Cone Beam Computed Tomography Updated Technology for Endodontic Diagnosis

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KEYWORDS

• Cone beam computed tomography • Radiographic diagnosis
• 3-dimensional radiology • Radiographic outcome assessment
• Root canal morphology • Endodontic diagnosis • Apical periodontitis

KEY POINTS

- Narrow field CBCT has many applications in Endodontics and reduces the negative effects of anatomic noise, geometric distortion and technique sensitivity observed on 2D images.
- Narrow field CBCT provides earlier detection of apical periodontitis than conventional 2D radiographs providing improved diagnostic value, treatment efficiency and outcome assessment.
- Narrow field CBCT provides excellent image resolution at reduced radiation exposure as compared to mid or large field of view CBCT.
- CBCT assists the practitioner to identify canal morphology, numbers of canals and relative positioning even in the presence of calcific metamorphosis and dystrophic calcifications.
- Identification and treatment of lateral canals is supported by viewing their specific location with the use of narrow field of view CBCT before or during endodontic therapy.

INTRODUCTION

According to the Merriam-Webster dictionary, the term "diagnosis" is defined as: "the art or act of identifying a disease from its signs and symptoms." In the field of endodontics, dentists review a multitude of signs and symptoms to formulate their diagnosis. These include, but are not limited to: sensitivity to heat, sensitivity to cold, percussion, palpation, bite, swelling, caries, periodontal disease, presence of sinus tracts, and unstimulated pain. In addition to these symptoms, tests are used to identify variations from normal such as electric pulp tests,[1] laser Doppler,[2] and radiographs[3] (first used in 1896 by Otto Walkhoff). In the early 1960s Seltzer and Bender[4,5] identified several discrepancies using 2-dimensional (2D) radiographs for observing

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apical periodontitis (AP). These included: (a) a delayed appearance of radiographic evidence of AP until 40% cortical plate demineralization developed and (b) a lack of correlation between the size of the histologic defect and AP image.

In addition, according to Durack and Patel, 2D radiographs are of limited value due to the compression of 3-dimensional (3D) structures, geometric distortion, anatomic noise, and temporal perspectives.[4–6]

Radiographs are used to identify the changes inside visually opaque objects. Although interpretations of these images are only part of the diagnostic process, the dental community places great emphasis on this information. In the early 1970s, Brynolf studied the benefit of using radiographs from multiple angles to increase their diagnostic value. She found that using 3 images improved diagnosis significantly.[7] Later that decade, grave concerns developed. Many articles published supported the idea that reading dental radiographs was too subjective.[8–10] To this concern, Orstavik and colleagues[12] developed a guide to standardize apical observations called the Periapical Index. Despite these efforts, 2D radiographs were still limited in diagnostic value due to the factors previously listed.[4–6]

Computer-assisted tomographic imaging or cone beam computed tomography (CBCT), a technology borrowed from medicine, previously focused on the need for better surgical guidance during implant placement.[14] The principle of ALARA[21] (As Low As Reasonably Achievable) as related to radiation exposure and the lack of resolution initially limited CBCT use in endodontics.[15] A new area of research emerged, and old paradigms were shifting.[17] These advances solved many of the listed 2D limitations.[6,13] Specific applications of this technology developed and the Endodontic community embraced them.[18–20]

The current narrow field of view CBCT provides a 3D, low-radiation/high-resolution solution to many endodontic diagnostic and treatment problems.[11] This article will display specific case scenarios and supporting literature for the application of CBCT technology.

ROOTS: ANATOMIC NOISE HIDES ANATOMY

Case #1: Maxillary Left First Bicuspid—Diagnosis: Pulpal Necrosis/Symptomatic Apical Periodontitis

Identification of root structure, curvature, and location are hampered in 2D radiographs by anatomic noise (**Fig. 1**).[6] In this case, CBCT (**Figs. 2** and **3**) assisted with

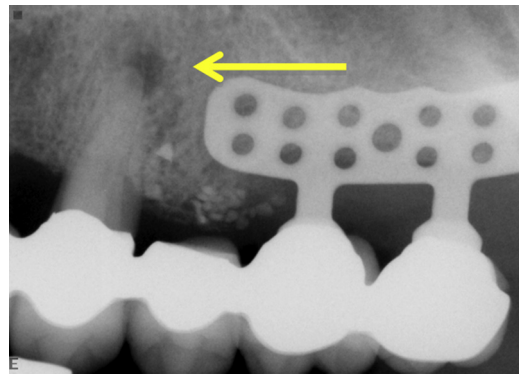

Fig. 1. Preoperative 2D periapical x-ray, *arrow* pointing to hidden radicular anatomy "Anatomic Noise".