Revascularization in a maxillary lateral incisor using bioceramic sealer: case report

Revascularização pulpar em incisive lateral com cemento biocerâmico: relato de caso

DOI:10.34117/bjdv8n9-147

Recebimento dos originais: 16/08/2022
Aceitação para publicação: 16/08/2022

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ABSTRACT
Revascularization is a regenerative endodontic dental procedure, which aims to stimulate the penetration of periradicular tissue inside the root canal, allowing vascularization of necrotic teeth, leading to a tissue repair and regeneration. Currently, Biodentine cement has been used to perform this procedure. The aim of this study was to report a clinical case about the revascularization of a maxillary lateral incisor with incomplete root formation using Biodentine. The patient, male, 10 years old, attended the multidisciplinary clinic of CEULP/ULBRA accompanied by the responsible, asymptomatic, reporting trauma to element 22, sensitivity and vertical percussion tests were performed with negative results. Through periapical radiography, incomplete root formation and a radiolucent area in the periapical region were observed. The revascularization technique was performed, aiming to stimulate the root formation. In the first session, instrumentation with K-type instruments at working length and intracanal medication were performed. After 15 days, the revascularization procedure was performed with a 25/0.02 K file led beyond the working length to stimulate periapical bleeding, so the canal was filled with blood up to the cervical third. Blood clotting was awaited, Biodentine was placed, and the definitive restoration was performed with composite resin. Follow-up up to 1 year and four months was carried out and the root development was observed. Thus, in the reported case, the revascularization technique proved to be efficient, allowing the continuity of the root formation a compromised tooth.

Keywords: regenerative endodontics, stem cells, dental pulp necrosis.

RESUMO
A revascularização é um procedimento odontológico endodôntico regenerativo, que visa estimular a penetração do tecido perirradicular no interior do canal radicular, permitindo a vascularização em dentes necrosados, levando o reparo e regeneração tecidual. Atualmente, o cimento Biodentine tem sido utilizado para este fim. O objetivo deste trabalho foi relatar um caso clínico de revascularização de um incisivo lateral superior com formação radicular incompleta utilizando Biodentine. O paciente, sexo masculino, 10 anos, compareceu ao ambulatório multidisciplinar do CEULP/ULBRA acompanhado do responsável, assintomático, relatando trauma ao elemento 22, foram realizados testes de sensibilidade e percussão vertical com resultados negativos. Através da radiografia periapical observou-se formação radicular incompleta e área radiolúcida na região periapical. A técnica de revascularização foi realizada, visando estimular a formação da raiz. Na primeira sessão, foi realizada instrumentação com instrumentos tipo K em

comprimento de trabalho e medicação intracanal. Após 15 dias, o procedimento de revascularização foi realizado com lima 25/0,02 K levada além do comprimento de trabalho para estimular o sangramento periapical, sendo o canal preenchido com sangue até o terço cervical. Aguardou-se a coagulação sanguínea, inseriu-se Biodentine e a restauração definitiva com resina composta foi realizada. Proservação de até um ano e quatro meses foi realizada, sendo observado o desenvolvimento radicular. Assim, no caso relatado, a técnica de revascularização mostrou-se eficiente, permitindo a continuidade da formação radicular de um dente comprometido.

Palavras-chave: endodontia regenerativa, células-tronco, necrose da polpa dentária.

1 INTRODUCTION

One of the greatest difficulties faced by endodontists concerns the treatment of permanent teeth with apices that have not been fully formed[1]. Immature permanent teeth with incomplete root formation with no apical dentin coated with cement and when radiographically the root has not reached Nolla stage 10, that is, the apex has not been formed by complete[2].

