Cone Beam Computed Tomography

Is dentistry ready for a new standard of care?

By Dr Lee M. Whitesides, USA

Since its commercial introduction into dentistry in 2001, cone beam computed tomography (CBCT) has been rapidly evolving into a new standard of care in maxillofacial imaging. In just over a decade, CBCT has exploded onto the dental landscape and permitted dental professionals a degree of three-dimensional (3-D) anatomic truth in maxillofacial imaging previously unavailable and unattainable.

Like many other new technologies, which have progressed from the extraordinary to the ordinary and thus gained acceptance by dentistry as cost decreases, access and permitted dental professionals a degree of three-dimensional (3-D) anatomic truth in maxillofacial imaging previously unavailable and unattainable.

The theory or technique behind medical grade computed tomography and CBCT has been tested and proven sound over many years of application in the medical and dental arena. The Housestaff unit, the only recognised standardised quantitative scale for describing radiodensity and provides doctors with a known standard and error rate in computed tomography. The widespread acceptance of CBCT by the medical and dental community is demonstrated by the ever increasing presence in dental and medical practices of the technology. Additionally, The Inter-societal Accreditation Commission, an accreditation organisation for medical and dental imaging, has developed guidelines and accreditation criteria for 3-D CBCT imaging. Thus CBCT appears to have satisfied both the Frey and Daubert criteria for acceptance as a standard of care technology.

To not discount the value of CBCT imaging or its ability to successfully satisfy the Frey or Daubert criteria, the absence of CBCT is not de facto evidence of lack of a standard of care imaging. Many patients present to their dentist with uncomplicated cases where traditional two-dimensional radiographic studies are appropriate and provide the dentist with standard of care imaging of the patient. For the more complicated cases, 3-D imaging may be employed to provide the dentist with superior anatomic evidence in treatment planning and diagnosis. Three-dimensional imaging with CBCT can also be used in uncomplicated cases, but it may not necessarily be considered as the standard of care for every case in 2014.

Expert Testimony

An expert is a person with sufficient minimal qualifications to render an opinion on the subject at hand. Not all experts are created equal, and in fact in three states (Iowa, South Dakota, and New Hampshire) an expert need only be qualified in a related field to provide an opinion. Experts are qualified by the courts to educate the judge and jury as to what constitutes normal minimal acceptable care of a patient in a given environment.

Expert testimony is by definition the opinion of one practitioner. It is an opinion based on fact, evidence, experience, and knowledge which the expert believes to be relevant, valid, and upheld in the scientific community.

When reviewing a case for suspected malpractice the expert against the confirming standard of care but not limited to: chart notes, radiographic studies, depositions, and

Trends & Applications

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Only prevalent and pertinent of but significant in the valuation of an opinion by an expert (and the jury) when reviewing a case. CBCT can be seen as an additional and important piece of information to help explain why the doctor did what he did or why an unfortunate outcome occurred additionally. CBCT provides powerful and easily understandable images for laypersons.

Recognising the value that CBCT adds to a case does not necessarily indicate that CBCT is the standard of care in each and every case. The decision to obtain a CBCT study before the procedure is determined by the dentist based on his experience and knowledge of the case.

Literature Support

For any technology to be considered as a standard of care, a plethora of literature in support for the technology should exist. The literature must discuss the risk and benefits of the technology, its applications to patient care and guidelines and protocols for acceptable use.

To assess the influence of CBCT in the dental literature, the author performed a PubMed literature search in October for the words cone beam CT, cone beam CT + dental, cone beam CT + dental implants, cone beam CT + orthodontics, cone beam CT + oral surgery, cone beam CT + endodontics in the search line. The results are in Table 1

<table>
<thead>
<tr>
<th>Key words in search</th>
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<th>Year article first appeared</th>
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<tr>
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<tr>
<td>CBCT + endodontics</td>
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Table 1


Professional Guidelines

For a technology such as CBCT to become a standard of care in dentistry, guidelines for its use and application in patient care must be established by the organisational bodies of those disciplines in dentistry who employ the technology to treat patients. In dentistry, the dental practitioners most involved in the use and application of CBCT in patient care include general dentists, oral and maxillofacial surgeons, endodontists, oral and maxillofacial radiologists, orthodontists, and periodontists.

