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Vital pulp therapy: an alternative to root maturation of a tooth with superficial micro abscess

Terapia em polpa vital: uma alternativa para a maturação da raiz de um dente com microabscesso superficial

Terapia pulpa vital: una alternativa a la maduración de la raíz de um diente con microabscess de superfície

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Abstract

Maintenance of pulp functional integrity should be aimed by the treatment of trauma affected immature permanent teeth. The prognosis of vital pulp therapies (VPT), when well indicated and correctly performed, not only preserves pulp vitality but also provides the immature root development. This case reports the treatment of a patient with a crown fractured immature maxillary right central incisor. Clinical examination, radiographic inspection and sensitivity tests confirmed tooth vitality. In spite of the superficial micro abscess presence, pulpotomy was the treatment of choice according to the pulp vitality characteristics found during the undergoing surgery. Root development and apical closure were verified at the 1st year radiographic control. After 3 years of follow-up, even with the occurrence of 3 new traumatisms, the treated tooth showed radiographic sound characteristics. Nevertheless, on the fourth-year return, the conventional endodontic treatment had to be carried out due to radiographic signal of initial root obliteration. It was concluded that pulp vitality diagnosis step and clinical-radiographic follow-up are extremely important for the pulpotomy outcome. This conservative approach resulted in success since it induced root development and apical closure, permitting the posterior execution of the endodontic therapy.

Keywords: Pulpotomy; Endodontics; Dental pulp cavity.

Resumo

A manutenção da integridade funcional da polpa deve ser o objetivo do tratamento dos dentes permanentes imaturos afetados por trauma. O prognóstico das terapias de polpas vitais (TPV), quando bem indicadas e realizadas corretamente, não só preserva a vitalidade pulpar, mas também proporciona o desenvolvimento radicular imaturo. Este caso relata o tratamento de um paciente com fratura coronária de incisivo central superior direito imaturo. O exame clínico, a inspeção radiográfica e os testes de sensibilidade confirmaram a vitalidade do dente. Apesar da presença de microabscesso superficial, a pulpotomia foi o tratamento de escolha de acordo com as características de vitalidade pulpar encontradas durante o transoperatório. O desenvolvimento radicular e o fechamento apical foram verificados no controle radiográfico do primeiro ano. Após 3 anos de acompanhamento, mesmo com a ocorrência de 3 novos

traumatismos, o dente tratado apresentava ausência de alterações radiográficas. Porém, no retorno do quarto ano, o tratamento endodôntico convencional teve que ser realizado devido ao sinal radiográfico de obliteração radicular inicial. Concluiu-se que a etapa do diagnóstico da vitalidade pulpar e o acompanhamento clínico-radiográfico são de extrema importância para o desfecho da pulpotomia. Essa abordagem conservadora resultou em sucesso, pois induziu o desenvolvimento radicular e o fechamento apical, permitindo a execução posterior da terapia endodôntica.

Palavras-chave: Pulpotomia; Endodontia; Cavidade pulpar.

Resumen

Mantener la integridad funcional de la pulpa debe ser el objetivo del tratamiento de dientes permanentes inmaduros afectados por traumatismos. El pronóstico de las terapias pulpares vitales (TPV), cuando se indican y se realizan correctamente, no solo preserva la vitalidad pulpar, sino que también proporciona un desarrollo radicular inmaduro. Este caso informa el tratamiento de un paciente con fractura coronaria del incisivo superior derecho inmadura. El examen clínico, la inspección radiográfica y las pruebas de sensibilidad confirmaron la vitalidad del diente. A pesar de la presencia de microabscesos superficiales, la pulpotomía fue el tratamiento de elección según las características de vitalidad pulpar encontradas durante la cirugía. Se verificó el desarrollo radicular y el cierre apical en el control radiográfico del primer año. Después de 3 años de seguimiento, incluso con la aparición de 3 nuevas lesiones, el diente tratado no presentó cambios radiográficos. Sin embargo, al regreso del cuarto año, se tuvo que realizar un tratamiento de endodoncia convencional debido al signo radiográfico de obliteración radicular inicial. Se concluyó que la etapa de diagnóstico de vitalidad pulpar y el seguimiento clínico-radiográfico son de suma importancia para el resultado de la pulpotomía. Este enfoque conservador resultó exitoso, ya que indujo el desarrollo de la raíz y el cierre apical, lo que permitió la ejecución posterior de la terapia endodóntica.

