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CASE REPORT

Access to original canal trajectory after deviation and perforation with guided endodontic assistance

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Abstract

Procedural accidents are eventualities that may occur during endodontic treatment because of lack of attention to detail or even unforeseeable situations. Knowledge of the root canal anatomy and its variations is a prerequisite for successful endodontic treatment. This case report describes an endodontic treatment where there was an intercurrence, generating deviation and perforation, which was solved with the aid of guided endodontics. A 37 years old, ASA1, was referred to the clinic for localisation and treatment of a calcified canal of the second right upper premolar. The tomographic images revealed the presence of only one canal and deviation with apical perforation. With the help of CBCT and CAD/CAM, it was possible to perform the guided access technique even after deviation and root perforation. Once again, this technique proved to be safe and predictable, allowing for a favourable prognosis in the long term.

Introduction

Procedural accidents are eventualities that may occur during endodontic treatment because of lack of attention to detail or even unforeseeable situations (1,2). Knowledge of the root canal anatomy and its variations is a prerequisite for successful endodontic treatment (3). The presence of additional canals or deviations should be avoided, because incomplete instrumentation and maintenance of bacteria and debris that may result in apical periodontitis (3).

One common complication during root canal negotiation and shaping is deviation from the original path (2,4), making it difficult or even impossible to reach the working length (5). Thus, with inadequate instrumentation and obturation, failure of endodontic treatment may occur (5). Inadequate preparation of the access cavity, false estimation of the direction of the root canal and attempts to access calcified canals favour the formation of deviations (1,5).

Endodontic treatment in cases of severely calcified canals is a challenge and is associated with an increased rate of technical failure and a reduced prognosis (6,7). In cases of failures that result in perforations, 75% occur at the time of localisation and negotiation in calcified canals (8).

When the root canal is severely calcified, as identified by radiographic examination, and associated with apical periodontitis and symptomatology, endodontic treatment is indicated, and the access and location of the remaining canal with the aid of guided endodontics have been shown to be safe and predictable (9–12). The combined use of cone beam computed tomography (CBCT) and intraoral optical scanning of the region of interest may potentiate the accuracy of guided drilling for the production of access guides (13,14). Guided access may be a useful tool for the treatment of these complex cases, even without the use of operative microscopy (9,10,15–20).

The use of guided endodontics was recently used and reported by some authors (10,15–20). This method is

reported to be effective, safe, requiring little time and possible even by less-experienced professionals. However, there is a need for a broader knowledge of the technique in various clinical situations. This case report described an endodontic treatment where there was an intercurrence, generating deviation and perforation, which was solved with the aid of guided endodontics.

Case report

Patient E.E.S.G.O, female, 37 years old, ASA1 (American Society of Anestesiology), was referred to the clinic for localisation and treatment of a calcified canal of the second right upper premolar. In the clinical examination, the patient presented sensitivity to the percussion test and fistula in the vestibular face near the apical region of the second right upper premolar. The patient reported facial swelling in the same region for approximately 1 month, which was subjected to several access attempts by other professionals. Radiographic images showed an area of bone rarefaction in the periapical region and absence of canal light that extended to the middle third (Fig. 1a). There have also been several previous attempts at access in addition to an image suggestive of a second canal. The diagnosis was chronic periapical abscess.

Under local anaesthesia, attempts were made to access the remaining canal without success. At one point, it was observed after radiographic examination that the instrument was outside the original canal pathway, resulting in perforation in the apical third (Fig. 1b). This path was then cleaned, filled with intracanal medication (Chlorhexidine Endogel 2%: LenzaFarm, Belo Horizonte, Brazil) and provisionally sealed with ionomer cement (Maxxion R: FGM, Santa Catarina, Joinville, Brazil). It was decided to perform the guided endodontic technique to return to the original canal path after patient consent.

