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# roots

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2 2012

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Cone-beam computed tomography in endodontics—Overcoming limitations

**opinion**

WaveOne—First experiences of third-year students

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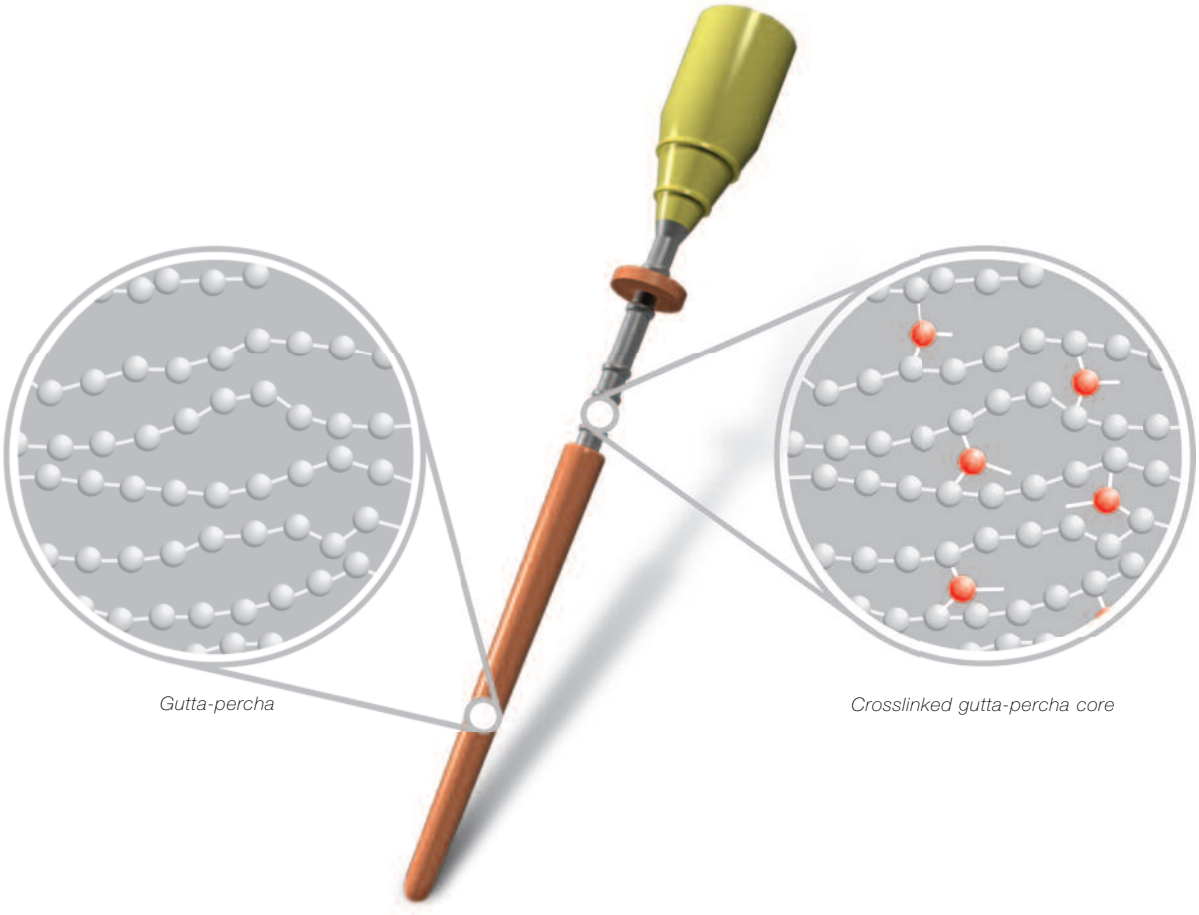


