"ROLE OF IMAGING (CT) IN STAGING OF ORAL CAVITY MALIGNANCIES WITH CLINICO-PATHOLOGICAL CORRELATION"

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With reference to the above, we wish to inform you that your proposed research project titled **"ROLE OF IMAGING (CT& MRI) IN STAGING OF ORAL CAVITY MALIGNANCIES WITH CLINICO-PATHOLOGICAL COORELATION"** is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee.

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LIST OF ABBREVIATIONS

CT	**COMPUTED TOMOGRAPHY**
DOI	**DEPTH OF INVASION**
OSCC	**ORAL SQUAMOUS CELL CARCINOMA**
SCC	**SQUAMOUS CELL CARCINOMA**
MRI	**MAGNETIC RESONANCE IMAGING**
UICC	**UNION INTERNATIONAL CONTRE LE CANCER**
SCCOC	**SQUAMOUS** MOBILE CARCINOMA OF THE ORAL HOLLOW SPACE
OSF	**ORAL SUBMUCOUS FIBROSIS**
PET	**POSITRON EMISSION TOMOGRAPHY**
CECT	**CONTRAST-ENHANCED COMPUTED TOMOGRAPHY**
ITF	**INFRATEMPORAL FOSSA**
US	**ULTRASONOGRAPHY**
PPV	**POSITIVE PREDICTIVE VALUE**
NPV	**NEGATIVE PREDICTIVE VALUE**

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ABSTRACT

BACKGROUND: Malignant lesions with similar morphology as bone might be clinically hamper the diagnosis on plain radiography. Might need unnecessary bone excision or poor prognosis due to mislead diagnosis. Hence, the most reliable radiological investigation would be needed to sort this.

OBJECTIVES: To evaluate the efficacy of preoperative imaging in the assessment of tumor depth of invasion (DOI) in oral squamous cell carcinoma (OSCC) and correlate with histopathological findings and assess the accuracy of imaging-based estimation of DOI in relation with the tumor histological DOI.

METHODOLOGY: Thirty diagnosed cases of oral malignancy aged more than 18 years of either gender were included for a period of 1 year conducted using 128 slice Computed Tomography machine manufactured by GE Healthcare.

RESULTS: The average age of subjects is 52.57± 11.13 years with male predominance including 21 (70%) males and 9 (30%) females. 26 (86.67%) had recurrence of the tumor and 4 (13.33%) were identified as new cases. Buccal mucosa was the most common site affecting 22 (73.33%). The observed sensitivity, specificity of CT was 96%, 33.33% with 100% of PPV and NPV. The accuracy was 96.38%.

CONCLUSION: CT could be one of the reliable diagnostic modalities in staging oral cancer with 96% of the sensitivity and 100% of positive as well as negative predictive value. With the accuracy of 96.38%, it would give us the specific diagnosis of bone invasion as well.

KEYWORDS:

Computed tomography, Squamous cell carcinoma, Depth of invasion (histological and imaging based), pre-operative assessment, clinico-pathological correlation, TNM staging, bone invasion,

INTRODUCTION

Oral cavity is a hollow structure from where the digestive system starts. The tongue, hard and soft palate, uvula, tonsillar bed, oro-pharyngeal system, and tongue are the components of oral cavity. Oral mucosa resides many normal commensals protecting the oral cavity from various diseases. Oral cancer or the cancer mouth-larynx-pharynx is one of the malignant conditions seen due to various etiological factors.[1,2]

Meanwhile, with the increased prevalence of tobacco usage in India, especially among the younger generation, we could see the raise in cases of oral and lung cancers as well. Because this has been one of the commonest associated etiologies.[3] Either due to lack of awareness among the general population about pre-malignant lesions or due to lack of available nearby healthcare facilities, the patients with oral cancer are seeking for management at late stages of cancer.[4]

Also, if the diagnosing of stage of this cancer is not efficient, changes of missing the depth of invasion could lead to ineffective management and hence the upgraded prognosis of cancer.[5] Increased Accurate evaluation of primary tumors and cervical lymph node status of squamous cell carcinoma (SCC) of the oral cavity is important for treatment planning and prognosis prediction.[6]

Though the histopathology is gold standard, pretherapeutic staging of tumours by other radiological imaging modalities of the oropharynx, the oral cavity and the floor of the mouth

is crucial, must be thorough and exact to ensure appropriate therapy.[7] Principally important is the assessment of infiltration of deeper compartments and the topographic relationship of tumour to vascular structures (lingual artery and vein, hypoglossal nerve), or the presence of spread of the tumor across the midline. As

spread of tumor may occur to a large degree underneath normal appearing mucosa, clinical assessment of the true tumor extent is difficult.[8,9]

The depth of invasion (DOI) of any considered tumor would be measured histological examination by the basal membrane of the normal mucosa perpendicularly to the deepest portion of invasion which is integrated into the newest 8th Union International Contre le Cancer (UICC), TNM Classification for Malignant Tumors for oral SCC.[10]

Cross-sectional computed tomography (CT) and magnetic resonance imaging (MRI) have been observed with vital role in staging loco-regional disease by demonstrating submucosal spread and involvement of deep layers.[11] Evaluation of specific pathways of spread to peculiar anatomical subsites is also fundamental information that can be obtained with these techniques as mentioned prior but few evidences have reported that these radiological evaluation by CT or MRI could overestimate it by 20 to 30%.[12] Also, few had opined that in superficial spreading, especially those cancer lesions less than 5 mm, chances of overestimation are worse.[13,14]

Meanwhile, few authors have reported DOI being an independent predictor even among the cases of early tumours and that these tumours might benefit from aggressive upfront surgery.[15]

Whereas other group of scholars have observed the CT and MRI being analysing the tumours with their measurement variation specific. So, with all the data mining we did, we could see that the rate of imaging-related artifacts execution the assessment of pre-operative DOI reliable but the extent varies. Hence, we took this present study to illustrate accuracy of CT and MRI findings of anatomical subsites involved by tumours of the oral cavity.

OBJECTIVE

- To evaluate the efficacy of preoperative imaging in the assessment of tumor depth of invasion (DOI) in oral squamous cell carcinoma (OSCC) and correlate with histopathological findings
- To assess the accuracy of imaging-based estimation of DOI in relation with the tumor histological DOI.

REVIEW OF LITERATURE

HISTORICAL VIEW OF ORAL CANCER

Oral cancer is a widely wide-spread shape of most cancers, mainly in developing countries but additionally in the advanced global. The maximum common type is squamous cell carcinoma (SCC), that is by and large because of tobacco and alcohol use. Disparities among the developing and Western international may be attributed to differences in population habits, existence expectancies, preventive schooling, and the high quality of medical statistics.[16]

HISTORICAL ASPECTS OF ORAL CANCER

There are many theories from the era of 1550 BC and till date.

Table 1: Summary of chronology of events occurred around Oral Cancers [17]

Chronology	Main Events
3000–1600 BC	Edwin Smith and Ebers' Egyptian papyri descriptions of cancers
1000 BC	The encyclopedic Sanskrit medical text, Sushruta Samhita, describes different head and neck cancers.
6th century BC	Pythagorean Alcmaeon's of Croton studies on the oral sensory system in "Περι Φυσεως" (About Nature).
15th– 17th century AD	Introduction of tobacco in the Western World The surgeon P. Marchetti performs the first glossectomy for tongue cancer.
17th–19th century	Infectious theories about origin of cancer. First hospital for cancer patients in Rheims, France

19th century	Introduction of general anaesthesia in 1846 allowed increasing cancer excisions with the development of many surgical access routes for oral cancer.
1885	Henry T. Butlin, head and neck surgeon, describes in his book "Diseases of the Tongue" an even more radical dissection of the primary tumor "en bloc" with surroundings cervical nodes.
1905–1906	G.W. Crile (1864-1943) publishes two papers describing a systematic and radical approach to "en bloc" dissections.
2002	The American Head and Neck Society standardizes neck dissection terminology and techniques, dividing neck nodes in a 6-level classification system.
21th century	Even more super-selective nodes dissections in early tumours with multi-integrated pharmacological therapies and reconstructive surgery.

EPIDEMIOLOGY AND ETIOLOGY

Oral cancer remains a vast international health problem, with an anticipated 405,000 new cases reported every year globally. The nations which provide the very best fees for oral cancers encompass Sri Lanka, India, Pakistan, Hungary, Bangladesh, and France.[18] Also, Considering the European Union separately, there are approximately sixty-six,650 new instances yearly. In the United States, the American Cancer Society predicts 42,440 new cases of oral hollow space and pharynx cancer, resulting in 8,390 deaths in 2014.[19]

Tobacco smoking and alcohol consumption are the primary elements contributing to squamous mobile carcinoma of the oral hollow space (SCCOC). Additionally, behaviors including betel nut and tobacco chewing were associated with better oral cancer quotes in the Asian population. Tobacco includes numerous carcinogenic materials, especially polycyclic hydrocarbons, and nitrosamines. There is an instantaneous correlation among the length of tobacco use (measured in p.C. Years) and the threat of developing SCCOC.[20,21]

Oral cancer is commonly diagnosed in men and normally takes place after the age of fifty. Approximately 5% of people recognized with oral cancer could have any other synchronous primary tumor in the oral hollow space or the aero-digestive tract which consists: larynx, esophagus, or lungs.[22]

Status of oral cancer in India

Oral cancer is a giant public health difficulty in India, affecting a large part of the populace. The danger is mainly high a number of the low-income populace, who're exposed to diverse risk elements.

The fundamental cause of oral cancer in India is tobacco consumption. The utility of tobacco in exclusive paperwork consisting of gutka, zarda, kharra, mawa, khaini, bidi, cigarettes, hookah etc contributes to the development of tumors within the oral hollow space among younger and grownup individuals. There is a sizeable gender-based total distinction in the incidence of tobacco-associated oral cancer, with men displaying a higher rate.[23,24]

ANATOMY OF ORAL CAVITY

The oral cavity, more commonly known as the mouth or buccal cavity, serves as the first portion of the digestive system. It includes the lips, tongue, palate, and teeth. The oral cavity, although smaller space, it is a complex structure-housing various components, their nerves and blood vessels. This intricate network plays a crucial role in human life due to the diverse functions it serves.

Parts of the Oral Cavity:[25-28]

The oral hollow space is an essential anatomical shape that extends from the oral fissure: the opening between the upper and the lower lips anteriorly to the oropharyngeal isthmus: the outlet to the oropharynx posteriorly.

The anatomy of the oral cavity can be divided into two primary parts. These parts are named as the vestibule and the mouth cavity. We have the upper dental arch and the lower dental arch, which serve as dividers between these two parts

1. **Vestibule:** The vestibule is the area among the lips or cheeks and the outer floor of the upper and lower dental arches. It is a space that lets in for motion of the lips and cheeks throughout speech, swallowing, and different oral functions.

2. **Mouth Cavity Proper:** This is the cavity that lies among the higher and lower dental arches. It includes the tongue, palate, gums, and teeth. The mouth hollow space right is often considered in obligations which include chewing, swallowing, and speech manufacturing.

The upper and lower dental arches, shaped by using the tooth and their helping structures, divide the oral cavity into these two compartments. The dental arches play a critical function in mastication (chewing) and articulate speech.

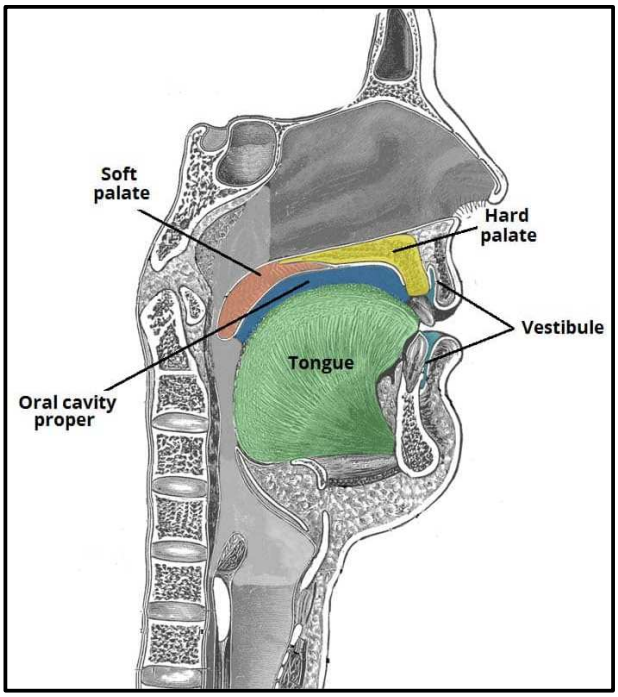


Figure 1: Simple schematic representation of oral cavity[29]

Structure and Function

The oral hollow space is surrounded by the lips and includes primary components: the vestibule and the oral cavity proper.

The first component i.e. the vestibule is the space that is enveloped by the enamel, cheeks, and lips.

The tongue plays a crucial role in the digestion process by compressing and manipulating food against the palate to form a bolus that can be swallowed.

