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European Society of Endodontology position statement: The use of CBCT in Endodontics

European Society of Endodontology

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Abstract

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This Position Statement represents a consensus of an expert committee convened by the European Society of Endodontology (ESE) on the use of Cone Beam Computed Tomography (CBCT). The statement is based on the current scientific evidence, and provides the clinician with evidence-based criteria on when to use CBCT in Endodontics. Given the dynamic and changing nature of research, development of new devices and clinical practice relating to CBCT, this Position Statement will be updated within 3 years, or before that time should new evidence become available.

Keywords: CBCT, endodontology, guidelines, radiography.

Introduction

Radiography is an essential component of diagnosis in dentistry, including Endodontics (Patel *et al.* 2009, Faculty of General Dental Practitioners UK 2013). However, conventional radiographic techniques, regardless of whether they are film based or digital have limitations. These include the two-dimensional nature of the images produced (Brynolf 1967, Velvart *et al.* 2001), anatomical noise masking the area of interest to varying degrees (Bender & Seltzer 1961, Paurazas *et al.* 2000) and geometric distortion (Vande Voorde & Bjorndahl 1969, Forsberg & Halse 1994). Cone Beam Computed Tomography (CBCT) does appear to overcome some of these limitations, and does generate three-dimensional images.

Cone beam computed tomography

Currently, there are over 40 CBCT scanners on the market (Horner K, 2013, Personal communication), which differ with regard to their specifications, exposure settings, effective dosages and image quality. The diagnostic yield of different CBCT scanners is not necessarily the same; therefore, the results of research on a specific CBCT scanner(s) may not be transferable to another CBCT scanner(s).

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Clinicians must have core knowledge of CBCT radiography before requesting CBCT scans, and must regularly update their knowledge (Brown *et al.* 2014). The principles of radiation protection must be adhered to (IRMER 2000, Holroyd & Gulson 2009, Patel & Horner 2009). A CBCT scan should have a net benefit to the management of a patient's (suspected) endodontic problem. A comprehensive discussion must take place between the clinician and patient; only then is the patient's consent to undergo a CBCT procedure valid.

As with any ionizing radiation imaging device, the radiation dose must be kept '*as low as reasonably achievable*' (ICRP 2007). Indeed, when considering whether to use CBCT, there is a much greater responsibility on clinicians to justify its use due to the increased ionizing radiation. The size of the 'field of view' (FOV) varies between CBCT scanners, from 3 to 4 cm up to 20 cm. Some CBCT scanners have a fixed FOV; others have the option to change the FOV size to suit the clinical situation. Only a limited FOV is suitable for endodontic purposes as it limits the area being irradiated to only the region of interest (SEDENTEXCT 2012, Brown *et al.* 2014). By doing so, the effective dose to the patient is reduced, and the reconstructed images produced have typically a higher spatial resolution than larger FOV scans (Pauwels *et al.* 2012). Whenever possible, the mA and exposure times should also be reduced (SEDENTEXCT 2012).

All equipment must be maintained correctly, and individuals involved in the patient journey must be trained correctly and, where appropriate, dose levels monitored (Brown *et al.* 2014). A robust quality assurance programme including appointing a suitably qualified Radiation Protection Advisor is mandatory before and after a CBCT scanner has been installed (IRR 1999, IRMER 2000, Holroyd & Gulson 2009). Due to the higher levels of scattered radiation, risk assessment for the need of personal dosimetry devices for staff involved in taking CBCT scans should be carried out before installation of CBCT scanners (Holroyd & Gulson 2010).

Assessment of images

The entire volume of data must be assessed and reported on. This would normally be completed by the clinician who has prescribed the scan, or the practitioner who has taken the scan; however, it is essential to refer the CBCT image data to a competent person if the interpretation of the scan is beyond the competence of the clinician who has prescribed and/or taken the scan (SEDENTEXCT 2012). This would normally be a maxillofacial radiologist; however, national guidelines for the evaluation of CBCT images must be followed.

Criteria for use of CBCT in endodontics

A CBCT scan may only be considered after a comprehensive clinical examination has been carried out, and appropriate conventional radiographs have been taken and assessed (Patel 2009, SEDENTEXCT 2012). As with any device emitting ionizing radiation, the benefits of the CBCT scan must outweigh the risks (ICRP 2007). This is particularly important in children and adolescents who are more radiosensitive to the potential effects of ionizing radiation (Theodorakou *et al.* 2012). The ALARA principle ("as low as reasonable achievable") has to be considered in all cases.

A request for a CBCT scan should only be considered if the additional information from reconstructed three-dimensional images will potentially aid formulating a diagnosis and/or enhance the management of a tooth with an endodontic problem(s).