For these teeth, the treatment consists of two possibilities, apexogenesis for cases of incomplete root formation in which the pulp is still vital and not totally inflamed, where the maintenance of the pulp will allow the remaining development of the root along its entire length[1]. For cases in which there has been pulp necrosis, one of the best-known treatments is apexification, using calcium hydroxide, which induces the formation of an apical barrier, but has the disadvantage of requiring several clinical sessions for a relatively long period. and the fact that calcium hydroxide weakens the dentinal walls, due to the dissolution of some components of the organic matrix, contributing to a possible fracture in the future[1-3] or using mineral trioxide aggregate (MTA), this being the material of choice for the technique, with the objective of forming a mineralized apical barrier (apical plug), despite the advantages of sealing, shorter clinical time, being biocompatible and producing a periapical tissue with better consistency than calcium hydroxide , both techniques do not induce dentin wall formation, either in thickness or in length, contributing to the risk of root fractures[4].

Recently, regenerative endodontics has gained a lot of interest in dentistry, with high success rates in the replacement of the pulp-dentin complex. The term became well known when it was used for a new procedure for the treatment of permanent teeth with incomplete root formation and called the procedure pulp revascularization[5]. One of the

main advantages over apexification is the continuity of root formation and reinforcement of dentinal walls through tissue deposition, preventing root fracture[5,6].

Regenerative endodontics aims to replace necrotic pulp tissues with regenerated pulp-like tissues, to revitalize the tooth, promoting continuity and increase in apical thickness, due to the migration of stem cells into the root canal, where they differentiate into several types. of tissues[7,8]. This technique is only possible due to advances in tissue engineering[9]. It is based on 3 keywords: stem cells, scaffolding/matrix and growth factors. According to the American Association of Endodontists (2013)[10], stem cells exist in several locations, but one of the stem cells with the greatest potential for regenerative endodontics are the apical papilla cells (SCAPS - Stem cells from apical papilla) found. at the apex of teeth with incomplete root formation, which can differentiate into odontoblasts. The scaffolds provide the three-dimensional support, the framework for the organization, proliferation, differentiation, and vascularization of the new tissue to form inside the root canal, although there are several, the main scaffold is the blood clot, which can be recruited using a file beyond the apical foramen. And growth factors, which are proteins that act signaling and inducing cell differentiation and proliferation, are found mainly trapped in dentin, which can be released using 17% EDTA (ethylenediamine tetraacetic acid) and present in the blood clot.

Another study added a new keyword for regenerative endodontics, disinfection, being a fundamental part, interacting with stem cells, scaffolds, and growth factors, which makes it important to use an efficient protocol of canal disinfection, using sodium hypochlorite for example and intracanal medications such as triantibiotic paste (ciprofloxacin, metronidazole and minocycline) or calcium hydroxide[11].

Therefore, the aim of this study was to report a case report of a regenerative endodontic treatment in a permanent maxillary lateral incisor affected by trauma and pulp necrosis with the aid of Biodentine bioceramic sealer.

2 CASE REPORT

The study was accepted by The Institutional Ethics Committee (CAAE: 48523821.7.0000.5516). The treatment was performed after signing the consent and was carried out in two sessions.

A 10-year-old female patient presented at CEULP/ULBRA (Tocantins, Brazil) Dental Clinic for dental evaluation. The patient's parent reported a previous dental trauma six months before the appointment. Tactile inspection and periapical radiography of tooth

22 and fistula sinus tracking were performed (Figure 1A), confirming the diagnosis of pulp necrosis and incomplete root formation.

In the 1st session, Lidocaine 1:200000 anesthesia (Dentsply/Sirona, Ballaigues, Switzerland) was applied. Subsequently, prophylaxis of the tooth was performed with a straight white CA Brush (Microdont, Socorro - SP). The coronal access with drills 1014 and 3082 (KG Sorensen, Barueri, Brazil) was carried out under absolute isolation. Initial exploration was performed with a K 10/0.02 type instrument (Dentsply/Sirona, Ballaigues - Switzerland). The root canal preparation was carried out 1 mm short the apical foramen till the K #50/0.02 file.

