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CASE REPORT

Maxillary lateral incisor with Vertucci's type V root canal configuration

ABSTRACT

Aim: *To describe and discuss the procedures adopted during the endodontic treatment of a maxillary lateral incisor with Vertucci's type V root canal configuration.*
Summary: *A 30-year-old Caucasian male patient was referred for analysis of his left maxillary incisors, both compromised by a traumatic injury occurred seven days prior. His medical history was non-contributory. The root of tooth 21 presented a vertical root fracture, thus indicating its extraction. Tooth 22 showed no periodontal involvement or response to the cold sensitive test, but presented mild pain on both vertical percussion and apical palpation. The initial radiographic exam showed asymptomatic apical periodontitis, and suggested apical root fracture or apical root canal bifurcation. A cone-beam computed tomography (CBCT) was requested, and revealed no apical root fracture, but the presence of apical root canal bifurcation. The 12-month clinical and radiographic follow-up evidenced the partial success of the established therapy. Technological resources were relevant to the successful management of the complex case report described herein. However, patience, perseverance and clinical experience were also essential factors.*
Key learning points

- *Vertucci's type V classification is considered one of the rarest and most challenging root canal configurations among the existing anatomical complexities.*
- *This paper describes and discusses the procedures adopted during the endodontic treatment of a maxillary lateral incisor with Vertucci's type V root canal configuration.*
- *Besides the technological resources, patience, perseverance, and clinical experience were essential for performing a predictable endodontic treatment in a tooth affected by a diagnosis posing a great difficulty such as that presented herein.*

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Introduction

The main goal of endodontic treatment is to maintain or restore the health of periapical tissues. In vital teeth, the pulp is removed, and the root canal is emptied, cleaned, shaped, and hermetically filled with biocompatible material. Considering that the inflammation process is restricted to the pulp, and that the periapical tissues have not yet been compromised, the endodontic intervention is performed basically to maintain their integrity. On the other hand, in necrotic teeth, the pulp cells are definitely compromised, thus triggering the microbial colonization of the root canal system (RCS), and the development of apical periodontitis (1). A periapical lesion may be present even without being radiographically visible (2); therefore, endodontic treatment aims to restore the local tissue (1).

Endodontic infection cannot be eliminated, mainly due to the anatomical complexity of the RCS (3, 4). The substantial success rates of endodontic treatment in necrotic and infected teeth – 78,9% (5), 82,64% (6), 84,7% (7) and 86% (8) – are explained by the reduction in the microbial contingent, i.e., infection control (3), achieved mainly by effective chemomechanical preparation (9). Although chemical and mechanical cleaning occur together, it is understood didactically that they are performed by chemical substances and by endodontic instruments in contact with the root canal walls, respectively. Moreover, both are complemented by the physical cleaning mechanism of the irrigation process, performed by the flow and reflux of the irrigant (10). Nevertheless, knowledge of the root canal anatomy is essential for proper chemomechanical preparation (11).

In general, anterior teeth have a single root and canal (12, 13). Nonetheless, in the upper arch, endodontic treatments performed on central (14, 15) and lateral incisors with 2 canals (16, 17), and lateral incisors with 3 (18, 19) and 4 canals (20), have already been reported in the literature. Among the existing anatomical complexities, Vertucci's type V (21) classification is considered one of the rarest and most challenging root canal configurations. The aim of this paper was to describe and discuss the procedures adopted during the endodontic treatment of a maxillary lateral incisor with Vertucci's type V (21) root