Additionally, the tongue has papillae on its upper surface that house taste buds, enabling the perception of flavour.

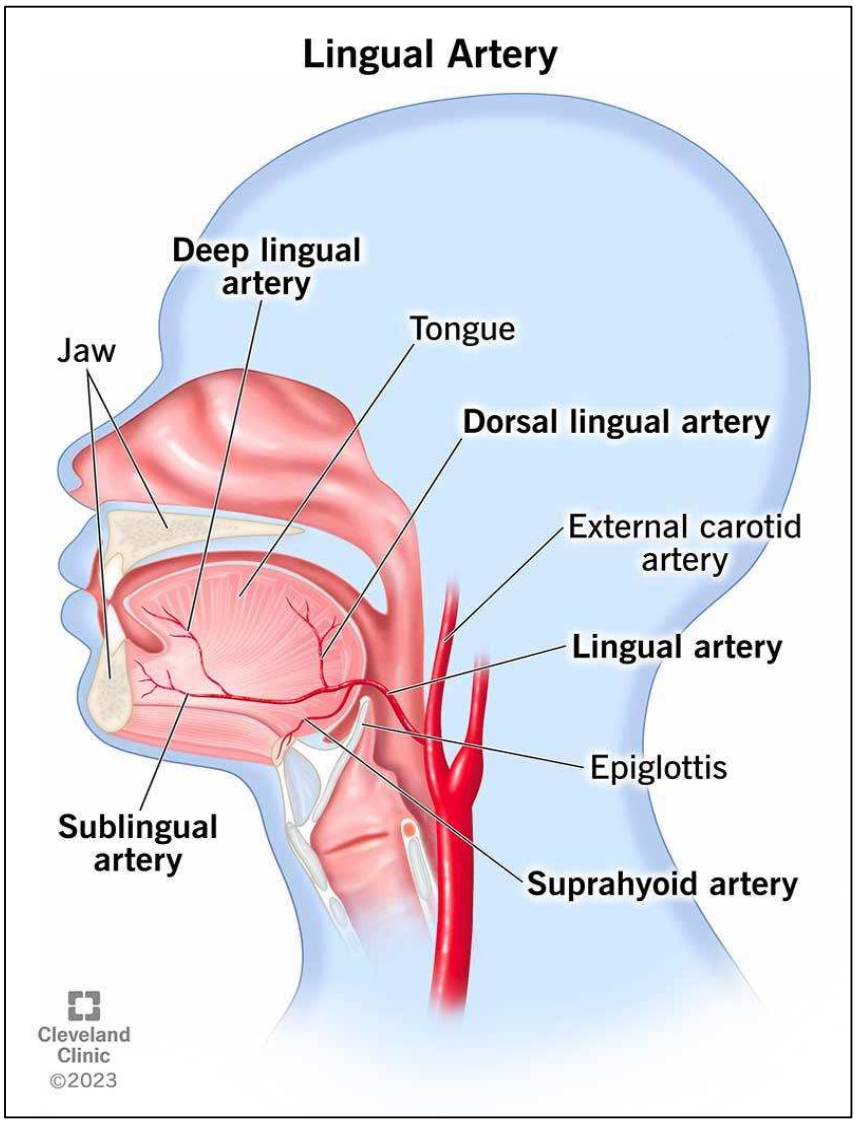
The palate acts as a physical barrier that separates the mouth from the nasal passages, allowing for simultaneous breathing and eating. It directs airflow through the nasal passages and prevents it from entering the mouth while chewing or swallowing.

To conclude, the oral cavity is critical for capabilities along with food digestion, speech formation, and everyday breathing. Its complex structures and interactions contribute to our capability to nourish ourselves and speak efficiently.

Blood Supply and Lymphatics

The blood supplied to the oral cavity primarily comes from branches of the external carotid artery.

The diagram below illustrates the main arteries and their respective areas of supply



Arterial supply to the oral cavity[30]

Nerves

The oral cavity is innervated mainly by the maxillary and the mandibular divisions of the trigeminal nerve. The oral mucosa, enamel, and supporting structures receive their innervation from these two trigeminal nerve divisions.

The tongue has complex innervation. Motor innervation to all intrinsic and extrinsic muscles, except for the palatoglossus, arises from the hypoglossal nerv, while the palatoglossus is innervated by the vagus nerve. The anterior 1/3rd of the tongue receives taste sensation from a branch of the facial nerve called the chorda tympani nerve. The posterior one-third of the tongue receives both sensory and taste sensations from the glossopharyngeal nerve. The buccal nerve, which is also a branch of the mandibular division of the trigeminal nerve, innervates the cheek.

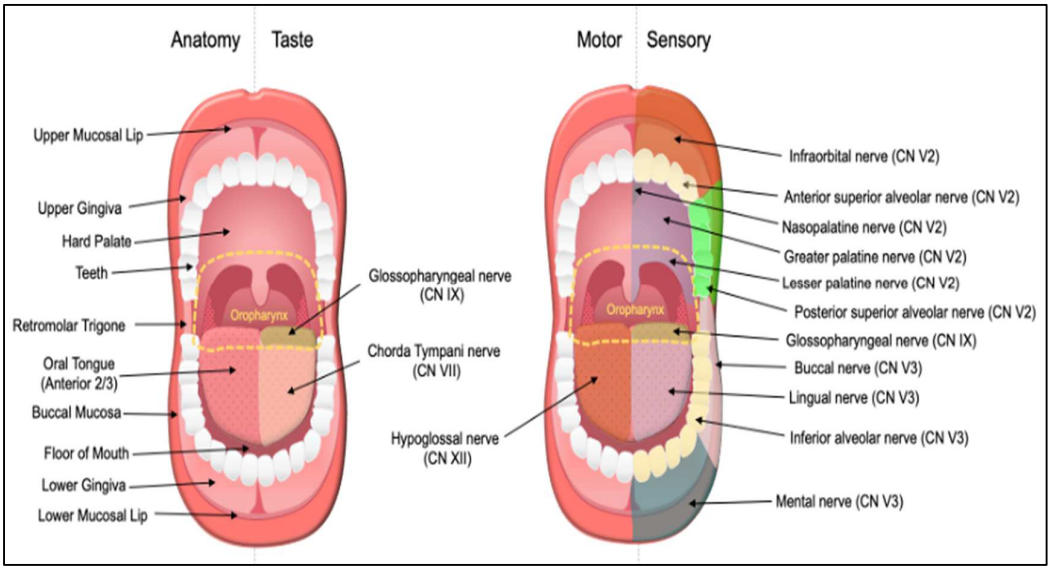


Figure 3: Nerve supply and division of oral cavity based on the nerve supply[31]

Muscles

The oral cavity contains several muscles that are important for various functions such as swallowing and speech. Here are some examples:

1. ***Mylohyoid and geniohyoid:*** Thes muscles form the floor of the oral cavity and help in the elevation of the hyoid-laryngeal complex during swallowing.

2. ***Tensor veli palatini:*** They tense and anteroinferior movement of the soft palate.

3. ***Musculus uvulae:*** Bulk of the uvula and helps in its shortening and thickening. It contributes to the sealing of the nasopharynx from the oropharynx during swallowing.

4. ***Levator veli palatini:*** This muscle elevates the soft palate and assists in closing off the nasopharynx during swallowing. It also assists in opening the auditory tube.

5. ***Palatopharyngeus and Palatoglossus:*** For raising the back of the tongue, nasopharynx and soft palate during swallowing.

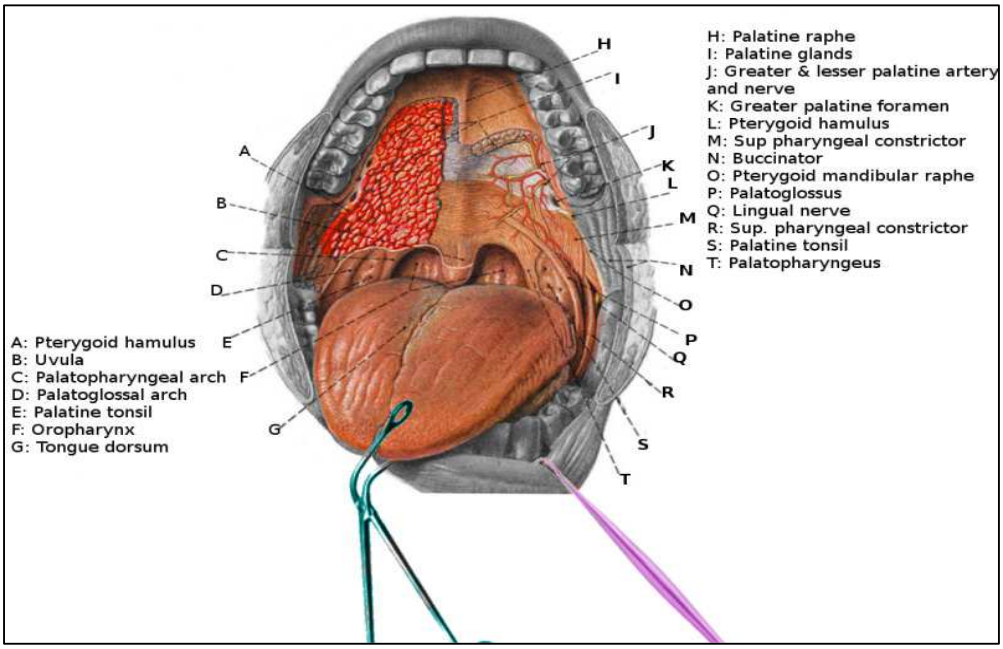


Figure 4: Major muscular attachments in the oral cavity[32]

LYMPH NODES IN THE NECK

Cervical lymph nodes are categorised based totally on their locations in the neck. The class gadget maximum typically used is the Level-primarily based Classification. Here are the tiers and their corresponding lymph node companies:

Level I: Submental and Submandibular

- Submental nodes: Located under the chin in the midline.

- Submandibular nodes: Located alongside the inferior mandible border.

Level II: Upper Jugular

- Superior deep lateral cervical nodes: Located along the course of the internal jugular vein , starting from the cranium base to the level of the hyoid bone.

Level III: Middle Jugular

- Inferior deep lateral cervical nodes: Located along the internal jugular vein from the level of the hyoid bone to the extent of the cricoid cartilage.

Level IV: Lower Jugular

- Deep imperative cervical nodes: Located inside the center of the neck alongside the internal jugular vein from the extent of the cricoid cartilage to the clavicle.

Level V: Posterior Triangle

- Posterior cervical nodes: These nodes are in the posterior triangle of the neck.

Level VI: Anterior Compartment

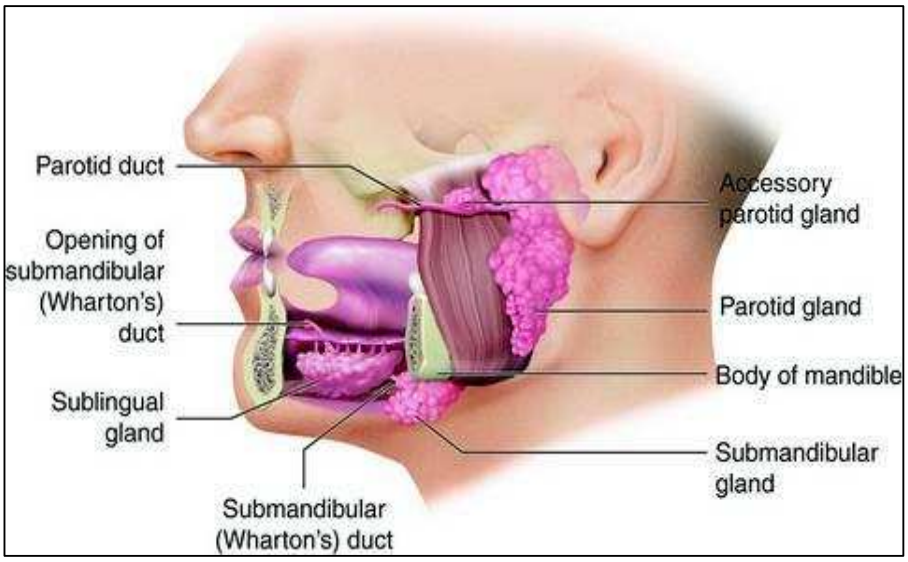
- Pretracheal (Delphian) nodes: These nodes are in the midline anterior to the trachea.

- Paratracheal nodes: These nodes are along the trachea and adjoining to the thyroid gland.

Level VII: Superior Mediastinal

- Superior mediastinal nodes: Located in the superior mediastinum under the trachea.

