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Original Article

Multi detector computed tomographic evaluation of neck spaces in locally advanced oral cancers.

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Abstract

Background: Malignancy of the oral cavity account for about 7.6% of total cancer in India. Local anatomical spread of oral cancers into the face and maxilla and further extension into neck spaces is critical for staging of cancers. Cancer staging helps in the treatment of oral cancers. CT is considered the primary modality of investigation as it helps in delineating the size and extent of primary tumor.
Objective: To perform multi-detector computed tomography (MDCT) and to evaluate its usefulness in assessing the involvement of deep neck spaces in locally advanced oral cancers. To assess CT morphology specifically to know resectability or non-resectability of oral cancers.
Methods and Material: Study included a total of 39 cases of locally advanced oral cancer referred for CECT neck. MDCT findings were analyzed with regard to location, size and extent of the disease and findings were correlated with either clinical follow up or surgical findings.
Results: In our study highest number of cases were of carcinoma buccal mucosa (71.8 %) followed by carcinoma tongue and lower alveolus. Most commonly involved neck space was buccal space (94.9 %). CT was 100% accurate in detecting the bone erosion.
Conclusion: MDCT evaluation of neck spaces in locally advanced oral cancers is a superior diagnostic tool in tumour staging and appropriate treatment planning. Surgical management of T4b oral cancers in our study subjects showed good results with > 50% of patients showing loco-regionally controlled disease after surgery.

Keywords: Computed tomography, Neck spaces, Oral, Cancers.

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Introduction

Malignancy of the oral cavity is common in clinical practice. In India, cancers of lip and oral cavity account for about 7.6% of total cancer cases and account for more than 7% of cancer-related mortality. Sex standardized distribution shows a higher predilection in males (incidence 11.3% and mortality 10.2%) compared to females (incidence of 4.3% and mortality of 4.8%). In fact, projections from current data show that the incidence of oral cancers is expected to grow over the coming years.[1,2]

In India, oral cancer is of significant public health importance due to myriad of features ranging from late diagnosis, lack of quality health care facilities to affliction predominantly in people of lower socioeconomic strata, probably due to increased exposure to risk factors.[2,3]

Oral cancers have multi-factorial etiology ranging from lifestyle practices to environmental changes.[2] Smoking, chewing tobacco, betel nut and alcohol consumption, which are implicated as causative factors for oral cancers, are largely preventable.[2,3,4] Additionally, many Indians also present late for diagnosis and treatment, which adds up to burden on healthcare and on the patient. Most of the cases who present are already at a late stage and therefore have a dismal prognosis. Data shows that approximately 60 to 80% of Indians present with advanced, while it is only 40% among westerners. The need for early detection cannot be stressed enough as it not only improves cure rate but also reduces morbidity and treatment costs.[2]

There are various factors that affect the overall diagnosis and management of oral cancers. One among them being the tumor extension into the local anatomical areas, which is a harbinger of poor prognosis. Local anatomical spread of oral cancers into the face and maxilla and further extension into neck spaces is critical for staging of cancers.[5,6] Cancer staging helps in the treatment of oral cancers by reducing excessive morbidity.[6]

Although the evaluation of oral cavity and oropharynx is done clinically cross-sectional imaging plays an important role in staging, visualization of pathology beneath mucosa, determine size, thickness and depth of tumour and invasion to local structures. CT is considered the primary modality of investigation as it helps in delineating the size and extent of primary tumor and also helps to evaluate metastatic lymph nodes and bone involvement. It is also easily available and relatively inexpensive compared to MRI.[6]

It is important to understand the anatomy of oral cavity and oropharynx to understand the associated malignancies. Squamous epithelium lining the oropharynx is endodermal in origin and has a greater tendency towards development of poorly differentiated, aggressive malignancies. On the other hand, squamous epithelium lining the oral cavity is ectodermal in origin, which tends to be more differentiated and less aggressive in nature. Additionally, it is important to identify specific subsite of origin of these tumors as routes of spread, lymphatic drainage and management options depend on sub-site of origin.[7]

Material and Methods

Source of data for the study was collected from patients with locally advanced oral cancers referred to the department of Radio Diagnosis of R.L. Jalappa hospital attached to Sri Devaraj Urs Medical College, Tamaka, Kolar.