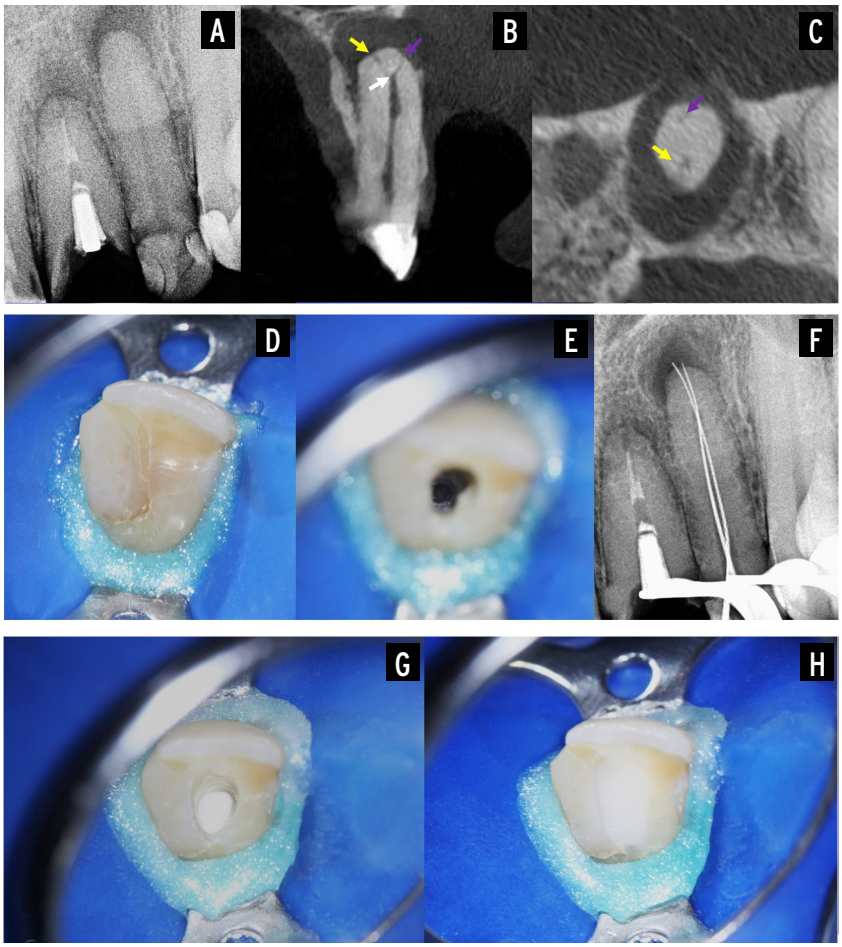

Figure 1
A) Initial periapical radiograph. **B)** and **C)** Sagittal and axial tomographic views, respectively (white arrow: start of bifurcation/purple arrow: buccal canal/yellow arrow: palatal canal). **D)** Initial clinical view. **E)** Coronal opening after initial exploration with #15 K-FlexoFile (Dentsply-Maillefer) and preparation of the root canal orifice and cervical and middle root canal thirds with #2, and #2 and #3 Largo and Gates-Glidden drills (Dentsply-Maillefer), respectively. **F)** Access to the apical bifurcation by using C-Pilot #10 (VDW) precurved files. **G)** Root canal filling with calcium hydroxide paste (Ultracal XS, Ultradent). **H)** Temporary coronary sealing with glass ionomer cement (Ionoseal, VOCO).

canal configuration. The 12-month clinical and radiographic follow-up evidences the partial success (repair in progress) of the established therapy.

Case report

This case report was written according to the Preferred Reporting Items for Case Reports in Endodontics (PRICE) 2020 Guidelines (22). A 30-year-old Caucasian male patient was referred to the clinic of one of the authors (H.B.) for analysis of his left maxillary incisors, both compromised by a traumatic injury caused by his falling from a horse seven days prior. His medical history was non-contributory. The anamnesis and clinical exam revealed that tooth 21 had a metal-ceramic crown that was lost due to the accident. Analysis of the root of this tooth using a dental operating microscope (DOM) showed a vertical root fracture, thus indicating its extraction. Tooth 22 showed no periodontal involvement or response to the cold sensitive test (EndoIce, Coltene/Whaledent, Cuyahoga Falls, OH, USA), but presented mild pain on both vertical percussion and apical palpation. The initial radiographic exam showed asymptomatic apical periodontitis, and suggested apical root fracture or apical root canal bifurcation (Fig. 1A). Therefore, a cone-beam computed tomography (CBCT) was requested, and revealed no apical root fracture, but the presence of apical root canal bifurcation (Fig. 1B and 1C). The patient was given a detailed explanation about the particularities and limitations of his case, and agreed to undergo the proposed endodontic treatment, for which he signed an informed consent form.

