

An observation and insight about potential arbitrary and inconsistent use of CBCT imaging

Cone beam computed tomography (CBCT) has enhanced three-dimensional visualization, specifically in the oral and maxillofacial region, to possibly necessitate a paradigm shift in dental imaging, interpretation and in some instances treatment modalities or approach.

In the past decade or so, India has also opened up to this frontier of dental imaging and has witnessed the installation of a number of CBCT apparatus. Access to CBCT imaging is more or less available to most of the tier-one and tier-two cities of India. The anatomic and scientific information gained through CBCT imaging, along with the potential business expansion opportunity for dental imaging centres, could combine synchronously to make CBCT imaging available to a wider population of dentists and patients in the near future. In the absence of any preset norms and guidelines, the use of CBCT technology and imaging is bound to be inconsistent, incomplete, arbitrary, subjective and fervent.

It is well documented that radiation exposure for dental imaging increases substantially from intra-oral periapical x-rays (<1.5 micro-Sieverts, μSv), panoramic radiographs (2.7-24.3 μSv) and lateral cephalograms (<6 μSv) to 2.9-1073 μSv for CBCT and the highest for spiral CT (SCT) (280-1410 μSv).¹ In addition to the further radiation exposure, SCT offers lesser spatial resolution and thus presumably lower diagnostic accuracy. Despite the obvious advantages of CBCT over SCT, a alarming and disturbing trend is that all endodontic case reports in the Medline database for the years 2011 to 2016 , including some cross sectional studies using SCT, have been by Indian authors.²⁻⁴ An even more distressing aspect is that all such publications involving SCT between 2013 -2015, have been exclusively from Indian edited journals.^{5,6} Literary citations are examples of only those that have made it to formal literature; a wide number of cases are unpublished and are displayed and shared on various social media platforms. The cited examples do not intend to disrespect or denigrate the work of the authors or editorial board of the journals; but instead illustrate the lack of focus across the board on minimalistic effective dose of radiation exposure and the absence of any guidelines or regulations for the use of spatial imaging.

In the past two years however, easier access to CBCT and other extraneous factors have resulted in use of mainly CBCT imaging in dental literature.^{7,8} The benefits and passion for exploring and planning a given case based on CBCT imaging needs to be balanced by justification as to whether it could result in an alternate diagnosis, and more importantly would that alternate diagnosis modify the treatment plan and eventually the prognosis and outcome.⁹ Root canal treatment is the mode of treatment irrespective of a change in diagnosis from pulpitis to apical periodontitis or other periapical pathology. For routine cases, a CBCT scan could be deferred until the endodontic intervention has been initiated and possibly hit a roadblock, confirming the absolute necessity of a scan. Such deferred usage of a scan, will also give a reference point within the initiated access cavity.¹⁰ For instance, relative position of an additional canal within a given access cavity, or the exact canal position of a calcified canal in relation to the apical most position of a pre-initiated access cavity.¹¹ Also, in cases of endodontic retreatment, mid-treatment CBCT imaging would allow for coronal disassembly including post and cores, gutta percha removal etc,

that would minimise artifacts and allow for maximum extrapolation of images from a given scan.¹²

So, how could these issues of inadequate, inconsistent use and potential overuse of CBCT be addressed? Where do the lacunae lie and what prospective remedial measures ought to be considered?

The present course curriculum and syllabus of all subjects, under-graduation and post-graduation included, has not been upgraded and updated to include enough theoretical knowledge and academic understanding about CBCT technology, its application and interpretation, except for oral radiologists. It could be made obligatory that all users of CBCT should have completed a structured, high-level training.¹³⁻¹⁴ Inadequately erudite clinicians could attempt to gain additional information through these three dimensional scans, albeit with an inability to accurately and adequately interpret and utilize the image data. Also, technical inability to provide treatment at an advanced or microscopic level may not have any meaningful clinical impact.^{15,16}

As there is no formal and structured curriculum on CBCT, its indications, applications, limitations, mechanics, etc., most knowledge on CBCT in the present time is mainly gained through non-institutional, continuing dental educational programs. More often than not, these programs are organized, conducted, sponsored and made viable by commercial CBCT centres. In such instances, the possibility exists for these courses and their content to be customized for and by specific commercial CBCT vendors. This scenario could make it more challenging for practitioners to validate or further research the information obtained. The effect of unethical marketing resulting in unnecessary or avoidable radiology scans could be potentially hazardous, infectious and epidemic, with far reaching consequences.

Detailed information about CBCT and its mechanics also needs to be understood; including the effective doses of radiation, field of view (FOV), slice thickness for specific applications, operating parameters, image display and formatting software, clinical limitations and hindrances etc. Information leaflets about technical specifications of CBCT machines should be made available along with the referral pads to the prescribing dentists. When smaller FOV's are adequate for diagnosis and treatment planning, as in the case of single tooth endodontics, mandatory use of minimal FOV should be obligatory. Smaller FOVs may not be available due to a possible technical limitation of the CBCT machine, image acquisition parameters or software inadequacy. Up-gradation of equipment and software and eventual phasing out of out-dated, unsafe and non-compliant machines should be introduced as a norm. Allowing for and necessitating audits of digital scan data could help curtail, restrict and eventually overcome any potential exploitation and misuse.

Practical non-availability of smaller FOV scans to patients' or dentists could also be due to ulterior commercial exploitation and business opportunism by the CBCT centres. This could be a possible necessity for CBCT centres, which by themselves cater specifically to the oral and maxillofacial region, and thus are inherently limited in their overall business scope as a medical investigative instrument.¹⁷ Additionally, a CBCT machine is an expensive investment, with additional overheads and maintenance costs. With a corporate outlook of multiple centres mushrooming, budgets and liabilities could be overstretched and revenue

targets could be aggressive. As much as these CBCT centres are needed for dentists' and patients' for diagnostic investigation, some form of standardisation through official regulation of certain common minimum technology and criteria should be looked at, to allow for a equal balance between medicine and commerce.

Restrictions by the radiation regulatory authorities need to be in place that fixes responsibility and accountability. Licenses for CBCT machine operation for dental purposes could be limited to certified oral radiologists, with concomitant use of a medical physics expert, for advice and implementation on radiation protection, equipment testing and patient dose optimization commanding smallest FOVs.¹⁸

An important point of contention is related to use of CBCT prospectively in patients for academic documentation, post-treatment academic or clinical follow-ups and as a clinical research methodology.^{19,20} The absence of guidelines in this regard definitely allows for individual subjective interpretation of the question. Also, availability and use of retrospective data of full arch scans, for analysis and conclusive extrapolation of maxillofacial or tooth anatomy, need to be addressed considering all possible aspects including ethical issues. Optimal use of such data could be extremely beneficial in shedding light on a number of aspects of Indian anatomy and endemic anatomic variations.²¹⁻²⁴

In the past few years, several recommendations, guidelines and revisions of the above mentioned, have been put forward by international organizations after a consultative process with all stakeholders under different specialties.²⁵⁻³² These could be used as a blueprint and a policy should be framed, adopted and implemented on a priority basis; at the departmental, institutional and university level in consultation with the specialty dental associations, professional academic societies, journal editorial staff, Dental Council of India, Indian Council for Medical Research, Atomic Energy Regulatory Board of India, state and union governments and all allied parties.

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