CASE SERIES

Innovative Approaches for Treating External Cervical Resorption: a Comprehensive Case Series

ABSTRACT

Aim: *The aim of this case series was to provide information on the clinical management of different types of external cervical resorption (ECR) lesions. This case report has been written according to Preferred Reporting Items for Case reports in Endodontics (PRICE) 2020 guidelines*

Summary*: ECR is a condition that is difficult to diagnose and manage and can lead to tooth loss if not treated properly and on time. This series of three case reports outlines effective methods for planning and managing teeth with ECR in a minimal invasive and effective way .*

Key learning points:

- *The decision to maintain a resorbed tooth should be made on a case-by-case basis, taking into consideration various factors, such as the extent and location of the resorption, the patient's overall dental health, and the treatment options available.*
- *Single visit handling in such cases is predictable and effective, granted the experience and the of the dedicated equipment.*
- *In cervical resorption lesions vitality can be maintained when diagnosis is obtained on early stages.*

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Received 2023, July 22

Accepted 2023, November 29

KEYWORDS *ECR, external cervical resorption, CBCT*

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Peer review under responsibility of Società Italiana di Endodonzia

10.32067/GIE.2023.37.01.30

Introduction

Root resorption refers to the loss of hard dental tissues (cementum, dentin, or enamel) owing to the activity of odontoclasts (1). While it is a natural and desirable process in primary teeth, where it facilitates the shedding of teeth and the emergence of permanent teeth (known as physiological root resorption), it is undesirable in adult teeth, as it can lead to irreversible damage which requires treatment or extraction.

Resorptions can be classified into external and internal root resorptions, based on their location on the root surface. External root resorption is further categorised into surface, inflammatory, cervical, replacement, and transient apical resorption, as defined by Patel and Pitt Ford (1, 2) and Patel and Saberi (3). External cervical resorption (ECR) typically occurs in the cervical aspect of teeth and is caused by damage or deficiency of the periodontal ligament (PDL) and subepithelial cementum, according to Andreasen and Andreasen (4). ECR is a dynamic process that affects periodontal, dental, and pulpal tissues in later stages (5, 6) and has gained more attention in the last two decades owing to improved detection using cone-beam computed tomography (CBCT) (1, 7, 8) and advanced assessment techniques such as micro-computed tomograophy (CT) and histopathology (6, 9, 10).

ECR can be challenging to diagnose and manage, and early detection is important to prevent further tooth damage. The most frequent diagnostic method is random radiographic control; otherwise, ECR is detected when it is severely spread, being either symptomatic with toothache when the pulp is involved or with the presence of pink discoloration on the cervical part of the tooth (pink spot) (11,12).

The treatment for ECR varies from external or internal repair of the resorbed tissue to root canal treatment when the pulp is involved and to intentional reimplantation, observation, or extraction based on symptoms, extension, and early or late detection (11). Despite all these treatment option it is importan for the clinician to understand the rational of maintinig or not a resorbed tooth. Obviously this choice depends on the conditions (positioning and extension of the resorptions), the function of the compromised tooth in the mouth, and certently on the genereal health of the oral cavity of the patient in treatment. The survival rate of ECR repaired teeth appears to be less favorable than of teeth under periodic observation, fact which implies that many times resorbed teeth are heavily compromised to be repaired or maintained (13). Unfortunately when symptoms are present, observationon is not an option. The aim of this case series was to provide information on the clinical management of different types of ECR lesions based mainly on the cost-effectiveness of the treatment for both the clinician and also the patient. This case series has been written according to Preferred Reporting Items for Case reports in Endodontics (PRICE) 2020 guidelines (14) (Fig. 1-3).

