ARC Journal of Dental Science
Volume 8, Issue 1, 2025, PP 7-12
ISSN 2456-0030 (Online)
DOI: https://doi.org/10.20431/2456-0030.0801002
www.arcjournals.org

Postoperative Outcomes in Oral Cancer Patients: A Study of Regional Lymph Node Metastasis, Perineural Invasion and Margin Status

Nasir Uddin[1*], Shahida Begum[2], Rehana Akhter[3], Nitish Krishna Das[4], Md. Helal Uzzaman[5], Md. Mostafizur Rahman[6], Kamrun Nahar[7]

[1]*Professor & Head, Department of Oral & Maxillofacial Surgery, Sapporo Dental College & Hospital, Dhaka, Bangladesh and Former Professor & Head, Department of Oral & Maxillofacial Surgery, Shaheed Suhrawardy Medical College & Hospital, Dhaka, Bangladesh*

[2, 3,4]*Assistant Professor, Department of Oral & Maxillofacial Surgery, Shaheed Suhrawardy Medical College & Hospital, Dhaka, Bangladesh*

[5]*Associate Professor, Department of Oral & Maxillofacial Surgery, Shaheed Suhrawardy Medical College & Hospital, Dhaka, Bangladesh*

[6]*Junior Consultant, Department of Oral & Maxillofacial Surgery, Shaheed Suhrawardy Medical College & Hospital, Dhaka, Bangladesh*

[7]*Lecturer, Department of Oral & Maxillofacial Surgery, Shaheed Suhrawardy Medical College & Hospital, Dhaka, Bangladesh*

Received: 12 May 2025 Accepted: 26 May 2025 Published: 07 June 2025

Corresponding Author:** ***Prof.Dr. Nasir Uddin, *Professor & Head, Department of Oral & Maxillofacial Surgery, Sapporo Dental College & Hospital, Dhaka, Bangladesh and Former Professor & Head, Department of Oral & Maxillofacial Surgery, Shaheed Suhrawardy Medical College & Hospital, Dhaka, Bangladesh.* ***Email:*** *nasiruddin200@yahoo.com*

Abstract

Background: *Oral squamous cell carcinoma (OSCC) is a significant public health concern in South Asia, with high rates of morbidity and recurrence. Identifying key prognostic factors is crucial to improve surgical outcomes and long-term survival.*

Methods: *This retrospective observational study included 120 histopathologically confirmed OSCC patients who underwent primary surgical treatment with or without adjuvant therapy at Shaheed Suhrawardy Medical College Hospital and Bangladesh ENT Hospital Ltd., Dhaka, Bangladesh from July 2019 to June 2024. Clinical, surgical, and histopathological data were collected and analyzed. Multivariate logistic regression was used to identify predictors of recurrence.*

Results: *The mean patient age was 52.0 ± 11.9 years, with a female predominance (60.8%). The most common tumor sites were the buccal mucosa (25.8%) and tongue (19.2%). Advanced-stage disease (Stage III–IV) was observed in 60% of cases. Histopathological findings revealed lymph node metastasis in 24.2%, perineural invasion in 30.8%, and close/positive surgical margins in 10.8%. Adjuvant therapy was given to 60.8% of patients. Postoperative recurrence occurred in 12.5%, while 20% developed regional lymph node metastasis. The 5-year survival rate was 84.2%. Multivariate analysis identified positive surgical margins (OR: 3.2; p<0.001), lymph node metastasis (OR: 2.7; p=0.001), and perineural invasion (OR: 1.9; p=0.02) as significant predictors of recurrence.*

Conclusion: *Clear surgical margins, absence of nodal involvement, and perineural invasion are critical to reducing recurrence risk in OSCC patients. Enhanced surgical precision and tailored adjuvant therapies are essential for improving long-term outcomes.*

Keywords: *Oral squamous cell carcinoma, recurrence, surgical margins, lymph node metastasis, perineural invasion, prognostic factors, survival*

