Keywords

Maxillofacial reconstruction; Temporalis flap; Head and neck surgery.

Authors

Nguyen Viet Dung[1*]
[1] Department of Otorhinolaryngology – Head and Neck Surgery, Ho Chi Minh City Oncology Hospital, Ho Chi Minh City, Vietnam

Corresponding Author: Nguyen Viet Dung, MD,PhD Department of Otorhinolaryngology – Head and Neck Surgery, Ho Chi Minh City Oncology Hospital, Ho Chi Minh City, Vietnam
Email: drdung1@gmail.com

Received:07-06-2026
Revised:14-07-2026
Accepted:20-07-2026
Doi:10.1922/ejprd.v34i7s.1593

Application Of Total Temporalis Flap In Maxillary Defect Reconstruction

ABSTRACT

- **Background:** Extensive maxillary defects following oncological resection, particularly advanced or recurrent cases previously treated with surgery and radiation, present a profound challenge in maxillofacial reconstruction. This study evaluates the surgical and functional outcomes of a modified, dual-pedicled total temporalis myofascial flap.
- **Materials and Methods:** A descriptive, non-controlled clinical trial was conducted on 33 patients with advanced (Stage III, IVA) or recurrent sinonasal malignancies invading the maxilla. All patients underwent radical resection (achieving R_0 margins) and immediate reconstruction using the total temporalis flap at the Ho Chi Minh City Oncology Hospital between November 2019 and December 2025. Flap viability, aesthetic outcomes, and functional rehabilitation (nasal breathing via NOSE criteria, mastication/deglutition, and speech intelligibility) were evaluated at 3 months postoperatively using Spearman's rank correlation (Rs).
- **Results:** The mean age was 53.6 ± 4.96 years (M:F ratio ~1:1). Maxillary defects were classified under Brown's system as Class IIb (n=4), IIIb (n=12), IVa (n=10), and IVb (n=7). The total flap survival rate was 100% (33/33) with zero partial or total necrosis and no CSF leaks; 3 cases of multidrug-resistant infections stabilized within 2 weeks. Optimal speech recovery was remarkably high in Class II and III defects (87.5%) but decreased to 55.6% in Class IV defects ($p > 0.05$). Masticatory function was well-preserved in primary cases but significantly degraded in patients with recurrent disease ($p = 0.010$). Conversely, postoperative nasal obstruction was strictly correlated with extensive Class IV defects ($p = 0.004$, where 77.8% experienced moderate-to-severe obstruction) and a history of radiotherapy ($p = 0.013$). Aesthetic outcomes demonstrated successful facial symmetry, and no local recurrence has been detected to date.
- **Conclusion:** The total temporalis flap serves as an ideal pedicled reconstructive option for complex maxillary defects. Its robust dual blood supply allows reliable single-stage multi-cavity isolation, rendering optimal functional rehabilitation and structural symmetry despite adverse conditions like prior irradiation or advanced age.

INTRODUCTION

Globally, the temporalis flap is considered one of the highly effective reconstructive techniques for extensive maxillary defects following oncological resection in the maxillofacial region, particularly for both soft tissue and bony defects.

The novelty of this study lies in our application of the total temporalis flap—a composite flap utilizing the entire temporalis muscle and the superficial temporal fascia. This flap is primary vascularized by the deep temporal artery (a branch of the maxillary artery) and augmented by the superficial temporal artery. This approach offers significant advantages over the classic flap, which utilizes either the temporalis muscle or the superficial temporal fascia alone. Consequently, it provides high flexibility, allowing the fascial component to reconstruct the nasal cavity, orbit, or oral cavity, while the muscle component completely obliterates the defect. Due to the dual blood supply from both the deep and superficial temporal vascular pedicles,

this is a robust flap with excellent viability and high reliability. Its dimensions are well-suited for large maxillary defects, particularly those involving communication among the oral cavity, nasal cavity, and orbit. Furthermore, it is one of the few pedicled flaps applicable for upper craniofacial reconstruction.

Meanwhile, the defects remaining after radical surgery for extensively invasive maxillary cancer remain a therapeutic challenge for each individual patient. An even greater challenge arises in cases of invasive maxillary cancer that have undergone prior surgical and radiation therapy but later developed progressive recurrence. When reconstructive options are limited, the role of this flap becomes highly critical.

In addition, we applied the total temporalis flap for challenging cases, including advanced-stage, extensively invasive maxillary cancer (Stages III, IVA) and recurrent cancer after initial treatment, both of which represent major challenges in current clinical practice.

Objectives: To evaluate the outcomes of maxillary defect reconstruction using the total temporalis flap.

MATERIALS AND METHODS

Study Population

The study included patients indicated for maxillary defect reconstruction following radical surgical treatment for extensively invasive maxillary cancer between November 2019 and December 2025 at the Department of Head and Neck Surgery - Otorhinolaryngology, Ho Chi Minh City Oncology Hospital.

Study Methodology

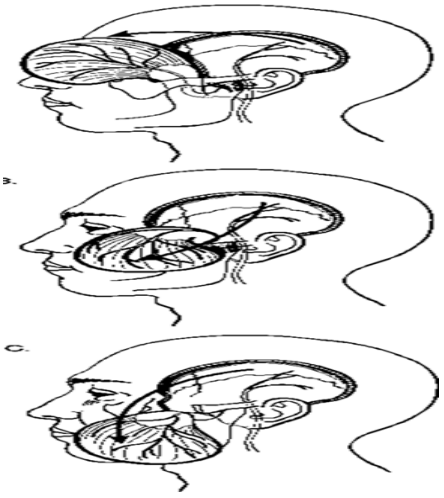
- **Study Design:** Descriptive, non-controlled clinical trial.
- **Study Execution:** Patient selection, surgical performance, and post-treatment follow-up and evaluation.
- **Inclusion Criteria:**
  - Patients diagnosed with nasal cavity and paranasal sinus cancer, Stage III or IVA (according to the AJCC 8th edition, 2017) with maxillary invasion (bone, skin, or mucosa), or resectable recurrent cancer with no distant metastasis.
  - Large-sized defects.
- **Exclusion Criteria:**
  - Malignant lymphoma, malignant melanoma, and invasive nasopharyngeal or oropharyngeal carcinoma.
  - Skull base invasion.
  - Carotid artery invasion.

