D3, the instruments studied did not present statistical difference in relation to the diameters (p> 0.05), but from that point there was a statistically significant difference (p <0.05). This can be observed in figure 2, where the two curves of the measured diameters of the instruments are almost overlapped and from D3 they diverge, demonstrating a larger diameter of the X1 Blue File instruments from that point (p <0.05).

The coincidence of the diameter of the instruments and the main gutta-percha point, as standardized by ANSI/ADA number 78, results in a better filling of the root canals.[5] In order to have a correct filling of the apical region, it is important to coincide the diameter D0 of the last instrument used in the apical region with that of the main gutta-percha point.[10] In this study, in relation to instrument preparation, until the D3 the two instruments studied did not present a statistically significant difference (p> 0.05) with a taper of 0.07 mm/mm. The gutta-percha point that presented the greatest discrepancy in relation to the repair in the region of the tip of the instruments was that of the VDW, because it presented D0 = 0.18mm and taper 0.06. From the gutta-percha point studied the VDW was the only with taper of 0.06 (p <0.05), the other marks had taper of 0,07 that would fit properly to the preparation of the tip of the two instruments.

It is important that there is a standardization of the gutta-percha point so that an adequate filling is possible[8]. All gutta-percha point presented a statistically significant difference in relation to the measured diameters (p<0.05). According to the findings of the present study, the cone that would best fit the preparation of the two instruments studied was the MK Life brand. The figure 3 shows a closer approximation of the curve of this cone in relation to the curve of the studied instruments.

Conclusion

The instruments diameter complies with the recommendation of ANSI/ADA number 101 and the GP studied with the ANSI/ADA number 78. The cone that that would suit best the instruments preparation was the MK life, and the VDW would provide the greatest mismatch among the brands.

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References

1. Silva EJNLS, Sa L, Belladonna FG, Neves AA, Accorsi-Mendonça T, Vieira VTL, et al. Reciprocating versus rotary systems for root filling removal: assessment of the apically extruded material. J Endod. 2014;40(12):2077-80.
2. De-Deus G, Arruda TEP, Souza EM, Neves A, Magalhães K, Thuanne E, et al. The ability of the Reciproc R25 instrument to reach the full root canal working length without a glide path. Int Endod J. 2013;46(10):993-8.
3. Lopes HP, Elias CN, Vieira MVB, Mangelli M, Souza LC, Vieira VTL. Resistência em flexão de instrumentos endodônticos obtidos de fios metálicos de NiTi convencional e M-wire. Rev Bras Odontol. 2012,69(2):170-7.
4. Marroquín BB, Wolter D, Willershausen-Zönnchen B. Dimensional variability of nonstandardized greater taper finger spreaders with matching gutta-percha points. Int Endod J. 2001;34(1):23-8.
5. Kopper PMP, Tartarotti E, Pereira CC, Figueiredo TAP. Estudo da padronização de cones de guta-percha de três marcas comerciais. Rev Gaúcha Odontol. 2007;55(2):123-6.
6. Waechter F, Antunes RO, Irala LED, Limongi O. Avaliação comparativa entre o diâmetro de cones estandardizados e cones secundários B8 calibrados por régua calibradora, distando 1 mm das suas pontas (D1). RSBO. 2008;6(1):34-43.
7. Castilho EH, Britto MLB, Machado MEL, Nabeshima CK. Acurácia do diâmetro de ponta de cones de guta-percha com diferentes conicidades. Arq Odontol. 2014,50(3):138-41.
8. Cagol A, Schwengber L, Soares RG, Irala LED, Limongi O, Salles AZ. Avaliação da acurácia de três diferentes marcas comerciais de réguas calibradoras de cones de guta-percha. RSBO. 2008;6(1):55-62.
9. Oliveia MRSS, Carvalho EP, Lunz JSC, Silva EJNL, Moreira EJL, Vieira VTL. Correlação do diâmetro do preparo de uma nova geração de instrumentos de NiTi com as dimensões de cones de guta-percha de sua antiga geração através de uma análise morfométrica. Rev Bras Odontol. 2016;73(3):180-5.
10. Aguiar CM, Cavalcanti JSC, Coelho KC. Vedamento apical pós-tratamento endodôntico. RGO. 2004;53(4):281-4.