Method of collection of data

Study was conducted on 39 patients with oral cancers. After taking informed written consent from all the patients contrast enhanced CT neck was performed with sixteen slice Multi-detector Computed Tomography scanner (SIEMENS SOMATOM EMOTION 16) and findings were correlated with either clinical follow up, or surgical findings. They were followed up after a period of 7 to 12 months.

Inclusion Criteria

1. Patients above 18 years of age with locally advanced cancers of oral cavity.

Exclusion Criteria

1. Patients medically unfit for surgery.
2. Patients who have undergone earlier radiotherapy or chemotherapy.
3. Patients who have undergone any earlier head and neck surgeries.
4. Patients with deranged renal function tests.

Preparation of patient

Risks of contrast administration were explained to the patients and written consent was obtained prior to the imaging with contrast.

Routine lateral topogram of the neck was initially taken in all patients in the supine position. Axial sections of 3 mm thickness were taken from the floor of orbit to the level of manubrium sterni. Kilovolt peak: 120–140 kVp, milli Ampere second: 200-300 mAs for an average-sized patient. Pitch: 1.5, Field of view: 230 mm; Collimation: 3mm, Time for scan: 30-40 seconds; Matrix: 512x512.

Plain and intravenous contrast scans were done with suspended inspiration. For intravenous contrast enhancement 80-100 ml bolus of injection of (Iopromide - 300mg Iodine per ml) was administered and axial CT sections were taken.

Sagittal and coronal reconstruction were made at 0.75mm thickness. MDCT findings were analyzed with regard to location, size and extent of

the disease. The findings were correlated with either clinical follow up or surgical findings.

Results

Study included 39 cases of locally advanced oral cancer patients. Highest number of patients were in the age group of 61 to 70 years (28.2 %).

History of betel nut chewing, tobacco chewing, smoking and alcohol consumption was seen in 59%, 38.5%, 12.8% and 15.3% respectively (Table 1). Few patients had more than one addictions. Among various sub-sites of oral cavity, buccal mucosa is the commonest site of carcinoma followed by lower alveolus and anterior 2/3rd of tongue (Table 2). 94.4% cases show buccal space involvement followed by masticator space (46.2%). About 41.1% cases showed involvement of two spaces (Table 3 & 4). Erosion of the mandible was more common as compared to maxilla (Table 5). Table 6, 7 and 8 shows the difference in tumor staging that has been attained after performing CT. CT tumor staging altered clinical staging of oral cancers with significant P values ($p = 0.011$).

Table 1: Incidence of oral carcinomas based on habits.

Habits	Gender		Total (n=39)%
	Female (n=26)	Male (n=13)	
Smoking	0	5	5(12.5%)
Tobacco chewing	10	5	15(38.5%)
Betel nut chewing	15	8	23(59%)
Alcohol	2	4	6(15.3%)
No Addictions	7	2	9(23.1%)

Table 2: CT Distribution of Carcinoma in Various Sub-sites of Oral Cavity.

Site Involved	Gender		Total
	Female	Male	
Buccal Mucosa	20	8	28(71.8%)
Lower Alveolus	2	2	4(10.3%)
Tongue-anterior 2/3rd	1	3	4(10.3%)
Upper alveolus	2	0	2(5.1%)
Floor of mount	1	0	1(2.6%)
Total	26	13	39(100%)

Table 3: CT Scan- Potential neck Spaces Involved.

Spaces Involved	Gender		Total (n=39)%
	Female (n=26)	Male (n=13)	
Submandibular/ Sub mental	13	4	17(43.6%)
Parotid	0	1	1(2.6%)
Para pharyngeal space	3	2	5(12.8%)
Carotid Space	0	1	1(2.6%)
Retropharyngeal space	0	0	0(0%)
Masticator space/ Infratemporal	13	5	18(46.2%)
Buccal space	25	12	37(94.9%)
Prevertebral space	0	0	0(0%)

Table 4: CT scan -Number of Potential neck Spaces Involved.