Upon consenting to participate in the study, participants were scheduled for the following procedures:

- Preoperative laboratory tests, risk assessment, and nutritional and internal medicine consultations.
- Radical resection of the maxillary lesion, with or without neck dissection, followed by reconstruction using a total temporalis flap.
- Postoperative monitoring and follow-up examinations at the Department of Head and Neck Surgery - Otorhinolaryngology.
- **Study Setting:** Department of Head and Neck Surgery - Otorhinolaryngology, Ho Chi Minh City Oncology Hospital. Surgical costs were covered by health insurance.
- **Data Collection:** Postoperative outcomes along with clinical and paraclinical characteristics were recorded and entered into data collection forms.

Study Protocol

- **Step 1:** Participants underwent clinical examination and paraclinical investigations to confirm the diagnosis, disease stage, and risk factors.
- **Step 2:** Investigators counseled patients regarding the treatment protocol, potential benefits, and adverse events that might occur.
- **Step 3:** Radical resection of the maxillary lesion was performed, with or without unilateral or bilateral neck dissection.
- **Step 4:** The extent of the defect was evaluated, followed by reconstruction using a total temporalis flap.
- **Step 5:** Postoperative monitoring was conducted to record flap status, complications, management of complications, and duration of nasogastric tube feeding. Evaluation of post-surgical reconstruction indicates successful function restoration, achieved through a precise technique involving a preauricular to vertex incision and meticulous isolation of the temporoparietal fascial flap. The procedure utilized a total temporalis muscle flap transposition to the maxillary defect, coupled with osteotomy of the zygomatic arch to optimize structural support.



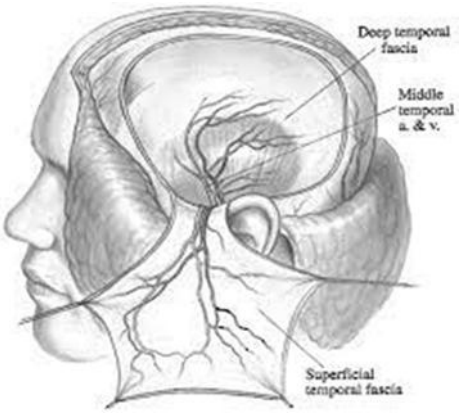


Figure 1. Steps of flap dissection.

Evaluation criteria for maxillary defects:

- Defects are classified as isolated or communicating with the nasal cavity, oral cavity, or orbit.
- Classification follows Class 1, Class 2, Class 3, Class 4, and subcategories a, b, c according to the Brown classification system.

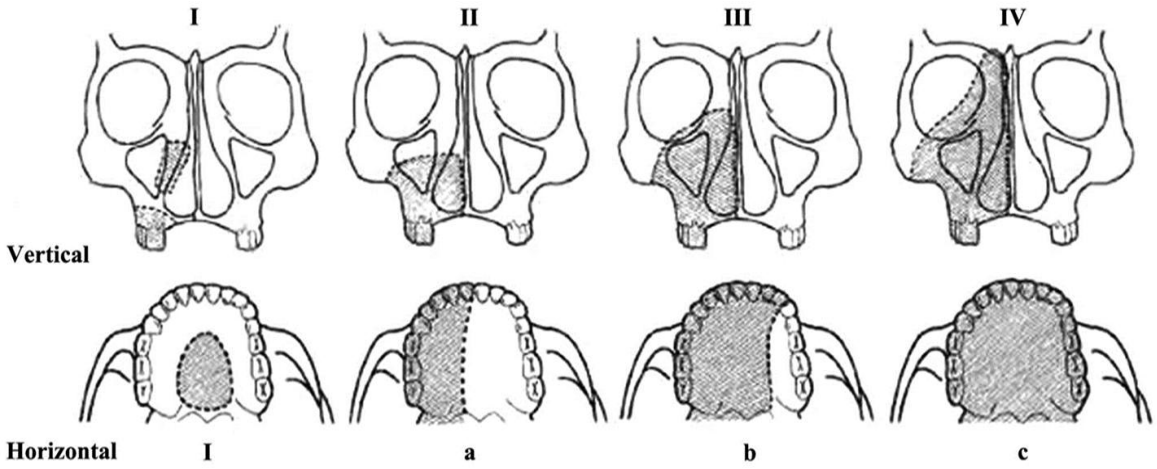


Figure 2. Brown's classification

Evaluation Criteria for Reconstructed Flap Status:

- **Good:** No flap necrosis, pinkish color, excellent turgor, no ulceration, absence of foul odor in the oral cavity, successful epithelialization (for flaps communicating with the oral cavity), and no further intervention required.
- **Fair:** Partial flap necrosis (limited to 20% of the periphery), presence of ulceration on the flap surface, requiring partial revision.
- **Poor:** Total flap necrosis, multiple ulcerations across the flap, foul odor in the oral cavity, requiring secondary flap reconstruction.