Use of endodontic guide for resolution of calcified root canals: case report

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ABSTRACT

Introduction: Endodontic science aims to maintain the dental element in function in the stomatognathic system, through procedures of sanification, modeling and obturation of the root conduits. However, the success of the treatment may be compromised due to the presence of partial or total obliterations of the pulp cavity, which hinder and even impede the procedure. Recently, the technological advance made it possible to transpose these barriers with the creation of a guide that allows rectilinear access and directs to the apical foramen of the obliterated canal. **Methods:** The present study describes the use of the endodontic guide in a 54-year-old male patient, diagnosed with pulp necrosis in element 14, with obliteration of the palatine conduit. **Results:** The success of the treatment could be observed after six months of radiographic control and absence of symptomatology. **Conclusions:** Endodontic treatment of calcified canals through guided endodontics demonstrates a clinically viable approach to locate obliterated root canals and prevent accidents and complications in teeth that cannot be predictably accessed through traditional endodontic therapy.

Keywords: Dental Implantation. Endosseous. Endodontic. Dental Pulp Calcification. Root Canal Obturation.

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» Patients displayed in this article previously approved the use of their facial and intraoral photographs.

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Introduction

Endodontic science aims to maintain the dental element in function in the stomatognathic system with no injury to the patient. Biological and mechanical principles need to be followed for a successful treatment, in addition to the correct execution of all stages of root canal preparation, including hermetic filling and coronary restoration. No attention to these principles can lead to failure of the treatment. Additionally, the presence of partial or total obliterations (calcifications) of the pulp can corroborate with it, preventing a correct sanification and modeling of the root canals.

Root canal calcification (hard tissue deposition of the root canal wall) is characterized by uncontrolled mineralization due to failure of the pyrophosphatase enzyme and, reduced of capillary permeability with decreasing of blood supply. It can be due to trauma, caries, periodontal disease and aging. Approximately 76,7% of the cases of calcified endodontic treatments are considerable difficult.

Thus, when this condition occurs, the clinician can face a difficult or impossible root canal treatment, increasing the treatment efforts, removing a large amount of dentin and, increasing the risk of endodontic complications as dentin steps, deviations and even root canal perforation.

The resources available today, such as apical locators, digital XR, ultrasound, rotary instruments, clinical microscope and high resolution image exams, added to surgical maneuvers, such as apical surgery, facilitate the resolution of complex cases.

Among these resources, the Operatory Microscope (OM) allows better illumination and visualization of the field. OM high magnification is necessary to assist in the coronary access, localization of calcified channels, detecting microfractures, identifying isthmuses, interpreting the complexities of the root canal system and, supporting in the removal of intracoronary nuclei and fractured instruments.

In addition, Cone Beam Computed Tomography (CBCT) has been shown to be a valuable diagnostic tool in previous root canal treatment, because it shows a greater variety of details when compared to routine radiographs. CBCT helps to identify apical pathologies, providing morphological details of the root canal system. Thus, the analysis of CBCT data on calcified teeth seems to be an interesting alternative when added to the clinical experience of dentists. Therewithal, CBCT is used in the field of implants for virtual planning, bone quantification and to visualize anatomical structures. It is often used to produce surgical guides when associated with three-dimensional scanning and printing.

Since 2012 in endodontics, it is possible to combine tomographic examination, surface scanning and three-dimensional printing to overcome difficulties related to the presence of calcified canals. This means that the access cavity preparation of an obliterate root canal can be planned three-dimensionally (3D) and when combined to optical surface scan allows the production of a guide pathway. This combination of techniques will result in a minimally invasive, planned and guided access cavity that will help to preserve tooth structure, allowing a treatment with predictable outcome.

The present report describes the resolution of a calcified canal case by using an endodontic guide through the combination of radiographic and computerized techniques.

Material and methods

case Report

A 54-year-old male patient sought endodontic care in April 2017, complaining of oral swelling in the buccal region of the upper premolars of the right side. At the time, he reported a history of abscess for at least two years. The anamnesis revealed a history of respiratory allergy, diabetes, and sinusitis.

Clinically, it could be observed relevant fracture of the palatal cusp of element 14 and the presence of active fistula associated to the root of the same tooth. Semi-technical maneuvers supported the diagnosis of pulp necrosis.

The diagnostic radiograph (Schick-Fona Sensor, Brazil) (Fig 1) showed a periapical radiolucent area associated with the apical root of the first right upper premolar with evident calcification in the palatine canal. The apparent root length was 22 mm for the vestibular root and 25 mm for the palatine root.

