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Endodontic treatment in a maxillary second molar with four root canals: A case report

Tratamento endodôntico em segundo molar superior com quatro canais: Relato de caso

Tratamiento endodóntico en un segundo molar maxilar con cuatro conductos radiculares: Reporte de caso

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Abstract
Endodontic treatment is based on an understanding of the internal anatomy, which facilitates the precise exploration of the canals. The present study aimed to report a clinical case referring to the endodontic treatment of the upper left second molar, presenting the mesiopalatal canal and communication with the periodontal tissues in the distal region of the pulp chamber, in the furcation region, due to dental caries. The 41-year-old patient did not present any systemic health problems. The treatment was divided into three sessions. In the first consultation, the diagnosis of pulpal necrosis was obtained with a periapical area without changes in normality, no pain on vertical and horizontal percussion, in addition to no pain on palpation at the bottom of the sulcus and around the tooth. The radiographic examination revealed a vast region suggestive of caries in the distal region of the tooth crown, so the carious tissue was removed and the pulp chamber was accessed. In the second session, disinfectant penetration, working length determination, and instrumentation of the root canals were performed with the Reciproc R25 system for the mesiopalatal, mesiobuccal, and distobuccal canals, and R50 for the palatal canal. Bio-C Temp was used as an intracanal medication. After 18 days, the root canals were filled with apical gutta-percha cones and Bio-C Sealer, a silicate-based cement. Then, the communication in the furcation region was sealed with the repair cement, Biodentine. The pulp chamber floor was sealed with light-curing glass ionomer, and the pulp chamber was filled with composite resin.
Keywords: Anatomy; Root canal preparation; Root canal obturation.

Resumo
O Conhecimento da anatomia interna é a base do tratamento endodôntico que favorece a correta exploração dos canais. O presente estudo objetivou relatar um caso clínico referente ao tratamento endodôntico do dente 26, apresentando o canal mesiopalatino e uma comunicação com os tecidos periodontais à distal da câmara pulpar, na região de furca, devido à cárie dental. O paciente, de 41 anos, não porta nenhum problema de saúde sistêmico. O tratamento foi dividido em três sessões. Na primeira consulta, foi obtido o diagnóstico de necrose pulpar, com ausência de sensibilidade ao frio e periápice sem alterações de normalidade, sem dor à percussão vertical e horizontal,

além de ausência de dor à palpação no fundo de sulco. Ao exame radiográfico, notou-se extensa região sugestiva de cárie na distal, então realizou-se a remoção do tecido cariado e a abertura coronária da câmara pulpar já exposta. Na segunda sessão, realizou-se a penetração desinfetante, a odontometria e a instrumentação dos canais, a 0,5 mm aquém do forame, com o sistema Reciproc R25, para os canais mesiopalatino, mesiovestibular, distovestibular e R50 para o palatino. Bio-C Temp foi utilizado para medicação intracanal. Após 18 dias, foi feita a prova do cone de guta-percha com a radiografia de confirmação e a cimentação dos cones, seguida da radiografia de qualidade. Utilizou-se o cimento Bio-C Sealer para obturação. Em seguida, a comunicação na região de furca foi selada com o cimento reparador, Biodentine. A câmara pulpar foi forrada com ionômero de vidro fotopolimerizável e selada com resina composta.
Palavras-chave: Anatomia; Preparo de canal radicular; Obturação do canal radicular.