In the first visit, the patient received buccal infiltrative anesthesia (2% mepivacaine with adrenaline - 1:100.000, DFL, Rio de Janeiro, RJ, Brazil), and was fitted with a rubber dam. The surgical field was cleaned with 2.5% sodium hypochlorite (NaOCl) (Biodinâmica, Ibiporã, PR, Brazil) (Fig. 1D), and the coronal opening was performed with #1014 and #3083 drills (KG Sorensen, Barueri, SP, Brazil). The root canal orifice and the cervical and middle thirds were explored initially with #15 K-FlexoFile (Dentsply-Maillefer, Konstanz, Germany), and then prepared with #2, and #2 and #3 Largo and Gates-Glidden drills (Dentsply-Maillefer), respectively (Fig. 1E), applying 2.5 mL of 5.25% (Fórmula & Ação, São Paulo, SP, Brazil) after each use or change of file, and a NaviTip needle coupled to a 5 mL plastic syringe (Ultradent, Indaiatuba, SP, Brazil). After numerous attempts, the apical root canal bifurcation was accessed by using several C-Pilot #10 (VDW, Munich, Germany) precurved files (Fig. 1F). Subsequently, the cervical and middle root canal thirds were irrigated with 2.5 mL of a chelating solution (17% EDTA, Biodinâmica) for 3 minutes, dried with sterile absorbent paper points (Endo Points, Manacapuru, AM, Brazil), and filled with calcium hydroxide paste (Ultracal XS, Ultradent) as an intracanal dressing (Fig. 1G). The pulp chamber was obturated with a small sterile sponge, and the coronal opening was sealed with glass ionomer cement (Ionoseal, VOCO, Cuxhaven, Germany) (Fig. 1H).

In the second visit, the patient received buccal infiltrative anesthesia (2% mepivacaine with adrenaline - 1:100.000, DFL), and was fitted with a rubber dam. The surgical field was cleaned with 2.5% NaOCl (Biodinâmica), and after removing the temporary restoration and calcium hydroxide paste with a #1014 drill (KG Sorensen) and 2.5mL of 5.25% NaOCl (Biodinâmica), respectively, an ultrasonic tip (The Finder, Helse, Santa Rosa de Viterbo, SP, Brazil) was used to facilitate access to the apical root canal bifurcation (Fig. 2A and B). Afterward, both canals' working length (WL) was determined with an electronic apex locator (Root ZX II, J. Morita, Kyoto, Japan). Chemomechanical preparation was performed by using manual K-FlexoFiles from #15 to #30 (Dentsply-Maillefer), and applying 2.5 mL of 5.25% NaOCl (Fórmula & Ação) after each use or change of file. Subsequently, 2.5 mL of 5.25% NaOCl and 17% EDTA (Biodinâmica) were activated for 30 seconds by using both passive ultrasonic irrigation (PUI) (Irrisafe, Helse) and Easy Clean (Easy Equipamentos Odontológicos, Belo Horizonte, MG, Brazil), alternately. The root canals were then rinsed