Number of Spaces Involved	Gender		Total (n=39)%
	Female (n=26)	Male (n=13)	
1	6	6	12(30.8%)
2	13	3	16(41.1%)
3	6	3	9(23.1%)
4	1	1	2(5.1%)

Table 5: Incidence of bony erosions in different sites due to oral carcinomas.

Bone Erosion	Total (n=39)%
Mandible	18(46.2%)
Maxilla	13(33.3%)
Both mandible and maxilla	4(10.2%)
No erosion	12(30.7%)

Table 6: Clinical & CT staging of primary tumor.

Clinical Tumor Staging	Gender		Total
	Female	Male	
T3	3	1	4(10.3%)
T4a	20	7	2769.2%)
T4b	3	5	8(20.5%)
Total	**26**	**13**	**39(100%)**

CT Staging of Primary tumor.

CT Tumor Staging	Gender		Total
	Female	Male	
T3	4	2	6(15.4%)
T4a	9	3	12(30.8%)
T4b	13	8	21(53.8%)
Total	**26**	**13**	**39(100%)**

Table 7: Clinical Tumor Staging Versus CT Tumor Staging.

	Clinical tumor Staging	CT Tumor Staging
T3	4	6
T4a	27	12
T4b	8	21

Table 8: Treatment and Follow up Given to Patients of Stage T3, T4a and T4b Disease.

Patients with CT tumor stage T3	Underwent surgery+ RT	Not taken treatment (Defaulted)	
	LRC	AWD	DDOC
Male	2	0	0
Female	2	1	1
Total (n=6)	**4**	**1**	**1**

Treatment and Follow up Given to Patients of Stage T4a Disease.

Patients CT stage T4a (n=12)	SURG+RT			SURG+ RT+CT	Defaulted treatment	
	LRC	DDOC	LTE	LRC	DDD	LTF
Male	2	0	0	1	0	0
Female	2	3	1	1	1	1
Total	**4**	**3**	**1**	**2**	**1**	**1**

Treatment and Follow up given to patients of stage T4b Disease.

Patients CT stage T4b	Neo-adj+SURG+CT	SURG+RT+CT		Palliative Treatment		
	LRC	LRC	AWD	AW	DD	LTE
Male	1	0	0	4	2	1
Female	0	2	1	3	5	2
Total (n=21)	**1**	**2**	**1**	**7**	**7**	**3**

AWD= Alive with disease; DDOC = death due to other cause; LRC= locoregionally controlled; RT= Radiotherapy, CT= chemotherapy; DDD= death due to disease; LTE= lost to follow-up; SURG= surgery.

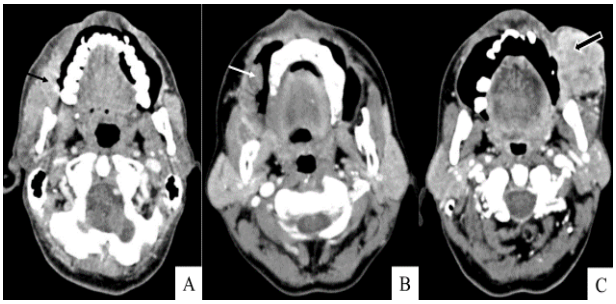

Figure 1:

(A) A 63 years old female patient with carcinoma of right buccal mucosa, axial CECT image showing heterogeneously enhancing soft tissue lesion of right buccal mucosa (black arrow).

(B) A 38 years old male patient with carcinoma of right buccal mucosa, axial CECT image showing heterogeneously enhancing soft tissue exophytic growth from right buccal mucosa (white arrow).

(C) A 40 year old male patient with carcinoma left buccal mucosa. Axial CECT image showing involvement of the skin on left side, fat plane between the lesion and skin is lost (black solid arrow).

