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Surgical Management of External Cervical Resorption Using Different Materials in Relation to the Bone Crest: A Case Report

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External cervical resorption is a condition that leads to the loss of hard dental tissues, including enamel, cementum, and dentin. Although it is an aggressive condition, its causes are not yet fully understood. The treatment of resorptions depends on their extent, location and the material used. When managing these lesions, the position of the bone crest and the ability of the periodontal tissue to adhere to the material after setting must be considered. This case report aims to demonstrate a clinical case of external cervical resorption which was treated by a proposed protocol that uses different dentin substitute restorative materials depending on the location of the resorptive area in relation to the bone crest. The success of this treatment depended on the correct use of materials and adequate tissue management. The combination of different materials has shown promising results in treating resorptions in both supra- and infra-osseous areas.

Keywords: Bioceramic; Dental Pulp; External Cervical Resorption; Root Canal Therapy; Tooth Resorption

Introduction

External cervical resorption (ECR) is a pathology characterized by the loss of hard dental tissues such as enamel, cementum, and dentin due to odontoclastic function [1, 2]. External cervical resorption typically develops in the cervical region of a tooth, just below the epithelial attachment [3]. It can infiltrate the root dentin in various directions and to different extents. In severe cases, ECR may advance to the mid and apical thirds of the root [3].

The concept of ECR was presented by Heithersay in 1999, aiming to highlight the aggressive and penetrating nature of this type of injury based on the level of dental deterioration. This two-dimensional categorization was performed using periapical radiographs, considering both the lesion's amplitude and its proximity to the root canal [2, 4].

The etiology of ECR initiation remains obscure. It has been commonly associated with orthodontic treatment. Other factors that are frequently linked to ECR include a history of dental trauma, parafunctional habits, poor oral hygiene, and periodontal treatment. In many cases of ECR, orthodontic treatment and a history of previous dental trauma or existing parafunctional habits are seen together [5]. The prevalence of ECR is poorly reported, with prevalence rates ranging from 0.02% to 2.3%, according to some epidemiological and retrospective studies [6, 7].

The clinical presentation of ECR can vary depending on factors such as the severity of the condition, the tooth type involved, and the stage of ECR [8]. In the early stages, it may not cause any symptoms [9]. However, in some cases a "pink spot" may appear in the cervical area of the tooth. This may be an incidental finding, noticeable on the labial/buccal or lingual/palatal surface [1]. One of the clinical features of ECR is loss of periodontal attachment and profuse bleeding upon probing the resorptive defect [1]. In more severe cases, resorption can eventually create a perforation in the root canal wall and enter the pulp. This can cause symptoms and/or signs of pulpitis and/or periapical periodontitis [1, 10].

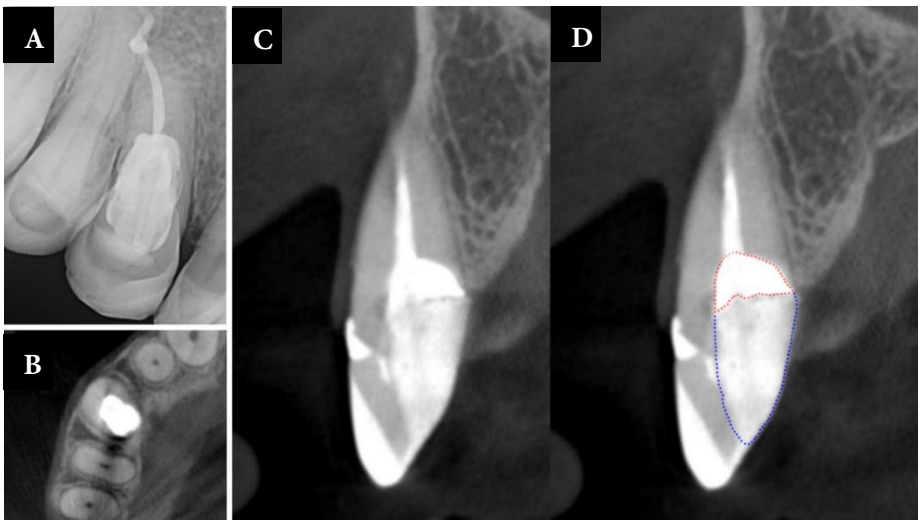

Figure 1. *A)* Immediate postoperative periapical radiograph; *B)* One-year follow-up: In the axial section of the CBTC, satisfactory sealing of the reabsorption area was noted; *C)* In the sagittal section of the CBTC, a satisfactory sealing of the reabsorption area is observed, in addition to being possible to distinguish the two biomaterials used due to their different hypodensities; *D)* In red is the bioceramic material's location (infra-bony area), and in blue is the glass ionomer cement (supra-bony area); Image taken with a professional camera attached to an operating microscope

