

Comparative Evaluation of Role of Magnetic Resonance and Computed Tomography Imaging In Oral Cancers and Its Histopathological Correlation

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Abstract

INTRODUCTION: Oral cancer is any malignant neoplasm which is found on the lip, floor of the mouth, cheek lining, gingiva, palate or in the tongue. Oral cancer is among the top three types of cancers in India. In India, 90-95% of the oral cancers is squamous cell carcinoma. Purpose of our study is to detect the Pattern of tumor spread and contribution of CT and MRI in staging of oral cavity malignancy with Histopathological correlation of above radiological findings.

METHODOLOGY: In our prospective study we included 38 patients after proper informed and written consent. In all patients, clinical complaints were recorded along with other relevant demographic data. Each patient underwent CT scan and MRI. Results were correlated with Histopathology. Imaging modalities were used for tumor staging, cervical lymph nodes assessment, bone (mandible) invasion & muscles of tongue invasion.

RESULTS: We have observed that Oral cavity SCC is more common in the age group of 51-60 years, with male to female ratio 1.92. Most common location is buccal mucosa and most common risk factor is tobacco chewing. Well differentiated SCC is most common histological grade. CT scan is less sensitive (65.78%) modality than MRI scan (81.52%) in detection of primary tumor stage; whereas no significant statistical difference is observed in CT and MRI for cervical lymph nodes detection. In detection of mandibular invasion MRI is more sensitive (81.23%) but equally specificity (90.91%) than to CT scan (sensitivity 68.75% & specificity 90.91%). For muscle of tongue invasion MRI is more sensitive and specific (86.67% & 91.30%, respectively) than to CT (sensitivity is 53.42% & specificity is 87.50%).

CONCLUSION: MRI was considered superior to CT scan in evaluating the primary tumor extent and muscle of tongue infiltration with significant statistical difference. CT and MRI are nearly similar in assessing cervical node metastasis. For bone invasion MRI is a superior over CT in our study, but this difference is not significant.

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I. Introduction

Cancers are the most common cause of death in adults. Oral cancer is among the top three types of cancers in India^[1]. According to the Globocan2018 data, the **global incidence** of oral cavity cancer is 354,864 and total mortality is 177,384; in which incidences in male population is 246,420 and in female population 108,444; & mortality in male population is 119,693 and in female population is 57,691. However India has one third of oral cancer cases in the world^[2]. According to globocan2018 data **Indian incidence** have 119,992 new cases (males: 92,011 & females: 27,981), out of which mortality is 72,616. In general, more men suffer and die from oral cancer than women.

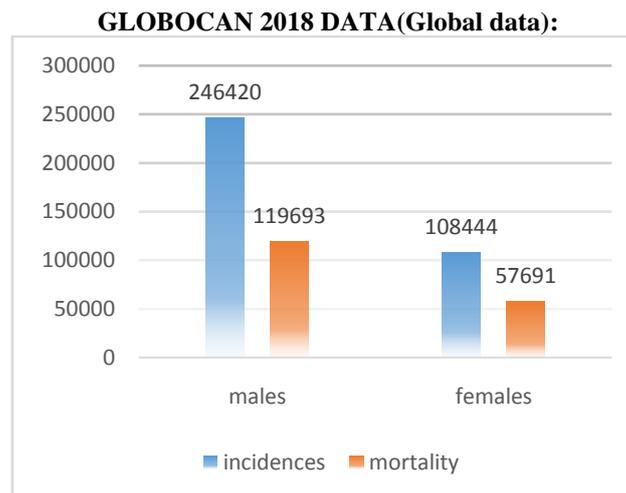


Figure 1: The global incidence of oral cavity cancer and mortality in males and females

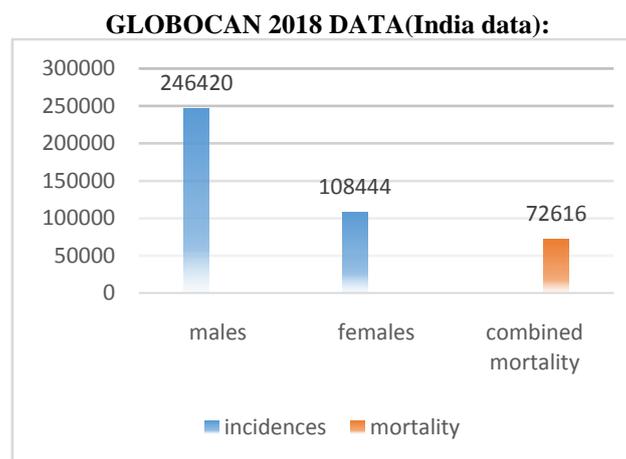


Figure 2: The incidence of oral cavity cancer and mortality in males and females in India

Oral cancer is considered to be a disease which occur in elderly people. However, most of the oral cancer cases occur between ages of 50 to 70 years, but it could also affect children as early as 10 years. Incidence of oral cancer increases by age^[3]. Considering the gender in all the age groups, men are more affected than women. In India, men are two to four times more affected than women due to the changes in the behavioral and lifestyle patterns. Cancer of buccal mucosa is the most common site of oral cancer and the other common site is tongue and gingiva.

