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Correlating MRI and histological tumor thickness in the assessment of tongue cancer

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ABSTRACT

Objective: Tumor thickness in tongue cancer is an important independent prognostic factor for local recurrence, nodal metastasis, and patient survival. An accurate preoperative assessment of tumor thickness is therefore essential for optimal treatment planning. The aim of our study was to evaluate the accuracy of MRI findings for the preoperative measurement of tumor thickness. **Subjects and methods**: Thirty six patients with oral tongue cancer underwent preoperative MRI of the tongue. After surgery, the glossectomy specimens were serially sectioned. The radiologic tumor thickness of contrast-enhanced T1-weighted and T2-weighted images was compared with the histologic tumor thickness using our proposed tumor thickness staging classifications. These included stage I (tumor ≤ 3 mm), stage II (> 3 mm but ≤ 9 mm) and stage III (> 9 mm).**Results:** The overall accuracy in assessment of proposed tumor thickness staging using contrast-enhanced T1-weighted and T2-weighted images was 83.33% and 61.11%, respectively. The radiologic tumor thickness as measured on contrast-enhanced T1-weighted and T2-weighted images had significant correlation with histologic tumor thickness (R = 0.980 and 0.985, respectively).**Conclusion:** MR images provide satisfactory accuracy for the measurement of tumor thickness and staging of tongue cancer. Preoperative MRI is recommended to assist in treatment planning for patients with this disease.

Key words: MRI, tongue, thickness

INTRODUCTION

Most common type of tongue cancer is squamous cell cancer. Imaging for Tongue cancer requires a modality with superior soft tissue characterization and hence MRI is the optimal modality displaying exquisite anatomical detail including intrinsic and extrinsic muscle, floor of mouth and the lingual vascular bundle. Tumor thickness is a significant independent prognostic factor in predicting subclinical nodal metastasis, local recurrence, and patient survival in oral tongue cancer, among other parameters such as the diameter, width, length, area, and volume of the tumor. The involvement of tongue cancer of the mucosal epithelium, lamina propria, and muscles is clearly depicted on MRI, thereby making measurement of the thickness of the tongue carcinoma possible. However, the accuracy of such measurement is not well defined. adjuvant therapy.[4,6,8]

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One of the primary predictor of nodal metastases and determinant of prognosis is tumor depth of invasion, therefore it is important to determine the extent of tumor depth of invasion pre-operatively.

MATERIAL AND METHODS

The study was conducted on the patients admitted in the surgery department of LLR Hospital, GSVM Medical College, Kanpur. For our prospective study, we recruited patients with squamous cell carcinoma of the tongue who preoperative MRI followed by gloss-ectomy treatment from January 2018 to October 2019.

Inclusion criteria

- S.C.C. of tongue operable T_1 T_2 T_3

Excluded criteria

- T4 tongue cancer
- Patient already underwent excisional biopsy
- Patients with base of tongue and other oral cavity cancer
- Post radiation tongue cancer
- A horizontal line joining the two tumor–mucosa junctions was be drawn as a reference line. We measured the tumor thickness by drawing perpendicular lines from the reference line to the

point of maximal tumor projection and invasion and then calculated the greatest radiologically determined tumor thickness by adding these two parameters. Each glossectomy specimen was pinned on a foam board during formalin fixation to prevent shrinkage of the tissue.

- The preserved specimen was cut into 3-mm sections in the coronal plane and stained with H and E. The tumor border was outlined, and the image on each slide will be analyzed using a computerized image analyzer. The tumor thickness was assessed in the same way as it was measured on coronal MR images. We drew a horizontal line to connect the two tumor–mucosa junctions and then drew vertical lines perpendicular to the horizontal line to measure the maximal thickness of both exophytic and endophytic parts of the tumor. We then calculated the greatest histo-logically determined tumor thickness by adding these two parameters.
- The tumors was divided into three groups in accordance with the previously proposed staging system for tumor thickness: stage I (tumor ≤ 3 mm), stage II (> 3 mm but ≤ 9 mm), and stage III (> 9 mm). We evaluated both MRI-determined and histologically determined tumor thicknesses.
- Pearson's product-moment correlation analysis was performed on paired data between measurements on MRI (contrast-enhanced T1-weighted spin echo and T2-weighted spin-echo sequences) and histologic sections. Scatterplots of tumor thicknesses from both sources will be obtained and analyzed using the linear regression method with 95% confidence interval.