The management of ECR depends on its nature and lesion accessibility. Treatment aims include excavating the resorptive lesion to stop the process, repairing the defect, and monitoring for recurrences [11]. Whenever possible, conservative pulp treatment should be the initial choice. However, in cases of irreversible pulpitis with excruciating pain or pulp necrosis, endodontic treatment becomes necessary. External repair, with or without root canal treatment, involves surgically exposing the resorptive defect, completely excavating it, and restoring it with composite, glass ionomer cement, or Biodentine [11, 12]. The location of ECRs is a limitation when restoring these cases due to the challenge of moisture control and visual restraints, in addition to the fact that they often have supra- and infra-bony regions, which require materials with different properties [13]. Therefore, this case report aims to propose a restorative protocol in cases of concomitant supra- and infra-bony resorptions, demonstrating the clinical management of a right upper canine with Heithersay class III ECR [4] utilizing different materials according to their location concerning the bone crest.

Case Report

The patient consented to participate in a clinical case that would be reported and published, having signed an informed consent form. A 60-year-old male patient visited a private dental clinic complaining of a "hole behind the tooth" in his upper right canine with excruciating and constant pain. The diagnosis was irreversible pulpitis. In his medical history, he reported that he had rheumatoid arthritis and was taking oral steroidal anti-inflammatory medication. Regarding dental history, the patient reported having undergone orthodontic treatment twice and a history of dental trauma in the anterior region. Radiograph and cone-beam computed tomography (CBCT) examination revealed loss of dentin structure in the crown and the root's cervical area along with preservation of the pericanal dentin wall and absence of the palatal cortical bone (Figures 1A-1C).

On clinical examination, cavitation was observed extending from the cervical region of the crown to the subgingival area (Figure 1D). High sensitivity to vertical and horizontal percussion tests was reported, and palpation of the periapical region also revealed sensitivity with the absence of edema. The patient was experiencing spontaneous pain with sensibility to the thermal tests. Periodontal probing was performed, and deep cavitation was observed on the palatal surface. During this examination, the patient complained of severe discomfort. Probing of the other sides of the tooth revealed no depth greater than 3 mm. According to data from the anamnesis, radiographs, the clinical condition and the extensive hypodense region presented on the CBCT, the tooth was diagnosed with irreversible pulpitis and class III ECR, according to the Heithersay and Patel classification [4, 14].

Management

First visit

After discussing the prognosis and possible treatment plans for retaining the tooth with the patient, it was decided to first perform a non-surgical approach. Conventional palatal access was created

