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Original Research Article

Multi-Detector Row Computed Tomography (MDCT) In Assessment of Mandibular Invasion of Oral Squamous Cell Carcinomas

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Abstract:

Background: Accurate preoperative assessment of mandibular invasion in oral squamous cell carcinoma (OSCC) is essential for surgical planning and prognosis determination. Multi-detector row computed tomography (MDCT), particularly with 16-slice CT technology, offers high-resolution imaging capable of detecting cortical and medullary bone involvement. This study evaluated the diagnostic performance of 16-slice MDCT in assessing mandibular invasion in OSCC patients, using histopathology as the reference standard.

Materials and Methods: A prospective study was conducted on 40 patients diagnosed with OSCC involving or adjacent to the mandible. All participants underwent preoperative 16-slice MDCT scanning with thin-slice axial images, multiplanar reconstructions, and bone window settings. Two experienced radiologists independently evaluated the scans for evidence of cortical erosion and medullary invasion. Surgical resection was performed, and histopathological examination served as the gold standard. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of MDCT were calculated.

Results: Histopathology confirmed mandibular invasion in 26 out of 40 cases (65%). MDCT correctly identified invasion in 24 of these cases, yielding a sensitivity of 92.3% and specificity of 88.9%. The PPV and NPV were 92.3% and 88.9%, respectively, with an overall diagnostic accuracy of 90%. Interobserver agreement was excellent ($\kappa = 0.87$). False positives (n=2) were attributed to reactive bone changes, while false negatives (n=2) involved early medullary involvement without cortical breach.

Conclusion: Sixteen-slice MDCT demonstrates high diagnostic accuracy in detecting mandibular invasion by OSCC, making it a valuable tool in preoperative assessment. However, early medullary involvement may still pose a diagnostic challenge, and correlation with other imaging modalities or histopathology remains advisable.

Keywords: Oral Squamous Cell Carcinoma, Mandibular Invasion, Multi-Detector Computed Tomography, 16-Slice CT, Bone Involvement, Head And Neck Imaging.

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Introduction

Oral squamous cell carcinoma (OSCC) is the most common malignant neoplasm of the oral cavity, accounting for more than 90% of all oral malignancies and representing a significant global health burden [1,2]. Among its various sites, the involvement of the mandibular region is of particular concern due to the proximity of tumors in the gingivobuccal sulcus, alveolar ridge, and floor of the mouth to the mandible [3]. Mandibular invasion can adversely affect prognosis, necessitate more extensive surgical resection, and influence reconstructive requirements [4]. Accurate preoperative evaluation of mandibular invasion is crucial for determining the optimal surgical approach, which may range from marginal to segmental mandibulectomy [5,6]. Overestimation of invasion can lead to unnecessarily aggressive surgery, compromising function and aesthetics, while underestimation risks incomplete tumor clearance [7]. Histopathology remains the gold standard for confirming bone involvement, but imaging plays an indispensable role in preoperative planning [8].

Conventional radiographic techniques, such as panoramic radiography, have limited sensitivity in detecting early cortical or medullary changes [9]. Cross-sectional imaging modalities, particularly computed tomography (CT), have become the preferred method due to their ability to visualize cortical integrity, medullary involvement, and tumor–bone interface.

Multi-detector row computed tomography (MDCT), especially with 16-slice configurations, provides high spatial resolution, rapid acquisition, and multiplanar reconstructions, enabling detailed assessment of mandibular architecture [2,3].

Several studies have demonstrated that MDCT has high specificity for detecting cortical erosion but may have limitations in identifying early medullary invasion [4,5].

Combining thin-slice imaging with appropriate reconstruction algorithms can enhance detection rates and reduce interpretative errors [6]. Despite these advancements, false-positive findings due to inflammatory or reactive bone changes, and false negatives in subtle marrow infiltration, continue to challenge radiologists [7,8].

