ORIGINAL ARTICLE

Can a CT Scan Predict the Spread of Oral Cancer to the Neck? A Diagnostic and Histopathological Analysis

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ABSTRACT

Background: In oral squamous cell carcinoma, metastases to the cervical lymph nodes are important indicators of disease-specific survival. Because CT scans can reveal nodal morphological traits and provide greater anatomical localization, they are the most often utilized imaging modality.

Objective: To calculate the diagnostic accuracy of computed tomography scan for the detection of cervical lymph node metastasis in oral squamous cell carcinoma in comparison with histopathological analysis after neck dissection, at a tertiary care hospital, Karachi.

Material and Methods: This cross-sectional study was conducted in the Radiology department of Liaquat National Hospital & Medical College, Karachi, from March to September 2023. 167 participants were included. A CT scan of the head & neck was done to look for the cervical lymph node metastasis. In histopathology, cervical lymph node metastasis was considered the gold standard. SPSS Version 22 was used for data analysis.

Results: The overall mean age was 44.87±14.65 years. The study results showed that among patients, males were 68.3% and 31.7% females were. 59.9% patients were diagnosed with cervical lymph node metastasis by CT scan and 64.7% by histopathology. Sensitivity, Specificity, PPV, NPV, and accuracy were 79.6%, 76.3%, 86.0%, 67.2%, and 79.64% respectively.

Conclusion: When it came to identifying cervical lymph node metastases in patients with carcinoma of oral squamous cells, CT scans demonstrated high sensitivity and diagnostic accuracy.

Keywords: *Computed tomography scan, cervical lymph node metastasis, oral squamous cell carcinoma, histopathological, neck dissection, diagnostic accuracy.*

INTRODUCTION

The most common cancer in the head and neck is oral squamous cell carcinoma (SCC) [1]. More than 50% of patients with oral SCC have neck lymph node metastases at the time of diagnosis, and it is characterized by strong biological activity and regional metastases [2, 3].

One of the most significant prognostic indicators is the condition of the neck lymph nodes [4, 5], and even a single positive neck lymph node reduces the survival rate by half.5 Among patients having OSCC, metastases to the cervical lymph nodes are important indicators of disease-specific survival [6]. Oral SCC has been reported to have a 34-50% cervical lymph node metastatic rate [7].

Computed tomography (CT), ultrasound (US), and magnetic resonance imaging (MRI) are the commonly utilized imaging methods for detecting lymphadenopathy in head and neck tumors [8]. However, because CT scans can reveal nodal morphological characteristics including central necrosis, vascular encasement, and borders, as well as provide better anatomical localization, they are the most often utilized imaging modality [9].

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Email: mailto:ambreenshaikh796@gmail.com
Received: January 25, 2025; Revised: July 12, 2025; Accepted: August 07, 2025
DOI: https://doi.org/10.37184/lnjcc.2789-0112.6.8

With a 73% overall diagnosis accuracy for preoperative staging of oral cavity squamous cell carcinoma, the CT scans are very helpful [10]. When compared to the gold standard, *i.e*., pathological reports, 69.23% sensitivity was observed by Mir Mohammad *et al*. [11] for the CT scan in detecting metastatic cervical lymph nodes. The corresponding diagnostic accuracy, specificity, PPV, and NPV were 38%, 27.02%, 25%, and 71.42%.

According to Qureshi *et al*. [10] study, the CT scan's overall diagnostic accuracy, sensitivity, specificity, negative predictive value, and positive predictive value for detecting cervical lymph node metastases in oral squamous cell carcinoma were 73%, 83%, 61%, 76.3%, and 70.9% respectively, when compared to histopathological analysis following neck dissection.

Numerous studies demonstrate varying diagnostic accuracy, and the majority of them are conducted internationally, with very few conducted locally. The results of this study would assist in establishing the local viewpoint and, given the varying demographic and cultural conditions, address the gap in variable frequencies to some extent.

