

**ORIGINAL RESEARCH****Knowledge and attitude about higher radiographic investigation methods in oral medicine post graduated: an original research**

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**ABSTRACT**

**Background:** Radiographs are a valuable diagnostic tool, as an adjunct to clinical examination in the diagnosis of dental diseases. Two dimensional periapical and panoramic radiographs are routinely used in dental practice. However, there are certain limitations of two dimensional radiographs, which can be overcome by three-dimensional, imaging techniques such as cone beam computed tomography, magnetic resonance imaging and ultrasound and other higher radiographic techniques.

**Aim:** The purpose of this study was to assess the knowledge, practice and attitude towards higher radiographic investigations among post graduates in the department of oral medicine and radiology.

**Materials and method:** In this cross-sectional study, a questionnaire dealing with knowledge, attitude, and practice used in dental radiology was conducted among 100 oral medicine post graduates, was electronically distributed via email and social media for a period of one year. The analysis was done using SPSS version

**Results:** A total of 100 volunteers participated but only 88 postgraduates responded to the questionnaire. Among the respondents, 54.5% were not using all the higher radiographic techniques other than the regular techniques for diagnostic purposes at their work place. A total of 68.2% of respondents were partially aware of common terminologies used. Most of the respondents were unsure about radiation exposure of the higher radiographic techniques used, when compared to other types of imaging. Almost nobody had any idea on relative importance of image characteristics. Only half of the respondents were willing to attend a hands-on course for the interpretations of the higher radiographic techniques versus pathology.

**Conclusions:** In the present study it was apparent that most of the respondents were lacking adequate knowledge of the higher radiographic techniques other than regular

**ones. Hence, there is an urgent need for more training programs which would result in better diagnosis and treatment planning.**

**Keywords: Cone-Beam Computed Tomography , questioner survey, radiographic techniques.**

## **INTRODUCTION**

Dentistry has witnessed tremendous advances in all its branches over the past three decades. With these advances, the need for more precise diagnostic tools, specially imaging methods, have become mandatory. From the simple intra-oral periapical X-rays, advanced imaging techniques like computed tomography, cone beam computed tomography, magnetic resonance imaging and ultrasound have also found place in modern dentistry. Changing from analogue to digital radiography has not only made the process simpler and faster but also made image storage, manipulation (brightness/contrast, image cropping, etc.) and retrieval easier. The three-dimensional imaging has made the complex cranio-facial structures more accessible for examination and early and accurate diagnosis of deep seated lesions.<sup>1</sup>

The current advanced modalities enabling superior treatment options and virtual surgeries .<sup>2</sup> Even a dig into the roots of literature reveals that the era of “cut and see” has transformed into the era of “see and cut” because of the paradigm shift seen in the field of imaging today.<sup>3</sup> thus the quality of imaging has not only improved the diagnostic accuracy of diseases but also the quality care with regard to patient exposure and time consumption.<sup>4</sup>

Categorically, the radiographic imaging methods used in dentistry can be divides as: intraoral and extra-oral, analogue and digital, ionizing and nonionizing imaging and two-dimensional (2-D) and threedimensional (3-D) imaging. Usually, the 2-D conventional radiographs suffice for most dental radiographic needs and they are used to reveal caries, periodontal and periapical diseases, and other osseous structures. Since these radiographs produce a 2-D image of a 3-D object, the interpretation of tooth with its adjacent anatomical structures cannot be done precisely which limits its diagnostic accuracy.<sup>5</sup>

The drawbacks of 2d imaging, involve the superimposition of anatomical structures surrounding the teeth leading to anatomical noise, appearance of less severe bone destruction than its actual condition, and inability to assess the soft- tissue to hard-tissue relationships. Considering the above mentioned drawbacks of 2-D imaging, the cases of diagnostic dilemma and treatment planning of special cases desire advanced 3-D imaging techniques.<sup>6</sup>

