RESEARCH

Contrast-enhanced CT and MRI for detecting neck metastasis of oral cancer: comparison between analyses performed by oral and medical radiologists

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Objectives: The aim of the study was to verify the concordance of contrast-enhanced CT (CECT) and MRI evaluation among four radiologists in detecting metastatic cervical lymph nodes of oral cancer patients.

Methods: Ten patients underwent clinical and imaging examinations (CECT and MRI). Four radiologists, two oral and maxillofacial radiologists (OMRs) and two medical radiologists (MRs), independently analysed the images twice. Cohen's kappa index and Wilcoxon signed-rank test were used to verify the concordance between all analyses.

Results: Regarding the interobserver agreement, the OMRs presented excellent kappa values for determining the regional lymph nodes (N-stage) in both CECT and MRI. The MRs presented moderate agreement for CECT evaluation at the first reading, but no concordance was found for the other analyses. When each imaging modality was analysed separately, kappa values were higher between all examiners. Greater variability was demonstrated between N-stage evaluation using different examinations. All radiologists were able to identify a greater number of metastatic lymph nodes in CECT than in MRI, except one MR, but no significant difference was found for all readers. The differences between the number of metastatic lymph nodes among all radiologists were not statistically significant. Moderate intraobserver agreement was observed for CECT and MRI evaluation, except for one MR.

Conclusions: The differences found between the N-stage performed by OMRs and MRs support the necessity of a multidisciplinary approach in the imaging evaluation of metastatic nodes. Further studies are necessary to confirm which imaging modality should be employed when evaluating neck areas.

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Introduction

Oral and pharyngeal cancer is the sixth most common type of cancer in the world.¹ In South America and the Caribbean, cancers of the mouth and pharynx rank fifth in men and sixth in women. In 2010, 14 120 new cases of oral and pharyngeal cancer were expected to occur in Brazil

(10 330 in males and 3 790 in women).² In Brazil, the male population has the third highest risk for oral cancer in the world, behind males in France and India, respectively.³ Specific risk factors have been identified including high tobacco smoking and alcohol drinking prevalence, high intake of charcoal-grilled red meat and mate drinking, a typical South American infused drink. Geographic variations in cancer incidence reflects the different risks; part of this variation may be artefactual on account of differences

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in case definition, incomplete ascertainment and differential access to care and diagnosis.^{4,5}

The most important factor that affects long-term outcome following initial treatment of oral cancer is the stage of disease at the time of presentation. Early staged tumours offer excellent remission rates; however, once regional lymph node metastases have taken place a significant drop in the remission rate is to be expected.⁶

The lymph node staging and localization of pathological lymph nodes are critical for the choice of therapy, either adjuvant or surgical, and are a major factor for prognosis in head and neck cancer patients. The presence of one isolated lymph node metastasis (stage N1) decreases the positive prognosis by 50%, whereas multiple metastases decrease the prognosis even more dramatically. Therefore, the lymph node status is one of the most important predictors of poor prognosis in head and neck tumours.⁷⁻⁹

The critical determinant of the utility of an imaging modality for head and neck cancer is its ability to detect the presence or absence of metastatic neck disease, particularly when it is not otherwise clinically evident.¹⁰ Contrast-enhanced CT (CECT) and MRI are well established in the pre-therapeutic staging of head and neck tumours, allowing the identification of tumour size, infiltration of the vessels and demonstration of cervical metastatic lymph nodes.^{8,11,12} Some authors consider CECT as the first-line examination owing to its high reliability, accessibility and its ability to make an assessment of the upper aero digestive ways at the same time.¹³ Other authors have mentioned that MRI has good accuracy for detecting metastatic cervical lymph nodes.^{14,15} The combination of 18F-fludeoxyglucose positron emission tomography and contrast-enhanced CT (¹⁸F-FDG PET/CT) has been reported to be more accurate for detecting metastatic lymph nodes than CECT and MRI.^{10,16} However, its routine use in population screening for cervical metastases is practically unfeasible owing to the high cost and low availability of the exam in the public services of developing countries.¹³ Moreover, some authors have demonstrated that the diagnostic performance of PET/CT in the local staging of oral cancer was not superior to MRI.¹⁷