Report

Case 1

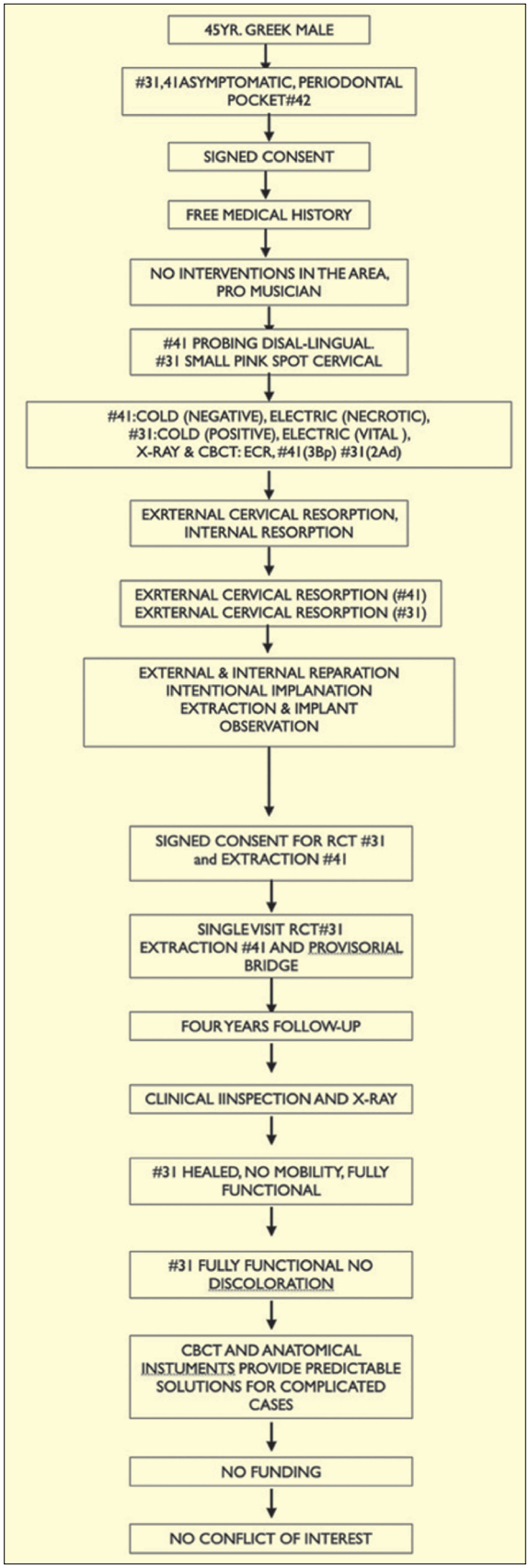
A 45-year-old man, greek with no medical history, was referred for endodontic evaluation of tooth #42 suffeing of periodontal problems with deep pockets (12 mm) and mobility 1. Radiographic investigation revealed resorption of teeth #41 and #31 (Fig. 4a). The patient did not report any symptoms in the area, and the only complaint was the mobility of #42. No previous intervenmtions were mentioned by the patient in the aera.

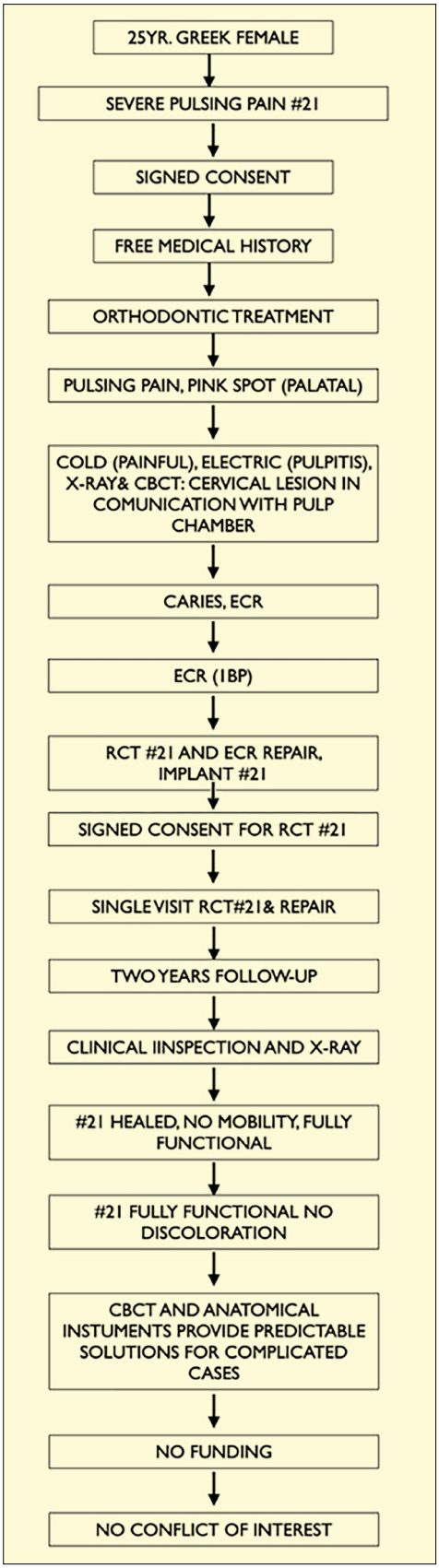
In the clinical investigation (cold and electric), #41 showed negative vitality, and #31 showed positive results in all vitality tests, with no evident pain symptoms.

After informing the patient and obtaining their consent, CBCT of the area was performed to thoroughly evaluate the resorbed elements and determine the most effective treatment plan. Three-dimensional imaging revealed massive resorption of tooth #41 in the lingual aspect of the root, extending to the medial and apical third of the root, communicating with periodontal tissues to the greater extent of its surface

Figure 1
Preferred Reporting Items for Case reports in Endodontics flow-chart for Case 1.

