

Study of Malignant Lesions of Oral Cavity and Oropharynx in North East Region of India

SUSHANT AGARWAL, PRADIPTA RAY CHOUDHURY, ABHAMONI BARO, PRABAHITA BARUAH, GAUTAM GOSWAMI, JYOTIRMOY PHOOKAN

ABSTRACT

Introduction: In India, oral cancer represents a major health problem and most of the malignancies arising from the various sub sites of the oral cavity are squamous cell carcinomas. Squamous cell carcinoma occurs mostly in men and is associated with tobacco and alcohol consumption. Certain regions of North East India have the higher cancer incidence rate compared to that of the rest of the country.

Aim: To study diagnosis and staging of malignant lesions of oral cavity and oropharynx with imaging facilities in a tertiary care hospital in North East India.

Materials and Methods: The sample size consisted of 47 patients with biopsy proven squamous cell carcinoma of oral cavity and oropharynx. All the patients were subjected

to clinical evaluation and MR scan. Total 20 patients suspected clinically of having mandibular invasion and were reviewed with both CT and MR scan.

Results: Most common primary site of cancer was buccal mucosa. MRI is more accurate to clinical evaluation for higher tumour stages (T3/T4). The accuracy of CT in the detection of mandibular cortical involvement was 95%.

Conclusion: Imaging along with dynamic maneuver should be made mandatory for evaluation of carcinoma oral cavity and oropharynx. Overestimation of T stage can be seen with MRI because of inadequate distinctions between tumour and edema, and inflammation and normal mucous membrane. Clinical examination, on the other hand, often underestimates the T stage.

Keywords: Imaging, Oral cancer, Squamous cell carcinoma

INTRODUCTION

Oral cancers are one of the leading cancers in India today [1]. According to the most recent GLOBOCAN (Web Portal for International Agency for Research on Cancer) estimates, worldwide in 2012, there were approximately 300,373 new cases of lip/oral cavity cancer and 142,387 new cases of "other pharyngeal" (excluding the nasopharynx) cancer [2]. According to World Health Organization (WHO), the estimated ASR (W) (age-standardised to the world population) for lip/oral cavity and "other pharyngeal" (i.e, excluding the nasopharynx) cancer is highest in South-East Asia region [2].

In India, oral cancer trends vary by region, although investigators estimate that the total number of new mouth cancer cases will increase from 45,859 in 2010 to 64,525 in 2020 [3]. In North-East (NE) India, which comprises of the states Arunachal Pradesh, Assam, Meghalaya, Manipur, Mizoram, Nagaland and Tripura, the incidence of head and neck cancer is reported to be highest in the country (54.48%) [4]. In NE India, oral cavity cancer (16.28%) is the third most

common and it is preceded by oropharyngeal and esophageal cancer among all the head and neck SCC [5,6].

Recent PBCRs: 2012-2014 (Population Based Cancer Registries) by ICMR (Indian Council of Medical Research) reported that cancer of all sites among males, seven NE India registry areas occupied top seven position with AAR (Age Adjusted Rates per 1,00,000) was highest in Aizawl district in Mizoram followed by Papumpare district covered by Naharlagun in Arunachal Pradesh, East Khasi Hills district of Meghalaya and Mizoram state [7]. Among females, cancer of all sites, four registry areas of NE India remained the top and these were: Papumpare district followed by Aizawl district, Kamrup urban district of Assam, and Mizoram state [7].

East Khasi Hills district from Meghalaya had the highest (11.7) of tongue cancer in males in India and same district of Meghalaya had the highest AAR (9.1) of mouth cancer in females [7].

Anatomically, the oral cavity and oropharynx are separate regions that border each other but do not overlap [8].

The anatomic sub sites of the oral cavity include the labial mucosa, buccal mucosa, floor of mouth, alveolar ridge and gingiva, anterior two-thirds of the tongue (anterior to the circumvallate papillae), hard palate, and retromolar trigone [8]. The oropharynx consists of the soft palate, base (or posterior one-third) of tongue, palatine tonsils, palatoglossal folds, valleculae, and posterior pharyngeal wall [8]. Distinct anatomic borders separate the two sites: from above, the junction of the hard and soft palate, and from below, the circumvallate papillae [8].

Many factors like consumption of tobacco and betel nut in its various forms, alcohol, lack of awareness and viruses like human papilloma and epstein barr virus are implicated for causation of head and neck SCC [5,9]. In India, where the habits of chewing tobacco with betel nut, reverse smoking and heavy alcohol usage are common, that is why its incidence is higher [5].