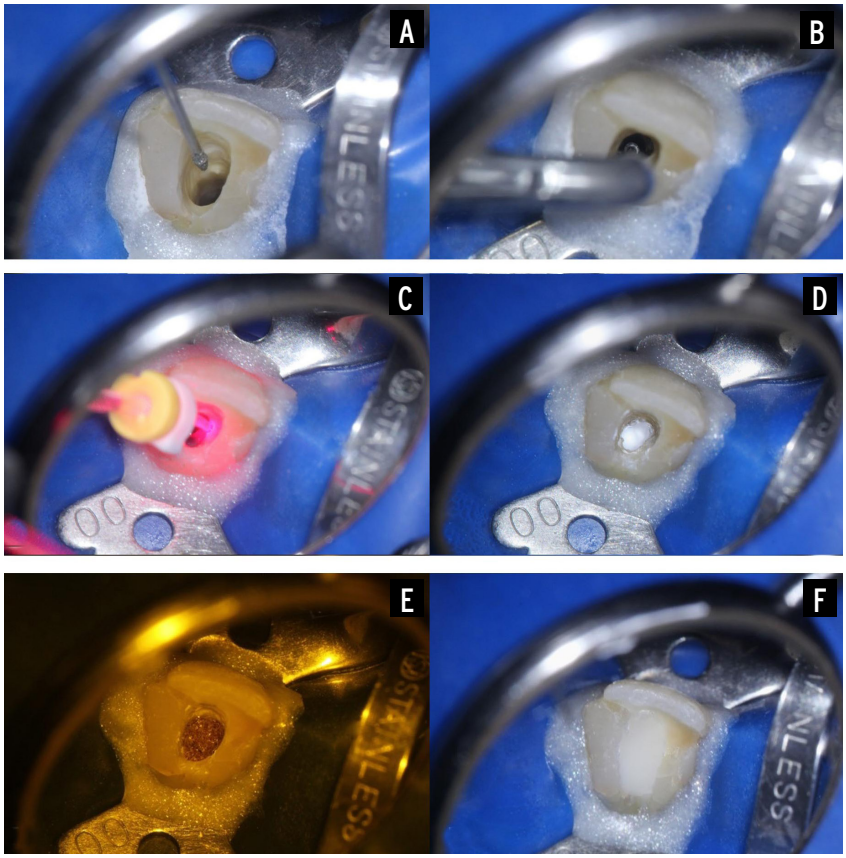

Figure 2
A) and **B)** Ultrasonic tip (The Finder, Helse) used to facilitate access to the apical root canal bifurcation. **C)** Optical fiber (MMOptics) positioned to perform irradiation. **D)** Root canal filling with calcium hydroxide paste (Ultracal XS, Ultradent). **E)** Small sterile sponge filling the pulp chamber. **F)** Temporary coronary sealing with glass ionomer cement (Ionoseal, VOCO).

with 1 mL of 5% sodium thiosulfate and 1 mL of 0.85% saline solution for 60 seconds each, and dried with sterile absorbent paper cones (Endopoints). Next, 0.5 mL of 25 µg mL^{-1} methylene blue (Vetec Quimica, Sigma Aldrich-Merck, Darmstadt, Germany) was injected into the root canals with a NaviTip needle coupled to a plastic syringe (Ultradent) up to the level of the access cavity, and left there 5 min for pre-irradiation. Then, the canals were irradiated with a low-power diode laser (Twin laser, MMOptics, São Carlos, SP, Brazil) through an optical fiber (MMOptics) with a diameter of 0.3 mm. The light was applied for 5 min at a wavelength of 660 nm and power of 40 mW without the optical fiber. The optical fiber was inserted into both root canals up to the WL (Fig. 2C). The root canals were again flushed with 10 mL of sterile 0.85% saline solution to remove the photosensitizer (23), dried with sterile absorbent paper cones (Endopoints), and filled with calcium hydroxide paste (Ultracal, VDW) as an intracanal dressing (Fig. 2D). The pulp chamber was obturated with a small sterile sponge (Fig. 2E), and the coronal opening was sealed with glass ionomer cement (Ionoseal, VOCO) (Fig. 2F). In the last visit, the same initial procedures were performed as described above. Next, the calcium hydroxide paste was removed by using a #30 manual K-FlexoFile, PUI and Easy Clean, as previously described. The root canals were then flushed with 2.5 mL of 17% EDTA (Biodinâmica) for 3 minutes, irrigated with 2.5 mL of saline solution, and dried with sterile absorbent paper cones (Endopoints). The main gutta-percha cones (30/.02) (Endopoints) were placed and checked radiographically for accurate positioning (Fig. 3A), then removed from the canals, labeled with AH Plus sealer, and reinserted. Additionally, 4 B8 accessory gutta-percha cones (Endopoints) were inserted, and #60 gutta-condenser (Dentsply-Maillefer) and #3 Paiva condenser were used to perform the thermomechanical and vertical compactions, respectively (Fig. 3B). The pulp chamber was cleaned with a small sterile sponge moistened with 70% alcohol, and the coronal sealing was performed with SDR bulk-fill resin (Dentsply-Maillefer) (Fig. 3C). Periapical radiography (Fig. 3D) and CBCT (Fig. 3E and F: sagittal and axial tomographic views, respectively) were both performed 12 months after treatment, and showed the healing in progress (Fig. 4).

Discussion

For a long time, diaphanization techniques were the main means used to analyze the root canal anatomy. Currently, other methods are used, such as CBCT and micro-computed tomography (micro-CT), which evidence in greater detail how changes in standard anatomical patterns can affect all the teeth (24). Anterior teeth typically have a single root and canal. Nonetheless, in the upper arch, endodontic treatments in central (14, 15) and lateral incisors with 2 canals (16, 17), and lateral incisors with 3 (18, 19) and 4 canals (20) have already been reported in the literature. Among the existing anatomical complexities, Vertucci's type V (21) classification is considered

