Section: Radiodiagnosis

Original Research Article

CT DETECTION OF MANDIBULAR INVASION BY SQUAMOUS CELL CARCINOMA OF THE ORAL CAVITY WITH HISTOPATHOLOGICAL CORRELATION

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Abstract

Background: Accurate detection of mandibular invasion in oral squamous cell carcinoma (OSCC) is critical for treatment planning. Computed tomography (CT) is widely used for preoperative assessment, but its diagnostic accuracy requires validation against histopathological examination (HPE).

Materials and Methods: A retrospective study of 12 patients with buccal carcinoma who underwent preoperative CT imaging and subsequent partial mandibulectomy as part of a composite resection procedure, combined with pectoralis major myocutaneous (PMMC) flap reconstruction. CT findings were correlated with histopathological results. **Result:** Among 12 patients, 6 were negative for mandibular invasion on both CT and HPE, 2 were positive on both, 3 were positive on CT but negative on HPE, and 1 was negative on CT but positive on HPE. The sensitivity of CT was 66.7%, specificity was 66.7%, positive predictive value (PPV) was 40%, and negative predictive value (NPV) was 85.7%. **Conclusion:** CT remains a valuable tool for ruling out mandibular invasion due to its high NPV, its moderate sensitivity and low PPV limit its reliability for confirming invasion. Histopathological correlation remains essential for accurate diagnosis and treatment planning.

INTRODUCTION

Oral squamous cell carcinoma (OSCC) is one of the most prevalent malignancies worldwide, accounting for over 90% of all oral cancers.[1] Among the various subsites of OSCC, buccal carcinoma is particularly common in regions where tobacco chewing and betel nut consumption are prevalent. The mandible, due to its proximity to the oral cavity, is frequently involved in advanced cases of OSCC, with mandibular invasion being a critical determinant of disease staging, treatment planning, and prognosis.[2-6]

Mandibular invasion by OSCC is associated with a higher risk of local recurrence, reduced survival rates, and increased morbidity.[2,6] Accurate preoperative detection of mandibular invasion is essential for determining the extent of surgical resection, the need for adjuvant therapy, and the overall management strategy.[1] Overestimation of mandibular invasion may lead to unnecessary aggressive surgery, such as segmental mandibulectomy, while underestimation may result in inadequate resection and higher recurrence rates.[4] Therefore, precise diagnostic tools are crucial for optimal patient outcomes.

Computed tomography (CT) is widely used for the preoperative assessment of mandibular invasion due to its ability to provide detailed visualization of bony structures and soft tissue involvement.[1,4] [Table 1]. CT is particularly valued for its accessibility, rapid acquisition time, and ability to detect cortical erosion and medullary infiltration [Figure 1–4].[5] However, the diagnostic accuracy of CT in detecting mandibular invasion remains variable, with studies reporting sensitivities ranging from 60% to 85% and specificities from 70% to 90%. False-positive results may occur due to reactive bone changes (sclerosis, periosteal thickening), partial volume artifacts (mimicking bone invasion), inflammatory changes (periosteal reaction, cortical irregularity), and technical factors (poor resolution, improper settings) [Figure 4 and 5]. Meanwhile false-negative results may arise from microscopic invasion that is not detectable on CT [Figure 3].[9]

Histopathological examination (HPE) remains the gold standard for confirming mandibular invasion, as it provides definitive evidence of tumour infiltration into the bone. However, HPE is only available postoperatively, underscoring the need for reliable

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preoperative imaging to guide surgical planning.[4,8] The correlation between CT findings and histopathological results is therefore critical for evaluating the diagnostic accuracy of CT and improving its clinical utility.

Furthermore, the variability in reported accuracy highlights the need for more robust evidence to establish the role of CT in this setting.[1,6] This study aims to address this gap by evaluating the diagnostic accuracy of CT in detecting mandibular invasion in patients with buccal carcinoma, with histopathological correlation.

The primary objective of this study is to assess the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of CT in detecting mandibular invasion in buccal carcinoma patients who underwent partial mandibulectomy as part of a composite resection procedure, combined with pectoralis major myocutaneous (PMMC) flap reconstruction.[2,6] By correlating CT findings with histopathological results, this study seeks to provide valuable insights into the strengths and limitations of CT as a diagnostic tool and its implications for clinical decision-making.

Table 1: Computed Tomography (CT) Findings Indicative of Mandibular Involvement in Oral Squamous Cell Carcinoma.

