Type of article : *Review Article*

Radiographic Methods as a Adjuvant Guide to Oral Pathologist in Diagnosis of Oral Cancer

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Abstract

The management of oral cancer is a multidisciplinary endeavour, as each patient presents the treating clinicians with a unique set of challenges the management of which impacts on both survival and quality of life. This article focuses on the different radiographic methods used in the diagnosis of oral cancer. Imaging techniques have become an important element in the field of oral oncology. Continued research has led to technical progress in the existing modalities and addition of newer, exiting and highly accurate techniques. Although this is a boon, it has created differences of opinion regarding the ideal choice of imaging techniques. Inappropriate choice of imaging modality can result in delay in diagnosis and treatment thereby inducing more suffering for the patients.

Keywords*: Oral cancer, Radiography, CT scans.*

Introduction

Oral cavity squamous cell cancers form a significant percentage of the cancers seen in India. While clinical examination allows direct visualization, it cannot evaluate deep extension of disease. Cross-sectional imaging has become the cornerstone in the pretreatment evaluation of these cancers and provides accurate information about the extent and depth of disease that can help decide the appropriate management strategy and indicate prognosis. Early cancers are treated with a single modality, either surgery or radiotherapy while advanced cancers are offered a combination of surgery, radiotherapy and chemotherapy. Imaging can decide resectability, help plan the precise extent of resection, and indicate whether organ conservation therapy should be offered. Quality of life issues necessitate preservation of form and function and pretreatment imaging helps plan appropriate reconstruction and counsel patients regarding lifestyle changes.

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WHY DO WE NEED TO RADIOGRAPHS EVEN AFTER HISTOPATHOLOGICAL CONFIRMATION OF ORAL CANCER:

Despite continued research and advances the survival rates have not improved significantly . This is because of the two main reasons. Firstly, the oral cancer lesions are detected only at an advanced stage when they have invaded the deeper structures and metastasized to another location, most likely the lymph nodes of the neck[1]. Secondly, there could be an inappropriate assessment of the lesion in terms of depth and extent, bone invasion, status of lymph node involvement and distant metastasis, thereby leading to inappropriate treatment planning and therapy failure[2,3]. Hence it is important not only to detect the tumors at the earliest but also make an adequate assessment which is critical for appropriate planning of surgical, radiation and chemotherapy treatment[4].

Histopathological examination by biopsy is a useful method to confirm diagnosis and to estimate the malignant potential of tumor. However digital examination needs mastery of skills for consistent accuracy and objectivity,

more so in inaccessible intra oral sites. Accurate lymph node assessment and appropriate staging are also difficult with clinical examination alone[5,6].

APPLICATIONS OF IMAGING IN ORAL CANCERS :

ADVANCES IN THE FIELD OF IMAGING HAVE PROVED TO BE A BOON IN:

i) In finding information regarding location, extent, depth, proximity to anatomical structures and lymph node assessment.

ii) Helps in grading the stages of cancer and determining the treatment modality.

iii) It guides during cancer treatments by focusing treatments on the tumors and thereby minimizing the damage to the adjacent normal tissues.

iv) And post-operatively to determine the treatment response

v) It plays a major role in monitoring cancer recurrence in patients previously treated for cancer[7].

IMAGING MODALITIES ARE AVAILABLE:

Ø RVG (Intraoral radiography)

Ø Conventional OPG (Panoramic radiography)

Ø Nuclear medicine Scintigraphy

Ø Ultrasonograhy (US)

Ø Computed Tomography (CT)

Ø Magnetic Resonance Imaging (MRI)

Ø Positron Emission Tomography (PET)

Ø Positron Emission Tomography/ Computed Tomography (PET/CT)

Ø Single Positron Emission Computed Tomography (SPECT)

IOPA/RVG (Intraoral radiography)

On regular basis of screening the patient, sometimes the complaint of patient can be common pain, swelling or mobility in tooth , in such cases basic IOPA/ RVG can reveal abnormal intraosseous changes which can be alarming. These Imaging can be useful in determining any suspicious abnormalities that might be cancerous.