The increasing number of head and neck SCC cases in NE India, is a major cause of concern, as it is associated with high morbidity and mortality in a sizeable population [5,6].

MATERIALS AND METHODS

This prospective study was conducted in the Department of Radiology, Gauhati Medical College & Hospital, Guwahati, India, after due approval of the hospital ethical committee. The study was done between the period of from April 2013 to August 2014.

The sample size consisted of 47 patients with biopsy proven SCC of oral cavity and oropharynx. All the patients, after taking informed written consent, were subjected to clinical evaluation and MR scan. T-stage findings obtained through MRI and clinical examination were compared with postoperative histological examination (HPE) findings considering HPE as gold standard. These findings classified the size and extent of the tumour, according to the Tumor-Node-Metastasis (TNM) system, as well as the number and size (maximum diameter to transverse diameter) of lymph nodes.

Among the 47 patients with SCC of the cavity and oropharynx, 20 patients, suspected clinically of having mandibular invasion and were reviewed with both CT and MR scan.

Exclusion Criteria

- Patients contraindicated for MRI.
- Pregnant patients for CT.
- Patients who had undergone any oral cavity or oropharyngeal surgery before imaging.
- Patients allergic to the contrast agents.
- Patients with recurrence of carcinoma after radiotherapy and chemotherapy.

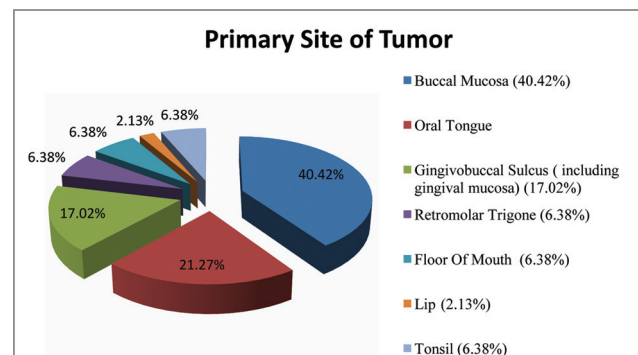
After taking proper history and examination of the patient,

magnetic resonance imaging (MRI) was performed with 1.5 TESLA MR unit- SOMATOM TIM AVATO (MAKE: SIEMENS) and CT evaluation was carried out using a 16 SLICE CT MX16 (MAKE:PHILIPS). Descriptive statistical analysis was carried out in the present study.

RESULTS

Out of 47 patients, 34 (72.34 %) and 13 (27.66%) were male and female respectively.

In the study population, most common primary site of cancer was buccal mucosa (40.42%) [Table/Fig-1,2]. The next

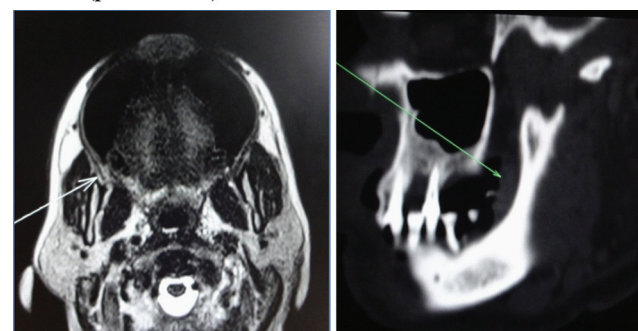


[Table/Fig-1]: Pie diagram showing percentage of malignant cases of oral cavity and oropharynx with primary site of tumours.



(a) Coronal T1W post Gad (puffed cheek)

(b) Axial DWI

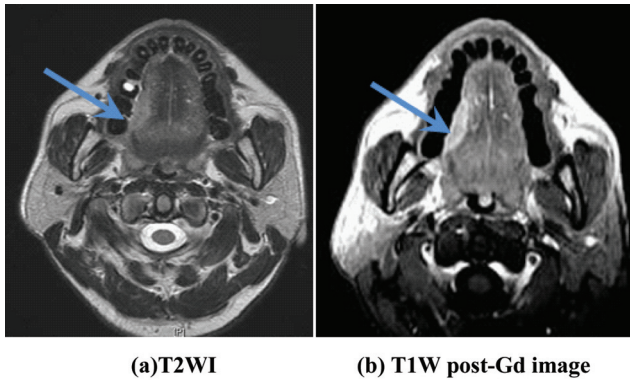


(c) Axial TIWI (puffed cheek)