Figure 6: Lymphatic system of oral cavity[34]



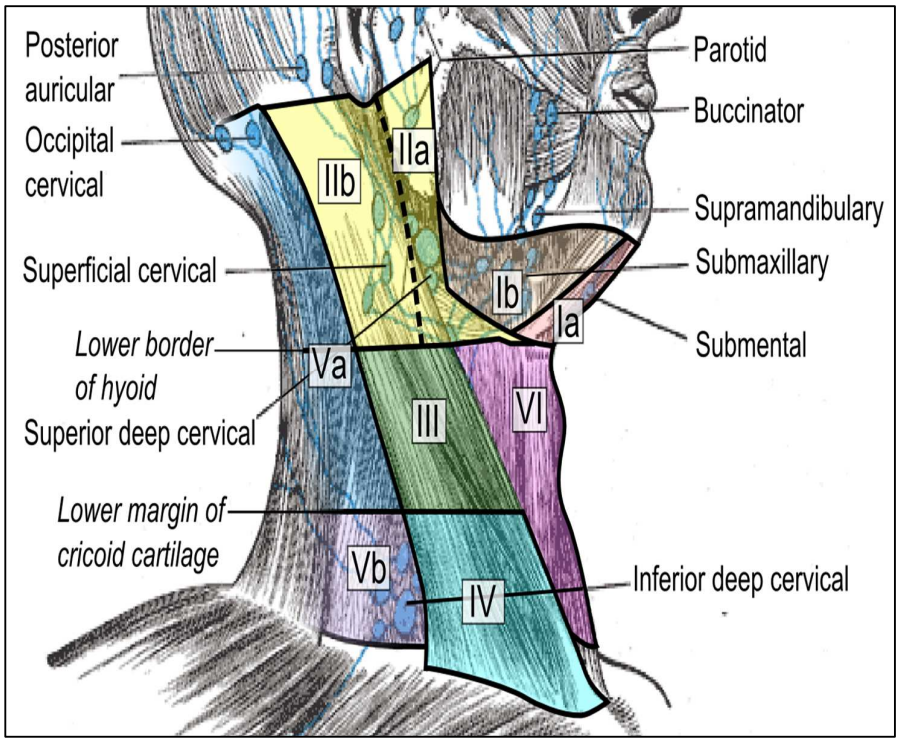


Figure 7: Cervical lymph node levels[33]

MALIGNANCY OF ORAL CAVITY

Squamous cellular carcinomas (SCC) are responsible for >90% of oral cancer cases, even as different malignant tumors can originate from diverse resources including the epithelium, connective tissue, minor salivary glands, lymphoid tissue, or even metastasize from remote tumors.[35]

The development of SCC or any other type of malignancy arise from the premalignant lesions as described below;[36-39]

1. ***Leukoplakia***: A white patch or plaque that cannot be described by any disease. Commonest among smoking and alcohol intake. Dysplastic changes are in 2-5% of leukoplakia cases and the once-a-year malignant transformation is around 1%.

2. ***Erythroplakia***: A brilliant purple velvety patch, considered greater concerning than leukoplakia due to its higher fee of dysplastic changes and more probability of malignant transformation, envisioned at around 70%.

3. ***Oral submucous fibrosis (OSF)***: A chronic disorder characterized by fibrosis of the lining mucosa of the upper digestive tract involving the oral cavity, oropharynx and frequently the upper third of the esophagus.

4. ***Nicotine stomatitis***: In this premalignant lesion, the mucosa of the palate is thickened, and hyperkeratotic. This lesion is usually associate with pipe smoking.

Also, various other palatal lesions, keratosis especially among tobacco smokers/chewers, actinic keratosis of oral and buccal mucosa, epidermolysis bullosa could be turning into malignant lesions in the future.

Table 3: TYPES OF BENIGN AND MALIGNANT LESIONS OF THE ORAL CAVITY [40-42]

EPITHELIAL TUMOURS AND LESIONS 1. Squamous cell carcinoma 2. Oral epithelial dysplasia- Low Grade and High Grade **3.** Proliferative verrucous leukoplakia
PAPILLOMAS 1. Squamous cell carcinoma 2. Condyloma acuminatum 3. Verruca vulgaris **4.** Multifocal epithelial hyperplasia
TUMOURS OF UNCERTAIN HISTOGENESIS 1. Congenital granular cell epulis **2.** Ectomesenchymal chondromyxoid tumour
SOFT TISSUE AND NEURAL TUMOURS 1. Granular cell tumour 2. Rhabdomyoma 3. Lymphangioma 4. Haemangioma 5. Schwannoma 6. Neurofibroma 7. Kaposi sarcoma 8. **9.** Myofibroblastic sarcom

SALIVARY TYPE TUMOURS
1. Mucoepidermoid carcinoma **2.** Pleomorphic adenoma
HAEMATOLYMPHOID TUMOURS
1. CD30-positive T-cell lymphoproliferative disorser 2. Plasmablastic lymphoma 3. Langerhans cell histiocytosis **4.** Extramedullary myeloid sarcoma

Table 2 : TNM CLASSIFICATION OF CARCINOMAS OF THE ORAL CAVITY

WHO histological classification of tumours of the oral cavity and mobile tongue

T — PRIMARY TUMOR	
TX	Primary tumor cannot be assessed
T0	No evidence of primary tumor
Tis	Carcinoma in situ
T1	Tumor 2 cm or less in greatest dimension
T2	Tumor more than 2 cm but not more than 4 cm in greatest dimension
T3	Tumor more than 4 cm in greatest dimension
T4a (lip)	Tumor invades through cortical bone, inferior alveolar nerve, floor of mouth, or skin (chin or nose)

T4a (oral cavity)	Tumor invades through cortical bone, into deep/extrinsic muscle of tongue (genioglossus, hyoglossus, palatoglossus, and styloglossus), maxillary sinus, or skin of face
T4b (lip and oral cavity)	Tumor invades masticator space, pterygoid plates, or skull base; or encases internal carotid artery
N - REGIONAL LYMPH NODES	
NX	Regional lymph nodes cannot be assessed
N0	No regional lymph node metastasis
N1	Metastasis in a single ipsilateral lymph node, 3 cm or less in greatest dimension
N2	Metastasis as specified in N2a, 2b, 2c below
N2a	Metastasis in a single ipsilateral lymph node, more than 3 cm but not more than 6 cm in greatest dimension
N2b	Metastasis in multiple ipsilateral lymph nodes, none more than 6 cm in greatest dimension
N2c	Metastasis in bilateral or contralateral lymph nodes, none more than 6 cm in greatest dimension
N3	Metastasis in a lymph node more than 6 cm in greatest dimension
M – DISTANT METASTASIS	
MX	Distant metastasis cannot be assessed
M0	No distant metastasis
M1	Distant metastasis

Stage		TNM staging	Criteria
I		T1N0M0	Tumour less than 2 cm
II		T2N0M0	Tumour more than 2 cm but less than 4 cm
III		T3N0M0 or T1/T2/T3 -N1 M0	Tumour >4 cm or ipsilateral node <3 cm
IV	IV A	T1/T2/T3 -N2 M0 or T4a N0/N1/N2 M0	All N2 lesions. Invasive lesions involving cortical bone, intrinsic or extrinsic muscles of the tongue, maxillary sinus, or skin.
	IV B	T1/T2/T3 -N3 M0 or T4b -N1/N2/N3 M0	All N3 lesions. Invasive lesions infiltrating masticator space, pterygoid plates, skull base or encase the carotid artery.

Figure 8: TNM classification and staging[43]

DIAGNOSIS OF ORAL CAVITY

Diagnostic modalities of oral or any other given cancer conditions are crucial parts of the management. Below are some requirements as a prerequisite with an algorithm for the diagnosis.[43]

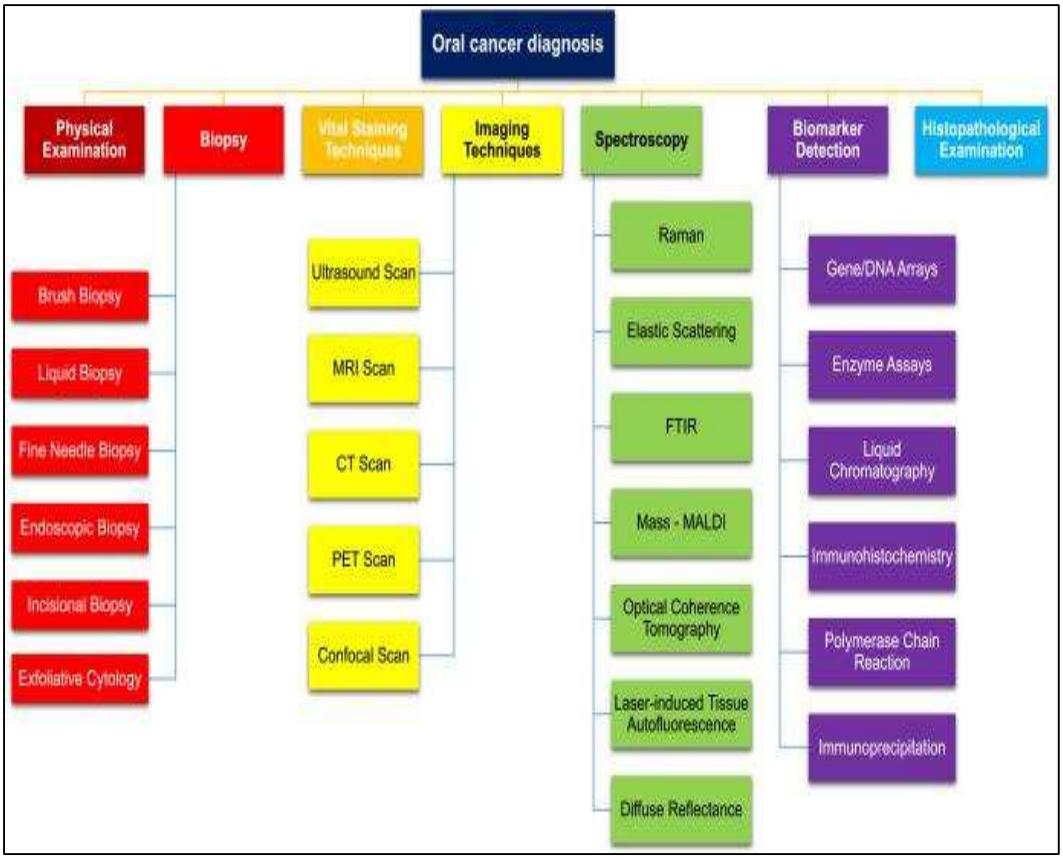


Table 4: Techniques and Diagnostic Modality used for Oral Cancer [44]

Sr. No.	Technique	Principle/Mechanism	Specimen	Sensitivity
1.	Autofluorescence spectroscopy	Autofluorescence spectroscopy and imaging	Oral tissue	91.1%
2.	Computed tomography	Ionizing radiation (X-ray)-based tissue imaging	Soft tissue in head and neck region *(in situ)*	NA
3.	Confocal microscopy	Optical imaging	Oral mucosal cells	NA
4.	Magnetic resonance imaging	Non-ionizing radio frequency electromagnetic radiation-based analysis	Soft tissue in head and neck region (in situ)	NA
5.	Positron emission tomography	Imaging using radioactive agents	Head and neck region (in situ)	NA
6.	Ultrasound (Sonography)	High-frequency sound wave-based imaging	Head and neck region (in situ)	NA
7.	X-ray	Radiation-based imaging	Head and neck region (in situ)	NA
8.	Diffuse reflectance spectroscopy	Tissue reflectance optical spectroscopy	Oral tissue	Collagen, elastin, keratin, FAD, and NADH biomarkers are needed. 98.5%

Borse V, Konwar AN, Buragohain P. Oral cancer diagnosis and perspectives in India. Sensors International. 2020 Jan 1;1:100046.

Among the various imaging strategies to be had, computed tomography (CT) and magnetic resonance imaging (MRI) are extensively applied and taken into consideration dependable equipment for staging head and neck tumors in step with the TNM cancer staging system. They offer valuable facts about the extent of the lesion, infiltration of large blood vessels, and the presence of cervical lymph node metastases.[45,46]

MRI, specifically, offers greater facts while assessing gentle tissues, bone marrow involvement, and neurovascular infiltration. It is especially, beneficial in diagnosing small lesions that can be tough to stumble on the use of other imaging modalities. CT and MRI were the mainstay techniques for decades due to their effectiveness in visualizing the anatomical structures and helping in the precise staging of tumors.[47]

In addition to CT and MRI, more superior technologies like positron emission tomography (PET) have emerged and might contribute to improved tumor staging. PET imaging, blended with the injection of a radiotracer, facilitates the evaluation of the metabolic interest of the tumors, offering valuable records on tumor viability and metabolic activity. This can further decorate the accuracy of tumor staging and guide treatment making plans.

Overall, an aggregate of imaging strategies, along with CT, MRI, and PET, performs a vital role in the accurate staging of oral cancer. These imaging modalities provide comprehensive information about the tumor extent, involvement of adjacent structures, and presence of metastases, aiding in the components of an effective treatment plan.[48]

DIAGNOSIS BY CT

Imaging performs a crucial role in the evaluation of oral cavity most cancers. The cutting-edge preferred modality for the number one analysis of oral cavity lesions (except oral tongue and difficult palate) is Contrast-Enhanced Computed Tomography (CECT) of the pinnacle and neck, finished with the puffed cheek approach and bone algorithm reconstruction.[49]

CECT head and neck with the puffed cheek method permits for an in-depth assessment of the oral cavity. This technique helps in better identification of the lesion in comparison to standard CECT imaging. It also allows the separation of the mucosal surface from the alveolus, ensuing in higher visualization of subtle lesions that may be missed in routine imaging. The puffed cheek method improves the delineation of structures together with the buccal mucosa, gingiva, buccal vestibule, and retromolar trigone.