The patient was referred to the radiological centre where tomographic examination and intraoral scanning were performed. The tomographic images revealed the presence of only one canal and deviation with apical perforation (Fig. 2a,b). A high-resolution, 0.12-mm voxel CBCT unit (iCAT; Imaging Sciences International, Hatfield, PA) and the surface scan (Trios 3 COLOR, 3SHAPE Holmens Kanal 7,4.1060 Copenhague K Dinamarca) were matched into a software de planejamento cirúrgico Simplant (Technologielaan, Leuven, Belgium Version 11; Materialise Dental). We used the radiographically visible structures and soft and hard tissues of the patient highlighted using the ST-CBCT technique (Soft tissue cone beam computed tomography) (21), aiming to match the CBCT and intraoral scanning. A virtual copy of the drill (Neodent Drill for Tempimplants, Ref.: 103179; JJGC Ind. e Comércio de Materiais Dentários SA, Curitiba, Brazil) was incorporated in the software with a total length of 20 mm, a working length of 12 mm and a diameter of 1.3 mm and superimposed to the upper second premolar, which allowed us to correct the previous deviation of the root canal path leading to the visible anatomical lumen (Fig. 3a,b,c). Using the described positions of the virtual drill, the software generated a virtual template by use of its designer tool. Aiming at the precision transfer of the virtual planning to the surgical procedure and better guide stability, two clamp pins were simulated (Fig. 3d) by means of conducting the bur guiding stainless steel sleeves (3.0 mm external diameter, 1.4 mm internal diameter and 8 mm length, Ref.: 102110; JJGC ind. E Comércio de Materiais dentários SA, Curitiba, Brazil) and virtually incorporated into the planning of clamp sites

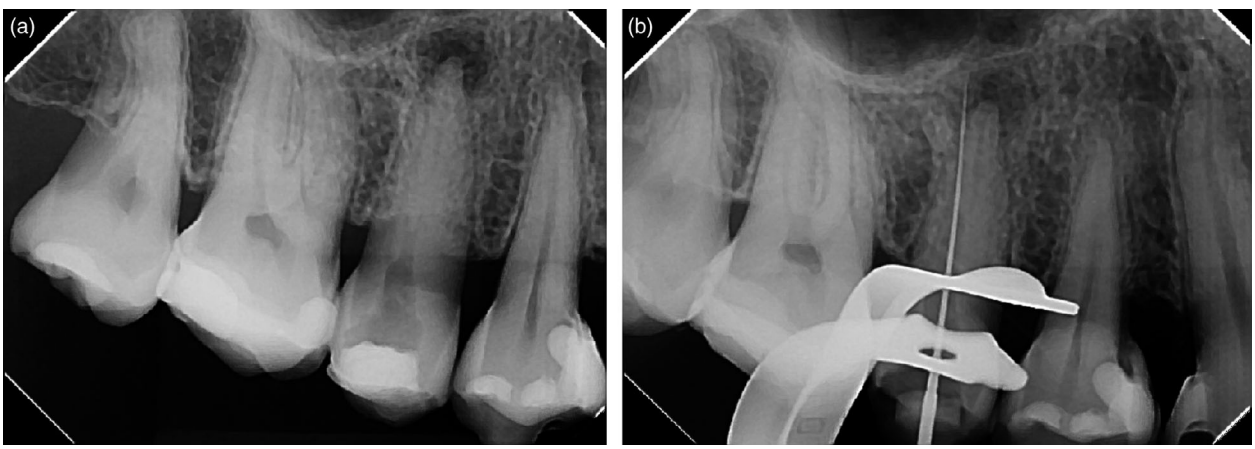

Fig. 1 (a) Preoperative radiographic image showing area of bone rarefaction in the periapical region on second right upper premolar, (b) Radiographic images showed that the instrument was outside the original canal pathway resulting in perforation in the apical third.