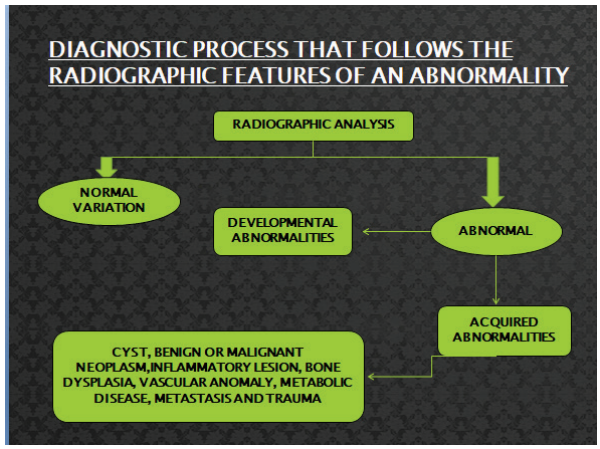

Figure 1 -Diagnostic process that follows the radiographic features of an abnormality

CONVENTIONAL OPG (PANORAMIC RADIOGRAPHY)

Conventional imaging techniques with x-rays are perhaps the most familiar type of imaging. Orthopantomography (OPG) provides a good overall view of the jaws and the dentition[7]. A combination of OPG and intraoral radiography play an important role in the detection of bone invasion especially in determining the supero-inferior extent in carcinoma of the mandibular gingiva. This assessment of the superoinferior extent is one of the most important factors influencing surgeons in choosing between a rim or segmental resection of the mandible. A study comparing OPG combined with intraoral radiography and CT in detecting the supero-inferior extent of tumor invasion of mandible, concluded that there was no difference in the diagnostic accuracy between the two techniques[8]. The sensitivity of OPG was lower than CT, MRI. Hence, it was suggested that decision to resect the mandible as a part of the management of oral cancer should be taken on the evidence of clinical examination, periosteal stripping and at least two imaging techniques that compliment each other in terms of specificity and sensitivity. A combination of OPG and Scintigraphy has high specificity and sensitivity thereby giving accurate results[9].

CT- COMPUTED TOMOGRAPHY

Numerous prospective and retrospective studies

have investigated various imaging methods such as orthopantomogram (OPG), CT scan, Denta scan, MRI, Bone scan and SPECT for assessing mandibular invasion in oral squamous cancers[10,11]. Comparison has also been made with clinical examination and periosteal stripping. Although initially imaging was pronounced inaccurate as compared to clinical examination, subsequent studies conclusively proved the role of imaging in assessing mandibular invasion. CT was found to have the highest specificity (87%) while SPECT and MRI had the highest sensitivity (96-97%)[12]

CT scans of the head/neck/chest are routinely employed in assessment of oral cancer and are excellent in highlight cortical destruction, potential cervical node metastases and pulmonary metastases.

disadvantages with the use of CT. Presence of amalgam fillings and metallic prosthesis in the oral cavity can result in artifacts and obscures the anatomy and pathology in the sections where devices are included. A CT scan is not as useful in cases where soft tissue malignancies are required to be studied[13,14]. Hence a CT is not recommended in cases of carcinomas of tongue and gingiva, instead MRI is preferred.

CT scan is also currently used for radiation therapy planning, with a specific positioning and immobilizing device. It will play an essential role, along with MRI, in the development of conformal radiation therapy[15].

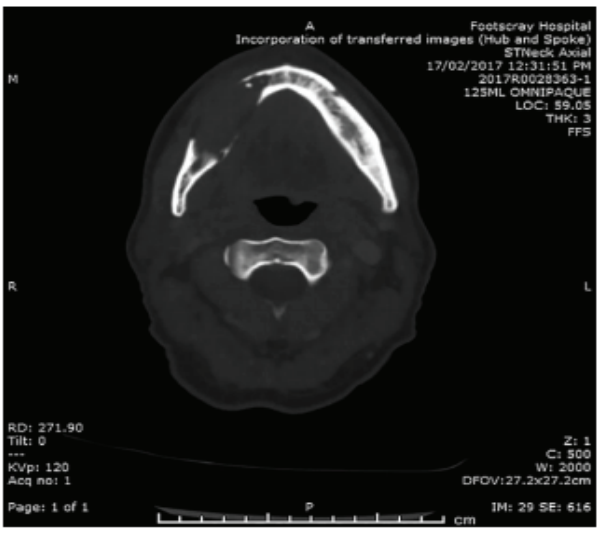

Figure 2-Image of Axial of CT scan-Head

MRI- MAGNETIC RESONANCE IMAGING

MRI of the neck is excellent at evaluating the soft tissue extent of the tumour, extent of marrow infiltration of the mandible or maxilla and assessment of intra or perineural involvement. MRI can assess the presence of marrow edema and hence bone infiltration which cannot be appreciated with CT. MRI can better assess the occult metastasis as the lymph nodes give the same signal intensity as the primary tumor[16]. In cases of salivary gland tumors, MRI can better assess the fine details of the gland. MRI can also accurately depict the T stage, another factor with bearing on prognosis and treatment. Extension to the extrinsic muscles (upstaging disease to T4a), encasement of neurovascular bundle, invasion and base tongue are well seen . These features influence the choice of therapy (single or multiple modality) and the extent of surgical resection that can vary from wide excision to partial glossectomy to total glossectomy (for tumors involving bilateral neurovascular bundles)[17,18].

