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**Original Research Article**

# Correlation of MDCT Findings with Histopathological Staging in Buccal Malignancy

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**Abstract:** ***Background*:** Buccal mucosa squamous cell carcinoma poses a significant public health burden in Bangladesh, with over 7,000 new cases annually. The accuracy of MDCT in preoperative staging and its correlation with histopathological TNM staging remains unclear. Therefore, the purpose of this study is to evaluate the correlation between MDCT findings and histopathological TNM staging in patients with buccal malignancy. ***Methods*:** This cross-sectional diagnostic accuracy study at the Departments of Radiology and Imaging, Otolaryngology and Head–Neck Surgery, and Pathology, Sylhet MAG Osmani Medical College and Hospital (March 2020–February 2022) included 65 histopathologically confirmed buccal malignancy patients who underwent punch biopsy, contrast-enhanced MDCT, and surgical resection for TNM staging. MDCT findings were compared with histopathology, data were analyzed using SPSS v23, and ethical approval with informed consent was obtained. ***Results*:** Among 65 patients (mean age 52.8 ± 11.1 years; 67.7% male), MDCT detected retromolar trigone involvement in 42 (64.6%) and masticator space in 28 (43.1%), with bone involvement in 16 (24.7%) and ipsilateral lymph nodes in 50 (77.0%). Histopathology showed Stage IVB in 27 (41.5%) and IVA in 20 (30.8%). Radiological staging concordance was highest for Stage IVB (96.3%), and MDCT demonstrated high sensitivity (75–96.3%), specificity (94.5–98.2%), and accuracy (>92%) across stages. ***Conclusion*:** MDCT reliably correlates with histopathological TNM staging and accurately guides preoperative assessment in buccal malignancy.

**Keywords:** MDCT, Histopathology, Buccal Malignancy.



## INTRODUCTION

Squamous cell carcinoma (SCC) affecting the head and neck exhibits considerable variation in both incidence and mortality across different regions globally. Oral cancers represent 2–6% of all malignancies and approximately 30% of head and neck cancers [1]. In Bangladesh, over 7,000 new cases of oral cancer are diagnosed annually, with mortality rates of 8.3% in men and 4.3% in women [2]. Specifically, oral cavity cancers, with SCC of the buccal mucosa being prominent, impose a substantial public health burden in Bangladesh [3]. On a global scale, oral cancer ranks as the sixth most frequent malignancy, with an estimated 389,846 new cases reported in 2022 [4].

Among the Bangladeshi population, the buccal mucosa is the most commonly affected site for oral cancers. This high prevalence is largely linked to habitual practices such as gutkha and betel quid chewing, often combined with tobacco, which increase the risk of developing oral submucous fibrosis, a recognized premalignant condition [5]. Buccal carcinoma is associated with several risk factors, including areca nut, betel leaf, and tobacco chewing, tooth extractions, heavy alcohol use, HPV infection, candidiasis, and

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premalignant lesions like leukoplakia, erythroplakia, and oral submucous fibrosis [6]. The combination of these habits with alcohol consumption has been shown to elevate the risk of oral squamous cell carcinoma (OSCC) by 5- to 25-fold [7].

Prompt detection of buccal mucosa carcinoma is essential, as prognosis significantly improves when the disease is identified at early stages [8]. While clinical examination may reveal superficial tumor features, such as ulceration or induration, it is often inadequate for evaluating deeper tumor infiltration [9]. The complex anatomy of the oral cavity—including the buccal mucosa, gingivobuccal sulci, and retromolar trigone—complicates accurate assessment due to the close proximity of soft tissue, glandular, and osseous structures [10]. Proper staging using the Tumor-Node-Metastasis (TNM) system is critical for determining resectability, guiding surgical margins, and planning adjuvant therapy [11]. Precise imaging of oral cavity tumors is therefore vital to define the size and extent of the primary lesion, which is crucial for surgical and radiotherapy planning [12]. Accurate tumor localization ensures adequate resection margins, appropriate radiotherapy field definition, and improved patient outcomes.

Various imaging modalities, such as orthopantomogram (OPG), computed tomography (CT), and magnetic resonance imaging (MRI), are employed to evaluate mandibular invasion and perineural spread in paramandibular lesions, although the diagnostic accuracy of these techniques for detecting mandibular bone invasion remains uncertain [13]. CT is typically the first-line imaging tool for oral cavity cancers, as it enables better assessment of cortical bone and nodal involvement and should ideally be performed with intravenous contrast to improve tumor visualization in soft tissues, unless contraindicated [14-16]. Multidetector CT (MDCT) has emerged as an accessible, non-invasive, and cost-effective modality for evaluating buccal mucosa SCC and allows for precise tumor staging [17]. MDCT provides detailed information critical for treatment planning, including involvement of the retromolar trigone, tongue muscles, masticator space, bones, neurovascular bundles, and regional or distant lymph nodes [18].