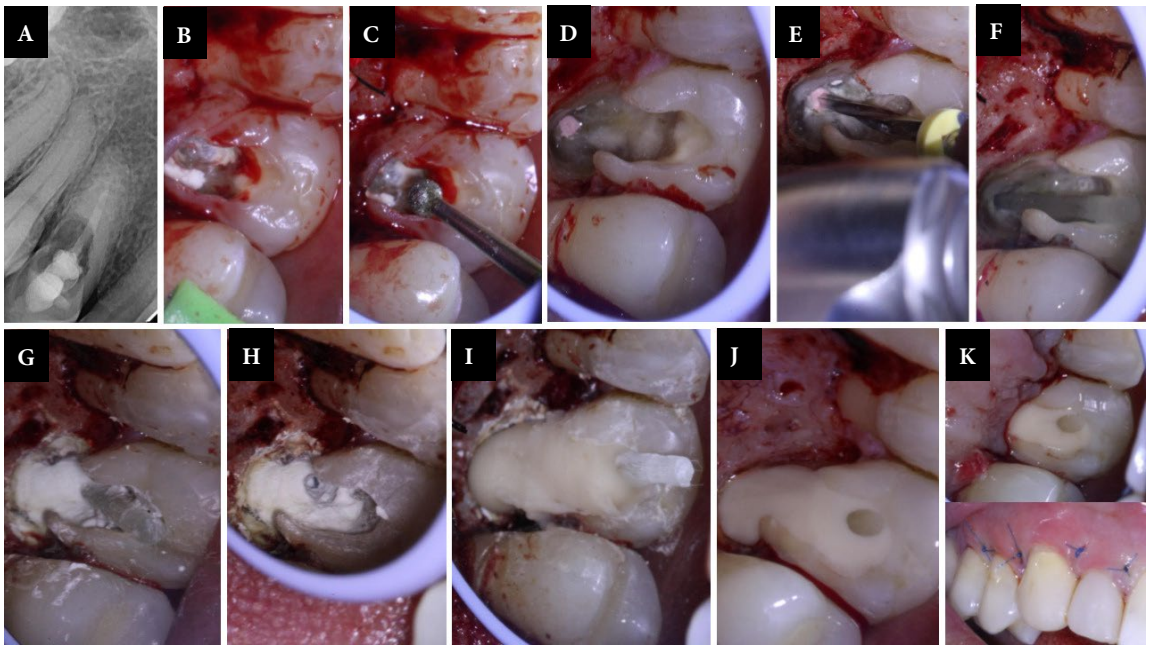

Figure 2*. A)* Periapical radiograph after attempted debridement using conventional endodontic access and medication with calcium hydroxide*; B)* Surgical access through the palatal aspect of tooth #13; *C)* Debridement of the resorption area using ultrasonic inserts*; D)* Resorption area after complete trans-surgical debridement; *E)* Preparation for placement of the intraradicular retainer*; F)* Intrarradicular retainer placed*; G)* Use of the intraradicular retainer as a shield for placing the bioceramic in the infra-bony resorption area*; H)* Appearance of the bioceramic material after setting*; I)* Cementation of the intraradicular retainer with glass ionomer cement and sealing of the supra-bony resorption area*; J)* Refinemt of restoration*; K)* Immediate clinical appearance after suturing; Images taken with a professional camera attached to an operating microscope

to the root canal system in the first visit. The resorption region was debrided and cleaned using ultrasonic inserts (E6D, ClearSonic Black and softsonic) (Helse Ultrasonic, Santa Rosa de Viterbo, Brazil) under aqueous irrigation. Abundant irrigation and agitation of 2.5% sodium hypochlorite solution (Asfer, Santa Maria, SP, Brazil) and 17% ethylenediaminetetraacetic acid (Fórmula e Ação, São Paulo-SP, Brazil) was performed. However, the efforts were insufficient for completely debriding the resorption area through the endodontic access (Figure 2A). Then, it was decided to insert a radiopaque calcium hydroxide paste (Ultracall, Ultradent Indaiatuba, SP, Brazil) to track the resorption area and perform a trans-surgical approach.

Second visit

An incision and detachment of the palatal flap was performed following periodontal surgical principles (Figure 2B). Endodontic treatment was completed trans-surgically after complete debridement of the ECR area (Figures 2C, 2D). The root canal was instrumented using the Logic system up to #40.05 file (Easy Dental Equipment, Belo Horizonte-MG, Brazil) and the obturation was performed with a gutta-percha cone (Odous de Deus, Belo Horizonte, MG, Brazil) and Bio-C Sealer bioceramic cement (Angelus, Londrina, PR, Brazil), with a working length of 23 mm. After that, the post space was prepared using a #0.5 drill (Exacto-Angelus, Londrina, PR, Brazil), considering a measurement of 15 mm from the incisal edge (Figures 2E, 2F).

The protocol proposed in this case utilized different materials according to the position of resorption in relation to crestal bone. The infra-osseous region of the resorption was sealed with Biodentine bioceramic cement (Septodont, St Maur des Fosses, France). A size 0.5 intra-radicular post was cemented (Figures 2G-2I) (Exacto-Angelus, Londrina-PR, Brazil). The supra-osseous resorption area was restored with chemically activated glass ionomer cement (Figure 2I) (Riva-SDI, Victoria, Australia) by a Centrix-type applicator (Maquira Dental Group, PA, Brazil). After the setting time, superficial polishing (Figure 2J), repositioning of the flap and suturing with a #5.0 Nylon Blue thread (Figure 3K) (Techsuture, Bauru, SP, Brazil) were performed. The entire procedure was carried out with a dental operating microscope.