A case control study from India demonstrates that oral cancer is interrelated with low income. Low social economic class is interrelated with factors like nutrition, health care, living condition and risk behaviors which contributes to the development of oral cancer^[4]. Mostly it is diagnosed at later stages which result in low treatment outcomes and high costs. Hence the delay is largely associated with advanced stages of oral cancer. Earlier detection of oral cancer offers the best chance for long term survival and has the potential to improve treatment outcomes and make healthcare affordable^[4].

High incidence of oral cancer in India is attributes to a number of etiological factors. Tobacco consumption habit among the patients either as smokeless tobacco ‘GUTAKA’ or smoking, alcohol consumption are the common causes for oral cancer^[5]. Positive family history of oral cancer, viral infections like HPV, poor oral hygiene are the other causes for oral cancer. Also some precancerous conditions are associated with increased incidences of oral cavity tumors eg: Erythroplakia, Leukoplakia (particularly: Erythroleukoplakia, Proliferative verrucous leukoplakia), Actinic cheilitis, Lichen planus etc.

II. Material And Methods

From July 2017 to July 2018, we collected 38 juxta-oral malignant tumor cases, including 17 cases of buccal mucosa carcinoma(CA), 12 cases of tongue CA, 4 cases of retro molar trigone CA, 3 cases of floor of mouth CA and 1 case of hard palate CA and 1 case of lip CA. Out of all cases in our series 25 were men and 13 were women. All the cases aged from 30 to 92 years and the mean age was 56 years old. In all patients, clinical

complaints were recorded along with other relevant demographic data. Each patient underwent CT scan and MRI. Results were correlated with Histopathology. Imaging modalities were used for tumor staging, cervical lymph nodes assessment, bone (mandible) invasion & muscles of tongue invasion.

INCLUSION CRITERIA: All patients with clinically diagnosed oral cavity tumors (oral cavity includes the anterior two thirds of the tongue, the hard palate, the floor of mouth, the buccal mucosa and the gingiva.)

EXCLUSION CRITERIA: Patients with Recurrent/treated tumors, oropharynx and hypo pharynx tumors, severely debilitated patient with renal impairment and Allergic to contrast media.

The CT examinations in our cases were performed with CT scanner after 100 ml contrast medium IV injection. The scanning planes included axial scan with 4mm-slice thickness for oral cavity from skull base to hyoid bone and 8mm-slice thickness for neck. The coronal scan was also performed with 4mm-slice thickness in some cases. Both soft tissue and bone window setting were displayed for evaluation of soft tissue extension and bony invasion.

The MRI of oral cavity was performed with 1.5T MRI scanner (PHILLIPS ACHEIVA) superconductive whole body MR scanner.

The CT and MRI imaging data were evaluated for the tumor border delineation, cervical lymph nodal status, bony invasion and floor of tongue muscles. The T-staging of CT and MRI were recorded according to American Joint Committee on Cancer (AJCC-8) criteria. After imaging study, the patients received operation for tumor resection. The pathological T-staging was also recorded according to the pathological findings under AJCCcriteria.

Statistical analysis: Descriptive and Inferential statistical analysis has been carried out in the present study using computer software (SPSS Trial version 23 and primer). The qualitative data were expressed in proportion and percentages, and the quantitative data expressed as mean and standard deviations. The difference in proportion was analyzed by using chi square test. Significance level for tests were determined as 95% ($P < 0.05$). The diagnostic accuracy, sensitivity, and specificity of the various imaging modalities were calculated.

III. Results

In our study, we have observed that Oral cavity SCC is most common in the age group of 51-60 years with 11 patients (28.94%) and age distribution is from minimum age 29 years and maximum age 92 years, with male to female ratio 1.92. Most common location for malignant lesion in oral cavity is buccal mucosa in 17 patients (44.73%) and most common risk factor is tobacco chewing in 31 patients (81.57%). Well differentiated SCC is most common histological grade.