Histopathological examination (HPE) continues to be the gold standard for confirming tumor characteristics, including perineural invasion (PNI), which is an important prognostic marker [19]. Imaging studies can determine tumor resectability and guide the extent of surgical excision [14]. Precise evaluation of mandibular involvement by oral cancers is essential for accurate staging, optimal treatment planning, and prognosis assessment. Therefore, identifying and delineating the extent of bone invasion caused by these tumors is of paramount importance.

Despite advances in imaging techniques, there remains limited clarity on the accuracy of MDCT in preoperative staging of buccal malignancy, particularly in correlating radiological findings with histopathological TNM staging. While MDCT provides detailed information on tumor extent, bone involvement, and nodal status, discrepancies between imaging and histopathology have been reported, and the degree of concordance varies across studies. Accurate preoperative staging is critical to avoid under- or over-treatment, optimize surgical planning, and minimize functional and cosmetic morbidity, yet data quantifying this correlation in the context of buccal mucosa carcinoma—especially in the Bangladeshi population—is scarce. Therefore, this study aims to evaluate the correlation between multidetector computed tomography (MDCT) findings and histopathological TNM staging in patients with buccal malignancy.

**Objective**

- To evaluate the correlation between multidetector computed tomography (MDCT) findings and histopathological TNM staging in patients with buccal malignancy.

## METHODOLOGY & MATERIALS

This cross-sectional diagnostic accuracy study was conducted at the Departments of Radiology and Imaging, Otolaryngology and Head–Neck Surgery, and Pathology, Sylhet MAG Osmani Medical College and Hospital, Sylhet, Bangladesh, from March 2020 to February 2022. A total of 65 patients with histopathologically confirmed buccal malignancy were enrolled using non-probability convenience sampling to evaluate the correlation between multidetector computed tomography (MDCT) findings and histopathological TNM staging.

**Inclusion Criteria:**

- Histopathologically confirmed buccal malignancy
- Patients who underwent surgical treatment

**Exclusion Criteria:**

- Previously treated cases (surgery, chemotherapy, radiotherapy, or combined therapy)
- Pregnant women
- Renal impairment

**Study Procedure and Imaging**

Patients underwent punch biopsy under local anesthesia. Confirmed cases were referred for contrast-enhanced MDCT prior to surgical resection. Resected specimens were sent for histopathological evaluation, including TNM staging and margin assessment.

CT imaging was performed from the paranasal sinuses to the clavicle using a 160-detector multidetector

CT scanner (Aquillion 160, Toshiba, Tokyo, Japan) with 2 mm slice thickness at 2–5 mm intervals after administration of nonionic iodinated contrast (370 mg/ml; 1.5–2 ml/kg). Multiplanar sagittal and coronal reformats with MIP and 3D reconstruction were obtained. A puffed cheek maneuver was used to improve visualization of the buccal mucosa.

**Variables assessed**

included lesion location, extension, bone and lymph node involvement, histopathological tumor type and grade, and demographic data (age, sex).

**Data Analysis and Ethics**

Data were collected using a structured questionnaire. Continuous variables were expressed as mean ± SD and categorical variables as frequencies and percentages. Diagnostic performance of MDCT (sensitivity, specificity, accuracy, PPV, NPV) was calculated using histopathology as the reference standard. $P < 0.05$ was considered statistically significant. Written informed consent was obtained from all participants, and ethical approval was granted by the Ethical Committee of Sylhet MAG Osmani Medical College.

# RESULTS

**Table 1: Age Distribution of Study Participants (n = 65)**

| Age (years) | Number of Patients | Percentage (%) |
|---|---|---|
| 30–39 | 7 | 10.8 |
| 40–49 | 19 | 29.2 |
| 50–59 | 23 | 35.4 |
| 60–69 | 13 | 20 |
| 70–76 | 3 | 4.6 |
| **Mean ± SD** | **52.8 ± 11.1** | |
| **Range (min–max)** | **30–76** | |

The mean age of participants was 52.8 ± 11.1 years (range 30–76 years). The largest proportion of patients were aged 50–59 years (23 patients, 35.4%), followed by 40–49 years (19 patients, 29.2%) and 60–69 years (13 patients, 20.0%). Patients aged 30–39 years and 70–76 years accounted for 10.8% and 4.6%, respectively.

