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ACCURACY OF CONTRAST ENHANCED MULTI-DETECTOR CT IN EVALUATION OF ORAL CAVITY AND OROPHARYNGEAL LESIONS

[1]Nida Rafiq, [1]Saba Sohail, [*2]Dr. Ghazala Shahzad and Dr. Aashfa Hassan

[1]Dow Institute of Radiology, Dow University of Health Sciences, [2]Liaquat University of Medical and Health Sciences (LUMHS) Jamshoro.

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Abstract:

Objective: *The purpose of this study was to determine the frequency of oraland to determine diagnostic accuracy of CT in diagnosing malignant conditions.*

Patients and Methods: *117 subjects presenting with oral mass were selected over a period of 4 months. All patients underwent contrast enhanced CT Neck. These studies were reviewed by consultant radiologist and imaging results were compared with histological findings.*

Results: *Histopathology revealed total 100 malignant and 17 benign lesions. True positive cases were 99, 14 true negatives, 3 false positives and 1 false negative. CT correctly identified malignant pathology in 99 of 100 cases and excluded malignant disease in 14 of 17 cases. Diagnostic accuracy of multidetector CT was: specificity 82.35%, sensitivity of 99%, PPV 99.05%, and NPV 93.33%.*

Conclusion: *CT has high accuracy in diagnosing and differentiating benign and malignant lesions. Malignant pathologies were more common in elderly males - most common being buccal carcinoma.*

Key Words: *Oral cavity, oropharyngeal lesions and CT scan*

Corresponding author:

[*]Dr. Ghazala Shahzad,

Liaquat University of Medical and Health Sciences (LUMHS) Jamshoro.

Email: zulfikar229@hotmail.com

QR code

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INTRODUCTION:

There is a wide spectrum of benign and malignant pathologies that clinically present with an oral mass.[1]The anatomy of the oral cavity and oropharynx is very complex as soft tissue, glandular and osseus structures are housed in a compact region. The key to diagnosing any abnormality lies is familiarity with the anatomical subsites of this region.[2]The subdivisions of oral cavity are lips, floor of mouth, oral tongue (anterior two thirds), buccoalveolar region, hard palate and retromolar trigone. Oral cavity and oropharynx are separated by a ring of structures – soft palate superiorly, tonsillar pillars laterally, and circumvallate papillae inferiorly. The subdivisions of oropharynx are the posterior one third of tongue, palatine tonsils and the oropharyngeal mucosa.[3]

Approximately 5–15% of the population has oral mucosal abnormalities and majority of these are benign. Computed Tomography (CT) is not routinely used to evaluate these conditions. An oral malignant or premalignant lesion also presents as a red or white patch, or a persistent non-healing ulcer.[4,5]

The vast majority of oral cancers will be diagnosed from lesions on the mucosal surfaces such as erythroplakia, leukoplakia, and submucosal fibrosis.[6]Precancerous lesions are early indicators of damage to the oral mucosa with a transformation rate of 2–12% to malignancies.[7] The challenge is to differentiate cancerous lesions from a spectrum of other lesions that also occur in the oral cavity. Malignant lesions seen in an early stage may be mistaken for a benign change.The most effective way to control oral cancer is a combination of early diagnosis and timely management.[8] Grey area between benign and malignant conditions – premalignant conditions, are a diagnostic challenge for clinicians and radiologists.

Oral and oropharyngeal carcinomas are sixth most common cancers in the world.[10] Oral squamous cell carcinoma represents the most common malignant neoplasm of the oral cavity and has varying destructive potential.[11] It has a male preponderance with M:F ratio of 1.5:1 likely due to indulgence in high-risk habits by men.[12] In Western countries, the tongue is the most frequently affected site with its involvement in 20% - 40% of cases, followed by the floor of the mouth in 15% - 20% of cases.[13] In Pakistan, cancer of the oral cavity is amongst the commonest cancer – according to a study conducted in Karachi South, carcinoma of oral cavity ranks second in both genders.[14] Unfortunately, it is appearing in a much younger population now. Major reason for this increased incidence is chewing tobacco i.e. qivam, pati, gutka, niswar and manpuri, betal quid containing areca nuts with fungus Aspergillus, and HPV infection.[15]

Imaging plays a vital role in accurate staging, treatment planning and determining prognosis of oral cancers. CT and MRI are complementary in the assessment of oral pathologies. CT is readily available, allows faster image acquisition, thereby eliminating movement artifact due to swallowing, and is better in assessment of cortical bone involvement. On the other hand, MRI has better soft-tissue resolution, is preferred in assessment of marrow involvement and perineural spread of tumors. Both modalities suffer from artifacts in case of dental amalgam. Diagnostic evaluation by computer tomography (CT) scanning is used to assess the extent of local spread, the depth of invasion, bone and vascular invasion, lymphadenopathy, and thus the lesion is classified for further management and need for histological evaluation.[16]