RESULTS

Total 36 patients were evaluated in the present study entitled "Correlating MRI and histological tumor thickness in assessment of tongue Cancer" which was conducted in the Post-graduate Department of Surgery, LLR Hospital and Associated Hospitals, GSVM Medical College, Kanpur during the period from January 2018 to October, 2018.The mean histologic tumor thickness was 8.20 (range 2.8-20mm).The tumor in 36 patient were assigned to the revised tumor stages according to the thickness measurement,11%(4/36) were assigned to stage1, 61%(22/36) to stage 2 and 28%(10/36) to stage 3 using 3- and 9-mm cut-off.

Table 1: Age wise distribution of occurrence of tongue cancer

Age group	No. of cases	%Age of case
20 – 39 yrs	12	33.33%
40 – 59 yrs	18	50%
≥60 yrs	6	16.67%
Total	36	100.00%

Table 2: Sex wise distribution of occurrence of tongue cancer

Sex group	No. of cases	%Age of case
Male	32	88.88%
Female	4	11.12%
Total	36	100.00%

All tumor showed enhancement on contrast enhanced T1-weighted spin-echo image and non-homogenous high signal intensity on T2-weighted spin-echo image. The mean radiological tumor thickness measured on contrast-enhanced T1W spin-echo image and T2W spin-echo image were 9.05(range 2.8-25mm) and 9.97(range 2.9-28mm) respectively. For the contrast enhanced T1W spin echo imaging study an accuracy rate of 83.33% was achieved

Table 3: Cut off thickness of tumor for staging and histological behaviour

Cut off thickness of tumor for staging	Histological tumor thickness staging with number	T_1-w spin Echo image thickness with same stage	% of T_1-w tumor in same stage
≤3 mm	4	2	50%
>3 – 9 mm	22	18	81%
>9 mm	10	10	100%
Total	36	30	83.33%

For the T2W spin-echo imaging study the accuracy rate of tumor staging for T2W spin-echo imaging compared with stage determined from histologically was 61.11%.

Table 4: Cut off thickness of tumor for staging and histology

Cut off thickness of tumor for staging	Histological tumor thickness staging with number	T_2-w symp. Echo image thickness with same stage	% of T_2-w tumor in same stage
≤3 mm	4	2	50%
>3 – 9mm	22	10	45.45%
>9mm	10	10	100%
Total	36	22	61.11%

We obtain scatterplot of the radiologically determined tumor thickness i.e. T_1W spin echo image tumor thickness against the histologically determined tumor thickness

R=0.980

Y= - 0.34 + 1.165x

Scatterplot of T_2 weighted spin echo image thickness against the histological determined tumor thickness

R=0.985 (R = correlation coefficient)

Y=1.021+1.09x

Number of patients

Pearson's correlation analysis showed a statistically significant correlation (correlation coefficient R=0.980, P<0.005) between tumor thickness determined with contrast enhanced T1W spin-echo image and tumor thickness determined histologically. The least square regression equation was Y=-0.34+1.165x. High correlation was also observed between thickness determined with T2W spin-echo image and thickness determined histologically (correlation coefficient R=0.985,P<0.005).The least squares regression equation was Y=1.021+1.09x

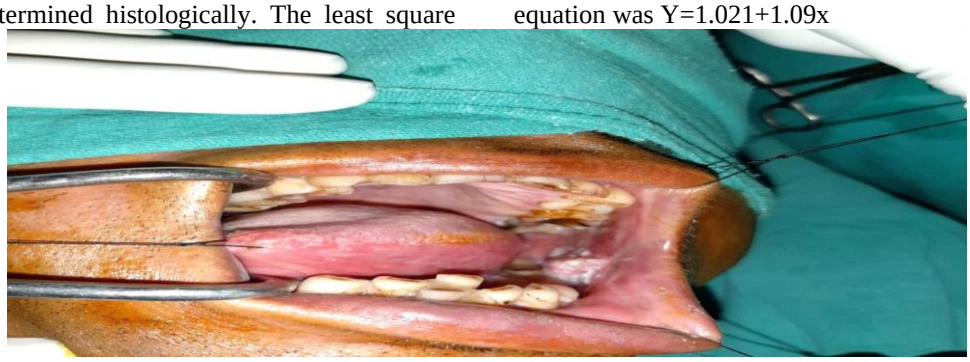

Fig 1: CA tongue lateral border (lt. side)