## **DIFFERENT TYPES OF MODALITIES**

The radiovisiography (RVG) was the very first imaging system introduced in digital dental radiography[3] . Digital radiography is a technique which produces radiographic image using a sensor with solid-state technology, breaking it into electronic pieces, displaying and storing the image using software in computer system. Radiation dose reduction (up to 80%, when compared with conventional plain film radiography) is considered to be one of the most advantageous outcomes of digital radiography.<sup>7</sup>

Computed Tomography (CT) utilizes a narrow fan-shaped X-ray beam and multiple exposures around an object to assess its anatomical structures enabling the clinician to observe the morphologic features and pathology in three- dimensions so that it can also measure the bucco-lingual extent of the lesions overcoming the drawback of 2-D imaging.<sup>8</sup> CT has been proven as gold standard imaging technique for interpretation of the maxillofacial skeleton structures. It helps in diagnosing the complex facial fractures, like those involving the frontal sinus, naso-ethmoidal region[12] , and the orbits[13] . It also detects undisplaced fractures of the mandible and the condyle, which are not generally seen on panoramic radiographs.<sup>9</sup>

The disadvantages of CT imaging include high radiation exposure, high costs of the scans and scatter because of metallic objects. It has poor resolution compared to conventional radiographs.<sup>9</sup>

Tuned Aperture Computed Tomography (TACT): TACT is comparatively a simple, faster method for reconstructing tomographic images, introduced by Webber and colleagues[18]. It utilizes the mechanism of tomosynthesis and optical-aperture theory[19,20]. TACT needs 2-D periapical radiographs obtained from different projection angles as base images and allows retrospective creation of longitudinal tomographic slices (TACT-S) lining up in the Z axis of the concerned area. It generally results true 3-D data from any number of arbitrarily oriented 2-D projections. The overall radiation dose of TACT is usually within double to that of a conventional periapical X-ray and the resolution has been found similar with 2-D radiographs. Also, it does not produce artifacts like starburst patterns as seen with metallic restorations in case of CT. TACT produces more accurate imaging for assessing non-destructive osseous changes within the healing bony lesions. It has also been proved that TACT can be a better option for analyzing trauma induced radicular fractures and mandibular fracture. TACT can also be alternative to CT for pre-surgical implant assessment. However, TACT is still at trial phase but thought to be a effective imaging technique for the future dentistry.<sup>10</sup>

Cone Beam Computed Tomography (CBCT): It performs 360° rotation around the object and generates a series of 2-D images which are reconstructed in 3-D using a modification of the original cone-beam algorithm. Radiation dose of one CBCT scan equals 3-20% that of a conventional CT scan, depending on the equipment used and the area scanned.<sup>9</sup>

CBCT provides a high spatial resolution of bone and teeth which permits definite understanding of the relationship of the adjacent structures. CBCT has wide applications in dentistry due to its high resolution, it determines variety of cysts, tumors, infections, developmental anomalies and traumatic injuries involving the maxillo-facial tissues plus evaluating dental and osseous disease in the jaws and temporo-mandibular joints and treatment planning for dental implants.<sup>9</sup>

CBCT is primarily indicated for imaging hard tissues. CBCT has lengthy scan times (15-20 sec) and they need the person to stay completely firmed.<sup>11</sup>

Magnetic Resonance Imaging (MRI): MRI scan is a specialized imaging technique without ionizing radiation. Most MRI machines are graded on the strength of the magnet, measured in Tesla units, which is the equivalent of 20000 times the magnetic field strength of Earth. MRI principle is based on behavior of hydrogen atoms (consisting of one proton and one electron) within a strong magnetic field which is used to generate the MR image. This forces the nuclei of many atoms in the body to align themselves with the magnetic field. The machine implies a radiofrequency pulse to depolarize the atoms and the energy that is emerging from the body is utilized and used to generate the MR image by a computer.<sup>12</sup>

The MRI has high contrast sensitivity to soft tissue differences as hydrogen is found in abundance in soft tissue, but is lacking in most hard tissues and this is the main reason behind MRI replacing the CT for soft tissues imaging and it provides the best resolution of tissues with low inherent contrast.<sup>13</sup>