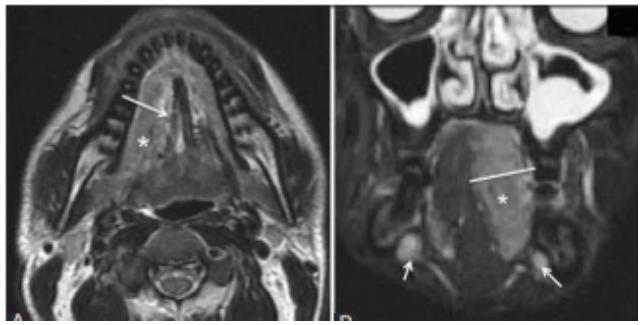

Figure 3-Image of Magnetic resonance imaging of head

ULTRASONOGRAPHY:

Ultrasound uses sound waves with frequencies above those humans can hear. A transducer sends sound waves traveling into the body which are reflected back from organs and tissues, allowing a picture to be made of the internal organs. Ultrasound, used either intraorally for accessible tumours, or more commonly for assessment of cervical nodes can be combined with a fine-needle aspirate for cytologic assessment of suspicious cervical nodes. In head and neck malignancies it is mainly limited to the tumors in salivary glands and detection of lymph nodes metastasis. For lesions in the parotid, submandibular and sublingual glands, ultrasound is an ideal tool for initial assessment[19]. These are relatively superficial structures accessible by high resolution ultrasound, which provides excellent resolution and tissue characterization without a radiation hazard. The main advantages are low cost and easily accessible

technique and can easily guide a fine-needle aspiration[20].

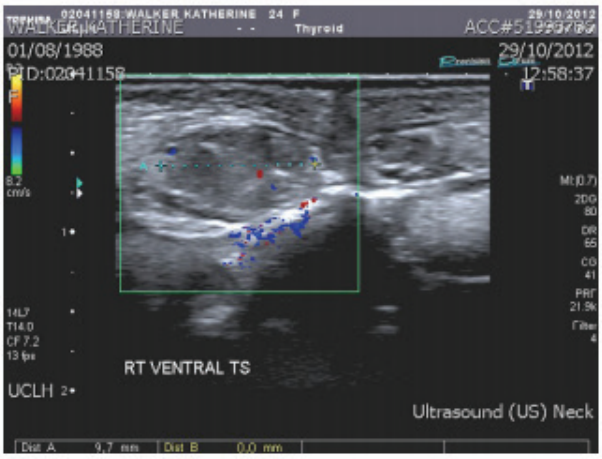

Figure 4 - Image of Ultrasonography of the tongue measuring the dimensions of the tongue tumour

POSITRON EMISSION TOMOGRAPHY/ COMPUTED TOMOGRAPHY (PET/CT):

PET/CT is a physiological imaging for assessment of metabolism within the tissues. It is the fusion of the two techniques of PET and CT. CT helps in localization of the tumor anatomically and PET helps in characterization, thereby providing information physiologically[21]. The main application is in the assessment of patients with cancer using the **glucose analogue 2-[18] fluoro-2-deoxy-Dglucose (FDG).** Cancer cells have increased glucose utilization and FDG PET/CT is used to investigate the increased FDG metabolism of malignant cells compared with non-malignant cells. PET is often combined with an anatomical imaging modality (CT or MR), and is a functional scan, where a radiotracer is administered intravenously to the patient; the tracer is preferentially taken up by cells with a high metabolic rate (a characteristic of many oral cancers). Infection and inflammation however can also provide similar radiologic appearances. It is most often used in advanced (stage 3 or 4 disease, or in salvage/recurrent cases) and the assessment of metastatic disease.

FDG PET/CT plays an increasing central role in the detection and management of head and neck cancers because most of the cancers in this region are squamous cell carcinomas. This technique is particularly useful in assessment of occult primary tumors and lymph nodes which are missed in other radiographic techniques. It helps in accurate staging of the carcinomas also assess the post treatment results and responses. The residual tumor and recurrences are also better assessed by this technique. PET/CT better assess the operability upto 95%. This technique is highly sensitive. The specificity is compromised and there are false positive results when there are other infections present. For example in case of post chemotherapy, the patients immunity is low and prone for infections. This can result in false uptake of the radiotracer and false positive results. It cannot be used in cases of uncontrolled diabetes where the blood sugar levels are higher than 150mg/dl[22,23].

