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Oral Cancer Early Detection and Stages Using Various Methods

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ABSTRACT: Cancer is a term used for diseases in which abnormal cells divide without control and are able to invade other tissues. Cancer cells can spread to other parts of the body through the blood and lymph systems. Cancer is not just one disease but many diseases. There are more than 100 different types of cancer. Most cancers are named for the organ or type of cell in which they start cancer that begins in the colon is called colon cancer. cancer that begins in melanocytes of the skin is called melanoma. Oral cancer is a significant health problem throughout the world. Most oral cancers are identified at a later stage where, treatment becomes less successful. It is very important to detect such types of cancer at an earlier stage. Early detection helps surgeons to provide necessary therapeutic measures which also benefit the patients. Most oral cancer cases occur when the patient is at least 40 years old. It affects more men than women. Mouth cancer has the same meaning as oral cancer - it is cancer that occurs in any part of the mouth, on the tongue's surface, in the lips, inside the cheek, in the gums, in the roof and floor of the mouth, in the tonsils, and also the salivary glands. This paper emphasizes on various aids in diagnosing potentially malignant lesions or early oral cancer along with their critical evaluation.

KEYWORDS: Tumor, Cancer, Screening, Diagnosis

I. INTRODUCTION

All cancers begin in cells, the body's basic unit of life. To understand cancer, it's helpful to know what happens when normal cells become cancer cells. The body is made up of many types of cells. These cells grow and divide in a controlled way to produce more cells as they are needed to keep the body healthy. When cells become old or damaged, they die and are replaced with new cells. sometimes this orderly process goes wrong. The genetic material (DNA) of a cell can become damaged or changed, producing mutations that affect normal cell growth and division. When this happens, cells do not die when they should and new cells form when the body does not need them. The extra cells may form a mass of tissue called a tumor.

Cancer Cells: Cancer begins in cells, the building blocks that make up tissues. Tissues make up the organs of the body. Normal cells grow and divide to form new cells as the body needs them. When normal cells grow old or get damaged, they die, and new cells take their place. Sometimes, this process goes wrong. New cells form when the body doesn't need them, and old or damaged cells don't die as they should. The buildup of extra cells often forms a mass of tissue called a growth or tumor. Tumors in the mouth or throat can be benign (not cancer) or malignant (cancer). Benign tumours are not as harmful as malignant tumours:

Benign tumors , are rarely a threat to life , it can be removed and usually ,it don't grow back, it don't invade the tissues around them ,it don't spread to other parts of the body.

Malignant tumors , may be a threat to life , it can grow back after they are removed, it can invade and damage nearby tissues and organs, it can spread to other parts of the body. Almost all oral cancers begin in the flat cells (squamous cells) that cover the surfaces of the mouth, tongue, and lips. These cancers are called squamous cell carcinomas. Oral cancer cells can spread by breaking away from the original tumour. They enter blood vessels or lymph vessels, which branch into all the tissues of the body. The cancer cells often appear first in nearby lymph nodes in the neck. The cancer cells may attach to other tissues and grow to form new tumors that may damage those tissues. The spread of cancer is called metastasis.

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Cancer types can be grouped into broader categories. The main categories of cancer include:

- **Carcinoma** - cancer that begins in the skin or in tissues that line or cover internal organs. There are a number of subtypes of carcinoma[3], including adenocarcinoma, basal cell carcinoma, squamous cell carcinoma, and transitional cell carcinoma.
- **Sarcoma** - cancer that begins in bone, cartilage, fat, muscle, blood vessels, or other connective or supportive tissue.
- **Leukemia** - cancer that starts in blood-forming tissue such as the bone marrow and causes large numbers of abnormal blood cells to be produced and enter the blood.
- **Lymphoma and myeloma** - cancers that begin in the cells of the immune system.
- **Central nervous system cancers** - cancers that begin in the tissues of the brain and spinal cord.