Resumen

El conocimiento de la anatomía interna es la base del tratamiento endodóntico que favorece la correcta exploración de los conductos. El presente estudio tuvo como objetivo relatar un caso clínico referente al tratamiento endodóntico del diente 26, presentando canal mesiopalatino y comunicación con los tejidos periodontales distal a la cámara pulpar, en la región de la furca, por caries dental. El paciente de 41 años no tenia ningún problema de salud sistémico. El tratamiento se dividió en tres sesiones. En la primera consulta se obtuvo el diagnóstico de necrosis pulpar, con ausencia de sensibilidad al frío y el periápice no presentaba alteraciones en su normalidad, sin dolor a la percusión vertical y horizontal, además de ausencia de dolor a la palpación en el fondo del surco. El examen radiográfico reveló una región extensa sugestiva de caries en la región distal, por lo que se eliminó el tejido cariado y se abrió la cámara pulpar a nivel coronal. En la segunda sesión se realizó penetración de desinfectante, odontometría e instrumentación de los canales, 0,5 mm por debajo del foramen, con el sistema Reciproc R25, para los canales mesiopalatino, mesiobucal, distobucal y R50 para el canal palatino. Se utilizó Bio-C Temp para la medicación intracanal. A los 18 días se realizó la prueba del cono de gutapercha con la radiografía de confirmación y la cementación de los conos, seguida de la radiografía de calidad. Para la obturación se utilizó cemento Bio-C Sealer. Seguidamente, la comunicación en la región de la bifurcación fue sellada con el cemento reparador Biodentine. La cámara pulpar se revistió con ionómero de vidrio fotopolimerizable y se selló con resina compuesta.
Palabras clave: Anatomía; Preparación de conductos radiculares; Obturación de conductos radiculares.

1. Introduction

Understanding the anatomy of root canals is important for all steps of endodontic treatment, from making a diagnosis to sealing the canal. Such science enables the precise location of root canal orifices as well as root canal incidence, number, and curvature direction. Thus, associating this knowledge with clinical and radiographic diagnosis and the entire technological arsenal of endodontics, one can expect treatment success. On the other hand, negligence, a lack of planning, and a lack of knowledge of the internal anatomy favor failure (Estrela et al., 2015).

The anatomical difficulty of locating the mesiopalatal canal frequently fascinates endodontists in their daily clinical practice. This canal, also known as mesiobuccal 2 (MB2), is present in the mesiobuccal root of the upper molars, particularly the first and second, with the highest average percentage for the first molar, 69.6%, in comparison to the second, 39% (Martins et al., 2019). Due to its location in the palatal portion of the mesiobuccal (MB1) canal, it is known by these two names.

Typically, the orifice of the MB2 is located mesially to or in the subpulpal groove within 3.5 mm palatally and 2 mm mesially of the MB1 (Gorduysus et al., 2001). Using cone beam computed tomography (CBCT), other authors determined that the distance between MB1 and MB2 is 2.06 mm (Zhuk et al., 2020). The distance between the two mesial canals ranges between 1.65 and 2.68 mm on average (Betancourt et al., 2015; Betancourt et al., 2016; Zhuk et al., 2020). The MB2 canal can converge at 58% with the MB1, with the presence of isthmuses between them at a frequency of 71%. MB2 appears independent in 42% (Somma et al., 2009). The distance between the mesiobuccal and distobuccal (DB) canals, as well as the mesiobuccal and palatal canals, in maxillary second molars, is related to the presence of the MB2 canal.

Some factors influence the search for the MB2 canal, such as the operator's skill, anatomical complexity, lighting, and use of the operating microscope (Wolf et al., 2017). Buhrley et al. (2002), demonstrated that magnification with microscopy or loupes is more effective for finding MB2. However, Gorduysus et al. (2001), stated that finding the MB2 is not mandatory with the presence of operative microscopy since they were able to locate the canal without difficulty in 93% of 45 extracted teeth samples without the use of this instrument. Nevertheless, since the mesiodistal diameter of the MB2 corresponds to 0.24 mm in the cervical region, compared to 0.81 mm in the MB1 canal (Degerness & Bowles, 2010; Ordinola-Zapata et al., 2019), the magnification is essential for better visualization.