Evaluation Criteria for Functional Recovery of the Reconstructed Region:

- **Assessment Timeline:** 3 months postoperatively.
- **Nasal Obstruction Symptom Evaluation (NOSE) Criteria [1]:**
  - 0 - 25 points: Mild nasal obstruction (or normal).
  - 30 - 50 points: Moderate nasal obstruction.
  - 55 - 75 points: Severe nasal obstruction.
  - 80 - 100 points: Extreme nasal obstruction.
  - *Nasal breathing recovery is categorized as:* **Good** (0–25 points), **Fair** (30–50 points), or **Poor** (55–100 points).
- **Masticatory and Deglutition Functional Recovery Criteria [2]:**
  - **Good:** Capable of a normal diet, including solid or semi-solid foods.
  - **Fair:** Capable of consuming only pureed or soft foods.
  - **Poor:** Capable of consuming liquids only or requiring tube feeding.
- **Speech Evaluation Criteria [2]:**
  - Assessed via the speech intelligibility score across 4 distinct levels:
    - Level 4: Completely normal, intelligible speech.
    - Level 3: Intelligible speech but presenting with a nasal tone.
    - Level 2: Unintelligible speech, requiring strict listener focus or intense patient effort to communicate.
    - Level 1: Completely unintelligible speech.
  - *Speech recovery is categorized as:* **Good** (Level 4), **Fair** (Level 3), or **Poor** (Levels 1 and 2).

Aesthetic Evaluation:

- **Good:** No head, neck, or facial deformity; symmetrical appearance.
- **Fair:** Mild structural changes; bilateral asymmetry.

- **Poor:** Severe craniofacial and neck deformity; irregularities or contours in the maxillofacial region and oral cavity.

4. Data Analysis:

- Each patient was assigned an individual, coded data collection form.
- The collected data were managed and analyzed using SPSS software (version 20.0), employing standard statistical algorithms.
- Spearman's rank correlation test was utilized to determine the correlation coefficient (Rs) in analyzing factors that influence the degree of functional recovery following reconstruction.
- Data Representation:
  - Continuous variables: Expressed as mean ± standard deviation (± SD) or median with interquartile range (IQR, 25% – 75%).
  - Categorical variables: Expressed as percentages (%).
  - Statistical significance: A p-value of < 0.05 was considered statistically significant.

RESULTS

Age and Sex Distribution

The mean age of the study population was 53.6 ± 4.96 years (range: 38 – 81 years). The male-to-female ratio was approximately 1:1.

Pathological and Treatment Characteristics

Table 1. Clinicopathological and Surgical Characteristics

Characteristics	Number of Patients (n=33)
Stage	
- Stage III	14
- Stage IVA	10
- Recurrent Cancer	9
Primary Tumor Site / Type	
- Nasal cavity and paranasal sinus squamous cell carcinoma	18
- Nasal cavity minor salivary gland carcinoma	7
- Skin cancer	5
- Sarcoma	3
Histopathology	
- Squamous cell carcinoma	20
- Adenoid cystic and mucoepidermoid carcinoma	7
- Rhabdomyosarcoma; angiosarcoma	3
- Basal cell carcinoma of the skin	3
Surgical Margin Status	
- Negative postoperative margins	33/33
Extent of Surgical Resection	
- Wide local excision of invasive tissue + reconstruction (skin, mucosa, muscle, bone)	33/33
- Split-thickness skin grafting (STSG)	1
- Neck dissection	19/33
Classification of Maxillary Defects (Brown's Classification)	
- Class IIb	4
- Class IIIb	12
- Class IVa	10
- Class IVb	7
History of Prior Surgery + Radiotherapy	9/33

Comments:

- Nine (9) patients presented with recurrent disease following prior multimodal treatment (combined surgery and radiotherapy, or concurrent chemoradiotherapy). Notably, one (1) patient recurred after prior radiation therapy and had a history of two previous failed wide local resections and reconstructions.
- Twenty-four (24) patients with primary stage III–IVA cancer were diagnosed and underwent initial surgical management.

Surgical Outcomes

Postoperative Complications

Table 2. Postoperative Complications

Complications	Number of Patients (n=33)
Flap necrosis	0/33
Surgical site hemorrhage	1/33
Flap seroma or hematoma	3/33
Surgical site infection	3/33
Cerebrospinal fluid (CSF) leak	0/33

Comments: Three (3) patients experienced multidrug-resistant (MDR) surgical site infections, which successfully stabilized after 2 weeks of targeted treatment.

Status of the Reconstructed Region

Table 3. Clinical Status of the Reconstructed Region

Good	Fair	Poor
30	3	0

Comments: All reconstructed flaps demonstrated excellent viability with a 100% flap survival rate postoperatively.

Functional Recovery of Natural Nasal Airway (Based on NOSE Criteria)

Table 4. Outcomes of Natural Nasal Airway Functional Recovery

Good	Fair	Poor
18	14	1

Comments: All patients successfully achieved oral intake without nasal regurgitation, exhibited no cutaneous fistulas, and demonstrated clear speech intelligibility (absence of hypernasality).

Factors Associated with the Recovery of Natural Nasal Airway Function

Table 5. Correlation Analysis Between Clinical Factors and Nasal Obstruction Recovery After Extensive Maxillectomy and Temporalis Muscle Flap Reconstruction (N = 33)

Variables	Nasal Obstruction Recovery Level	Good (n) (%)	Fair (n) (%)	Poor (n) (%)	Total (n)	Correlation Coefficient (Rs)	*p-value*
Clinical Stage	Stage III	12 (85.7%)	2 (14.3%)	0 (0.0%)	14	0.231	0.196
	Stage IVA	6 (60.0%)	4 (40.0%)	0 (0.0%)	10		
	Recurrent disease	6 (66.7%)	2 (22.2%)	1 (11.1%)	9		
Defect Classification	Class II	7 (87.5%)	1 (12.5%)	0 (0.0%)	8	0.489	**0.004**
	Class III	9 (56.3%)	7 (43.7%)	0 (0.0%)	16		
	Class IV	2 (22.2%)	6 (66.7%)	1 (11.1%)	9		
History of Radiotherapy	Yes	5 (55.6%)	3 (33.3%)	1 (11.1%)	9	0.426	**0.013**
	No	22 (91.7%)	2 (8.3%)	0 (0.0%)	24		

Spearman's rank correlation coefficient (Rs) measures the ordinal association. Bold values ($p < 0.05$) indicate statistically significant correlations.