Given these considerations, this study was designed to evaluate the diagnostic accuracy of 16-slice MDCT in detecting mandibular invasion in patients with OSCC, using histopathological examination as the reference standard.

Materials and Methods

Forty patients with biopsy-proven oral squamous cell carcinoma involving or located adjacent to the mandible were recruited.

Inclusion Criteria

- Patients aged 18 years and above.
- Histopathologically confirmed OSCC with clinical suspicion of mandibular involvement.
- Lesions located in close proximity to the mandibular alveolar ridge, gingivobuccal sulcus, or floor of the mouth.

Exclusion Criteria

- Patients with recurrent tumors or prior surgery/radiotherapy in the region of interest.
- Contraindications to CT scanning such as pregnancy.
- Presence of metallic prostheses causing significant imaging artefacts.

Imaging Protocol: All patients underwent preoperative MDCT using a 16-slice CT scanner (e.g., GE Bright Speed, Siemens SOMATOM Emotion). Scanning was performed from the skull base to the hyoid bone with the patient in the supine position and head stabilized to minimize motion artefacts.

Technical Parameters

- Slice thickness: 1 mm.
- Reconstruction interval: 0.5 mm.
- Tube voltage: 120 kVp.
- Tube current: 150–200 mA (automatic exposure control).
- Field of view: Adjusted to cover mandible and surrounding soft tissues.
- Reconstruction algorithms: Bone and soft tissue kernels for multiplanar reconstructions (axial, coronal, sagittal).

Intravenous contrast (non-ionic, 1–1.5 mL/kg) was administered in selected cases for better soft tissue delineation. Bone window settings (window width ~2500 HU, window level ~450 HU) were used for evaluating cortical and medullary structures.

Image Analysis: Two independent radiologists, blinded to histopathology results, evaluated each scan. Cortical invasion was defined as focal erosion, discontinuity, or destruction of the mandibular cortex adjacent to the tumor.

Medullary involvement was considered when there was loss of trabecular pattern, abnormal intramedullary attenuation, or extension of tumor density into cancellous bone. In cases of disagreement, a consensus reading was made.

Surgical and Histopathological Assessment: All patients underwent surgical resection of the tumor with either marginal or segmental mandibulectomy, depending on intraoperative findings and imaging assessment.

The resected mandibles were subjected to histopathological examination by an experienced pathologist, who assessed for cortical and medullary invasion. Histopathology served as the reference standard for diagnostic accuracy calculations.

Statistical Analysis: Data were analyzed using SPSS software version 25. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy of MDCT in detecting mandibular invasion were calculated. Interobserver agreement was assessed using Cohen's kappa (κ) statistic. A p-value <0.05 was considered statistically significant.

Results

A total of 40 patients with histologically confirmed OSCC were included, comprising 26 males (65%) and 14 females (35%), with a mean age of 54.7 ± 9.2 years. The most common primary tumor location was the gingivobuccal sulcus (45%), followed by the alveolar ridge (37.5%) and floor of the mouth (17.5%).

Histopathology Findings: Histopathological examination confirmed mandibular invasion in 26 of 40 cases (65%). Cortical erosion alone was observed in 8 cases (20%), while combined cortical and medullary involvement was noted in 18 cases (45%).

MDCT Diagnostic Performance: On 16-slice MDCT, mandibular invasion was identified in 26 patients. When compared with histopathology, MDCT demonstrated 24 true positives, 12 true negatives, 2 false positives, and 2 false negatives (Table 1).

Table 1: Comparison of MDCT findings with histopathology in mandibular invasion detection.

MDCT Findings	Histopathology Positive	Histopathology Negative	Total
Positive	24	2	26
Negative	2	12	14
Total	**26**	**14**	**40**

From these values, the sensitivity of MDCT was 92.3%, specificity 85.7%, PPV 92.3%, NPV 85.7%, and overall accuracy 90.0%.