Palabras clave: Pulpotomía; Endodoncia; Cavidad Pulpar.

1. Introduction

High rates of violence, traffic accidents and extreme sports activities make dental trauma a public health problem (Caldas & Burgos, 2001; Lee & Divaris, 2009). The prevalence of traumatic dental injuries is 20%–30% (Andersson, 2013; Forsberg & Tedestam,1990). Crown fracture is the most frequent kind of trauma, 65–75% (Svizero et al.,

2003; Andreasen et al., 2010), and it involves enamel, dentin and pulp tissues in 0.9 - 13% of all dental injuries (Tapias et al., 2003; Abuelniel et al., 2020). When young patients are affected, it is usually associated with pulp exposure and can harm incompletely developed teeth (Nosrat et al., 2013; Shabahang, 2013). The selection of a coherent treatment plan should enable the preservation of normal functions of the pulp (Shabahang, 2013; Sonmez & Sonmez, 2007; Martens et al., 2015; Tuloglu & Bayrak, 2016), which will bring about immature root development, apical closure and root structure strengthening (Katebzadeh et al., 1998; El-Meligy & Avery, 2006).

The vital pulp therapy (VPT) is a conservative treatment that aims to promote the healing of pulp tissue and the formation of hard tissue to preserve pulp vitality (Cvek, 1978; Haikal et al., 2020; Çaliskan & Güneri. 2017) and whenever possible this therapy is the treatment of choice for immature complicated crown fractures (Nosrat et al., 2013; Chueh et al., 2009; Garcia-Godoy & Murray, 2012; Eppa et al., 2018). The VPT can only be carried out on vital teeth which do not have spontaneous pain, extreme reaction to percussion tests nor mobility (Witherspoon et al., 2006; Cohenca et al., 2007); displaying normal radiographic characteristics in the periapex and in the dental periodontum (Svizero et al.,2003). There has been some controversy about VPT durability, while some researches consider it a definitive treatment (Fuks et al., 1993; Robertson et al., 1996; Rafter, 2005), others recommend a conventional root canal filling after tooth complete apical foramen formation to prevent calcific degeneration and obliteration of the pulp canal (Cvek, 1978; Bergenholtz & Spångberg, 2004). In spite of this disagreement, the VPT has demonstrated satisfactory results on root maturation, even better than pulp revascularization treatment (Forghani et al., 2013).

The purpose of this case report is to highlight the pulp vitality diagnosis importance on the conservative pulp approach, describing a pulpotomy treatment as a strategy to the root apical sealing of an incompletely developed permanent tooth with exposed pulp and superficial micro abscess.

2. Methodology

This article consists of a description of a clinical case. The work was not submitted to the ethics committee, since it is a case report in which the procedure performed was not experimental. A free and informed consent form was signed by the patient's parents about the procedures performed and the use of images.

3. Case Report

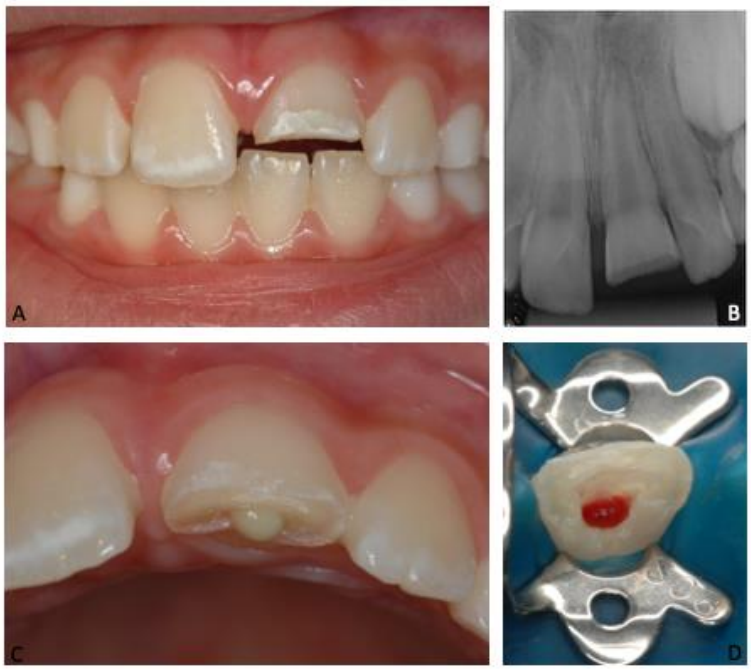
An 8-year-old-male patient searched for treatment 30 days after suffering a sport-related traumatic dental injury. The patient anamnesis reported that he did not have any pain symptoms and went to a community health center three days after the accident, where glass ionomer cement was applied on the dental fracture.

