

The improvement of the art of saving teeth by endodontic microsurgery - case report

O aprimoramento da arte de salvar dentes pela microcirurgia endodôntica - relato de caso

El perfeccionamiento del arte de salvar dientes por microcirugía endodóntica - reporte de caso

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Abstract

The success of an endodontic surgery depends on the removal of a persistent infection from the external apical surface and necrotic tissue or contaminated filling material within the root canal system followed to a complete filling of the root end preparation. The current concepts of surgical endodontics recommend that its execution with the use of magnification and illumination of the operating microscope, which allows an easier identification of the root apices, small ostectomies and smaller apex resection angles. The objective of this article is to report and discuss a clinical case of endodontic microsurgery where the main resources currently recommended were used to increase the success in surgical endodontics. Based on specific equipments, instruments and materials the endodontic microsurgery increases the predictability of success of the surgery. Among the main advances compared to traditional surgery we could observe less trauma to the operated region which resulted in a faster and more comfortable healing for the patient.

Keywords: Apical surgery; Endodontic surgery; Microsurgery.

Resumo

O sucesso de uma cirurgia endodôntica depende da remoção de uma infecção persistente da superfície apical externa e tecido necrótico ou material obturador contaminado dentro do sistema de canais radiculares seguido de um preenchimento completo do preparo da extremidade radicular. Os conceitos atuais da endodontia cirúrgica preconizam sua execução com o uso de ampliação e iluminação do microscópio cirúrgico, que permite uma identificação mais fácil dos ápices radiculares, pequenas ostectomias e menores ângulos de ressecção do ápice. O objetivo deste trabalho foi relatar e discutir um caso clínico de microcirurgia endodôntica onde os principais recursos atualmente recomendados foram utilizados para aumentar o sucesso na endodontia cirúrgica. Com base em equipamentos, instrumentos e materiais específicos a microcirurgia endodôntica aumenta a previsibilidade de sucesso da cirurgia. Dentre os principais avanços em relação à cirurgia tradicional podemos observar menor trauma na região operada o que resultou em uma cicatrização mais rápida e confortável para o paciente.

Palavras-chave: Cirurgia apical; Cirurgia endodôntica; Microcirurgia.

Resumen

El éxito de una cirugía endodóntica depende de la eliminación de una infección persistente de la superficie apical externa y del tejido necrótico o del material de obturación contaminado dentro del sistema de conductos radiculares,

seguida de una obturación completa de la preparación del extremo de la raíz. Los conceptos actuales de endodoncia quirúrgica recomiendan su ejecución con el uso de magnificación e iluminación del microscopio operatorio, lo que permite una identificación más fácil de los ápices radiculares, ostectomías pequeñas y ángulos de resección apical menores. El objetivo de este trabajo fue reportar y discutir un caso clínico de microcirugía endodóntica donde se utilizaron los principales recursos actualmente recomendados para incrementar el éxito en la endodoncia quirúrgica. Basada en equipos, instrumentos y materiales específicos, la microcirugía endodóntica aumenta la previsibilidad del éxito de la cirugía. Entre los principales avances respecto a la cirugía tradicional podemos observar un menor traumatismo en la región operada lo que se tradujo en una curación más rápida y cómoda para el paciente.

Palabras clave: Cirugía apical; Cirugía endodóntica; Microcirugía.

1. Introduction

The root canal treatment acts to prevent or resolve apical periodontitis by maintenance of the aseptic environment and/or the decontamination of the root canal system provided by strategies from the mechanical preparation, intracanal dressing, obturation and coronary sealing. Those steps guarantee in most cases the ideal conditions for success. However, in cases of intra or extra-radicular infections that cannot be treated via the root canal or simply endodontic retreatment procedures that are not efficient an endodontic surgery is indicated (Setzer et al., 2012).

The success of an endodontic surgery depends on the removal of a persistent infection from the external apical surface and/or necrotic tissue or contaminated filling material within the root canal system. It allows the root end filling and can provide an efficient sealing of the root end canal. There is a strong recommendation to perform all endodontic surgical procedures under an Operating Microscope at magnifications of x3 to x26, since the beginning of the endodontic microsurgery (EM) era that began in the 1990s (Kim, 1997; Rubinstein & Kim, 1999).