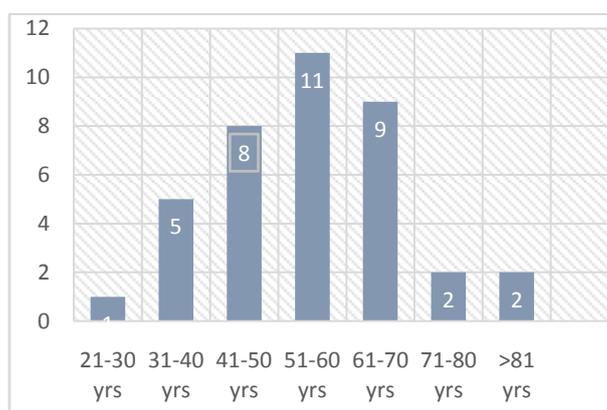


Figure 3: Bar chart showing age distribution of patients in our study

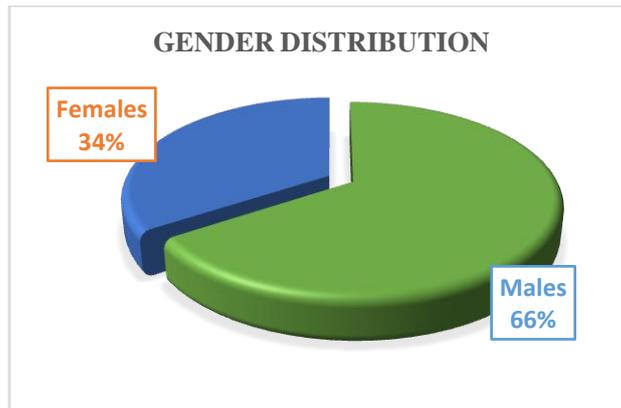


Figure 4: Pie chart showing gender distribution of patients in our study

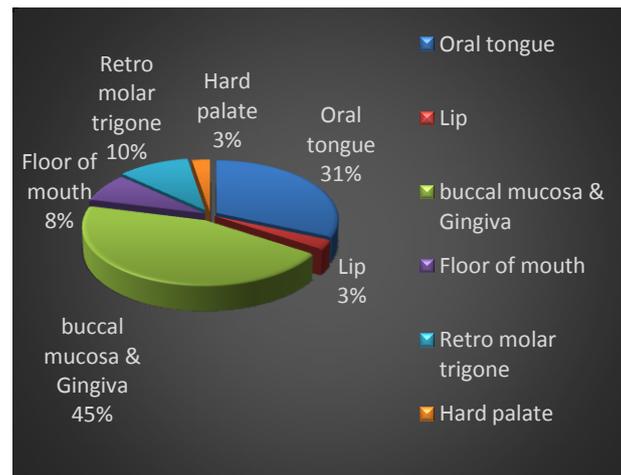


Figure 5: Pie chart showing location of oral cavity tumours in our study

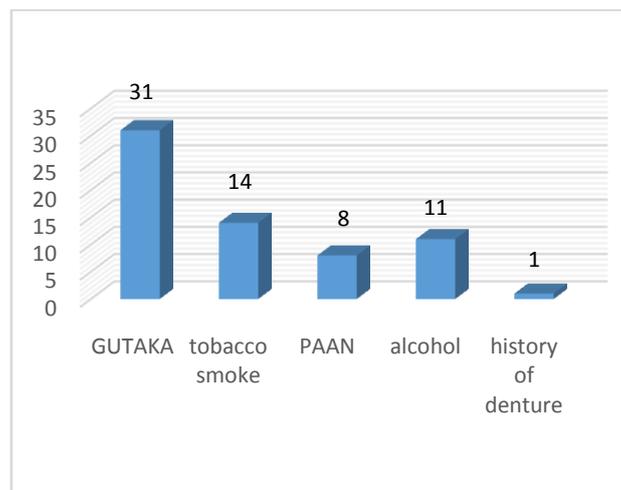


Figure 6: Bar chart showing risk factors of patients in our study

Tumor staging (T stage)

In our study, CT scan correctly identified 25 out of 38 primaries i.e. 66.10% while attaining 13 FN cases, giving a sensitivity of 66.10 %, PPV is 100% and accuracy is 66.10%. Whereas, MRI scans correctly identified 31 out of 38 primary tumors, while producing 7 false negatives cases, giving a sensitivity of 81.5%, PPV is 100% and accuracy is 81.5%. This data is statistically significant (p value=0.038) making CT scan less sensitive modality than MRI scan in detection of primary tumor stage.