- Wider defects of the maxilla and nasal cavity (particularly Class IV) significantly exacerbate postoperative nasal obstruction. The rate of good airway patency decreased sharply from 87.5% to 22.2%, with cases of severe/poor obstruction emerging.
- A history of prior radiotherapy exerted a severe negative impact on the airway mucosa, lowering the optimal recovery rate from 91.7% to 55.6%.
- Clinical stage did not yield a statistically significant difference, demonstrating that the trend of postoperative nasal obstruction depends more heavily on physical tissue damage (defect extent and radiation injury) than on the initial tumor stage classification.

Masticatory and Deglutition Functional Recovery

Table 6. Correlation Analysis Between Clinical Factors and Masticatory Functional Recovery After Extensive Maxillectomy and Temporalis Muscle Flap Reconstruction (N = 33)

Variables	Masticatory Recovery Level	Good (n) (%)	Fair (n) (%)	Poor (n) (%)	Total (n)	Correlation Coefficient (Rs)	*p-value*
Clinical Stage	Stage III	13 (92.9%)	1 (7.1%)	0 (0.0%)	14	0.440	**0.010**

	Stage IVA	8 (80.0%)	2 (20.0%)	0 (0.0%)	10		
	Recurrent disease	4 (44.4%)	5 (55.6%)	0 (0.0%)	9		
Defect Classification	Class II	7 (87.5%)	1 (12.5%)	0 (0.0%)	8	0.186	0.301
	Class III	13 (81.3%)	3 (18.7%)	0 (0.0%)	16		
	Class IV	6 (66.7%)	3 (33.3%)	0 (0.0%)	9		
History of Radiotherapy	Yes	6 (66.7%)	3 (33.3%)	0 (0.0%)	9	0.311	0.079
	No	22 (91.7%)	2 (8.3%)	0 (0.0%)	24		

Spearman's rank correlation coefficient (Rs) measures the ordinal association. Bold values (p < 0.05) indicate statistically significant correlations.

- **Clinical Stage (Rs) = 0.440; p = 0.010 < 0.05):** Yielded clear statistical significance. This positive correlation confirms that advanced disease stages, particularly in the group with recurrent disease after initial treatment, significantly lower the capacity for masticatory recovery (with the rate of fair-only recovery surging to 55.6%).
- **Defect Classification (p = 0.301) and History of Radiotherapy (p = 0.079):** Did not reach statistical significance at the 95% confidence level. However, the radiotherapy factor demonstrated a borderline clinical trend (p close to 0.05), indicating that the irradiated group carries a higher descriptive percentage risk of impaired masticatory force (33.3% Fair vs. 8.3% in the non-irradiated group).

Speech and Voice Evaluation

Table 7. Correlation Analysis Between Clinical Factors and Speech Quality Recovery After Extensive Maxillectomy and Temporalis Muscle Flap Reconstruction (N = 33)

Variables	Speech Recovery Level	Good (n) (%)	Fair (n) (%)	Poor (n) (%)	Total (n)	Correlation Coefficient (Rs)	*p-value*
Clinical Stage	Stage III	12 (85.7%)	2 (14.3%)	0 (0.0%)	14	0.288	0.103
	Stage IVA	6 (60.0%)	4 (40.0%)	0 (0.0%)	10		
	Recurrent disease	5 (55.6%)	4 (44.4%)	0 (0.0%)	9		
Defect Classification	Class II	7 (87.5%)	1 (12.5%)	0 (0.0%)	8	0.291	0.100
	Class III	14 (87.5%)	2 (12.5%)	0 (0.0%)	16		
	Class IV	5 (55.6%)	4 (44.4%)	0 (0.0%)	9		
History of Radiotherapy	Yes	6 (66.7%)	3 (33.3%)	0 (0.0%)	9	-0.241	0.177
	No	21 (87.5%)	3 (12.5%)	0 (0.0%)	24		

Spearman's rank correlation test (Rs) was applied with a significance level of α = 0.05.

- **Overall Correlation:** Across the sample size of 33 patients, none of the three analyzed factors reached statistical significance (p > 0.05). This indicates that speech and voice quality were relatively well-preserved and stable, primarily attributed to the complete closure provided by the total temporalis muscle flap structure.
- **Clinical Trends:** The subgroup of patients with recurrent disease (44.4% Fair) and those with Class IV defects (44.4% Fair) demonstrated a descriptively higher rate of speech impairment compared to patients presenting with early-stage primary disease or smaller defects.

Aesthetic Outcomes

Table 8. Aesthetic Outcomes

Good	Fair	Poor
29	4	0

Note: The table number has been updated to Table 8 to maintain chronological order from previous sections.

Comments: Aesthetic evaluation remains inherently subjective and relative; the assessment was performed at least 1 month postoperatively.

Length of Hospital Stay

The mean length of hospital stay was 7.5 days. One (1) patient required a prolonged hospitalization due to two previous failed reconstructive procedures using a submental flap and a supraclavicular flap, which was complicated by postoperative infection. The inpatient postoperative recovery period following the total temporalis muscle flap reconstruction for this specific patient was 21 days.