Follow-up

One-year follow-up CBCT images exhibited evidence of bone integrity in the palatal region and satisfactory sealing of the ECR area. No signs and symptoms were detected on clinical examination. Furthermore, it was possible to observe the different types of biomaterials used according to their location and hypodensity in the tomographic examination (Figure 3).

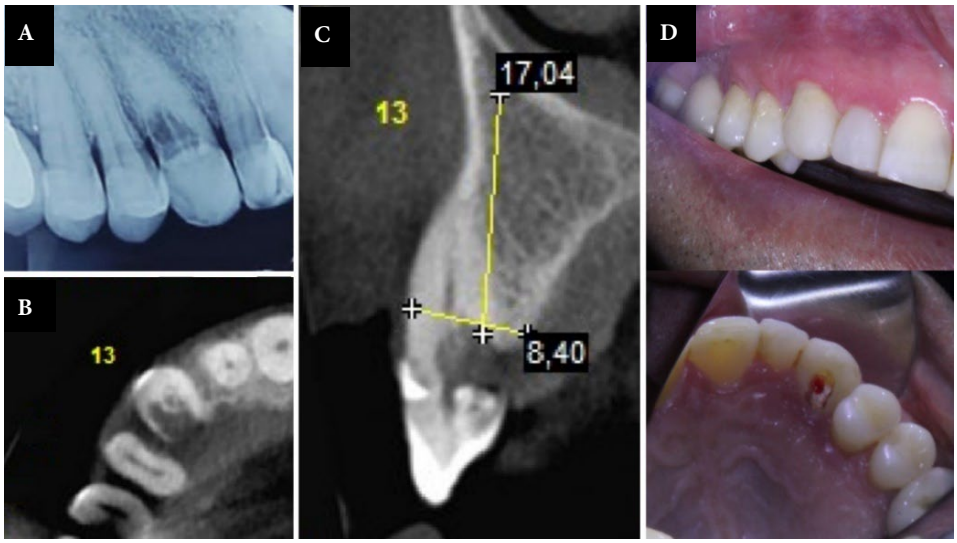

Figure 3. *A)* Periapical radiograph of the region of tooth #13 showing a radiolucent area with the presence of predentine, suggesting a diagnosis of external resorption; *B)* An axial tomographic image is observed with an extensive hypodense area, demonstrating external loss of dentin structure, mainly in the palatal and distal region of the root; *C)* In the sagittal section, extensive dentin loss associated with the absence of the palatal cortical bone can be observed, in addition to pulp involvement; *D)* Clinically, it was possible to observe extensive cavitation on the palatal surface of tooth #13; Image taken with a professional camera attached to an dental operating microscope

Discussion

Cases of ECR have been an increasing challenge in the routine of endodontists [15-22]. Treatment may vary according to the complexity of the case. Proper treatment planning requires knowledge of the location and extent of resorptive lesions [23]. In general, treatment for ECR aims to debride and restore of the resorptive defect by placing appropriate materials so that the tooth remains esthetically and functionally healthy [11, 23].

The choice of materials used to restore the resorption region in the present case report was based on its position in relation to the bone crest. This case required a material that presented bioactivity and greater biocompatibility to inhibit inflammation and consequently bone resorption in the infra crestal region". The use of bioceramic materials has been recommended with great support in the literature in cases of perforations or infra-osseous resorptions [12, 15-18]. Therefore, we chose a bioceramic material due to its sealing and bioactivity properties, which can benefit bone repair in the region. However, bioceramic materials normally do not have the surface smoothness and shear resistance necessary for restorative materials in regions exposed to the gingival sulcus and the oral environment; therefore, bioceramic cements should be avoided in these areas. The choice of glass ionomer as a restorative material in the supra-crestal region was based on its resistance, biocompatibility with the supporting periodontal tissues, smoothness and polishing capacity [13, 16]. These characteristics indicate that this material can be successfully used in cases of invasive cervical resorption in supra-bony defects [13]. In the present case, the connection between the infra-crestal bioceramic material and the supra-crestal glass ionomer obtained the desired characteristics of each material in relation to its position, and avoided the need for bone wear in order to carry out the restoration procedure. To our knowledge, this is the first report in the literature on hybrid restoration of invasive cervical resorptions using different materials based on their position in relation to the bone crest, and their physicochemical and biological characteristics.