The use of an Operating Microscope (OM) enables an easy identification of apices which results in a reduction of the osteotomy and shallower resection angles of the root apices. This way, both bone tissue and length of the root can be preserved. (Kim & Kratchman, 2006). Moreover, Ultrasonic tips and root end filling materials based on tricalcium silicate are notably additional resources applied in EM, in order to provide 90% or more success (Rubinstein & Kim, 1999; Kim & Kratchman, 2006; Tsesis et al., 2013; Kim & Kratchman, 2018).

According to the science and in a good predictability prognosis for the case, the maintenance of natural teeth must always be our first choice in dentistry. In view of what was exposed, the main goal of this paper is to describe and discuss a case report of EM where the main equipments, instruments, and materials that match biological concepts with clinical practice were applied.

2. Methodology

This work is a descriptive case report study. Informed written consent was obtained from the patient before the treatment. There was respect for all ethical procedures corresponding to the kind of case report. The authors declare that they followed the national research committee ethical standards and the 1964 Helsinki Declaration.

3. Case Report

A 73-year-old, female ASA 1 (American Society of Anesthesiologists) was referred to a private dental clinic for evaluation of the tooth 21. According to the professional that referred the patient, since the first session the tooth 21 has showed a sinus tract at buccal area that was not solved after many attempts to reach the disinfection of the root canal. After the explanation of a surgical treatment option, including extraction, the patient chose to preserve the tooth through an endodontic surgery. During the clinical exams the sinus tract was confirmed. Radiographic evaluation showed an apical lesion. The cone beam computed tomography (CBCT) was requested for surgical planning and it made possible to observe the presence of a

periapical lesion also on tooth 11 (Figure 1) which had a satisfactory crown and metallic post. A lack of endodontic treatment in the apical root third was verified. Besides being asymptomatic the incidental findings revealed for tooth 11 supporting indication for an endodontic surgery as well.

The surgical approaches were planned for each tooth. For 21 tooth only a root end resection around 3 to 5 mm of apice was designed. Regarding to the tooth 11 some apical procedures as: root end resection, retro mechanical preparation with ultrasonic retrotips/CM rotary files and retro filling with sealer and repair bioceramic cements were intended in the planning.

One day before the surgical procedure the tooth 21 was filled using the single cone technique with a bioceramic sealer Bio C (Angelus, Londrina, PR, Brazil). The patient was instructed to take the preoperative medication of 2 tablets of Dexamethasone 4mg and 1 tablet of Clavulin BD 875mg an hour before the surgery.

3.1 Surgical Procedure

A local anesthetic 4% Articaine with 1:100.000 epinephrine (DFL Ind. Com., Brazil) was injected by the suprapariosteal and subperiosteal infiltrative technique in both buccal and palatal areas. The submarginal rectangular flap was accomplished and in the sequence the apices were easily located because of a cortical plate fenestration. After the initial remotion of granulation tissues, the apex procedures were performed individually for each tooth. The tooth 21 root end resection was executed with a Bladesonic ultrasonic tip (Helse, Brazil) under constant irrigation with saline solution. The length of the resection was around 5mm and after that it was possible to remove the remaining granulation tissue behind the root tip. The adaptation of the root canal filling material (cone gutta-percha and sealer) was checked with an apical explorer Camargo Microendodontic Kit (M Polachini, Brazil). Since the explorer did not advance into the apical obturator mass an efficient apical seal was confirmed and the procedures on tooth 21 were completed.