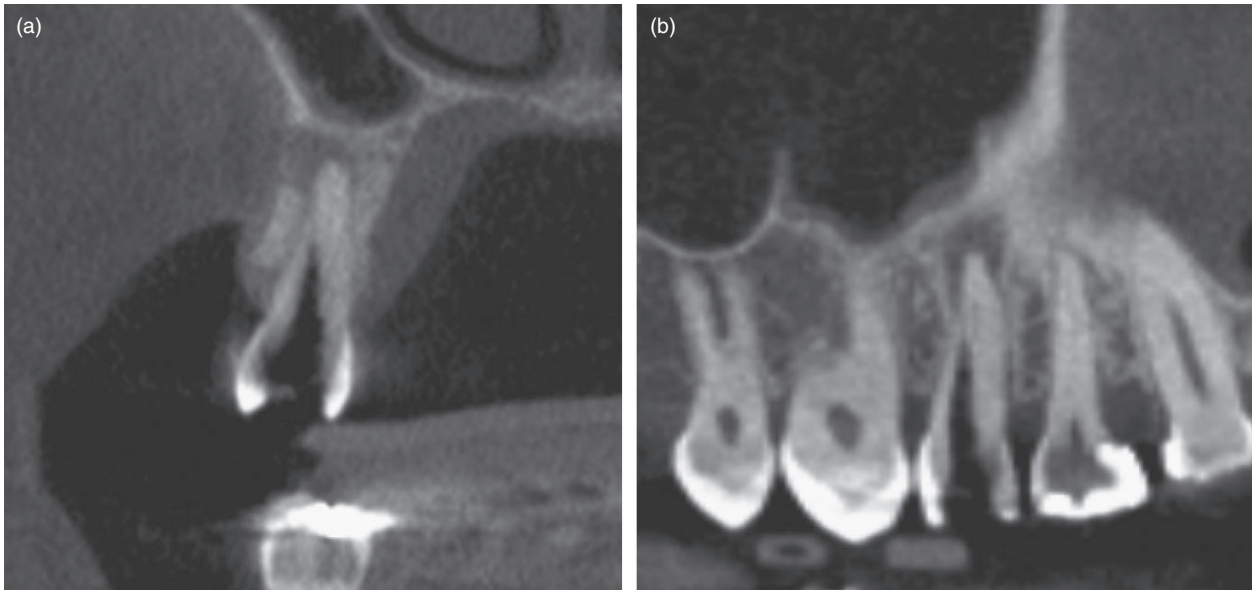

Fig. 2 CBCT showing suggestive images of bone resorption in the periapical region and perforation in the apical third.

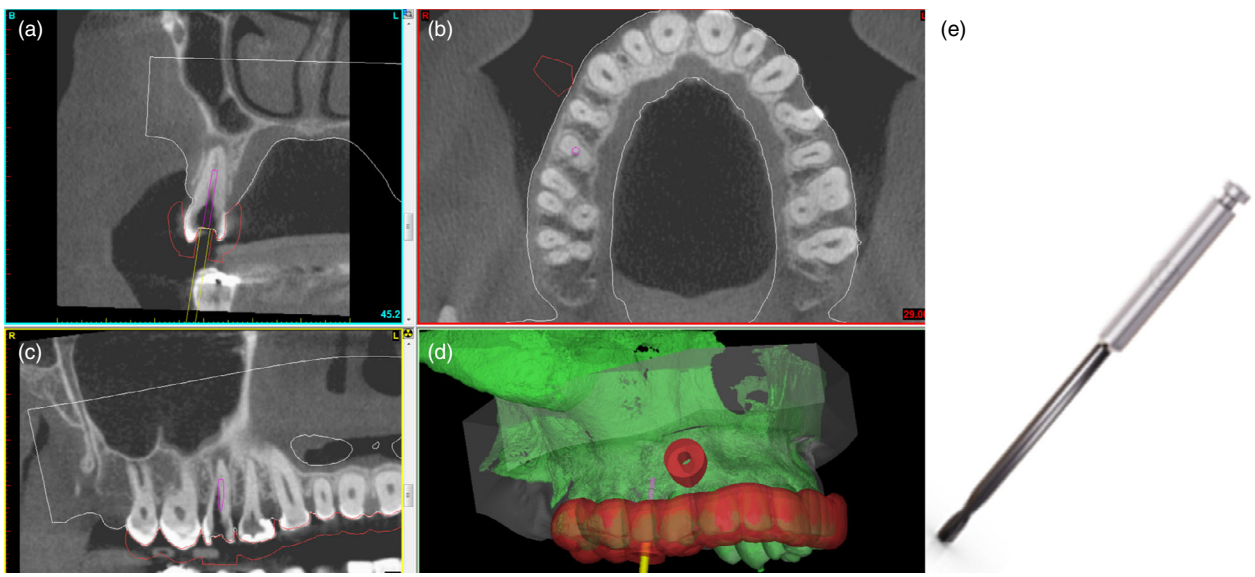

Fig. 3 (a, b, and c) Virtual planning of the drill overlapping the upper second premolar, which allowed for the correction of the previous deviation of the root canal path, leading to the visible anatomical lumen, (d) The virtual template presenting sleeves, dispensing with the need for digital support for stabilisation and (e) Drill (Neodent Drill for Tempimplants, Ref.: 103179; JJGC Ind. e Comércio de Materiais Dentários SA, Curitiba, Brazil).

and tool access. Another sleeve with the same characteristics as the previous ones was virtually incorporated to the surgical guide to direct the access of the drill through the root. The designed 3d template images were exported in a specific STL (Stereolithography) format and sent to a 3D printer (Objet Eden 260 V with FullCure 720; Stratasys Ltd, Minneapolis, MN).

