INTERNATIONAL
ENDODONTIC JOURNAL

doi:10.1111/iej.13187

European Society of Endodontology position statement: Use of cone beam computed tomography in Endodontics

European Society of Endodontology (ESE) developed by:

S. Patel[1,2], J. Brown[1], M. Semper[3], F. Abella[4] & F. Mannocci[1]

[1]Endodontic Postgraduate Unit, King's College London Dental Institute, London; [2]Specialist Practice, London, UK; [3]Private Practice, Bremen, Germany; and [4]Universitat Internacional de Catalunya, Barcelona, Spain

Abstract

European Society of Endodontology (ESE) developed by: Patel S, Brown J, Semper M, Abella F, Mannocci F. European Society of Endodontology position statement: Use of cone beam computed tomography in Endodontics. *International Endodontic Journal*.

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) in Endodontics. This paper is an update of the ESE CBCT position statement which was published in 2014 (European Society of Endodontology 2014, https://doi.org/10.1111/iej.12267). Recent review articles provide more detailed background information and the basis for this position statement. It is intended that this position statement will be updated at least every 4-5 years to keep abreast of relevant research. The aim of this paper is to provide clinicians with evidence-based guidance on the application of CBCT in Endodontics. Since 2014, there has been an increase in the number of clinical studies confirming the positive impact of CBCT on treatment planning, decision-making when reviewing cases and reduced practitioner stress levels.

Keywords: CBCT, endodontology, guidelines, position statement.

Received 8 July 2019; accepted 8 July 2019

Introduction

Radiography is an integral component of Endodontics; however, it is well established that conventional radiographic techniques have limitations. These include anatomical noise (Bender & Seltzer 1961), the two-dimensional nature of the images produced (Brynolf 1967) and various degrees of geometric distortion (Forsberg & Halse 1994), which may impede the accurate detection of periapical lesions confined to cancellous bone (Abella *et al.* 2014, 2015, Davis *et al.* 2016).

CBCT largely overcomes these limitations, and although providing lower spatial resolution than periapical radiographs, this is compensated for by demonstration of structures in all three dimensions. This has resulted in a steady increase in the use of CBCT in Endodontics (Setzer *et al.* 2017), which is reflected in position statements from a number of professional organizations (European Society of Endodontology

Further contributions and revisions were made by ESE Executive Board members: Dummer PMH, Duncan H, Franco V, Gambarini G, Ørstavik D, Tjäderhane L, Whitworth J.

Correspondence: Paul M. H. Dummer, CEO of the European Society of Endodontology, Postboks 1237 Vika, 0110 Oslo, Norway (e-mail: ceo@e-s-e.eu).

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2014, American Association of Endodontists/American Academy of Oral & Maxillofacial Radiology 2015).

Cone beam computed tomography

The potential benefits of CBCT over conventional imaging must outweigh the mostly higher levels of radiation exposure (Wenzel 2014). Radiation dose varies greatly for commercially available CBCT units and is influenced further by the investigation parameters chosen. It is essential and enshrined in both UK and European legislation, to comply with the ALARA principle (as low as reasonably achievable); a record of the justification process must be maintained and, as with conventional radiographs, informed consent must be obtained from the patient. CBCT should be considered on a case-by-case basis where lower dose conventional radiography does not provide adequate diagnostic information.

As part of this justification process, only high resolution, small FOV (i.e. <5 cm) is applicable in Endodontics, thus minimizing the effective dose, as well as improving spatial resolution. The availability and correct use of scout views facilitate accurate positioning of the FOV over the region of interest. Each CBCT examination should be tailored to the individual patient (for example, anatomy and restorations) and the specific diagnostic needs by adjusting the exposure parameters (e.g. mA, kVp, voxel size, exposure time and number of basis images). There are several studies which have shown that adjusting the exposure parameters (resulting in a lower effective dose) away from the manufacturer's default settings can produce diagnostically acceptable images even when resolution is diminished (Durack *et al.* 2011, Al-Nuaimi *et al.* 2016). Risk assessment for the need of personal dosimetry devices for staff involved in taking CBCT examinations should be carried out before installation of CBCT devices (Health Protection Agency 2010).