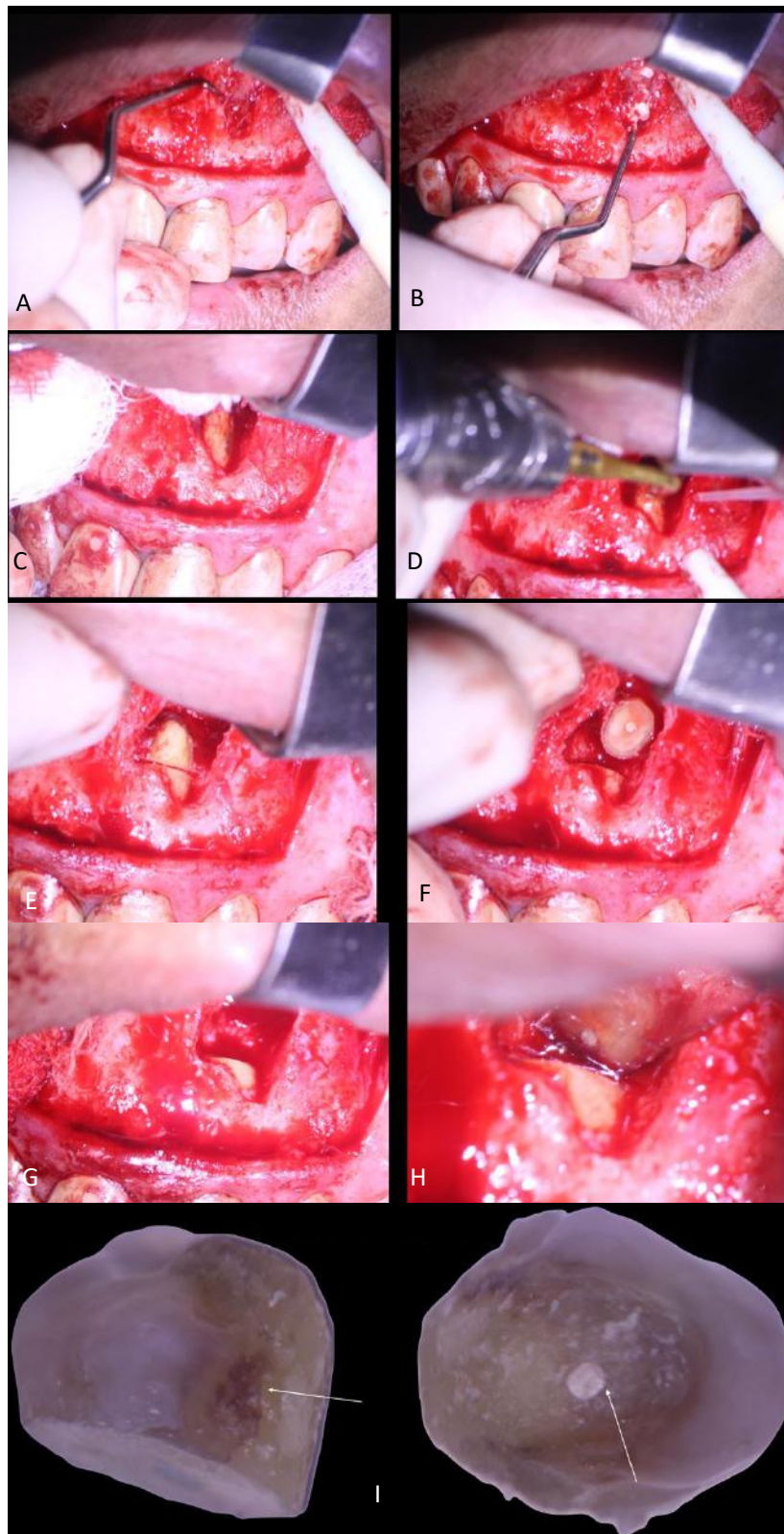
The entire team involved in the surgery was aware that tooth 11 would be a harder task as the surgical modality has involved greater complexity. The apex was cut off in the same way as tooth 21 with the difference that a smaller size (3mm) was removed. Subsequently the canal was located and a P1 ultrasonic tip (Helse, Brazil) was used to initiate the root end preparation of the canal. Once the canal was enlarged by the final 3 mm a rotary controlled memory (CM) files 0.01 taper and tips #30-35-40 and 45 Logic 2 (Easy, Brazil) were used to a mechanical preparation of the rest of the root canal length up to the end of the metallic post. After that, the entire root end preparation was irrigated with 2% chlorhexidine, washed with saline solution and dried with paper points. The root end filling materials used were Bio C Sealer (Ângelus, Brazil) that filled all the prepared cavity and after that, the MTA (Ângelus, Brazil) was placed into the final 3mm of the root end. Camargo's micro pluggers (M Polachini, Brazil) were used to gently condense the mixture. After confirming the filling of the root end preparation with a periapical Rx, a copious irrigation with saline solution was delivered inside the bone crypt. Due to the great disruption of the buccal bone plate the bone crypts were filled with Calcium Sulfate Lumina-Set (Criteria, Brazil). Finally, the flap was repositioned and the suture was performed with 5-0 nylon monofilament Tech Suture (São Paulo, Brazil). A final X-ray was taken and the patient was instructed about the medication for pain and postoperative infections control. An attendance of 3 days for post observation of the operated area and a 7 days suture removal was programmed. All the steps of the surgical procedures can be seen in figures 2 to 4.