During the entire instrumentation, irrigation was performed at 3 mm short of the apparent working length, with 2% chlorhexidine gel and saline solution (Formula e Ação, São Paulo, Brazil), using a Lüer Slip 10 Ml plastic syringe. (Advantive, Nanchanc Jangxi, China) and disposable needle 25 x 0.55 (BD, Curitiba, Brazil). A 30 ml of solution were used.

The root canal was dried with capillary tips (Ultradent Products, Inc, South Jordan, USA) and with absorbent paper cones (Tanari, Manacapuru, Brazil). Intracanal medication, calcium hydroxide (Calen, SSWhite, Ballaigues, Switzerland), was inserted with the aid of a number 40 lentulo drill and the coronary sealing was performed with glass ionomer cement (Riva light cure, SDI, Bayswater, Victoria, Australia).

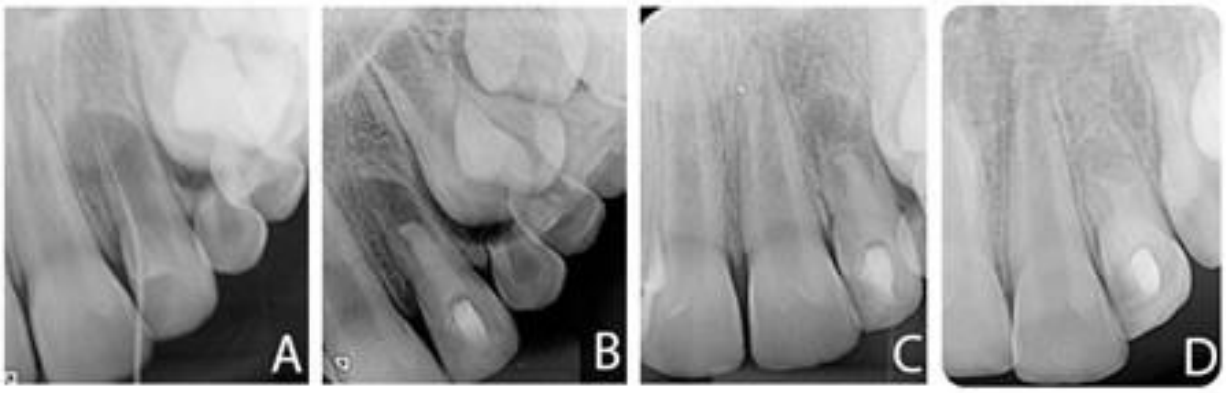
The second session was held 15 days later. The irrigation with 2% chlorhexidine gel and saline solution using a 10 ml Lüer Slip plastic syringe and a 25 x 0.55 disposable needle and a K 45/0.02 manual instrument, for intracanal medication removal.

The final irrigation was performed with 3 ml of 17% EDTA with 1 ml of 17% EDTA followed by ultrasonic vibration with a 25 IRRI S insert (VDW; Endo Ultrasonic Files, Endodontic Synergy, Munich, Germany) at 30 kHz for 20 s for three times, connected to a piezoelectric device (CVDent 1000; CVD Vale, São José dos Campos, SP, Brazil). After, irrigation with 5 ml of 2% chlorhexidine gel and saline solution. The canal was dried with Capillary tips (Ultradent Products, Inc, South Jordan, Utah, USA) coupled to a high-power suction device and with absorbent paper cones

Subsequently, a K 25/0.02 type instrument was introduced into the apical third of the tooth element to stimulate apical bleeding. The blood filled the entire root canal up to the cervical third and the clotting process was awaited. The Biodentine bioceramic sealer was inserted over the clot. After 12 minutes of setting time, the definitive restoration with composite resin was performed (Figure 1B).

After 4 months, the patient was asymptomatic and a new radiography was performed (Figure 1C), showing progression of the dentinal root thickness. The case remains under investigation. After one year and four months, the patient returned asymptomatic in follow-up appointment and was also observed a dentinal wall thickening (Figure 1D). The case will continue in follow-up for 10 years.