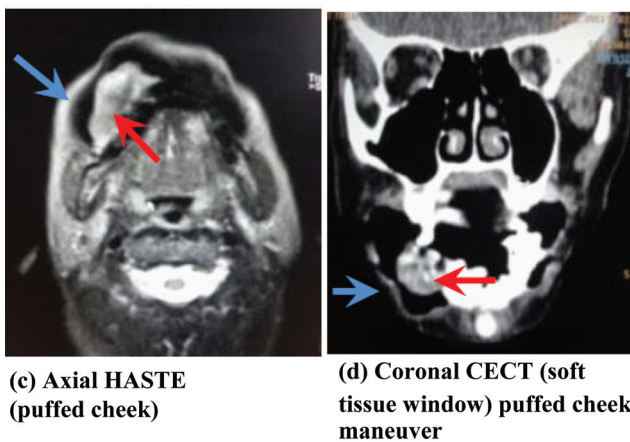
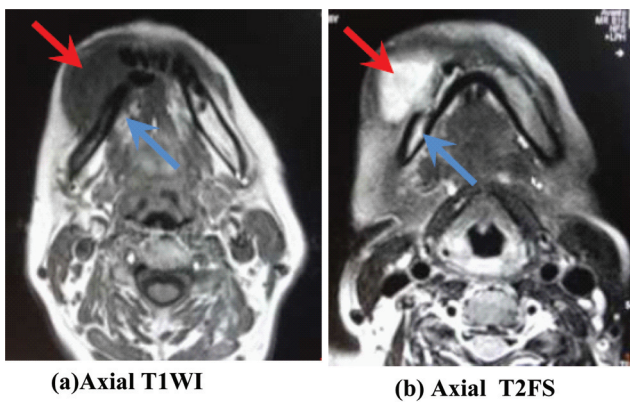
(d) Oblique MPR (bone window) showing intact mandibular cortex

[Table/Fig-2]: Carcinoma buccal mucosa showing enhancing right buccal mucosa (a) with restricted diffusion (b) extending into right retromolar trigone (c) without enlarged nodes (T1 N0). No mandibular involvement noted (d).

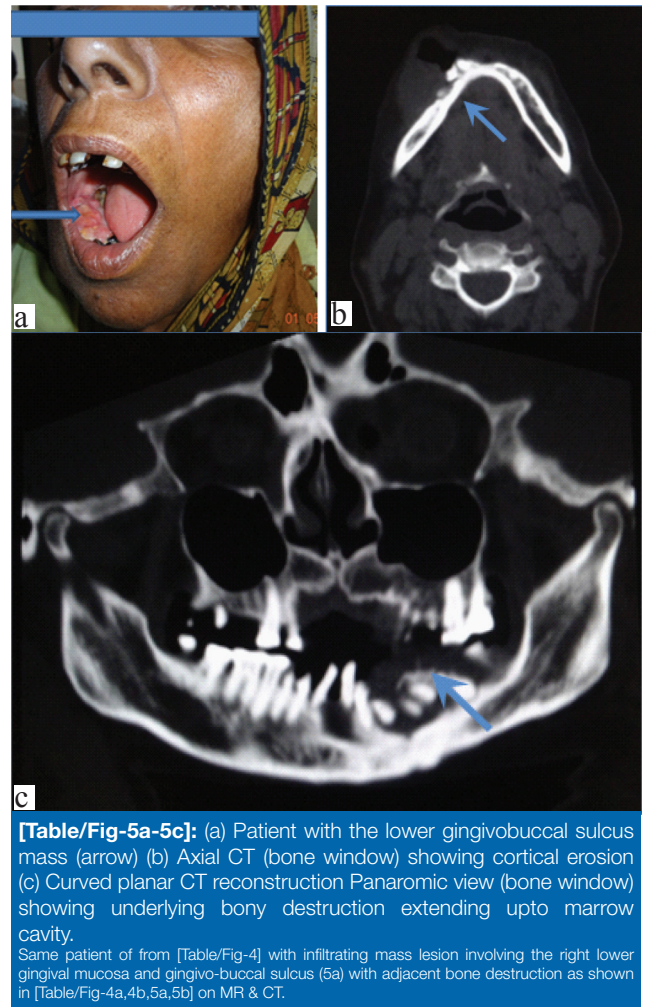
common sites were oral tongue (21%) [Table/Fig-1,3] and gingivobuccal sulcus (17%) [Table/Fig-1,4,5]. In oropharynx



(a)T2WI **(b) T1W post-Gd image**
[Table/Fig-3a,3b]: Showing case of oral tongue carcinoma. Axial T2W image showing lesion in lateral border of right hemitongue (relatively decreased tumour conspicuity without contrast) without any muscle or bony involvement (a). On Post contrast axial T1 W image (b) showing striking enhancement of lesion along the right lateral border of tongue.