Final verdict in differentiating between benign and malignant lesions requires evaluation of tumor cells by histopathologic examination[17.] However, there are CT parameters that can give clues to the benign or aggressive nature of the lesion. Malignant lesions of oral cavity are usually ill-defined, without calcification, invading and infiltrating adjacent structures and metastasizing through lymphatic or hematogenous routes. Benign tumors are well-defined, displace adjacent structures -blood vessels, or compress neurovascular structures.[18]

There is insufficient radiological data regarding oral cavity and oropharyngeal lesions in the developing countries. The purpose of this study was to determine the frequency of various pathologies referred to CT department with an oral mass and to determine the diagnostic accuracy of CT in diagnosing malignant oral pathologies.

PATIENTS AND METHODS:

This was a retrospective analytical study of 117 patient records referred for clinical oral mass who underwent contrast enhanced CT oral cavity and neck at our department. All the patients meeting the inclusion criteria, registered over a period of four months from December 2013 to March 2014 were included in the analysis.

Inclusion criteria in the study were(i) presence of a clinical lesion in oral cavity or oropharynx, (ii) a contrast enhanced oral cavity and neck CT performed and (iii) biopsy report availability. Patients with

tumor extending from the maxillary sinus were also included in the study where the initial presenting complain was an oral mass.The cases in which histopathology results were not available or with histological ambiguous results were excluded from the study. Patients with other symptoms such as restricted mouth opening and excessive salivation, with no lesion on clinical examination were also excluded.

Patients' demographic data, history and clinical findings were recorded from the CT request form filled at the time of procedure. All patients underwent axial contrast-enhanced CT from the skull base to the thoracic inlet. The CT imaging system was Toshiba Activion 16 slice CT scanner. The scanning orientation was parallel to the Frankfurt horizontal line. Scanning was performed with a collimation of 3 mm, a pitch of 1:1, a matrix of 512 ×512, a display field of view of 23 cm, 120 kVp, and 200 mA. CT examination was carried out after an IV bolus injection of approximately 100 mL (2 mL/kg of body weight) of Iopamidol at a rate of 1.0 mL/sec. Scanning started 50sec after the start of contrast medium injection. Reformatted coronal and sagittal images of 5 mm in thickness were obtained from these data. All studies were reconstructed with soft-tissue and bone algorithms.The CT studies were reported by a qualified FCPS radiologist. Histopathology findings were later recorded on the same form.

Each lesion was classified according to site of origin: the sub-sites of oral cavity and oropharynx included were bucco-alveolar region, tongue, lips,tonsils, floor of mouth, palate, maxilla and mandible, and tumors extending from the maxillary sinus.

The lesions was classified according to its (i) margins, (ii) enhancement, (iii) local invasion: this was further divided into involvement of – skin and subcutaneous tissues, buccal region, tongue, floor of mouth, hard palate, retromolar trigone, tonsillar pillars,andthe masticator space.

Local bone invasion - maxilla, mandible or both, was studied. It was determined by the presence of either one or a combination of these findings (i) cortical erosion adjacent to the primary lesion, (ii) aggressive periosteal reaction, (iii) abnormal attenuation in bone marrow, (iv)pathological fractures.

Lymph node status was classified as - none, benign or malignant.Lymph nodes were considered malignant when they had two or more of the following features: enlarged, enhancing, loss of fatty hilum, or necrotic.

The status of adjacent neurovascular bundle was classified as - not involved, abutting, displaced, or encased by the lesion.

Statistical analysis included calculation of mean and standard deviations for quantitative variable i.e age. Frequency and percentage was calculated for gender, addiction, location of lesion, laterality, regional bone and neurovascular bundle invasion, and nodal involvement. Frequencies were also determined for respective pathologies. Radiological findings were compared to biopsy report in all cases. Diagnostic accuracy was calculated in terms of positive predictive value, negative predictive value, sensitivity and specificity.

RESULTS:

Total of 117 patients were included in the analysis.The age range was 11 to 74 years with mean age of 48.7years. There were 79 male and 38 female patients with male to female ratio of 2.1:1.

Histopathology revealed a total of 100 malignant cases. Out of these the respective sub-sites of origin were – 71 in the bucco-alveolar region, 18 cases involving the tongue, 7 of the tonsils, and 2 involving the lips. There were 2 cases of maxillary sinus malignancy. (Figure 1)

On histopathology, there were 17 benign lesions includingfive cases of hyperplastic squamous epithelium, two patients each of odontogenicmyxoma and hemangioma. There was one patient each with epidermoid cyst, abscess/necrotizing fasciitis and actinomycosis fungal infection respectively. There were 5 patients with no tumor recurrence on post treatment follow-up examination.