Figure 1. Clinical, radiographic and tomographic appearance of teeth 11 and 21 prior to surgery.



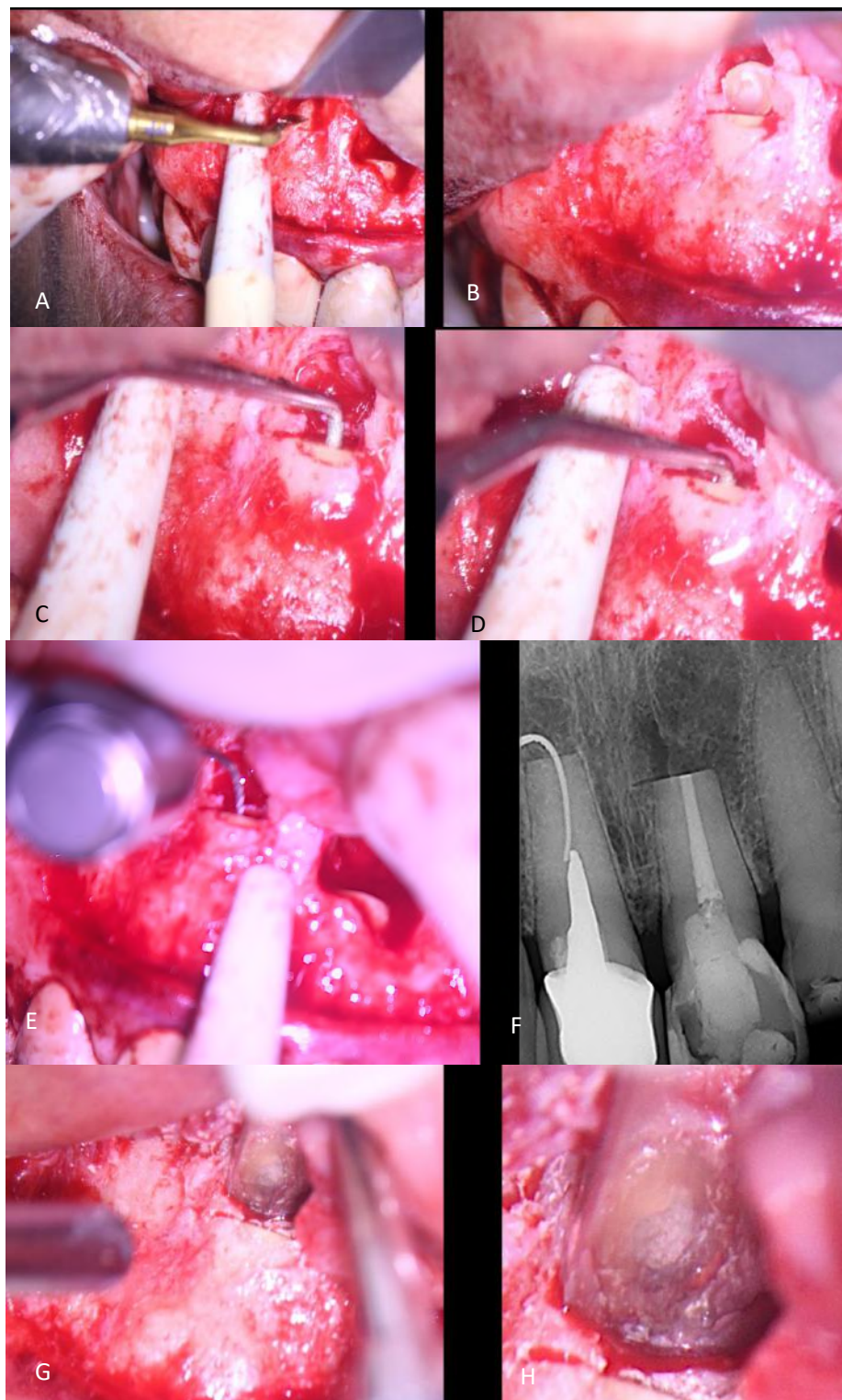
Fonte: Authors.

Figure 2. Surgical procedures on tooth 21: observe in A and B the remotion of the granulation tissue. In D Bladesonic tip performing the resection of the apex. In H the root end canal sealed and in I the apex fragment showing the attached extra radicular biofilm.