(a)Axial T1WI **(b) Axial T2FS**
(c) Axial HASTE (puffed cheek) **(d) Coronal CECT (soft tissue window) puffed cheek maneuver**
[Table/Fig-4a-4d]: Carcinoma lower gingivobuccal sulcus with mandibular involvement (cortical and marrow). Mandibular marrow showing hypointense signal on T1WI and hyperintense signal on T2WI (blue arrow in 4a&4b suggestive of marrow infiltration. Red arrow shows that the lesions is not involving the buccal mucosa (blue arrow in 4c&4d on puffed cheek manoeuvre, indicating the importance of dynamic manoeuvre in head and neck imaging).



[Table/Fig-5a-5c]: (a) Patient with the lower gingivobuccal sulcus mass (arrow) (b) Axial CT (bone window) showing cortical erosion (c) Curved planar CT reconstruction Panaromic view (bone window) showing underlying bony destruction extending upto marrow cavity.

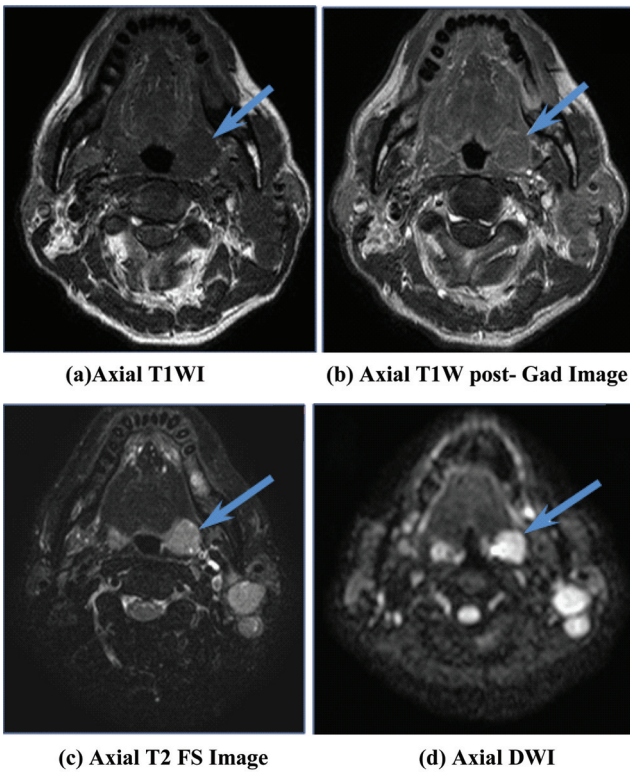
Same patient of from [Table/Fig-4] with infiltrating mass lesion involving the right lower gingival mucosa and gingivo-buccal sulcus (5a) with adjacent bone destruction as shown in [Table/Fig-4a,4b,5a,5b] on MR & CT.

tonsillar mass was detected in 6.38% cases [Table/Fig-1,6]. Other sub-sites of oropharynx like base of tongue were excluded as surgery could not be done as primary treatment.

T Staging by Clinical Evaluation and MRI: Staging obtained by means of clinical examination and MRI were compared to the pathological (HPE) data as shown in [Table/Fig-7-9].

On correlating clinical data with pathological (HPE) findings, down staging was seen in 10 cases and upstaging was seen in 17 cases in T stage evaluation. Four cases were down staged from T2 to T1, three cases were down staged from T3 to T2, two cases were down staged from T4 to T2 and one case was down staged from T4 to T3. Three cases were upstaged from T1 to T2, four cases were upstaged from T2 to T3 and five cases each were upstaged from T2 to T4 and T3 to T4.

On correlating MRI data with pathological findings, three cases each of down staging and up staging was seen in T stage evaluation. One case each was down staged from T2 to T1, T3 to T2 and T4 to T2. On the other hand, one case each was



[Table/Fig-6a-6d]: Case of tonsillar mass. Left tonsillar carcinoma. On all conventional MRI sequences the signal intensity of the infiltrated left tonsil is similar to that of the contralateral uninvolved tonsil, which highlights the difficulty of detecting small tonsil tumours using conventional MRI. However, here there is asymmetry with diffusion restriction and increased ADC (apparent diffusion coefficient) value of $0.93 \times 10^{-3} \text{ mm}^2 \times \text{s}^{-1}$. No involvement of the tongue.