The incidence of MB2 in upper molars varies based on the various in vitro and in vivo studies reported in the literature, which include magnification, clearing, staining, scanning electron microscopy, stereomicroscopy, photomicrographs, histological analysis, periapical radiographs, cone beam computed tomography (CBCT) and computed microtomography (Estrela et al., 2015; Zuck et al., 2020). There is a significant difference between in vivo and in vitro detection of MB2, with the former ranging from 19.7 to 51.1% and the latter from 29 to 100% (Betancourt et al., 2015). HESS, in 1925, reported the presence of this canal in 54% of first molars. Weine et al. (1969), found 62%, Pineda e Kuttler (1972), found 51.5%, Fogel, Peikoff, e Christie (1994), found 71.2%, Stropko (1999), found 73 to 93%, Wolf et al. (2017), found 58.4% and Studebaker et al. (2018), found 55.8% (Coutinho et al., 2006). In these findings, a wide variety of studies and percentages of the presence of the MB2 canal are observed, which vary, in the scientific literature, between 10 and 95% in upper molars (Martins et al., 2019).

Gender and population type are additional factors that affect the presence of a second canal in the mesiobuccal root. In 2019, Martins et al. conducted a systematic review of 16 studies and discovered that the average presence of MB2 was higher in men (71.9%) than in women (66.8%). Out of the 41 population groups, the MB2 canal was observed most often in Africa (80.9%), and it was least often in Oceania (53.1%). Estrela et al. (2015), investigated, using CBCT, the presence of MB2 in a subpopulation in Brazil and found a frequency of 76% and 41% in the upper first and second molars, respectively. More precisely, using micro-CT, it was possible to determine that 87% of 96 mesiobuccal root samples from a Brazilian subpopulation contained MB2 (Camargo et al., 2020).

Faced with these challenges, failure to locate and instrument the MB2 is detrimental to the success of endodontic treatment, with 4.38 times greater propensity to initiate periapical pathologies. In a retrospective study using CBCT, a frequency of 65% of non-localized MB2 was observed; this canal also presented the highest proportion of non-instrumentation among upper molars. (Karabucak et al., 2016). In another study with CBCT to evaluate 39 superior molars, the MB2 was identified in 30 teeth, 27 of which were not instrumented and, 22 of these teeth had periapical lesions (Huumonen et al., 2006). Therefore, the relevance of the location of this canal for the success of endodontic treatment is evident.

Another commonly encountered clinical condition is communication between pulpal and periodontal tissues. Communications can be iatrogenic or pathological. Communications of pathological origin are mainly caused by extensive carious lesions as well as resorptions. With the advent of calcium silicate-based materials, the treatment of communications was faced with a new prognostic perspective. MTA was developed in the 1990s with the aim of sealing perforations. Its sealing characteristics, associated with the ability to induce tissue mineralization, are of great value in the treatment of communications. Several studies demonstrate long-term success with the use of these materials in sealing communications.

Biodentine is a material based on calcium silicate with properties that seek to overcome deficiencies in MTA related to improved handling and physical and biological properties, such as reduced particle size, the presence of pure tricalcium silicate, the absence of silicate dicalcium, and the addition of calcium chloride and water-soluble polymer. In this way, the setting time became faster, the handling became better, and the release of calcium ions became greater (Rajasekharan et al., 2021; Al-Nazhan et al., 2022). Biodentine is, according to the manufacturer, a dentin substitute material indicated for cases of cavity lining, apexification, pulp capping, pulpotomy, root and furcation perforations, and retrograde obturation in endodontic microsurgeries (Parirokh et al., 2018). Biodentine has a higher modulus of elasticity and greater compressive strength compared to MTA, making it an interesting material in cases of restorations (Anta et al., 2022). In 2021, Chaniotis and Kouimtzis reported the use of Biodentine as a restorative material in the case of root fractures, with success after 10 years of treatment, with the healing of the periapical lesion, healthy lamina dura, normal percussion sound, and absence of pain. Thus, the use of Biodentine is interesting for sealing pathological communications.