CECT facilitates the identification of critical factors inclusive of the depth of invasion (DOI), neighborhood and nearby volume of the tumor, presence of bony erosion, and perineural spread. Surgical resection is taken into consideration viable in instances with involvement confined to the low infratemporal fossa or retro-antral infratemporal fossa, in addition to superficial or deep cortical bony erosion. However, it ought to be cited that CECT has limitations, because it presents much less smooth tissue decision as compared to Contrast-Enhanced MRI (CE-MRI).

CE-MRI can be beneficial as a problem-solving device in identification of subtle lesions and demonstrating perineural or intracranial unfold. While CE-MRI is treasured in positive instances, it is not typically selected because the initial modality for oral hollow space imaging because of its longer acquisition time and susceptibility to motion artifacts.

Overall, CECT with the puffed cheek approach and bone algorithm reconstruction is the preferred imaging modality for primary diagnosis of oral cavity lesions.[50,51]

STAGING ON CECT

The usage of imaging in staging is dependent on identifying the local/regional extent followed by nodal and distant metastases. CECT whenever performed for initial workup should include thorax and upper abdomen as part of staging evaluation. Involvement of the infratemporal fossa (ITF), masticator space, and presence of perineural spread are important predictors of locoregional staging. [52]

Table 7. Imaging findings of perineural spread[52,53]

Direct signs	**Indirect signs**
1.Nerve enhancement	1. Denervation atrophy.
2.Nerve enlargement	2. Denervation enhancement
3.Foramina fat plane obliteration	In acute or subacute phase, T2 hyperintense edema in the corresponding muscle develops postcontrast enhancement. In chronic phase, muscle atrophy shows hyperintense signal on T1 and T2-weighted sequences due to fatty replacement
4.Foramina enlargement and destruction	
5.Intracranial spread	

Table 8: Key points in evaluation of each nerve[54]

Nerves	**Key findings**
1.Ophthalmic branch of trigeminal nerve(V1)	Obliteration of the orbital fat pad and enhancement of V1 in the orbit and the cavernous sinus
2. Maxillary branch of the trigeminal nerve(V2)	● Obliteration of the fat pads in the pterygopalatine fossa Enlargement of the infraorbital fissure ● Thickening and enhancement of V2 in the round foramen and cavernous sinus
3. Mandibular branch of the trigeminal nerve(V3)	● Obliteration of the fat pads of the mental or mandibular foramen and of the parapharyngeal fat below the foramen ovale ● Enlargement or erosion of foramina ● Thickening and enhancement of V3 in the parapharyngeal space and foramen ovale ● Abnormal bone marrow in the jaw; signs of denervation of the masticatory muscles
4. Trigeminal nerve	Obliteration of Meckel's cave
5. Facial nerve	Obliteration of the fat pad of the stylomastoid foramen and abnormal enhancement
6. Geniculate ganglion	Enlargement, obliteration and sclerosis of the geniculate fossa
7. Greater superficial petrosal nerve	Obliteration of the fat pad and enlargement or erosion of the vidian canal
8. Auriculotemporal nerve	Tumor growth in the posterior mandible

MRI FOR ORAL CANCER DIAGNOSIS

Magnetic Resonance Imaging (MRI) is rather useful in the assessment of oral cavity most cancers due to its advanced smooth tissue evaluation, capability to provide direct multiplanar formats, and shortage of ionizing radiation. MRI offers a detailed imaging of the anatomy of oral hollow space, allowing for unique delineation of the tumor's boundaries and areas of infiltration.[55]

Its ability to determine the depth of invasion, supplying critical records for treatment making plans. Also, It can examine the oncological involvement of various important systems, such as the skeletal system, the vascular system like the internal carotid artery. Information about the involvement of other structures are critical consideration in designing the appropriate remedial approach. Additionally, MRI is powerful in detecting perineural dissemination, that is the unfold of cancer along nerves, assisting within the identification of ability areas of tumor extension.

The exceptional gentle tissue comparison of MRI lets in for the visualization and characterization of lesions inside the oral hollow space with outstanding accuracy. This imaging modality provides particular information about tumor length, area, and involvement of adjacent structures. It can also perceive the presence of lymph node metastases and check the general level of the ailment.[56,57]

Furthermore, MRI's multiplanar abilities permit imaging in diverse orientations, bearing in mind comprehensive evaluation and accurate willpower of tumor volume. The absence of ionizing radiation makes MRI a safe imaging choice for repetitive reviews and for patients who're susceptible to radiation publicity.[58]

In precis, MRI plays an important role in the assessment of oral cavity most cancers by using imparting superior tender tissue comparison, multiplanar codecs, and exact visualization of the tumor's obstacles, infiltration, intensity of invasion,

involvement of critical structures, and perineural dissemination. This information is important for treatment planning and ensuring the satisfactory viable outcomes for sufferers.[59]

ACCURACY OF RADIOLOGICAL IMAGING IN DIAGNOSING ORAL CANCERS COMPARING WITH HISTOPATHOLOGY, THE GOLD STANDARD

M. Lenz et al in 2000 was an review on evaluation of oropharynx, oral cavity, and ground of the mouth the use of CT and MRI scans. Based on their analysis, over the beyond two decades, computed tomography (CT) has proved its value as a supplementary non-invasive method and established its role in modern diagnostic evaluation. Magnetic resonance imaging (MRI) is a non-invasive scanning method that offers excellent tissue contrast. Ultrasonography (US) is of secondary importance but provides useful guidance due to its wide availability and its easy use.[60]

The have a look at study conducted by means of José de Souza Brandão Neto et al in 2018 aimed to compare the accuracy of magnetic resonance imaging (MRI) and computed tomography (CT) in predicting mandibular invasion in sufferers with oral hollow space of most cancers. The systematic evaluation blanketed 11 research, encompassing a total of 477 patients. The findings of the study indicated that both MRI and CT tested similar overall performance in detecting mandibular invasion. The sensitivity of MRI was suggested to be 78% when the specificity became 86%. The positive likelihood fee and poor likelihood fee for MRI have been 5.29 and 0.23, respectively. Similarly, CT confirmed a sensitivity of 76%, specificity of 89%, fine chance value of 6.00, and bad chance value of 0.28.[61]

Tobias Waech et al in 2020 carried out an examination on measurement versions of MRI and CT inside the evaluation of tumor intensity of invasion in oral

cancer. The have a look at was executed retrospectively reviewed 121 sufferers with OSCC handled at University Hospital Zurich. The radiologic DOI of CT, T1-weighted, and T2-weighted MRI had been in comparison with histological DOI. The frequency of applicable imaging artifacts was assessed as well. Results confirmed that a general of 110 CT (90 %) and 90 MRI (74 %) were analyzed. Both modalities had been to be had for seventy-nine sufferers (65.3 %). For 25 (22.7 %) patients, dental scattering on CT yielded DOI as not estimable.[62]

Singh A et al had analysed 50 patients presented with oral malignancy. The incidence of tongue malignancy was the highest accounting for about 82%. This was followed by buccal mucosa malignancy and gingivobuccal sulcus malignancy among 18%. Majority of them were aged between 51 to 60 years (32%) with male predominance. Analysis of diagnostic modalities showed moderate agreement with k of 0.537 for T stage between the clinical and MRI staging assessments. Meanwhile the agreement for N stage between clinical and MRI staging assessments was fair 0.328. The final diagnosis for each patient was decided based on the histopathology in 22 patients. It was found that the agreement for the T stage was good/substantial (k=0.790) and for N stage was moderate (k=0.458) between MRI and histopathology staging assessments.[63]

Thoenissen P et al (2023) was a retrospective analysis, including 174 preoperative MRI accounted for about 78.74%, 137 samples and CT of 21.26% with sample size of 37. These diagnoses were correlated with the histopathological findings. CT had a sensitivity of 67% and specificity of 68% while MRI had the sensitivity of 66% and a specificity of 68%. In 52.87% of all cases no differences between CT imaging and post-operative histopathology were found. MRI and CT

were found to be overestimating lymph node involvement. The overestimation incidence was 27% and 21.62% respectively.[64]

Shah AH et al (2021) had carried out research on 14 tongue and 22 buccal mucosa malignancy patients to understand the correlation between the depth of tumor and neck node metastasis in oral (tongue and buccal mucosa) carcinoma. After comparing the imaging modalities, they interpreted that the depth of tumor is an important prognostic indicator in the tongue and buccal mucosa and the radiological investigations such as USG, CT and MRI had been almost similar effectiveness in identifying the depth of lesion.[65]

Valecha J et al had assessed 60 patients with SCC oral cavity to evaluate the accuracy of MRI scan with histopathology. The correlation of T stages (TNM system) was obtained in 51 out of 60 cases on MRI. One lesion was labelled as T2 on MRI. However, when histopathology was studied, they found it to be T4 as MRI failed to detect subtle infiltration of the cortical bone. The accuracy of clinical data in T stage evaluation was 62 % (K- 0.470), however the MRI accuracy found to be 82 % (k 0.740). The sensitivity, specificity and accuracy of MRI in the detection of mandibular involvement were 94.1%, 60% and 81.5%, respectively.[66]

Whereas Sharma J et al had strongly suggested FNAC over the radiological investigations. Tibrewala S et al have described in detail about the role of CT imaging in identifying the oral cancers, especially the SCC. They have described that CT imaging could be beneficial in identifying the extent of tumor spreading with better accuracy which is similar to the MRI. Also, had suggested that these two methods could be complementary to improve the accuracy of diagnosis. According to their research, both types of imaging suffer from issues when used with dental amalgam. However, using an angled gantry with CT scans may help reduce these issues.[67]

MATERIALS AND METHODS

Source of Data: Patients with oral cavity lesions coming to the department of radiology of KLE'S Dr Prabhakar kore hospital suspecting to have oral cavity malignancy getting imaging done from January 2023 to December 2023

Study Design: prospective observational study

Study Period: January 2023 to December 2023

Sample Size: The formula used for sample size calculation is, where, μ1 is mean of the first group, μ2 is mean of the second group, is the common

error variance, value is 1.96 for 95% confidence level and value is 0.8416 for 80% power. The sample size is obtained to be 30 subjects for each group.

Sampling technique: Convenient sampling

Criteria	Description
Inclusion	– histologically proven squamous cell carcinoma of the oral cavity or oropharynx – resectable tumor stage III or IV (UICC classification) – no tumor-specific pretreatment – an ECOG performance status of 0, 1 or at least 2 – adequate hepatic, renal, cardiac and pulmonary function white blood cell count >4 $\times 10^3/\mu l$ platelets >100,000/μl bilirubin <21 μmol/l creatinine <125 μmol/l – informed consent – at least 18 years old
Exclusion	– distant metastasis – secondary malignancies – cardiac insufficiency or myocardial infarction within the last 6 months – pregnancy – no disposing capacity or expected insufficient compliance

UICC = International Union against Cancer; ECOG = Eastern Cooperative Oncology Group.

The study was conducted using 128 slice Computed Tomography machine manufactured by GE Healthcare. Standard oral cavity scan protocol had been done for all the patients referred to the Radiology department for the same and Consent was taken from all the patients. All the data collected and entered in to MS Excel sheet, data was tabulated &amp tables, charts and graphs will be prepared.

STATISTICAL METHODS:

Data is analyzed using statistical software R version 4.4.0. and Microsoft Excel. Categorical variables given in the form of frequency tables. Continuous variables given in Mean ± SD /Median (Min, Max) form. Diagnostic parameters were assessed using medical software.

RESULTS

Data contains measurements on 30 subjects.

Tables 1: Distributions of subjects according to demographic details.

Variables	Sub Category	Number of subjects (%)
Age (years)	Mean ± SD	52.57 ± 11.13
	Median (Min, Max)	49.5 (30, 78)
Gender	Female	9 (30%)
	Male	21 (70%)

The mean age of subjects is 52.57± 11.13 years. The age ranged from a minimum of 30 years to a maximum of 78 years, with a median age of 49.5 years. There are 21 (70%) males and 9 (30%) females.