1. INTRODUCTION

Oral cancer, primarily oral squamous cell carcinoma (OSCC), is a major public health concern worldwide and a leading cause of cancer-related mortality in many countries, including Bangladesh. The incidence of oral

cancer is notably high in regions where tobacco and betel nut use is prevalent. According to the World Health Organization (WHO), OSCC accounts for approximately 90% of all oral cancers [1]. Despite advancements in early detection and surgical techniques, the prognosis for OSCC patients remains poor in many cases, primarily due to recurrence and metastasis [2]. Surgical resection remains the cornerstone of treatment for OSCC, often followed by adjuvant therapies such as radiotherapy (RT) and chemotherapy (CT) [3]. The success of surgical treatment is largely dependent on achieving clear resection margins, as inadequate margins are strongly associated with local recurrence and poor survival outcomes [4]. In addition, the presence of regional lymph node metastasis (LNM) is a critical factor in determining prognosis and treatment strategies [5]. Perineural invasion, where cancer cells invade nerve tissues, has also been identified as a significant predictor of recurrence and poor survival in OSCC patients [6].

Although multiple studies have explored the predictors of recurrence and survival in OSCC, there remains a need for further investigation, particularly in settings like Bangladesh, where the prevalence of oral cancer is rising due to cultural practices such as the widespread use of tobacco and betel nuts [7, 8]. The clinical significance of resection margins, lymph node metastasis, and perineural invasion in predicting postoperative outcomes remains a topic of ongoing research [9]. Understanding these factors is essential for tailoring treatment plans, improving outcomes, and guiding follow-up care [10].

The objective of this study was to evaluate the postoperative outcomes in oral cancer patients, focusing on recurrence, regional lymph node metastasis, and margin status. We aimed to identify the predictors of recurrence and survival, particularly the role of positive margins, lymph node metastasis, and perineural invasion, using a cohort of patients who underwent surgical resection at the Department of Oral & Maxillofacial Surgery, Shaheed Suhrawardy Medical College & Hospital and Bangladesh ENT Hospital Ltd., Dhaka, Bangladesh. By analyzing clinical and histopathological data, we sought to provide insights into the factors that influence postoperative outcomes and recurrence in OSCC patients in a Bangladeshi setting.

This study is crucial as it adds to the limited body of knowledge on oral cancer outcomes in Bangladesh, offering insights into local patterns and outcomes. Given the high rate of tobacco and betel nut use in Bangladesh, this study's findings could help inform public health strategies and clinical practices, guiding the management of OSCC patients and improving their survival rates. Furthermore, by identifying key predictors of recurrence, we aim to support early interventions, refine surgical techniques, and promote more personalized adjuvant therapy.

2. Methodology & Materials

This retrospective observational study was conducted at the Department of Oral & Maxillofacial Surgery, Shaheed Suhrawardy Medical College Hospital and Bangladesh ENT Hospital Ltd., Dhaka, Bangladesh, over a five-year period, from July 2019 to June 2024. A total of 120 patients with histopathologically confirmed oral squamous cell carcinoma (OSCC) who underwent surgical resection were included. Patients were selected based on the availability of complete clinical, surgical, and follow-up data. Exclusion criteria included patients with recurrent tumors at presentation, distant metastasis at the time of diagnosis, or incomplete medical records.

Demographic and clinical data including age, gender, history of tobacco and betel nut use, tumor site, and clinical TNM staging were collected from hospital records. Surgical details such as margin status and lymph node involvement were noted from operative and histopathology reports. Histopathological variables assessed included resection margin status, lymph node metastasis, and perineural invasion. Margin status was categorized as negative (>5 mm clearance) or close/positive (≤5 mm). Postoperative outcomes such as local recurrence, regional lymph node metastasis, and five-year survival were documented from follow-up visits.

Patients were managed either with surgery alone or with adjuvant therapy (surgery followed by radiotherapy and/or chemotherapy) based on tumor stage and histopathological findings, according to institutional protocols. The primary outcome of interest was recurrence, and its association with margin status, lymph node metastasis, and perineural invasion was analyzed.