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# Dear Reader,

Dr Gary Glassman

**_Vince Lombardi so eloquently stated,** "Practice does not make perfect. Only perfect practice makes perfect." In other words, we can perform a procedure repeatedly yet not obtain the expected outcome for success. We must continually advance in all disciplines of dentistry in order to provide our patients with the most predictable treatment regimens possible, understanding that the greatest variable that stands in our way is the human variable. Elevating the standards of endodontic care is inexorably tied to an important dynamic, our armamentaria.[1] The objective of endodontic treatment has remained a constant since root-canal treatment was first performed: the prevention and/or treatment of apical periodontitis such that there is complete healing and an absence of infection.[2] The most important advancements in clinical endodontics forever changed the endodontic landscape with the emergence and development of four technologies.[3,4]

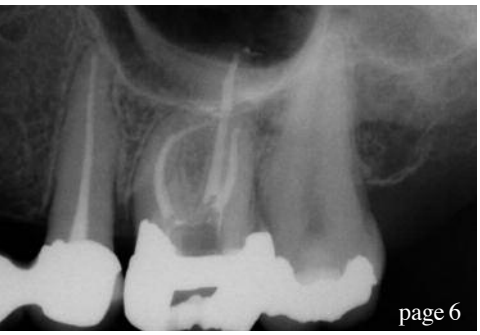
The *dental operating microscope*, not only provides us superior vision to diagnose cracks and track vertical fractures[3,5], but also to locate anatomy and then subsequently address that anatomy. *Sonic and ultrasonic instruments* have allowed us to be able to carry out refinement of access openings, locate calcified canals in a controlled and predictable manner, and eliminate the smear layer, and biofilm that has remained in the canal after instrumentation.[3,6,7] *NiTi files* have allowed more predictable canal shapes,[3] in reduced time compared to stainless-steel files, while maintaining the original canal anatomy and producing less extrusion of debris.[8,9] *Mineral trioxide aggregate* is a remarkable and biocompatible restorative material that has become the standard for pulp capping and root perforation, and has salvaged countless teeth that previously had been considered hopeless. Perhaps the greatest international attention in recent years has focused on methods to improve endodontic disinfection in the root-canal system.[3] Files shape; irrigants clean. We rely on our irrigants and irrigant delivery systems to penetrate into the complex anatomy that our instruments cannot shape, in order to eliminate the organic tissue and bacterial inoculum that exists within. The early works of Hess suggest this is ongoing to be challenging by virtue of it complexity.[10]

As I fly 32,000 feet over the Pacific Ocean after lecturing and running Essential Endo Clinical Skill set programmes in both Europe and Asia, it boggles my mind how, with all the modern technologies that exist today to provide predictable endodontics, the fundamentals are often ignored: *Vision, tooth isolation* and *irrigation*. An overwhelming number of general dentists and, surprisingly, endodontists worldwide do not use rubber dams and provide endodontic treatment through a matte of caries. Saliva is allowed to slop into the pulp chamber like the pungent backwater of a contaminated estuary. This is analogous to providing state-of-the-art building technology with the finest of materials but constructing the foundation on a bog-land. To take short-cuts during treatment to reduce costs, and to justify it to oneself, is to retreat into a mindset of persistent cognitive dissonance. In order to achieve endodontic nirvana and enjoy the successes that the recent technologies allow us to achieve, we must get back to fundamentals and provide grass roots education in a stepwise, systematic manner to those who will be providing the treatment."