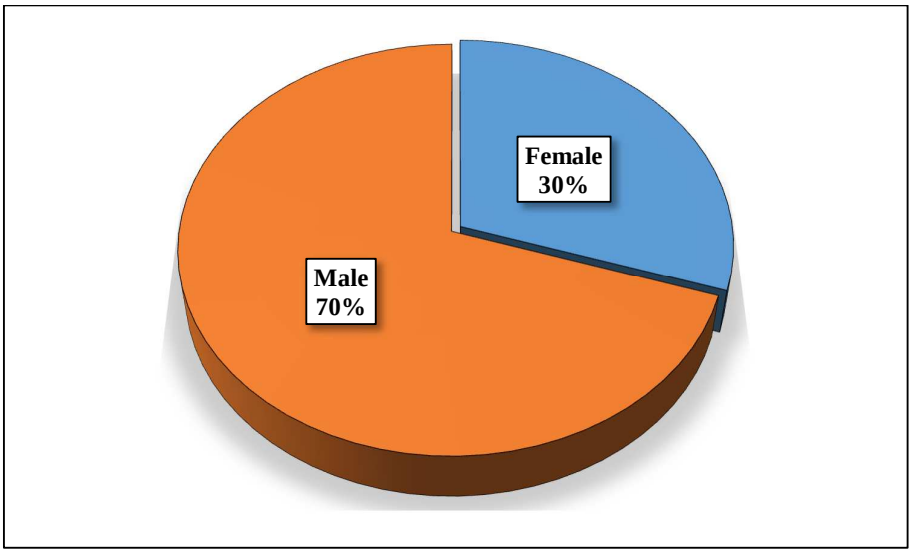


Figure 1: Distribution of subjects according to gender.

Table 2: Distribution of subjects according to comorbid conditions.

Comorbidity	Number of subjects (%)
No	17 (56.67%)
Yes	13 (43.33%)

Out of 30 subjects, 13 (43.33%) had comorbidities while the remaining 17 (56.67%) didn't.

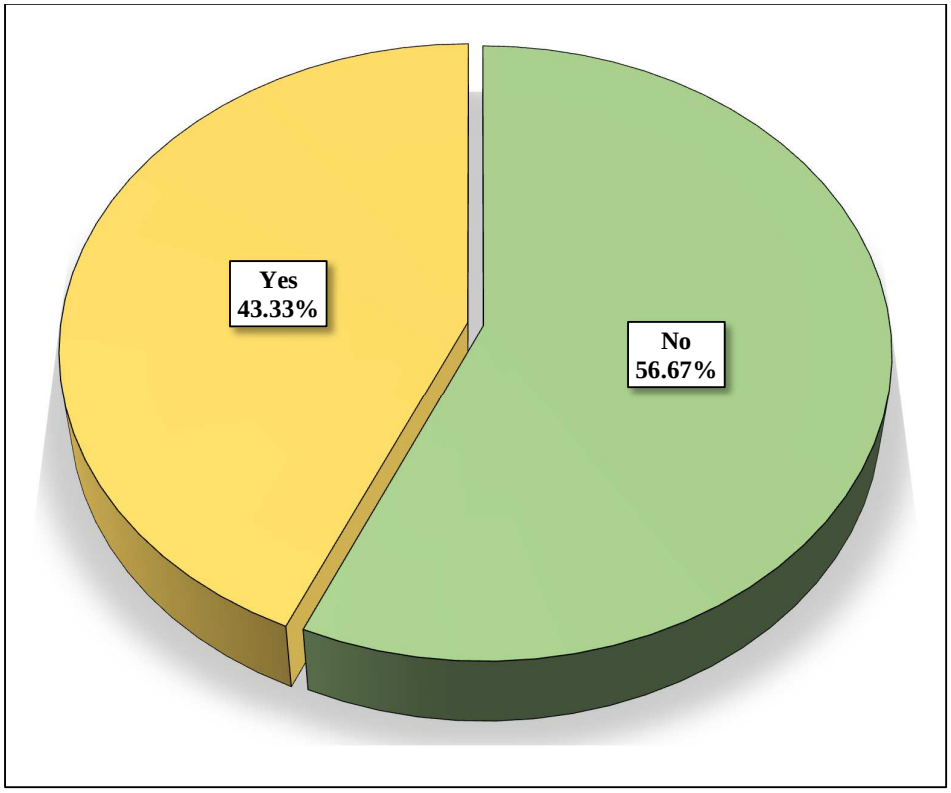


Figure 2: Distribution of subjects according to comorbidity.

Table 3: subjects according to new case or recurrent.

New case or recurrent	Number of subjects (%)
No	4 (13.33%)
Yes	26 (86.67%)

The majority of the subjects, 26 (86.67%)were experiencing a recurrent condition. In contrast, only 4 (13.33%) were identified as new cases.

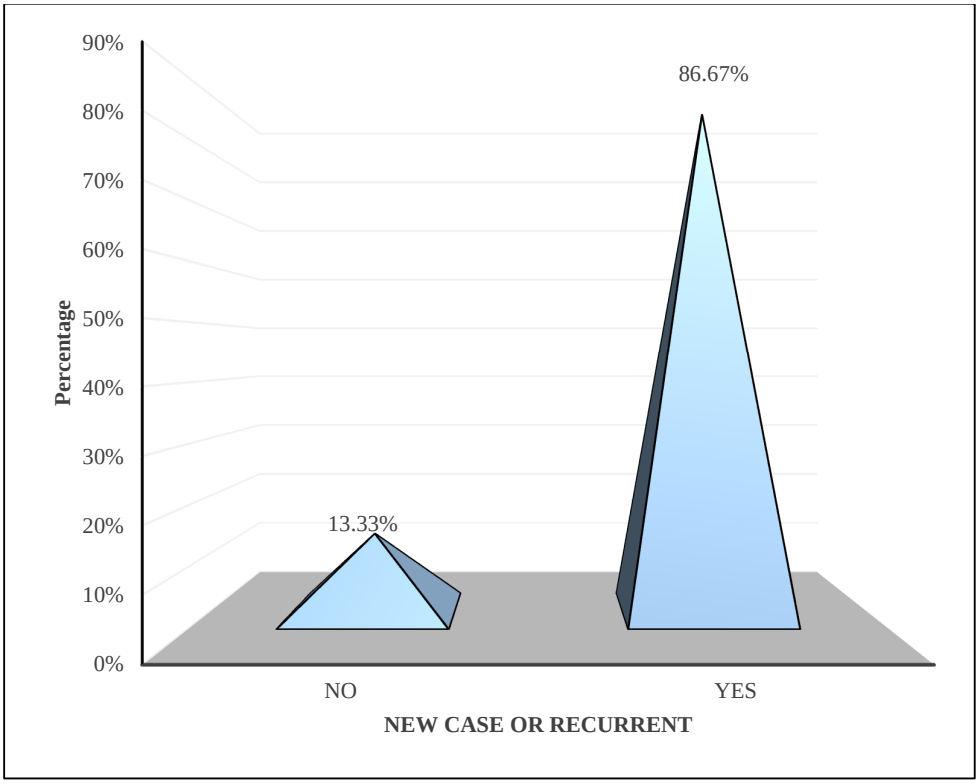


Figure 3: Distribution of subjects according to new case or recurrent.

Table 4: according to duration of previous therapy if recurrent.

If recurrent then previous therapy duration	Number of subjects (%)
No	26 (86.67%)
Yes	4 (13.33%)

Out of the 30 subjects, 26 (86.67%) did not have a previous therapy duration. Conversely, only 4 (13.33%) had a documented duration of previous therapy.

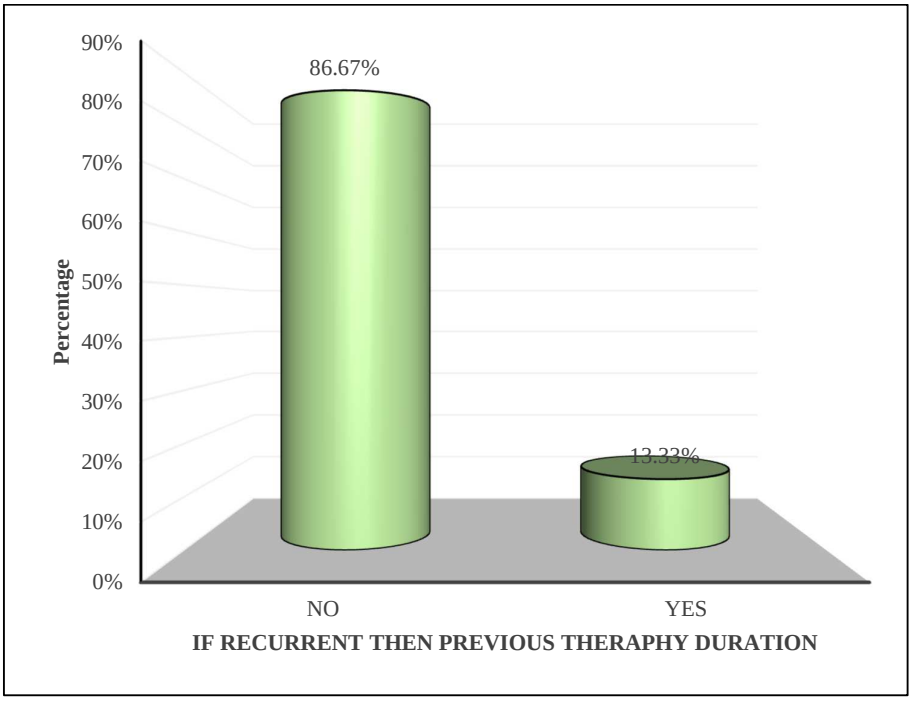


Figure 4: Distribution of subjects according to duration of previous therapy if recurrent.

Table 5: duration of lesion.

Variable	Mean ± SD	Median (Min, Max)
Duration of lesion	1 ± 0.58	1 (0.25, 2)

The mean duration of the lesion was 1 ± 0.58 year. The median duration was also 1 ye ar, and duration of lesions ranged from a minimum of 0.25 years (3 months) to a maxi mum of 2 years.

Note: The lesion type was squamous cell carcinoma in all 30 (100%) subjects.

Table 6: site of lesion.

Site of the lesion	Number of subjects (%)
Buccal mucosa	22 (73.33%)
Gingivobuccal sulcus	17 (56.67%)
Retromolar trigone	15 (50%)
Floor of mouth	1 (3.33%)
Upper alveolus	2 (6.67%)
Lower alveolus: Right	1 (3.33%)
Hard palate	1 (3.33%)
lateral border of tongue	3 (10%)
Lower alveolus: Left	1 (3.33%)
Superior alveolar arch	2 (6.67%)

Buccal mucosa was the most common site, with 22 (73.33%) subjects having lesions there. This was followed by the gingivobuccal sulcus, with 17 (56.67%) subjects, and the retromolar trigone, with 15 (50%) subjects. Less commonly affected sites included the floor of the mouth, lower alveolus, and hard palate, each with 1 (3.33%) subject. The upper alveolus and the superior alveolar arch were each affected in 2 (6.67%) subjects, while the lateral border of the tongue had lesions in 3 (10%) subjects.

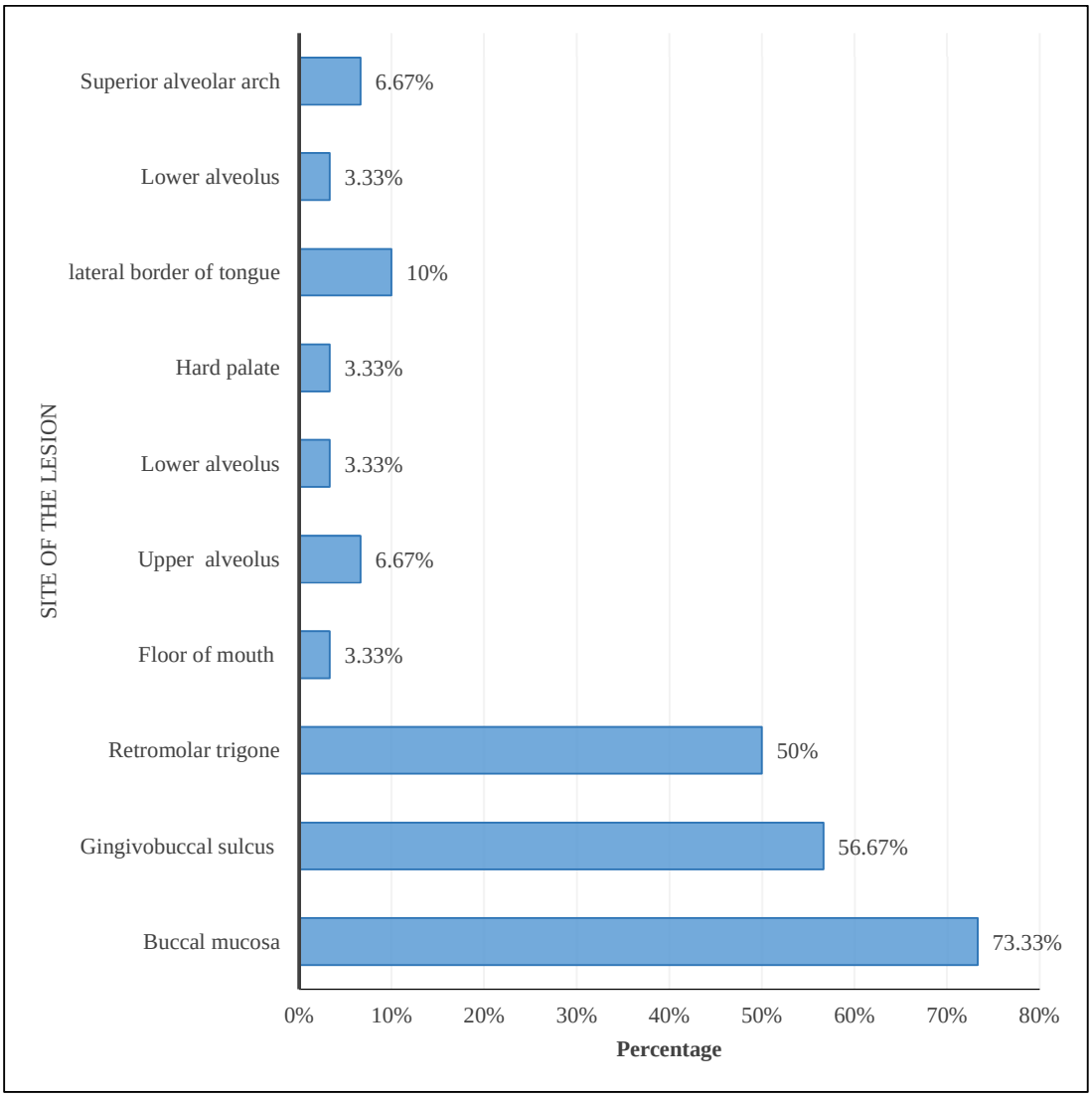


Table 7: Laterality

Side	Number of subjects (%)
Right	7 (23.33%)
Bilateral	4 (13.33%)
Left	19 (63.33%)

The majority of subjects, 19 (63.33%) had lesions on the left side, 7 (23.33%) had lesions on the right side. Additionally, a minority of subjects, 4 (13.33%) exhibited bilateral lesions.