Given the above, the present study reports a clinical case of endodontic treatment of a second upper molar in which it was possible to locate and instrument the MB2 root canal. Furthermore, the sealing of communication with the periodontal tissues in the distal region of the pulp chamber, in the furcation region, with the repairing cement Biodentine was reported.

2. Methodology

The present study describes a case report of a qualitative nature. According to Pereira et al. (2018), a case report is a kind of research centered on or focused on a phenomenon that is described in as much detail as possible for the moment. The report showed the endodontic treatment of a maxillary second molar with four root canals and the presence of perforation. This study was approved by the Human Research Ethics Committee (protocol number CAAE 270272723.5.0000.5418) of the Piracicaba Dental School, State University of Campinas (UNICAMP), Piracicaba, SP, Brazil. The patient signed an informed consent form prior to participation.

3. Case Report

The 41-year-old male patient came to the dental office reporting pain in the gingival tissues around tooth 27, which had been provisionally restored with Coltosol (Coltene/Whaledent, Switzerland) in the disto-occlusal position.

When performing the anamnesis, the patient's normal health status was verified without the presence of systemic diseases or regular use of medication. During the clinical probing of tooth 27, no periodontal pockets were found. As for the diagnostic tests, the presence of pulpal necrosis was verified through the cold sensitivity test (Endo-ice, Maquira Ind. Prod. Odontologicos LTDA, Maringá, Paraná, Brazil). In the vertical and horizontal percussion tests, using the mirror handle, the responses were normal, as was the palpation at the bottom of the sulcus with the index finger.

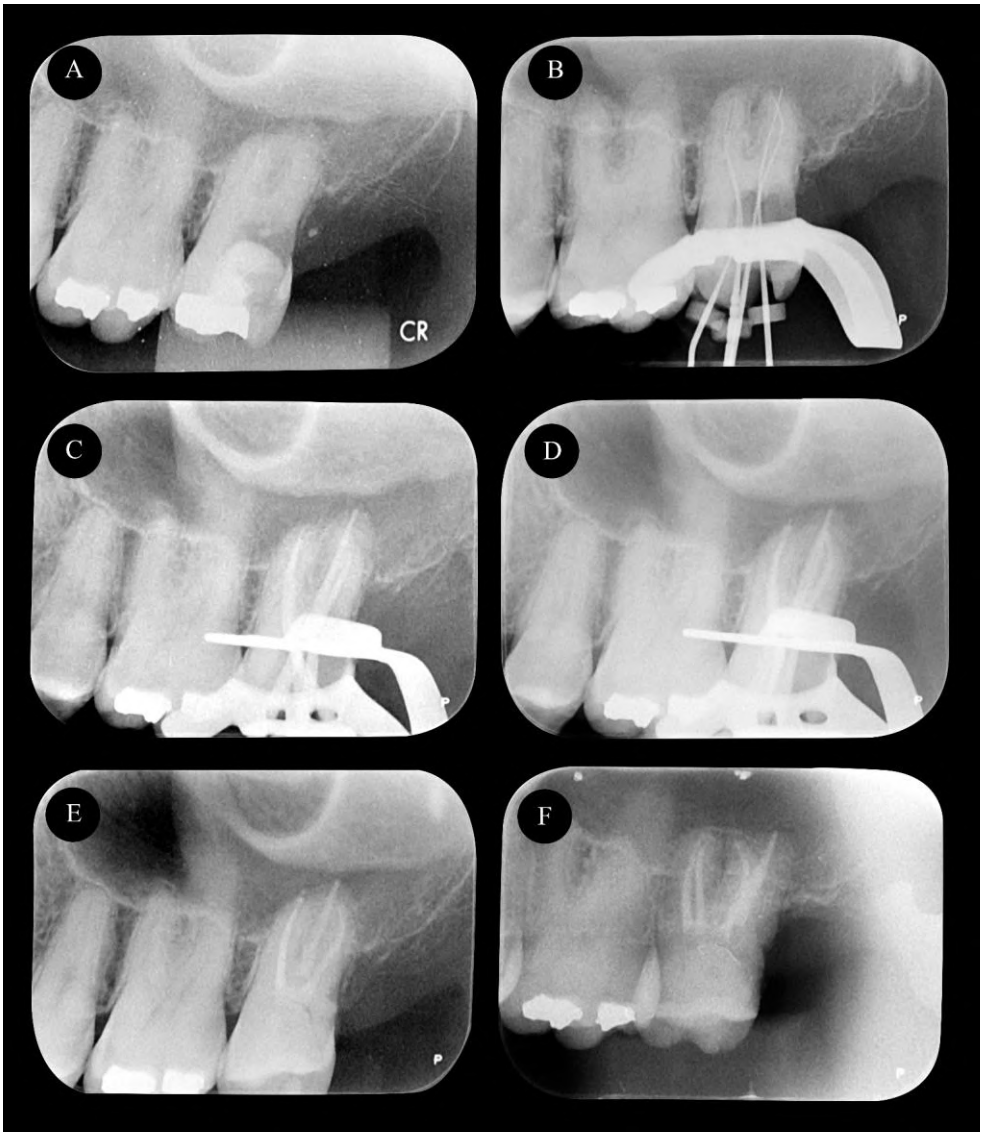
The initial radiographic examination showed a radiopaque region on the occlusal surface of tooth number 27, corresponding to the Coltosol, and a radiolucent region on the distal side, close to the furcation (Figure 1A). In addition, in the periapical region, there was no radiolucency suggestive of injury, with intact cortical bone and periodontal ligament space.