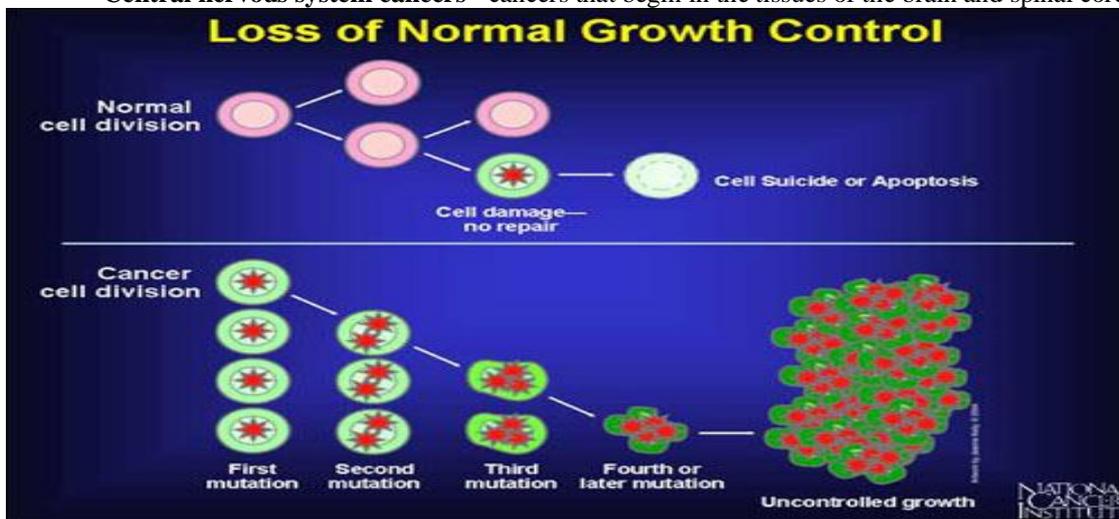


Fig :1 Growth of cancer cells

SYMPTOMS OF MOUTH CANCER

The most common symptoms of mouth cancer are a sore or ulcer in the mouth that does not heal, and pain in the mouth that does not go away. In many cases, changes are seen in the mouth before the cancer develops. This means that early treatment of these changes will actually prevent a cancer developing.

Other symptoms include: White patches anywhere in your mouth (leukoplakia). Red patches anywhere in your mouth (erythroplakia). A lump on the lip, tongue or in the mouth or throat.

- (1) Unusual bleeding or numbness in the mouth.
 - (2) Pain when chewing or swallowing.
 - (3) A feeling that something is caught in the throat.
 - (4) Unusual bleeding or numbness in the mouth.
 - (5) Loose teeth or dentures feeling uncomfortable and not fitting properly.
 - (6) A change in your voice or speech problems.
 - (7) Weight loss.
 - (8) A lump in the neck.
 - (9) If the cancer spreads to other parts of the body, various other symptoms can develop.
- All of these symptoms can be due to other conditions, so tests are needed to confirm the diagnosis.

II SCREENING AND EARLY DETECTION

Screening for oral cancer should include a thorough history and physical examination. The clinician should visually inspect and palpate the head, neck, oral, and pharyngeal regions. This procedure involves digital palpation of neck node regions, bimanual palpation of the floor of mouth and tongue, and inspection with palpation and observation of the oral and pharyngeal mucosa with an adequate light source, mouth mirrors are essential to the examination. Forceful



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protraction of the tongue with gauze is necessary to visualize fully the posterior lateral tongue and tongue base. The clinician should review the social, familial, and medical history and should document risk behaviours (tobacco and alcohol usage), a history of head and neck radiotherapy, familial history of head and neck cancer, and a personal history of cancer. Patients over 40 years of age should be considered at a higher risk for oral cancer.

Criteria for screening and for screening tests: There are various different criteria's for oral cancer which should meets at least three of these criteria, screening measures for this condition seem warranted.

