soft tissue defect reconstructed by Temporal flap.

3 cases of complete lower lip cancer were constructed by Bilateral Karpazadic flap see Figure 11 A,B,C.

Figure 11: A: Lower and Lt commissure lip cancer. B: Reconstruction Bilateral Karpazadic flap. C: Post flap reconstruction healing wound.

One cases of complete upper jaw cancer were reconstructed by forehead flap see Figure 12:

Figure 12: Post forehead flap follow up.

Post Reconstruction Flap Outcomes

Local complications: were recorded in 12 patients (7.7%) of all 156 cases, were 4 cases (2.6%) had seroma at donor site of treated conservatively Table 4. There are 3 complications occurred with PMM flap, 1 with submental flap, 2 with submental flap ,2 with deltopectoral flap and 3 with Temporal flap and one in bilateral Karpazadic flap and one in bilobar PMM flap. Partial flap loss occurred with 2 patients with PMM flap and revision and secondary suturing was done

Hematoma occurred with 2 patients with temporal flap and treated conservatively, Orocutaneous fistula occurred with 2 patient one with Pectoral flap and another with submental flap due to hair growth treated conservatively, Plate extrusion occurred in one patient after she received adjuvant radiotherapy and treated by plate removal (Figure 13A).

Total flap loss occurred in one patient with submental flap (Figure

13B). and managed conservatively by repeated dressing and then split thickness graft taken to cover raw area.

Figure 13: A: Plate extrusion. B: Total loss of submental flap that used in reconstruction of buccal mucosal defect.

Short term Donor-site complications in the form of wound infection, seroma, pain and numbness were experienced in some patients in varying degrees, but overall were mild and treated conservatively. Long term donor site disability was not recorded for any patient.

Table 4: Post Reconstruction Complication.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Partial flap loss	2	1.3	1.3	1.3
	Ischemic Flap	1	.6	.6	1.9
	Heamatoma	2	1.3	1.3	3.2
	Orocutaneous Fistula	2	1.3	1.3	4.5
	Plate extraction	1	.6	.6	5.1
	Healthy flap without complication	144	92.3	92.3	97.4
	SEROMA	4	2.6	2.6	100.0
	Total	156	100.0	100.0	

Statistical Association between Reconstruction Flap Type and Clinical Outcomes

The functional and aesthetic outcome will be compared preoperatively and 6 months postoperative between 155 successful flaps from 156 flaps. The overall success rate of study cases was 98.1 %. The lost flaps were one submental flap and 2 partial losses of PMM flap. Reconstruction flaps were seen in Tables 5, 6 with post-operative function outcomes evaluation.

Postoperative Functional Outcome

The Pearson chi-square test (Table 7) for flap type versus postoperative functional status (categorized as "Good" vs "Excellent") was highly significant ($\chi^2(7) = 105.026$, $p < 0.001$). This indicates a statistically significant association: the distribution of functional outcomes differs markedly across flap types. The magnitude of this effect is very large (Cramer's $V \approx 0.82$), reflecting that flap type strongly predicts functional outcome.

In practical terms, almost all "Excellent" functional ratings occurred in just a few flap categories. For example, the Pectoralis major myocutaneous flap had 3 of 24 cases rated Excellent, the Submental flap had 3 of 21, and the general "Local flap" group had 6 of 54 Excellent (see Table). No other flap type produced any Excellent ratings. Thus, these three flap types contributed all the observed superior functional outcomes – their observed counts of Excellent outcomes exceeded the expected counts under the null hypothesis of no association. In contrast, flaps like Local Buccal, Nasolabial, Deltopectoral, Temporal, Bilateral Karpazadic, and Forehead had zero Excellent outcomes. This pattern suggests that Pectoralis major, Submental, and Local Flaps are disproportionately associated with "Excellent" postoperative function.

Table 5: Reconstruction flaps * Post operation function Crosstabulation.