When all clinical findings were obtained, planning was performed, and it was determined that tooth 27 would undergo endodontic treatment in three sessions. In the first session, during the removal of Coltosol with a spherical diamond bur 1016 HL (KG Sorensen, Barueri, São Paulo, Brazil), coupled at high speed, cotton was found in the cavity with excessive bleeding underneath. After washing away all the blood, the communication between decayed tissue and periodontal tissue was observed in the furcation region, on the distal side of the pulp chamber. All caries were removed with a carbide drill (KG Sorensen, Barueri, São Paulo, Brazil), coupled at low speed. Then, the coronal access began, removing the entire roof of the pulp chamber, which was already exposed, using a truncated conical diamond bur with an inactive tip, 3082 KG (Sorensen, Barueri, São Paulo, Brazil). After cavity access and preparation, the canals were explored with a straight probe, including the mesiobuccal 2 (MB2) canal. At the end of the session, a cotton ball soaked in camphorated paramonochlorophenol (Biodinama, Ibiporã, Paraná, Brazil) was inserted into the pulp chamber cavity, and, on top, glass ionomer was applied as a temporary coronal sealer.

In the second session, the patient was anesthetized with 2% lidocaine and 1:100,000 epinephrine. Rubber dam isolation of tooth number 27 was performed using nº 200 rubber dam clamp, a rubber dam, and an Ostby arch frame. Then, the glass ionomer was removed with a round diamond bur 1016 HL, coupled at high speed, until reaching the cotton ball that was removed. To achieve a complete seal around the tooth and isolate the region of communication with the periodontium, a photopolymerizable gingival barrier was applied.

With the aid of an operating microscope, a magnification of the pulp chamber was obtained, and the root canals (palatal, mesiobuccal 1, distobuccal, and mesiobuccal 2) patency was performed using a #10 K-file (VDW, Munich, Germany), according to the tooth full length measured on the radiograph. All canals were atresic, mainly MB2, showing resistance and difficulty achieving patency. Then, using an electronic apex locator, the length of the tooth was measured again, obtaining measurements of each root canal as follows: 20 mm for the palatal (referenced by the palatal cusp), distobuccal (referenced by the distobuccal cusp), and mesiobuccal 2 (referenced by the distobuccal cusp); and 19 mm for the mesiobuccal 1 (referenced by the palatal cusp). In all these steps, the pulp chamber was flooded with 1% sodium hypochlorite (Asfer, Santa Maria, São Caetano do Sul, São Paulo, Brazil).