Therefore, CECT and MRI remain the most widely used imaging methods in the evaluation of cervical metastasis.¹⁸ As the initial diagnosis of oral cancer is generally performed by dentists and physicians, it is important to compare the evaluation differences between these professionals with different backgrounds.¹⁹ The main purpose of this study was to verify the concordance of CECT and MRI evaluation among two oral and maxillofacial radiologists (OMRs) and two medical radiologists (MRs) in detecting the metastatic cervical lymph node of oral cancer patients.

Materials and methods

Initially, 52 patients with oral squamous cell carcinoma were referred to the Oral Cancer Centre of the

University of Brasilia Hospital between October 2005 and December 2008. The criterion for patient inclusion in the present study was no prior treatment. Patients who were not able to receive intravenous contrast, such as those with multiple myeloma, kidney diseases and allergies, were excluded from the study. Patients who were not able to undergo both imaging examinations (CECT and MRI) were also excluded. The final sample consisted of ten patients who underwent clinical examination, CECT and MRI.

After histopathological confirmation of squamous cell carcinoma of the oral cavity, the patients were invited to participate in the study. The study was approved by the Research Ethics Committee of the Faculty of Health Science, University of Brasilia, Brazil. Written informed consent was obtained from all patients.

Firstly, a head and neck surgeon performed the clinical staging, according to the TNM criteria that describes the extent of the tumour at the primary site (T-stage), at the regional lymph nodes (N-stage) and the presence or absence of distance metastases (M-stage).²⁰ Concomitantly, the patients were referred for imaging examinations (CECT and MRI). Four radiologists, two OMRs and two MRs, with experience of head and neck cancer patients analysed the images separately twice in order to evaluate inter- and intraobserver agreement. All radiologists had at least 4 years' experience with both imaging modalities and they received their coursework and hands-on training in diagnostic radiology at the same hospital.

Contrast-enhanced CT

The patients were examined in a multislice CT Light-speed QX/I (GE, Milwaukee, WI), located at the imaging centre of the university hospital. The region of interest spanned from the base of the skull to the upper mediastinum. Scanning was performed in the axial plane at 120 kVp and 250 mA. Slice thickness was 1.3 mm with a 0.8 s table feed using a display matrix of 512×512. The patients were scanned in the supine position (gantry tilt, 0°). Contrast material enhancement was achieved by intravenous manual administration of non-ionic contrast material (Iopamiron 300; Schering, São Paulo, Brazil). An intravenous dose of 50 ml of the contrast was administered at the start of scanning and an additional 50 ml infusion was performed during the scanning to allow better visualization of the vascular structures.

The criteria for defining a metastatic lymph node in CECT by the four radiologists were based on shape, size, presence of central necrosis and extracapsular spread.^{14,21,22} The delineation of lymph node levels in CECT followed criteria proposed by Som *et al.*²³

Magnetic resonance imaging

Patients underwent MRI with a 1.5 T unit (GE) using the spin-echo technique before and after injection of gadolinium diethylenetriaminepentaacetic acid. T_1 and T_2 -weighted images were acquired in the sagittal, coronal and axial planes. The criteria for defining a

Table 1 Demographic data of studied patients

Case	Gender	Age (years)	Smoker	Alcohol	Clinical TNM	Primary site
1	Female	50	No	No	T2N0M0	Gingiva
2	Male	72	Yes	Yes	T3N0M0	Tongue
3	Male	55	Yes	Yes	T2N1M0	Retromolar region
4	Male	51	Yes	Yes	T4N2M0	Floor of mouth
5	Male	41	Yes	Yes	T4N2M0	Tongue
6	Male	69	Yes	Yes	T4N0M0	Floor of mouth
7	Female	48	Yes	Yes	T1N0M0	Tongue
8	Female	50	Yes	No	T1N0M0	Tongue
9	Male	62	Yes	Yes	T1N0M0	Tongue
10	Male	54	Yes	Yes	T2N2M0	Floor of mouth

metastatic lymph node in MRI were the same as for CECT.^{14,21,22} The level of lymph nodes was also evaluated following the criteria proposed by Som *et al.*²³