Criteria for the screening programme:

1. The disease must be an important health problem
2. Facilities for diagnosis and treatment must be available
3. An accepted treatment must be available for patients with recognised disease
4. There must be a recognizable latent or early symptomatic stage
5. Suitable test must be available
6. Test should be acceptable to the population

In addition, there are a various characteristics that should be considered in the development of an ideal screening test.

Characteristics of a good screening test:

1. Simple, safe and acceptable to the patient
2. Detect disease early in its natural history
3. Preferentially detect those lesions which are prone to cancer

The many signs and symptoms of oral cancer are usually divided into early and late presentation. They can be so diverse that the differential diagnosis may not lead to oral malignancy. Table 1 summarizes the signs and symptoms.

Table 1: Frequent Signs and Symptoms of Oral Cancer

Early	Late
1.Persistent red and/or white patch Nonhealing ulcer	Indurated area
2. Progressive swelling or enlargement Unusual surface changes	Paresthesia, dysesthesia of the tongue or lips
3.Sudden tooth mobility without apparent cause	Airway obstruction
4.Unusual oral bleeding	Chronic earache

Table 2: Comparison of Toluidine Blue Uptake with Microscopic Diagnosis

Biopsy Diagnosis	No. Lesions	Positive	Negative	Correct
Carcinoma	62	58	4	94%
Dysplasia	13	11	2	85%
Benign	94	6	88	94%
Total	169			93%

Toluidine blue: Toluidine blue (tolonium chloride) is a metachromatic dye used in histology laboratories to stain nuclear material, it stains DNA very well.^{7,19} Its use as a screening tool for oral cancer detection, or as an adjunct to a COE for the identification of oral lesions, is more problematic because of significant number of both false positive and false negative reactions that have been associated with this method. Historically, it has proven valuable for demarcating the extent of a lesion prior to surgical removal.

In general examination, toluidine blue is associated with low specificity and this has prevented toluidine blue from becoming a standard component of early oral cancer detection efforts in the USA. Toluidine blue (vital staining) also is a useful adjunct to clinical examination and biopsy. The mechanism is based on selective binding of the dye to dysplastic or malignant cells in the oral epithelium. It may be that toluidine blue selectively stains for acidic tissue components and thus binds more readily to DNA, which is increased in neoplastic cells.



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Optical Coherence Tomography:

Optical coherence tomography (OCT), first applied in 1991 by Huang et al., is a non-invasive, interferometric (superimposing or interfering waves) tomography imaging modality that allows millimetre penetration with micrometre-scale axial and lateral resolution. OCT has been applied in the head and neck in an attempt to detect areas of inflammation, dysplasia and cancer. Results were promising but some studies suffered from poor-resolution images and poor penetration depth.

Brush cytology: Brush cytology involves the use of a circular brush designed to obtain a complete trans-epithelial tissue sample which is then smeared onto a glass slide for the subsequent identification of abnormal or malignant cells. Advantages of this method are that it causes minimal discomfort and less bleeding. However, the accuracy, sensitivity, and specificity of brush cytology for the identification of cancerous and potentially malignant lesions is disputed and a follow-up scalpel tissue biopsy is needed in the case of an malignant cells, result as the technique does not provide a definitive diagnosis.

II. STAGING SYSTEMS FOR MOUTH AND OROPHARYNGEAL CANCERS

The stage of a cancer means how big it is and whether it has grown or spread. The staging information helps your doctor to decide on the best treatment. The tests and scans that you had to diagnose your cancer give some staging information. But if you need surgery your doctor may not be able to tell you the exact stage until after the operation. There are different ways of staging cancers. The two main systems are the TNM system and number system. Understanding your cancer stage may help you understand why your specialist has recommended a particular treatment for you. If you don't understand and would like to know more, you can ask your doctor. There is a list of questions for your doctor at the end of this section that may help you. There is also more information about staging cancers in the about cancer section

TNM STAGES OF MOUTH AND OROPHARYNGEAL CANCERS

TNM stands for Tumour, Node and Metastasis. The system describes

- (1) The size of a primary tumour (T)
- (2) Whether the cancer has spread to the lymph nodes (N)
- (3) Whether the cancer has spread to a different part of the body (M)