Figure 1 - Initial periapical radiograph of tooth 27 (A). Root canal length confirmation radiograph with #10 K files (B). Cone test radiography (C). Obturation quality radiography (D). Final radiograph (E). Radiographic control after 14 months (F).



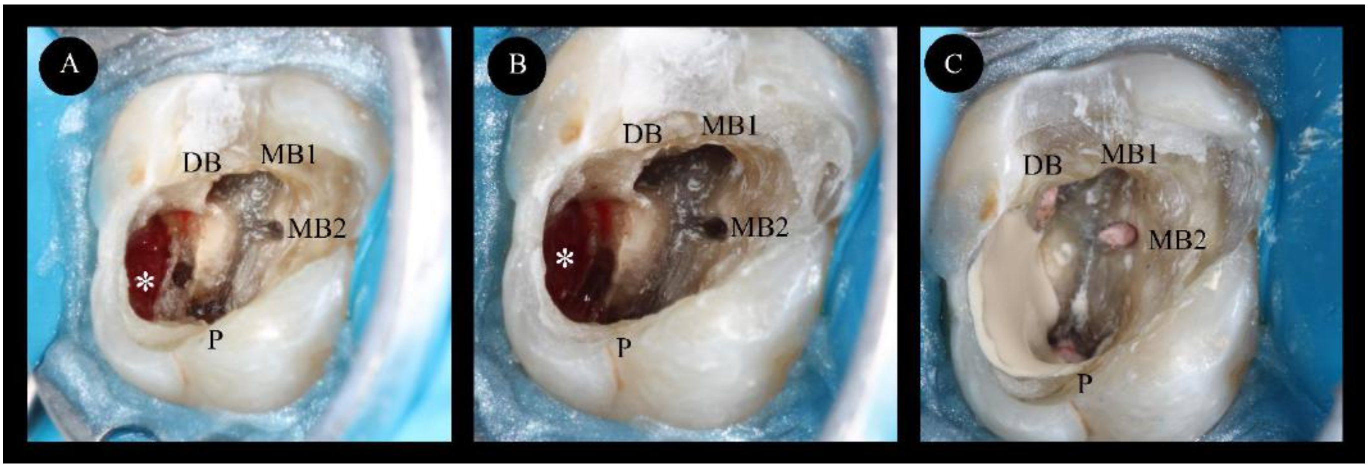
Source: Authors.

For canal instrumentation, the established working length was 0.5 mm beyond the apical foramen. The anatomical diameter was defined with a #10 K-file for the mesiobuccal, mesiopalatal, and distobuccal canals and a #20 K-file for the palatal canal. At this moment, a radiograph was taken to confirm the measurement taken with the electronic apex locator (Figure 1B).

The Reciproc system (VDW, Munich, Germany) was used to instrument the canals, using files #25 for the distobuccal, mesiobuccal, and mesiobuccal 2 canals and #50 for the palatal canal. At the end of instrumentation, the canals were abundantly irrigated with 1% sodium hypochlorite. At the end of the session, the canals were medicated with Bio-C Temp (Angelus, Londrina, Paraná, Brazil), based on calcium silicate and specific for cases of perforation. Temporary sealing was performed with glass ionomer cement.

The Reciproc system (VDW, Munich, Germany) was used to instrument the canals, using files #25 for the distobuccal, mesiobuccal, and mesiobuccal 2 canals and #50 for the palatal canal (Figure 2A and B). At the end of instrumentation, the canals were abundantly irrigated with 1% sodium hypochlorite. At the end of the session, the canals were medicated with Bio-C Temp (Angelus, Londrina, Paraná, Brazil), based on calcium silicate and specific for cases of perforation. Temporary sealing was performed with glass ionomer cement.