The true positive cases (i.e malignant lesions) were 99. There were 14 true negatives (i.e benign lesions), 3 false positives and 1 false negative case. CT correctly identified malignant pathology in 99 of 100 cases. CT correctly excluded malignant disease in 14 of 17 patients with benign pathology. Therefore, the diagnostic accuracy of multidetector CT in determining malignant lesions is: specificity of 82.35%, sensitivity of 99%, positive predictive value of 99.05%, and negative predictive value of 93.33%.

MALIGNANT LESIONS:

The 100 malignant cases included 70 male and 30 female patients with male to female ratio of 2.3:1. The age range was between 25 to 74 years with mean

age of 50.3. Among the patients with malignant lesions, only five patients did not have any addiction, thirty five patients had addiction to tobacco chewing, forty six patients were addicted to tobacco as well as cigarette smoking, and three patients were alcoholic. (Figure 2)

All malignant lesion were squamous cell carcinomas of the respective subsites, however, there was one case of metastatic carcinoma with neuro-endocrine differentiation of the bucco-alveolar region.

Involvement of bone was observed in 35 cases, including involvement of maxilla in 10, mandible in 19 and involvement of maxilla and mandible both in 6 cases. (Figure 3) Among these 35 cases, the malignancy of buccoalveolar subsite involved the mandible in 15 cases, the maxilla in 7 and maxilla and mandible both in 6 cases. Two cases each of tongue and lips squamous cell carcinoma involved the mandible, whereas, two cases of the maxillary sinus subsiteand one of the tonsillar malignancyinvolved the maxilla.

Local neurovascular bundle involvement was observed in 18 of 100 malignant cases – including nine buccoalveolar, six tongue, two maxillary sinus and one case of tonsillar malignancy.

Lymphatic dissemination with morphologically malignant lymph nodes was observed in 74 patients. Distant metastasis with lung nodules was observed in 7 patients – all of these cases were of buccoalveolar origin.

BENIGN LESIONS:

The 17 cases of benign lesions included 9 males and 8 femaleswith male to female ratio of 1.1:1.0. The age range was between 11 to 66 years with mean age of 39.2 years. Eleven of these patients were addicted to tobacco chewing and one patient was alcoholic.

Local bone involvement was observed in 4 cases – two each of the maxilla and mandible. The underlying pathologies were two cases of odontogenicmyxoma, one case of fungal infection and one case of osteoradionecrosis.
Neurovascular bundle encasement was only observed in necrotizing fasciitis. Enlarged but benign appearing lymph nodes were observed in 6 patients.