Data were entered and analyzed using SPSS version 25.0. Descriptive statistics were used to summarize

patient characteristics and clinical outcomes. Categorical variables were presented as frequencies and percentages. To identify independent predictors of recurrence, multivariate logistic regression analysis was performed, with recurrence as the dependent variable and margin status, lymph node metastasis, and perineural invasion as independent variables. Odds ratios (ORs) with 95% confidence intervals (CI) and p-values were reported, with a p-value of <0.05 considered statistically significant.

3. RESULTS

Table 1. *Demographic and Clinical Characteristics*

Characteristics	Category	Frequency (n=120)	Percentage (%)
Age (years)	<50	42	35.0
	≥50	78	65.0
	Mean ± SD (yrs.)	52.0 ± 11.9	
Gender	Male	47	39.2
	Female	73	60.8
Tobacco/Betel Nut Use	Yes	74	61.7
	No	46	38.3
Tumor Site	Tongue	23	19.2
	Buccal Mucosa	31	25.8
	Alveolar Ridge/RMT	14	11.7
	Other	52	43.3
TNM Stage	I–II	48	40.0
	III–IV	72	60.0

Table 1 presents the demographic and clinical profiles of 120 oral cancer patients. The majority were aged 50 years or older (65%), with a mean age of 52.0 ± 11.9 years. Females comprised a larger proportion (60.8%) compared to males (39.2%). A significant number (61.7%) reported tobacco or betel nut use. The most common tumor sites were the buccal mucosa (25.8%) and tongue (19.2%), followed by the alveolar ridge/retromolar trigone (11.7%). Tumors in other locations accounted for 43.3%. Most patients (60%) presented with advanced-stage disease (TNM Stage III–IV).

Table 2. *Surgical and Histopathological Outcomes*

Variable	Category	Frequency (n=120)	Percentage (%)
Resection Margin Status	Negative (>5 mm)	107	89.2
	Close/Positive (≤5 mm)	13	10.8
Lymph Node Metastasis (LNM)	Present	29	24.2
	Absent	91	75.8
Perineural Invasion	Present	37	30.8
	Absent	83	69.2
Adjuvant Therapy	Surgery Alone	47	39.2
	Surgery + RT/CT	73	60.8

Table 2 summarizes the surgical and histopathological findings among the 120 oral cancer patients. Clear resection margins (>5 mm) were achieved in the majority (89.2%), while 10.8% had close or positive margins (≤5 mm). Regional lymph node metastasis was detected in 24.2% of cases. Perineural invasion was observed in 30.8% of patients. Most patients (60.8%) received adjuvant therapy (surgery combined with radiotherapy and/or chemotherapy), while 39.2% underwent surgery alone.

Table 3. *Postoperative Outcomes*

Outcome	Frequency (n=120)	Percentage (%)
Recurrence	15	12.5
Regional LNM (Post-op)	24	20.0
5-Year Survival	101	84.2

Table 3 outlines key postoperative outcomes in the studied oral cancer patients. Recurrence occurred in 12.5% of cases during the follow-up period. Postoperative regional lymph node metastasis was observed in 20% of patients. The 5-year survival rate was 84.2%, reflecting

favorable long-term outcomes in the majority of cases.

Table 4. *Predictors of Recurrence (Multivariate Analysis)*

Variable	Odds Ratio (OR)	95% CI	p-value
Positive Margins	3.2	1.8–5.6	<0.001
Lymph Node Metastasis	2.7	1.5–4.9	0.001
Perineural Invasion	1.9	1.1–3.3	0.02

Table 4 displays the multivariate analysis of factors associated with recurrence in oral cancer patients. Positive surgical margins significantly increased the risk of recurrence (OR: 3.2; 95% CI: 1.8–5.6; $p < 0.001$). Lymph node metastasis was also a strong predictor (OR: 2.7; 95% CI: 1.5–4.9; $p = 0.001$). Additionally, perineural invasion showed a significant association with recurrence (OR: 1.9; 95% CI: 1.1–3.3; $p = 0.02$).

4. Discussion

This retrospective observational study assessed postoperative outcomes and predictors of recurrence in oral cancer patients treated surgically at two tertiary centers in Bangladesh. Our findings contribute valuable insight into the clinical behavior, recurrence patterns, and prognostic markers relevant to oral squamous cell carcinoma (OSCC) in our population.