Figure 2
Preferred Reporting Items for Case reports in Endodontics flow-chart for Case 2.





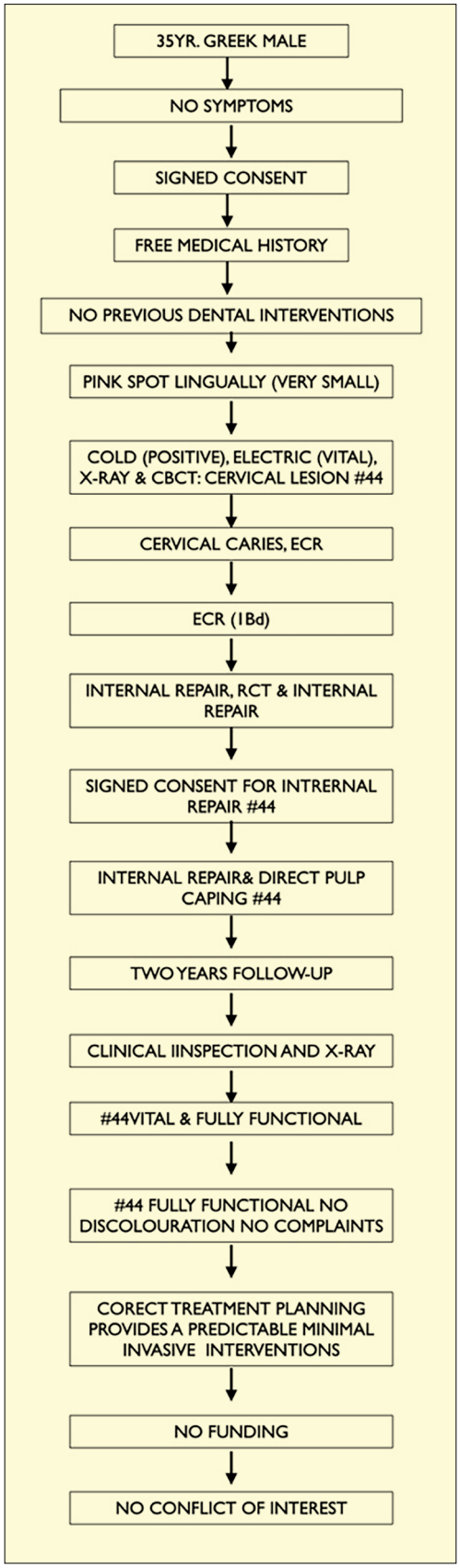


Figure 3
Preferred Reporting Items for Case reports in Endodontics flowchart for Case 3.

(Fig. 5a). A more localised and centrally positioned resorption area was observed in tooth #31, and a small communication was observed in the mesial part of the medial third of the tooth (Fig. 5b). Based on both clinical and radiological findings, the teeth were diagnosed with ECR. According to the most accurate classification which describes the position (1:CEJ- 4:apical third), the extension (A<90o-D>270o) and the depth of the resorption, (d:dentine, p:pulpalinvolvement), tooth #41 presented a 3Bp resorption and #31a 2Ad lesions (15).
The patient was informed about different treatment options. Importantly, the patient was a professional trombone player, which may have caused the ECR lesion in the first place.
The internal and external repair of tooth #41 was aborted because of the risk of periodontal complications. No intentional reimplantation was considered because of the patient's occupation and the need for more secure treatment.
The final treatment plan was extraction of tooth #41 and endodontic treatment of tooth #31 (internal repair). The extracted #41 would initially be replaced with a bonded bridge (#42–31) until further periodontal evaluation and implant placement at a later moment. Patient was informed about treatment options and the final treatment plan, which he agreed to proceed. At the same appointment, we proceeded with the endodontic treatment and repair of tooth #31.
Local anaesthesia and rubber dam isolation were performed before access cavity preparation with a long round diamond bur 0.012 tip (D&Z DIAMANT, Kalletal, Germany) under an operating microscope Ompi Pico (Zeiss, Oberkochen, Germany). Using k-file #10 (FKG Dentaire, La Chaux de Fotns, Switzerland), scouting was performed, and patency was obtained. The working length was measured electronically (Morita Root ZX Mini, J. Morita Corp, Tokyo, Japan). Chemomechanical preparation was completed using an anatomical file XP Endo Shaper (FKG Dentaire) at 1,000 rpm and 1N/cm. During preparation, 15 mL of 5.25% NaOCl was used for irri-