Figure 2 - Occlusal view showing the mesiobuccal (MB1), mesiobuccal 2 (MB2), distobuccal (DB), and palatal (P) canals and communication with the periodontium (*) (A and B). Sealing of the communication with Biodentine (C).



Source: Authors.

Eighteen days after the second session, the patient returned to complete the treatment. All initial procedures, such as anesthesia, rubber dam isolation, and removal of the temporary restoration, were performed in the same way as in the previous steps. The canals were washed with 1% sodium hypochlorite to remove the medication. Once this was done, the fitting of gutta-percha cones was confirmed by radiograph (Figure 1C). The gutta-percha cones selected were #50 in diameter for the palatal canal and #35 in diameter for the mesiobuccal, mesiobuccal 2, and distobuccal canals. The cones were 0.5 mm short of the foramen. After, the cones were immersed in 1% sodium hypochlorite for disinfection.

Meanwhile, the root canals were flooded with 17% EDTA for 5 minutes. After that time, the canals were dried with absorbent paper points corresponding to the diameter of the respective gutta-percha cones. The cement was applied inside the canal, and soon after the cones. We chose to use a ready-to-use calcium silicate-based cement, Bio-C Sealer (Angelus, Londrina, Paraná, Brazil), which is suitable for cases of perforations and communications with the periodontium. A radiograph was taken at this moment to confirm the quality of the cementation (Figure 1D). Then, the cones were cut with Paiva condensers.

Likewise, the communication was also sealed using a repairing cement, Biodentine (Septodont, Saint-Maur-des-Fossés, France), based on calcium silicate, and presented in the form of a capsule, which is mixed for 30 seconds in an amalgamator. The material was poured onto a glass plate and gradually introduced into the cavity using a Paiva condenser in order to seal the entire communication (Figure 2C). A 0.05x7x500mm steel matrix (Preven, Guapirama, Paraná, Brazil) was adapted to the tooth to adapt the bioceramic material in the distal region.

At the end of the obturation, the pulp chamber floor was covered with resin-modified glass ionomer cement, Vitremer (3M, Sumaré, São Paulo, Brazil), followed by restoration and coronal sealing with composite resin Z250 A2 (3M, Sumare, São Paulo, Brazil). Finally, the final radiograph of the case was taken (Figure 1E).

After 14 months, the patient returned for a follow-up consultation. The absence of pain on vertical percussion and palpation was identified. The patient had no periodontal pocket and no painful symptoms. Upon radiographic examination, the periodontal region was normal and without images suggestive of a periapical lesion (Figure 1F).

4. Discussion

Among the various factors that cause failure in endodontics, untreated and non-localized root canals are one of them. The limitations of two-dimensional periapical radiographs, the lack of magnification, calcifications, anatomical variations of the canals, and the operator's lack of skill are influential factors in the non-identification and instrumentation of a canal (Bhuva & Ikram, 2020). Teeth with non-localized root canals can negatively influence the prognosis of recurrent apical periodontitis, which varies between 82.6 and 98% (Costa et al., 2019; Baruwa et al., 2020; Bhuva & Ikram, 2020).

In the present study, the MB2 canal was located approximately 2 mm mesially from the MB1, in the subpulpal groove, in agreement with Gorduysus et al. (2001). The use of a microscope was not necessary for the identification of MB2, but this equipment allowed for better visualization during instrumentation. On a positive note, Camacho-Aparicio et al. (2022), identified the MB2 canal in 82% of their patient samples using microscopy, compared to 79% using only an explorer probe and the clinical mirror. This 3% difference, despite being minor, is effective in preventing unfavorable prognoses, such as apical periodontitis. Still, in the same study, an association between microscopy and the removal of dentin using ultrasonic inserts improved the chance of finding the MB2 canal by 86%, providing yet another alternative for greater chances of exploring the canal.