"Science and research will elevate the specialty of endodontics to its rightful pinnacle."[11] "The cornerstone to our specialty's integrity and relevance must be built on a strong foundation of randomised clinical trials and evidenced-based endodontics."[11] The future of endodontics is bright and holds incredible promise as we continue to develop new techniques and technologies that will allow us to perform endodontic treatment painlessly and predictably, and continue to satisfy one of the main objectives in dentistry, that being to retain the natural dentition.[12]

Dr Gary Glassman
Doctor of Dental Surgery
Fellow of Royal College of Dentists of Canada

*Editorial note: A complete list of references is available from the publisher.*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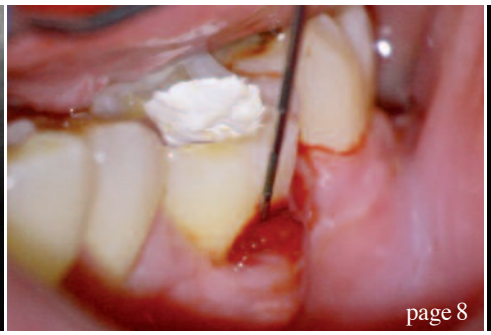
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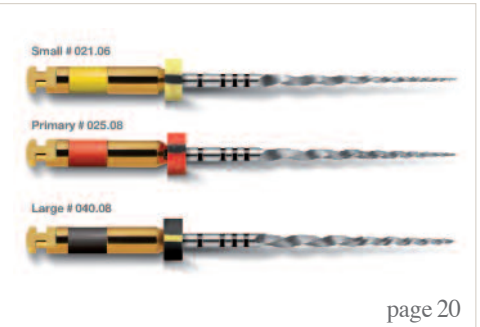
*Cover image courtesy of Produits Dentaires SA (www.pdsa.ch)*



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# 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.