Out of the 120 patients, recurrence was observed in 12.5%, and regional lymph node metastasis (LNM) postoperatively occurred in 20.0%. These rates are in alignment with findings from Mahieu et al., who reported similar recurrence levels in early-stage oral cancer managed with sentinel lymph node biopsy compared to elective neck dissection [11]. The 5-year survival rate in our cohort was 84.2%, suggesting favorable outcomes compared to international cohorts, possibly due to early surgical intervention or effective adjuvant therapy.

Multivariate logistic regression identified three independent predictors of recurrence: positive surgical margins (OR 3.2, $p < 0.001$), lymph node metastasis (OR 2.7, $p = 0.001$), and perineural invasion (OR 1.9, $p = 0.02$). These factors are consistently recognized in the literature. Positive or close margins have been strongly associated with local recurrence and poor prognosis [12, 13]. Hasegawa et al. emphasized that even close margins (<5 mm) significantly affect recurrence rates, a finding corroborated by our study's 10.8% incidence of close/positive margins [12].

Lymph node metastasis, observed in 24.2% of our patients, remains a powerful prognostic indicator. Studies by Mamic et al., and Ma et al., emphasized the lymph node ratio (LNR) and total nodal burden as significant predictors of survival and recurrence [14, 15]. Although our study did not calculate LNR, the presence of LNM alone was significantly associated with recurrence. Moreover, the work by Voss et al. and Sansgiri et al., further confirms that nodal involvement independently predicts worse outcomes, reinforcing the importance of comprehensive neck dissection and nodal evaluation [16, 17].

Perineural invasion (PNI), found in 30.8% of patients in our study, was also a significant predictor. PNI has been linked to increased loco regional recurrence and reduced disease-free survival in multiple studies [18, 19]. Our findings support this association and emphasize the need for aggressive adjuvant therapy in patients with PNI.

Adjuvant therapy, given to 60.8% of our patients, showed a trend toward improved outcomes. Similar findings were reported by Haderlein et al., who observed better local control with adjuvant radiotherapy, especially in patients with risk factors like PNI or margin involvement [20]. Despite advancements, recurrence in patients receiving adjuvant therapy still occurred, suggesting the influence of tumor biology and highlighting a potential role for intensified or targeted therapies.

Tumor site distribution in our cohort was comparable to other regional studies, with the buccal mucosa and tongue being the most common sites. This site distribution may affect recurrence and survival, as noted by Lee et al., who found the lingual lymph node status to significantly influence prognosis in tongue cancer [21].

Lastly, our recurrence rate of 12.5% aligns with global estimates but may be improved with the integration of biomarkers, PET-CT-based nodal stratification, and consideration of contralateral neck risk, as discussed in studies by Cheng et al. and Swain et al. [22, 23].

5. Limitations of the Study

This study has several limitations. As a retrospective observational study conducted in a

tertiary care center and a specialized hospital, the generalizability of the findings may be restricted due to geographical and institutional differences in patient management. The sample size, though adequate for primary outcome analysis, may not capture the full spectrum of variables influencing prognosis such as extranodal extension or lymph node ratio.

6. Conclusion

In conclusion, this study highlights positive surgical margins, lymph node metastasis, and perineural invasion as significant predictors of recurrence in patients with oral squamous cell carcinoma. Despite a relatively high five-year survival rate of 84.2%, the presence of these high-risk features necessitates meticulous surgical planning and vigilant postoperative follow-up. Recognizing and addressing these prognostic factors can improve clinical decision-making and long-term outcomes in oral cancer patients.

Financial Support and Sponsorship

No funding sources.

Conflicts of Interest

There are no conflicts of interest.

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Citation: *Nasir Uddin et al. Postoperative Outcomes in Oral Cancer Patients: A Study of Regional Lymph Node Metastasis, Perineural Invasion and Margin Status. ARC Journal of Dental Science. 2025; 8(1):7-12. DOI: https://doi.org/10.20431/2456-0030.0801002.*