

# Using CBCT in the General Practice

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**Q:** Cone Beam Computed Tomography— is it overused or not used enough?



Dr. Farman

**A:** Cone Beam Computed Tomography (CBCT) gets its name from the computed integration of a sequence of 2-dimensional transmission images that, like all such images since the discovery of x-rays, are “cone beam” in geometry.<sup>1</sup> “Cone Beam” or “Cone Beam Technology” by definition has been around since 1895, with the first cone beam 2-D images for dentistry being attributed to Otto Walkhoff in January 1896. On this basis, this question could be restated as: “Are too many radiographs being made by dentists?” I believe this is the most germane question because CBCT is but one source of ionizing radiation to dental patients and should not be used outside of this context.

There are several general themes for minimizing patients’ exposure to radiation to as low as reasonably achievable, including: 1) image selection based upon professional judgment of diagnostic or treatment guidance need rather than using ionizing radiation exposure as a “routine” without prior individualized patient assessment by the dentist; 2) minimizing the field of view by collimation to reduce radiation exposure to tissues that need not be imaged; and 3) using the fastest exposure/lowest dose parameters consistent with adequacy in diagnostic image quality. The restriction of radiation dose is particularly important for younger individuals. The International Commission on Radiological Protection (ICRP) has indicated that the effect of dose to children can be as much as three times that for young adults aged 20 to 25 years and

as much as an order of magnitude more than for mature adults aged around 60 years.<sup>2,3</sup> Children are more susceptible to untoward effects of ionizing radiation than adults due to the longer life ahead of them during which changes might occur, and also due to their faster turnover of cells compared to adults. Looking at traditional radiography, intraoral radiographs should be made with F-speed film or digital sensors using similar or faster parameters, and preferably should be collimated to the shape of the detector (usually rectangular). Such radiographs should only be made when they will contribute to diagnosis. Similarly, CBCT should only be done after clinical evaluation of the patient by the dentist, and after a judgment is made that the benefits of this procedure will sufficiently outweigh the risks to the patient.

CBCT is a valuable technology when used wisely. My greatest concern is that some orthodontists have been advocating essentially “routine” use of CBCT for orthodontic planning, and that such imaging can occur at several different stages before, during, and at the end of treatment. If, as with surgical intervention for craniofacial anomalies, multi-slice CT was previously used and CBCT can produce the same information with lower dose, I have no problem with such a substitution. Further, for impacted maxillary canines a small field of view (FOV) CBCT may be needed. My concern is that it has been shown that even with traditional 2-D images made for orthodontics, many of the radiographs made are not used, and that orthodontists have questioned the concept of cephalometrics in orthodontic treatment outcomes.<sup>4,5</sup> Evidence for the value of CBCT in orthodontic assessment and treatment outcomes is wanting.

Maxillofacial CBCT has definite value for 3-dimensional imaging for dental implant planning, for assessment of the relationship of mandibular third molar roots to the mandibular canal (when the roots are superimposed on the canal in panoramic radiographs), and for endodontic

evaluation in certain instances. All of these procedures tend to use small FOV and are largely applied to mature adults rather than children. Maxillofacial CBCT is useful for evaluation of maxillofacial trauma. It should not be used for evaluation of jawbone pathoses where a soft-tissue component is suspected.

One additional consideration is that CBCT represents a range of different systems, with a range of different exposures. Even among large FOV systems there is a range of more than 10:1 from highest to lowest dose with the upper-end systems having doses that are comparable to or even more than multi-slice CT in medicine.<sup>6</sup> Some of these units can be physically collimated to reduce the FOV to that needed for the specific task, whereas others cannot be so collimated. Be careful

that collimation is physical rather than merely electronic. In electronic collimation, the full field is exposed but only the selected region is recorded. There are also small FOV systems, often combined with 2-D panoramic or cephalometric detectors. These small FOV systems tend to be relatively low dose. Finally, spatial resolution above 0.2-mm isotropic voxel dimensions is inadequate for evaluation of many endodontic tasks and for demonstration of the periodontal ligament space. It is not just a matter of whether or not to use CBCT, but rather what system to use and at what settings given the task at hand.

In medicine it is apparent that high-technology imaging systems owned by non-radiologists, where there is “self-referral” by the owning physicians, tend to be used more than those outside, in

specific imaging clinics where self-referral is not the case.<sup>7,8</sup> It would not be surprising, perhaps, should similar trends emerge for CBCT in dentistry.

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Dr. Feuerstein

**A:** As with most procedures, processes, and medications, more is not better. We often get carried into a wave of a new process and start using it every chance we get. The new CBCT units are no exception. Their intended use is to get outstanding diagnostic information for intelligence and procedures that we never had available before. Analyses of bone quality for implants, precise locations of impacted or developing teeth, size and locations of cysts, or even accessory root canals are just a few of the areas that previously required multiple radiographs from a variety of angles to arrive at diagnostic endpoints. Now with one scan, at radiation doses equal to or less than these prior processes, the information is there. The newer units also allow the scans to “zoom in” on a specific area (“limited field”) with even less exposure. The value of this information far outweighs concerns about even this small amount of radiation—we have been hearing this for years from those patients who refuse x-rays and after 2 to 3 years have a mouthful of large areas of decay.

This information, though, should be sought out when it is necessary—not every time you think you can use it. Do you take a new panoramic every year on children throughout orthodontic treatment? An additional scan could be taken only if something seems wrong and, even then, perhaps a single PA could suffice. In my own practice we have used it to help with treatment planning of tooth fractures, resorption, and failed endodontics before deciding to retreat, as well as in the world of implants—for planning, finding out why some failed, and more. If used in the proper situations, CBCT will be seen as one of the greatest advances in dentistry in a long time.



Dr. Levato

**A:** This is definitely a topic that does not have a simple answer; the appropriate answer is one that is based on the individual circumstance. The overriding principle with any diagnostic radiation is the ALARA principle, which stands for “as low as reasonably achievable.” This principle is designed to minimize the risk of radiation exposure while realizing that some exposure may be acceptable and necessary to get an accurate diagnosis. A benefit/risk analysis should always be part of the consideration prior to ordering radiographic images.

CBCT units vary in the amount of radiation exposure used, depending on the type and sensitivity of the receptor, the size of the patient, and the size of the FOV. (Note that a smaller FOV does not necessarily translate into a less effective radiation dose; actually, in many cases the opposite is true.) Some common sense issues that immediately come to mind include:

- CBCT imaging should not be used as a routine screening technique.

- For routine dental diagnostic needs, intraoral digital sensors are more effective, require less radiation, and have better resolution than current CBCT units.
- For implant planning and placement, CBCT offers the most information concerning anatomical limitations, although it is not required with an open flap design and full visibility.
- For flapless implant placement, a CBCT is the safest way to proceed to avoid numerous potential complications.
- For implant guided surgical implant placement, a 3-D image is required.
- When an intraoral or 2-D extraoral radiograph inadequately displays an image for proper diagnosis, a 3-D image is indicated.
- CBCT is extremely helpful in cases of trauma.

To sum it up, my opinion is that CBCT technology is underused in general because the average dentist has not been exposed to the advantages and applications of 3-D imaging to help with certain diagnostic challenges. Conversely, CBCT imaging can be overused when a dentist has made a major investment and is concerned about maximizing his or her return on investment.

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