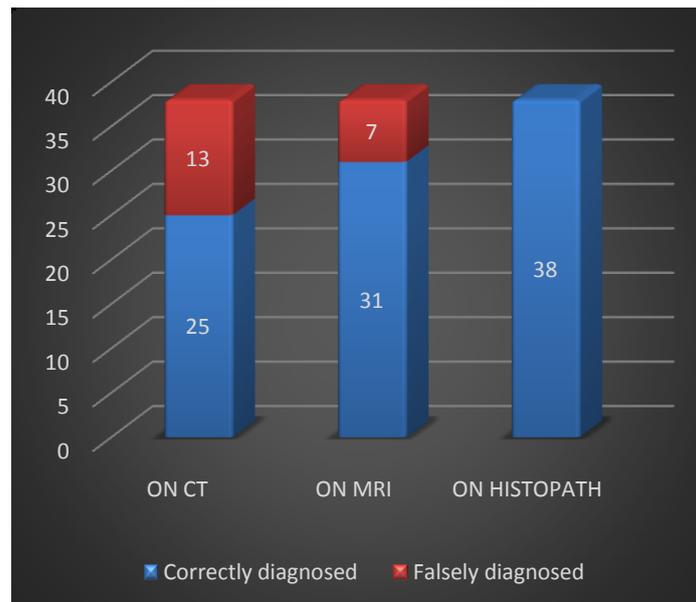


Figure7: Bar chart showing correctly identified T staging on CT and MRI scan with respect to histopathological data

Cervical lymph node metastasis

On post op. histopathological data 47.4% of patients showed positive neck nodes (n = 18). The CT predicted positive neck nodes in 15 cases that included 12 TP cases and 3 FP cases. The CT predicted no neck nodes in 23 cases in which 17 are TP whereas 6 is FN. The sensitivity for MRI predicted is 66.67%, specificity is 85.01%, PPV is 80.00%, NPV is 73.91% and accuracy is 76.32%. Whereas, MRI predicted positive neck nodes in 17 cases that included 14 true positive cases and 3 false positive cases. The MRI predicted no neck nodes in 21 cases in which 17 are true negatives whereas 4 is false negative. The sensitivity for MRI predicted was 77.8%, specificity is 85.01%, PPV is 82.35%, NPV is 80.95% and accuracy is 81.52%. Chi square equals 0.216 with 1 degrees of freedom, P value equals 0.3211. The association is considered to be statistically not significant ($P < 0.05$).

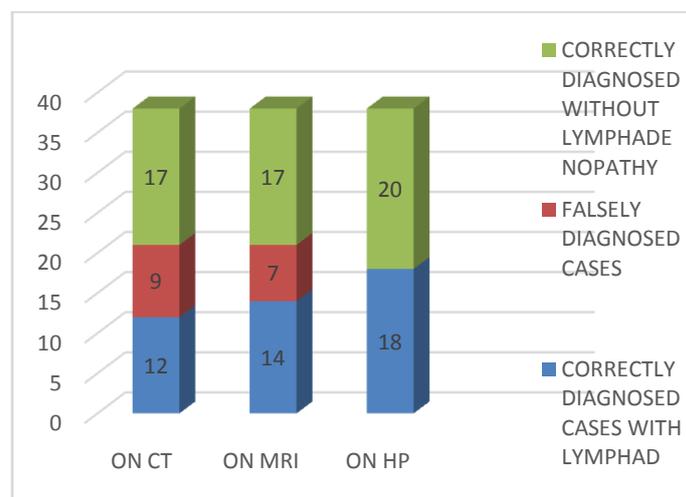


Figure8: Bar chart showing correctly identified N staging on CT and MRI scan with respect to h/p

Regional bony invasion

The CT predicted bony invasion in 13 patients that included 11 were TP cases and 2 were FP cases. The CT scan predicted no bony invasion in 25 cases in which 20 were TN whereas 5 were FN. The sensitivity for CT scan in bony invasion by juxta-oral malignant tumors was 68.75%, specificity was 90.91%, PPV is 84.62%, NPV is 80.00% and accuracy is 81.58%. MRI predicted bony invasion in 15 patients that included 13 true positive cases and 2 false positive cases. The MRI predicted no bony invasion in 23 cases in which 20 are TN whereas 3 is FN. The sensitivity for MRI predicted bony invasion by juxta-oral malignant tumors was

81.25%, specificity was 90.91%, PPV is 86.67%, NPV is 86.96% and accuracy is 86.84%. Chi squared equals 0.226 with 1 degrees of freedom. The one-tailed P value equals 0.3172 is considered to be not statistically significant.