The main use of MRI in dentistry is for investigation of soft-tissue lesions in salivary glands, TMJ and tumor staging. Also, it seems to be ideal for assessment of internal derangement of TMJ. MRI can also detect joint effusions, synovitis, erosions and associated bone marrow edema. Odontogenic cysts and tumors can be differentiated better on MRI than on CT. It can simultaneously image both hard. and soft dental tissues with high resolution with less scan time. But MRI is usually not supposed to be used in patients with cardiac pacemakers, implantable defibrillators, some artificial heart valves, cerebral aneurysm clips, or ferrous foreign bodies in the eye. Metallic dental restorations can generate artifacts producing a

major diagnostic problem in CT examinations of malignant tumors in the maxillofacial region.<sup>13</sup> Claustrophobic patients should not be positioned in the close confines of an MRI machine. Other drawback of MRI includes long scanning time and much expensive compared to other conventional radiographic methods.<sup>13</sup>

## ULTRASOUND

Ultrasound (US) is a non-invasive, cost-effective and painless imaging technique. Unlike X-rays, it is devoid of harmful ionizing radiation. US can be utilized for both hard and soft tissue assessment. US principles depend on the reflection of sound waves (echoes) with a frequency outside the human range (1-20 kHz), at the interface of tissues which have different acoustic properties. Ultrasonic waves are generated by the piezoelectric mechanism within a transducer (probe). US waves transmit energy, as X-ray does, but it needs a medium for its transmission, unlike X-rays which pass readily through a vacuum. The transducer detects the echoes and transforms them into an electrical signal and finally, a real-time black, white and shades of grey picture are viewed on a computer screen. US can be an important and alternative diagnostic method when MRI is contra-indicated in conditions like cardiac pacemakers, claustrophobia and metallic prostheses. US is used to diagnose fractures of the orbital margin and nasal bone, zygomatic arch, and the anterior wall of the frontal sinus. It can also be helpful in assessing the patients with mid-facial fracture. Ultrasonography also determines extra-capsular subcondylar fractures. US can differentiate solid and cystic lesions in the parotid gland. It also detects sialoliths in parotid, submandibular and sublingual salivary glands.<sup>14</sup> The limitations of US include inability in diagnosing displaced fractures, complex maxillofacial fractures, posterior orbital floor fractures and intra-capsular mandibular condyle fractures due to overlapping of zygomatic arch.<sup>15</sup> US are restricted by bone and therefore it can be indicated only if there is a bony defect over the lesion through which ultrasonic waves can traverse.<sup>15</sup>

A literature search revealed various studies that focused on the use of various digital systems in imaging and interpretation, but there was no study to present the awareness of and knowledge on higher radiographic techniques among postgraduate students of Oral medicine and Radiology. Thus, The present study was conducted among postgraduates of dental specialty of oral medicine and radiology to assess their knowledge on these advanced and higher radiographic techniques.

## MATERIALS AND METHOD

An cross sectional questioner based survey was carried among postgraduates of dental specialty of oral medicine and radiology in a dental college in India to access their knowledge on these radiographic techniques. The study protocol was reviewed by the Ethical Committee and was granted ethical clearance. The prepared validated questionnaire was distributed among post graduate students of dental specialty of oral medicine and radiology from various colleges across India. A total of 100 volunteers participated in the study but only 88 postgraduates responded to the questionnaire which comprised of 14 close-ended questions. The completed questionnaires were collected and the results thus obtained were subjected to statistical analysis using SPSS software.