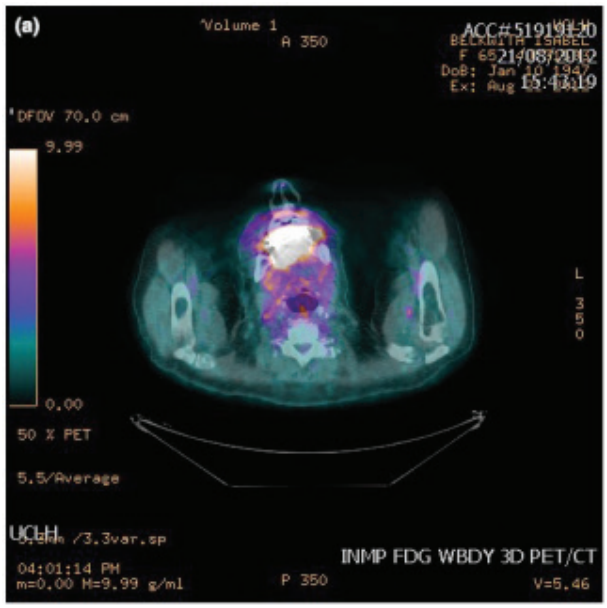

Figure 5a - Image of assessment of metastasis using 3D PET/CT

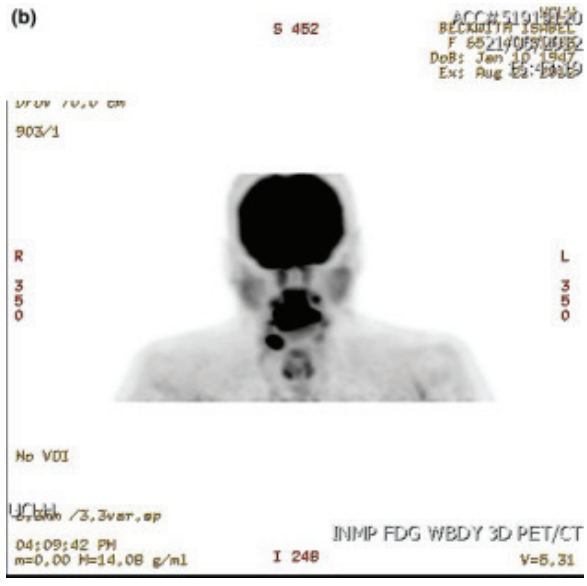

Figure 5b - Image of PET-CT showing extensive uptake in the floor of mouth and bilateral cervical nodes

BONE SCINTIGRAPHY:

Bone imaging with radionuclides is a non-invasive technique for demonstrating the osteoblastic lesion of the skeletal system. It is based on the uptake of a radiotracer that occurs where bone is being formed or repaired. It can be particularly helpful in tumors of head and neck which invade the adjacent bones. A bone loss upto 5 percent can also be detected with accuracy with a bone scan. It is also of particular importance in distant metastasis in the bones.

SINGLE POSITRON EMISSION COMPUTED TOMOGRAPHY - SPECT/CT:

SPECT/CT is a imaging technique that combines the functional information from Scintigraphy with the anatomical information from Computed Tomography into one set of images. It measures the concentration of chemicals injected into the body, and provides images of the chemical function of body parts of interest. In this technique the image obtained by a gamma camera is a 2-D view of 3-D distribution of a radionuclide[24,25].

Conclusion

Oral cavity cancer is a challenging disease with high mortality rates; dentists and dental specialists play a critical role at all stages in the management of patients. Choice among further sophisticated imaging modalities depend on number of factors like availability, affordability and clinical situation. If clinical findings are suggestive of bone involvement, the preferred imaging method is CT as it assesses bone architecture better. If the clinical findings are suggestive more of soft tissue involvement and nodal metastasis, MRI is the preferred imaging modality. In addition to these, several new techniques that aid in diagnosis and staging of oral carcinomas like SPECT and PET/CT are also available. PET/CT is superior and is of particular value in investigation of occult primary tumors, staging primary disease, detection of residual and recurrent lesions.

Prevention through education about smoking cessation and safe alcohol consumption is critical, detection and early referral of premalignant lesions and oral cancers and ongoing surveillance, follow up and preservation of oral health are just a few of the many roles of the dental practitioner in the management of oral cancer.

Ethical Clearance – Not required since it is a review article

Source of Funding – Nil

Conflict of Interest – Nil

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