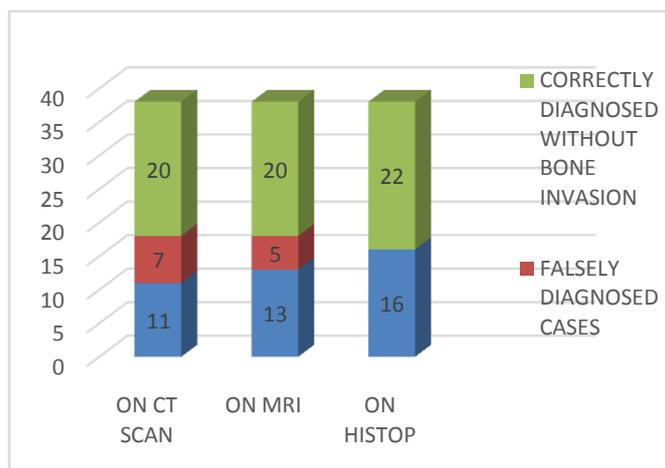


Figure 9: Bar chart showing correctly diagnosed regional bony invasion noted on CT and MRI scan with respect to histopathology

Muscles of tongue invasion

The CT predicted muscles of tongue invasion in 11 cases that included 9 true positive cases and 2 false positive cases. The CT scan predicted no muscle of tongue invasion in 27 cases in which 19 were true negatives whereas 8 were false negative. The sensitivity for CT scan predicted muscles of tongue invasion by juxta-oral malignant tumors is 53.42%, specificity is 87.50%, PPV is 81.82%, NPV is 70.37% and accuracy is 73.68%. MRI predicted muscles of tongue invasion in 15 cases that included 13 true positive cases and 2 false positive cases. The MRI predicted no muscles of tongue invasion in 23 cases in which 21 are true negatives whereas 2 is false negative. The sensitivity for MRI predicted muscles of tongue invasion by juxta-oral malignant tumors is 86.67%, specificity is 91.30%, PPV is 86.67%, NPV is 91.30% and accuracy is 89.47%. Chi squared equals 2.732 with 1 degrees of freedom, one-tailed P value equals 0.0492 is considered to be statistically significant i.e. p value < 0.05%.

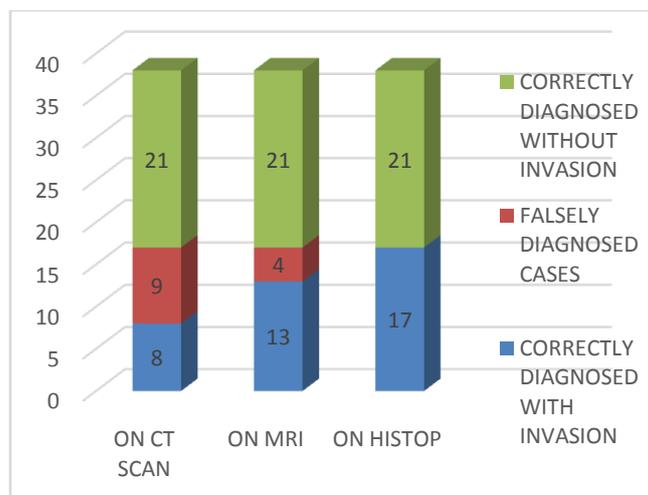


Figure 10: Bar chart showing correctly diagnosed muscles of tongue invasion noted on CT and MRI scan with respect to histopathology

IV. Discussion

In present study, the study group is divided into seven age groups with minimum age was 29 years and maximum age was 92 years. It was observed that maximum 11(29%)patients were in the 51 to 60 years age group while age group 61 to 70 years constituting 9(23.6%) of patients. **Johnson NW et al.**(2011) found that the Oral cancer is usually a disease that occurs in males after the fifth decade of life. The mean age of presentation is in the fifth and sixth decade of life in Asian populations^[6]. **Gangane et al.** (2007), who have reported majority

of the patients with OSCC in the age group of 50 to 59 years in their study^[7]. Although it is well-known that oral cancer is more prevalent in older age groups, but there is a recent trend of rising incidence of oral cancer in younger patients^[8,9].

In 25(65.7%) of patients were male and 13(34.3%) of patients were females i.e. male-to-female ratio 1.92:1. **Iype et al.** reported male-to-female ratio of (2.3:1)^[10]. **Khandekar SP et al.** (2006) have reported 49(61.25%) of the subjects were male while 31 (38.75%) were females with male-to-female ratio (1.6:1)^[11]. A high proportion of cases among males may be due to the high prevalence of tobacco consumption habits among males. Moreover, tobacco is consumed in both chewing and smoking form in males predominantly in low socioeconomic groups, whereas in our society, less females indulged in tobacco smoking^[9].