The American Dental Association has over 180,000 licensed dentists representing approximately 75 per cent of dentists in the USA. The American Dental Association published an advisory statement article in its principal journal, The Journal of the American Dental Association, in August 2012. The article discusses many positive aspects of CBCT, but stops short of calling CBCT a new standard of care. Rather, the ADA encourages the dentist to use CBCT “selectively, as an adjunct to conventional radiography.” The article recognises the value and presence of CBCT by including CBCT-related courses at the annual meeting and continuing education courses during the year.

The American Association of Oral and Maxillofacial Surgery (AAOMS) has over 9,500 members representing approximately 99 per cent of oral and maxillofacial surgeons practicing in the US. Literature addressing the application of CBCT in oral and maxillofacial surgery has been around as approved by the AAOMS. The AAOMS has offered continuing education in the use and application of CBCT for patient care as far back as 2001. The AAOMS has worked with the IADC to develop guidelines and credentialing criteria for CBCT. Two recent survey of OMFS residency programs, 87 per cent of programs report the use of CBCT in patient care by their residents.

The American Association of Endodontists (AAE) and the American Association of Oral and Maxillofacial Surgeons (AAOMS) have released position papers on CBCT. This paper makes many important points, such as limiting the cone beam examination to minimise radiation exposure and increase resolution, careful patient selection in CBCT, and the responsibility of the clinician to interpret the entire image. The position paper goes on to declare “the use of CBCT in endodontics should be limited to the assessment and treatment of complex conditions.” The article then lists a number of these “complex conditions.” In summation, the position paper recognises the value of CBCT as an adjunct to 2D images and “CBCT may provide dose savings over multiple traditional images in complex cases.”

Literature pertaining to the use of CBCT in endodontics first appeared in the Journal of Endodontics in 2003. The American Association of Endodontists sponsor continuing education in endodontia related CBCT on their website and the organisation evaluates various CBCT programs as part of the process of CBCT. CBCT is relatively new in the use of CBCT in dentistry and CBCT education and training programs must be developed. All seven ADA approved oral surgery residency programs involve CBCT in their curriculum. Of the 95 residency programs, 92 per cent of oral surgery programs require the use of CBCT for patient care.

The International Congress of Oral Implantologists (ICOI), the world’s largest dental implant organisation and provider of dental implant continuing education with an excess of 25,000 active members, published a consensus report on CBCT in its Journal Implant Dentistry in April of 2012. In the article, authored by many leaders in the dental implant field, the ICOI states: “The literature supports the use of CBCT in dental implant treatment planning particularly in terms to conventional radiographs, 3D evaluation of preoperative ridge topography, proximity to vital anatomical structures, and fabrication of surgical guides.” The ICOI reminds the dentist that use of CBCT must be justified in each case and should be considered as an imaging alternative where conventional radiographs may not provide sufficient anatomic truth. Literature discussing the application of CBCT in implant dentistry is ubiquitous and comprises the lion’s share of research in applying CBCT technology to dentistry. The vast majority of post-doctoral residencies involved in dental implant patient care and all private dental implant training courses in the US incorporate CBCT in their dental implant education curriculum.

Many professional organisations in dentistry for general dentists and specialists have weighed in on CBCT by providing recommendations, guidelines, and a position paper. While these guidelines are beneficial in establishing a society or specialty’s position on CBCT, they are not mandates. Recommendations, guidelines, CE programs, and position papers are used by professionals to influence the practice of their discipline. As the practice of the discipline changes in response to many factors including, but not limited to court verdicts, expert testimony, literature, fee guidelines, cost of the technology, and reimbursement by third party payers, the recommendations, guidelines, and position papers may facilitate the evolution of CBCT into a standard of care. Thus, in 2014 the professional organisations that comprise dentistry may not formally declare CBCT is the standard of care. In 2015, these organisations may recognise the influence CBCT is having on the profession.
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with significant cost. This will undoubtedly lead to an increase in the number of dental professionals utilizing CBCT in their practices. 