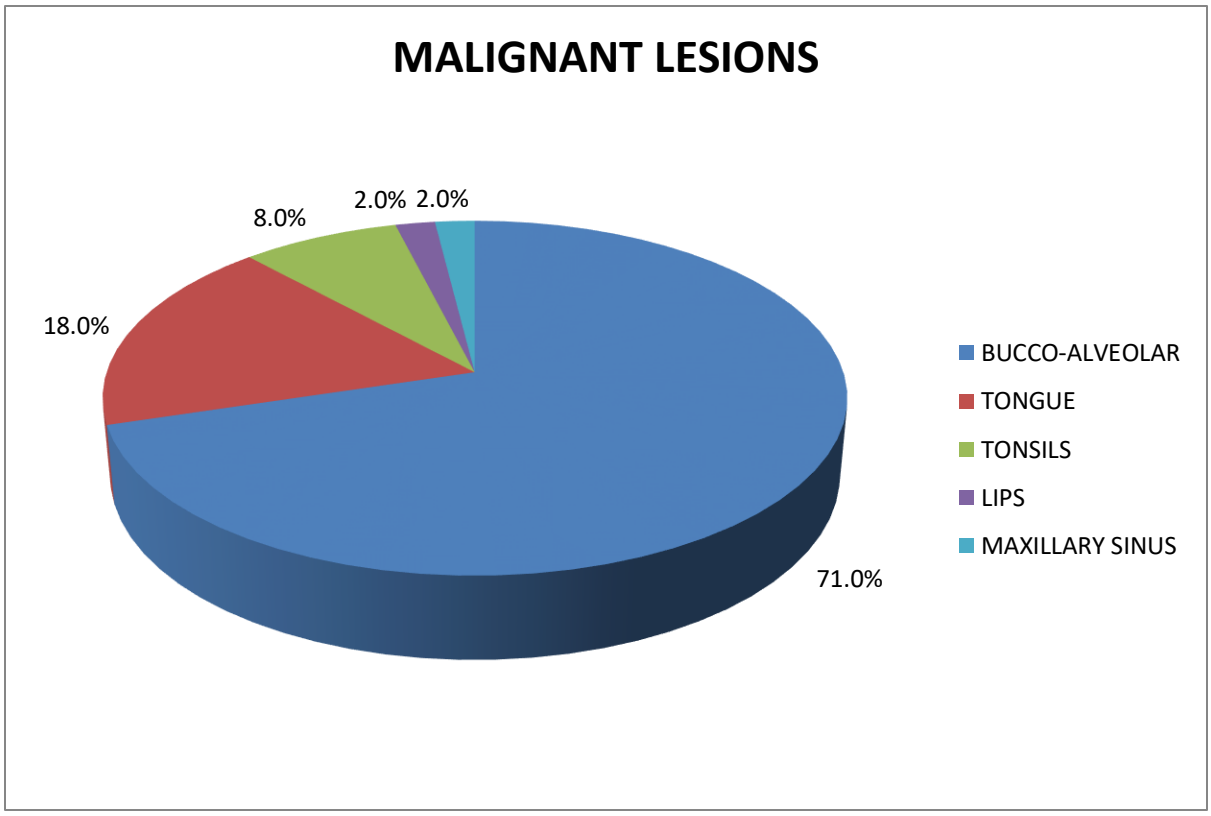

Figure 1: Malignant lesions: Subsites of origin: 71 in the bucco-alveolar region, 18 cases of the tongue, 7 of tonsils, and 2 each involving the maxillary sinus and lips.

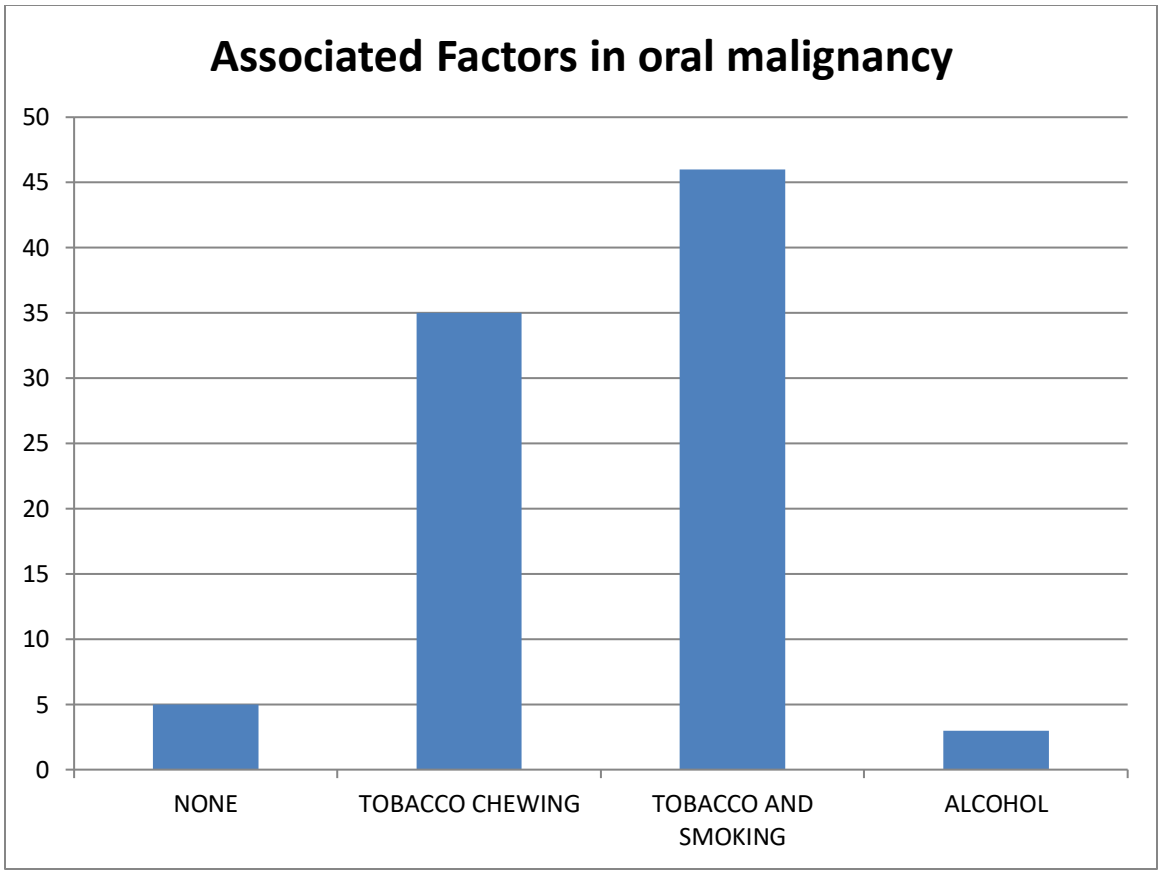

Figure 2: Thirty five patients were addicted to tobacco chewing, forty six to tobacco as well as cigarette smoking, and three patients were alcoholic