Clinical examination revealed an enamel-dentin crown fracture on the left central incisor (Figure 1A). The sensitivity tooth tests of percussion, palpation and temperature (Endo Ice - Hygenic, Akron, OH) resulted in a positive answer. The radiography (Figure 1B) confirmed the presence of an immature apex, with normal periapical and periodontal conditions.

As soon as the emergency dressing was removed, a micro abscess sprang out the surface of the exposed pulp (Figure 1C). Even though this micro-abscess was found during the undergoing surgery, pulpotomy was the treatment of choice due to positive response to the sensitivity tests, absence of spontaneous pain and radiographic normal periapical conditions.

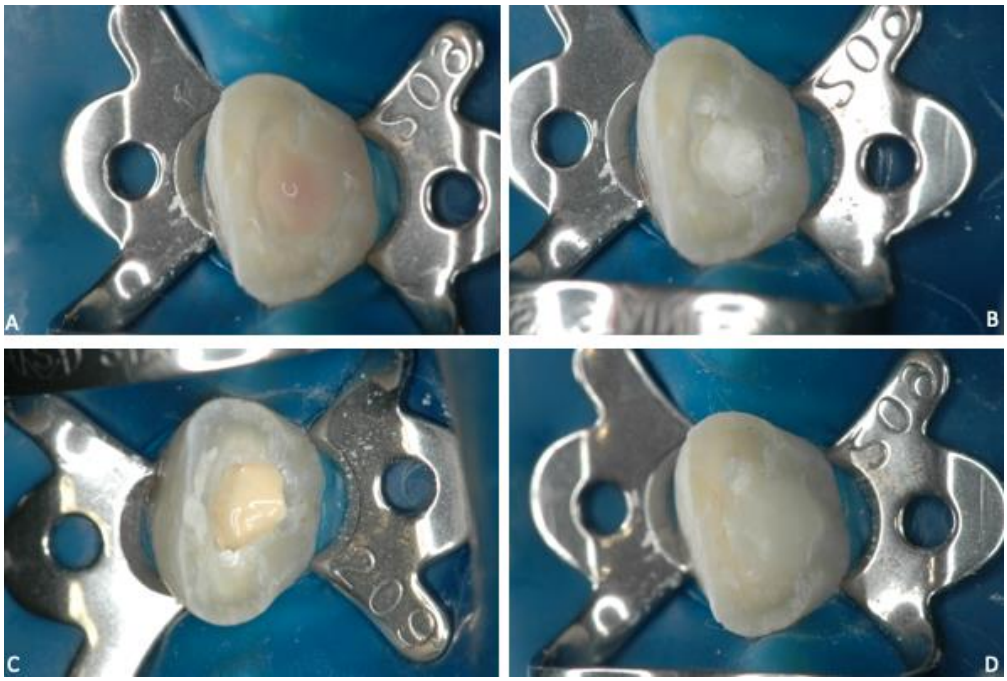
After local anesthesia the rubber dam isolation was done. Then, coronal opening and pulp surgical excision were carried out with a high speed sterile diamond. The total pulpotomy was done, so the removal of inflamed pulp tissue extended to the level of the crown cervical third (4 mm of depth). At this moment, clinical pulp characteristics that indicate the pulpotomy technique were recognized: adequate pulp bleeding of a bright reddish color with easy hemostasis and a consistent pulp radicular remainder (Figure 1D). The hemostasis was obtained through the pulp compression with a cotton ball soaked in sterile saline. As long as the pulp bleeding was controlled, a steroid-antibiotic combination (Otosporin® - Glaxo-Wellcome Pharma, Vienna, Austria) was applied on the pulp stump for 10 minutes (Figure 2A). Subsequently, the cavity was lined with a paste of calcium hydroxide (Biodinâmica Química e Farmacêutica, Ibiporã, Brazil - Figure 2B), sealed with a calcium hydroxide cement (Hydro C® - Dentsply, São Paulo, Brazil), (Figure 2C), and provisionally restored with glass ionomer cement (Vitro-Fil LC® - DFL, Rio de Janeiro, Brazil - Figure 2D).