CT Finding	Description	Clinical Significance
Cortical Erosion	Irregularity or disruption in the outer bone cortex.	Strong indicator of tumor invasion.
Medullary Involvement	Marrow infiltration or trabecular bone destruction.	Suggests deeper invasion, higher recurrence risk.
Mandibular Canal Involvement	Loss of normal cortical outline.	May indicate perineural spread, poor prognosis.
Periosteal Reaction	Thickening or irregular elevation of periosteum.	Can be reactive or due to aggressive tumours.
Soft Tissue Extension	Tumour breaching cortical bone into soft tissues.	Suggests advanced disease stage.
Pathologic Fracture	Fracture secondary to tumour invasion.	Indicates severe bone destruction, requiring major surgery.
Sclerosis	Increased bone density around lesion.	May be reactive rather than true invasion.
Mixed Lytic & Sclerotic Changes	Bone loss with areas of increased density.	Suggests tumour infiltration with reactive changes.

MATERIALS AND METHODS

Study Design: This was a retrospective study conducted in the department of Radiodiagnosis at PES Institute of Medical Sciences and Research, Kuppam, between November 2023 and February 2025. The study included 12 patients with biopsy-proven buccal carcinoma who underwent preoperative CT imaging and subsequent partial mandibulectomy as part of a composite resection procedure, combined with pectoralis major myocutaneous (PMMC) flap reconstruction [Figure 5 and 6].

Inclusion Criteria

- Patients with histologically confirmed buccal carcinoma.
- Availability of preoperative CT scans and histopathological reports.
- Patients who underwent partial mandibulectomy as part of a composite resection procedure, combined with pectoralis major myocutaneous (PMMC) flap reconstruction.

Exclusion Criteria

- Patients with prior mandibular surgery or radiotherapy.
- Incomplete imaging or histopathological data.

CT Imaging Protocol: CT scans were performed using a GE Revolution Aspire 32-slice CT scanner with slice thickness of 1.25mm. Images were evaluated for signs of mandibular invasion, including cortical erosion, medullary involvement, mandibular canal involvement and soft tissue extension [Figure 1–4].

Histopathological Examination: Surgical specimens were processed and evaluated for the presence of mandibular invasion. Histopathological findings were considered the gold standard for diagnosis.

Data Analysis: CT findings were compared with histopathological results. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated. Statistical analysis was performed.

RESULTS

Patient Characteristics: The study included 12 patients (3 males and 9 females) with a mean age of 62 years. All patients had biopsy-proven buccal carcinoma and underwent partial mandibulectomy as part of a composite resection procedure, combined with pectoralis major myocutaneous (PMMC) flap reconstruction.

CT and Histopathological Findings

- True Positive (TP): 2 patients were positive on both CT and HPE [Figure 1].
- True Negative (TN): 6 patients were negative for mandibular invasion on both CT and HPE [Figure 2].
- False Negative (FN): 1 patient was negative on CT but positive on HPE [Figure 3].
- False Positive (FP): 3 patients were positive on CT but negative on HPE [Figure 4].

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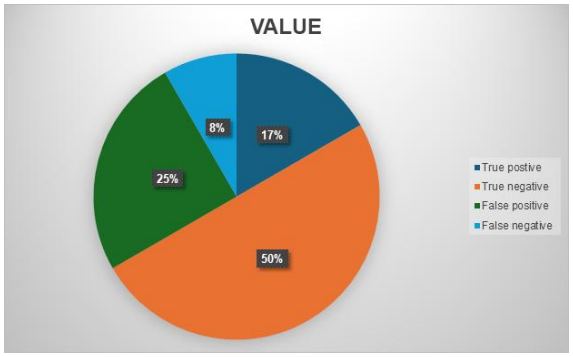
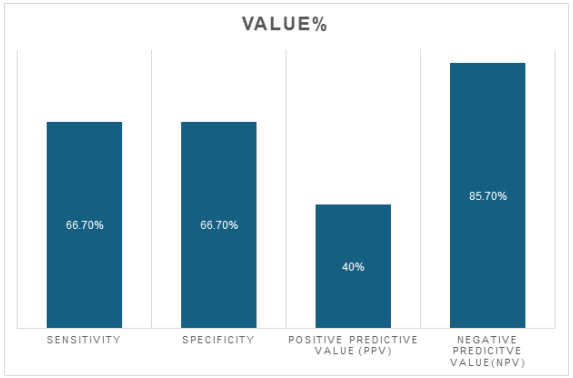
Diagnostic Accuracy