The image quality and therefore diagnostic yield of different CBCT scanners vary; therefore, the results of CBCT research tends to be device(s) specific and is not necessarily transferable to other CBCT devices. The presence of artefacts in images must be acknowledged as another relevant factor decreasing CBCT diagnostic image quality and diagnostic yield (Schulze *et al.* 2011, Queiroz *et al.* 2018), especially in the presence of highly radiopaque objects, such as posts, metal restorations, gutta-percha, and root-end filling materials (Chavda *et al.* 2014). In order to reduce motion artefacts, stable patient positioning is mandatory.

Education

Two levels of training are recommended by the European Academy of DentoMaxilloFacial Radiology (Brown *et al.* 2014); level 1 training (core course) to be undertaken by those prescribing CBCT examinations and those involved in the acquisition of CBCT imaging, and level 2 training (advanced training) for those interpreting on CBCT image volumes and offering a CBCT imaging and reporting service.

Assessment of images

The entire volume of data must be assessed systemically in all three planes and reported on by the clinician who has prescribed the examination. In some cases, for example, where there is ambiguity or a second opinion is required, the CBCT image data, accompanied by relevant clinical information, should be referred for independent reporting by a Maxillofacial Radiologist (SEDENTEXCT 2012). All clinically relevant, as well as incidental findings, should be reported. An understanding of the impact of artefacts on quality and interpretation of CBCT images must be appreciated.

Criteria for use of CBCT in Endodontics

A CBCT examination should only be considered after a detailed clinical examination, including conventional radiographs, has been performed (Kruse *et al.* 2015, Patel *et al.* 2019a). The potential benefits as well as potential risks must be discussed with the patient beforehand. Even though the effective dose is relatively low, CBCT must be used judiciously. This is especially relevant in children and adolescents who are more sensitive to the potential effects of ionizing radiation (Theodorakou *et al.* 2012) and dose reduction measures should be considered.

In those cases in which lower dose conventional radiography does not provide sufficient information for confident diagnosis a small FOV CBCT examination should be considered if the additional information from reconstructed three-dimensional images is likely to aid diagnosis and treatment planning and/or enhance clinical management (Ee *et al.* 2014,

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Rodríguez *et al.* 2017a,b, Patel *et al.* 2019b), examples include the following:

- detection of radiographic signs of periapical pathosis when the signs and/or symptoms are non-specific and plain film imaging is inconclusive;
- assessment and/or management of dento-alveolar trauma, which may not be fully appreciated with conventional radiographs;
- appreciation of anatomically complex root canal systems prior to endodontic management (e.g dens invaginatus);
- nonsurgical re-treatment of cases with possible untreated canals and/or previous treatment complications (e.g. perforations);
- assessment and/or management of root resorption, which clinically appears to be potentially amenable to treatment;
- presurgical assessment prior to complex periradicular surgery (e.g. large periapical lesions in posterior teeth, and the evaluation of their proximity to adjacent relevant anatomical structures);
- identification of the spatial location of extensively obliterated canals, also taking into account the possibilities of guided endodontics;
- detection of periradicular bone (secondary) changes indicative of root fractures, when clinical examination and conventional imaging modalities are not conclusive.

Conclusion

The aim of this position statement is to assist clinicians who are considering using CBCT. It is essential that every image is justified, optimized and reported on. CBCT imaging has become an essential tool for the diagnosis and/or management of Endodontic problems requiring 3 dimensional imaging; however, it must be used cautiously.

All clinicians using CBCT must have the appropriate and accredited training.

Dental undergraduate and endodontic postgraduate programmes should incorporate CBCT-related education into their curricula, such as the mode of operation, justification, interpretation and reporting of CBCT images (Rabiee *et al.* 2018).

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