DISCUSSION

Treatment Indications

According to the National Comprehensive Cancer Network (NCCN) guidelines, surgical intervention is indicated for extensively invasive maxillary

malignancies, particularly in cases of nasal cavity and paranasal sinus cancers that are recurrent or residual after initial multi-modality treatment (surgery, radiotherapy), provided that the lesion remains resectable and the procedure offers meaningful enhancement in regional disease control [3]. Combining radical resection with immediate reconstruction reinforces the primary therapeutic goal of achieving wide surgical margins while simultaneously restoring functional and anatomical defects, thereby contributing to superior oncological outcomes and improving the patient's overall quality of life.

Our study comprised 33 patients with stage III or IVA cancer extensively invading the maxillary region, including 9 patients who experienced recurrence following initial surgery and radiotherapy or concurrent chemoradiotherapy, representing a substantial therapeutic challenge for salvage surgery (Table 1). These 33 cases—consisting of either advanced-stage primary malignancies or progressive diseases following primary therapy—were highly complex. Surgical management faced multi-faceted challenges due to tumor invasion into natural anatomical spaces such as the orbit, oral cavity, nasopharynx, and oropharynx, as well as critical structures like the skull base and carotid artery. These factors carried high risks of intraoperative complications that are difficult to manage, including major hemorrhage, vascular injuries, and nerve damage. Postoperative risks included delayed wound healing, cerebrospinal fluid (CSF) leaks, salivary fistulas, reconstructive failure, and the inherent difficulty of achieving macroscopically complete tumor clearance through wide local excision.

Selection and Application of the Reconstructive Flap

We carefully considered the selection of an appropriate flap for reconstruction. For primary Stage III and IV malignancies, the defects resulting from radical wide resection are extensive, involving the removal of multiple anatomical organs and structures. In contrast, for cases of recurrence following initial multi-modality treatment, the application of free flaps carries an increased risk of prolonged postoperative recovery and a high failure rate, as the reconstruction must be performed within a previously operated and irradiated field. Other pedicled flaps, such as the submental flap or the pectoralis major myocutaneous (PMMC) flap, proved inadequate regarding dimensions, arc of rotation, and flexibility. Therefore, we selected the total temporalis flap—which can be harvested unilaterally or bilaterally—to fulfill these complex surgical requirements. The modified flap utilized in our study is a composite graft consisting of the temporalis muscle and an extended temporal fascia. Beyond utilizing the muscular component to obliterate the dimensional defect volume, the temporal fascia can effectively reconstruct the walls of the nasal cavity, orbit, and oral cavity. This constitutes the primary novelty and technical advancement of our approach compared to the classic temporalis muscle flap technique.

Defects caused by Stage III, IVA, or progressive malignancies following primary treatment are typically extensive and complex, encompassing multiple critical organs and structures of the head and neck. Maxillary defects following the resection of invasive malignancies are frequently caused by extensively invasive sinonasal and ethmoid tumors (involving muscle, bone, and mucosa). These severe defects substantially alter facial aesthetics and directly impair the patient's essential functions, including mastication, deglutition, speech, and natural respiration. The Brown classification system serves as a valuable tool for defining the resection boundaries and planning the subsequent reconstruction.[4]

In the present study, four (4) patients were classified as Class IIb (including two cases of nasal cavity cancer invading the maxilla and hard palate, resulting in an oro-nasal communication). Twelve (12) cases were classified as Class IIIb (ethmoid-maxillary cancers invading the maxilla, orbital floor, and nasal cavity extending to the posterior choana, and crossing the midline of the hard palate; notably, one case extended into the pterygoid process and the ipsilateral pterygopalatine fossa). Ten (10) cases were classified as Class IVa, including one patient with a massive defect remaining after two prior failed surgeries combined with radiotherapy; this extensive defect encompassed the entire ethmoid-maxillary complex, orbital floor, a portion of the zygomatic bone and palate, along with a cutaneous defect. Seven (7) cases were classified as Class IVb, which required concurrent orbital exenteration due to tumor invasion into the skull base and the pterygopalatine fossa. Consequently, the defects managed in this study were extensive and involved multiple critical anatomical structures, carrying a high risk of surgical complications. Nevertheless, the utilization of the total temporalis flap for reconstruction in our series was technically straightforward and successfully executed.

The flap was harvested to include the entire temporalis muscle combined with an extended superficial temporal fascia. This fascial flap was meticulously dissected and separated from the muscle component to enhance flexibility and optimize surface coverage for the nasal cavity and oral cavity, as well as to reconstruct and support the orbital floor. Consequently, the muscular component completely obliterated the volumetric defect of the maxilla, providing a reasonably firm tissue density. Meanwhile, the superficial temporal fascia perfectly reconstructed the mucosal defects of the nasal and oral cavities and provided robust orbital floor support in 14 cases that required orbital floor resection. Executing the dissection down to the pedicle, releasing the fascial attachment at the coronoid process of the mandible, performing a partial coronoidectomy, and mobilizing the zygomatic arch allowed the entire flap to be transposed seamlessly into the maxillary defect. This technical approach facilitated optimal flap inset and eliminated any tension on the flap or twisting and kinking of the vascular pedicle, particularly for defects extending beyond the midline or those requiring reconstruction of the posterior choana and the lateral pharyngeal wall. Following flap fixation, complete isolation among the nasal cavity, oral cavity, orbital floor, and posterior choana was successfully achieved.

This effectively served the objective of restoring the patient's essential functions—including mastication, deglutition, speech, and nasal respiration—while simultaneously controlling the risks of postoperative hemorrhage in the oral cavity and posterior choana.