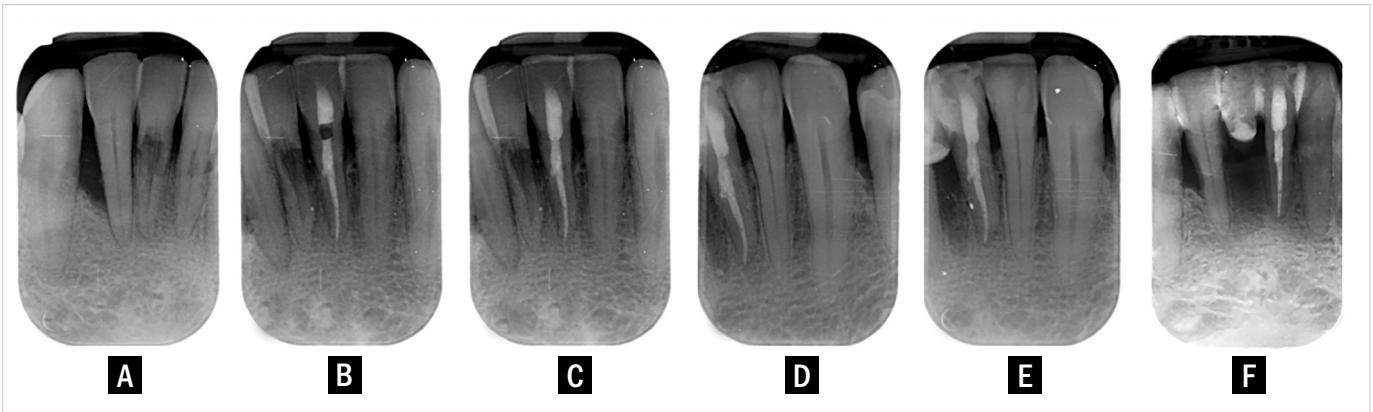


Figure 4
Periapical radiographs of Case 1: **A)** initially, **B)** after RCT #31, **C)** after restoration #31, **D)** after extraction #41 and bonded bridge placement, **E)** at 6-month follow-up.

gation with an IRRIFlEX needle (Produis Dentaires SA, Vevey, Switzerland).
After preparation, the root canal space was debrided using an XP Endo Finisher (FKG Dentaire) at 1000 rpm and 1 N/cm. During this procedure, 10 mL of 5.25% NaOCl and 5 mL of 17% ethylenediaminetetraacetic acid were used. The debridement protocol was performed twice, each for 30 s. First, the root canals were irrigated with activated NaOCl, followed by irrigation with activated ethylenediaminetetraacetic acid for 30 s. After debridement, NaOCl was left in the root canal space without agitation for 3 min, followed by rinsing with 10 mL of saline solution. Consequently, a 35.04 TotalFill BC Point gutta-percha cone (FKG Dentaire) was fitted to the canal. The canal space was then dried using sterile TotalFill BC Point paper cones (FKG Dentaire). After drying, the bioceramic TotalFil BC Sealer (FKG Dentaire) was placed in the root

Figure 5
Cone-beam computed tomography images of Case 1.

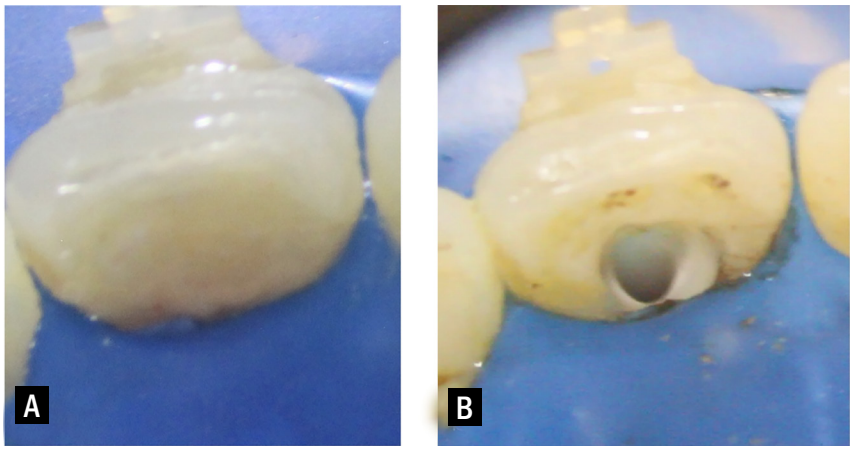


Figure 6
Clinical images of Case 2: **A)** isolation, pink spot on palatal, **B)** after cleaning the ECR.

canal space using an application tip. The gutta-percha cone was then placed in the canal and cut 3 mm from the orifice, and the rest of the canal was filled with thermoplastic gutta-percha and compacted vertically. After terminating the root canal treatment (Fig. 4b,c), the final composite restoration was performed, and the patient was referred to his general practitioner for the extraction of #41 and temporary bridge placement. Periodontal sessions were arranged to prepare the implant site and the desiesed area.
Follow-up was performed after 6 months and 4 years (Fig. 4d, e, f), and the teeth appeared healthy (clinically and radiographically). At the later follow-up the bonded bridge was still in place and no implant was placed yet. Since all was functional (esthetics and fonetics) the patients decided to maintain this setting for longer time. Meanwhile bone healing proceded regularly. The patient was happy about the overall treatment, teeth were fully functional and permiteed the patient to continue his profession as a trombone performer.