			Post operation function		Total
			Good	Excellent	
Reconstruction flaps	Local tongue flap	Count	6	0	6
		% within Reconstruction flaps	100.0%	0.0%	100.0%
	Local Buccal flap	Count	15	1	16
		% within Reconstruction flaps	93.8%	6.3%	100.0%
	Pectoralis major myocutaneous flap	Count	21	3	24
		% within Reconstruction flaps	87.5%	12.5%	100.0%
	Nasolabial Flap	Count	6	0	6
		% within Reconstruction_flaps	100.0%	0.0%	100.0%
	Submental flap	Count	18	3	21
		% within Reconstruction_flaps	85.7%	14.3%	100.0%
	Deltopectoral flap	Count	11	0	11
		% within Reconstruction_flaps	100.0%	0.0%	100.0%
	Temporal flap	Count	14	0	14
		% within Reconstruction_flaps	100.0%	0.0%	100.0%
	Local Flap	Count	48	6	54
		% within Reconstruction_flaps	88.9%	11.1%	100.0%
	Bilateral Karpazadic flap	Count	3	0	3
		% within Reconstruction_flaps	100.0%	0.0%	100.0%
	forehead flap	Count	1	0	1
		% within Reconstruction flaps	100.0%	0.0%	100.0%
Total		Count	143	13	156
		% within Reconstruction flaps	91.7%	8.3%	100.0%

Table 6: Post operative function evaluation.

Post operation function	Observed N	Expected N	Residual
Good	102	78.0	24.0
Excellent	54	78.0	-24.0-
Total	156		

Table 7: Chi-Square test of post-operative function.

Test Statistics	Flap	Post operation function
Chi-Square	105.026[a]	14.769[b]
df	7	1
Asymp. Sig.	.000	.000
a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 19.5.		

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	18.863[a]	9	.026
Likelihood Ratio	24.711	9	.003
Linear-by-Linear Association	1.771	1	.183
N of Valid Cases	156		
a. 13 cells (65.0%) have expected count less than 5. The minimum expected count is .18. b. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 78.0.			

Aesthetic Outcome

The difference between the pre and post-operative aesthetic appearance was evaluated buy the chi-square test (Table 8) for reconstruction flap type versus aesthetic result (Good vs Excellent) was also significant, though more modestly ($\chi^2(9) = 18.863$, df = 9, p = 0.026). The association is statistically significant at the 5% level but of moderate strength (Cramer's V ≈ 0.35). In other words, flap type is significantly related to aesthetic outcome, but the relationship is weaker than for functional outcome. Examining the contingency table reveals which flaps yielded disproportionately high numbers of Excellent aesthetic ratings. The "Local flap" group (n=54) had 15 Excellent outcomes (28%, observed vs ~10 expected), substantially more than expected. Similarly, the Nasolabial flap (3 Excellent of 6 total, 50%) and the Local Tongue flap (2 of 6, 33%) showed far higher-than-expected Excellent rates. In contrast, several flaps (Local Buccal, Deltopectoral, Temporal, Forehead) had no Excellent aesthetic ratings at all. These findings imply that the Local, Nasolabial, and Local Tongue flaps are most associated with superior cosmetic outcomes see Table 9.

Table 8: Aesthetic results by Chi-Square Tests.

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	18.863[a]	9	.026
Likelihood Ratio	24.711	9	.003
Linear-by-Linear Association	1.771	1	.183
N of Valid Cases	156		
a. 13 cells (65.0%) have expected count less than 5. The minimum expected count is .18.			

Table 9: Reconstruction flaps * Aesthetic outcome Crosstabulation.

			Good	Excellent
Reconstruction flaps	Local tongue flap	Count	4	2
		% within Reconstruction flaps	66.7%	33.3%
	Local Buccal flap	Count	16	0
		% within Reconstruction flaps	100.0%	0.0%
	Pectoralis major myocutaneous flap	Count	21	3
		% within Reconstruction flaps	87.5%	12.5%
	Nasolabial Flap	Count	3	3
		% within Reconstruction flaps	50.0%	50.0%
	Submental flap	Count	17	4
		% within Reconstruction flaps	81.0%	19.0%
	Deltopectoral flap	Count	11	0
		% within Reconstruction_flaps	100.0%	0.0%
	Temporal flap	Count	14	0
		% within Reconstruction_flaps	100.0%	0.0%
	Local Flap	Count	39	15
		% within Reconstruction_flaps	72.2%	27.8%
	Bilateral Karpazadic flap	Count	2	1
		% within Reconstruction_flaps	66.7%	33.3%
	forehead flap	Count	1	0
		% within Reconstruction_flaps	100.0%	0.0%
Total		Count	128	28
		% within Reconstruction_flaps	82.1%	17.9%