Figure 1: Periapical radiography (fistula sinus tract) of element 22, with incomplete root formation (A). Final radiography (B). Follow-up of 4 months (C). One-year and 4-month follow-up (D).



3 DISCUSSION

According to the American Associations of Endodontists (2013)[10], regarding regenerative procedures, there are still no evidence-based guidelines that support a specific protocol for the success of regenerative treatment.

A previous study stated some recommendations on regenerative endodontic treatment in traumatized immature permanent teeth, due to the lack of long-term evidence, regenerative procedures should only be performed when treatments such as apexogenesis, apexification or treatments partial pulpotomy have already been performed and had a poor prognosis[12]. In contrast to studies published in recent years, long-term outcomes in humans are scarce, the revitalization process has high survival rates and positive outcomes[6]. Another work considered 96.4%-100% success rate for revascularization on average 14 months after treatment[13,14]. Thus, regenerative endodontic treatments is demonstrated to have high rates of clinical and radiographic success, which was confirmed in the present study.

Root canal debridement and disinfection are essential factors for a positive treatment outcome, mechanical cleaning is contraindicated or performed minimally, as it can weaken the thin walls of the root[15]. In the present study, minimal instrumentation was performed until K #50/0.02 file, to avoid weakening as the removal of vital tissue remains

that may be present in the apical portion. Regenerative endodontic treatment, therefore, relies more on chemical disinfection for the elimination of microbial biofilm and its by-products[6].

Although there is no standardized protocol, it is necessary an efficient root canal disinfection protocol, with 2.5% NaOCl or 2% chlorhexidine used as irrigating solutions for disinfection[16]. There is an inverse relationship between the potency and the cytotoxicity of NaOCl, the concentration of 0.5 to 3% of NaOCl reduces the viability to 60%, however with a rinse soon after with 17% EDTA the cell viability is recovered[17].

In a previous study, regenerative endodontic treatment was performed on 23 anterior teeth, separated into 2 groups, 1 received the medication of calcium hydroxide and 2% chlorhexidine gel and the other received the triple antibiotic paste and both groups received irrigation with 6% NaOCl. , 5% sodium thiosulfate, saline and 2% chlorhexidine gel, at the end of treatment were continued for a period of 19 months and both groups demonstrated successful treatment and similar results with symptom resolution[18].

Another important issue is the supposed chlorhexidine cytotoxicity to stem cells from the apical papilla were found to survive and growth factors trapped in the dentin were exposed, obtaining resolution of the clinical case, periapical healing and increase in the thickness of the dentinal walls[5,19-24]. This agrees with the finding of this reported case, which was successful using chlorhexidine as irrigant solution. Although further studies are necessary to assess the real influence of chlorhexidine on mesenchymal cells and, consequently, on pulp revascularization treatments.

Given the lack of standardization in the literature and successful cases using both chlorhexidine and sodium hypochlorite, and due to the characteristic of the reported clinical case presented a large apex opening, 2% chlorhexidine and saline solution were used to canal disinfection[24]. The EDTA solution was used with ultrasonic activation, which appears to improve the release properties of growth factors and subsequent cellular functions[25,26].

Despite the current development of synthetic scaffolds such as plasma risk in platelets, the blood clot is the most used scaffold, due to its simplicity, no cost, as well as the natural presence of stem cells and growth factors that influence the success of the treatment[27]. This was confirmed in the present work, where success was demonstrated when using the blood clot as a scaffold. Studies indicate that there may be an inability to produce an ideal clot, such as incomplete bleeding[28,29].

The most recent research reports the use of platelet concentrates such as platelet-rich plasma (PRP) and fibrin (PRF) remains in platelets as a substitute for blood clot, the fibrin network is more suitable for the storage of cytokines and growth factors[30]. Despite the advantages, the procedure requires specialized equipment and, especially when working with children, there is a need to collect blood from the patient. In addition, as it is an innovative and not fully understood method, it is not possible to predict its future implications[31,32]. A systematic review of clinical studies showed that pulp regeneration using PRP and PRF was not significantly better than using a blood clot as a scaffold in promoting root canal wall thickening and root development[33].