Figure 1 - (A) Pretreatment clinical patient view (30 days after trauma). **(B)** Preoperative periapical radiograph (30 days after trauma). Immature traumatized tooth with absence of periapical changes and integrity of the lamina dura. **(C)** Micro abscess sprang out the exposed pulp after emergency dressing was removed. **(D)** Vitality pulp aspects during the trans-operative procedure.



Source: Authors.

Figure 2 - (A) Application of steroid-antibiotic combination. **(B)** Overlaying the pulp stump with calcium hydroxide paste. **(C)** Sealing with calcium hydroxide paste. **(D)** Tooth provisory restoration with glass ionomer cement.



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At a second appointment, 40 days later, the radiograph showed a dentin barrier formation (Figure 3A). After the restorative material was removed, a superficial necrosis area was noticed (Figures 3B and 3C) overlying the mineralized tissue barrier (Figure 3D). Therefore, the cavity was covered with calcium hydroxide cement (Hydro C® - Dentsply, São Paulo, Brazi), sealed with glass ionomer cement (Vitro-Fil LC® - DFL, Rio de Janeiro, Brazil), and the tooth fragment was bound with composite resin (Opallis® - FGM, Joinville, Brazil - Figures 4A, 4B, 4C, 4D).

Figure 3 - (A) Radiographic image of the mineralized dentin barrier formed on the exposed area. **(B)** Removal of pulpotomy sealing materials. **(C)** Presence of a superficial necrosis area. **(D)** Mineralized tissue barrier.

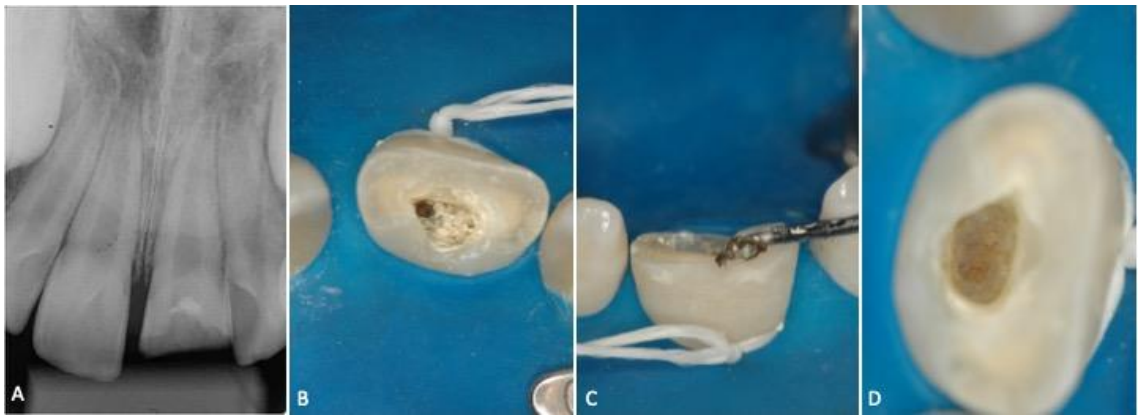

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Figure 4- (A) Tooth preparation for bonding the fragment. **(B)** Fragment of the left central incisor. **(C)** Dental bonding of crown fragment with composite resin. **(D)** Final aspect.

Source: Authors.

