Cone-beam computed tomography in endodontics—Overcoming limitations

Author_ Dr Shanon Patel, UK


Fig. 1

Fig. 1_The Accuitomo CBCT scanner (Morita) housed in a purpose-built acquisition room; the radiographer sits on the other side of the room, allowing her to programme the scanner.

_Introduction

Irreversible pulpitis can often be challenging to diagnose and therefore frustrating to manage. Often patients will complain of poorly localised pain on one side of their face; they may be unable to localise even the quadrant from which the symptoms originate. Clinical examination may be unremarkable, no obvious signs may be elicited, and the results of vitality testing may be inconclusive.

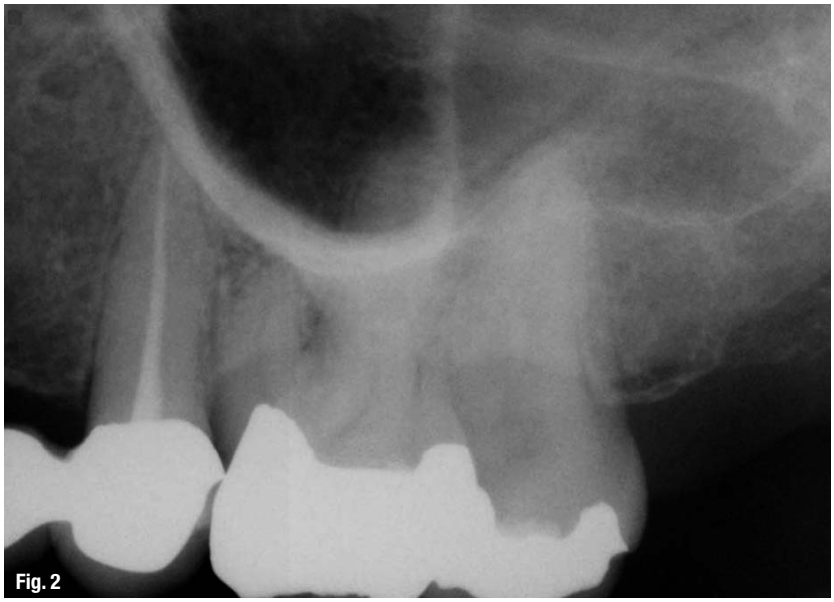
Fig. 2

Fig. 2_A periapical radiograph of the upper left quadrant does not show any signs of apical pathology. Note that the zygomatic buttress is obscuring the apices of teeth #26 and 27. Tooth #25 had been root treated to an acceptable standard.

In these situations, it is not uncommon for conventional radiographs (film or digital sensors), taken at several different views of the area of interest, not to reveal anything untoward. This is because conventional radiographs have several limitations. The image is the result of the complex (3-D) anatomy being radiographed being compressed into a 2-D "shadowgraph"; this inevitably results in loss of potentially useful information (for example, the axial plane that is not usually seen with radiographs). The images produced with radiographs, even when taken with a beam-aiming device, have a certain degree of geometric distortion, as it is often impossible to place the image receptor parallel to the long axis of the tooth. Finally, the anatomy overlying the area of interest (for example, zygomatic buttress, cortical bone) often masks the area of interest—this phenomenon is known as anatomical noise.

CBCT may be used to overcome the limitations of conventional radiographs. CBCT is an imaging system that has been specifically designed to produce 3-D images of the maxillo-facial skeleton (Fig. 1). These images are produced quickly and effortlessly, and assessed using relatively simple software on standard PCs.

Having access to CBCT imaging is a tremendous benefit in specialist endodontic practice. Most importantly, using a small field of view, the effective dose to the patient can be kept to a minimum.

The case described in this article demonstrates how CBCT may be used to manage a common diagnostic problem more effectively.

_Case report

A 45-year-old fit and healthy female patient was referred by her GDP for management of her pain, localised to the left side of her face. On presentation,

