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 with technology and services, CBCT provides the doctor with a technology, which not only has significant advantages in treating patients but also has a noteworthy “wow” factor as the 3-D images are seen on a large screen in “real time” for the doctor and patient to view.

CBCT, like plain film radiographic studies, may be considered a revenue generator for a practice. The more a CBCT machine is utilised, the more revenue it will generate. Additionally, the owner may allow others in the profession to utilise the machine for a fee, thereby reducing his overall cost of operation.

Standard of care influences

The influence of an emerging technology, like CBCT, into a new standard of care involves many criteria. These criteria include but are not limited to: court verdicts, expert testimony, literature support, professional guidelines, cost and availability of the technology, reimbursement by third party payers, and multi-specialty use and recognition.

No database exists to search verdicts in dental malpractice cases in which CBCT has played an important or pivotal role. For a new technology to become admissible as a standard of care in court, it must pass the Frey test. This standard comes from Frey v. United States which is a 1923 in a case discussing the admissibility of a polygraph test as evidence. The Frey standard maintains that scientific evidence presented to the court must be interpreted by the court as “generally accepted” and expert testimony must be based on scientific methods that are sufficiently established and accepted.

In Frey, the court opined: “Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Some where in this twilight zone the evidential force of the principle must be recognised, and while the courts will go a long way in admitting experimental testimony deduced from a well-recognised scientific principle or discovery, the things from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.”

In many jurisdictions and in Federal court, the Frey standard is superseded by the Daubet standard. The Daubert standard is used by a trial judge to make a preliminary assessment of whether an expert’s scientific testimony is based on reasoning or methodology that is scientifically valid and can properly be applied to the facts at issue. Under this standard, the factors that may be considered in determining whether the methodology is valid are:

- theory or technique in question can be and has been tested;
- if it has been subjected to peer review and publication;
- there is a known or potential error rate;
- the existence of maintenance standards controlling its operation;
- widespread acceptance within a relevant scientific community.

...a technology which not only has significant advantages but also has a noteworthy ‘wow’ factor.”
The DTI publishing group is composed of the world’s leading dental trade publishers that reach more than 650,000 dentists in more than 90 countries.
Correspondences. In the last five years, the author has noted a remarkable increase in the number of cases in which plain-
tiffs and defense attorneys, as well as experts, rely on pre- and post-
procedure CBCT imaging studies to prove malpractice or support good practice. Post-
treatment radiographic imaging to
prove malpractice or support good practice is not new to medicine. In the past two decades, some of the highest malpractice claims were awarded in cases where post-treatment radiographs played a pivotal role.

Logic would dictate that if plain-
tiffs and defense counsels and ex-
erts are making CBCT part of their strategy, then CBCT must be not
only prevalent and pertinent but of
some significance in the value 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 lay-
person jury.

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 be-
fore the procedure is determined by the dentist based on his experi-
ence and knowledge of the case.

**Literature Support**

For any technology to be con-
sidered 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 ap-
plication to patient care, and guide-
lines 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 im-
plants, cone beam + orthodontics, cone beam CT + oral surgery, cone beam CT + endodontics in the search line. The results are listed in Table 1.

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<tr>
<th>Year first appeared</th>
<th>Literature discussing the application of CBCT in implant dentistry</th>
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<td>1998</td>
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A systematic review of the litera-
ture, Int J Oral Maxillofac Surg 2009,38:609–623. Both of these exhaustive articles demonstrate the plethora of articles address-
ning CBCT and its application in the many disciplines in dentistry.

**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 den-
sty who employ the technology to treat patients. In dentistry, the dental practitioners most involved in the use and applica-
tion of CBCT in patient care include general dentists, oral and maxillofacial surgeons, endodontists, oral and maxillofacial radiologists, ortho-
dontists, and periodontists.

The American Dental Associa-
tion has over 180,000 licensed den-
tists 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 the 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 radiogra-
phy. “The reader is advised that the value and presence of CBCT by including CBCT-related courses at continuing education courses during the year.”

The American Association of Oral and Maxillofacial Surgery (AAOMS) has over 9,000 members representing approximately 95 per cent of oral and maxillofacial sur-
gery practice in the USA. Lit-
terature addressing the application of CBCT in oral and maxillofacial sur-
gery has been around since 2007. The AAOMS has offered continuing education in the use and appli-
cation of CBCT for patient care as far back as 2011. The AAOS has

Trends & Applications

**Cost and Availability**

The cost of CBCT machines today range from US$100,000 to US$500,000 with yearly mainte-
nance fees in the US$8,000 to US$50,000 range. As with any emerging technology, advances create a secondary market for slightly used machines. Each new technological advancement has created the CBCT machine of only a few years ago slightly out-of-date, de-
valuing its technology. New guidelines are beneficial in establishing a society or specialty’s position on CBCT, but are not mandates. Rec-
ommendations, guidelines, CE pro-
grammes, and position papers are used by professionals to influence the practice of the discipline. As the practice of the discipline changes in response to many fac-
tors including, but not limited to court verdicts, expert testimony, literature, professional 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 2013 the professional organisa-
tions that comprise dentistry may not formally declare CBCT is the standard of care, but in these organisations do recog-
nise the influence CBCT is having on the profession.
with significant cost. This will undoubtably lead to an increase in the number of dental professionals utilising 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 dentist purchase the machines and more third party non-dentist owned imaging centres enter the market. Since more dentist and more patients are becoming exposed to the technology, patient acceptance will increase, facilitating the incorporation of CBCT into the mainstream culture of dentistry. The increasing omnipresence of CBCT technology will not singularly make it standard of care, but it will serve to increase patient awareness of the technology, which in turn will influence what the public perceives as a standard of care.

The insurance industry

Reimbursement from major insurance companies and government-sponsored health care is traditionally the last to embrace (i.e. pay for) a new service such as CBCT. Although codes for medical CBCT have been around for decades, specific codes for in-office CBCTs began to materialise in 2009. Current reimbursement rates for in-office CBCT’s average around US$300, provided the study is covered. 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, 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 as 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. Were CBCT studies to be considered of 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. As CBCT becomes more accepted and expected by our patients due to aggressive marketing or clinical relevance, incorporating the technology into one’s practice may not be entirely necessary but prudent.

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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 study 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 any 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 other) 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 gold standard by which many cases will be judged.

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