At the first and second readings of CECT and MRI, the radiologists revised the aforementioned criteria for diagnosing metastatic lymph nodes. All CECT and MRI images, originally stored on optical disks, were transferred to an independent workstation Satellite (Toshiba, Tokyo, Japan) with eFilm 2.0 software (Merge Technologies, Chicago, IL) for post-processing, analysis and interpretation. All images were analysed on eFilm and the staging based on TNM criteria.²⁰

Statistical methods

The concordance between the clinical and imaging analyses for the lymph node involvement (N-stage), as well as the intra- and interobserver agreement in both CECT and MRI were evaluated using the Cohen's kappa index. The kappa results were interpreted according to the criteria of Landis and Koch:²⁴ 0.81 (very good or excellent), 0.61–0.8 (good or substantial), 0.41–0.60 (moderate), 0.41–0.2 (fair) and <0.2 (poor) agreement. The Wilcoxon signed-rank test was used to verify whether there were differences between the number of metastatic lymph nodes detected by OMRs

and MRs in both CECT and MRI examinations. The Wilcoxon signed-rank test was also used to compare the number of metastatic lymph nodes detected by CECT and MRI in both readings. All analyses were carried out using SPSS for Windows 17.0 (IBM Corporation, formerly SPSS Inc., Armonk, NY). *p*-values <0.05 were considered statistically significant for all statistical tests and a substantial power analysis was assumed for both statistical tests.

Results

The main demographic data of the studied patients, including clinical evaluation of the N-stage, are reported in Table 1. The sample consisted of 7 male patients and 3 female patients with oral squamous cell carcinoma with a median age of 52.5 years (range, 41–72 years). The most common site of a primary tumour was the tongue (50%). Almost all patients (nine) smoked tobacco and eight consumed alcohol. As expected, clinical assessment yielded more negative necks than CECT or MRI. No significant concordance was found between clinical and CECT evaluation of the N-stage for the two OMRs. Figures 1 and 2 show

Figure 1 Two cases of metastatic lymph nodes (white arrows) not clinically detected and detected in contrast-enhanced CT (CECT) and MRI. (a) Two metastatic lymph nodes detected in CECT, one defined by increased size and presence of central necrosis (right side) and the other defined by increased size and round shape (left side). (b) One metastatic lymph node detected in MRI, defined by increased size, round shape and the presence of central necrosis (right side)

Figure 2 Patient with two metastatic lymph nodes with central necrosis detected in both contrast-enhanced CT (a) and MRI (b) (white arrows) but not clinically detected

examples of cases in which metastatic lymph nodes were not detected on clinical examination but were detected on CECT and MRI.

The results of the imaging evaluation of N-stage, performed by the radiologists (OMRs and MRs) at the first and second readings are demonstrated in Tables 2 and 3, respectively. Table 4 shows the concordance of clinical, CECT and MRI evaluation of N-stage between OMRs and MRs at the first reading. The OMRs were in excellent agreement for determining the N-stage as the kappa values were 0.82 and 0.84 for the interpretation of CECT and MRI, respectively. On the other hand, the kappa values for the two MRs revealed fair to

moderate agreement for the MRI and CECT (0.31 and 0.53, respectively). Regarding the interobserver agreement between OMRs and MRs, the kappa values showed great variation in the results. For the CECT evaluation of the N-stage between OMRs and MRs, the concordance varied from poor to substantial. For the MRI evaluation of the N-stage between OMRs and MRs, the concordance varied from fair to perfect.