By using histology as the gold standard, our study aims to compare the diagnostic accuracy of computed tomography scans for the identification of cervical lymph

node metastases in oral squamous cell carcinoma with histological examination following neck dissection. If histology additionally reveals cervical lymph node metastases, the head and neck CT scan will be diagnostically accurate. Since CT scans of the head and neck have a very high sensitivity and specificity, we can come up with a less invasive and more economical method of avoiding neck dissection on patients who show no cervical lymph node metastases. In addition to offering evidence for patients, physicians, and policymakers, this current and trustworthy data would aid in determining the seriousness of the condition and supporting interventional educational initiatives.

MATERIALS AND METHODS

This cross-sectional study was carried out at Liaquat National Hospital & Medical College's Radiology Department in Karachi, over six months (March 29, 2023-September 28, 2023), after ethical approval. Patients aged 18 to 80 years with biopsy-confirmed oral squamous cell carcinoma (SCC) were included in the study. All patients had undergone contrast-enhanced CT scans of the head and neck, followed by surgical removal of the primary tumor along with cervical lymph node dissection. Exclusion criteria included a history or clinical evidence of lymphoma or granulomatous disease.

Using Dr. Lin Naing's calculator, the sample size of the research study, *i.e.*, 167 patients, was estimated based on a sensitivity of 69.23%, specificity of 27.02% [11], and a prevalence of 50%, with a 95% confidence interval and 10% margin of error. The nonprobability consecutive sampling was applied to recruit patients aged.

Informed consent was obtained, and demographic data (name, MR number, age, sex, addiction, and education level) were recorded. CT scans were performed to assess cervical lymph node metastasis, with histopathology as the gold standard. Surgery was conducted by senior registrars or consultants, and radiological outcomes were assessed by senior registrars or consultants in radiology.

Data were analyzed using SPSS Version 22, with the Shapiro-Wilk test for normality. Quantitative data were presented as mean ± SD or median (IQR), while qualitative variables (gender, addiction, education level, lymph node metastasis on CT and histopathology) were analyzed using 2×2 tables to assess diagnostic accuracy, sensitivity, specificity, NPV, and PPV. The effects of modifiers, *i.e.*, addiction, age, education level, and gender, were controlled through stratification followed by post-stratification analysis using 2×2 tables. Chi-square test was applied to compare the two results. P-value less than or equal to 0.05 was considered statistically significant.

RESULTS

Among 167 patients, there were 68.3% male and 31.7% female patients. The overall mean age was 44.87±14.65 years. A total of 10.8% of patients were smokers, 69.5% were addicted to gutka addictive, and 19.8% were addicted to betel nuts. In our study, 59.9% patients were diagnosed with cervical lymph node metastasis by CT scan, and 64.7% as presented in Table **1**.

Table 1: Descriptive statistics of study population (n=167).

Study Population	Frequency (%)
Age Group	
=35 years	45 (27)
36-50 years	67 (40)
>50 years	55 (33)
Cervical Lymph Node Involvement Level	
Level-1a	37 (22.1)
Level-1b	52 (31.1)
Level-2	65 (38.9)
Level-3	13 (7.78)
Site	
Mandible	59 (35.3)
Tongue	40 (23.9)
Lower lip	27 (16.2)
Buccal mucosa	22 (13.2)
Maxilla	19 (11.4)
Cervical LN Metastasis Diagnosed by CT Scan	
Positive	100 (59.9)
Negative	67 (40.1)
Cervical LN Metastasis Diagnosed by Histopathology	
Positive	108 (64.7)
Negative	59 (35.3)

The study results showed that by CT scan, 86 patients were correctly diagnosed positively, *i.e.*, true positive, and

Table 2: Diagnostic accuracy of CT scan with histopathology as gold standard in diagnosis of cervical LN metastasis.

Cervical LN Metastasis By CT Scan	Cervical LN Metastasis by Histopathology n(%)			p-value
	Positive	Negative	Total	
Positive	86 (79.6)	14 (23.7)	**100 (59.8)**	**<0.001***
Negative	22 (20.4)	45 (76.3)	**67 (40.2%)**	
Total	**108 (64.6)**	**59 (35.4)**	**167 (100)**	

Diagnostic Accuracy Parameters				
Sensitivity	**Specificity**	**PPV**	**NPV**	**Accuracy**
79.6%	**76.3%**	**86%**	**67.2%**	**79.64%**

Chi-square/Fisher exact test was applied.
* Significant at 0.05 level.