The bottom line for most practices in regards to CBCT machines is: can I afford this for my practice?

To determine affordability, the price of the machine (purchase and maintenance) must be considered against potential revenue generated by the machine. Revenue can be directly from patients, insurance companies, or from other dentists who utilise the CBCT machine.

A cost-effective alternative to owning and operating a CBCT device can be the outsourcing of the study to a third party (dentist or facility) and insourcing the software necessary to employ the images in treatment planning and diagnosis.

CBCT machines are becoming ubiquitous as more dentists purchase the machines and more third-party non-dentist owned imaging centres enter the market. Since CBCT has been around for decades, specific codes for in-office CBCTs have been debated by insurance companies, or from other dentists who utilise the CBCT machine.

A cost-effective alternative to owning and operating a CBCT device can be the outsourcing of the study to a third party (dentist or facility) and insourcing the software necessary to employ the images in treatment planning and diagnosis. 

As time progresses, insurance companies may, as they have in the past, require CBCT owner/operators to obtain a certification via the IAC or some other regulating entity for an owner/operator to qualify for financial reimbursement from any third party payer.

By providing dentists with a CPT code, the insurance industry has validated the technology of CBCT and thus acknowledged its value in treatment planning and diagnosis. As time progresses, insurance companies may, as they have in the past, require CBCT owner/operators to obtain a certification via the IAC or some other regulating entity for an owner/operator to qualify for financial reimbursement from any third party payer.

Two of the major malpractice carriers of the insurance industry (OMNISC and MedPro) have influenced the evolution of CBCT by mandating a new standard of care by offering coverage for CBCT owner/operators commensurate with the level of risk to which the owner/operators are exposed. Wite CBCTs are believed to be a little value or representative minimal risk these leaders in the dental malpractice industry would not offer such coverage. Additionally OMNISC requires the owner/operator to have CBCT images interpreted by a dental or medical radiologist to minimise risk.

Two of these aspects (cost and availability) will more likely than not be determined by the invisible hand of the market as the Keynesians laws of supply and demand move the dental industry to provide the best possible service at a price patients and insurance companies are willing to pay. The third (legal) will be slowly determined in the court systems as attorneys and experts begin to rely more on CBCT in support of their clients’ cases.

Patient expectations are difficult to accurately ascertain. We know patients expect our practices to be contemporary. Buying the latest and greatest machine for your practice may not be wise if cost exceeds benefits both clinically and financially.

A standard of care is an evolving concept. Many in the dental profession are willing to pay. The third (legal) will be slowly determined in the court systems as attorneys and experts begin to rely more on CBCT in support of their clients’ cases.

There are many questions yet to be answered definitively regarding CBCT: 1. Who is responsible (and liable) for interpreting the images? 2. Is an entire field of view interpretation necessary or simply the pertinent structures? 3. Must all images be interpreted by a board certified oral and maxillofacial radiologist or can the ordering doctor interpret the images? 4. What level of training is sufficient to own and operate the machine, as well as, and interpret CBCT images? 5. What cases deserve a CBCT? 6. If the patient refuses a CBCT and the dentist believes a CBCT is necessary for successful case completion, must the dentist complete the case without the CBCT, or can he refuse the case without fear of legal repercussions?

Lastly, as mentioned earlier, standard of care is an evolving concept. Darwin stated clearly no organism (or concept in this case) which is subject to the laws of evolution must adapt in response to outside forces in order to survive. The standard of care in dentistry is adapting to CBCT as forces (legal, financial, clinical, and others) act upon the industry to account for the powerful influence CBCT has on treatment planning and diagnosis of patients. While recognising that all that glitters is not gold, CBCT may soon represent a new standard of care by offering the best possible service at a price patients and insurance companies are willing to pay. The third (legal) will be slowly determined in the court systems as attorneys and experts begin to rely more on CBCT in support of their clients’ cases.

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