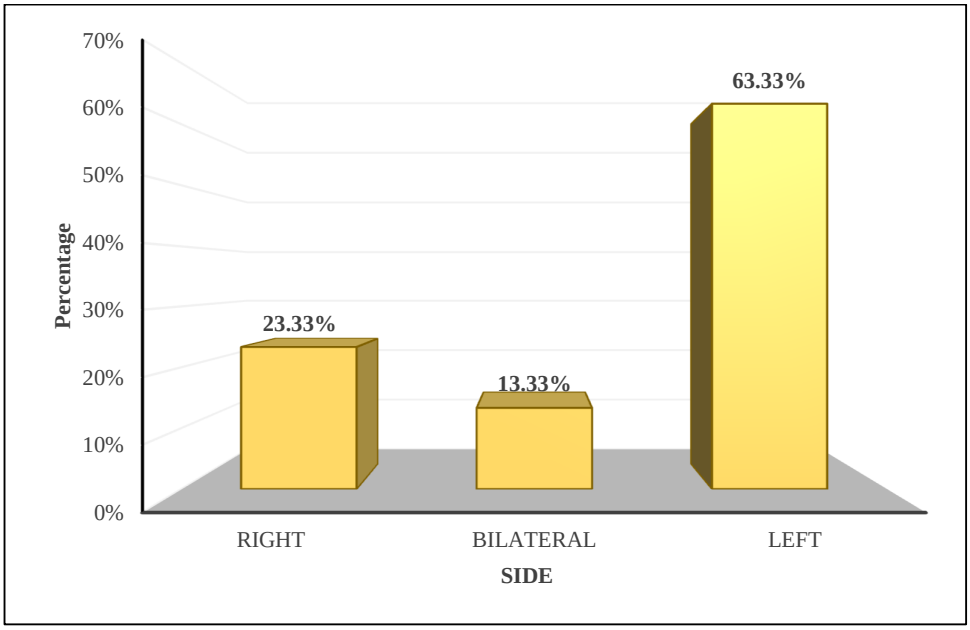


Figure 5: Distribution of subjects according to side of lesion.

Table 8: Distribution of subjects according to CT TNM stages.

Variables	**Sub Category**	**Number of subjects (%)**
Clinical T staging	T1	14 (46.67%)
	T2	9 (30%)
	T3	1 (3.33%)
	T4	6 (20%)
N staging	N0	11 (36.67%)
	N1	10 (33.33%)
	N2	7 (23.33%)
	N3	2 (6.67%)
Metastasis	No	20 (66.67%)
	Yes	10 (33.33%)

Regarding Clinical T staging, the majority of subjects were categorized as T1, comprising 14 (46.67%) of the total, followed by T2 with 9 (30%). T3 and T4 stages were less common, representing 1 (3.33%) and 6 (20%) of subjects, respectively. In terms of N staging, N0 and N1 were the most prevalent categories, with 11 (36.67%) and 10 (33.33%) of subjects falling into these stages, respectively. N2 and N3 stages were less frequent, accounting for 7 (23.33%) and 2 (6.67%) of subjects, respectively.

Furthermore, in terms of metastasis, the majority of subjects, 20 (66.67%), did not exhibit metastasis, while 10 (33.33%) showed evidence of metastasis.

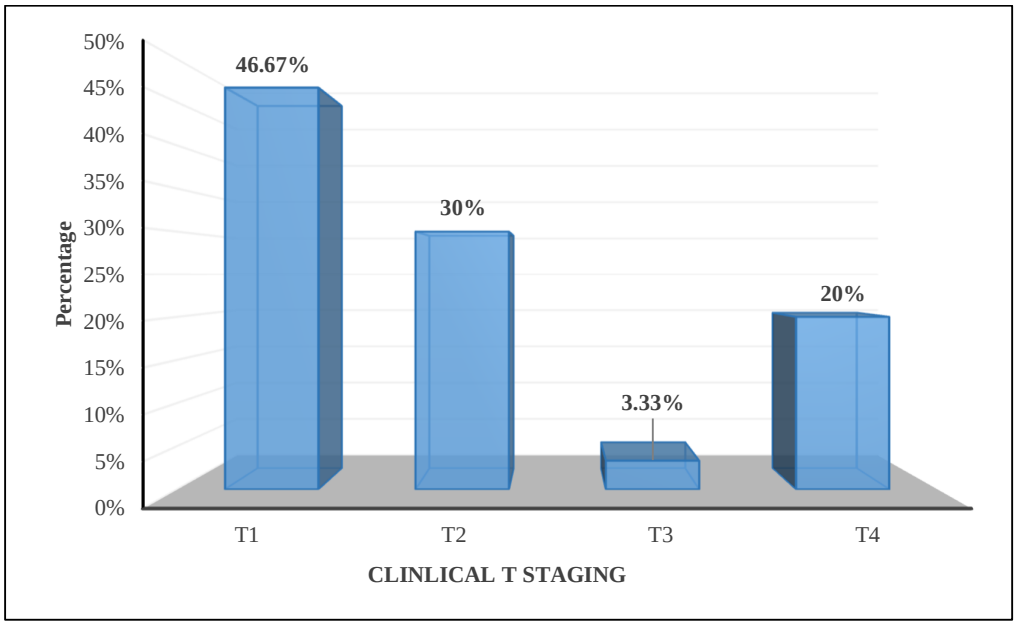


Figure 6: Distribution of subjects according to T staging from CT.

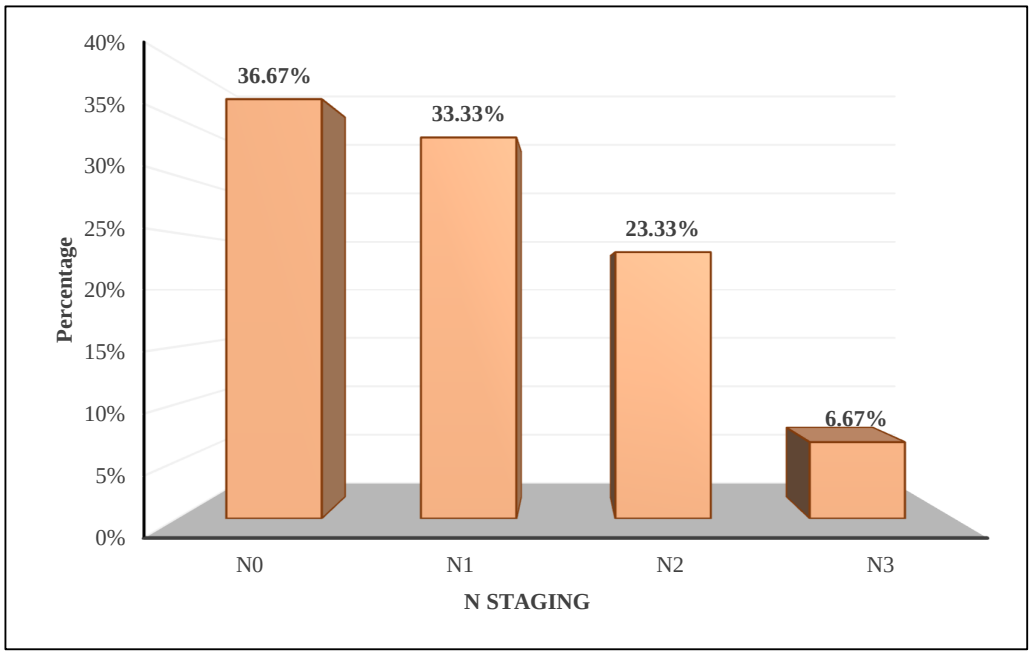


Figure 7: Distribution of subjects according to N staging from CT.

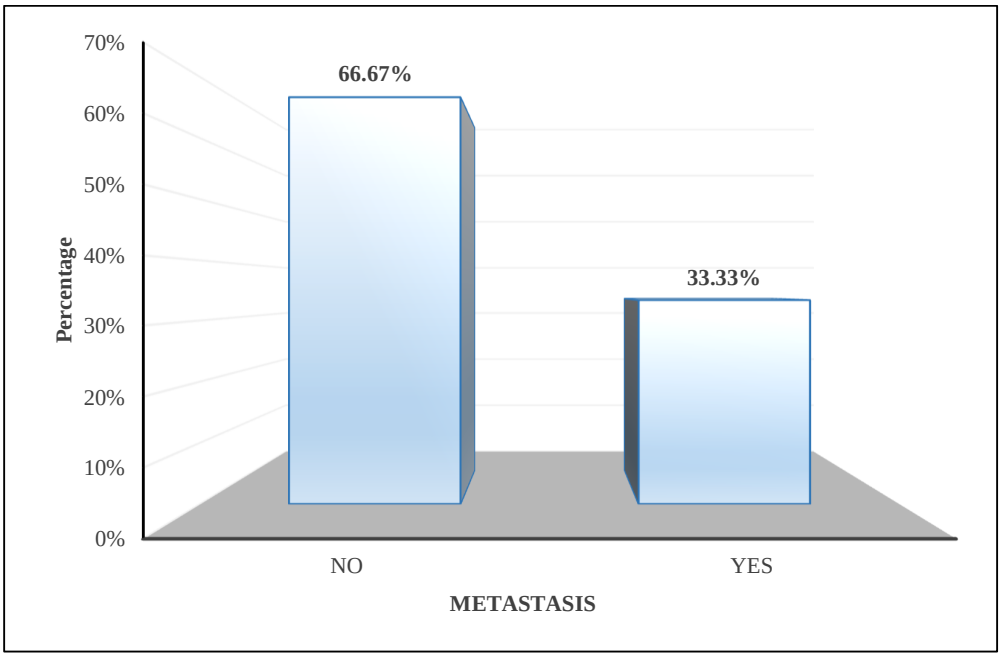


Figure 8: Distribution of subjects according to M staging from CT.

The following to histopathology M staging.

Table 9: histopathology M staging.

Histopathology M staging	Number of subjects (%)
M0	20 (66.67%)
M1	10 (33.33%)

Among the subjects, 20 (66.67%) were classified as M0, while 10 (33.33%) were categorized as M1.

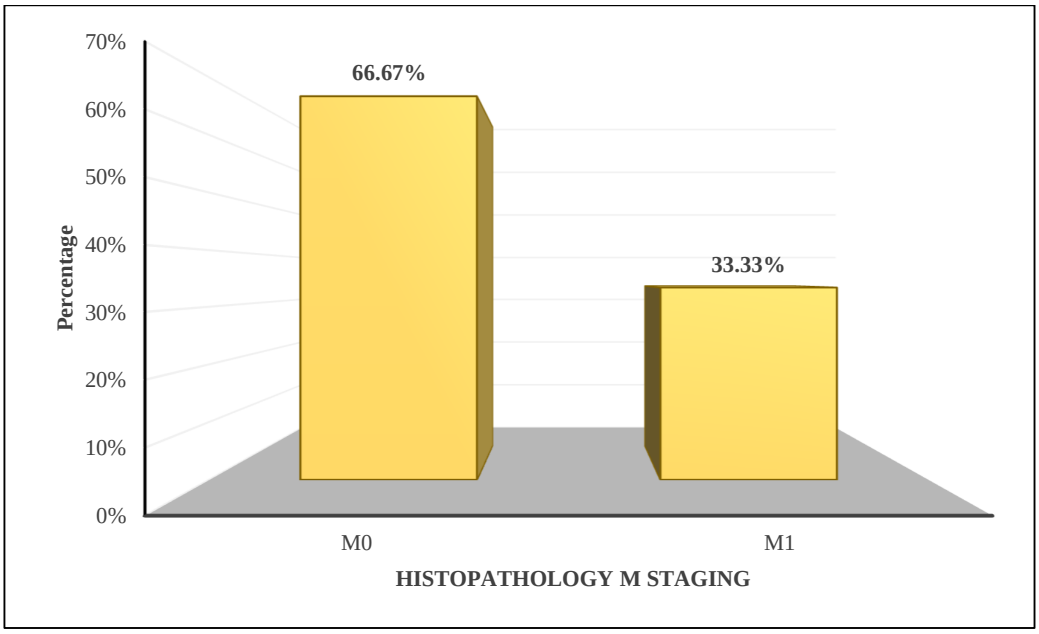


Figure 9: Distribution of subjects according to M staging from histopathology.