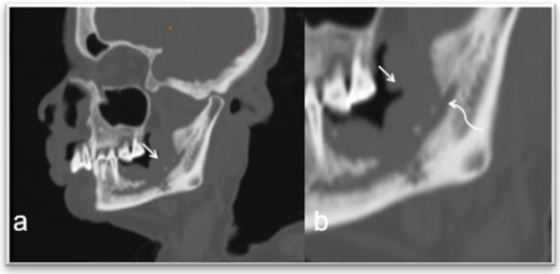
- Sensitivity: TP / (TP + FN) = 2/ (2 + 1) = 66.7%
- Specificity: TN / (TN + FP) = 6 / (6 + 3) = 66.7%
- Positive Predictive Value (PPV): TP / (TP + FP) = 2 / (2 + 3) = 40%
- Negative Predictive Value (NPV): TN / (TN + FN) = 6 / (6 + 1) = 85.7%



Graph 1: Distribution of CT and Histopathological Findings in Mandibular Invasion Detection.



Graph 2: Diagnostic Accuracy of CT in Detecting Mandibular Invasion: Sensitivity, Specificity, PPV, and NPV



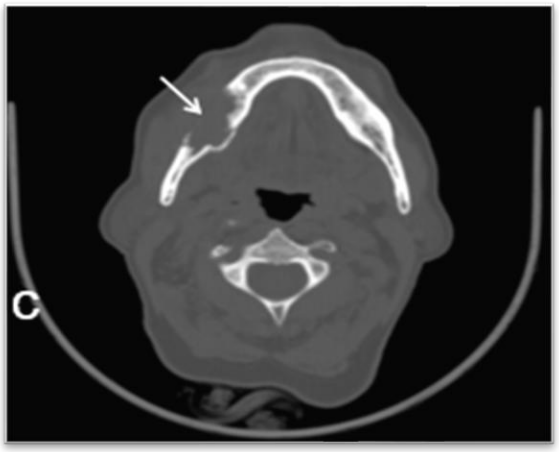


Figure 1: True positive case – Oblique sagittal CT sections in the bone window (a–b) and axial CT sections in the bone window (c) show an ulcerative growth in the right gingivobuccal region involving the retromolar trigone, causing severe erosion of the ramus and angle of the mandible with soft tissue extension (straight arrow). The mandibular canal is also involved (curved arrow). HPE correlation confirms the presence of mandibular invasion, consistent with the CT findings.

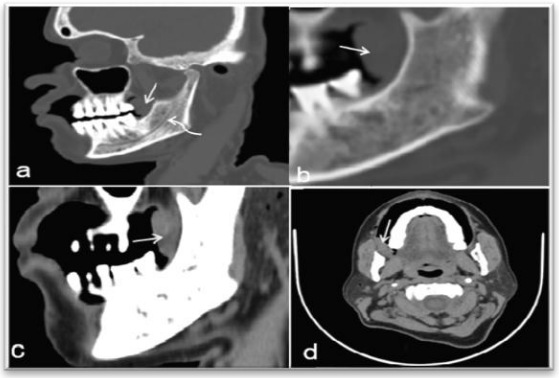


Figure 2: True negative case – Oblique sagittal CT sections in the bone window (a–b) and soft tissue window (c), along with axial CT sections in the bone window (d) at the level of the angle of the mandible, show a mass lesion in the left buccal region involving the gingivobuccal sulcus (straight arrow). There is no evidence of cortical erosive changes in the mandible. The cortical and medullary bone of the mandible appear intact, with no soft tissue extension. The fat plane between the lesion and the bone appears intact. HPE correlation confirms the absence of mandibular invasion, consistent with the CT findings.

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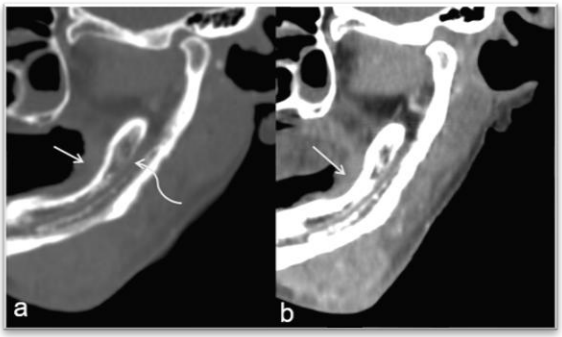

Figure 3: False negative case – Oblique sagittal CT sections in the bone window (a) and soft tissue window (b) at the level of the angle of the mandible show a mass lesion in the left buccal region (straight arrow). No significant bony erosive changes or soft tissue extension are detected on CT imaging. The mandibular canal is also visible (curved arrow). However, HPE correlation demonstrates microscopic tumor invasion into the mandible, which was not evident on imaging due to early or subtle involvement.