The tooth was isolated and the access surgery was carried out using a spherical drill (1012) (KG Sorensen, Barueri, Brazil) and solution of Endogel (TM, Itapetininga, SP, Brazil) associated with saline. Endogel and saline were used as auxiliary chemicals over the treatment.

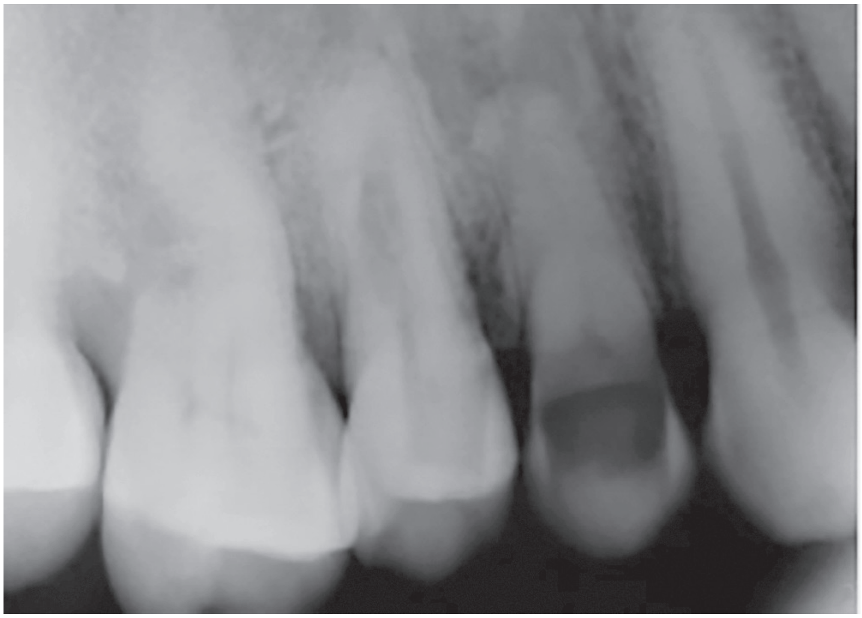

Figure 1. Diagnostic Radiography in 04/2017.

The vestibular conduit was located and the preparation of the cervical and middle third of the canal was performed using Prodesign S system (EASY, Brazil) (instruments # 30/10 and 25/06). An electronic odontometry (Root ZX II, JMorita, Japan) was performed, having a real conduit length of 22 mm. The vestibular canal was then completely prepared according to the manufacturer's instructions, file # 25.01 at 23 mm, 1 mm beyond the actual length, maneuver of canal patency, and then file # 25.06 at 22 mm, followed by files # 30.06 and # 40.06. The conduit was filled with intracanal medication, using a mixture of calcium hydroxide P.A with endogel.

The palatine conduit was not found. The entire procedure was performed with magnification (Vasconcelos with integrated LED).

The CBCT (Morita Accuitomo 80, J. Morita Mfg. Corp. Irvine, CA, USA) confirmed both the presence of associated periapical lesion, especially the vestibular root with severe interruption of the vestibular bone cortex, and the calcification of the palatal conduit.

It is noteworthy that two other microscopy sessions were performed aiming to localize the palatine canal, not being successful.

Confection of the endodontic guide

An intraoral analysis was performed through a scanner (CS3600; Carestream Health, Rochester, NY, USA) (Fig 2) and it was loaded into software for planning virtual implants (Simplant Pro 11.04; Materialise, Leuven, Belgium). After further upload of the CBCT examination (Fig 3), both CBCT and scan were combined based on radiographic structures (Fig 4). The virtual model was exported as an STL file and sent to a 3D printer (Objet Eden 260 V, Material: MED610, Stratasys Ltd., Minneapolis, MN, USA).

Computerized numerical control technology (CNC) was used to fabricate the surgical path, which was integrated into the model to guide a drill during cavity preparation (Fig 5).