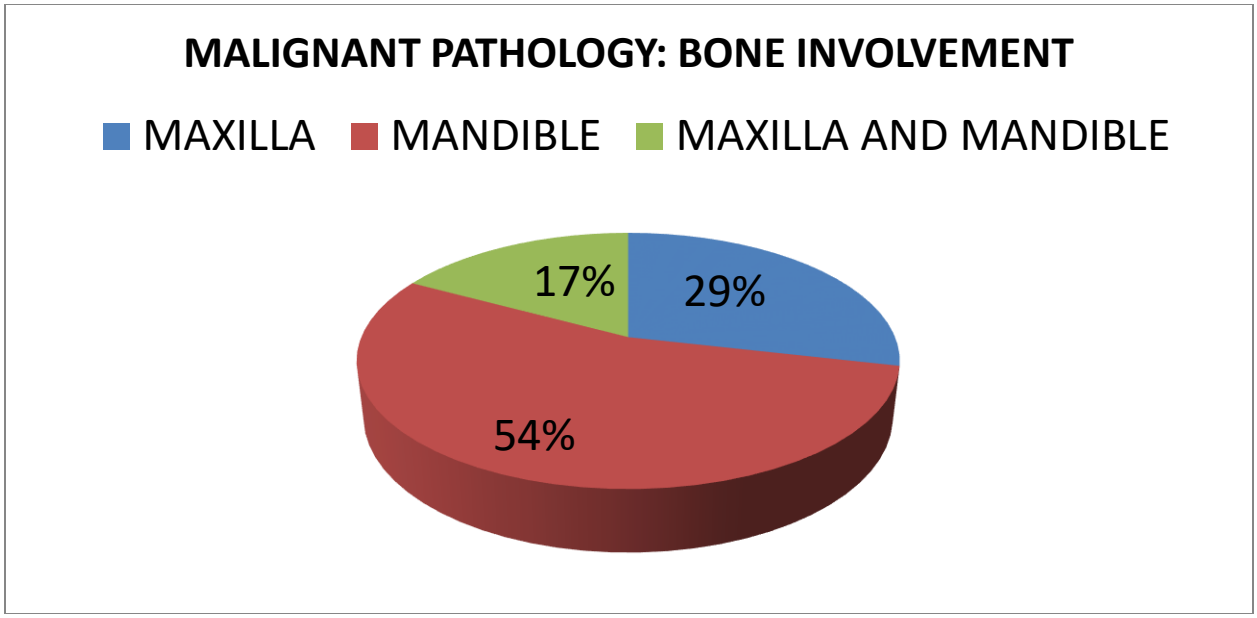

Figure 3: Involvement of bone was observed in 35 cases, including involvement of maxilla in 10, mandible in 19 and involvement of maxilla and mandible both in 6 cases.

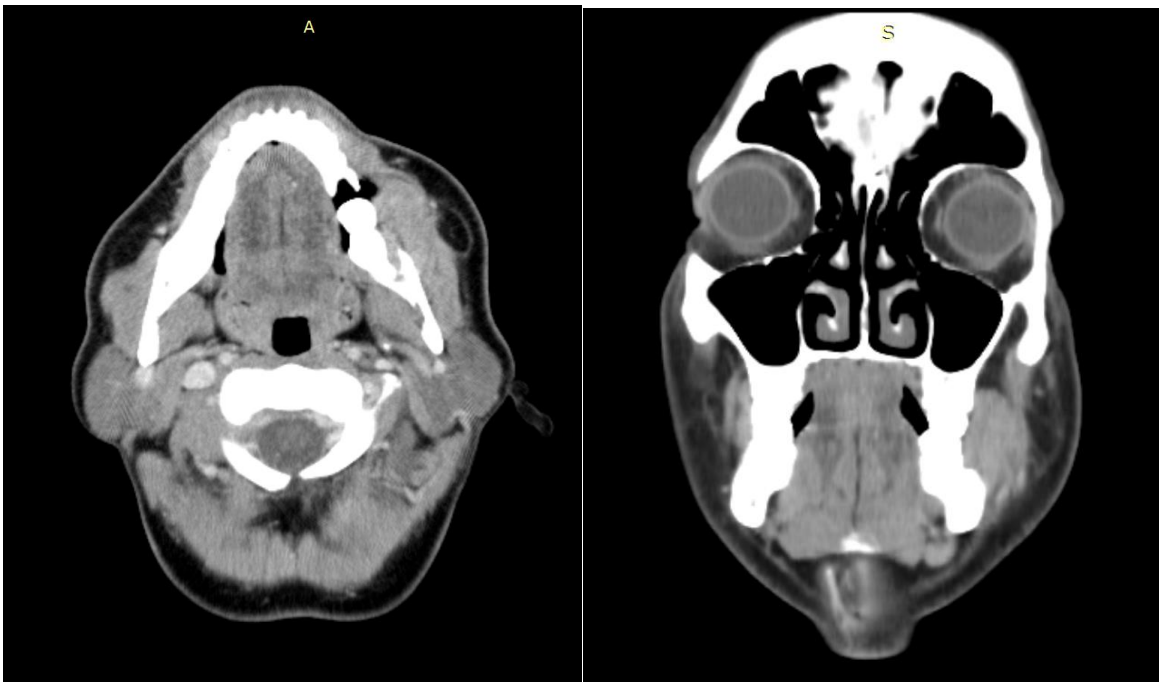

Figure 4: Enhancing solid mass in the left buccoalveolar region involving the buccinator muscle, extending into the retromolartrigone with erosion of mandibular ramus. Histopathology revealed fungal infection – Actinomycosis