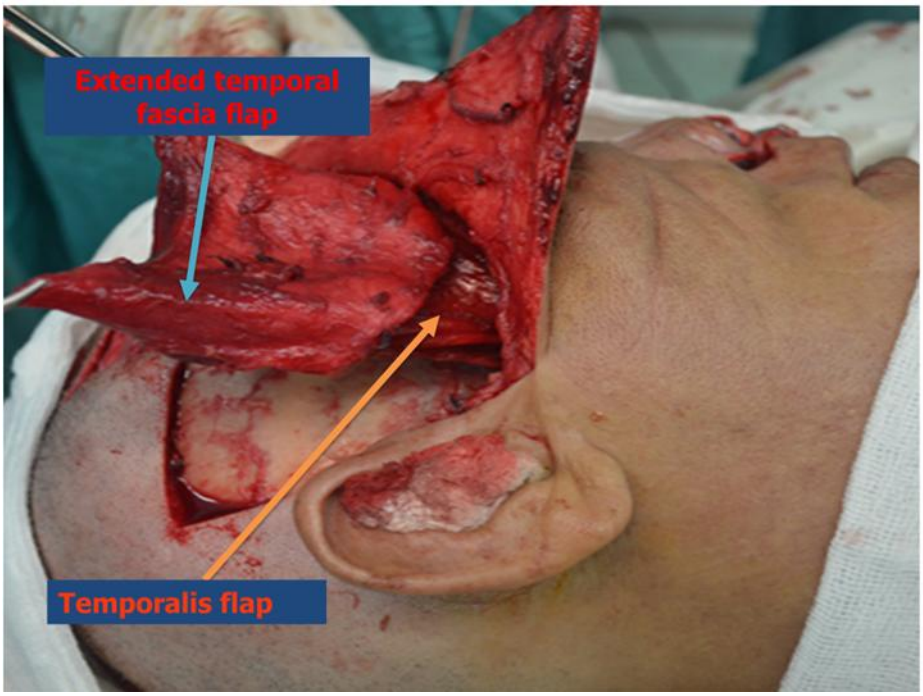


Figure 3. Design of the total temporalis muscle flap.

The dissection technique for the total temporalis flap—incorporating the entire temporalis muscle combined with an extended superficial temporal fascia—represents a modified flap well-suited for extensive defects presenting with oro-nasal, orbital floor, and nasopharyngeal communication. Recently, several authors globally have adopted a similar technical approach. Jose et al. (2019) performed a successful reconstruction for a recurrent maxillary malignancy with an extensive defect communicating with the orbit, achieving favorable postoperative outcomes.[5]

The extended superficial temporal fascia flap, vascularized by the middle temporal artery (which provides anastomotic branches connecting the deep and superficial temporal arteries), was utilized and further developed by our team to harvest down to the epicranial aponeurosis/galea layer in cases of malignancies extensively invading the nasal cavity, contralateral palate, and posterior choana. This technical modification aims to expand the anatomical reach of the reconstruction. Additionally, the inclusion of the superficial temporal fascia component is essential for cases requiring single-stage split-thickness skin grafting over the flap.

Our preliminary postoperative outcomes are highly encouraging, effectively addressing cases of recurrent, invasive malignancies that otherwise present severe therapeutic indications challenges. All patients successfully fulfilled the reconstructive goals and requirements established preoperatively, with no unanticipated complications. Adverse factors—such as a history of prior surgery and radiotherapy, advanced age, or poor performance status—did not lead to technical failure. Nevertheless, meticulous preoperative preparation—including nutritional optimization, management of underlying comorbidities, and stabilization of pre-existing infections—remains a critical factor that facilitates prompt surgical intervention for these patients.

Concurring with the perspective that the temporalis myofascial flap can adequately obliterate the volume of extensive maxillary defects, reports by Wang and several other authors have demonstrated comparable outcomes [6-10]. According to Brennan et al., the temporalis myofascial flap can be utilized to reconstruct almost all degrees of palatomaxillary defects, serving as an excellent alternative to vascularized free bone flaps while successfully restoring the morphology and function of the maxillomandibular region. [8]

Treatment Outcomes

In all cases, successful flap survival was achieved postoperatively. The flaps exhibited excellent turgor and a healthy pinkish color; a pinprick test performed immediately after surgery demonstrated brisk, bright-red bleeding. After approximately 1 to 2 weeks, flaps in the oral cavity—including both fascial and cutaneous flaps—developed a white pseudomembrane that was easily detached, revealing a underlying pinkish surface with granulation tissue, which marked the initiation of the epithelialization process. Following 1 month of monitoring, the fascial and cutaneous flaps underwent complete epithelialization progressing from the periphery to the center, appearing pink like normal mucosa. According to Son LV, surface biopsy of the temporalis myofascial flap after reconstruction demonstrated a lining epithelium with complete structural components, including the basement

membrane, basal cell layer, spinous cell layer, and granular cell layer. [9]

Our remarkably high rate of good speech recovery (87.5%) for Class II and III defects is in complete agreement with the classic case series reported by Salzman and Shindo [13], as well as the study by Rieger et al.[11] These authors asserted that the temporalis muscle flap (TMF) represents the "gold standard" among regional flaps due to its exceptionally abundant blood supply derived from the deep temporal artery, which facilitates excellent flap survival and secondary epithelialization within the oral cavity.[11,12]

However, for extensive Class IV defects, our rate of good speech outcomes decreased to 55.6% of cases, with the remaining 44.4% classified as fair, and no poor outcomes recorded (Table 7); this remains a highly favorable result following reconstruction. Bradley and Brockbank [14] reported post-reconstructive speech recovery outcomes using the classic temporalis flap that are comparable to our study regarding overall voice rehabilitation. To explain the cases of postoperative speech impairment, the authors highlighted the phenomenon of physiological denervation atrophy over time. This process leads to flap thinning and gravity-induced ptosis, which creates microscopic air leaks into the nasal cavity. In contrast to the use of palatal obturators, which tend to loosen and leak over time, the favorable outcomes achieved with our modified total temporalis flap reinforce the consensus that the temporalis muscle flap is an optimal material for maxillary reconstruction, providing permanent closure and a superior quality of life.[11,13]