Operative Sequence

After anesthesia and isolation, the endodontic guide was positioned in the upper teeth of the maxilla and fixed to the bone with the aid of guide pins (NGS, Curitiba, Paraná). Such planning was previously determined by combining the techniques already described so there would be no risks and sequels to the patient. The stabilization of the endodontic guide

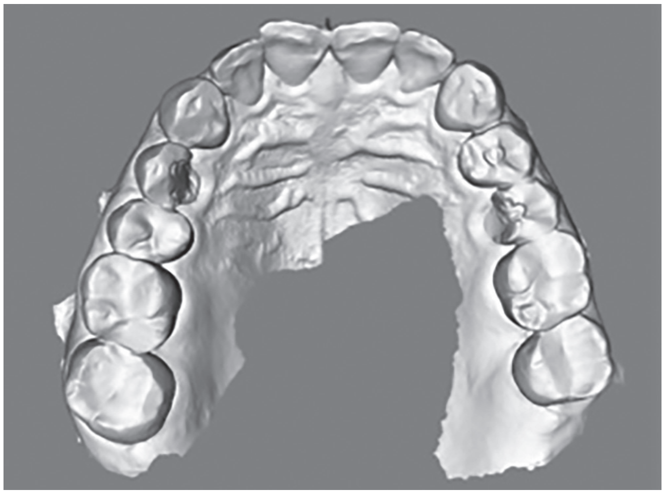

Figure 2. Virtual Scanning by Simplant® software.

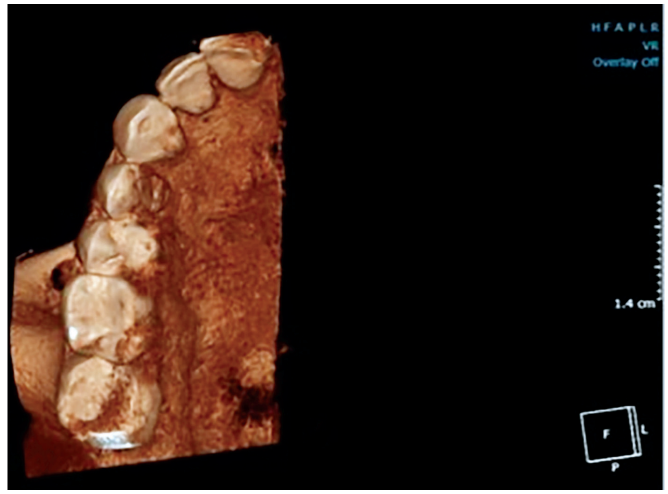

Figure 3. Cone Beam Computed Tomography for planning.

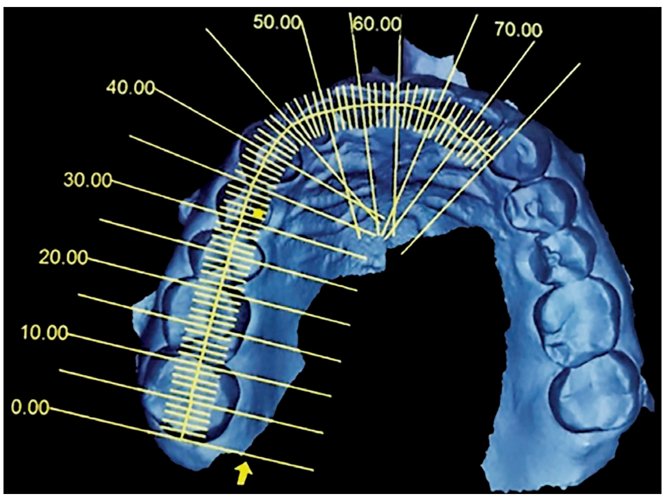

Figure 4. Combined scans for surgical access planning.

Figure 5. Printed Endodontic guide.

by the guide pins was preceded by the insertion of a drill (NGS Titamax, 103.385, Curitiba, Paraná) operated at 10000 RPM, under constant refrigeration (saline) in the inlet holes of the guide in position. This procedure was aiming the passive entry of the guide pins on the mucosa and alveolar bone (Fig 6).

Then, a drill (NGS Titamax, 103,385, Curitiba, Paraná) was applied at 10000 RPM with penetration and withdrawal movements through the calcified part of the palatal canal, aiming to obtain access to the apical region (Fig 7).

The drill shaft was tilted in such a way that the tip of the drill extended would reach the visible apex of the tooth (saw in the radiography) .The drill was cleaned during its preparation. Irrigation was performed with 2% chlorhexidine and saline.

After each increase of 2 mm in depth, a No. 10 K-type manual file (Dentsply-Maillefer-Ballaigues, Swiss) was used to verify if the root canal could be treated at that depth. This was possible at a distance of 5 mm from the apex, approximately 1 mm before reaching the apical target point. Using the technique described, root canal location and further treatment to reach the apex were possible.

The determination of the working length was performed using a combination of apical locator and

Figure 6. Installation and Fixing using guide pins.