Case 2
A young greek woman (25 years old) was referred for evaluation of tooth #21 because of severe pulpitis. Clinically, the tooth was free of caries, and only a small pinkish spot was evident in the palatal part of the crown at the gingival level with deeper probing (6 mm) (Fig. 6a). The patient was in the final step of orthodontic therapy. Radiographic evaluation revealed a cervical lesion communicating with the root canal (Fig. 7a). Positive vitality test results were observed with pain on cold and electrical stimulation. The patient was informed of the possibility of ECR, and CBCT was performed for a more precise evaluation and treatment planning.
CBCT revealed a cervical lesion in the apical and medial parts of the crown, extending into the dentin and pulp chambers. Vertically, the lesion did not extend below the bone (supracrestal). Communication with the gingiva was evident in the palatal aspect of the crown (1 Bp) (15) (Fig. 8a, b, c).
Owing to pulpitis symptoms, endodontic treatment and internal repair of the ECR

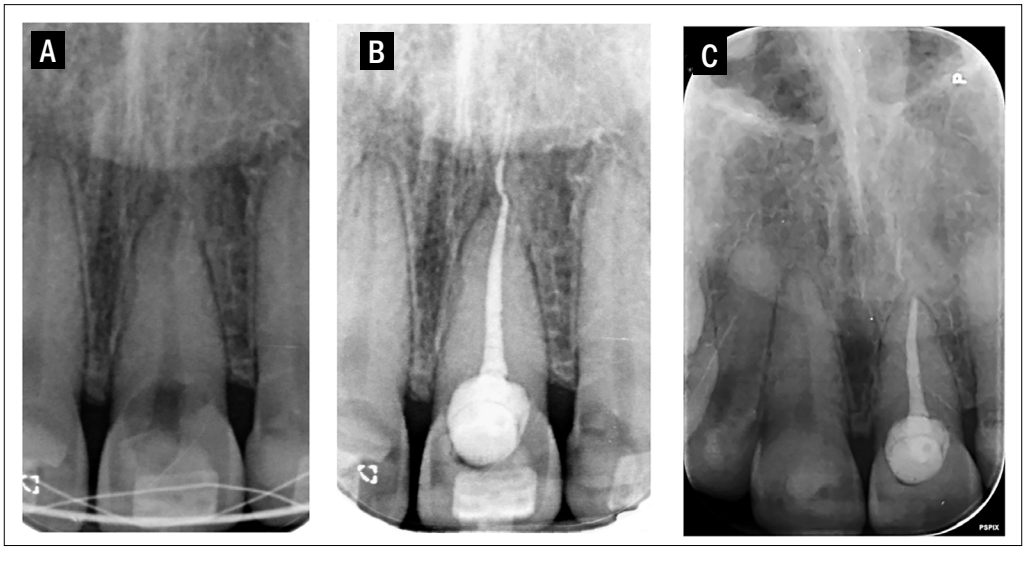


Figure 7
Periapical radiographs of Case 2.

