International Endodontic Journal

doi:10.1111/j.1365-2591.2009.01607.x

EDITORIAL

The use of cone beam computed tomography in endodontics

Cone beam computed tomography (CBCT) is a major advance in the imaging of teeth and the maxillo-facial skeleton. Reconstructed CBCT images provide 3-dimensional information of the area under investigation in a matter of minutes, usually at a lower radiation dose than that from 'medical' Computed Tomography but usually higher than that associated with simple dental radiographic techniques. All dental specialities are exploring the use of CBCT for managing dental problems. This is reflected in the rising numbers of papers being published on CBCT, not least in the field of endodontics.

In endodontics, CBCT has been used for several applications, including periapical diagnosis, evaluation of root canal anatomy, assessment of resorption defects, suspected perforations and in planning endodontic surgery but, with isolated exceptions (Özen *et al.* 2009, Patel *et al.* 2009), few are properly validated studies of diagnostic accuracy. Instead, the literature is dominated by case reports and observational studies without a reference standard. There is a need for well designed, validated, studies to assess the use of CBCT for diagnosis and management of endodontic problems. Furthermore, greater emphasis is needed on quantifying the impact of CBCT images on management. Only one study appears to have measured this, suggesting that CBCT images may increase the likelihood of the correct treatment plan being chosen when root resorption was considered (Patel *et al.* 2009).

As with any imaging technique involving patient exposure to ionizing radiation, it is essential that the radiation dose is kept *As Low as Reasonably Achievable* (Farman 2005). Therefore, before prescribing a CBCT scan it is essential that the clinician can *justify* it use, i.e. what potential additional relevant information can a CBCT scan yield over and above conventional radiography which may ultimately improve the management of the potential endodontic problem?

When the decision has been made to expose the patient to a CBCT scan it is essential to *optimize* the patient radiation dose. The smallest field of view (FOV) compatible with the clinical situation should be used where possible to lower radiation doses. As the resolution selected affects the radiation dose used, this variable also needs to be carefully selected. Not all CBCT equipment is the same in either radiation dose or image quality; these should be important considerations for the clinician considering purchase of a machine or referring patients to colleagues. Optimization is particularly important in children and adolescent patients, who are more sensitive to the stochastic effects of radiation.

It is essential to assess the entire FOV, not just the region of interest. Clinicians may be able to interpret the dento-alveolar anatomy in three-dimensions confidently; however, they may be unfamiliar with the anatomy beyond this region (for example, base of the skull or the nasal cavity). In these cases, and also in instances where the clinician feels he/she is out of their 'comfort zone' he/she must obtain the opinion from a suitably qualified Dental Maxillo-facial Radiologist (Dawood *et al.* 2009). At present CBCT is not taught in the undergraduate curriculum and very few endodontic postgraduate programmes have incorporated CBCT into their curricula. Therefore, clinicians considering using CBCT technology must undergo specific training to appreciate CBCT technology, radiography and radiology.

Cone beam computed tomography technology is improving at a rapid pace, as does its uptake. As with any new technology, early enthusiasm may lead to inappropriate use. In response to this risk, the European Academy of Dental and Maxillofacial Radiology (Horner *et al.* 2009) and the American Academy of Oral and Maxillofacial Radiology (Carter *et al.* 2008) have each developed some guidelines designed to set core standards for CBCT. Similarly, the need for research and standard-setting was recognized by the European Commission's Seventh Euratom Framework in financing a 42 month collaborative project Safety and Efficacy of a New and Emerging Dental X-ray Modality (SEDENTEXCT), the aim of which is to acquire

key information necessary for sound and scientifically based clinical use of CBCT. SEDENTEXCT has just released some provisional detailed guidelines on CBCT use, including in endodontics (http://www.sedentexct.eu/guidelines).

Whilst it is essential that the endodontic speciality appreciates the potential value of three-dimensional images, it is just as important to recognize the limitations of CBCT for endodontic use. The enthusiasm for CBCT seen in the literature over the last few years may well be justified, but we should remain cautious and keep some scepticism for the time being. Only when there is an adequate body of excellent research validating the diagnostic accuracy and clinical impact of CBCT will we be able to make an informed judgement on its role in endodontics. In the meantime, every use of CBCT should be carefully justified and optimized.

S. Patel[1] & K. Horner[2]

[1]*Endodontic Postgraduate Unit, King's College London Dental Institute, London; and* [2]*Department of Oral and Maxillofacial Radiology, School of Dentistry, University of Manchester, Manchester, UK*

e-mail: shanonpatel@gmail.com

References

Carter L, Farman AG, Geist J *et al.* (2008) American Academy of Oral and Maxillofacial Radiology Executive opinion statement on performing and interpreting diagnostic cone beam computed tomography. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology* **106**, 561–2.

Dawood A, Patel S, Brown J (2009) Cone beam CT in dental practice. *British Dental Journal* **207**, 23–8.

Farman AG (2005) ALARA still applies. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology* **100**, 395–7.

Horner K, Islam M, Flygare L, Tsiklakis T, Whaites E (2009) Basic principles for use of dental cone beam CT: consensus guidelines of the European academy of dental and maxillofacial radiology. *Dentomaxillofacial Radiology* **38**, 187–95.

Özen T, Kamburoğlu K, Cebeci ARI, Yüksel SP, Paksoy CS (2009) Interpretation of chemically created periapical lesions using 2 different cone-beam computerized tomography units, an intraoral digital sensor, and conventional film. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology* **107**, 426–32.

Patel S, Dawood A, Wilson R, Horner K, Mannocci F (2009) The detection and management of root resorption lesions using intraoral radiography and cone beam computed tomography – an *in vivo* investigation. *International Endodontic Journal* **42**, 831–38.