T stages

There are 4 main T stages of mouth and oropharyngeal cancer

- (1) T1 means the tumour is contained within the tissue of the mouth or oropharynx and is no larger than 2cm ($\frac{3}{4}$ inch).
- (2) T2 means the tumour is larger than 2cm, but smaller than 4cm (about 1½ inches)
- (3) T3 means the tumour is bigger than 4cm.
- (4) T4a means the tumour has grown further than the mouth or oropharynx and into nearby body tissues such as bone, tongue, the air cavities of the face (sinuses) or the skin.
- (5) T4b means the tumour has spread into nearby areas such as the space around and behind the jaws, the back of the upper jaw where the large jaw muscles attach, the base of the skull, or the area of the neck that surrounds the main arteries (carotid arteries).

N stages

There are 4 main lymph node stages in cancer of the mouth and oropharynx. One of these, stage N2, is broken down into 3 sub stages. The important points here are whether there is cancer in the lymph nodes in the neck and if so, the size of the node and which side of the neck it is on.

- (1) N0 means there are no cancer cells in the lymph nodes
- (2) N1 means there are cancer cells in 1 lymph node on the same side of the neck as the cancer, but the node is less than 3cm across
- (3) N2a means there is cancer in 1 lymph node on the same side of the neck, and the node is more than 3cm across but less than 6cm across



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- (4) N2b means there is cancer in more than 1 lymph node, but none of these nodes are more than 6cm across. All the affected nodes are on the same side of the neck as the cancer.
- (5) N2c means there is cancer in nodes on the other side of the neck, or in nodes on both sides, but none of these nodes are more than 6cm across
- (6) N3 means that at least 1 node containing cancer is more than 6cm across

M stages

There are two M stages for cancers of the mouth and oropharynx

- (1) M0 means there is no cancer spread to other parts of the body
- (2) M1 means the cancer has spread to other parts of the body, such as the lungs

Together, the T, N and M stages give a complete description of the stage of your cancer. For example, if you have a T2, N0, M0 cancer, you have a tumour larger than 2cm but not larger than 4cm. There are no cancer cells in the lymph nodes and there is no spread of your cancer to other parts of the body.

M stages

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Number stages of mouth and oropharyngeal cancers

There are four main stages in this system – stages 1 to 4. Some doctors also refer to stage 0.

Stage 0 or carcinoma in situ (CIS)

If you have CIS or stage 0 cancer of the mouth or oropharynx, you have a very early stage cancer. Some doctors prefer to call this pre cancer. There are cancer cells but they are all contained within the lining of the mouth or oropharynx. So they have not spread. As the cells have not spread, this is not yet a true cancer. If the pre cancer is not treated, there is a high chance of this condition going on to develop into an invasive cancer.

Stage 1

This is the earliest stage of invasive cancer. It means that cancer has begun to grow through the tissues lining the mouth or oropharynx and into the deeper tissues underneath. The cancer is no more than 2 cm across and has not spread to nearby tissues, lymph nodes or other organs

Stage 2

If you have stage 2 cancer, the tumour is larger than 2cm across, but less than 4cm. The cancer has not spread to lymph nodes or any other organs.

Stage 3

Having stage 3 mouth or oropharynx cancer can mean one of two things. Either the cancer is bigger than 4cm but has not spread to any lymph nodes or other parts of the body. Or the tumour is any size but has spread to one lymph node on the same side of the neck as the cancer. In this case the lymph node involved is no more than 3cm across.