**Table 1: Sample Questionnaire**

Questions	Options
Do you need all the radiographic machinery needed to be present at your work place and have u had the knowledge about the same?	1. Yes 2. No 3. A little 4. No idea
Do you prescribe any of these higher	1. Yes

radiographic techniques for your cases	2. No 3. Case dependent
Have you know all the terminologies of these advanced radiographic techniques.	1. Yes 2. No 3. Few
Are you able to interpret the images of these advanced techniques or reliable on reports given by medical radiologists	1. Yes 2. No
Do you any of the softwares related to these advanced techniques,used in the interpretation of images	1. Yes 2. No
How many images u Come across a month related to these advanced radiographic technologies	1. Not at all 2. Rarely 3. Frequently
How many cases you have prescribed any of the advanced techniques like CT / MRI/ CBCT	1. Almost all the cases 2. Not for single case 3. Rarely
Have u ever had a personal experience with any of the advanced radiographic technique	1. Yes 2. No
Do you know radiation exposure of these advanced radiographic techniques compared to other regularly used techniques such as OPG	1. High 2. Low
Do you have idea of image characteristics of these higher radiographic techniques (CT/MRI/CBCT/USG)	1. Yes 2. No 3. a little
Have you ever done an exposure using these advanced radiographic techniques	1. Yes 2. No 3. choose out of CT/MRI/CBCT/USG
Have you attended any seminars regarding these advanced radiographic techniques	1. Yes 2. No
Do you feel there is a need of conducting CDE programs for the enchancement of these advanced radiography	1. Yes 2. No
For which of the following cases, u prescribe this advanced radiographic techniques quite frequently	1. Impactions 2. Fractures 3. Sinus pathologies 4. Cysts and tumors 5. TMJ pathologies 6. Implant cases 7. Tumors 8. Endodontic procedures 9. Orthognathic surgeries and orthodontic purposes

## RESULTS

Among 100 participants 88 volunteers responded to the questionnaire. Ninety-two percent of respondents felt that there was a need for all these advanced radiographic equipments and machinery at their work place. A total of 54.5% of respondents said that they had not used or advised higher radiographic techniques for diagnostic purposes in their cases. Among all the respondents only 68.2% were partially aware of common terminologies used in like FOV, SSV, MIP, MPR, and DICOM images. Only 29.5% of the respondents were able to interpret images of few higher radiographic techniques while 46.6% said that they would self-interpret the images and also relied on the reports given by medical radiologists. Among the questions related to the software used in the interpretation of images, a majority of the respondents (34.1%) were familiar with iCAT classic mostly used in CBCT. Some of the respondents (i.e. 34.1%) said that they had no knowledge on the software used. When questioned how many images they come across a month, 83.0% said that around 0-5 images. The majority of participants i.e. 53.4% said they never used advanced radiographic techniques such as CBCT or CT for 2D panoramic radiography while a few said 'rarely' (23.9%) and 'once in a month' (11.4%). Majority of respondents i.e. 45.5% never used advanced radiographic techniques in case of the third molar while a few reported rare use (31.8%) and once a week (11.4%). A total of 36.4% of respondents said they never used in diagnosing fracture cases while 27.3% said 'rarely', and 17.0% 'once a month'. Most of the participants, i.e. 42.0%, said that they never used these techniques for sinus pathologies while a few said 'rarely' (25.0%) and 'once a month' (22.7%). As much as 34.1% of respondents said that they never used these techniques for diagnosing cysts and tumors, followed by 25.0% 'once a month', and 21.6% 'rarely'. A total of 39.8% of respondents said that they never used for TMJ pathologies while a few said 'rarely' (25.0%) and 'once a month' (23.9%). Most of the respondents said that they never used or advised for implant cases (39.8%), orthodontic analysis (52.3%) and orthognathic surgeries (45.5%) or for endodontic purposes (47.7%). When enquired about the radiation exposure for these higher radiographic techniques, a majority of them were unsure about it as compared to other types of imaging. Most of the respondents did not have any idea on image characteristics. A majority of respondents were willing to attend a CDE program in future and most of dint done any of the exposure using these higher radiographic techniques as most of the colleges are not fully equipped or dint have peripheral programs to involve in these procedures.