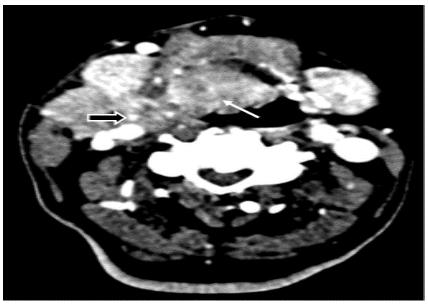

Figure 2: A 65 year old male patient with carcinoma tongue. Axial CECT image showing heterogeneously enhancing lesion on right side of tongue (white arrow) surrounding the right carotid artery and involving of right carotid space (solid arrow).

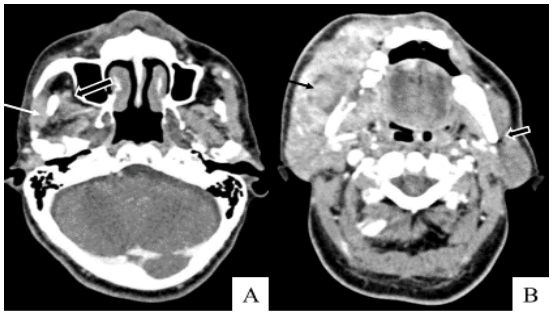

Figure 3:

(A) 60 year old female patient with carcinoma right buccal mucosa. Axial CECT image showing involvement of right masticator space, right masseter (solid arrow) and temporalis muscle (white arrow) appears bulky.

(B) 70 year old male patient with carcinoma right buccal mucosa. Axial CECT image showing involvement of right parotid space, fat plane between the lesion and right parotid gland is lost on right side (black arrow) which is maintained on the contralateral side (solid arrow).

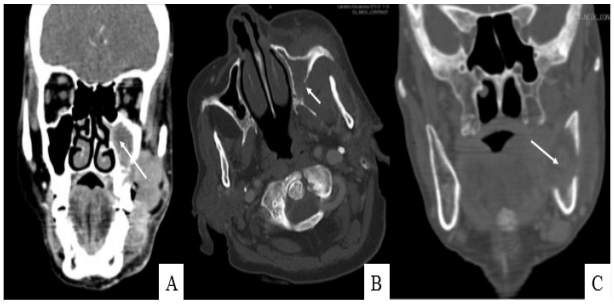

Figure 4:

(A) 70 years old male patient with carcinoma of left buccal mucosa, coronal CECT image showing heterogeneously enhancing soft tissue lesion of left buccal mucosa extending into adjacent maxillary sinus (white arrow).

(B) 87 year old female patient with carcinoma left buccal mucosa. Axial CT image bone window showing erosion of lateral wall of left maxillary sinus (white arrow).

(C) 63 years old female patient with carcinoma of left buccal mucosa, CT bone window- Coronal reformatted, showing erosion of left mandible (white arrow).

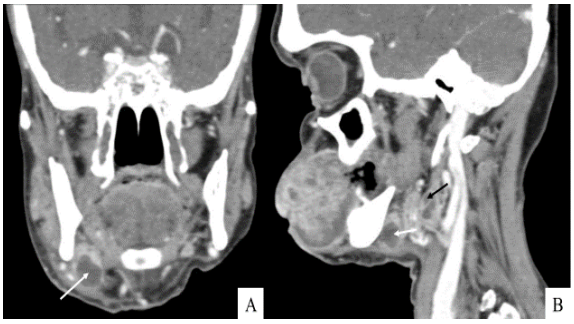

Figure 5:

(A) 48 years old female patient with carcinoma of right buccal mucosa, Coronal CECT image showing necrotic lymph node in right submandibular region (white solid arrow).

(B) 87 years old female patient with carcinoma of right buccal mucosa, CECT image showing necrotic lymph nodes in right level IB (white solid arrow) and level II (blue solid arrow).

Discussion

Our study included 39 patients with locally advanced oral cancers, the youngest patient was 30 years old, and the oldest was aged 87 years. The highest percentage of patients 11(28.2 %) were in the age group of 61 to 70 years, followed by the age group of 51 to 60 and 41 to 50 years (10 each; 25.6%). Other studies in literature also showed similar demographics, where the maximum percentage of patients were seen in the age group of 61-70 years followed by 41-50 years and 51 - 60 years.