Table 10: Diagnostic accuracy parameters

True positive: Confirmed cases both on both CT and Histopathology	**True negative:** Negative cases on both on both CT and Histopathology	**False positive:** Metaplastic features on CT but not on Histopathology	**False negative:** Inconclusive on CT but positive on Histopathology
26	1	2	1

Table 10A:

Statistic	**Value**	**95% CI**
Sensitivity	96.30%	81.03% to 99.91%
Specificity	33.33%	0.84% to 90.57%
Disease prevalence (*)	100.00%	
Positive Predictive Value (*)	100.00%	87.66% to 100.00%
Negative Predictive Value (*)	0	
Accuracy (*)	96.30%	82.22% to 99.87%

As we had included all patients with oral cancer, prevalence was considered as 100%

DISCUSSION

Tumors clinically similar to the bone may not show invasion clinically or on plain radiography, yet such cases might have poor prognosis when the tumor is excised without the bone or cases where there is no bone invasion, treatment might involve unnecessary mandibular resections.[68,69] The accurate prediction of the presence and extent of mandibular invasion takes on considerable importance as an in appropriate segmental resection which will increase the complexity of reconstruction and the burden of rehabilitation. Conversely, an in appropriate marginal resection will potentially compromise the oncological aims and increase the risk of local recurrence. [14,68,69]

In ordered to predicts invasion of the mandible several radiological techniques have been familiarized over the past few years. These have comprised plain radiographs, imaging, radionuclide examinations, ultrasound, computerized tomography and magnetic resonance imaging. Our study was undertaken to assess the accuracy of clinical examination and OPG findings as likened to dissimilarity enhanced CT. The use of CT in the assessment of bone invasion in oral cavity cancers has been advocated by a number of authors

Close LG et al, one of the oldest studies we came across, endorsed CT as the radiologic study of choice. Data contains measurements on 30 subjects. The mean age of subjects is 52.57± 11.13 years. The age ranged from a minimum of 30 years to a maximum of 78 years, with a median age of 49.5 years. Similarly in Hussain et al, age of their study population was ranged from 26 to 80 years with the average age of 53.72±14.458 years. [71]

Of thirty cases in the present study, 21/30(70%): Males and 9/30(30%) females. Whereas, Hussain et al, observed that of 25 subjects, 16 males and 9 females were there. Out of 30 subjects, 13 (43.33%) had comorbidities while the remaining 17 (56.67%) did not. The majority of the subjects, 26 (86.67%) were experiencing a recurrent condition. In contrast, only 4 (13.33%) were identified as new cases. Out of the 30 subjects, 26 (86.67%) did not have a previous therapy duration. Conversely, only 4 (13.33%) had a documented duration of previous therapy.[71]

The mean duration of the lesion was 1 ± 0.58 year. The median duration was also 1 year, and duration of lesions ranged from a minimum of 0.25 years (3 months) to a maximum of 2 years. 67

Among our study population, buccal mucosa was the most common site, with 22 (73.33%) subjects having lesions there. This was followed by the gingivobuccal sulcus, with 17 (56.67%) subjects, and the retromolar trigone, with 15 (50%) subjects. Less commonly affected sites included the floor of the mouth, lower alveolus, and hard palate, each with 1 (3.33%) subject. The upper alveolus and the superior alveolar arch were each affected in 2 (6.67%) subjects, while the lateral border of the tongue had lesions in 3 (10%)subjects. The majority of subjects, 19 (63.33%) had lesions on the left side, 7 (23.33%) had lesions on the right side. Additionally, a minority of subjects, 4 (13.33%) exhibited bilateral lesions. Shah et al, mandibular was the commonest site with incidence of 45.76% followed by buccal mucosa among 23.73%. Tongue in 18.31%, maxillary alveolus among 5.76%, lips were affected in about 3%,floor of mouth (2%) and palate (1.36%).[65]

Regarding Clinical T staging, the majority of subjects were categorized as T1, comprising 14 (46.67%) of the total, followed by T2 with 9 (30%). T3 and T4 stages were less common, representing 1 (3.33%) and 6 (20%) of subjects, respectively. In

terms of N staging, N0 and N1 were the most prevalent categories, with 11 (36.67%) and 10 (33.33%) of subjects falling into these stages, respectively. N2 and N3 stages were less frequent, accounting for 7 (23.33%) and 2 (6.67%) of subjects, respectively. Furthermore, in terms of metastasis, the majority of subjects, 20 (66.67%), did not exhibit metastasis, while 10 (33.33%) showed evidence of metastasis. Among the subjects, 20 (66.67%) were classified as M0, while 10 (33.33%) were categorized as M1.

In the present study, 96.33% was the sensitivity, 33.335 of specificity, positive predictive value was 100% with zero negative prediction. Also, the accuracy was 96.3%, which was comparatively higher than Hussain et al among whom, 12 confirmed CT and 4 false positive cases , with an accuracy off 64%. It showed up a sensitivity of 63.2%, specificity of 66.7%, positive predictive value of 85.7% whereas a negative predictive value of 36.4%. This is in concordance with the findings of Van Cann et al who found the sensitivity of clinical examination to be 59.1%.[72] HandSchel J et al CT showed 8 false-positive results and 8 false-negative patients. The quality criteria for detecting bone involvement of OSSC by CT were calculated as follows: sensitivity 82.6%; specificity 86.9%; positive predictive value 82.6%; negative predictive value 86.9%. [73]

Even in review article by Tibrewala et al, sensitivity of CT scan for assessing neck node metastases varies from 55 to 95% and specificity is reported to vary from 39 to 96%. Though we had not separately analysed the diagnostic parameters for nodal involvement, nodal spread being part of CT staging, we could understand that it was one of the effective assessment.[67] Shah et al, who had detailed about the accuracy of each staging as well have reported that CT could be used as front line imaging modality for oral cancer including mandible invasion.[64]

CONCLUSION

Based on our analysis, CT had diagnosed exact staging of the oral cancer compared to histopathology among 26 cases and 2 had been inconclusive. With this, the sensitivity of CT in oral cancer was 96.33% but the specificity was just 33.33% of specificity, positive predictive value (PPV) was 100% with 0% negative prediction. Accuracy of CT was 96.3%. Hence, CT could be one of the reliable diagnostic modalities in staging oral cancer.

SUMMARY

As the malignant lesions with similar morphology of bone might be clinically hamper the diagnosis of on clinical examination and even on plain radiography. Because of this, such cases might have poor prognosis with the need for bone excision due to invasion into the bone or wrong interpretation of the invasion would lead to unnecessary mandibular resections. Hence, the most reliable radiological investigation would be needed to sort this. So, the present study was done to evaluate the efficacy of preoperative imaging in the assessment of tumor depth of invasion (DOI) in oral squamous cell carcinoma (OSCC) and correlate with histopathological findings and assess the accuracy of imaging-based estimation of DOI in relation with the tumor histological DOI.

The average age of subjects is 52.57± 11.13 years with male predominance including 21 (70%) males and 9 (30%) females. 26 (86.67%) were recurrence of the tumor and 4 (13.33%) were identified as new cases. We did not find any positive association between bone invasion and the demographic details.

Buccal mucosa was the most common site affecting 22 (73.33%) subjects followed by the gingivobuccal sulcus in 17 (56.67%) subjects, and the retromolar trigone, with 15 (50%) subjects. On radiology, T1N0 with no metastasis was the commonest type we observed, which was almost similar to the finding on histopathology. Ten out of thirty cases had metastasis both on radiological observation as well as the histopathology.

Confirmed cases both on both CT and Histopathology were 26, Negative cases on both on both CT and Histopathology 1, Metaplastic features on CT but not on Histopathology 2, Inconclusive on CT but positive on Histopathology 1. With this, then observed sensitivity, specificity, were 96%, 33.33% with 100% of PPV and NPV. The accuracy was 96.38%. Hence, this could be the most reliable mode of investigations.

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LIMITATIONS

Lesser sample size. As there were limited number of cases to our OPD during the period of the study, we could not include more than 30 cases. We suggest that there is need for studies including more sample size.

ANNEXURES – I

INFORMED CONSENT FORM

TITLE OF THE STUDY: "ROLE OF IMAGING (CT & MRI) IN STAGING OF ORAL CAVITY MALIGNANCIES WITH CLINICO-PATHOLOGICAL COORELATION"

OBJECTIVE: The aim of this study was to evaluate the efficacy of preoperative imaging in the assessment of tumor depth of invasion (DOI) in oral squamous cell carcinoma (OSCC) and correlate with histopathological findings

INTRODUCTION: Accurate evaluation of primary tumors and cervical lymph node status of squamous cell carcinoma (SCC) of the oral cavity is important for treatment planning and prognosis prediction. Pretherapeutic staging of tumors of the oropharynx, the oral cavity and the floor of the mouth is important and should be thorough and exact to ensure appropriate therapy. Particularly important is the assessment of infiltration of deeper compartments and the topographic relationship of tumor to vascular structures (lingual artery and vein, hypoglossal nerve), or the presence of spread of the tumor across the midline. As spread of tumor may occur to a large degree underneath normal appearing mucosa, clinical assessment of the true tumor extent is difficult.

In the last 20 years computed tomography (CT) has proved its value as a supplementary non-invasive method and established its role in modern diagnostic evaluation. Magnetic resonance imaging (MRI) is an non-invasive scanning method that offers excellent tissue contrast. Ultrasonography (US) is of secondary importance, but provides useful guidance due to its wide availability and its easy use.

EXPLANATION OF PROCEDURE: The patient referred to the radiology department for the Ct oral cavity will undergo the scan according to the standard protocol

WITHDRAWAL FROM PARTICIPATION IN THE STUDY: Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

POSSIBLE BENEFITS FROM PARTICIPATING IN THE STUDY: You will/will not have nor get any benefits by participating in this study. The data gathered will help the population at large.

POSSIBLE RISKS FROM PARTICIPATING IN THE STUDY: There are no risks involved in participating in this study.

PRIVACY AND CONFIDENTIALITY: The information collected from you will be coded, to prevent any person from identifying you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

FINANCIAL INCENTIVES: You will not receive any payment for participating in this study.

AUTHORIZATION FOR PUBLICATION OF AGGREGATED DATA:

Results obtained after processing of the aggregated data will be published for scientific purposes and or presented to scientific groups. However, your identity will never be revealed.

QUESTIONS: In case of any questions about this study, you are free to contact:

REG NO. BS0121005	Dr. _____	DR. HARSHA HEGDE
Post-Graduate, Department of Radio-Diagnosis. J.N. Medical College, Belagavi	Guide, Professor, Department of Radio-Diagnosis J.N. Medical College, Belagavi	CHAIRPERSON, JNMC, IEC & SCIENTIST D, ICMR, NATIONAL INSTITUTE OF TRADITIONAL MEDICINE, BELAGAVI

LEGAL RIGHTS: By signing this consent form, we are not waving any of your legal rights.