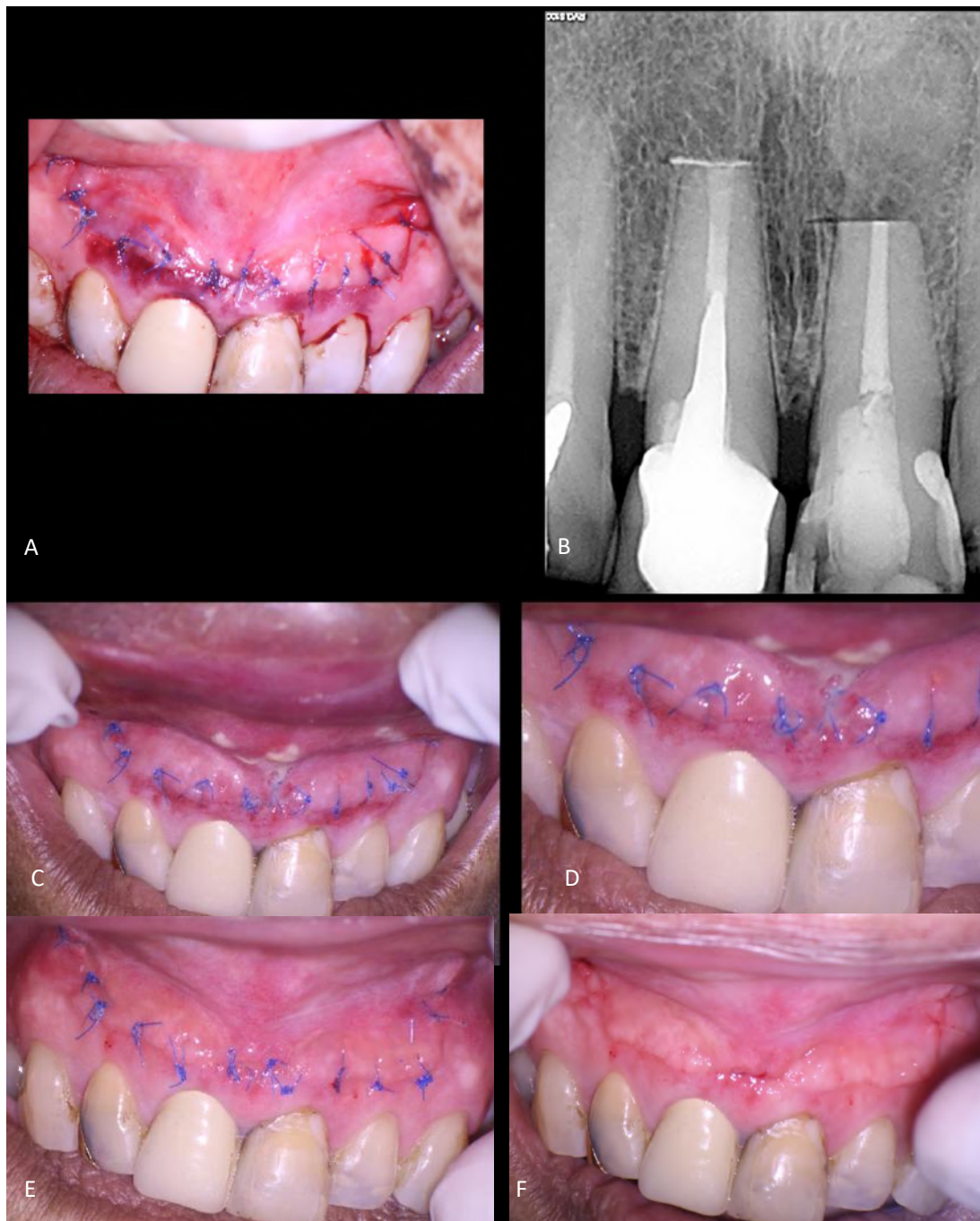
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Figure 3. Surgical procedures on tooth 11: in A Bladesonic cutting off the apex. In C and D P1 tip enlarging the root end 3mm in depth. In E and F Logic rotary file being driven by portable electric motor. Note how much the file is pre-curved to reach the entire length of the root endo canal up to the metallic post. In H it is possible to observe the MTA filling the root end preparation.



Fonte: Authors.

Figure 4. Final clinical appearance: In A suture 5.0 nylon monofilament. In B immediate post-surgical x-ray. In C and D clinical appearance after 3 days of surgery. In F suture removed after 7 days.