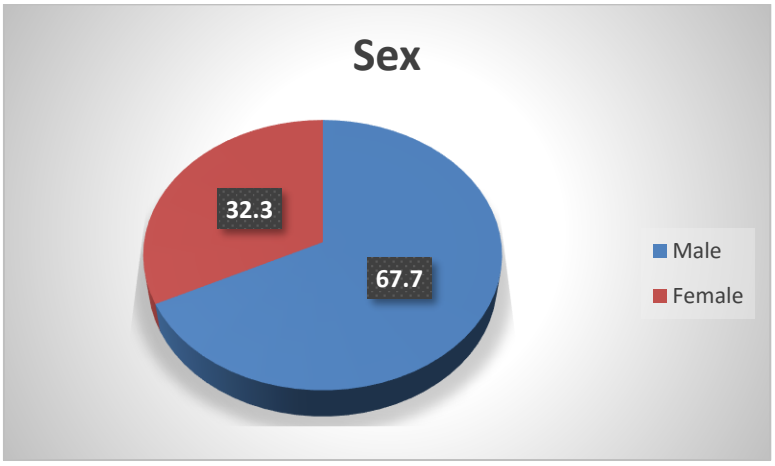


**Figure 1: Sex Distribution of Study Participants (n = 65)**

Among the study participants, 44 (67.7%) were male and 21 (32.3%) were female, resulting in a male-to-female ratio of 2.1:1.

**Table 2: MDCT Findings in Buccal Malignancy (n = 65)**

| MDCT Variable | | Number of Patients | Percentage (%) |
|---|---|---|---|
| **Extension** | Retromolar trigone | 42 | 64.6 |
| | Masticator space | 28 | 43.1 |
| | Skin | 6 | 9.2 |
| **Bone Involvement** | Mandible | 12 | 18.5 |
| | Maxilla | 2 | 3.1 |
| | Maxilla & Mandible | 2 | 3.1 |
| | None | 49 | 75.3 |

| MDCT Variable | | Number of Patients | Percentage (%) |
|---|---|---|---|
| **Lymph Node Involvement** | Ipsilateral | 50 | 77.0 |
| | Bilateral | 8 | 12.3 |
| | None | 7 | 10.8 |
| **Lymph Node Size (cm)** | 1.1–3.0 | 55 | 84.6 |
| | 3.1–4.3 | 6 | 9.2 |

MDCT evaluation showed tumor extension to the retromolar trigone in 42 patients (64.6%) and the masticator space in 28 patients (43.1%), while skin involvement was observed in 6 patients (9.2%). Bone involvement included the mandible in 12 patients (18.5%), maxilla in 2 patients (3.1%), and both mandible and maxilla in 2 patients (3.1%), with 49 patients (75.3%) showing no bone involvement. Lymph node assessment revealed ipsilateral involvement in 50 patients (77.0%), bilateral in 8 patients (12.3%), and no lymph node involvement in 7 patients (10.8%). Most lymph nodes measured 1.1–3.0 cm (55 patients, 84.6%), with 6 patients (9.2%) having lymph nodes sized 3.1–4.3 cm.

**Table 3: Histopathological TNM Stage Distribution of Study Participants (n = 65)**

| TNM Stage | Number of Patients | Percentage (%) |
|---|---|---|
| II | 8 | 12.3 |
| III | 10 | 15.4 |
| IVA | 20 | 30.8 |
| IVB | 27 | 41.5 |

Histopathological analysis revealed that the most common TNM stage was IVB (27 patients, 41.5%), followed by IVA (20 patients, 30.8%), III (10 patients, 15.4%), and II (8 patients, 12.3%).

**Table 4: Correlation Between Radiological (MDCT) and Histopathological TNM Staging (n = 65)**

| Radiological Stage | Histopathological Stage | Number of Patients | Percentage (%) |
|---|---|---|---|
| **Stage II** | II | 6 | 75.0 |
| | III | 1 | 10.0 |
| | IVA | 0 | 0.0 |
| | IVB | 0 | 0.0 |
| **Stage III** | II | 2 | 25.0 |
| | III | 8 | 80.0 |
| | IVA | 1 | 5.0 |
| | IVB | 0 | 0.0 |
| **Stage IVA** | II | 0 | 0.0 |
| | III | 1 | 10.0 |
| | IVA | 17 | 85.0 |
| | IVB | 1 | 3.7 |
| **Stage IVB** | II | 0 | 0.0 |
| | III | 0 | 0.0 |
| | IVA | 2 | 10.0 |
| | IVB | 26 | 96.3 |

Stage IVB demonstrated the highest concordance, with 26 of 28 patients (96.3%) correctly staged by MDCT. Stage IVA showed agreement in 17 of 20 patients (85.0%), Stage III in 8 of 10 patients (80.0%), and Stage II in 6 of 8 patients (75.0%). Discordant cases were minimal.