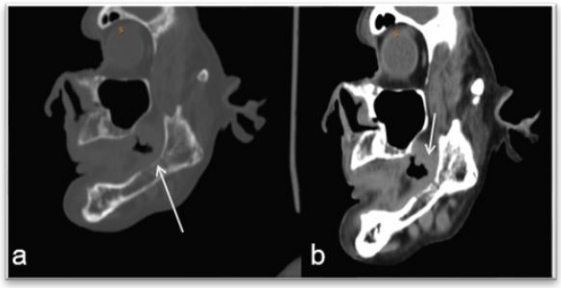

Figure 4: False positive case – Oblique sagittal CT sections in the bone window (a) and soft tissue window (b) at the level of the mandible show a mass lesion in the left gingivobuccal region. Apparent erosive changes in the mandible with associated soft tissue thickening (straight arrow) are suggestive of mandibular invasion. However, HPE correlation reveals no evidence of tumor invasion, and the changes are attributed to reactive or inflammatory processes.

Figure 5: Hemimandibulectomy specimen (buccal aspect) – Shows the resected mandible and adjacent soft tissues.

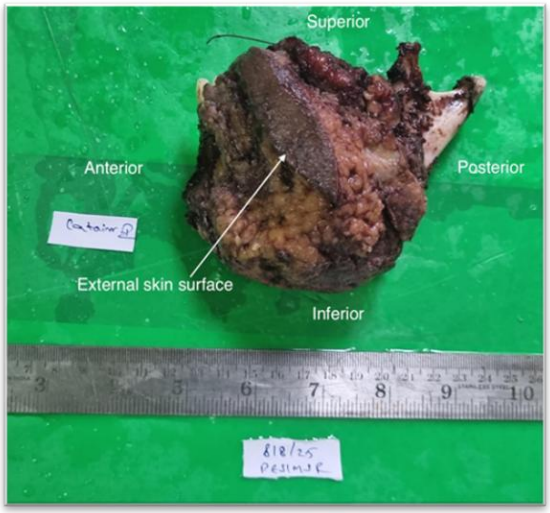

Figure 6: Hemimandibulectomy specimen with elliptical skin (external aspect) – Shows the resected mandible and adjacent soft tissues.

DISCUSSION

This study evaluated the diagnostic accuracy of CT in detecting mandibular invasion in patients with buccal carcinoma. The results demonstrated moderate sensitivity (66.7%) and specificity (66.7%), with a low positive predictive value (PPV) (40%). The high negative predictive value (NPV) (85.7%) suggests that CT is reliable for ruling out mandibular invasion when findings are negative [Figure 2]. However, the low PPV and moderate sensitivity highlight the limitations of CT in accurately diagnosing mandibular invasion, particularly in cases of early or microscopic involvement [Figure 3].

The false-positive cases (n=3) may be attributed to reactive bone changes (e.g., sclerosis, periosteal thickening), partial volume artifacts (mimicking bone invasion), inflammatory changes (e.g., periosteal reaction, cortical irregularity), and technical factors (e.g., poor resolution, improper settings), which can mimic mandibular invasion on CT [Figure 4].[6,9] The false-negative case [Figure 3] (n=1) underscores the challenges of detecting early or microscopic invasion using CT, as it may not adequately visualize subtle pathological changes.[2,8]

The diagnostic accuracy of CT in this study aligns with findings from previous studies, though with some variability. For instance, Bouhir et al,[6] reported a sensitivity of 70% and specificity of 71%, with a PPV of 66%, emphasizing the difficulty in distinguishing true invasion from inflammatory changes on CT. Agarwal et al,[4] reported a sensitivity of 83.3% and specificity of 72.7%, further supporting the moderate specificity of CT observed in our study. These comparisons highlight the need for cautious interpretation of CT findings and the importance of histopathological correlation for definitive diagnosis, particularly in equivocal cases.

The low PPV (40%) in this study underscores the challenges of relying solely on CT for diagnosing

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mandibular invasion. Advanced imaging modalities, such as MRI or PET-CT, may improve diagnostic accuracy in equivocal cases, as suggested by Ye et al,[1] who emphasized the complementary role of MRI in assessing mandibular invasion. Additionally, Singh et al,[2] highlighted the utility of combining clinical examination and imaging findings to enhance diagnostic precision.

CONCLUSION

While CT remains a valuable tool for ruling out mandibular invasion due to its high NPV, its moderate sensitivity and low PPV limit its reliability for confirming invasion. The findings of this study reinforce the importance of integrating clinical, radiological, and histopathological assessments to achieve accurate diagnosis and optimal patient management. Histopathological correlation remains essential for accurate diagnosis and treatment planning.[1,6]

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