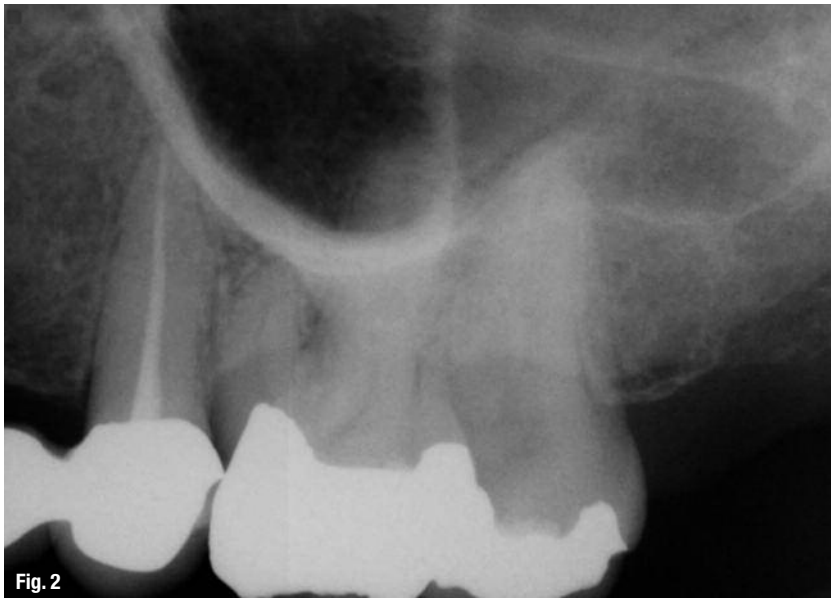
Fig. 2

**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,

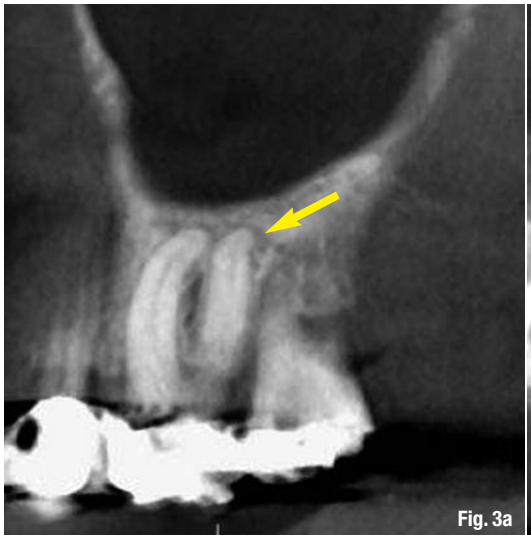
Fig. 3a

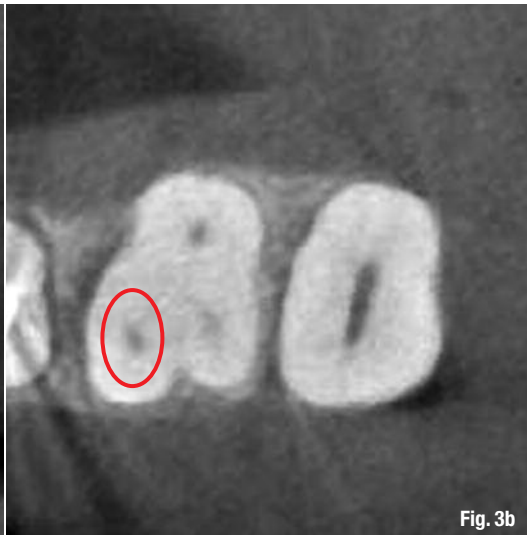
Fig. 3b

**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**_Completed root-canal treatment.

_author roots

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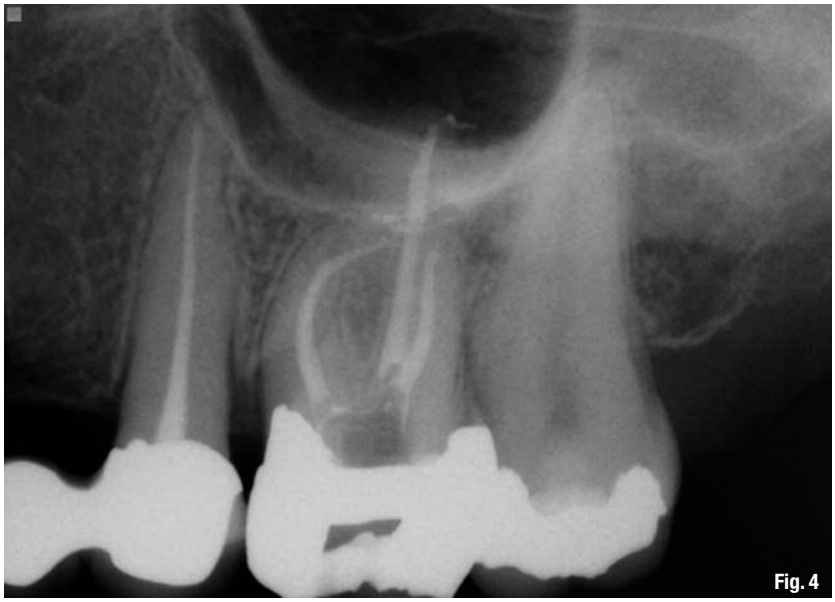
Fig. 4