| | Tumours (T) stage of malignant lesions of oral cavity and oropharynx determined by pathological evaluation | | | | | | |
|--|--|----|----|----|----|----|-------|
| | Tumors (T) Stage | T0 | T1 | T2 | T3 | T4 | Total |
| Tumours (T) stage of malignant lesions of oral cavity and oropharynx determined by clinical evaluation | T0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | T1 | 0 | 8 | 3 | 0 | 0 | 11 |
| | T2 | 0 | 4 | 6 | 4 | 5 | 19 |
| | T3 | 0 | 0 | 3 | 1 | 5 | 9 |
| | T4 | 0 | 0 | 2 | 1 | 5 | 8 |
| Total | | 0 | 12 | 14 | 6 | 15 | 47 |

[Table/Fig-7]: Showing both clinical and pathological evaluation of tumors (T) stage of malignant lesions of oral cavity and oropharynx.

upstaged from T0 to T1, T2 to T3 and T2 to T4. The accuracy of MRI seems to be far higher than clinical examination in case of middle-size tumors and larger tumours.

Altogether, 87.23% (41 out of 47) cancer cases with correct T stage were identified by MRI, whereas 42.56% (20 out of 47) cancer cases with correct T stage were identified by clinical

| | Tumours (T) stage of malignant lesions of oral cavity and oropharynx determined by pathological evaluation | | | | | | |
|---|--|----|----|----|----|----|-------|
| | Tumours (T) Stage | T0 | T1 | T2 | T3 | T4 | Total |
| Tumours (T) Stage of malignant lesions of oral cavity and oropharynx determined by MRI Evaluation | T0 | 0 | 1 | 0 | 0 | 0 | 1 |
| | T1 | 0 | 10 | 0 | 0 | 0 | 10 |
| | T2 | 0 | 1 | 12 | 1 | 1 | 15 |
| | T3 | 0 | 0 | 1 | 5 | 0 | 6 |
| | T4 | 0 | 0 | 1 | 0 | 14 | 15 |
| Total | | 0 | 12 | 14 | 6 | 15 | 47 |

[Table/Fig-8]: Showing both MRI and pathological evaluation of T stage of malignant lesions of oral cavity and oropharynx.

| Tumours (T) stage of malignant lesions of oral cavity and oropharynx | Different methods of determination of tumours stage of malignant lesions of oral cavity and oropharynx | | |
|--|---|--|--|
| | Correct identification of tumours (T) stage of malignant lesions of oral cavity and oropharynx determined by clinical examination | Correct identification of tumours (T) stage of malignant lesions of oral cavity and oropharynx determined by MRI | Correct identification of tumours (T) stage of malignant lesions of oral cavity and oropharynx determined by pathological evaluation |
| T1 | 8 | 10 | 12 |
| T2 | 6 | 12 | 14 |
| T3 | 1 | 5 | 6 |
| T4 | 5 | 14 | 15 |
| Total | 20 | 41 | 47 |

[Table/Fig-9]: Number of malignant cases of oral cavity and oropharynx with correct identification of T stage determined by different methods.

examination. Comparison between correct identification of T stage of cancer cases determined by clinical examination and MRI is significant with p-value 0.0390.

Thirteen (65%) of the 20 tumors (clinically suspected to invade the mandible) had histopathologic evidence of mandibular invasion [Table/Fig-10] whereas, the remaining 7 had no evidence of invasion. The primary site of 13 tumors with mandibular invasion was gingivobuccal sulcus in four cases, floor of mouth in two cases, retromolar trigone in two cases, buccal mucosa in two cases, oral tongue in two cases and lip in one case.

Nodal (N) Staging: Number of malignant cases of oral cavity and oropharynx with correct identification of nodal (N) stage determined by different methods is depicted in [Table/Fig-11].

Out of 47 cases, five cases were over staged and 17 cases

| Spread of Tumour | Total no of cases detected on MRI | Total no of cases confirmed on HPE |
|--------------------------|-----------------------------------|------------------------------------|
| Extrinsic tongue muscles | 3 | 4 |
| Intrinsic tongue muscles | 1 | 1 |
| Sublingual space | 2 | 2 |
| Bone | 12 | 13 |
| Total | 18 | 20 |

[Table/Fig-10]: Spread of malignant lesions of oral cavity and oropharynx as detected on MRI and HPE.

were under staged by clinical examination in comparison to HPE.