45 patients were also correctly diagnosed negatively, *i.e.*, true negative. The diagnostic accuracy, sensitivity, specificity, NPV, and PPV were 79.64%, 79.6%, 76.3%, 67.2%, and 86.0%, respectively, as presented in Table **2**.

The site of the primary tumor, the level of involved lymph nodes, and their comparison are demonstrated in **Fig.** (**1**).

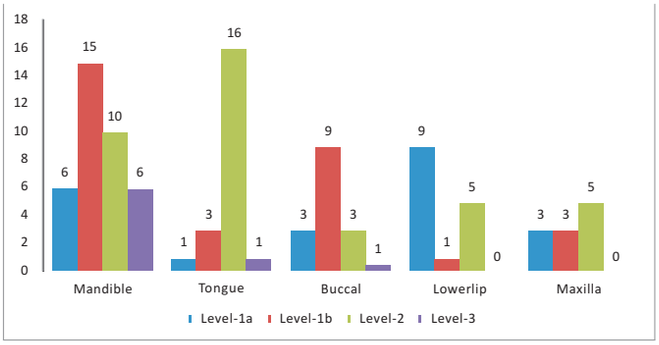

Fig. (1): Levels of cervical lymph node metastasis according to site of involvement.

DISCUSSION

The most common cancer in the oral cavity, OSCC, has become more common in recent years [12-15]. Nearly half of individuals are diagnosed with OSSC between the ages of 45 and 64, and males are more likely than women to receive a diagnosis [16-18]. Accurate diagnosis, including possible lymph node involvement, is essential for effective treatment and good long-term survival, as it is for many other tumor forms [12].

Imaging modalities are used to identify nodal metastases based on the node's size and form, extracapsular tumor dissemination, and internal architectural abnormalities [19]. Strong nodal enhancement, cystic change, calcification, central necrosis, jugulo-digastric and submandibular nodes of more than 1.5 cm, three or more contiguous nodes of 8-15 mm diameters, or a lymph node larger than 1 cm that is not enhancing to the level of the vessels in the neck are all regarded as malignant as demonstrated in **Fig.** (**2**). The most common diagnostic criteria is size, however there are significant differences in the modalities' sensitivity and specificity [20].

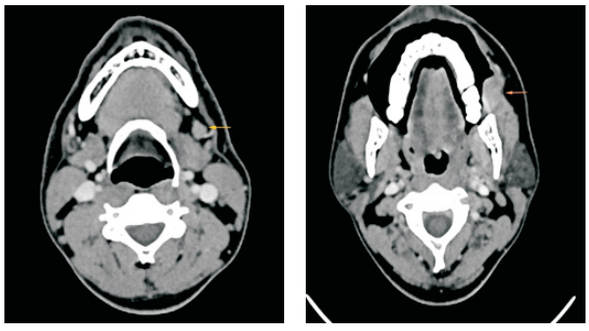

Fig. (2): Contrast-enhanced CT shows left level 1B lymph node with loss of fatty hilum (yellow arrow), likely metastatic. Note the carcinoma (orange arrow) in the left buccal mucosa. Reaching up to the retromolar trigone.

Every diagnostic instrument has its pros and cons. Although ultrasound (US) is a low-cost, non-invasive technique that offers the benefit of US-guided FNAC, it has significant drawbacks, including the inability to distinguish between benign and malignant nodes, the difficulty to reach main tumors, and deep-seated retropharyngeal cervical nodes, which are more common with CT, MRI, and PET-CT scans [21, 22].