In 17 (45%) patients malignant lesions were located to buccal mucosa & gingiva and in 12 (31%) patients lesions were of tongue. **Khandekar et al.** reported that buccal mucosa and alveolus was the most common site of oral cancer^[8]. **Kandath S et al.** (2017) reported the most common site observed was buccal mucosa (41%) followed by lower alveolus (21%)^[12]. The most common sites of OSCC were buccal mucosa and GBS followed by alveolus, and the findings are consistent with other studies^[6,12,13]. The tongue is considered as the most common site of occurrence of primary OSCCs in the developed countries, but in the developing countries, betel quid and/or tobacco chewing more commonly results in cancer of the buccal mucosa.^[14,15] This is mainly because of prolonged placement of the betel quid in the buccal pouch to obtain a maximum effect as the constituents of betel quid produce a sense of well-being and increased capacity to work by stimulation of parasympathetic nervous system.^[15]

Most common risk factor is tobacco chewing 'Gutaka' in 31(81.6%) patients followed by tobacco smoke in 14 (37%) patients. **Chi AC et al.** found that tobacco consumption is a major risk factor for oral and oro-pharyngeal SCC^[14]. **Krishna A et al.** found that there is a strong association between the use of smokeless tobacco and the risk of development of OSCC^[16].

For **primary tumour staging**, MRI scans correctly identified 31 out of 38 patients giving a sensitivity of 81.5%. whereas CT scan correctly identified 25 out of 38 patients, giving a sensitivity of 65.78%, making CT scanning less sensitive than MRI scanning in correctly identifying primary tumor of oral cavity. **Boottz F. et al** had studied 174 CT scans and 32 MRI examinations of oropharynx & mouth carcinoma and he concluded that MRI is superior to CT in delineating tumor margins in 78% of patients. The T-staging based on clinical & CT findings was changed in only 5% of cases by MRI and the MRI is useful in T1-staged tongue base carcinoma. MRI rather than CT should be used when dental fillings obscure the region of interest^[17]. **El Kininy W et al.** in their study of 54 patients noted that MRI scans correctly identified 37/54 primary tumors, giving a sensitivity of 69%. CT scanning correctly identified 25/54 primaries, giving a sensitivity of 46%, making CT scanning less sensitive than MRI scanning in identifying primary tumors^[18].

Although, it is often difficult to differentiate metastatic from non-metastatic **reactive nodes** from CT and MR imaging, because the diagnosis of metastatic nodes is mainly based on measurement of nodal size. There have been many different size criteria for metastatic nodes with CT and MR imaging^[9,11]. Some authors consider any node greater than 10 mm as abnormal^[19]. Whereas, other investigators give different values according to the location of lymph nodes. Other criteria used in the interpretation of CT and MR for staging lymph nodes include the presence of central necrosis, indistinct nodal margins, and more than one lymph node specially conglomerated. In our study, on postoperative histopathological data 47.4% of patients showed positive neck nodes (n = 18). The sensitivity for MRI predicted was 77.78%, and the specificity was 85.1%. The sensitivity for CT predicted was 66.67%, and the specificity was 85.00% however this difference is non-significant (p value is not <0.05). **Weiner et al.** reported that detection of cervical lymph nodes involvement was similar for CT and MRI. In their study sensitivity and specificity of CT scan for cervical lymphadenopathy were 84.2% and 63.6% whereas for MRI sensitivity and specificity were 78.9% and 75.7% respectively^[20]. However both of these modalities were failed to detect small nodal metastasis. **El Kininy W1 et al.** reported that With regards to neck (nodal) disease/metastases, histology was only available for 34 of the 54 subjects, who underwent bilateral neck dissections. Of these 34 cases histology confirmed the presence of positive nodal disease in 19 of them. MRI scanning correctly identified 14 of 19 true positive nodal disease cases. This gives MRI scanning a sensitivity of 74%. CT scanning identified positive nodes in 12 of 19 cases, producing a sensitivity of 63%.^[18]

In present study, the sensitivity for MRI predicted bony invasion by juxta-oral malignant tumors was 81.23%, specificity was 90.91%, PPV is 86.67%, NPV is 86.96% and accuracy is 86.84%. The sensitivity for CT scan in bony invasion by juxta-oral malignant tumors was 68.75% specificity was 90.91%, PPV is 84.62%, NPV is 80.00% and accuracy is 81.58%. However this difference is non-significant (p value is not <0.05). **Koopai M. et al.** (n = 30) in their study noted that sensitivity and specificity of CT scan was 50.00% and 85.00% and for MRI sensitivity and specificity was 90.00% and 85.00%^[21]. **Wiener et al.** reported that for CT scan sensitivity, specificity, Positive predictive value and Negative predictive value for bone invasion were

71.4%, 95.5%, 71.2% & 95.5% respectively and for MRI sensitivity, specificity, Positive predictive value and Negative predictive value for bone invasion were 100%, 93%, 69.90% & 100% respectively^[20].