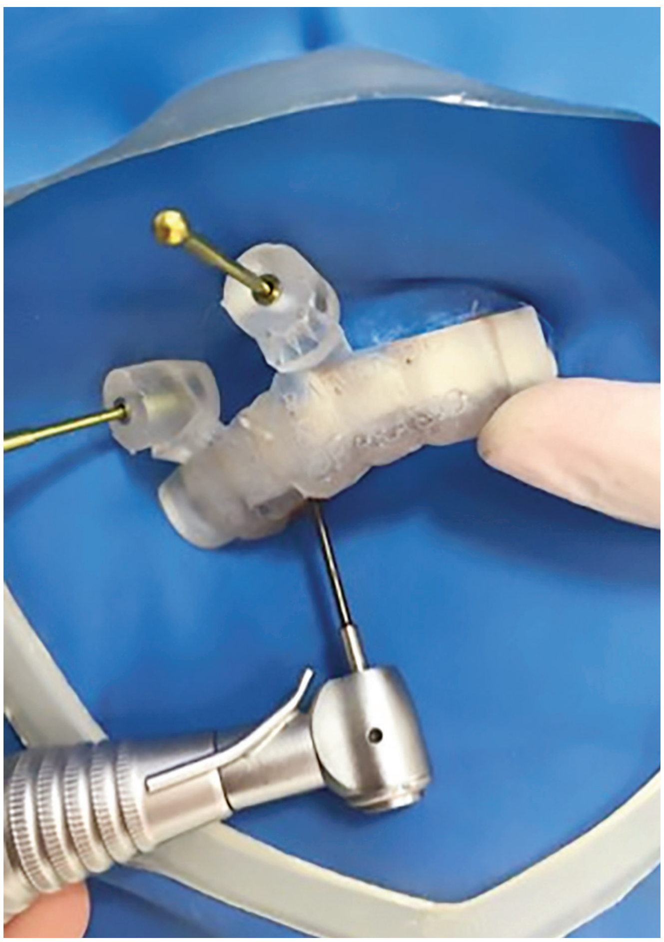

Figure 7. Access to the cavity.

periapical radiography (Fig 8). The root canal was instrumented using # 30/10 and 25/06 instruments from Prodesign S system (EASY, Brazil). An electronic odontometry (Root ZX II, JMorita, Japan) was performed, with a real conduit length of 24 mm. The palatal canal was completely prepared according to the manufacturer's instructions: file # 25.01 at 25 mm (1 mm beyond the actual length), canal patency maneuver, and then file # 25.06, followed by files # 30.06 and # 40.06, all in 24 mm.

After drying the root canal with paper spots, a calcium hydroxide associated with endogel (as carrier) were used as curative. The access cavity was sealed with glass ionomer (FGM, Brazil).

The palatine canal was filled with vertically condensed gutta-percha (BeeFill®, VDW, Munich, Germany) using an endodontic cement (AH plus®, De Trey, Konstanz, Germany) (Fig 9). In addition, the surgical complementation was motivated by the presence of chronic fistula associated with the apex of the vestibular root, the lack of bone tissue, and consequent close contact with the soft tissue. Thus, 2-mm apical ressection of the root canal with operatory filling (gutta-percha filling vertically condensed) (BeeFill®, VDW, Munich, Germany) and endodontic cement (AH plus®, De Trey, Konstanz, Germany). Beyond that, there was performed retrograde preparation using ENAC ultrasonic tip (Osada Eletric Co, Japan) and, sealing with MTA in the retro-filing step.

The access cavity was cleaned and filled with photopolymerizable resin (Filtek Supreme XTE, 3M ESPE, Seefeld, Germany). After 6 months of the end of treatment, radiographic examination was performed for control (Fig 10).

Results

After filling the root canal, the patient was clinically asymptomatic and painless to percussion. Six months after definitive treatment, the patient was still free of clinical symptoms. There was no sensitivity to percussion, and probing depths. Control CBCT showed no signs of apical pathology.

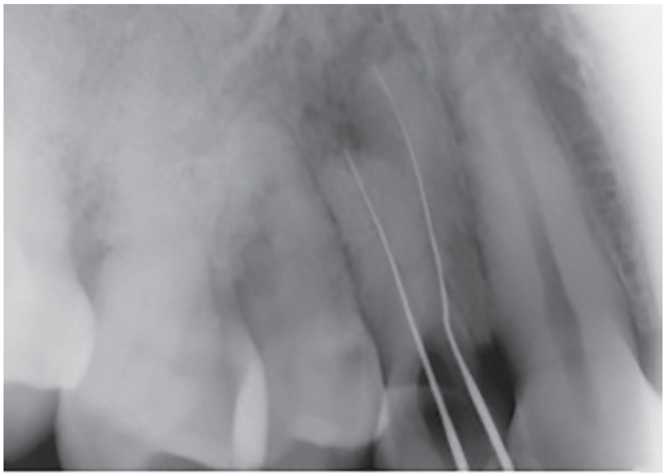

Figure 8. Determination of working length of the root canal.