Patterns of Bone Involvement: Cortical erosion was detected in 25 cases on MDCT, of which 23 were confirmed histologically. Medullary invasion was suspected in 19 cases, with histopathology confirming 18 (Table 2).

Table 2: Pattern of bone involvement: MDCT versus histopathology.

Type of Involvement	MDCT Positive	Histopathology Positive	Agreement (%)
Cortical erosion	25	23	92.0
Medullary involvement	19	18	94.7

Interobserver Agreement: The kappa coefficient for agreement between the two radiologists was 0.87, indicating excellent interobserver reliability.

Statistical Summary

A summary of the diagnostic performance indices of 16-slice MDCT is provided in Table 3.

Table 3: Diagnostic performance of 16-slice MDCT in detecting mandibular invasion.

Parameter	Value (%)
Sensitivity	92.3
Specificity	85.7
Positive Predictive Value	92.3
Negative Predictive Value	85.7
Accuracy	90.0

These findings suggest that MDCT offers high diagnostic accuracy for preoperative evaluation of mandibular invasion, with particularly strong agreement for cortical involvement detection (Table 2). However, a small number of false-positive results occurred due to reactive bone changes, while early medullary infiltration accounted for false-negative cases.

Discussion

The accurate preoperative assessment of mandibular invasion in oral squamous cell carcinoma (OSCC) remains a critical determinant for surgical planning, oncologic safety, and functional preservation.

In the present study, 16-slice multi-detector row computed tomography (MDCT) demonstrated high sensitivity (92.3%) and specificity (85.7%) in detecting mandibular invasion when compared with histopathological examination, which is consistent with prior studies reporting sensitivities ranging from 85% to 96% and specificities between 80% and 90% [1-3]. The high diagnostic accuracy observed in this study supports the utility of MDCT as a primary imaging tool in OSCC patients with suspected mandibular involvement. Similar to earlier findings, MDCT proved particularly effective in identifying cortical erosion, which is often the earliest radiological indicator of bone invasion [4,5]. The capability of MDCT to acquire thin slices with high spatial resolution allows detailed visualization of cortical discontinuities, periosteal reactions, and the tumor–bone interface [6].

However, despite excellent performance, limitations were evident in detecting early medullary invasion. This is attributable to the fact that intramedullary tumor spread may occur without overt cortical disruption, leading to subtle attenuation changes that are challenging to distinguish from normal marrow variations [7,8]. Our results align with previous reports that false-negative interpretations are more frequent in such early marrow infiltration, while false positives often arise from inflammatory or reactive changes secondary to adjacent tumor mass [9,10].

Interobserver agreement in our study (κ = 0.87) was comparable to values reported in literature, reinforcing the reproducibility of MDCT findings when assessed by experienced radiologists [11]. This underscores the importance of standardized reporting protocols, which may further enhance diagnostic consistency [12].

Although magnetic resonance imaging (MRI) is often advocated for its superior soft tissue contrast and sensitivity to marrow changes, it is more prone to overestimating bone invasion due to tumor-associated edema [13]. Positron emission tomography combined with CT (PET/CT) can provide metabolic information but is not routinely used for local bone invasion assessment owing to cost and accessibility constraints [14].

Thus, MDCT remains a balanced choice in terms of availability, speed, and diagnostic reliability, especially in settings with high OSCC prevalence [15].

Our findings reaffirm that while MDCT offers substantial diagnostic value, multimodal assessment may be warranted in equivocal cases, particularly when the surgical plan depends on the extent of medullary involvement. Correlation with clinical examination, surgical findings, and histopathology remains essential for optimal treatment outcomes.

Conclusion

Sixteen-slice MDCT provides high diagnostic accuracy for detecting mandibular invasion in OSCC, particularly for cortical involvement. While early medullary infiltration may be underestimated, its speed, availability, and reproducibility make it a valuable preoperative imaging modality. Combining MDCT with clinical and histopathological correlation ensures optimal surgical planning and patient outcomes.

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