A high NPV preoperative method for cervical metastatic node identification is necessary for patient selection. According to one study, a CT scan's 19 NPV of 92.1% is sufficient to maintain it as the primary modality in the preoperative workup. Furthermore, the same study's evaluations of sensitivity, specificity, and diagnostic accuracy indicate CT scans that are comparable to those in other series. According to Pandeshwar *et al*. [20], a CT scan can detect cervical node metastases with 88% accuracy, 92% sensitivity, and 84% specificity.

King *et al*. [23] determined that the CT scan's accuracy, sensitivity, and specificity were 92%, 91%, and 93%, respectively, in another investigation. Merritt *et al*. [24] contrasted the diagnostic precision of physical examination and CT scan. They discovered that CT scans were 83% more accurate than physical examinations, compared to 77%. Furthermore, some people believe that CT scans are more sensitive than other modalities for detecting regional tumor nodal dissemination, and they are even more so than PET and US [22].

There have been observed differences in the diagnosis accuracy of CT scans between studies, which are probably caused by different morphological presentations of sick lymph nodes, mistakes made by people, and insufficient histological and surgical methods [25]. While Yoon *et al*. [26] found 97% accuracy in combining CT, MRI, US, and PET-CT, Eida *et al*. [27] support combining US and CT, but we don't think it will be cost-effective.

Based on CT imaging data, a study conducted by Chung *et al*. created a straightforward 9-point risk rating system for cervical lymph nodes that have spread from head and neck squamous cell carcinoma with excellent prediction performance. By offering objective proof for diagnosis, this 9-point grading method helps to reduce interobserver variability [28, 29].

Observers in another research reported that the system of risk scoring worked well in terms of diagnostic validity, with accuracy (83.3 to 82.1%), specificity (68.3 to 70%), and sensitivity (89.2 to 91.2%). Overall, the findings of the results were positive. Given that they rely on CT data, which have been well confirmed in several studies [30, 31] and are a dependable modality for the detection of metastatic cervical LN, these results are not surprising [28].

In a different research, 43.16% of patients were female, and [32], 54 (56.84%) were male. All of the patients had neck CT scans, which showed 48 True Positives and 4 False Positives. Histologically, all study patients had benign cervical nodes and were also CT-negative patients (True Negative), but four of the 43 patients (False Negative) had malignant cervical nodes (p=0.0001). The multislice CT scan demonstrated an overall diagnostic accuracy of 91.58%, sensitivity of 92.31%, specificity of 90.70%, a negative predictive value of 90.70%, and a positive predictive value of 92.31% when employed to detect cervical lymph node metastases, with histopathology serving as the gold standard.

This study's usefulness is limited by its tiny sample size. Because it was carried out in an urban setting, the findings might not apply to broader groups.

CONCLUSION

The CT scan's great sensitivity and diagnostic accuracy were demonstrated by the study's findings. To identify cervical lymph node metastases in patients with oral squamous cell carcinoma, the CT scan is an accurate, sensitive, non-invasive, and cost-effective technique. Additionally, it helps to enhance patient care by pre-operatively arranging the appropriate therapy for patients, in addition to accurately detecting cervical lymph node metastases in patients with oral squamous cell carcinoma. However, PET/CT is more accurate for nodal assessment due to its metabolic imaging, but it is less cost-effective, so it's used selectively when detailed staging is needed.

ETHICS APPROVAL

This study received an exemption from the Institutional Review Board under approval number: 1007-2024. All procedures involving human participants were conducted following the ethical standards of the institutional and/or national research committee and the Declaration of Helsinki.

CONSENT FOR PUBLICATION

Informed consent was obtained from the participants.

AVAILABILITY OF DATA

The data is available from the corresponding author upon reasonable request.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGEMENTS

Declared none.

AUTHORS' CONTRIBUTION

BR: contributed to the study conception and design, data acquisition, analysis, interpretation, and manuscript writing. SA: was actively involved in manuscript drafting, critical revision for important intellectual content, and coordination of the overall project. AS: contributed significantly to data acquisition, patient follow-up, clinical documentation, data interpretation, and provided substantial input during manuscript revision. MR: performed data analysis, assisted in statistical evaluation, and helped in preparing the results section.

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