In our study, The sensitivity for CT scan predicted **muscles of tongue invasion** by juxta-oral malignant tumors is 53.42%, specificity is 87.50%, PPV is 81.82%, NPV is 70.37% and accuracy is 73.68%. The sensitivity for MRI predicted muscles of tongue invasion by juxta-oral malignant tumors is 86.67%, specificity is 91.30%, PPV is 86.67%, NPV is 91.30% and accuracy is 89.47%. This difference is statistically significant p value <0.05. **Wiener et al.**(2006) found sensitivity and specificity of CT scan for muscle of tongue invasion was 72.7% and 61% respectively whereas, for MRI sensitivity and specificity was 81.8% and 63.4% respectively (n = 52)^[20].

V. Conclusion

Oral cavity malignancy is among the commonest cancer in India. As the management is almost entirely dependent on stage of the disease, there is a need for reliable and accurate method for staging of the disease and thus for planning treatment. Radiological imaging serves as the ideal solution for staging of oral cavity malignancy.

Here it was concluded from our study that MRI was considered superior to CT scan in evaluating the primary tumor extent and muscle of tongue infiltration with significant statistical difference. CT and MRI are nearly similar in assessing cervical node metastasis. For bone invasion MRI is a superior over CT in our study, but this difference is not significant.

CASE: 1

30yrs old male patient came with complaints with left side cheek swelling since 12 months with neck swelling since 4 months.

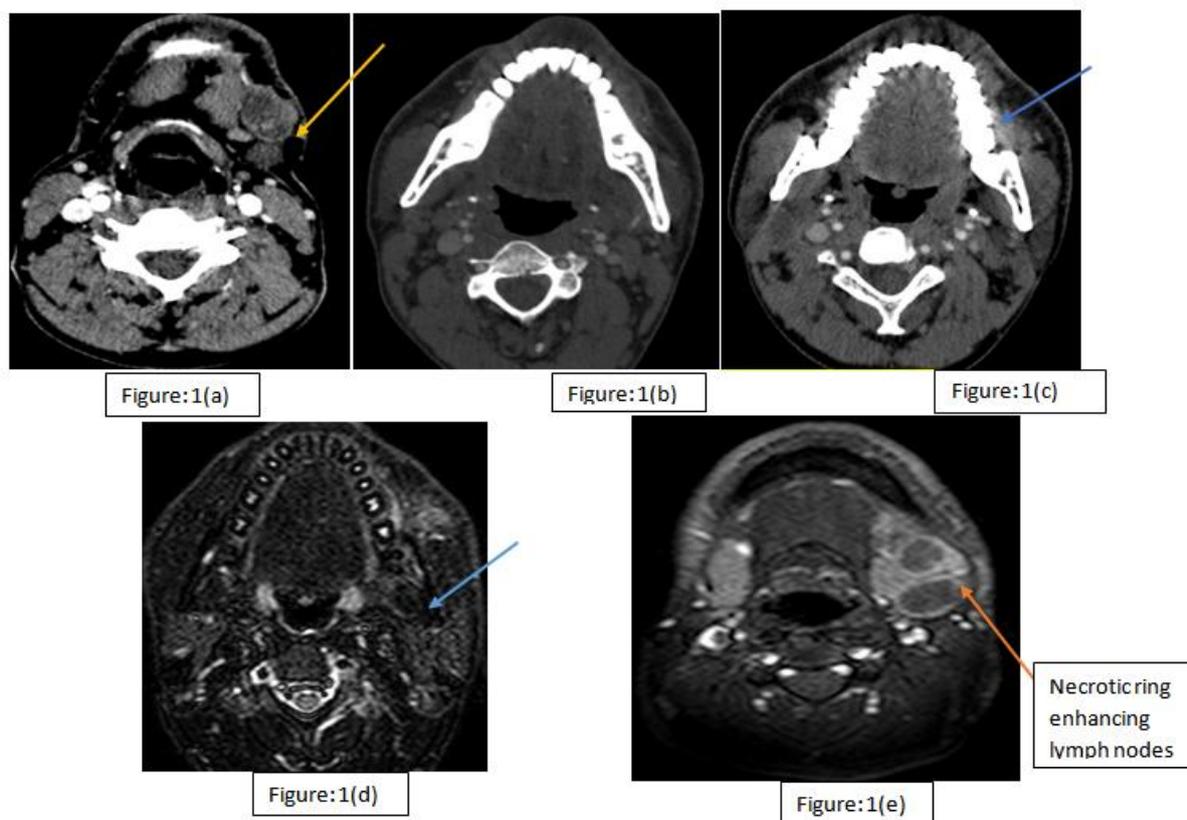


Figure: 1. 30 yrs. Old, male patient with buccal mucosal mass lesion left side, on CT no bone invasion seen and on MRI bone invasion is present which is further confirmed on HPE.