Discussion

Our study provides valuable evidence supporting the efficacy of pedicled flaps for immediate oro-mandibular reconstruction in a resource-constrained environment of udder developing country like Yemen. The findings challenge the notion that microvascular free flaps are the only viable option for complex head and neck reconstruction, particularly when infrastructure or expertise is limited. The high overall flap success rate (98.1%) and the significant associations between specific flap types and favorable functional/aesthetic outcomes offer crucial insights for surgeons practicing in similar settings globally. The highly significant association between flap type and functional outcome ($\chi^2(7)=105.026$, *p*<0.001; Cramer's V=0.82) is a core finding. The superior performance of **submental flaps**, **PMMC flaps**, and local flaps in restoring function (speech, swallowing, chewing) aligns with their anatomical suitability for common defects in this region. The submental flap's thinness, pliability, and proximity make it ideal for intraoral lining and moderate-sized defects, explaining its high rate of excellent functional results (14.3%) – consistent with its reputation for excellent functional restoration in floor-of-mouth and tongue reconstruction [13,14]. The PMMC flap's reliability

for larger defects, including composite bone and soft tissue loss (often reconstructed with plate and muscle wrapping), underscores its enduring role as a "workhorse" when bone stock isn't the primary concern or free flaps aren't feasible [15,16]. Its 12.5% excellent functional rate highlights its capacity to restore critical functions despite its bulk. Local flaps, while simple, demonstrated good functional utility (11.1% excellent) for smaller, well-selected defects, minimizing morbidity. While the association between flap type and aesthetic outcome was significant ($\chi^2(9)=18.863$, *p*=0.026), the effect size was more moderate (Cramer's V=0.35). This reflects the inherent challenge of achieving optimal cosmesis with pedicled flaps compared to meticulously tailored free flaps. The strong performance of **nasolabial flaps** (50% excellent) and **local flaps** (27.8% excellent) is logical. Nasolabial flaps offer excellent color and texture match for lip, cheek, and anterior defects [17], while local flaps minimize donor-site disruption. The submental flap's 19.0% excellent aesthetic rating reinforces its value, offering hidden donor scars and good match. The lower aesthetic ratings for bulkier flaps like PMMC (12.5% excellent) are expected due to volume mismatch and potential tethering [15], emphasizing the need to balance functional reliability with cosmetic goals. The study effectively demonstrates that good-to-excellent aesthetics are achievable with careful flap selection, particularly for soft tissue-centric defects. The remarkably low complication rate (7.7% total, 1.3% partial/total flap loss, 1.3% fistula) is a major strength. This compares favorably even to many free flap series [18] and significantly surpasses some reports of pedicled flap morbidity in complex reconstructions [19]. This success likely stems from meticulous patient selection, adherence to sound surgical principles (e.g., careful pedicle dissection, defect classification), and the experience of the surgical team. The low fistula rate, especially considering the use of tunnels (e.g., Deltopectoral flap), speaks to careful technique. The minimal donor site morbidity (primarily seroma) further underscores the practicality and safety of these techniques in a setting where managing complex free flap complications or prolonged ICU stays would be challenging. The single plate extrusion post-radiotherapy (0.6%) is a known risk with hardware in irradiated fields [20].

This study directly addresses outcomes data for reconstruction strategies feasible outside high-resource centers. While free flaps (fibula, DCIA) remain the gold standard for large, complex bony defects requiring significant bone stock [21,22], this research powerfully demonstrates that **PMMC and submental flaps are highly effective alternatives** for a wide spectrum of oro-mandibular defects prevalent in settings like Yemen. The reliance on Boyd's classification for defect assessment and flap selection provides a practical framework adaptable to similar environments [12]. The findings validate a tiered reconstructive approach, maximizing outcomes with locally available resources and expertise. The study's long duration (2013-2025) also suggests established protocols and sustained outcomes.

Conclusion

Our study provides compelling evidence that pedicled flaps, particularly the PMMC and submental flaps, are reliable and effective for immediate reconstruction of most oro-mandibular defects in resource-limited settings. These techniques achieve high success rates, good-to-excellent functional outcomes (especially with submental/PMMC/local flaps), acceptable aesthetic results (best with nasolabial/local/submental flaps), and minimal morbidity. This study empowers surgeons facing microsurgical limitations to perform oncologically sound resections confidently, knowing that robust reconstruction is achievable. It validates the essential role of these established techniques in the global management of head and neck cancer.

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