The results of the second readings are presented in Table 5. When CECT and MRI evaluation were analysed separately, kappa values were higher between the radiologists. However, the medical radiologists did not demonstrate concordance between both CECT and

Table 2 N-stage evaluation in contrast-enhanced CT (CECT) and MRI—first reading. Oral and maxillofacial radiologists (Observers 1 and 2) and medical radiologists (Observers 3 and 4)

Patient	CECT1	CECT2	CECT3	CECT4	MRI1	MRI2	MRI3	MRI4
1	N2	N2	N1	N0	N0	N0	N0	N0
2	N0	N1	N0	N0	N0	N0	N0	N0
3	N2	N2	N2	N2	N1	N0	N0	N1
4	N2	N2	N2	N2	N2	N2	N2	N2
5	N1	N1	N1	N1	N2	N2	N2	N2
6	N1	N1	N1	N1	N0	N0	N0	N1
7	N1	N1	N0	N0	N0	N0	N0	N1
8	N1	N1	N1	N0	N1	N1	N1	N1
9	N2	N2	N2	N0	N2	N2	N2	N2
10	N2	N2	N2	N2	N2	N2	N2	N2

Table 3 N-stage evaluation in contrast-enhanced CT (CECT) and MRI—second reading. Oral and maxillofacial radiologists (Observers 1 and 2) and medical radiologists (Observers 3 and 4)

Patient	CECT1	CECT2	CECT3	CECT4	MRI1	MRI2	MRI3	MRI4
1	N2	N2	N1	N2	N0	N0	N1	N2
2	N0	N0	N0	N0	N0	N0	N0	N0
3	N2	N1	N0	N2	N2	N2	N0	N2
4	N2	N2	N2	N2	N2	N2	N2	N2
5	N1	N1	N1	N2	N2	N2	N2	N2
6	N2	N2	N2	N2	N1	N1	N1	N1
7	N0	N0	N0	N0	N0	N0	N0	N1
8	N1	N1	N2	N1	N1	N1	N2	N1
9	N2	N2	N2	N2	N2	N2	N2	N2
10	N2	N2	N2	N2	N2	N2	N2	N2

Table 4 Concordance of clinical, contrast-enhanced CT (CECT) and MRI evaluation of N-stage between oral and maxillofacial radiologists (OMRs) and medical radiologists (MRs)—first reading

	<i>Clinic</i>	<i>OMRI CECT</i>	<i>OMR2 CECT</i>	<i>MRI CECT</i>	<i>MR2 CECT</i>	<i>OMRI MRI</i>	<i>OMR2 MRI</i>	<i>MRI MRI</i>	<i>MR2 MRI</i>
Clinic		$\kappa = 0.067$ ($p = 0.662$)	$\kappa = 0.067$ ($p = 0.662$)	$\kappa = 0.167$ ($p = 0.340$)	$\kappa = 0.286$ ($p = 0.116$)	$\kappa = 0.677$ ($p = 0.003$) ^a	$\kappa = 0.474$ ($p = 0.056$)	$\kappa = 0.474$ ($p = 0.057$)	$\kappa = 0.189$ ($p = 0.249$)
OMR1 CECT			$\kappa = 0.800$ ($p = 0.010$) ^a	$\kappa = 0.677$ ($p = 0.004$) ^a	$\kappa = 0.180$ ($p = 0.439$)	$\kappa = 0.265$ ($p = 0.173$)	$\kappa = 0.265$ ($p = 0.080$)	$\kappa = 0.296$ ($p = 0.080$)	$\kappa = 0.206$ ($p = 0.359$)
OMR2 CECT				$\kappa = 0.516$ ($p = 0.027$) ^a	$\kappa = 0.048$ ($p = 0.832$)	$\kappa = 0.155$ ($p = 0.359$)	$\kappa = 0.221$ ($p = 0.131$)	$\kappa = 0.155$ ($p = 0.359$)	$\kappa = 0.048$ ($p = 0.832$)
MR1 CECT					$\kappa = 0.531$ ($p = 0.019$) ^a	$\kappa = 0.412$ ($p = 0.047$) ^a	$\kappa = 0.429$ ($p = 0.022$) ^a	$\kappa = 0.429$ ($p = 0.022$) ^a	$\kappa = 0.531$ ($p = 0.019$) ^a
MR2 CECT						$\kappa = 0.394$ ($p = 0.064$)	$\kappa = 0.403$ ($p = 0.042$) ^a	$\kappa = 0.403$ ($p = 0.042$) ^a	$\kappa = 0.697$ ($p = 0.001$) ^a
OMR1 MRI							$\kappa = 0.839$ ($p < 0.001$) ^a	$\kappa = 0.839$ ($p < 0.001$) ^a	$\kappa = 0.286$ ($p = 0.145$)
OMR2 MRI								$\kappa = 1$ ($p < 0.001$) ^a	$\kappa = 0.315$ ($p = 0.068$)
MR1 MRI									$\kappa = 0.315$ ($p = 0.068$)
MR2 MRI									