Subsequently, the surgical guide was properly positioned for the execution of bone milling, under refrigeration, using the access drill (Neodent Drill for Tempimplants, Ref: 103179; JJGC Ind e Comércio de Materiais Dentários SA, Curitiba, Brazil) at a speed of 1200 rpm and 4 N.cm of torque in the X-Smart Plus engine (Dentsply Sirona Endodontics, Ballaigues,

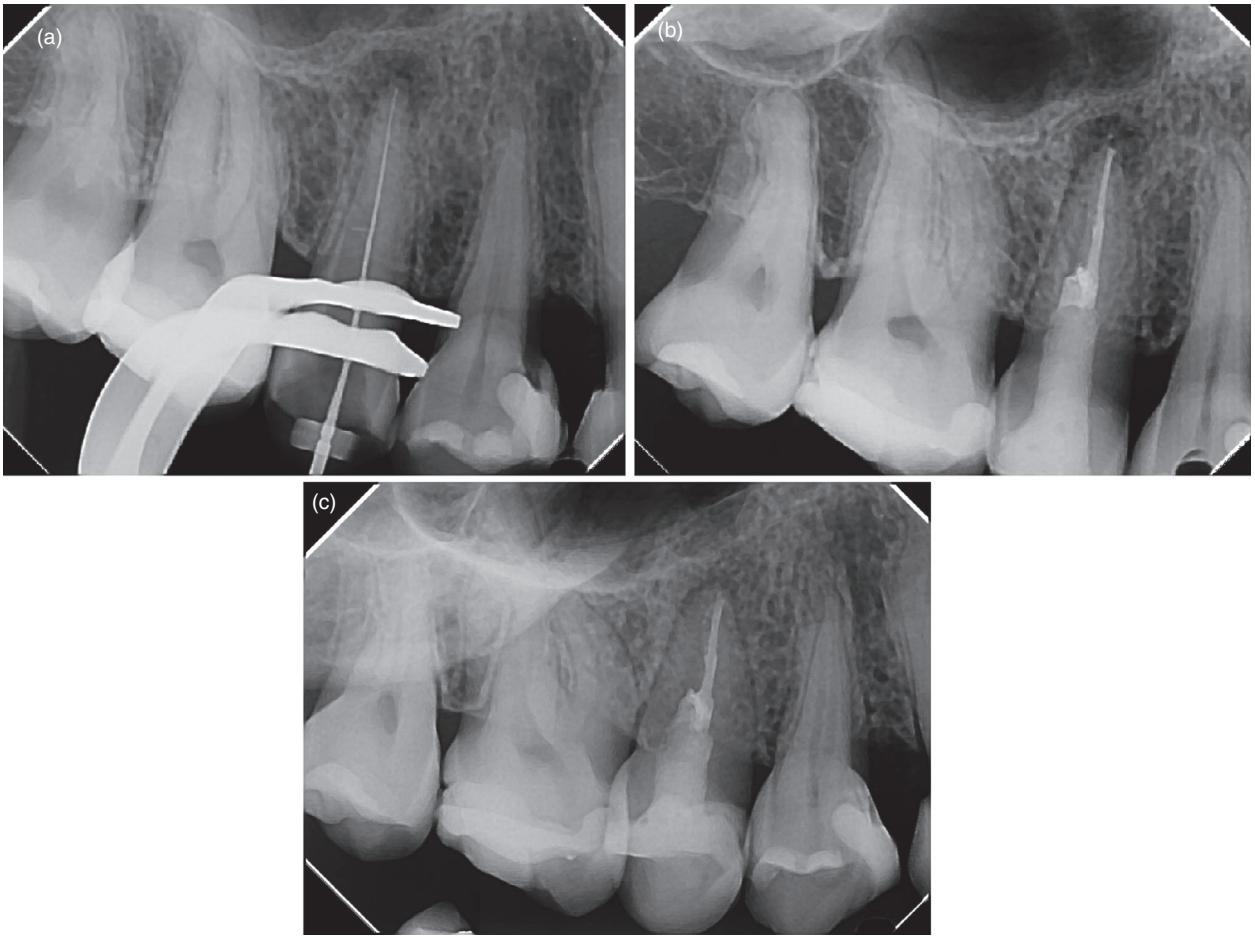

Fig. 4 (a) Canal patency length with a C-Pilot # 15 manual file, (b) Concluded case and (c) Control 1 year after the procedure.