| N Stage of malignant lesions of oral cavity and oropharynx | Different methods of determination of nodal (N) stage of malignant lesion of oral cavity and oropharynx | | |
|--|---|--|--|
| | Correct identification of N stage of malignant lesions of oral cavity and oropharynx determined by clinical examination | Correct identification of N stage of malignant lesions of oral cavity and oropharynx determined by mri | Correct identification of N stage of malignant lesions of oral cavity and oropharynx determined by pathological evaluation (HPE) |
| N0 | 13 | 15 | 15 |
| N1 | 7 | 18 | 20 |
| N2a | 2 | 5 | 5 |
| N2b | 2 | 2 | 2 |
| N2c | 1 | 4 | 5 |
| Total | 25 (53.19%) | 44 (93.61%) | 47 (100%) |

[Table/Fig-11]: Number of malignant cases of oral cavity and oropharynx with correct identification of N stage determined by different methods.

On comparison of nodal stages by MRI and HPE, MRI correctly identified 44 out of 47 cases in comparison to histopathological examination. Only three cases were changed by HPE. The three cases under staged by MRI were one case of N2a was changed to N2c and two cases of N0 were changed to N1 by HPE.

Overall TNM staging of malignant cases of oral cavity and oropharynx

In comparison with HPE data, the clinical examination over staged the overall stage groupings [Table/Fig-12] in seven cases & under staged overall staging in 19 cases. However, on comparing the overall stage grouping by MRI data and HPE data, MRI over staged only three cases and under staged two cases out of 47 cases [Table/Fig-12].

Thirteen (65%) of the 20 tumors (clinically suspected to invade

| TNM stage of malignant lesions of oral cavity and oropharynx | Different methods of determination of TNM stage of malignant lesions of oral cavity and oropharynx | | |
|--|---|--|---|
| | Correct identification of TNM stage of malignant lesions of oral cavity and oropharynx determined by clinical examination | Correct identification of TNM stage of malignant lesions of oral cavity and oropharynx determined by MRI | Correct identification of TNM stage of malignant lesions of oral cavity and oropharynx determined by Histopathological Evaluation (HPE) |
| 0 | 0 | 0 | 0 |
| I | 6 | 7 | 9 |
| II | 2 | 5 | 6 |
| III | 5 | 13 | 15 |
| Iva | 8 | 16 | 16 |
| IVb | 0 | 1 | 1 |
| IVc | 0 | 0 | 0 |
| Total | 21 (44.68%) | 42 (89.36%) | 47 (100%) |

[Table/Fig-12]: Number of malignant cases of oral cavity and oropharynx with correct identification of TNM stage determined by different methods.

the mandible) had histopathological evidence of mandibular invasion, whereas the remaining seven had no evidence of invasion. The primary site of 13 tumours with mandibular invasion was gingivo-buccal sulcus in four cases, floor of mouth in two cases, retromolar trigone in two cases, buccal mucosa in two cases, oral tongue in two cases and lip in one case. All of these tumors involved or extended to the alveolar crest.

Mandibular Cortical Invasion

Out of 13 tumours with histopathologically (HPE) positive results, 11 were TP with both modalities, remaining two were TP with CT but FN with MRI. The sensitivity of MR imaging and CT was 85% and 100%, respectively and the difference was not significant ($p > 0.05$). On the other hand, out of seven tumors with HPE negative results, five were TN and one was FP with both modalities, remaining one tumour were TN with CT but false-positive with MRI. The specificity of MRI and CT was 71% and 86%, respectively [Table/Fig-13]. Specificity of MRI was lower than that of CT. One of the two tumours in which only MRI showed FP result was anterior floor-of-mouth carcinoma. The misclassification of this one case with MRI seemed to be attributed to chemical shift artifacts induced by bone marrow fat and the black line of the cortex adjacent to the tumour mass was obscured by spatial misplacement of fat. The other FP cases, including one case with only MRI, were attributed to severe periodontal disease or secondary changes from tooth extraction. Such misclassification was

| Mandibular cortical invasion | Number of Cases | | | | Percentage (%) | | | | |
|------------------------------|-----------------|----|----|----|----------------|-------------|-------|------|----------|
| | TP | TN | FP | FN | Sensitivity | Specificity | PPV | NPV | Accuracy |
| MRI | 11 | 5 | 2 | 2 | 84.6 | 71.4 | 84.6 | 71.4 | 80 |
| CT | 13 | 6 | 1 | 0 | 100 | 85.7 | 92.86 | 100 | 95 |

[Table/Fig-13]: Showing diagnostic accuracy of MRI and CT in evaluating mandibular cortical invasion (TP-True Positive, TN-True Negative, FP-False Positive, FN-False Negative, PPV- Positive Predictive Value, NPV-Negative Predictive Value).