In the reported clinical case, the MB2 canal was slightly calcified, which is one of the reasons why it is challenging to locate it. It has been demonstrated that MB2 is the canal with the highest percentage of calcification, with the cervical, middle, and apical thirds exhibiting increasing levels of calcification (Keleş et al., 2022). The use of operative microscopy and ultrasonic inserts increases the probability of finding the MB2 canal. When calcifications are present, the MB2 canal may not be identifiable even with these tools (Yoshioka et al., 2005; Smadi & Khraisat, 2006).

In this treatment, it was decided to use the Reciproc system for canal instrumentation. The R 25 file, used in the preparation of MB1, MB2, and DB canals, has a D0 of 0.25 mm, increasing its diameter by 0.8 mm (8%) per millimeter of active part. As for the palatal canal, the R50 file was used, which has a D0 of 0.50 mm, and a taper of 5%, increasing by 0.5 mm in diameter per millimeter of its active part. These instruments are manufactured with the M-Wire nickel-titanium alloy, which guarantees greater flexibility and resistance to cyclic fatigue (Kiefner et al., 2014) and has an “S”-shaped cross-section. The movement performed by the instrument is reciprocating, with a 150º counterclockwise and 30º clockwise rotation. Due to its characteristics, such as high flexibility, high cutting capacity, and relative strength at its tip, it was demonstrated that the Reciproc file is effective in negotiating the MB2, reaching the working length successfully (Zuolo et al., 2015).

In addition to the fourth canal, communication between the furcation region and periodontal tissues was reported to have been sealed in this clinical case. The entire treatment consisted of the use of calcium silicate-based materials: intracanal medication, communication sealing, and root canal filling. These materials are capable of promoting healing and osteoblastic differentiation and exhibit dimensional stability, bioactivity, and adhesive and biocompatible properties (Kaur et al., 2017;

Giacomino et al., 2019). By increasing the pH of the medium during setting, these types of cement have antimicrobial activities, including against Enterococcus faecalis, which is often present in secondary endodontic infections (Barbosa et al., 2020; Bose et al., 2020).

As for Bio-C Temp intracanal medication, cytocompatibility, and antimicrobial activity have been demonstrated (Guerreiro et al., 2021). The communication region was sealed with Biodentine repair cement. Previous research has shown that, in posterior teeth, Biodentine works as a restorative material and dentine substitute under a composite resin restoration (Koubi et al., 2018). Also, it has been shown to be successful in extensive restorations of root defects caused by trauma after 10 years (Chaniotis & Kouimtzis, 2021). This material initiates the setting reaction during manipulation by mixing the powder with the liquid, producing crystals of hydrated calcium silicate (C-S-H) and calcium hydroxide. Tissue fluids contain phosphate ions that bind to the positive charges of calcium, resulting in the precipitation of calcium phosphate and apatite on the surface of the cement. In this phase, the bioactivity principle of these materials is characterized, as they are capable of forming a similar mineral structure to dentin (Prati & Gandolfi, 2015). Biodentine has several advantages over MTA, including its manageability, quick setting time, and superior resistance to compression and flexion (Kaur et al., 2017).

Bio-C Sealer is a calcium silicate-based cement that, unlike Biodentine, is ready-to-use and does not require the addition of water. Dentin moisture is responsible for cement setting. Due to the presence of polyethylene glycol, a water-soluble polymer, Bio-C Sealer has a significantly lower viscosity, allowing for adequate flow throughout the entire length of root canals (Zordan-Bronzel et al., 2019). In addition to adequate physicochemical properties including fast setting time, flow, radiopacity, and alkalinization, this material is biocompatible (López-García et al., 2019; Silva et al., 2020) and bioactive (Alves et al., 2020).

5. Conclusion

During endodontic treatment, the presence of the second canal in the mesiobuccal root presents challenges in terms of location, preparation, and obturation. In these situations, well-executed access surgery and the use of complementary diagnostic imaging techniques are crucial. In the present case report, the mesiobuccal 2 canal was located, and it was possible to perform a satisfactory endodontic treatment.

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