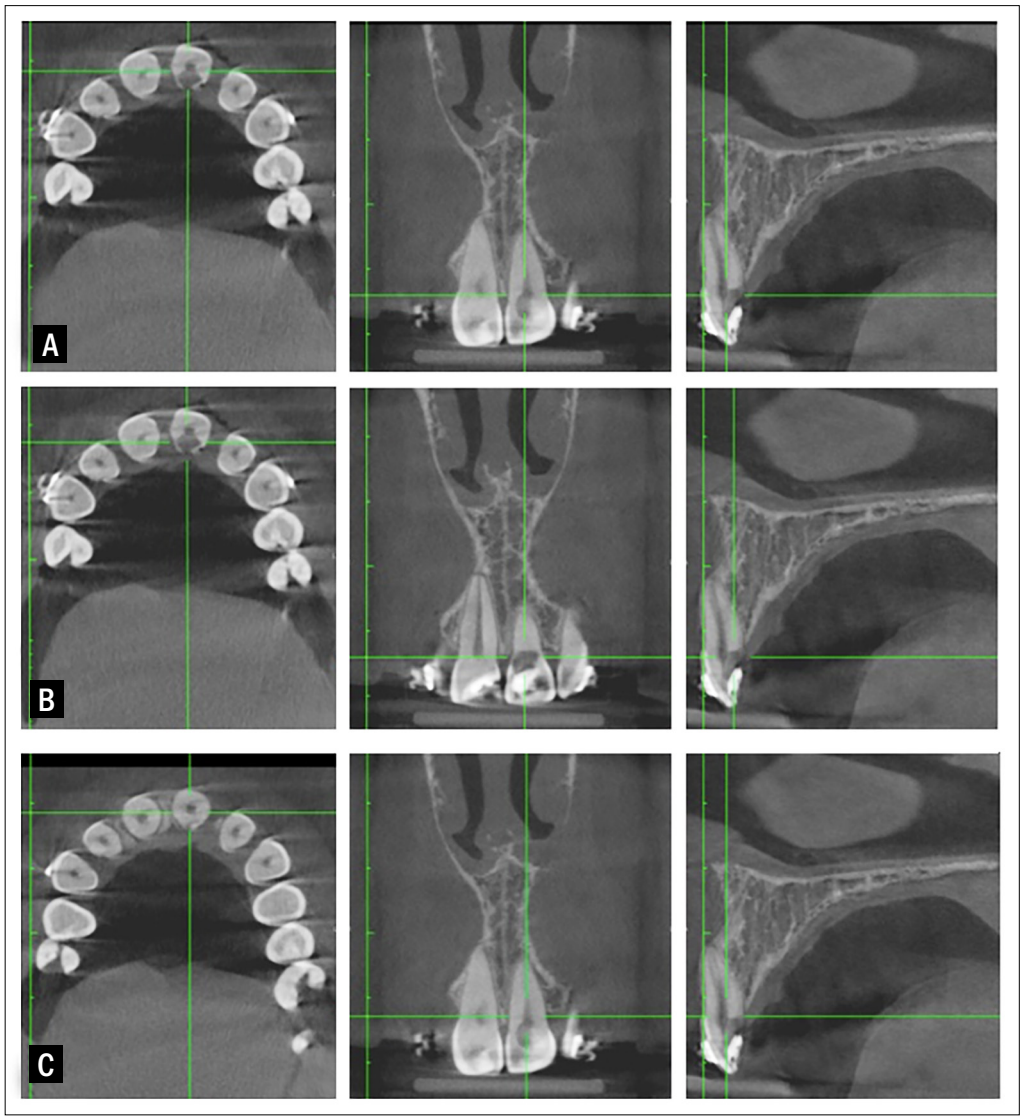


Figure 8
Cone-beam computed tomography images of Case 2.

were decided; otherwise, internal repair would have been performed while maintaining vitality under observation. The patient was informed about treatment possibilities and options and agreed to undergo the root canal treatment and repair of the resorption area.

For better isolation, removing the wire from the brackets before beginning endodontic treatment is recommended. The tooth was anaesthetised and isolated with multiple isolations to avoid interference between the clam and the ECR. To obtain concrete isolation in the palatal part, a double-knotted ligature was placed in tooth #21 to push and maintain the dental dam apically (Fig. 6a). Access was gained through a long round diamond bur 0.016 tip (D&Z DIAMANT) under an operatory microscope, and the resorption site was thoroughly cleaned using a bur and 90% aqueous trichloroacetic acid placed on a microbrush.

After cleaning the resorption, the root canal was accessed with K-file #10, and patency was obtained. The working length was measured electronically using an apex locator (Morita Root ZX Mini, J. Morita Corp). Chemical preparation, debridement, and obturation were performed following the protocol described for Case 1 (Fig. 6b). In this case, a gutta-percha cone 45 was fitted and, the single-cone technique with a bioceramic sealer was performed. During