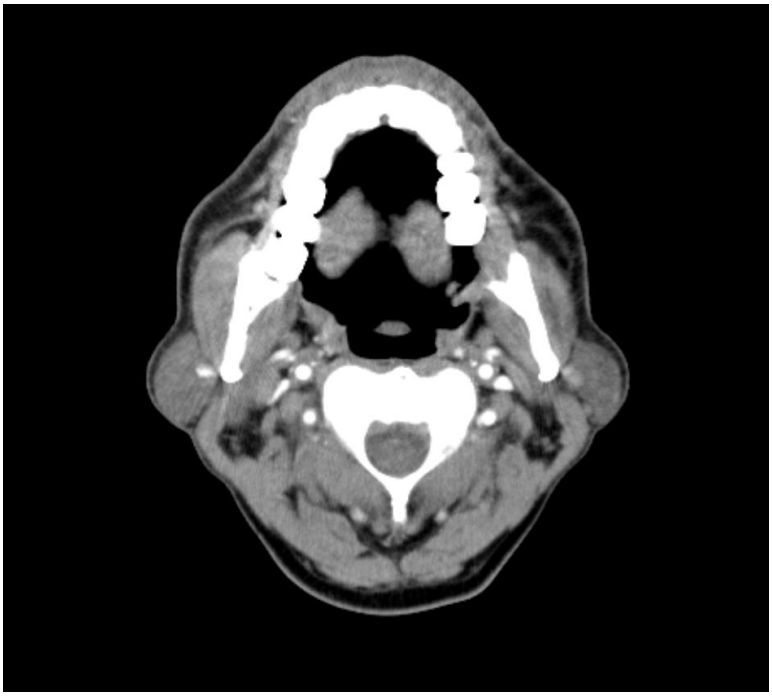

Figure 5: Soft tissue density lesion in left retromolartrigone. No definite post contrast enhancement is identified. It was diagnosed hyperplastic squamous epithelium on histopathology.

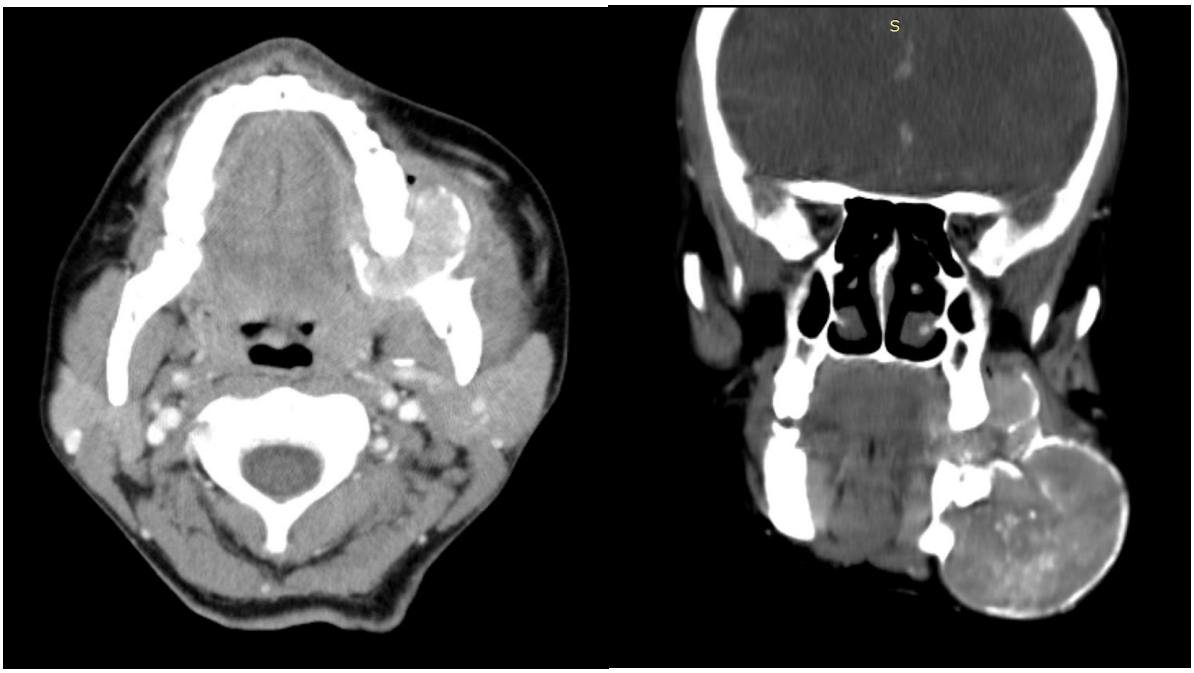

Figure 6: Expansileosteolytic lesion involving the left mandibular ramus with coarse calcific foci. It is displacing, but not infiltrating adjacent structures