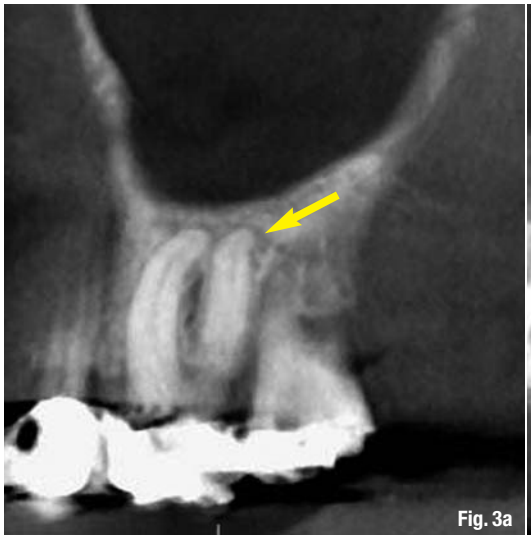
Fig. 3a

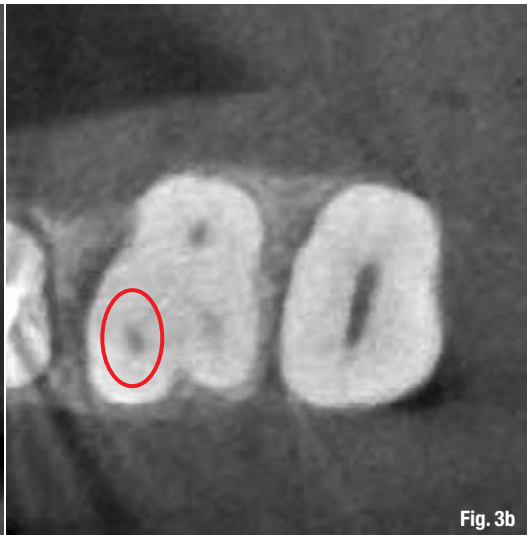
Fig. 3b

Figs. 3a & b_Reconstructed sagittal (a) and axial (b) slices clearly show the presence of a periapical radiolucency (yellow arrow), and three canals.

the patient complained of poorly localised pain over the left side of her maxilla. The pain was spontaneous, woke her up at night, and was dull and throbbing in character. These symptoms had been present for five days and were steadily deteriorating.

She had seen her dentist when the symptoms first developed. He examined her and diagnosed tooth #25 as the cause of her symptoms and with her consent root treated this tooth. Unfortunately, the symptoms did not improve after this treatment.

Clinical examination revealed that the upper and lower left quadrants were heavily restored; however, none of these teeth was tender to percussion or palpation. None of the teeth was mobile and all responded positively to vitality testing.

Conventional radiographs did not reveal anything untoward: tooth #25 had undergone a well-executed root-canal treatment, and no periapical radiolucencies could be detected (Fig. 2). A small-volume CBCT scan was taken of the upper left quadrant. Reconstructed sagittal images clearly showed a periapical radiolucency associated with the distobuccal root of tooth #26, and the axial slices revealed the presence of three canals (mesiobuccal, distobuccal and palatal; Figs. 3a & b).

A diagnosis of chronic periapical periodontitis was made for this tooth, and with the patient's consent this tooth was root treated in a single visit under local anaesthetic (Fig. 4). The patient was contacted the following day and reported that she was completely asymptomatic.

_Discussion

The key to effective management is accurate diagnosis. Invasive (and irreversible) treatment should not be carried out until a definitive diagnosis has been made. In this case, a periapical radiolucency was readily detected with CBCT.

Perhaps not surprisingly, this same apical pathology could not be detected with conventional radiography, as the cortical plate and zygomatic buttress masked the pathological changes occurring in the cancellous bone. This case highlights the difficulties that even experienced endodontists commonly face in everyday practice, and demonstrates how CBCT may be used to help make an accurate diagnosis.

The reconstructed axial slices were also useful during examination. They confirmed the number and exact position of the root-canal entrances before treatment was commenced. This resulted in a conservative access-cavity preparation and swift identification of the root-canal entrances, thus allowing treatment to be carried out effectively and efficiently._

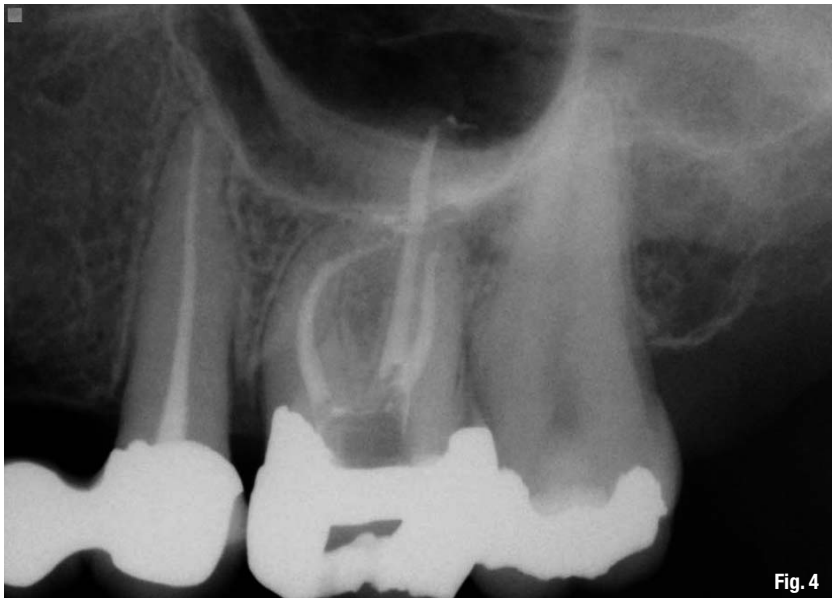
Fig. 4

Fig. 4_Completed root-canal treatment.

_author roots

Dr Shanon Patel
(BDS, MSc, M.Clin.Dent., MFDS Royal College of Surgeons, MRD Royal College of Surgeons)

Specialist endodontist