| Bone marrow involvement | Number of Cases | | | | Percentage (%) | | | | |
|-------------------------|-----------------|----|----|----|----------------|-------------|-------|------|----------|
| | TP | TN | FP | FN | Sensitivity | Specificity | PPV | NPV | Accuracy |
| MRI | 12 | 7 | 0 | 1 | 92.3 | 100 | 100 | 87.5 | 95 |
| CT | 11 | 6 | 1 | 2 | 84.6 | 85.7 | 91.67 | 75 | 85 |

[Table/Fig-14]: Showing diagnostic accuracy of MRI and CT in evaluating bone marrow involvement.

found in both modalities, though more commonly with MRI than with CT. The accuracy of MRI in the detection of mandibular cortical involvement was 80% while the PPV and NPV predictive values were 85% and 71%, respectively [Table/Fig-13]. The accuracy of CT in the detection of mandibular cortical involvement was 95% while the PPV and NPV values were 93% and 100%, respectively [Table/Fig-13].

Bone Marrow Involvement

The results with CT for bone marrow involvement were lower as those for cortical invasion. With regard to MRI, two of the cases that showed FP results for cortical invasion due to chemical shift artifacts had true-negative results for bone marrow invasion. The specificity of MRI and CT was 100% and 86% [Table/Fig-14], respectively and the difference was not significant ($p > 0.05$). The accuracy of MRI in the detection of marrow involvement was 95% respectively while the PPV and NPV values were 100% and 88% [Table/Fig-14], respectively. The accuracy of CT in the detection of marrow involvement was 85% respectively while the PPV and NPV values were 92% and 75%, respectively [Table/Fig-14].

DISCUSSION

Oral cancer is of significant public health importance to India [10]. SCC is the commonest oral malignant pathology worldwide [11,12], accounting for more than 90% of all oral malignant tumours [13,14].

In the present study, 47 patients from different age groups were included. Bulk of the cases were between 40-75 years [Table/Fig-15] and these age groups matched quite closely with the study of Khandekar SP et al., [15], who found most of the cases in his study to be in the age groups of more than 40 years (88%). Moreover, in the present study, 4th decade (29.79% cases) was the most common age group followed by 5th decade of life (25.52% cases) [Table/Fig-15]. A study by Bhattacharjee A et al., [5] on head neck cancers in NE India, reported that the commonest affected age group was 6th decade (31.13% cases) followed by 4th (22.8% cases) and

| Age Groups (years) | Number of malignant cases of oral cavity and oropharynx | Percentage (%) of malignant cases of oral cavity and oropharynx |
|------------------------|---|---|
| 0-10 | 0 | 0 |
| 11-20 | 0 | 0 |
| 21-30 | 6 | 12.77 |
| 31-40 | 6 | 12.77 |
| 41-50 | 14 | 29.79 |
| 51-60 | 12 | 25.52 |
| 61-70 | 8 | 17.02 |
| 71-80 | 1 | 2.13 |
| Total | 47 | 100 |
| Mean | 5.875 | 12.5 |
| Standard Deviation | ±5.357 | ±11.396 |
| Standard Error of Mean | ±1.894 | ±4.029 |

[Table/Fig-15]: Showing number and percentage of malignant cases of oral cavity and oropharynx with distribution in different age groups.

5th decade (18% cases) [5] of life. Another study in Meghalaya by Shunyu NB et al., [16] found that most common age group was 4th decade especially in case of male patients for oropharynx, oral and hypopharyngeal cancer.

In the present study male patients (72.34 %) outnumbered female (27.66 %) patients and the ratio of male and female cases was 2.6:1. This is consistent with study done by Dikshit R et al., [17] which showed male predominance. Also, according to Bhat SP et al., [18] study, majority (74.3%) were males with a male to female ratio of 3:1.

In the study by Bhat SP et al., [18], buccal mucosa was the commonest site of oral cancer, comprising 27.2% cases, followed by oral tongue (23.7%), tongue base and tonsil (11.8%). In the present study, most common primary site was buccal mucosa (40.43%) followed by oral tongue (21.28%) and gingivobuccal sulcus (17.02%) [Table/Fig-1]. Ahluwalia et al., from Allahabad, also found carcinoma of cheek to be

commonest, representing (55.6%) of cases [19].