A thorough clinical examination, careful evaluation of CBCT images and accurate diagnosis are essential [23, 24]. In order to achieve a better prognosis due to the limitations of two-dimensional periapical radiographs that only detect the mesial and distal extent of ECR, a CBCT was requested before the management of this case [25]. The Heithersay [2] and Patel [14] classifications were used to evaluate the extent of ECR. The invasion of granulation tissue through resorption, extending from the coronal dentin into the coronal third of the root, indicated a class III ECR.

Initially, an attempt was made to treat the patient *via* conventional endodontic access. However, complete debridement of the tissue was not possible due to the extent and complexity of the resorptive lesion. Then, a trans-surgical access was performed. The resorption lesion was debrided using ultrasonic tips that allowed the removal of granulation

tissue and cleaning of the resorptive area with excellent safety, in addition to a better visibility with a dental operating microscope. The irrigating solutions were agitated to clean the recessed areas [26]

The location of the ECR lesion may hinder the restoration due to moisture and visual limitations. In addition, supra- and infra-bony areas require materials with different properties [13]. The materials used in the proposed protocol for restoring ECR reinforced the dental structure, had a coefficient of thermal expansion close to the tooth structure, promoted an excellent biological response and maintained periodontal health as they came into direct contact with this tissue [12, 16, 23].

Bioceramic filling materials have good biocompatibility, fluidity, and chemical stability. Bio-C Sealer (Angelus, Londrina, PR, Brazil) was the material of choice for filling the root canal system in this case. This bioceramic cement contains tricalcium silicate, dicalcium silicate, and tricalcium aluminate as its main components [27]. Furthermore, it has the potential to induce mineralization in human periodontal ligament stem cells and has shown good laboratory and clinical results [28].

After filling the root canal system, a bioceramic cement such as Biodentine (Septodont, St Maur des Fosses, France) was the choice of the protocol to seal the infra-osseous resorption defect because its high pH can assist in stopping osteoclastic action [11]. This material can serve as a bioactive replacement for both crown and root dentin. It is paramount that the material in this position has a higher compressive strength than others because of the low water/cement ratio used during its handling [29].

The other material proposed for the presented case in the supra-crestal region was glass ionomer cement, due to its mechanical properties and surface smoothness [16, 30]. The chemical adhesion to the dental structure, biocompatibility and low cytotoxicity makes glass ionomer cement an attractive clinical option for restoration in cases of ECR in supra-osseous regions [13, 31, 32]. An inherent limitation of glass ionomer may be esthetic issues. For restorations in buccal or other esthetic regions, final supplementation with resin in supra-gingival areas may be necessary. In the present case, due to the palatal and interproximal position of the resorption, without any esthetic involvement, the glass ionomer remained as the definitive restorative material [13, 31, 32].

The fracture resistance of endodontically treated teeth is influenced by several factors, including loss of tooth structure [33]. The choice to use a glass fiber post was due to its ability in increasing fracture resistance in anterior teeth with cavities in the cervical region by providing more excellent retention of the restorative material [34].

Conclusion

This case report depicts the effective management of an ECR with concomitant supra- and infra-bony resorption, utilizing a protocol with different restorative materials. It highlights the importance of conducting a comprehensive clinical and radiographic examination to ensure appropriate treatment. The success of this treatment was due to the use of correct materials and proper tissue management. The combination of different materials has shown promising outcomes in treating resorptions occurring in supra- and infra-osseous areas.

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Conflict of interest
None.

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Authors' contributions
CAM: writing original draft, design and revision of the manuscript, LFM: Data curation, Formal analysis, Funding acquisition, Investigation, BCV: writing original draft, design and revision of the manuscript, TCFTA: Writing review & editing, FB: writing original draft, design and revision of the manuscript, RRA: writing original draft, design and revision of the manuscript, WLFT: Clinical treatment of the patient, conception, supervision, funding acquisition, validation, and review & editing manuscript. All authors contributed to the stud and approved the final manuscript.

Ethics statement
All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Patients consent statement
Written informed consent was obtained from the patient to publish the case report and any accompanying images.

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