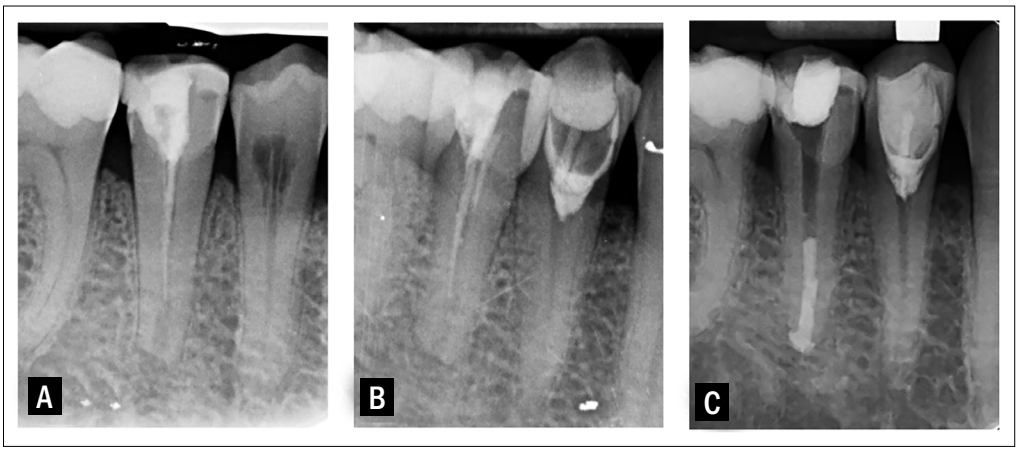


Figure 9
Periapical radiographs of Case 3.

the same session, while maintaining the same isolation, the cleaned ECR site was repaired using direct composite restoration (Fig. 7b).
Follow-up was performed after 2 years. The patient then underwent orthodontic treatment. No clinical or radiographic findings (Fig. 7c) were observed, and the tooth became fully functional and aesthetically stable without the need for bleaching.

Case 3
A young greek male (35 years old) was referred by his general physician after noticing a strange finding using periapical radiography. A lesion was observed in the cervical area of tooth #44 using characteristic ECR imaging. CBCT revealed a lesion in the crown of #44, extending from the cervical to the medial area of the crown (supracrestal). Small communication was observed lingually at the cemento-enamel junction level (1 Bd) (15). Clinically, there was no evidence of communication or caries. A small probing (5 mm deep) was found at the communication site. Vitality was positive in both cold and electric tests. The patient had no relevant complaints.
After informing the patient about the condition of the tooth and the possible implications if not treated, the patient agreed to proceed with internal reparation of the ECR aiming to avoid further demineralisation and maintain the vitality of the #44 as long as possible.
After anaesthesia, multiple isolations were performed, and the dental dam was positioned apically with a double-knotted ligature. Access was obtained using a long round diamond bur 0.012 tip (D&Z DIAMANT) under an operating microscope. The ECR was cleaned carefully using a long

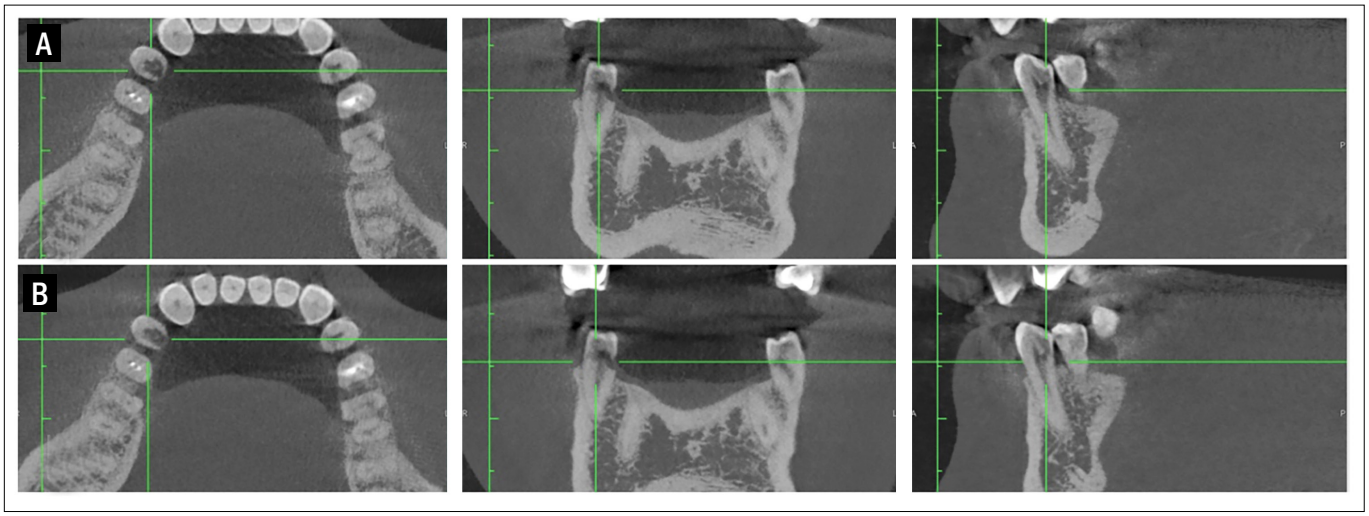


Figure 10
Cone-beam computed tomography images of Case 3.