- (a) & (b). Axial CECT image showing left buccal mucosal mass lesion arrow in (a), On bone window no any bone cortex breach seen(b).
(c). Axial CECT image showing few internal necrotic lymph nodes in ipsilateral submental region, arrow in (c).
(d). Axial STIR image in same patient showing hyperintense mass lesion, arrow in (d) with mandibular hyperintensity seen s/o bone invasion.

(e). Axial T1+C fat sat image showing necrotic lymph nodes in ipsilateral submental region with peripheral rim enhancement.

On HPE, mandible invasion is present with well differentiated squamous cell carcinoma.

CASE: 2

61-year-old female with poorly differentiated squamous cell carcinoma of the floor of mouth.

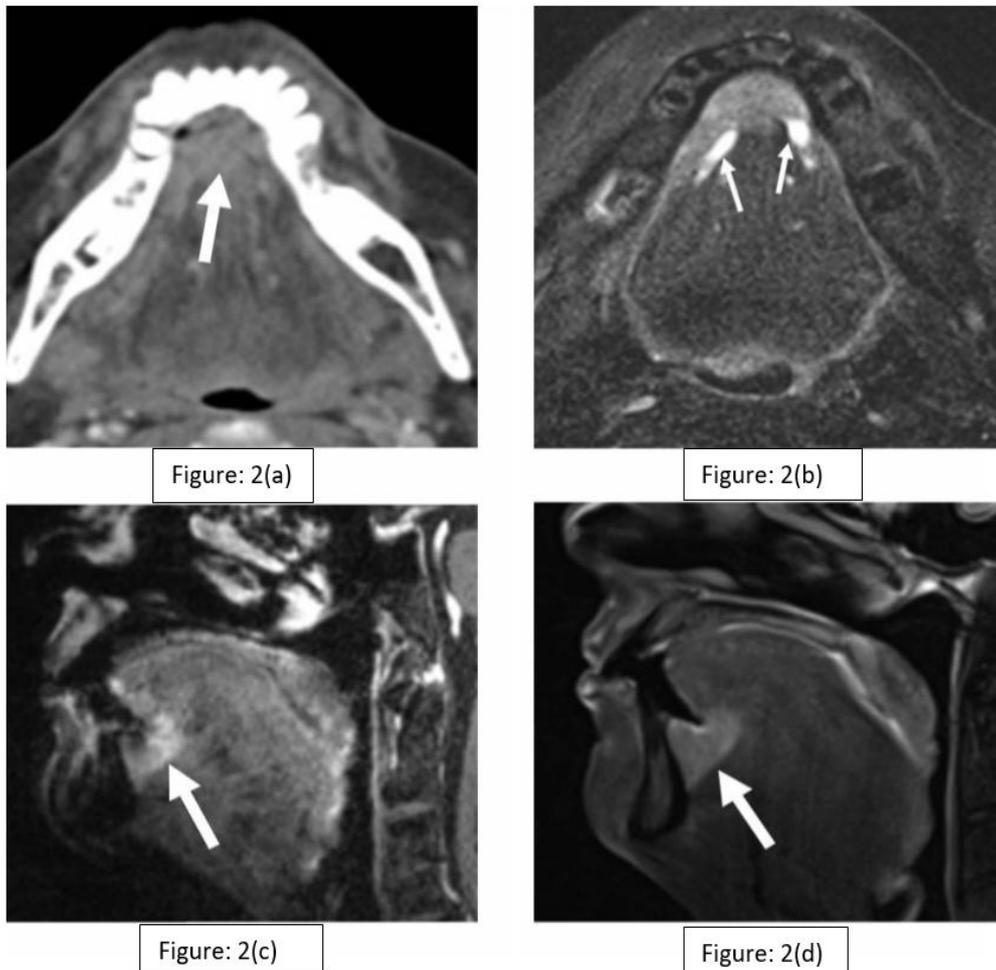


Figure 2. 61-year-old female with poorly differentiated squamous cell carcinoma of the floor of mouth.

(a) Initial evaluation by contrast-enhanced CT at the level of the mandibular alveolus demonstrated an ill-defined hyperdense mass (arrow) in the anterior floor of mouth.

(b) Further characterisation with axial T2 MRI at the same level demonstrates a well-defined T2 hyperintense mass in the anterior floor of mouth extending posteriorly to involve the genioglossus muscle. The mass obstructs the submandibular ducts bilaterally (small arrows).

(c) Sagittal gadolinium-enhanced T1 and

(d) fat-suppressed T2 weighted MRIs demonstrate the full extent of the anterior floor of mouth lesion (arrows), which is seen to involve the anterior fibres of the genioglossus muscle and the ventral surface of the tongue. This necessitates more complex resection and reconstructive surgery. On HPE, mass is diagnosed as well differentiated squamous cell carcinoma.

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