Clinic, N-stage evaluated by clinical examination; CECT, N-stage evaluated by CECT; MRI, N-stage evaluated by MRI; κ , Cohen's kappa index.^a $p < 0.05$ = concordance statistically significant.**Table 5** Concordance of contrast-enhanced CT (CECT) and MRI evaluation of N-stage between oral and maxillofacial radiologists (OMRs) and medical radiologists (MRs)—second reading

	<i>OMRI CECT</i>	<i>OMR2 CECT</i>	<i>MRI CECT</i>	<i>MR2 CECT</i>	<i>OMRI MRI</i>	<i>OMR2 MRI</i>	<i>MRI MRI</i>	<i>MR2 MRI</i>
OMR1 CECT		$\kappa = 1.000$ ($p < 0.001$) ^a	$\kappa = 0.500$ ($p = 0.027$) ^a	$\kappa = 0.808$ ($p < 0.001$) ^a	$\kappa = 0.500$ ($p = 0.027$) ^a	$\kappa = 0.375$ ($p = 0.081$)	$\kappa = 0.167$ ($p = 0.461$)	$\kappa = 0.464$ ($p = 0.043$) ^a
OMR2 CECT			$\kappa = 0.500$ ($p = 0.027$) ^a	$\kappa = 0.808$ ($p < 0.001$) ^a	$\kappa = 0.500$ ($p = 0.027$) ^a	$\kappa = 0.375$ ($p = 0.081$)	$\kappa = 0.167$ ($p = 0.461$)	$\kappa = 0.464$ ($p = 0.043$) ^a
MR1 CECT				$\kappa = 0.298$ ($p = 0.177$)	$\kappa = 0.194$ ($p = 0.401$)	$\kappa = 0.231$ ($p = 0.299$)	$\kappa = 0.677$ ($p = 0.003$) ^a	$\kappa = 0.016$ ($p = 0.939$)
MR2 CECT					$\kappa = 0.649$ ($p = 0.003$) ^a	$\kappa = 0.524$ ($p = 0.008$) ^a	$\kappa = 0.298$ ($p = 0.177$)	$\kappa = 0.623$ ($p = 0.003$) ^a
OMR1 MRI						$\kappa = 0.846$ ($p < 0.001$) ^a	$\kappa = 0.516$ ($p = 0.025$) ^a	$\kappa = 0.672$ ($p = 0.002$) ^a
OMR2 MRI							$\kappa = 0.538$ ($p = 0.015$) ^a	$\kappa = 0.531$ ($p = 0.012$) ^a
MR1 MRI								$\kappa = 0.344$ ($p = 0.107$)
MR2 MRI								

CECT, N-stage evaluated by CECT; MRI, N-stage evaluated by MRI; κ , Cohen's kappa index.^a $p < 0.05$ = concordance statistically significant.