Masticatory Functional Recovery and the Impact of Recurrent Disease Following Initial Therapy

One of the most valuable findings in our study is that the recurrent disease stage significantly and statistically correlates with impaired masticatory function ($p = 0.010$) (Table 6). This finding provides a deeper, more specialized insight compared to the retrospective study by a group of authors on Pocket Dentistry, which only evaluated primary post-maxillectomy defects collectively and concluded that temporalis muscle flap reconstruction yields generally acceptable masticatory outcomes.[11]

The decrease in masticatory force observed in our recurrent disease group aligns with the pathophysiological theory proposed by Dijkstra et al.[16] During radical salvage surgery for recurrent malignancies or deeply invasive skin cancers, surgeons are compelled to perform extensive clearance into the infratemporal fossa to ensure negative (R0) surgical margins. This maneuver frequently damages the motor branches of the mandibular nerve (V3) that innervate the masticatory muscle system. Furthermore, the trend toward impaired masticatory force associated with a history of radiotherapy ($p = 0.079$) in our data is consistent with the conclusions of Dirix et al.[17]They explained that progressive radiation-induced endarteritis destroys salivary gland acini, causing chronic xerostomia and fibrosis of the transposed muscle fibers, which ultimately deprives them of the elasticity required during the masticatory cycle.[17]

Nasal Obstruction and Airway Patency

The strong correlation between the defect extent ($p = 0.004$) and a history of radiotherapy ($p = 0.013$) with postoperative nasal obstruction observed in our study highlights an aspect that has rarely been thoroughly investigated in prior maxillofacial reconstructive literature, which conventionally focuses heavily on deglutition and speech functions.[11,12]

The finding that moderate-to-severe nasal obstruction accounted for 77.8% of cases within our Class IV defect subgroup provides clinical validation for the airflow dynamics model proposed by Lipan and Most.[11] The radical resection of rigid supporting frameworks (such as the septal cartilage and superior maxilla) triggers a complete collapse of both the internal and external nasal valves. When the temporalis muscle flap is rotated to obliterate the void, the lack of an attached rigid skeletal framework causes the muscle tissue to compromise the effective cross-sectional area of the nasal cavity. This volumetric encroachment converts physiological laminar airflow into turbulent airflow, thereby increasing upper airway resistance. This mechanical obstruction, combined with radiation-induced chronic atrophic rhinitis, ciliary atrophy, and crusting as described by Denham and Hauer-Jensen, explains why the endonasal airway remains the organ most severely compromised following radical maxillectomy. Consequently, this underscores the necessity of modern surgical strategies involving structural cartilage grafting (such as spreader or alar grafts) to reinforce the nasal valve mechanism as advocated in current literature.[11]

Patients achieved early functional recovery of deglutition (demonstrating no nasal regurgitation and absence of cutaneous salivary fistulas), clear speech intelligibility, and satisfactory nasal respiration. Overall patient satisfaction regarding the surgical outcome was high. Furthermore, satisfactory aesthetic outcomes were achieved across all cases, displaying facial symmetry without conspicuous contours or maxillofacial depressions. Postoperative margin analysis revealed negative margins (R0) in all cases, and no patients have presented with local recurrence during the follow-up period to date.

CONCLUSION

The application of the modified total temporalis flap—incorporating the entire muscle and an extended superficial temporal fascia based on dual vascular pedicles—presents a highly reliable, safe, and effective reconstructive modality for extensive maxillary defects (particularly Brown Class IIIb, IVa, and IVb) following radical resection of advanced primary or recurrent malignancies. Separating the fascial component maximizes architectural flexibility, facilitating perfect coverage of anatomical voids and permanent closure of oro-nasal-orbital communications, achieving a 100% flap survival rate without any necrosis. Functionally, this approach yields excellent speech, masticatory, and deglutition outcomes, ensuring post-surgical quality of life and symmetrical facial aesthetics. However, masticatory force was significantly impaired in the recurrent cancer group ($p = 0.010$) due to mandatory aggressive infratemporal fossa clearance injuring the V3

nerve motor branches, alongside a borderline descriptive trend of radiation injury (p = 0.079). Furthermore, postoperative nasal patency was strictly compromised by the extent of Class IV structural defects (p = 0.004) and prior radiotherapy (p = 0.013) due to nasal valve collapse and mucosal fibrosis, highlighting the necessity of integrated cartilage structural grafting (spreader/alar grafts) for extreme defects in future protocols.

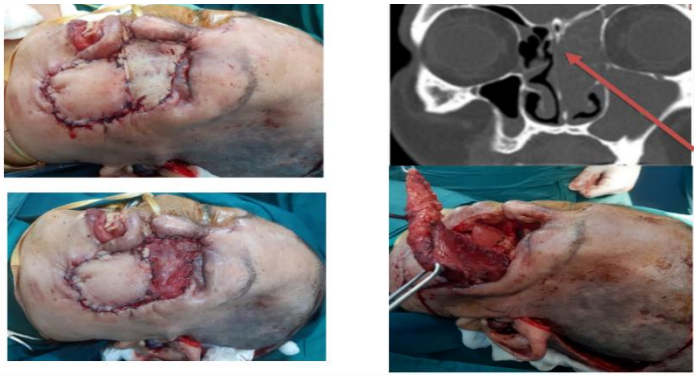


Figure 4. Extensively invasive carcinoma involving the maxilla, ethmoid-maxillary complex, and orbit.

Figure 5. Massive defect with orbital, nasopharyngeal, oropharyngeal, and oral communication, and subsequent nasal septum reconstruction with restored natural nasal airway post-reconstruction.