In the present study, in T stage evaluation, the accuracy of clinical data was 42.56% [Table/Fig-9] down staging was present in 10 cases and upstaging in 17 cases [Table/Fig-7]. On the other hand, MRI accuracy resulted to be 87.23% [Table/Fig-9] and recorded three cases each of down staging and up staging [Table/Fig-8]. Thus, in the present study, MRI determined an accuracy of 87% which was significantly higher than clinical evaluation. This value was similar to study conducted by Vidiri A et al., [20] who observed a higher T stage accuracy on MRI in compare to clinical examination. They observed an accuracy of 62 % in clinical data and MRI accuracy resulted to be 82%. Heissler E et al., [21] observed accuracy of MRI to be 87% in identifying the T stage, as compared with the histopathologic result.

In the present study decreased accuracy on MRI were attributed to severe dental caries, severe periodontal disease or secondary changes from tooth extraction. It is a well known fact that lifestyle of people of this NE region are quite different from rest of India. A higher addiction for chewing betel nut, betel leaves and areca is noted in this region leading to increase in incidence of oral cancers and periodontal diseases. The present study showed that chemical shift artifact was a possible cause of FP results with MRI and decreased clinical accuracy is likely due to the difficulty in determining the deep extension of the tumour in soft tissue organs, such as the tongue and floor of the mouth, through only inspection and palpation.

The risk of regional nodal spreading of carcinoma of oral cavity and oropharynx are high, as had been already detected in 30 patients in our study. In the present study MR detected nodal metastasis in oral tongue in 70 % and FOM (floor of the mouth) in 67% cases. Most of them involved level II and level I nodes. Trotta et al., [22] who quoted regional metastases of nearly 30-59% in case of carcinoma of floor of mouth and 34 % -65 % in case of oral tongue, there is a slight increase in detection of nodal metastases in the present study. MR reported 2 N1 cases as N0 [Table/Fig-11] which suggests that MR is not a good predictor of micro metastasis.

Direct mandibular involvement by SCC of the oral cavity occurs in two main patterns [23]: erosive and infiltrative. Erosive involvement occurs when cortical bone recedes before a pushing tumour border and there is often a scalloped excavation of underlying medullary bone. In the infiltrative pattern of tumor involvement, cancer diffusely spreads throughout the cancellous, medullary bone. Finally, another, more unusual pattern of mandibular invasion is characterised by neoplastic vascular embolization with cortical integrity [24]. We do not attempt to identify the different types of patterns in pathology or by radiology because bony invasion caused by either type is treated with some form of mandibulectomy at our institution.

In our study the sensitivity of MRI and CT for detecting mandibular invasion was 85% and 100%, respectively but specificity for cortical invasion detected by MRI was 15% less than that by CT, but the difference was not significant ($p>0.05$) The accuracy of CT in the detection of mandibular cortical invasion was slightly higher than MRI. However the sensitivity of MRI and CT for detecting evaluation of bone marrow was 92% and 85% respectively but specificity for bone marrow detected by MRI and CT were 100% and 86% respectively. Thus MRI had 14% more specificity for detection of bone marrow lesions.

Bolzoni et al., [24] found high sensitivity, specificity and accuracy using MRI (93%); the NPV was 87.5% and the negative value was 96%. Imaizumi et al., [25] found a sensitivity of MR and CT for mandibular invasion to be 96 % & 100 % respectively and of sensitivity of MR and CT for marrow involvement to be 81% and 88% respectively, however without any statistical difference.

LIMITATIONS

Limitation of the present study was that a good number of patients who fulfilled the inclusion criteria were imaged but had to be excluded because of long time interval between imaging and surgery.

CONCLUSION

For assessment of bone involvement, soft-tissue infiltration, and depth, MRI is more accurate to clinical evaluation for higher tumour stages (T3/ T4). However, for small superficial tumors, the sensitivity of MRI is equal or slightly higher compared to clinical evaluation. Overestimation of T stage can be seen with MRI because of inadequate distinctions between tumour and edema, inflammation and normal mucous membrane. Clinical examination, on the other hand, often underestimates the T stage. The T2 weighted sequence is the most sensitive sequence for tumour presentation. As opposed to the T2 weighted sequence, the Gd-DTPA (Gadolinium-DTPA) supported T1 weighted sequence allows distinction between edema and tumour. Mandibular cortical bone invasion is best seen on CT. However, the exact extent of the medullary bone invasion is better defined with MR imaging. Dynamic maneuvers should be mandatorily included during imaging.

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FINANCIAL OR OTHER COMPETING INTERESTS:

None.

Date of Online Ahead of Print: **Nov 23, 2016**

Date of Publishing: **Jan 01, 2017**