Frequency of oral cancer in our study was highest among females in the age group of 41-50 years (n=8) and males in the age group of 61-70 and 51-60 years (n=4 each). 66.7% of our patients were women.

Female patients outnumbered males in this study except in carcinoma tongue (F:M = 3:1) unlike in a study done in Tamil Nadu which quotes male to female ratio was 1.68:1. The female preponderance may be because of addiction of female patients in Kolar region to tobacco, quid which is kept in their cheek. Oral cancer in female patients is due to smokeless tobacco and chewing habits leading to irreversible damage in oral mucosa.[10,11,12]

Out of 39 patients of our study, 23 (59%) patients were addicted to betel nut chewing (15 females, 8 males), 15 (38.5%) patients were addicted to tobacco chewing (10 females and 5 males) and 5 patients were addicted to smoking (Table 1). Among them, few patients had multiple addictions.

Krishna et al13 and Khanna et al14 studies showed that chewing tobacco was present in 80.4 and 80.46% patients respectively and smoking habits were present in 51.5 and 31% patients respectively.

Out of 39 patients in our study, 71.8 % were having carcinoma buccal mucosa (Figure 1A, B & C), followed by 10.3% with carcinoma tongue (Figure 2) & lower alveolus, 5.1% with carcinoma of upper alveolus and 2.6 % with carcinoma floor of mouth (Table 2).

A study conducted in south India on 997 patients of oral cancer also shown higher prevalence of carcinoma buccal mucosa (57.5%) followed by tongue (24.2%).[9]

In our study out of 39 patients with carcinoma oral cavity, 94.9% (37) patients had involvement of buccal space, followed by involvement of masticator space (Figure 3A) in 46.2% (18) patients and submandibular / sub mental space in 43.6% (17) patients. Para-pharyngeal space is involved in 12.8% (5) patients. Parotid (Figure 3B) and carotid spaces involvement is seen in 1 patient each (Table 3).

Our results are similar to a large study conducted on 122 patients of gingival cancers by Kimura Y et al[5], showed that buccal space (more than 40% cases) was most commonly involved followed by the masticator space (20 %) (Figure 2B) from where it can extend to maxilla and adjacent paranasal sinuses (Figure 4A & B).

It was shown in literature that spread of buccal mucosa cancer to masticator space is along ramus of mandible (Figure 4C) (Table 5), RMT and lateral pterygoid plates or along buccinators muscle or buccal fat of pad. [15,16,17,18,19,20] Literature also showed that tongue cancers spread easily to submandibular space which can be detected by CT with relatively high sensitivity and specificity.[21,22]

It was Gatenby et al [23], who first demonstrated the advantage of CT over clinical examination for the staging of head and neck cancers. In his study involving 100 patients, the oral cancers were upstaged by CT scanning and the treatment planning was altered significantly in 36 patients.

Few of the patients showed necrotic lymph nodes, secondary to metastasis to the lymph nodes (Figure 5A & 5B).

Modifying treatment options in 13 T4 oral cancer patients, who were upstaged from T4a to T4b**.** In 12 patients of T4a disease 10 had taken treatment and 6patients are alive with loco-regionally controlled disease and 3 patient died due to other causes. In T4b cases 80% of patients underwent palliative treatment. 4 patients in whom involvement of masseter, temporalis, lateral pterygoid plates and ramus of mandible below sigmoid notch were operated with better outcome.

Similarly, in our study clinically before CT was done out of 39 patients 4 patients were staged as T3, 27 were staged as T4a and 8 were staged as T4b (Table 6). After CT, 6 patients were staged as T3, 12 were staged as T4a and 21 were staged as T4b (Table 7).

Among 4 clinically staged T3 patients, after CT 2 were staged as T3 who underwent surgery followed by radiotherapy and 2 patients were upgraded to stage T4a, they underwent surgery followed by radiotherapy and chemotherapy (Table 8). All 4 patients are alive with loco-regionally controlled disease.