# Diagnosis and management of a longitudinal fracture necrosis associated with an extensive periodontal defect

**Author**_ Dr Antonis Chaniotis, Greece

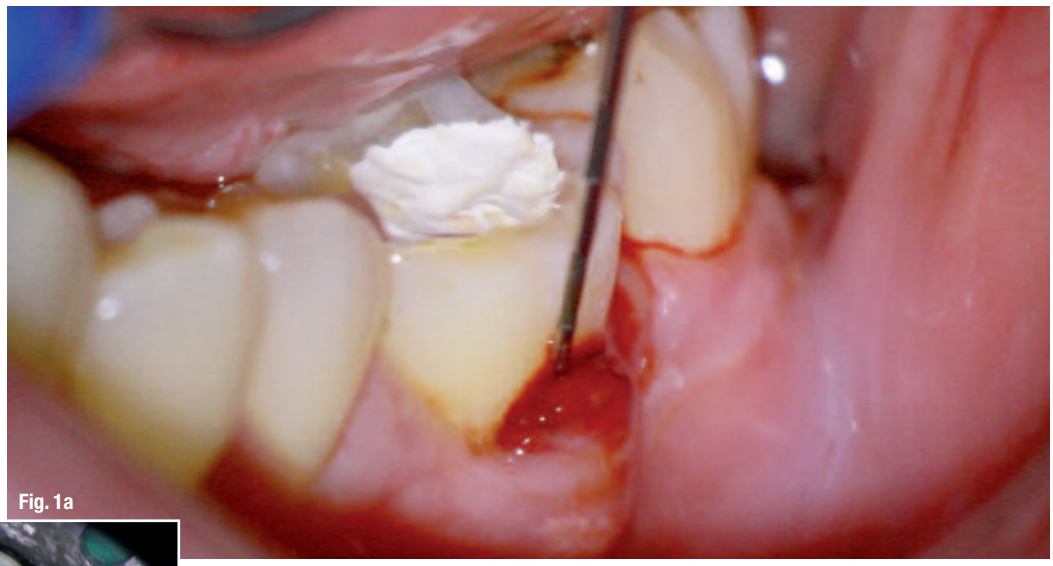

Fig. 1a

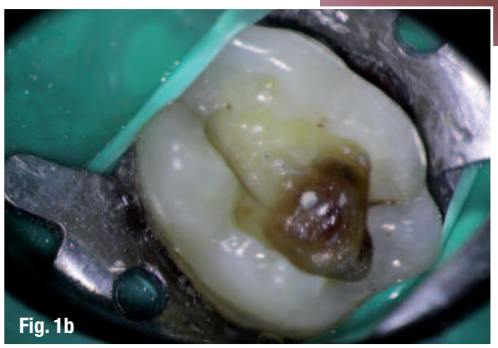

Fig. 1b

## _Introduction

The terminology and classification of incomplete tooth fractures have received significant attention in the scientific literature for many decades. Numerous terms and definitions have been proposed through the years, arising from the difficulties related to diagnosis, prognosis assessment and treatment planning. Cuspal fracture (Gibbs 1954), fissure fracture (Thoma 1954), fissural fracture (Down 1957), crack lines and greenstick fracture (Sutton 1961; 1962), cracked tooth syndrome (Cameron 1964), hairline fracture (Wiebusch 1972), split-root syndrome (Silvestri 1976), enamel infraction (Andreasen 1981), crack lines and craze lines (Abou-Rass 1983), and incomplete tooth fracture (Luebke 1984) are some of the terms used through the years. Many of these terms were used by different authors to describe the same clinical entity.

Recently, the American Association of Endodontists categorised longitudinal tooth fractures into five major classes:

_craze line;
_fractured cusp;
_cracked tooth;
_split tooth; and
_vertical root fracture (VRF).

Craze lines affect only the enamel, originate on the occlusal surface, are typically from occlusal forces or thermo-cycling, and are asymptomatic.

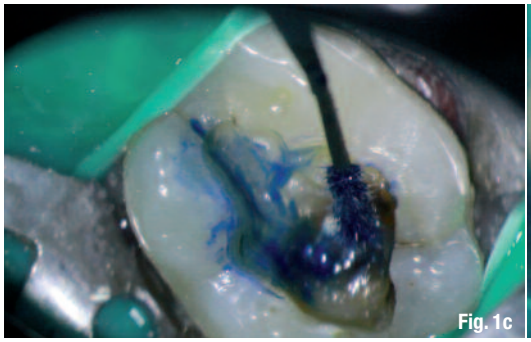
Fig. 1c

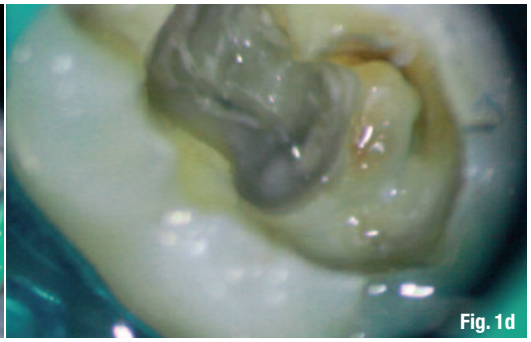
Fig. 1d

A fractured cusp is defined as a complete or incomplete fracture initiated from the crown of the tooth and extending sub-gingivally, usually directed both mesiodistally and buccolingually.