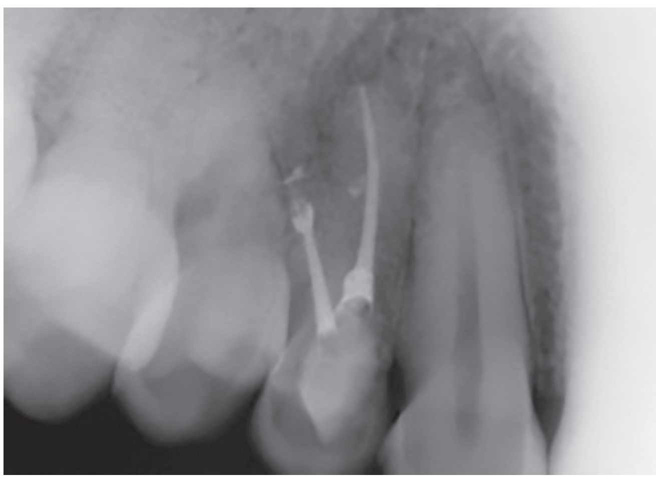

Figure 9. Final radiographic examination.

Figure 10. Radiographic control after 6 months of treatment.

Discussion

This in vivo study demonstrated a novel procedure for handling and treating dental elements with root canal obliteration based on a guided access of cavity preparation. The guided drilling path was developed based on the combination of a CBCT and an optical surface scanning, allowing the production of a guide pathway.

In the traditional approach of calcified pulp chambers, if the canal orifice or pulp chamber is not located after 3-4 mm penetration into the teeth, it is recommended to modify the orientation of the drill. So, the orientation is parallel to the long axis of the tooth (van der Meer, 2015).[16] In most of the described cases of failure, the long axis of the tooth was not respected, causing root perforations among other complications (Amir, 2001).[17]

In addition, several approaches have been described in order to obtain success in these types of cases. The approaches included: modified access cavities (Dula, 2014),[18] the use of an operating microscope, the use of long neck drills as well as ultrasonic tips combined with periodic radiographs during the course of the drilling (da Cunha et al. 2009, Johnson 2009, Reis et al 2009, McCabe & Dummer 2012).[19]

Between this and that, new studies have been described addressing the continuous improvements in 3D imaging, printing and virtual planning that may help the operator to plan and deal with endodontic treatments of relevant complexities (Shah, 2018).[20] The election and adaptation of the cited advances in dentistry have influenced the teaching and / or management of cases involving not only canal treatments, but implant, orthognathic treatments and also, periodontal procedures.

Although guided endodontic access allows a greater control, periodic radiographs are an advantageous additional procedure to control the drill path. Besides that, the use of the microscope in endodontic procedures, described by other papers, (Saunders, 1997. West, 2000)[21,22] gives a gradual control of the necessary depth of the drill path. It indicates when the canal can finally be handled and conventional instrumentation be performed.

In this case, the use of CBCT demonstrated important value in preoperative planning. Some studies have described the efficacy of CBCT diagnostic test images in the identification of root canal obliterations (Patel, 2009, Sheehy 1997).[23,24] Although additional costs associated with CBCT may arise in treating cases with complex morphologies, guided endodontic approach seems considerably lower when compared with implant installation (Connert, 2018).[25]

According to Krastl (2016),[26] It can be speculated to consider the rapid modern digitalization of the dentistry in the last years. It is likely that the combination of information obtained from CBCTs and digital prints will become standard in the future. Therefore, partial and complete obliterated root canals can be treated successfully by accurate, fast and operator-independent technique, without major impairment of the dental organ.

Conclusions

The endodontic treatment of calcified canals through guided endodontic shows a clinically feasible approach, aiding the prevention of dental accidents that cannot be predictably accessed through traditional endodontic therapy. Using the technique adopted in this report, compromised cases can be treated by less experienced or qualified clinicians, reducing treatment time and enabling predictability and success of calcified teeth.