Among 27 clinically staged T4a patients, after CT 4 patients were down-staged to T3, in whom 2 patients underwent surgery followed by radiotherapy and are alive without disease. 10 patients were staged as T4a in whom 8 underwent treatment, among them 4 patients are alive with loco-regionally controlled disease and 3 were dead due to other causes. 13 Patients were upstaged to T4b, 9 of them were given palliative treatment and only 4 selected cases were surgically treated with curative intent. CT findings were histopathologically confirmed in operated patients (Table 8).

All 8 clinically staged T4b patients, after CT remained as stage T4b and took palliative treatment. 3 of them were dead due to disease and 4 patients are alive with disease.

Thus in our study it is evident that CT was more accurate compared to clinical examination for staging oral cancers and altered treatment planning in 19 patients.

In literature it was shown that sensitivity and specificity of CT for mandibular cortical invasion in a study conducted on 49 patients of oral SCC was 96 and 87% 42 and in another study conducted on 51 patients of oral SCC was 100 and 88% respectively.[8]

In our study, CT evidence of bone erosion was seen in 27 patients (Figure 3A). Out of 27 patients 14 patients underwent surgery and proved to have bone erosion histopathologically.

In 4 surgically treated T4b patients 2 of the tumors involved temporalis muscle alone, at the level of insertion, 1 tumor involved temporalis and masseter muscle and 1 tumor involved temporalis, lateral pterygoid muscles and ramus of mandible below sigmoid notch.

Out of 4 patients with T4b disease who underwent surgery, 75% (3) patients are alive without disease after surgery and 25% (1) patients are alive with disease (local recurrence).

Liao et al 9 study conducted on 103 surgically operated T4a and T4b patients (58 patients with T4a and 45 patients with T4b disease) showed that 41.3% of the T4a patients were alive. 46.7% of the T4b patients were alive. Their study was done retrospectively and patient was followed-up for 5 years after surgery where as ours is a prospective study and follow-up period is shorter.

They also showed in their study about the involvement of various components of masticator space (MS components include the ramus of the mandible, masseter, medial & lateral pterygoid and temporalis muscle), including the pterygoid plates in surgical operated T4b patients. Of the 45, T4b patients, 37.8% of the tumors (17 of 45) involved 1 anatomic component, 62.2% tumors (28 of 45) involved multiple components. Five patients had PP invasion, 28 had ramus of the mandible invasion, 26 had masseter and medial pterygoid muscle invasion, 4 had lateral pterygoid muscle invasion, and 3 had temporalis muscle invasion.

Conclusion

The challenge in management of oral cancers is to identify the site of primary tumor and to know its local extensions into various neck spaces for staging the tumor and for appropriate treatment planning, as different stages of tumor have different treatment options.

Most of our cases were of carcinoma buccal mucosa (71.8 %) followed by carcinoma tongue (10.3%) and lower alveolus (10.3%), showing female preponderance (F:M-2:1), this is probably due to prevalence of tobacco and betel nut chewing in this area.

Most commonly involved anatomically potential face and neck space in locally advanced (T3, T4a & T4b) oral cancers is buccal space (94.9 %), followed by masticator space/ infratemporal fossa (46.2 %) and Submandibular space (43.6 %). CT was 100% sensitive in detecting the bone erosion, was confirmed in 18 patients who underwent surgery.

Surgical management of T4b oral cancers in patients with involvement of temporalis, masseter, lateral pterygoid muscles and ramus of mandible below sigmoid notch in our study subjects showed good results with > 50% of patients showing loco-regionally controlled disease after surgery, which were previously considered to be inoperable as per AJCC, 2002 staging.

It is proved that CT is useful over clinical examination for the staging of advanced oral cancers as CT scan helped in accurate staging and treatment planning in 19 patients (out of 39 patients).

Hence, CECT evaluation of neck spaces in locally advanced oral cancers is a superior diagnostic tool in tumor staging and appropriate treatment planning.

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