Table 6 Intra-observer agreement of contrast-enhanced CT (CECT) and MRI evaluation of N-stage (first×second reading)

	CECT	MRI
OMR1	$\kappa = 0.623$ ($p = 0.003$) ^a	$\kappa = 0.688$ ($p = 0.002$) ^a
OMR2	$\kappa = 0.500$ ($p = 0.024$) ^a	$\kappa = 0.697$ ($p = 0.001$) ^a
MR1	$\kappa = 0.545$ ($p = 0.010$) ^a	$\kappa = 0.524$ ($p = 0.020$) ^a
MR2	$\kappa = 0.655$ ($p = 0.002$) ^a	$\kappa = 0.385$ ($p = 0.066$) ^a

MR, medical radiologist; OMR, oral and maxillofacial radiologist; κ , Cohen's kappa index.

^a $p < 0.05$ =concordance statistically significant.

MRI evaluation. Greater variability was demonstrated between N-stage evaluations by different examinations as the kappa values varied from fair to excellent.

The intraobserver agreement for the CECT and MRI evaluation of the N-stage is demonstrated in Table 6 with moderate kappa values except for the MRI N-stage evaluation by the second medical radiologist.

At both readings, all radiologists were able to identify a greater number of metastatic nodes in CECT than in MRI, except one radiologist that found a similar result at the second reading (Figure 3). However, using the Wilcoxon signed-rank test, the difference between the

number of lymph nodes detected on both CECT and MRI was not statistically significant ($p = 0.091$). Figure 4 shows a patient with metastatic lymph nodes identified only on CECT and not on MRI.

The results showed a trend for OMRs to detect more suspected nodes on CECT than MRs (Figure 3). However, the difference between these professionals was not statistically significant for the CECT and MRI ($p = 0.437$ and 0.461 , respectively).

Discussion

To the authors' knowledge, this study is the first to compare the analysis of CECT and MRI performed by OMRs and MRs. In addition, the study also verified intra- and interobserver differences in N-staging evaluation between professionals with different backgrounds. No calibration was performed before analysing the images, since the purpose was to verify exactly how different professionals would evaluate the exams routinely. However, they revised the criteria for diagnosing metastatic lymph nodes. Health professionals involved in the diagnosis of oral cancer (physicians and dentists) should use additional imaging tools to detect cervical metastatic lymph nodes to improve global survival rates.

Figure 3 Number of metastatic lymph nodes detected by the four radiologists [oral and maxillofacial radiologists (OMRs) and medical radiologists (MRs)] in both contrast-enhanced CT (CECT) and MRI

Figure 4 Patient with metastatic lymph node detected only in contrast-enhanced CT (CECT) (a) (white arrow) but not in MRI (b). Note the increased size and the presence of central necrosis in the CECT

CECT and MRI are the most available and, consequently, the preferred technique for imaging metastatic lymph nodes in the head and neck.¹⁸

The two OMRs showed interobserver agreement in N-stage determination with excellent kappa values. The OMRs also identified a greater number of metastatic lymph nodes on CECT compared with the MRs. A previous study has demonstrated that there were differences between different radiologists in determining the N-stage by CECT, but with significant agreement for the T-stage.²⁵ Regarding the medical radiologists, a lower agreement was observed between them. This could be explained by the fact that they are general radiologists because in Brazil head and neck radiology is not usually a subspecialty. Although they have a large experience in reading cancer CECT and MRI examinations, because our hospital is a reference in managing cancer patients, head and neck cancer does not represent the most prevalent kind of tumour. However, the OMRs read all the head and neck cancer examinations referred to our hospital.

Although the difference between the numbers of metastatic lymph nodes detected by OMRs and MRs were not statistically significant, the results showed a trend for OMRs to detect more suspected nodes on CECT than MRs (Figure 3). This could be explained by the fact that OMRs in Brazil usually read more head and neck CT examinations than MRs but MRI has a less frequent usage in dentistry.