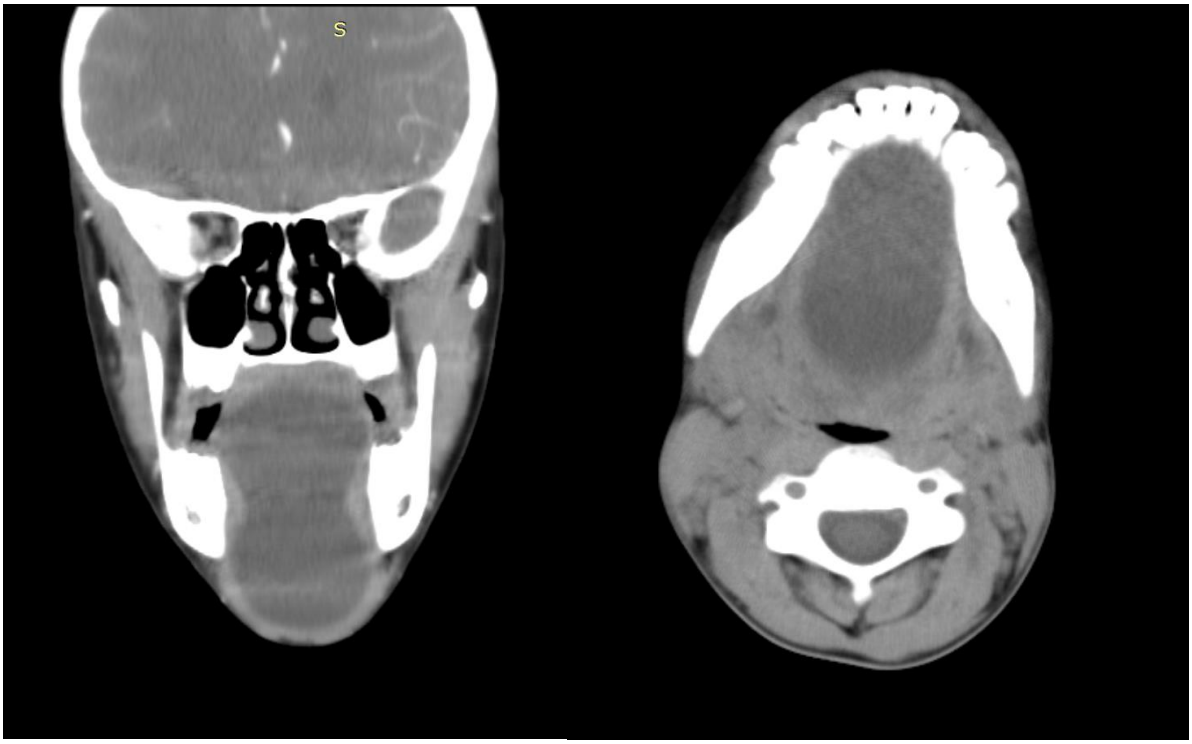

Figure 7: Epidermoid Cyst: Cystic lesion in the anterior part of tongue, displacing the genioglossus muscle, extending into the sublingual and submental spaces. No enhancement was seen after contrast administration.

DISCUSSION:

Malignant pathologies were more common in our study population with Squamous cell carcinoma as the most common entity; the commonest site being the buccoalveolar region. These were encountered in middle aged population (mean age 50.3 years) with male preponderance (M:F ratio of 2.3:1). A strong association between oral cavity and oropharynx squamous cell carcinoma with tobacco chewing was observed in our study. 91% of the patients were addicted to one or more forms of tobacco.

On CT the malignant pathologies had irregular margins, infiltrating and invading adjacent structures including muscles, bones, skin and subcutaneous tissues. The neurovascular bundles were abutted or invaded in eighteen patients. Lymphatic dissemination was seen predominantly in tonsillar malignancy, followed by tongue and buccoalveolar regions. However, bone invasion was predominantly from buccoalveolar carcinoma.

In our study, we had onepatient diagnosed as metastatic carcinoma with neuroendocrine differentiation of left buccoalveolar region. This case was of an elderly female with aggressive tumor involving the retromolar trigone, left upper maxilla, maxillary sinus, masticator space and infratemporalfossa.

There was one false negative case of a 30 year old patient with squamous cell carcinoma of right bucco alveolar region. She underwent surgical excision as well as chemoradiation. On follow-up CT, there was a peripherally enhancing hypodense lesion in the right bucco-alveolar region with extension into oral cavity and infratemporal fossa. On imaging it was reported as soft tissue abscesses, however, histopathology revealed this to be tumor recurrence.