CONSENT STATEMENT

I am making a voluntary decision to participate in the study "**ROLE OF IMAGING (CT & MRI) IN STAGING OF ORAL CAVITY MALIGNANCIES WITH CLINICO-PATHOLOGICAL COORELATION"**

My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

ANNEXURE – II – PROFORMA

PROFORMA FOR ORAL CAVITY CANCER CASES:

CLINICAL HISTORY

- NAME:
- AGE:
- GENDER:
- IP NUMBER:
- PRESENTING COMPLAINS:
- ANATOMICAL SITE OF THE LESION:

  PRIMARY SUBSITES –

  - BUCCAL MUCOSA
  - RETROMOLAR TRIGONE
  - TONGUE
  - UPPER AND LOWER ALVEOLUS
  - HARD PALATE
  - FLOOR OF MOUTH
  - LOWER LIP /UPPER LIP
  - GINGIVOBUCCAL SULCUS

- PREVIOUS OPERATIVE HISTORY

CLINICAL DIAGNOSIS WITH STAGE:

- CLINICAL DIAGNOSIS / DIFFERENTIAL DIAGNOSIS
- TYPE OF SAMPLE: BIOPSY / COMPLETE EXCISISON / ANY OTHER PROCEDURE
- OPERATIVE PROCEDURE:

GROSS

- SIZE
- EXTENSION
- LYMPH NODE INVOLVEMENT
- NO.OF LYMPH NODES INVOLVED

MICROSCOPIC FINDINGS:

- TUMOUR TYPE:
- TUMOR SIZE
- DEPTH OF INVASION
- LYMPHOVASCULAR INVASION, PERINEURAL INVASION, BONE INVASION, INVOLVEMENT OF ADJACENT STRUCTURES

CT FINDINGS

CLINICOPATHOLOGICAL COORELATION

RADIOLOGICAL T STAGE DISTRIBUTION OF PATIENTS STUDIED

RADIOLOGICAL T STAGE	TOTAL
T1	
T2	
T3	
T4a	
ONLY BONE INFILTRATION	
MUSCLE INFILTRATION	
MAXILLARY SINUS INFILTRATION	
SKIN INFILTRATION	
BONE & MUSCLE INFILTRATION	
BONE, MUSCLE AND SKIN INFILTRATION	
BONE AND SKIN INFILTRATION	

RADIOLOGICAL N STAGE DISTRIBUTION OF PATIENT STUDIED

RADIOLOGICAL N STAGE	TOTAL
NO	
N1	
N2a	
N2b	
N2c	
N3	
TOTAL	

PATHOLOGICAL T STAGE DISTRIBUTION OF PATIENTS STUDIED

PATHOLOGICAL T STAGE	TOTAL
T1	
T2	
T3	
T4a	
ONLY BONE INFILTRATION	
MUSCLE INFILTRATION	
MAXILLARY SINUS INFILTRATION	
SKIN INFILTRATION	
BONE & MUSCLE INFILTRATION	
BONE, MUSCLE AND SKIN INFILTRATION	
BONE AND SKIN INFILTRATION	

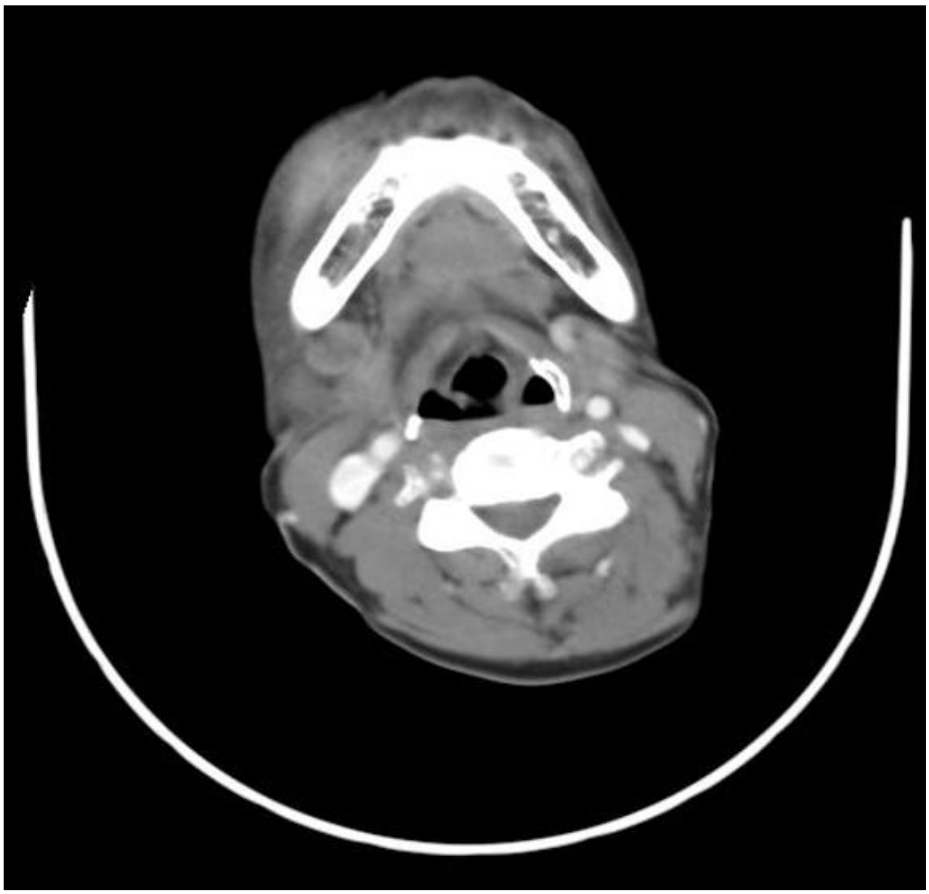
PATHOLOGICAL N STAGE DISTRIBUTION OF PATIENT STUDIED

PATHOLOGICAL N STAGE	TOTAL
NO	
N1	
N2a	
N2b	
N2c	
N3	
TOTAL	

TUMOR STAGING	OBSERVATION	COORELATION

ANNEXURE – III – PHOTOGRAPHS

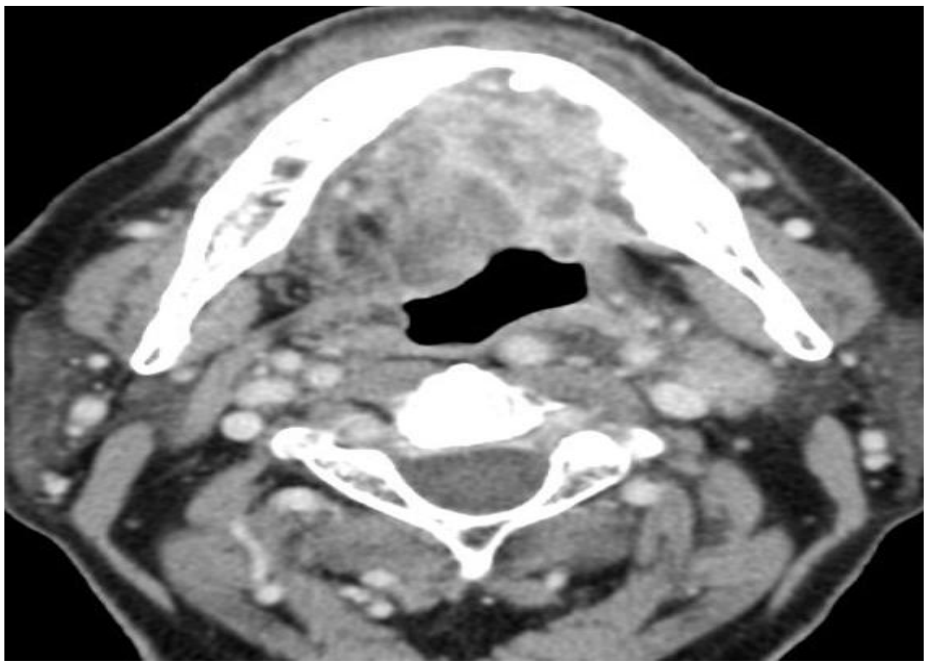
Case 1: biopsy proven case of squamous cell carcinoma of right buccal mucosa



Case 2: 60years old female came with complains of right cheek swelling associated with pain for 2 weeks.

Large lobulated heterogenous enhancing mass at right buccal space. Multiple areas of low attenuation which may represent collections or necrotic components. Posteriorly, this mass extends into the right masticator space with no clear fat plane to the right masseter muscle. The normal right buccinator muscle is not visualized as it is infiltrated by the mass. Laterally, this mass abuts the subcutaneous tissue and the skin. Medially, it involves the right sided buccal mucosa

Case 3: 70 years old male presented with a large ulcer at the left floor of the mouth.



CT showed an infiltrating tumour with irregular borders at the anterior left floor of the mouth and gingivo-buccal sulcus, that crossed the midline and eroded the mandibular bone. There was a centrally necrotic lymph node metastasis at the anterior border of the left sternocleidomastoid muscle.

ANNEXURE – V; KEY TO MASTERCHART

1.	Buccal mucosa
2.	Gingiva-buccal sulcus
3.	Retromolar trigone
4.	Floor of mouth
5.	Upper and lower alveolus
6.	Hard palate
7.	Lateral border of tongue
8.	Lower alveolus
9.	Superior alveolar arch
scc	Squamous cell carcinoma

SL No	Age	Gender	Comorbidity	New case or recurrent	If recurrent then previous theraphy duration	Duration of the lesion	Lesion type	Site of the lesion	RIGHT/ LEFT / BILATERAL	MRI or CT	Clinlical T staging- Mention 1,2,3,4 only	N staging- Mention 0,1,2 only	Metastasis- Yes or no only	Total score	Histopatholog y M staging	N staging
1	43	M	NO	YES	NO	1 YEAR	SCC	1	RT	CT	T1	N3	YES	T1N3M1	M1	
2	60	F	YES	YES	NO	8 MONTHS	SCC	1,2	RT	CT	T1	N1	NO	T1N1MO	M0	
3	52	M	YES	NO	YES		SCC	2,3,4,5	RT	CT	T2	N1	NO	T2N1MO	M0	
4	54	M	NO		NO	8 MONTHS SQUAMOUS	SCC	9,2	B/L	CT	T1	N1	NO	T1N1M0	M0	
5	65	M	YES	YES	NO	1.5 YEARS	SCC	1,2,3,6	LT	CT	T4a	N1	NO	T4aN1M0	M0	
6	42	M	NO	NO	YES	2 YEARS	SCC	1,2,3	LT	CT	T4a	N2c	YES	T4bN2cM1	M1	
7	60	F	YES	YES	NO	6 MONTHS	SCC	3,7	LT	CT	T1	N1	NO	T1N0M0	M0	
8	43	F	NO	YES	NO	4 MONTHS	SCC	2	LT	CT	T1	N2a	YES	T1N2aM1	M1	
9	65	M	YES	YES	NO	2 YEARS	SCC	1,2,3	LT	CT	T2	N2a	YES	T2N2aM1	M1	
10	49	M	NO	YES	NO	6 MONTHS	SCC	1	LT	CT	T2	N1	NO	T2N1M0	M0	
11	60	M	YES	YES	NO	1 YEAR	SCC	1,3	LT	CT	T2	N1	M0	T2N1M0	M0	
12	50	M	YES	YES	NO	6 MONTHS	SCC	1,2	LT	CT	T1	N1	M0	T1N1M0	M0	
									LT							
13	42	M	NO	YES	NO	4MONTHS	SCC	8	B/L	CT	T2	N0	M0	T2N0M0	M0	
14	48	M	NO	YES	NO	1 YEAR	SCC	1,2,3	RT	CT	T4a	N2b	M1	T4aN2bM1	M1	
15	30	F	NO	YES	NO	3 MONTHSSQUAMOUS CELL	SCC	1,3	RT	CT	T2	N0	M0	T2N0M0	M0	
16	49	M	NO	YES	NO	6MONTHS	SCC	2	B/L	CT	T2	N0	M0	T2N0M0	M0	
17	49	M	NO	YES	NO	1YEAR		1,3	LT	CT	T2	N2b	M1	T1N2bM1	M1	
18	70	F	YES	YES	NO	2 YEARS	SCC	1,2,3	RT	CT	T4a	N2b	M1	T4aN2bM1	M1	
19	78	F	YES	NO	YES	1 YEAR	SCC	1,2,5,7	LT	CT	T4a	N0	M0	T4aN0M0	M0	

SL No	Age	Gender	Comorbidity	New case or recurrent	If recurrent then previous theraphy duration	Duration of the lesion	Lesion type	Site of the lesion	RIGHT/ LEFT / BILATERAL	MRI or CT	Clinlical T staging- Mention 1,2,3,4 only	N staging- Mention 0,1,2 only	Metastasis- Yes or no only	Total score	Histopatholog y M staging	N staging
20	44	M	NO	YES	NO	4 MONTHS	SCC	1,9	LT	CT	T4b	N2b	M1	T4bN2bM1 M1		
21	43	M	NO	YES	NO	6MONTHS SQUAMOUS CELL	SCC	1	LT	CT	T1	N0	M0	T1N0M0	M0	
22	42	M	NO	NO	YES	1 YEAR	SCC	1,7,10	LT	CT	T1	N0	M0	T1N0M0	M0	
23	58	F	YES	YES	NO	1 YEAR	SCC	1,2	RT	CT	T1	N0	M0	T1N0M0	M0	
24	57	M	YES	YES	NO	2 YEARS	SCC	1,3	LT	CT	T1	N0	M0	T1N0M0	M0	
25	60	F	YES	YES	NO	1YEAR	SCC	1,2,3	LT	CT	T2	N0	M0	T2N0M0	M0	
26	57	F	NO	YES	NO	2 YEARS	SCC	1,3	LT	CT	T3	N3	M1	T3N3M1	M1	
27	38	M	NO	YES	NO	6 MONTHS SQUAMOUS CELL	SCC	1,2	LT	CT	T1	N0	M0	T1N0M0	M0	
28	46	M	NO	YES	NO	1 YEAR	SCC	3	LT	CT	T1	N1	M1	T1N1M1	M1	
29	75	M	YES	YES	NO	2 YEARS	SCC	2	B/L	CT	T1	N1	M0	T1N1M0	M0	
30	48	M	NO	YES	NO	1 YEAR	SCC	1,2,3	LT	CT	T1	N0	M0	T1N0M0	M0	