CONCLUSION

The application of the modified total temporalis flap—incorporating the entire muscle and an extended superficial temporal fascia based on dual vascular pedicles—presents a highly reliable, safe, and effective reconstructive modality for extensive maxillary defects (particularly Brown Class IIIb, IVa, and IVb) following radical resection of advanced primary or recurrent malignancies. Separating the fascial component maximizes architectural flexibility, facilitating perfect coverage of anatomical voids and permanent closure of oro-nasal-orbital communications, achieving a 100% flap survival rate without any necrosis. Functionally, this approach yields excellent speech, masticatory, and deglutition outcomes, ensuring post-surgical quality of life and symmetrical facial aesthetics. However, masticatory force was significantly impaired in the recurrent cancer group (p = 0.010) due to mandatory aggressive infratemporal fossa clearance injuring the V3 nerve motor branches, alongside a borderline descriptive trend of radiation injury (p = 0.079). Furthermore, postoperative nasal patency was strictly compromised by the extent of Class IV structural defects (p = 0.004) and prior radiotherapy (p = 0.013) due to nasal valve collapse and mucosal fibrosis, highlighting the necessity of integrated cartilage structural grafting (spreader/alar grafts) for extreme defects in future protocols.

REFERENCES

1. Menegat F, Monnazzi MS, Silva BN, de Moraes M, Gabrielli MAC, Pereira-Filho VA. Assessment of nasal obstruction symptoms using the NOSE scale after surgically assisted rapid maxillary expansion. *International Journal of Oral and Maxillofacial Surgery*. 2015;44(11):1346-1350. doi:10.1016/j.ijom.2015.06.018
2. Awad SS, Zaid AM, Attia AAMM. Functional and Esthetic Outcomes after Mandibular Reconstruction in Patients with Squamous Cell Carcinoma. *International Journal of Science and Research Archive*. 2022;05(02):272–280. doi:10.30574/ijsra.2022.5.2.0091
3. National Comprehensive Cancer Network (NCCN). Head and neck cancer. NCCN Clinical Practice Guidelines in Oncology. Version 1.2021.
4. Brown JS, Rogers SN, McNally DN, Boyle M. A modified classification for the maxillectomy defect. *Head & Neck*. 2000;22(1):17-26. doi:10.1002/(sici)1097-0347(200001)22:1<17::aid-hed4>3.0.co;2-2

5. Jose A, Nagori SA, Arya S, Roy ID. Chimeric temporoparietal osteofascial and temporalis muscle flap; a novel method for the reconstruction of composite orbito-maxillary defects. *Journal of Stomatology, Oral and Maxillofacial Surgery*. 2019;120(3):250-254. doi:10.1016/j.jormas.2019.02.015
6. Lam D, Carlson ER. The temporalis muscle flap and temporoparietal fascial flap. *Oral and Maxillofacial Surgery Clinics of North America*. 2014;26(3):359–369. doi:10.1016/j.coms.2014.05.003
7. Abubaker AO, Abouzgia MB. The temporalis muscle flap in reconstruction of intraoral defects: an appraisal of the technique. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology*. 2002;94(1):24–30. doi:10.1067/moe.2002.122822
8. Brennan T, Tham TM, Costantino P. The Temporalis Muscle Flap for Palate Reconstruction: Case Series and Review of the Literature. *International Archives of Otorhinolaryngology*. 2017;21(3):259-264. doi:10.1055/s-0036-1593835
9. Son LV. *Restoration of Maxillofacial Defects Using the Temporalis Myofascial Flap* [Doctoral dissertation in Medicine]. Hanoi Medical University; 2004. *(Vietnamese)*
10. Nguyen VD, et al. Application of Flaps in Plastic and Reconstructive Surgery for the Treatment of Head and Neck Skin Cancers. In: *Specialized Topics in Otorhinolaryngology and Head and Neck Surgery*. Ho Chi Minh City Medical Association, Ho Chi Minh City Society of Otorhinolaryngology and Southern Provinces. Medical Publishing House; 2021:78-86. *(Vietnamese)*
11. Rieger J, Wolfaardt J, Seikaly H, et al. Speech outcomes in patients reconstructed with primary closure, flaps, or obturators after maxillectomy. *The International Journal of Prosthodontics*. 2002;15(4):353-358. PMID:12173111.
12. Lipan MJ, Most SP. Development of a severity scale for airflow obstruction of the nasal valve. *JAMA Facial Plastic Surgery*. 2013;15(5):347-350. doi:10.1001/jamafacial.2013.791
13. Salzman RE, Shindo ML. Temporalis muscle flap reconstruction of maxillectomy defects. *The Laryngoscope*. 1998;108(8):1135-1140. doi:10.1097/00005537-199808000-00007
14. Bradley PJ, Brockbank MJ. The temporalis muscle flap in oral and head and neck reconstruction. *Head & Neck Surgery*. 1987;9(4):212-222. doi:10.1002/hed.2890090403
15. Denham JW, Hauer-Jensen M. The radiotherapeutic injury: a complex 'wound'. *Radiotherapy and Oncology*. 2002;63(2):129-145. doi:10.1016/s0167-8140(02)00060-9
16. Dijkstra PU, Sterken MW, Stirneman R, et al. Relation between trismus in more advanced head and neck cancer and physical and social functioning. *Oral Oncology*. 2007;43(5):472-477. doi:10.1016/j.oraloncology.2006.05.003
17. Dirix P, Nuyts S, Van den Bogaert W. Radiation-induced xerostomia in patients with head and neck cancer: a literature review. *Cancer*. 2006;107(11):2525-2534. doi:10.1002/cncr.22302
18. Temporalis muscle flap in craniofacial reconstruction: A comprehensive review. *Frontiers in Surgery*. 2025;12(2):1678935. doi:10.3389/fsurg.2025.1678935 [1]