Calcium hydroxide is a common intracanal medication in regenerative endodontic treatments due to its antimicrobial properties and has been found to promote stem cell survival and proliferation[34]. On the other hand, many protocols also include the use of antibiotic pastes, such as the triple antibiotic paste (ciprofloxacin, metronidazole and minocycline) which has been shown to be highly effective against endodontic pathogens[35]. However, it has harmful effects on stem cells and coronary staining due to minocycline and that even after attempts at complete removal, can lead to the development of antimicrobial resistance and risk of sensitization[36]. Unlike triple antibiotic paste, calcium hydroxide has no harmful effects on stem cells, but calcium hydroxide can lead to decreased fracture resistance when used for prolonged periods[25].

Due to the disadvantages of the triple antibiotic paste, the calcium hydroxide was chosen as intracanal medication in the present work, considering that it was used for a short period (15 days)[37,38].

Regardless of the type of protocol used (using the clot or not, different concentrations of irrigants, and the type of intracanal medication), different treatments were able to promote success, with elimination of symptoms, clinical signs, increase in dentinal wall thickness and even the continuous development of the root[1, 41].

To allow the inflow of blood into the root canal, the use of an anesthetic has been recommended[40]. The anesthetic of choice in the 2nd visit was 3% mepivacaine without vasoconstrictor, consistent with previous work, since the anesthetic must have effective bone penetrability and at the same time allow blood inflow[12].

One of the extremely important steps is the insertion of the “coronal plug” using dental materials such as MTA or Biodentine, among other bioceramic materials[39]. They provide a barrier between the restorative material and the blood clot. However, the role

of the coronary plug is still not fully understood. In our study, it was possible to verify success in the observations made up to one year and four months.

It is important to note that when using certain bioceramic materials, such as MTA, a coronal discoloration May happen[40]. This result can be avoided by using Septodont Biodentine, because in addition to its improved color stability, better consistency, short setting time and lower staining potential than MTA, it also promotes odontogenic proliferation of mesenchymal stem cells[41,42], which is why Biodentine was selected to reduce the potential risk of coronal discoloration. Another advantage of this material is the deposition of hard tissue in the cervical region, increasing fracture resistance and tooth survival. The discoloration even in white MTA can be attributed to the presence of bismuth oxide and its interaction with the collagen present in the dentinal tissue[1,42]. Then, since Biodentine does not have bismuth oxide but zirconium oxide, it does not result in discoloration[42].

There is still a debate about the term “regeneration”. According to previous work, regeneration is defined as the restoration of tissue and biological function of tissues damaged by morphofunctionally identical tissue. Repair is the replacement of damaged tissue with tissue other than the original tissue[43]. In histological studies with animals, the pulp tissue was replaced by tissue similar to bone, cementum and periodontal ligament, demonstrating that the tissue formed is not the same as that of the lost dentin-pulp complex, true odontoblasts are still missing, the cells formed are called “cells”. similar to odontoblasts”[11]. A more appropriate term would be guided endodontic repair instead of regeneration[37].

To date, most dentists tend to a patient-based outcome assessment and consider the absence of signs and symptoms, tissue formation within the canal, and root development to be a success. Whether it is really pulp or not, it may be dispensable, if the root is fortified by the deposition of mineralized tissue[44].

4 CONCLUSION

In view of the case presented, the pulp revascularization technique, using Biodentine, proved to be efficient, enabling the rehabilitation and maintenance of the tooth. The patient is asymptomatic, and the dentin root shows signs of progression in size and thickness. So far, the case has been continued for a period of 1 year and 4 months and will continue under observation.

ACKNOWLEDGMENTS

This study was supported by grants from Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ) and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Brazilian Governmental Institutions.

DISCLOSURE STATEMENT

The authors certify that they have no commercial or associative interest that represents a conflict of interest in connection with the manuscript.

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