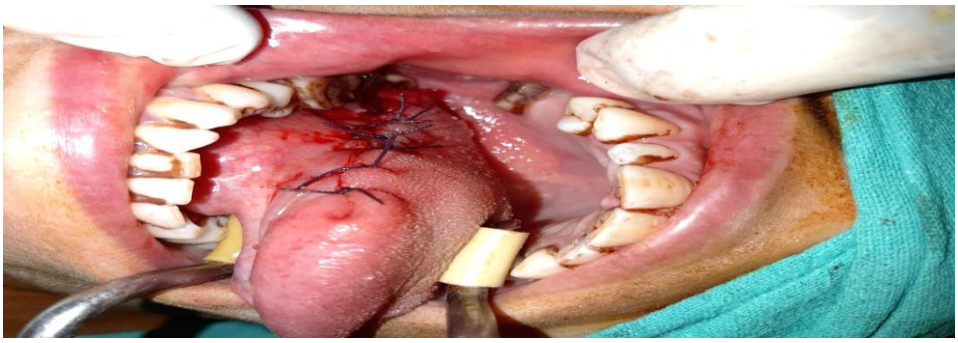

Fig 2: Postoperative image of CA tongue lateral border (lt. side)

Fig 3: CA tongue lateral border (rt. side)

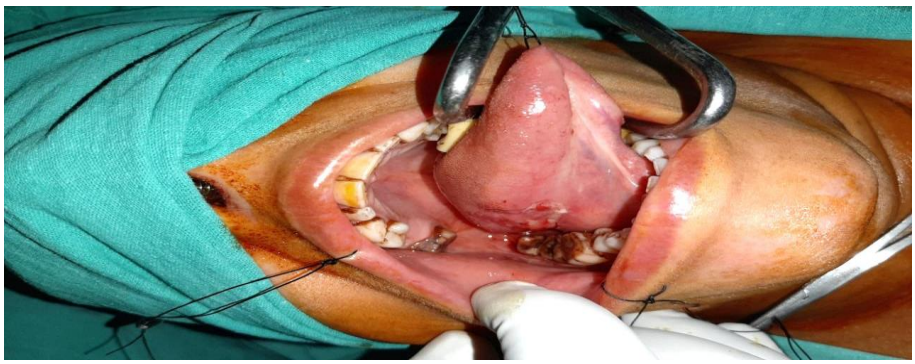

Fig 4: CA tongue lateral border (rt. side)

Discussion

This study was conducted at L.L.R. Hospital, Kanpur. It include 36 patients (32 male and 4 female) who underwent proper pre-operative measured thickness of tongue cancer radiologically and were subjected to glossectomy and then thickness of tumor measured histologically. Tumor thickness is a more accurate prognostic factor for subclinical nodal metastases, local recurrence and disease free patient survival. Accurate pre-operative assessment of tumor thickness is therefore important in planning clinical management of tongue cancer. Ultrasonography may also be used for evaluation of tongue cancer but difficulties with sonographic evaluation are non-visualisation of superficial lesion, reduced accuracy for evaluation of extension of large tumors, excessive pain experienced by patient render accurate placement of probe and interpretation is more operator dependent.MRI has been shown to satisfactory depict tongue cancer because tumor has higher signal intensity than the normal tongue tissue. The use of gadopentenate dimeglumine and high resolution MRI further improves tumor visualization. We found that MRI can be used to satisfactorily measure thickness of tongue carcinoma, although both T_1 and T_2 weighted measured tumor thickness strongly correlated with the histologically determined thickness, the mean thickness of tumor measured on T1-weighted image was 0.85mm larger than histologically determined thickness, where as tumor thickness measured on T_2-weighted image was 1.77 mm larger than the histologically determined thickness. We found that tumor thickness determined with contrast enhanced T1W-spin echo image and tumor thickness determined histologically are significantly correlated with correlation coefficient (R)=0.980 and P<0.005.We also found that high correlation was also observed between thickness determined with T2W-spin echo image and thickness determined histologically with correlation coefficient(R)=0.985 and P<0.005.This observation is also similar to Preda[1] et al showed a direct correlation between measured MRI and histological tumor thickness(correlation coefficient=0.80 and P<0.0001) in their study of 33 patient. Iwai[2] et al found in a study of 30 T_1-T_3 tongue SCC patient, found a correlation of 0.609(P=0.002) between their MRI and histological tumor thickness which became more