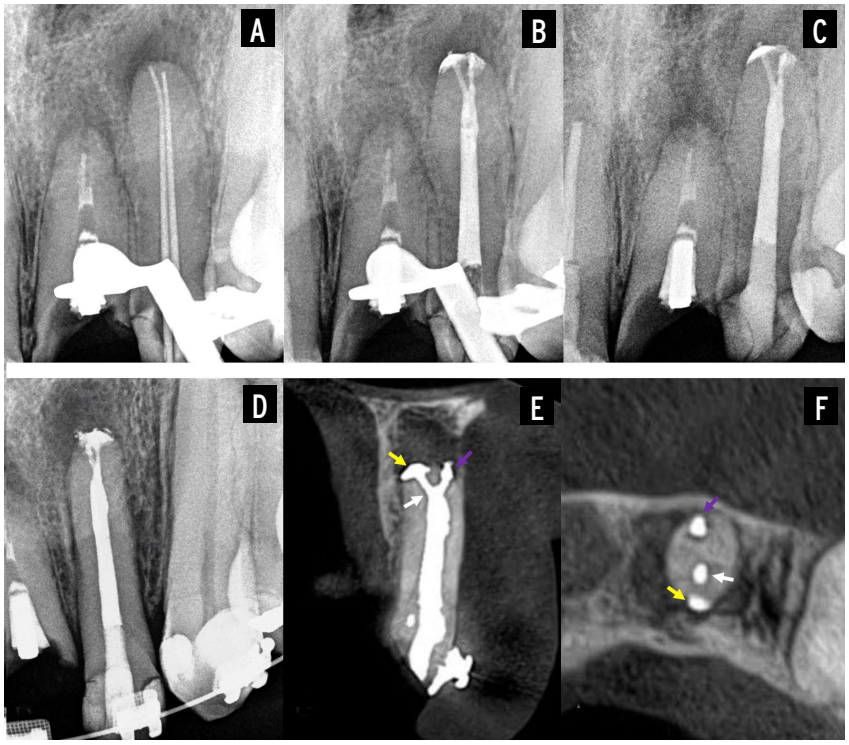

Figure 3
A) Periapical radiograph of the main gutta-percha cones. **B)** Periapical radiograph after thermomechanical and vertical compactions. **C)** Final periapical radiograph after coronal sealing with SDR bulk-fill resin (Dentsply-Maillefer). **D)** Periapical radiograph performed 12 months after the treatment. **E)** and **F)** Sagittal and axial tomographic views, respectively, taken 12 months after the treatment, showing partial success (healing in progress) (white arrow: start of bifurcation/purple arrow: buccal canal/yellow arrow: palatal canal).

one of the rarest and most challenging root canal configurations. The aim of this paper was to describe and discuss the procedures adopted during the endodontic treatment of a maxillary lateral incisor with Vertucci's type V (21) root canal configuration. The 12-month clinical and radiographic follow-up evidences the partial success (repair in progress) of the therapy.

Although the success of endodontic treatment mainly depends on the cleaning and/or disinfection of the RCS (1), it is imperative to be knowledgeable about anatomical complexities, including extra- and intracanal variations (14-20, 25). This understanding is required to accurately identify anatomical landmarks before and during the treatment, associated with normal and aberrant anatomy situations observed in daily clinical practice. Accurate diagnosis and careful analysis of periapical radiographs could provide relevant anatomical information. Should the clinician judge this information not sufficient for conducting the correct endodontic treatment, a CBCT may be useful (13, 14). In the present case report, a CBCT was requested to investigate the presence of both apical root fracture and apical root