Cone Beam Computed Tomography with a limited FOV may be considered in the following situations:

- Diagnosis of radiographic signs of periapical pathosis when there are contradictory (nonspecific) signs and/or symptoms;
- Confirmation of nonodontogenic causes of pathosis;
- Assessment and/or management of complex dento-alveolar trauma, such as severe luxation injuries, suspected fracture of the overlying alveolar complex and horizontal root fractures, which may not be readily evaluated with conventional radiographic views;
- Appreciation of extremely complex root canal systems prior to endodontic management (for example, class III & IV dens invaginatus);
- Assessment of extremely complex root canal anatomy in teeth treatment planned for nonsurgical endodontic re-treatment;
- Assessment of endodontic treatment complications (for examples, [post] perforations) for treatment planning purposes when existing conventional radiographic views have yielded insufficient information;
- Assessment and/or management of root resorption, which clinically appears to be potentially amenable to treatment;

- Pre-surgical assessment prior to complex periradicular surgery (for example posterior teeth).

Conclusion

The guidelines contained in this ESE Position Statement are designed to aid clinicians who are contemplating using, or are already users of CBCT. It cannot be over-emphasized that every image involving ionizing radiation, including CBCT, must be justified and optimized. A record of the justification process must be maintained.

Dental undergraduate and endodontic postgraduate programmes should incorporate the justification and interpretation of CBCT images into their curriculum. There is also a need for robust continuing education in CBCT (Brown *et al.* 2014).

Disclaimer

The European Society of Endodontology and the authors deny any conflict of interest related to this ESE Position Statement.

References

Bender IB, Seltzer S (1961) Roentgenographic and direct observation of experimental lesions in bone: I. *Journal of the American Dental Association* **62**, 152–60.

Brown J, Jacobs R, Jäghagen EL *et al.* (2014) Basic training requirements for the use of dental CBCT by dentists: a position paper prepared by the European Academy of DentomaxilloFacial Radiology. *Dentomaxillofacial Radiology* **43**, 1–7.

Brynolf I (1967) A histological and roentenological study of the periapical region of human upper incisors. *Odontologisk Revy* **18**(Supplement 11).

Faculty of General Dental Practitioners UK (2013) *The Royal College of Surgeons of England. Selection criteria for dental radiography*. London, UK: FGDP(UK) Good Practice Guidelines.

Forsberg J, Halse A (1994) Radiographic simulation of a periapical lesion comparing the paralleling and the bisecting-angle techniques. *International Endodontic Journal* **27**, 133–8.

Holroyd JR, Gulson AD (2009) The Radiation Protection Implications of the Use of Cone Beam Computed Tomgraphy (CBCT) in Dentistry – What You Need To Know. Health Protection Agency, Leeds, UK.

Holroyd JR, Gulson AD (2010) Guidance on the Safe Use of Dental Cone Beam CT HPA-CRCE-010 *Prepared by the HPA Working Party on Dental Cone Beam CT Equipment*. Chilton: *Health Protection Agency*, Leeds, UK.

ICRP (2007) Publication 103: The 2007 recommendations of the International Commission on Radiological Protection. *Annals of the ICRP* **37**.

IRMER (2000) *The Ionising Radiation (Medical Exposure) Regulations 2000*. SI 2000/1059, London: HMSO.

IRR (1999) *The Ionising Radiations Regulation 1999*. SI 1999/3232. London: HMSO.

Patel S (2009) New dimensions in endodontic imaging: Part 2. Cone beam computed tomography. *International Endodontic Journal* **42**, 463–75.

Patel S, Horner K (2009) Editorial: The use of cone beam computed tomography in Endodontics. *International Endodontic Journal* **42**, 755–6.

Patel S, Dawood A, Whaites E, Pitt Ford T (2009) New dimensions in endodontic imaging: part 1. Conventional and alternative radiographic systems. *International Endodontic Journal* **42**, 447–62.

Paurazas SB, Geist JR, Pink FE, Hoen MM, Steiman HR (2000) Comparison of diagnostic accuracy of digital imaging by using CCD and CMOS_APS sensors with E-speed film in the detection of periapical lesions. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontics* **89**, 356–62.

Pauwels R, Beinsbergera J, Collaert B *et al.* (2012) Effective dose range for dental cone beam computed tomography scanners. *European Journal of Radiology* **81**, 267–71.

SEDENTEXCT (2012) European Commission, Radiation Protection N 172: Cone beam CT for dental and maxillofacial radiology. Evidence based guidelines. A report prepared by the SEDENTECT Project, 2011. www.sedentexct.eu/files/guidelines_final.pdf.

Theodorakou C, Walker A, Horner K, Pauwels R, Bogaerts R, Jacobs R (2012) Estimation of paediatric organ and effective doses from dental cone beam CT using anthropomorphic phantoms. *The British Journal of Radiology* **85**, 153–60.

Vande Voorde HE, Bjorndahl AM (1969) Estimated endodontic "working length" with paralleling radiographs. *Oral Surgery, Oral Medicine and Oral Pathology* **27**, 106–10.

Velvart P, Hecker H, Tillinger G (2001) Detection of the apical lesion and the mandibular canal in conventional radiography and computed tomography. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics* **92**, 682–8.