significant at 0.839(P<0.0001) when they used reconstructive tumor thickness on MRI. Lam[3] et al studied 18 patient with T1-T3 tongue SCC showed a correlation MRI and histological tumor thickness to be 0.941(P<0.0005)Jung[4] et al in 50 patient with T1-T2 tongue SCC reported a correlation of 0.813(P<0.001). Tomura [5] et al (2002) shows that T2-weighted imaging is feasible for differentiating viable from nonviable tumor tissue in irradiated carcinoma of the tongue. Minsu Kwon[6] et al (2015) . ResultsTT on MRI in each plane showed relatively high concordance rates with the histological measurements. TT in all three planes was significantly correlated with lymph node (LN) metastasis. Antigone Delantoni et al[7] (2015) study showed that MRI images are adequate to establish the dimensions of tumors and the depth of tumor invasion

Jun-Ook park et al[8] (2011) Pearson's correlation coefficients for histologic and MRI invasion depths in oral tongue, tongue base, and tonsil cancers were 0.949, 0.941, and 0.578, respectively.

M. Okura et al[9] (2008) MR images provide satisfactory accuracy for the preoperative estimation of the tumor thickness and the paralingual distance, which are valuable for predicting cervical lymph node metastases. A Tetsumura et al[10] (2014) High-resolution MR imaging appears reliable for the *in vitro* evaluation of depth of tumor invasion in carcinoma of the tongue. H. A. Alsaffar et al[11] (2016) . Although MRI is used widely to stage the head and neck disease, its utility in depth evaluation has not formally been assessed.

Sandya Chirukandath Jayasankaran et al[12] (2017) Recent evidence, including our study, suggests that MR imaging is concordant with pathological findings, justifying its use in the pretreatment evaluation of oral tongue lesions

E.A.M. Weimar et al[13] (2018) This study demonstrates a good radiologic-pathologic tumor thickness correlation. Intrarater and interrater reliability for radiologic tumor thickness was excellent. Radiologically thicker tumor was predictive of inferior survival.

Spiro et al [14] (1986) depth of invasion (represented by para-lingual distance), not merely tumour thickness, is another important prognostic factor.

The possible cause of discrepancy between histological and radiological thickness may be due to the shrinkage and distortion of glossectomy specimen .The large discrepancy between thickness measured on T2-weighted spin-echo MR image and that measured histologically is probably due to the fact that on T2W image the signal of inflammation and edema show higher intensity than on the T1W image. The T1W tumor thickness had a higher rate of concordance (83.33%) with the histological thickness than did the T2W tumor thickness (61.11%) in the assessment of tumor thickness and staging using the 3- and 9-mm cut-off values. Therefore we recommend T1W-spin echo imaging for assessing pre-operative tumor thickness and staging and for planning of tongue cancer treatment [Figure 1,2,3,4].

Conclusion

The following conclusion were drawn from our study

- Mean age of occurrence of tongue cancer was 48 yr
- Minimal age of occurrence of tongue cancer is in a 25 year old male having history of tobacco chewing since last 12 year.
- 88.89% patient were males and 11.12% were female
- Tumor thickness determined with contrast enhanced T1W spin echo image and tumor thickness determined histologically are significantly correlated with correlation coefficient [R]=0.980 and P<0.005
- High correlation was also observed between thickness determined with T2w spin echo image and thickness determined histologically with correlation coefficient[R]=0.985 an P<0.005
- We can skip neck dissection in a patient having thickness of tongue cancer <3mm inspite of enlarged lymph node because there is minimal chance of lymph node metastases and lymph node enlargement is mainly reactive enlargement.

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