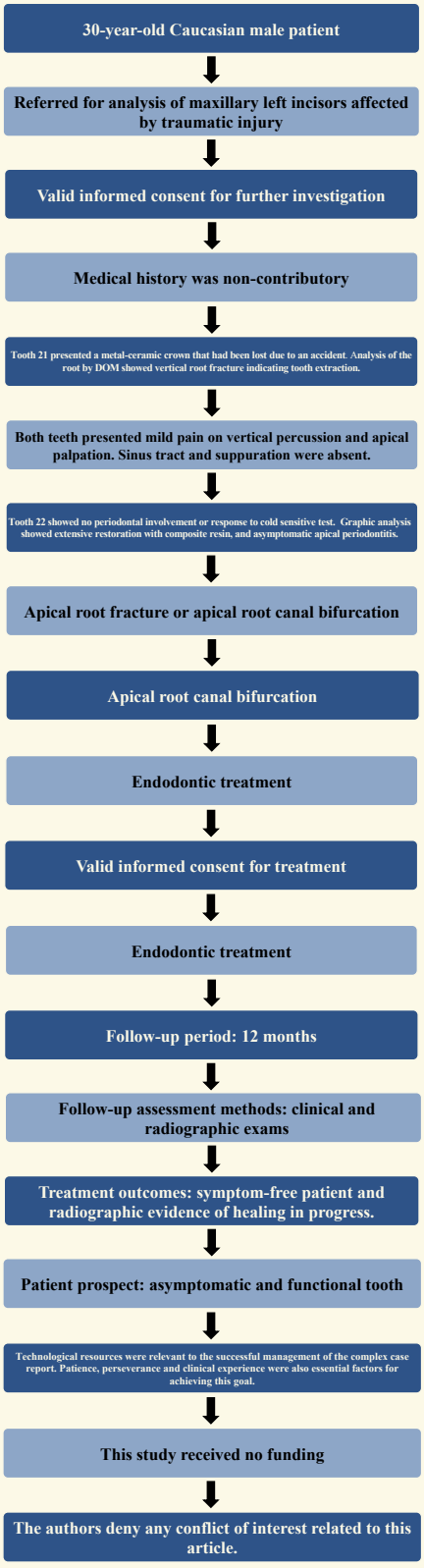

Figure 4
PRICE 2020 flowchart.

canal bifurcation, in a previously traumatized maxillary lateral incisor, following a suspicion established after careful analysis of the initial radiograph.

An adequate initial radiograph can show anatomical complexities directly or indirectly. A sudden break, or the narrowing or change in the radiographic density of the root canal, may indicate the presence of additional canals (25). In the current case report, a sudden break was not clearly visible in the initial radiograph, because of the bifurcation in the last millimeters of the root canal. A CBCT exam clearly revealed the absence of apical root fracture, and the presence of apical root canal bifurcation, thus providing an accurate diagnosis, and enabling more predictable treatment planning.

According to Perrin et al. (26), although complex root canal configuration poses a serious endodontic challenge, visualization of the pulp chamber under DOM (mainly) (27), or loupes, and subsequent exploration help decrease the risk of iatrogenic errors, increase the likelihood of discovering extra canals, and facilitate canal negotiation. Yadav et al. (28), reported that it is important to extend the access opening carefully, particularly over the lingual shoulder, in order to uncover any additional canals. In the present case report, this strategy was not used "for diagnostic purposes", since the bifurcation was identified by CBCT; however, it was important to facilitate the initial negotiation of the canals, and accurately perform the other treatment stages.

A more conservative instrumentation by using manual files was chosen due to the reduced dimensions of the root canals beyond the bifurcation. This strategy could only be performed based on the tactile sensitivity provided by manual instrumentation. Less root wear (i.e. less effective mechanical cleaning) was "compensated" by complementary antimicrobial strategies, such as using calcium hydroxide paste as intracanal dressing and photodynamic therapy, both extensively reported in the literature (23, 29).

Despite the metallurgical revolution experienced by Endodontics in recent decades through the development of new instruments, it is infeasible to complete an endodontic treatment without using manual files. They must be used during the initial exploration of the root canal, the investigation, location, and initial negotiation of extra-canals, especially in cases of high (anatomical) complexity, such as the one presented herein, etc. In addition, it is also important to reiterate that robust scientific evidence has shown that using endodontic instruments in an automated way has provided greater comfort for both patient and clinician and greater dynamism to complete the treatment when possible. However, the prognosis of endodontic treatment was not changed from the automation of biomechanical preparation (30).

Another important issue that must be discussed is the root canal obturation method. Tagger's hybrid technique has been shown to provide promising results in terms of adaptation and adhesiveness of filling materials to the root canal walls (31, 32), and sealer penetration into dentinal tubules (33). This technique was used in the present case report, because of these advantages.

Lastly, it is important to emphasize that all the measures highlighted herein were relevant for the successful management of this complex case report. However, patience, perseverance and clinical experience were also essential factors for achieving this goal (34, 35).

Conclusion

Although most studies indicate the presence of a single root and canal in maxillary lateral incisors, the clinician must be aware that there are anatomical complexities that also affect this dental group. An accurate initial radiograph, and superior diagnostic imaging resources, such as CBCT and DOM, as well as patience, perseverance and clinical experience are essential for performing a predictable endodontic treatment in a tooth affected by a diagnosis posing a high level of difficulty such as that presented herein.

Clinical Relevance

Vertucci's type V classification is considered one of the rarest and most challenging root canal configurations among the existing anatomical complexities. This paper describes and discusses the procedures adopted during the endodontic treatment of a maxillary lateral incisor with Vertucci's type V root canal configuration. The 12-month clinical and radiographic follow-up evidences the partial success (repair in progress) of the established therapy. Besides the technological resources, patience, perseverance, and clinical experience were essential for performing a predictable endodontic treatment in a tooth affected by a diagnosis posing a great difficulty such as that presented herein.

Conflict of Interest

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

Acknowledgements

The authors deny any financial affiliations.

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