Switzerland). Fixing screws were used to stabilise the guide, eliminating the need for digital support during the procedure. Access to the remaining canal was performed using the same bit for bone milling. This procedure lasted approximately 8 seconds. After removal of the guide, there was no need for suturing in the bone milling region. The absolute insulation was positioned, and the canal patency length was reached with a C-Pilot # 15 manual file and confirmed through the apical foramen locator (ROOT ZX II; J. Morita, Osaka, Japan) and radiographic examination (Fig. 4a). The chemical–mechanical preparation was performed using NiTi rotary instruments from the ProDesign Logic system (Easy, Belo Horizonte, Brazil) a CM-Wire file that features heat treatment. Sequence # .15/05, .25/01, .25/04 was used, ending with the .30/05 file and copious irrigation with distilled water and 2% chlorhexidine endogel. The following was performed: Passive Ultrasonic Irrigation – PUI (Irrisonic 01; Helse, Santa Rosa do Viterbo, SP, Brazil), drying the canals with a paper points and the obturation was performed with the aid of a gutta-percha cone (Odous De Deus, Belo Horizonte) and cement based on epoxy resin AH Plus (Dentsply DeTrey GmbH, Konstanz, Germany) by the hydraulic compression technique. The deviation was sealed with MTA cement (MTA Repair HP; Angellus, Londrina, Paraná, Brazil). Canal shielding was performed with composite resin (Filtek ™ Z350 XT, 3M). A final periapical radiograph was performed (Fig. 4b). The guided access and the endodontic treatment were performed in one single visit. The patient remained asymptomatic, and the tooth was rehabilitated with protease c after 20 days. One year after the conclusion of the case, regression of the periapical lesion (Fig. 4c) was observed, as well as absence of painful symptoms and a negative response to clinical tests.

Discussion

Occasionally, even very skilled clinicians can create a deviation from the original path of a root canal when

treating teeth with complex anatomies and severe calcifications (2). Factors such as tooth anatomy, canal location, curvature and instrumentation technique may be associated with the formation of deviations (22–24). The deviations hamper adequate endodontic treatment and may significantly alter the long-term prognosis. Training and experience in managing and diagnosing such intercurrences may encourage a favourable ultimate outcome of treatment (2).

The ageing of the population and, consequently, the increase in the number of older patients who need endodontic treatment are a reality. Throughout the life of these patients, their teeth are predisposed to dentin apposition, and they may present with partially or completely calcified canals (25–28). Young patients may also present with calcified root canals as a result of dental trauma (29). Fifteen per cent of traumatic permanent incisors present with partial obliteration of the pulp, and 1% become fully calcified, which could be considered a sign of healing of the pulp and, therefore, a case in which endodontic treatment would not be indicated (9,14). However, there is a risk that approximately one-third of these pulps will become necrotic at some point in the future (30).

The guided endodontic technique consists of accessing and locating severely calcified root canals through guides created virtually as reported by some authors (9,10,15–20). This technique seems to be a safe and clinically viable method, especially when calcified canals cannot be accessed by conventional endodontic strategies in a predictable manner (10,19). Therefore, even without the aid of a surgical microscope, guided endodontic treatment has proven to be very useful for professionals in the face of more complex cases (9).

In this case report, the guided endodontic technique favoured the resumption of the original anatomical trajectory after conventional endodontic treatment without success in a severely calcified canal. The guided access allowed for the drill to penetrate with the proper angulation and direction to the visible light point of the canal located in the CBCT. Thus, it was possible to perform cleaning and modelling of the root canal throughout its extension, in addition to promoting the repair of the diversion and drilling area. The rapidity and predictability of this technique are also noteworthy and can be considered an important aid in the treatment of accidents and complications in endodontics. Although the learning curve for performing this technique is small, allowing for less-experienced professionals to perform it, the professional's ability to perform tomographic and virtual planning is essential to the success of the final result.

With the help of CBCT and CAD/CAM, it was possible to perform the guided access technique even after deviation and root perforation. Once again, this technique proved to be safe and predictable, allowing for a favourable prognosis in the long term.

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The authors deny any conflicts of interest related to this study.

Disclosure

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Authorship declaration

The content is original and does not consist of plagiarism or fraud; The work is not under consideration or will be submitted to other journal until a final decision is issued by this journal; I have effectively contributed to this work and am familiar with its contents; I have read the final version and assume the responsibility for its contents. I understand that if the work, or part of it, is considered deficient or a fraud, I take shared responsibility with the other authors.

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