**Table 5: Diagnostic Performance of MDCT TNM Staging Compared with Histopathology (n = 65)**

| TNM Stage | Sensitivity (%) | Specificity (%) | Accuracy (%) | Positive Predictive Value (PPV, %) | Negative Predictive Value (NPV, %) |
|---|---|---|---|---|---|
| Stage II | 75.0 | 98.2 | 95.4 | 85.7 | 96.6 |
| Stage III | 80.0 | 94.5 | 92.3 | 72.7 | 96.3 |
| Stage IVA | 85.0 | 95.6 | 92.3 | 89.5 | 93.5 |
| Stage IVB | 96.3 | 94.7 | 95.4 | 92.9 | 97.3 |

MDCT showed excellent diagnostic performance across all stages. Stage IVB demonstrated the highest sensitivity (96.3%) and accuracy (95.4%). Stage IVA had sensitivity of 85.0% and accuracy of 92.3%, Stage III sensitivity 80.0% and accuracy 92.3%, and Stage II sensitivity 75.0% and accuracy 95.4%.

Positive predictive values ranged from 72.7% (Stage III) to 92.9% (Stage IVB), and negative predictive values ranged from 93.5% (Stage IVA) to 97.3% (Stage IVB).

# DISCUSSION

Buccal squamous cell carcinoma often involves local tissues and lymph nodes, making accurate preoperative assessment crucial for treatment planning. This study shows that MDCT correlates closely with histopathological TNM staging, demonstrating high diagnostic accuracy, particularly in advanced stages. These findings emphasize MDCT's value in guiding surgical planning and optimizing patient outcomes.

The present study demonstrated that buccal malignancy predominantly affects middle-aged and older adults, with the highest proportion of patients in the 50–59-year age group (35.4%), followed by those aged 40–49 years (29.2%) and 60–69 years (20.0%). The mean age was 52.8 ± 11.1 years, with a range of 30–76 years, indicating that the majority of cases clustered in the fifth and sixth decades of life. This age pattern aligns closely with the findings of Bobdey *et al*. [20], who reported a median age of 52 years (range 24–85) in a retrospective analysis of 409 patients with squamous cell carcinoma of the buccal mucosa, mirroring both the mean age and age span observed in the present cohort. Similarly, Padma *et al*. [21] documented a mean age of 54.16 ± 17.25 years among 198 cases of buccal mucosa carcinoma, with a predominance of patients in older age groups. The consistency between these studies and the current findings reinforces the well-established epidemiological trend that buccal carcinoma largely affects individuals in middle and later adulthood, likely reflecting cumulative exposure to risk factors such as tobacco and betel nut use over time.

The present study also demonstrated a clear male predominance in buccal malignancy, with 44 (67.7%) male patients and 21 (32.3%) female patients, yielding a male-to-female ratio of 2.1:1. This finding is consistent with previously published data indicating that oral squamous cell carcinoma occurs more frequently in males. For instance, Jayasooriya *et al*. [22], in a descriptive study of 896 oral squamous cell carcinoma cases, reported a male-to-female ratio of approximately 2.7:1. Although their study encompassed all oral cavity subsites, buccal mucosa was among the commonly affected locations, and the observed male predominance closely parallels the sex distribution noted in the present cohort. This similarity underscores the epidemiological pattern of higher incidence in males, which may be attributable to greater exposure to risk factors such as tobacco use, betel quid chewing, and alcohol consumption.