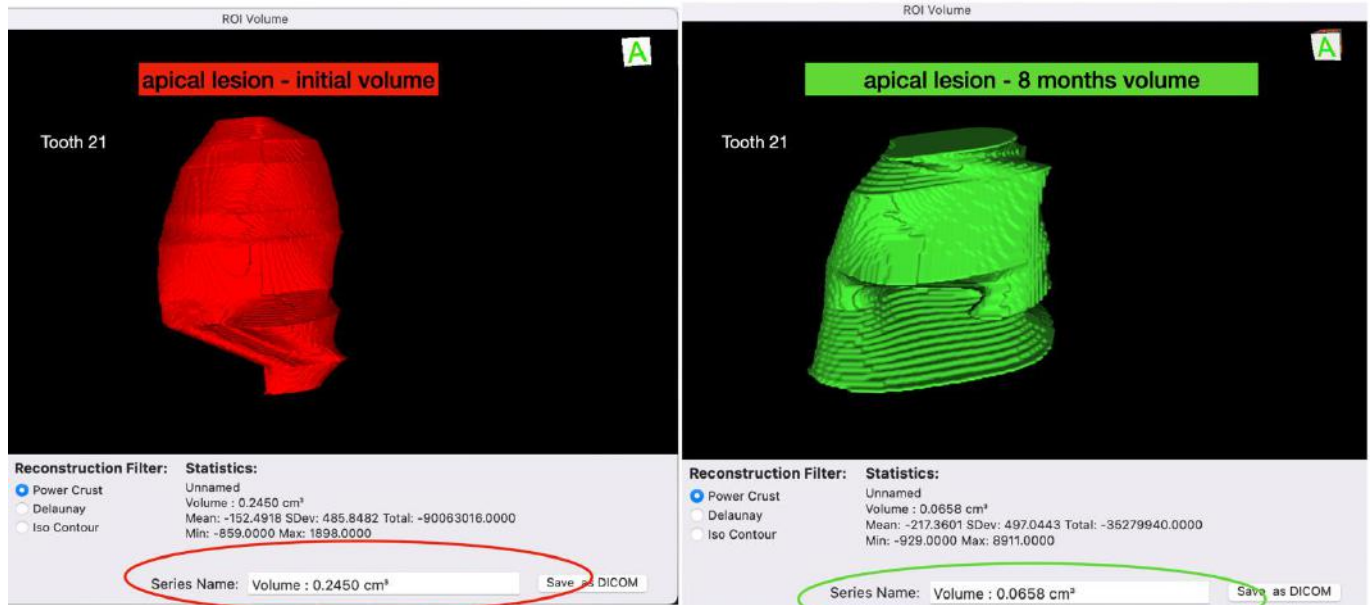
Fonte: Authors.

Figura 5. Follow up 8 months. (A) clinical aspect, (B) periapical image and the CBCT pre (C) and pos operative (D).



Fonte: Authors.

Figure 6. The volume of apical lesion was calculated by Horos software (Horos Project, GNU Lesser General Public License, Version 3.0). The left image shows the initial volume of apical lesion and the right the volume after 8 months of microsurgical procedure on tooth 21. The information regarding volume (cm³) of the apical lesions are highlighted below the images.



Fonte: Authors.

3. Discussion

Contemporary non-surgical endodontic treatment has technologies and techniques that have enabled the reduction of indications for apical surgeries. These resources have increased the success rates of complex endodontic treatments and retreatments as well. There is a need for a broad study and case discussion to carry out the decision-making for the surgical indication since the preference should always be for a non-surgical endodontic treatment (Salehrabi & Rotstein, 2010). However, when the surgical indication of the case is confirmed, the professional has to be prepared with knowledge, equipments, instruments and materials to perform a surgical procedure that results in high predictability of success.

The operating microscope provides appropriate magnification and illumination which are both essential to reduce surgical trauma over interventions in small fields resulting smaller flaps, osteotomies and sutures. In addition, there is a more controlled handling of the procedures performed at the apex which is decisive for the success of the case. According to (Kim & Kratchman, 2018) EM is an effective treatment option when it guarantees enough access to the entire pathological area, root end resection to adequate length, preparation with ultrasonic tips of all root canals exit ports (foramens), easy placement of suitable retro-filling material and healing by first intention of the surgical area.