The diagnosis of metastatic lymph nodes by CECT and MRI was based mainly on the size and shape of the node, density, extracapsular tumour spread and abnormality of the internal architecture, especially the presence of central necrosis.^{14,20,21} It should be emphasized that the four radiologists did not identify any case with extracapsular tumour spread, although this is an important criterion for the diagnosis of metastatic lymph nodes.²⁶ Lymph node density seems to be another significant predictor in patients with oral cancer.²⁷

The discrepancy found in the diagnosis of metastatic lymph nodes between different radiologists occurred mainly in the case of small size nodes, in which the presence of central necrosis and shape were the main criteria used to consider whether they were metastatic. Some authors have shown that, in cases of squamous cell carcinoma with low-grade differentiation, central nodal necrosis would be difficult to detect on CECT scans.²⁸ Other authors have stated that the size of lymph nodes did not significantly influence the detection capability.²⁹ Some authors have further stated that two major pitfalls in assessing for nodal metastasis by CECT and MRI include misinterpreting benign enlarged, reactive nodes and the inability to detect disease in normal-sized nodes that are not necrotic.¹⁴

The poor reproducibility of the detection of metastatic lymph nodes represents a serious concern as the correct diagnosis of neck metastases might influence the prognosis of oral cancer patients, lowering recurrence and improving survival rates. In line with other authors, there is an obvious need for more reliable imaging parameters that would diminish the risk of occult neck metastasis.³⁰

It is well established in the literature that clinical examination alone is not able to correctly identify cervical metastatic lymph nodes.^{31,32} In the present study, clinical evaluation yielded more negative necks than both CECT and MRI. The detection of clinically occult metastases by imaging modalities might be invaluable, since many patients initially classified clinically with no neck metastases (cN0) have, in fact, occult metastatic disease (pN1), detected by histopathological analysis.^{33,34} However, the lack of a histological proof for N-stage in our study prevents any assessment of possible under- or overestimation in either analysis. Moreover, specificity of imaging modalities is also important because false-positive results can lead to an elective or radical neck dissection, which are associated with increased morbidity and mortality and overshadow the improvement in survival.³⁵

This study was not intended to test the diagnostic performance of CECT and MRI in evaluation of cervical lymphadenopathy but to verify the concordance of imaging N-stage evaluation among radiologists with different backgrounds. Nevertheless, the study has shown that CECT has a tendency to detect more positive lymph nodes than MRI. Further diagnostic studies are necessary to verify which imaging modality is the best to detect neck metastases, comparing different imaging examinations with a representative sample and using histopathological analysis. Future studies should be focused on patients with clinically N0 necks because imaging techniques play an important role in directing treatment for these patients.³⁶ Despite advances in imaging technology, none of the methods have reached 100% accuracy as they are unable to detect the presence of micrometastases in the lymph nodes of clinically N0 necks. Thus, neck dissection with subsequent pathological examination remains the criterion standard for node staging.^{37–39} Diagnostic performance of imaging studies are difficult to compare owing to a variety in study

designs, study populations, imaging modalities and techniques.^{29,36}

In conclusion, the study has found differences between the N-stage performed by OMRs and MRs. However, no significant differences were found between the number of metastatic lymph nodes detected by all radiologists in both CECT and MRI. In addition, OMRs tended to detect more metastatic nodes on CECT than MRs. However, further studies are needed to confirm who is more accurate in evaluating neck areas and which imaging modality should be employed. This study demonstrated that the imaging diagnosis of metastatic lymph nodes is a complex subject, involving different criteria. A multidisciplinary approach from diagnosis through treatment and follow-up is essential for oral squamous cell carcinoma patients and therefore interprofessional collaboration should be encouraged to standardize the evaluation criteria of metastatic lymph nodes. Nevertheless, the development of a more accurate diagnostic method capable of improving the survival rate of patients with oral squamous cell carcinoma is still indispensable.

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