There were three cases that were reported as malignant lesions on CT imaging findings, however, biopsy revealed them to be benign pathologies. The first case was a 54 year old female, addicted to betel nut, who presented with right buccal mass since the last 6 months. CT showed an enhancing mass in right buccoalveolar region involving the buccinators muscle. The underlying bone was intact. The ipsilateral level Ib lymph node was 1.8cm in long axis on axial section. On histopathology, this lesion was reported to be hyperplastic squamous epithelium.

The second case was of a 42 year old alcoholic male who presented with a left buccal mass. CT revealed a well-defined enhancing solid mass in the left buccoalveolar region involving the buccinator muscle, extending into the retromolar trigone with erosion of adjacent mandibular ramus. Histopathology revealed fungal infection – Actinomycosis (Figure 4).

Third false positive case was of a 35 year old male with biopsy proven buccoalveolar carcinoma, status-post surgery, and chemo radiation. On CT this patient had a heterogeneously enhancing swelling of the lower lip and angle of mouth involving the skin, subcutaneous tissues as well as the muscles. It was given as suspicious of recurrent/ residual disease due to close proximity to the excision margin, site and enhancement pattern. However no recurrence was reported on histopathology.

In our study, we encountered a diverse group of benign oral pathologies. Benign lesions were more common in younger females; most common being squamous hyperplasia. Seventy percent of benign lesions were also associated with exposure to tobacco.

There were five cases of hyperplastic squamous epithelium – three of these involving the buccal mucosa and two involving the tongue. These lesions were well defined non-enhancing or mildly enhancing with no significant perilesional infiltration. No malignant lymph nodes were observed in these patients. (Figure 5)

Twocases were of bone pathology - odontogenicmyxoma. One of them was a twenty two year old female with no history of addiction, fever or trauma was given by the patient. On CT there was an enhancing expansileosteolytic lesion involving the left mandibular ramus with coarse calcific foci. It was displacing, but not infiltrating adjacent structures (Figure 6). The other patient was a 27 year old female with similar lesion involving the right maxilla.

There was one case of an 11-year old boy with fluctuant swelling in the floor of mouth. CT is in this patient demonstrateda midline cystic lesion in the anterior part of tongue, displacing the genioglossus muscles. It was extending into the sublingual and submental spaces. No enhancement was seen after contrast administration. No cervical lymph nodes were noted. This was diagnosed as an epidermoid cyst. (Figure 7)

One case was of a 23 year old female with reddish lesion on the mucosa of hard palate. On CT scan, it was a small well defined mass in the hard palate with delayed enhancement on contrast administration. No calcification or local invasion was seen.Itwas a hemangioma of the hard palate.

Another case was of aneleven year old girl referred to our CT department withmass in left buccal region. CT revealed a hypodense mass with foci of coarse calcification in left buccal region extending posteriorly to the masticator space displacing adjacent structures. It showed peripheral serpigenousenhancement on post contrast images. No local invasion was noted. Benign appearing enlarged lymph nodes were seen at cervical levels I, II and V bilaterally. It was diagnosed as hemangioma on CT as well as on histopathology.

There was one case of necrotizing fasciitis - A middle aged male patient with swelling involving the right side of face and fever. Imaging revealed diffuse swelling of muscles of buccal and masticator space with extensive foci of air extending into the lingual region. Adjacent fat stranding and skin thickening was also noted. It was reported as extensive inflammatory cells on histopathology.

Our data is in concert with published foreign data which depicts that more than 90 % of head and neck cancers are of epithelial origin, of which squamous cell carcinoma constitutes the greatest majority.[19]

In contrast to our study, the statistics provided by Cancer Research UK depict the largest proportion of oral cancer cases occur in the tonsils, with smaller proportions in the base of the tongue, floor of the mouth and palate. Most of these oral cancer cases were linked to exposure to tobacco smoke – 65%of cases, followed by alcohol consumption in 30% cases.[20] However, similar studies conducted on our local population also detected strong association with tobacco smoking and chewing betel quid and its substitutes.[21]

The male to female ratio of 2.3:1 in our study was in accordance with data presented by Chester et al and Braachius et al, studying the American and Netherland populations respectively, that males are twice as likely as females to be diagnosed with oral and oropharyngeal cancer.[22,23]

The limitation of our study was small sample size. Also, the study was conducted at a public sector hospital where majority of the patients belong to low socio-economic group. Therefore, our results may not reflect the true picture of the local population.

CONCLUSION:

CT has a high accuracy in diagnosing and differentiating between the benign and malignant lesions presenting as an oral lump. Malignant pathologies were more common in elderly males; most common being bucco-alveolar carcinoma.Benign lesions were more common in younger females; most common being squamous hyperplasia. However, both are associated with tobacco use.

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