The case was performed under microsurgical concepts and some devices were decisive to reach what the scientific community considers ideal to a surgical success. The root end resection of apices were executed with an ultrasonic tip Blade Sonic (Helse, Brazil). According to the manufacturer the Bladesonic tip (Helse, Brazil) is a .020mm diameter blade which allows the control of a cut line. Besides that, the use of ultrasonic is always selective avoiding an unnecessary wear of the dental tissue. (Plotino et al., 2007). Regarding to the amount of root that should be resected in the 21 tooth the 3-mm rule of root resection (Kim et al., 2001) did not apply because there was a great extension of extra radicular biofilm and the solution was to cut off a 5mm length of the apice. Moreover, that procedure provided a free access to the palatal part of the bone crypt and enhanced the remotion of the granulation tissue (Kim & Kratchman, 2018).

Tooth 11 received the same root end resection protocol but only 3mm of the root end was sectioned by Bladesonic

(Helse, Brazil) as the apical external surface was cleaned by extra radicular biofilms. In sequence the root end preparation and filling were initiated. The ideal root end preparation is defined as a Class I cavity at least 3 mm into root dentine after the apical root tip of 3 mm is resected with walls parallel to and within the anatomic outline of the root canal space. According to the image exams, there was no filling from foramen up to the final part of the metallic post, due to the long distance to be prepared, the P1 ultrasonic tip did not reach the total root canal length to be cleaned. Although there is a specific ultrasonic insert P1 Long (Helse, Brazil) to perform preparations in long retro cavities a larger osteotomy in the apical direction of the bone crypt would be necessary to fit P1 Long. In addition, there would be a risk that the P1 Long tip would not reach the entire length to be cleansed. To solve this situation NiTi Controlled Memory (CM) files was indicated. Logic CM files (Easy, Brazil) 0.01 taper and 30-35-40 e 45 tips were applied to a mechanical preparation of the rest of the cavity. The CM files allow large pre-bends and they are very safe in curved areas because its notably resistant to cyclic fatigue ((Topçuoğlu et al., 2016). We can observe the CM file performing the root end preparation in figures 3E and 3F.

The root end filling material MTA (Angelus, Brazil) was placed into the root end preparation. This material has been the first choice for over two decades (Toubes et al., 2021; Souza et al., 2021) as long as its wide acceptance as a root end filling material is due to its excellent properties of biocompatibility, sealing (Osborne et al., 2005; Shinbori et al., 2015) and potential bioactive actions such as biomineralization. (Chong & Rhodes, 2014). Prior to place the MTA the Bioceramic Bio C Sealer (Angelus, Brazil) was injected into the root end preparation. These “sandwich technique” has been recommended aiming a better sealing of the entire root end canal (Rench et al., 2021), since the sealer form of a bioceramic product has a better flow than the consistency of the MTA it seems a good option to be applied in the filling of root end preparation.

The indication of regenerative techniques has grown in endodontic surgeries as they improve the healing of the periapical lesion (Liu et al., 2020). The present case, Calcium Sulfate Lumina-Set (Criteria, Brazil) was used to fill the bone crypt. This material has been used as a biological barrier in guided tissue regeneration, physically hindering the proliferation of connective tissue and epithelial cells of the bone defect, allowing a bone regeneration by the principle of osteoinduction (Pecora et al., 1993; Maeda et al., 2007).

The patient presented for recall exams 8 months later with no symptoms or concerns. A new CBCT enabled us to observe the complete bone repair of tooth 11 while tooth 21 showed a bone not fully formed (Figure 5). The periapical lesion of tooth 21 is still being healed and it also can be observe a 73,14% reduction of the original periapical lesion detected in the pre operative CBCT. (Figure 6). Until this moment there is no concern about the healing of tooth 21 because its bone or scare tissue formation can keep active during long periods. According to (Zhang et al., 2015), the periapical healing is a dynamic process.

After reviewing the literature and reporting the present clinical case, the evidence that the EM has brought notable benefits in producing more predictable results in the healing of endodontic lesions has been confirmed. The recommendation of pioneer researchers on the subject (Kim & Kratchman, 2018; Salehrabi & Rotstein, 2010; Rubinstein & Kim, 1999; Kim & Kratchman, 2006) is that we should consistently learn and teach microsurgery because the preservation of the natural teeth resources should be our main objective. After all, the human natural teeth are always better than any man-made replacement.

4. Conclusion

Based on specific equipments, instruments and materials the EM increases the predictability of success in the surgical endodontics. Among the main advances compared to traditional surgery we could observe less trauma to the operated region which resulted in a faster and more comfortable healing for the patient.

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