In the present study, MDCT provided detailed delineation of locoregional tumor extent relevant for accurate staging. Tumor extension to the retromolar trigone was observed in 42 patients (64.6%) and to the masticator space in 28 patients (43.1%), while skin involvement was present in 6 patients (9.2%). Bone involvement included the mandible in 12 patients (18.5%), maxilla in 2 patients (3.1%), and both mandible and maxilla in 2 patients (3.1%), with 49 patients (75.3%) showing no bone involvement. Cervical lymph node metastasis was predominantly ipsilateral (77.0%), with most nodes measuring 1.1–3.0 cm (84.6%). These findings highlight MDCT's utility in evaluating both T and N components of TNM staging. The results are comparable to those reported by Sankhe *et al*. [23], who demonstrated that MDCT effectively identified retromolar trigone extension, masticator space involvement, bone invasion, and regional nodal metastasis in buccal mucosa squamous cell carcinoma, emphasizing its value for staging and surgical planning. Similarly, Bamdhamravuri *et al*. [24] reported that MDCT accurately delineated tumor spread to adjacent structures and cervical lymph nodes, correlating well with pathological findings and supporting its reliability in staging assessment. The consistency between these studies and the present results reinforces that MDCT is a dependable imaging modality for preoperative evaluation and shows strong potential for correlation with histopathological staging in buccal malignancy.

Histopathological TNM stage distribution in the present study revealed a predominance of advanced disease at diagnosis. While only 8 patients (12.3%) were in Stage II and 10 patients (15.4%) in Stage III, a substantial proportion presented with Stage IVA (20 patients, 30.8%) and Stage IVB (27 patients, 41.5%). This trend mirrors the findings of Daneste *et al*. [25], who reported that in an oral cancer series including buccal mucosa cases, only 12% of patients were in Stage II, whereas the majority were diagnosed in Stage III (54%) and Stage IV (33%). These similarities underscore the persistent trend of late-stage presentation in buccal malignancy, particularly in regions with high-risk factor exposure and limited early screening. The predominance of Stage IVA and IVB cases in the present cohort emphasizes the clinical importance of accurate preoperative imaging and its correlation with histopathological staging, which was the central objective of the study.

The correlation between radiological TNM staging by MDCT and histopathological staging was strong in the present cohort. Stage II tumors showed 75.0% concordance, Stage III 80.0%, Stage IVA 85.0%, and Stage IVB 96.3%, demonstrating that MDCT accurately reflects tumor extent, nodal involvement, and local invasion in most cases. These findings align with Agarwal *et al*. [26], who reported that CT-based TNM staging in oral cavity cancers, including buccal mucosa, correlated significantly with postoperative histopathological staging, particularly for tumor extension, bone invasion, and lymph node metastasis. Tehzeeb *et al*. [27] similarly found that clinical and radiological TNM staging demonstrated substantial

agreement with histopathology across oral squamous cell carcinoma subsites, reinforcing the reliability of imaging-based staging. The high concordance observed in the present study highlights the utility of MDCT for accurate preoperative assessment, guiding surgical planning and prognostication in buccal malignancy, and aligns closely with prior evidence supporting imaging as a dependable surrogate for pathological staging.

The diagnostic performance of MDCT TNM staging in this study demonstrated high reliability. Sensitivity ranged from 75.0% in Stage II to 96.3% in Stage IVB, specificity from 94.5% to 98.2%, accuracy exceeded 92% across all stages, and positive and negative predictive values were high. These results are consistent with Saher *et al*. [28], who reported very high sensitivity (95.8%) and specificity (96.4%) for detecting mandibular invasion in oral cavity cancers, including buccal mucosa, with PPV 97.9% and NPV 92.9%, highlighting the excellent preoperative staging capability of MDCT. Similarly, Struckmeier *et al*. [29] demonstrated that contrast-enhanced CT achieved sensitivity of approximately 76.9% and specificity of 82.2% for bone invasion, with NPV approaching 89.7%, confirming that imaging provides reliable assessment of true negative cases. Taken together, these studies reinforce the present findings that MDCT is a highly effective tool for preoperative TNM staging in buccal malignancy, accurately reflecting tumor extent, bone involvement, and nodal status, which is essential for surgical planning and prognostication.

**Limitations of the study**

The study had several limitations:

- Stage I cases were not encountered during the study period; therefore, the sensitivity and specificity of MDCT for evaluating Stage I buccal malignancy could not be determined.
- Benign cases were not included, as only biopsy-proven malignancies underwent MDCT followed by surgery and histopathological examination.
- Minimally enhancing buccal lesions were challenging to evaluate due to their lower vascularity.

## CONCLUSION

Buccal malignancy frequently presents in middle-aged to older adults and exhibits a clear male predominance. This study demonstrates that multidetector computed tomography (MDCT) provides reliable preoperative assessment, accurately delineating tumor extension, bone involvement, and lymph node metastasis, with strong correlation to histopathological TNM staging. Advanced stages were most common, and MDCT showed excellent diagnostic performance across all stages, confirming its value as a non-invasive tool for staging, surgical planning, and prognostication in buccal malignancy.

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