A cracked tooth is defined as an incomplete fracture initiated from the crown and extending sub-gingivally, usually directed mesiodistally.

A split tooth is defined as a complete fracture initiated from the crown and extending sub-gingivally, usually directed mesiodistally through both of the marginal ridges and the proximal surfaces.

A true VRF is defined as a complete or incomplete fracture from the root at any level, usually directed buccolingually.

Cracked teeth are thought to occur as a result of para-functional habits or weakened tooth structure. The fractures are incomplete, tend to present in a mesial-to-distal orientation, and are generally centred on the occlusal table. The symptoms that develop subsequent to these cracks have been termed "cracked tooth syndrome". This has been described as acute pain that results during the mastication (or release) of small, hard food substances and is exacerbated by cold. However, the signs and symptoms of a cracked tooth may also be consistent with an irreversible *pulpitis* or *necrosis*.

Based on the available literature and investigations on root cracks and fractures, it has been suggested that the endodontic prognosis for teeth with these types of cracks is poor, with a high potential for unfavourable post-treatment sequelae. In their paper, Berman and Kuttler (2010) conclude that pulp necrosis, in the absence of extensive restorations, caries or luxation injuries, is likely caused by a longitudinal fracture extending from the occlusal surface and into the pulp. They suggest, based on the available literature, that these types of teeth may have a poor prognosis after endodontic treatment, with the potential ramification of extensive periodontal and/or periapical bone loss. They therefore suggest extraction as the primary treatment option.

Although this conclusion appears reasonable enough, it should be noted that the detection of the incomplete fracture line limits before proceeding to the extraction of a longitudinally fractured tooth is of outmost importance.

The detection of incomplete longitudinal fractures is a challenging task that is very often neglected. Generally, a combination of simple inspection, transillumination, staining with dyes, diagnostic surgery, microscopy and a cone-beam computerised tomography scan is necessary to identify and confirm the presence of cracks. The extraction of cracked teeth without identifying and documenting the fracture line limits is unjustifiable according to the author.

The aim of the present case report is to demonstrate the importance of the diagnostic procedures in the prognosis and treatment planning of incompletely longitudinally fractured teeth.

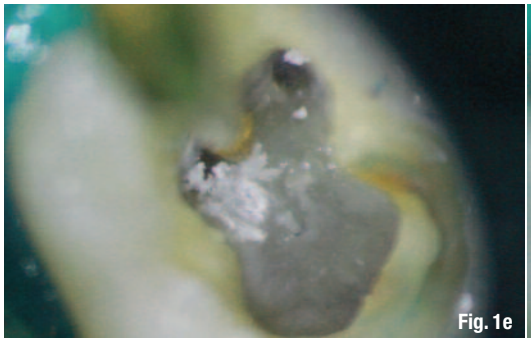
Fig. 1e

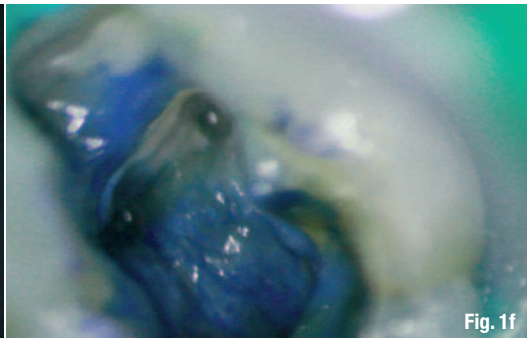
Fig. 1f