Stage 4

Stage 4 means the cancer is advanced. It is divided into 3 stages

- (1) Stage 4a means the cancer has grown through the tissues around the lips and mouth – lymph nodes in the area may or may not contain cancer cells
- (2) Stage 4b means the cancer is any size and has spread to more than 1 lymph node on the same side of the neck as the cancer, **or** to lymph nodes on both sides of the neck, **or** any lymph node is bigger than 6cm
- (3) Stage 4c means the cancer has spread to other parts of the body such as the lungs or bones

The grades of mouth and oropharyngeal cancer

The grade of a cancer tells you what the cells look like under a microscope. The cells are graded according to how normal or abnormal they appear. There are 4 grades of oral and oropharyngeal cancer cells

- (1) Grade 1 (low grade) – the cancer cells look very much like normal mouth or oropharyngeal cells
- (2) Grade 2 (intermediate grade) – the cancer cells look slightly different to normal mouth or oropharyngeal cells



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- (3) Grade 3 (high grade) – the cancer cells look very abnormal and not much like normal mouth or oropharyngeal cells
- (4) Grade 4 (high grade) – the cancer cells look very different to normal mouth or oropharyngeal cells
- Differentiation means how developed or mature (differentiated) a cell is. So doctors may describe grade 1 cancer cells as well differentiated. Grade 2 cancer cells are moderately differentiated. Grade 3 cancer cells are poorly differentiated. Grade 4 cells are undifferentiated.

IV. THE RISK FACTORS FOR MOUTH CANCER

A risk factor is anything that increases that likelihood of developing a disease or condition. For example, regular smoking increases the risk of developing lung cancer; therefore smoking is a risk factor for lung cancer. The risk factors for mouth cancer include:

- **Smoking** - studies indicate that a 40-per-day smoker has a risk five times great than a lifetime non-smoker of developing oral cancer.
 - **Chewing tobacco.**
 - **Taking snuff** (snorting tobacco).
 - **Both heavy and regular alcohol consumption** - somebody who consumes an average of 30 pints of beer per week has a risk five times greater than a teetotaler or somebody who drinks moderately.
 - **Heavy smoking combined with heavy drinking** - as tobacco and alcohol have a synergistic effect (their combined effect is greater than each one added together separately), people who drink and also smoke a lot have a significantly higher risk of developing oral cancer compared to others. Somebody who smokes 40 cigarettes per day AND consumes an average of 30 pints of beer a week is 38 times more likely to develop oral cancer compared to other people.
 - **Too much sun exposure** on the lips, as well as sunlamps or sunbeds.
 - **Diet** - people who consume lots of red meat, processed meat and fried foods are more likely to develop oral cancer than others.
 - **GERD** (gastro-esophageal reflux disease) - people with this digestive condition where acid from the stomach leaks back up through the gullet (esophagus) have a higher risk of oral cancer.
 - **HPV** (human papillomavirus) infection.
 - **Prior radiation treatment** (radiotherapy) in the head and/or neck area.
 - **Regularly chewing betel nuts** - these nuts, from the betel palm tree, are popular in some parts of south east Asia. They are slightly addictive and are also carcinogenic.
- Exposure to certain chemicals** - especially asbestos, sulphuric acid and formaldehyde

V. CONCLUSION

The importance of routine screening to improve early diagnosis of oral malignancies cannot be overemphasized. Worldwide, there has been a call for early detection in at-risk populations to decrease the morbidity and mortality associated with oral cancer visual detection is a well-established and accurate diagnostic method for other types of cancer. The visual detection of premalignant oral lesions remains problematic. Recent advances have shown that the risk of malignant transformation is associated with chromosomal aberrations. The ability to identify lesions and to predict which lesions will undergo malignant transformation would facilitate early diagnosis and subsequent disease management. These adjuncts for detection and diagnosis have the potential to assist in early detection, leading to early diagnosis and improved treatment outcomes. In this paper, various methods to detect cancers are analyzed. The proposed work will identify oral cancer at an earlier stage which helps surgeons to provide medications and other treatments necessary for the particular cancer type. The proposed work will explore different enhancement techniques to improve the quality of images capturing devices like Ultra – Sonography (US), Positron Emission Tomography (PET), Single photon Emission Computed Tomography (SPECT), Optical Imaging (OI), Computed Tomography (CT), X ray, Ultrasound and MRI. This will benefit the patients suffering from oral cancer.



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BIOGRAPHY

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