## DISCUSSION

Imaging has experienced a paradigm shift from conventional to advanced in the recent years with the advent of numerous advanced imaging modalities which technically converted two-dimensional images into three-dimensional life-like images making interpretation and diagnosis more accurate.<sup>16</sup>

Intraoral radiographic examination is the backbone of imaging for the general dental practitioner. It comprises of three categories: periapical, bitewing and occlusal projections. Still there usage is ongoing and considered conventional and its time consuming with lots of disadvantages like minimal coverage of lesion and difficulty in exposing, artifacts and errors etc., hence the advanced radiographic techniques were evolved. This is accordance with the studies conducted by naseem shah et al.,<sup>1</sup>

The extra-oral radiographic examination used in Dentistry includes panoramic radiographs, postero-anterior and lateral skull view, Water's view and postero-anterior and lateral cephalometric examinations which help to examine larger areas of the jaws and skull, monitor growth and development of cranio-facial skeleton, to locate impacted teeth and large pathological lesions and evaluate the temporo-mandibular joint.<sup>1</sup> yet these Radiographs

provide a two-dimensional image of a three-dimensional object. Hence there is evolution of three dimensional advanced radiographical techniques such as CT, MRI, USG , TACT, and most recently CBCT.

This study used a questionnaire to gauge the awareness about the higher radiographic techniques among oral medicine graduates which assesses the knowledge and attitude of about the same and their opinions on the implications of increased use of these techniques in their practices.

In the present study, it is found that there is partial awareness amongst the Post Graduate students , This is in accordance with the study by Mahdizadeh et al (2012)<sup>17</sup> which is attributed to the lack of full fledged infrastructure in the colleges and some are separated dental colleges.

In our study we found that 54.5% of the respondents did not use/advised CBCT for diagnostic purposes and only 68.2% of the participants were partially aware of common terminologies used in like FOV, SSV, MIP, MPR, and DICOM images. This can be attributed to the unavailability of radiographic equipments at their work place. Most of the respondents in our study , i.e, 92% felt that there is a need for a at their work place because it is important to get familiar with the handling of the scanner and to interpret more images rather than to have theoretical knowledge only. This is in accordance with the study by Kamburoğlu et al.,<sup>18</sup> on Turkish dental students which highlighted the difficulties with acquiring knowledge on a given system without practical experience and thus the lack of advanced radiographic machinery units at institutions may constitute a significant factor contributing to students' unfamiliarity with this technology.

In the present study we found that most of the respondents were unsure about their radiation exposure when compared with other imaging modalities. Moreover, a majority of the respondents did not have any idea on image characteristics of CBCT which could be attributed to the lack of CBCT units at their work place and even the lack of practical experience and unfamiliarity with image characteristics in image acquisition.

Most of the responders were in need of awareness programmes such as CDEs and workshops in order to have expertise of the advanced radiography and thus have proper diagnosis and that helps us to have proper treatment with enhanced perfection. This is in accordance with studies conducted by Rai et .al <sup>19</sup>

Most of the responders agreed that advanced radiographic techniques can be used for dental imaging. The main reason for this that it can be due to its use in implant assessment, TMJ analysis, as well as diagnosis of cysts and tumors, and the results of our study were supported by the findings from Dölekoğlu et al.,<sup>20</sup>

Furthermore, in a study conducted by Balabaskaran and Srinivasan,<sup>[10]</sup> only 7.32% of them believed that it will not be used all areas of dentistry in routine dental practice and will have its use in selected applications.<sup>21</sup>

### **LIMITATIONS OF THE STUDY'**

The study could also have been carried out in other regions of India involving large group of population where there are differences in the methods of study as well as no usage of advanced radiographic techniques and where people rely on conventional methods for radiographic techniques. This could give us large variation in results showing those people who have no idea about advanced radiography and its advantages which would help to create awareness in those areas. Sample size was limited and randomly selected and generalized .

### **CONCLUSION**

To draw the conclusion, exact knowledge about oral radiology in dental fraternity is of paramount importance due to its wide applications in future as well. Taking into account the

results of the present study, it is endorsed that OMR departments should organize various courses to update the knowledge toward different imaging modalities. The students must acquire more and more knowledge about indications and contraindications, its advantages and disadvantages for its precise diagnosis, and further its preferable management which will amplify patients safety and ameliorate the clinical outcomes significantly.

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