A three-month clinic-radiographic follow-up was proposed to the patient during the first year. However, the patient returned only after six months due to another dental traumatism which resulted in the crown fragment falling off. As the entire coronal portion of the pulp was removed, thermal testing of the tooth was no longer possible. For this reason, before proceeding to a new bonding, radiographic exam confirmed normal periapical

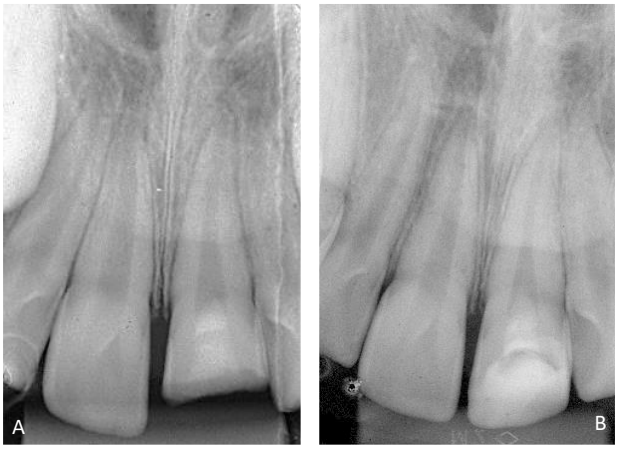
characteristics.

A year after the pulpotomy, the patient was stricken by a third trauma, which resulted in the crown fragment falling off again. Radiographic examination (Figure 5A) indicated not only periapical and periodontal health, but also showed that the VPT promoted root closure and created a natural apical constriction for root canal filling. After the diagnosis tests the fragment was bound once more.

The patient missed the 2nd year appointment, but came to the 3rd year clinical and radiographic examination. Due to a fourth trauma, the patient returned with class IV composite restoration instead of the bound tooth fragment. Nevertheless, pulpotomy was found as a satisfactory treatment because the tooth radiographic images showed sound characteristics and no signs of root reabsorption or calcification.

After 4 years, however, the patient radiographic image (Figure 5B) showed initial obliteration of the pulp canal when compared to the anterior control exam. Therefore, in order to prevent the total calcification of the root canal the conventional endodontic treatment was indicated. After local anesthesia and rubber dam isolation the mineralized barrier remove was done with burs. The root canal was cleaned and shaped through passive back technique. A calcium hydroxide medication was applied for one week, and then, the canal was filled in with gutta-percha (Maillefer®- Dentsply, York, United States).

Figure 5- Radiographic monitoring. **(A)** One year after pulpotomy. **(B)** Four years after pulpotomy- inicial obliteration of the pulp canal.



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4. Discussion

The perception of the right diagnosis and the selection of the adequate treatment plan are complex and essential tasks in the dental trauma treatment. Pulpotomy researches have demonstrated high success rate when the treatment is done in young permanent teeth with exposed pulp due to dental trauma (Cvek & Lundberg, 1983). The size and the time period between the pulp exposure and the pulpotomy are important factors, but not aggravating on the pulp repair process (Svizero et al., 2003; Cvek, 1978; Fuks et al., 1993; Wang et al., 2017). This can be explained by the action of saliva constant flow on buccal cavity which may hinder debris and micro-organism accumulation on the exposed pulpal surface (Sonmez & Sonmez, 2007). Cvek & Lundberg (1983) proved that the pulp repair potential remains unchanged when the inflamed portion of the pulp is removed; therefore, the pulpotomy may be considered a definitive treatment.

The patient's age is another factor related to the treatment success (Garcia-Godoy & Murray, 2012; Cohenca et al., 2007). Young patients' teeth have large pulp tissue volume and are rich in cells and blood vessels which enable them to respond favorably to physical and microbiological aggression (Traebert et al., 2003). By means of clinic and radiographic evaluations, the treatment success percentage has shown to be of 90% in young patients and 70% in adults (Horsted et al., 1985).

The conventional, clinical and radiographic propaedeutic is unsure for the pulp vitality evaluation; therefore, the definitive pulpotomy indication must be decided at the trans-operative (Leonardo, 2005). Thus, the acknowledgement of the clinical characteristics of a pulp with favorable conditions for pulp conservative treatment is extremely important. During the surgery procedure of this case report, the pulpotomy was indicated when the pulp vitality was verified through a bright reddish pulpal bleeding with easy hemostasis, as well as a body existence or a consistent pulp radicular remaining after the crown pulp removal (Figure 1D).

The purulent exudate spotted after the curative removal (Figure 1C) may be explained because after the pulp exposition there is a possibility of a quantitative increase of neutrophils and leukocytes, which generally spread from the pulp stump to the cervical region (Harrán-Ponce et al., 2002) forming a pulp micro abscess (Alvares, 2008). Due to this finding, the crown pulp amputation, i.e. total pulpotomy, was the chosen technique (Shabahang, 2013; Fuks et al., 1993). After the infected tissue removal, the adjacent pulp presented vital macroscopic characteristics depicting the inexistence of the inflammatory infiltrate; therefore, becoming apt for the conservative therapy (Ricucci et al., 2019).

At the immediate pulpotomy technique, the pulp amputation and the remaining tissue protection with the capping material were carried out in the same section. After the crown pulp removal and the accomplishment of the hemostasis, the steroid-antibiotic combination was applied to decrease the inflammation caused by pulp excision, avoiding the internal pressure increase (Leonardo, 2005). The subsequent overlaying with calcium hydroxide is a fundamental step for the mineralized barrier formation.

The literature demonstrates that the properties of the capping material are directly related to the healing capacity of the dental pulp (Eppa et al., 2018). Traditionally, calcium hydroxide has been considered the first choice in pulpotomy treatment with a high pulp repair success rate due to its characteristics as antibacterial activity (El-Meligy & Avery, 2006), biocompatibility (Cavalcanti et al. 2005), induction of dentin bridge formation (Svizero et al., 2003), stimulations of cell activity and the increase of bioactive molecules (Witherspoon et al., 2006). Other materials have been used for direct pulp capping in pulpotomies such as MTA (Çaliskan & Güneri, 2017; Gomes, 2020) and Biodentine (Awawdeh et al., 2018). MTA has been identified as a good material for its biocompatibility, good sealing capacity, induction of hard tissue formation and antimicrobial properties with good results documented in permanent teeth (Çaliskan & Güneri, 2017; Costa e Silva et al., 2019; Linsuwanont et al., 2017). However, when factors such as cost and handling characteristics are considered, this material cannot stand out (Eppa et al. 2018; Esmaeili et al., 2016; Martens et al., 2015).

For many years, the pulpotomy was seen as a provisory treatment which should be substituted by conventional endodontic therapy after the radicular closing and apical foramen formation (Cvek, 1978; Bergenholtz & Spångberg, 2004). However, some researchers have already considered it as definitive treatment when well indicated and carried out, with high rates of success in the long run (Robertson et al., 1996; Rafter, 2005; Forghani et al., 2013; Fuks et al., 1982; Tan et al., 2020). Through periodic clinical-radiographic controls it has become possible to follow-up the biological response to conservative pulp treatment, and also highlight beforehand any possible pathologic alterations (Sonmez & Sonmez., 2007).

Pulpotomy replacement by the conventional root filling did not turn it into an unsuccessful treatment. First of all, the completed formation of dentinal bridge at the site of the pulpotomy (Figures 3A and 3D) suggests that the pulp had maintained its vitality after the treatment (Rafter, 2005; Webber, 1984). Thus, in the presence of pulp vitality the remaining odontoblasts could lay down dentine and produce a thicker root, decreasing the chance of root fracture (Shabahang, 2013). In addition, the completion of the rhizogenesis process and the root formation created a natural apical constriction (Webber, 1984).

Probably, the pulpotomy efficacy was affected by the occurrence of the three posterior traumatisms that may have modified the pulp biologic response to the treatment, inducing the initial obliteration of the pulp canal. Although it is not considered a failure factor, this obliteration increases the difficulty in future endodontic treatment and can lead to accidental perforations when trying to locate the root canal (Chen et al., 2019). This fact emphasizes the dentistry actual goal of preventing dental and oral traumatism through the use of mouthguards (Bakland, 2013) in organized sports and mainly by the education of children and teenagers about how to avoid injuries and what to do if they occur (Sigurdsson, 2013).

5. Conclusion

This case report reveals the importance of pulp vitality diagnosis step on pulpotomy treatment, not only in the clinical and radiographic exams, but also during the trans-operative procedure. Furthermore, the outcomes of this report highlight the need of periodic clinic-radiographic follow-up in cases where the final result is not totally predictable and depends on the individual biological response. Although the conservative treatment had to be replaced by a conventional one, this approach resulted in success since it maintained the dental vitality which induced root development and apical closure, allowing the posterior execution of the endodontic therapy.

It is important that future work shows a long-term follow-up of other cases of pulpotomy on immature teeth, even with the use of other materials that have the same qualities as calcium hydroxide and at a viable price for use in public service, highlighting the use of this technique as an excellent option in these cases and as a definitive treatment.

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