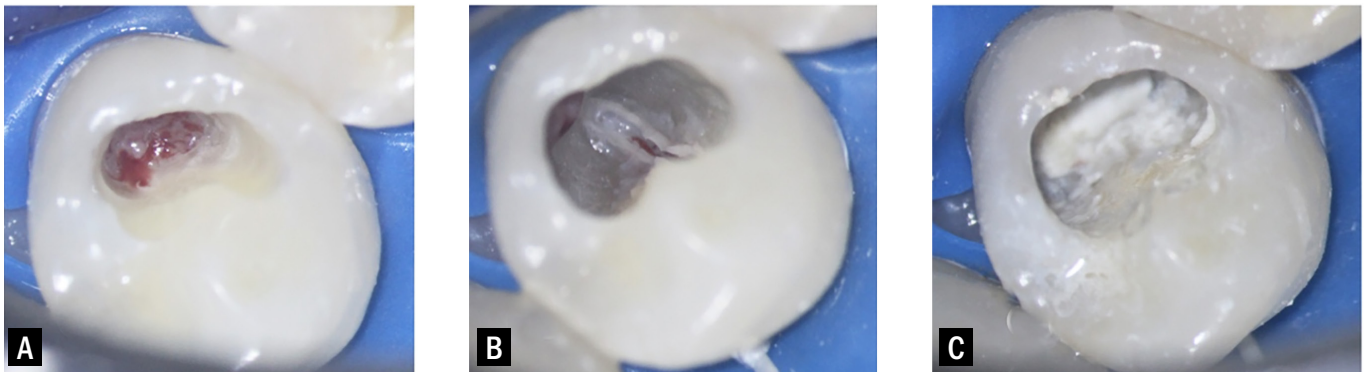


Figure 11
Clinical images of Case 3.

round bur; using 90% aqueous trichloroacetic acid placed on a microbrush, the bleeding sites around the pulp chamber were carefully scraped. During the cleaning of the resorption, communication with the pulp chamber was created owing to the extension of the ECR. The minor bleeding from the pulp was controlled using sterile cotton pellets soaked in NaOCl (5.25%). After cleaning, the cavity was washed with saline solution, and pulp caping was performed using a bioceramic premixed putty Total Fill Putty Fast Set (FKG Dentaire). After 15 min, to avoid excessive contact with the pulp-capping site, a very thin and small layer of flowable composite material was placed and polymerised above the bioceramic capping. Subsequently, bonding was performed to the entire cavity using a self-etching primer and bonding Optibond XTR (Kerr Dental, Brea, Canada), and a thin layer of flowable material (Revolution, Kerr Dental) was placed and polymerised. Finally, the composite restoration was positioned in the cavity.
Follow-up was performed after 2 years. Vitality was positive, and the tooth was fully functional. At the follow-up, the patient mentioned difficulty while chewing with tooth #45, which seemed symptomatic, and root canal retreatment had to be performed. In a clinical follow-up to the second treatment the patient was fully satisfied about the functionatily of the treated territory.

Discussion

ECR is a pathological process that can lead to significant loss of tooth structure and result in tooth loss if left untreated or not diagnosed during the early stages. The decision to maintain a resorbed tooth should be made on a case-by-case basis, taking into consideration various factors, such as the extent and location of the resorption, patient's overall dental health, and treatment options available. In the three cases described above, the majority of treatment options for ECR aimed to maintain resorbed tooth function (11). ECR treatment options vary from external and internal repair to intentional reimplantation, extraction, periodic follow-up, or also regenerative endodontic treatment (RET) (16) depending on the severity of the case and the extent of resorption of the dental tissue and crestal bone. As reported previously, in heavily compromised teeth (class 3 or 4 resorption), the outcome of external repair is poor, making this treatment option less favourable in such cases (11).
Intentional reimplantation is reported to be a cost-effective and predictable treatment, especially for ECR lesions (17,18); however, it is usually preformed in cases with minor resorption in dentin and difficulty in restoration (17,19). Periodic follow-up is always an option for heavily compromised teeth with no symptoms and no treatment possibilities, provided that no further problems occur owing to the compromised tooth. In the first case, even if tooth #41 was asymptomatic, there was severe periodontal lesion involvement, and further delay would have led to problems in future restoration of the area. In this case, extraction and implant replacement appear to be the most cost-effective and long-lasting choices (20). As for the regenerative endo-

dontic treatment (RET) as a treatment option, even though it would be a promising treatment option, there is still no solid evidence about positive outcomes of such treatment (16).
Successful clinical outcomes of resorption cases depend largely on early detection and accurate differential diagnosis. It is essential to differentiate between internal and external tooth resorption, which can be achieved through radiographic examination and an understanding of the internal root anatomy. The advent of diagnostic aids such as magnification and CBCT has further improved the accuracy of diagnosis, enabling predictable treatment and enhancing the prognosis. In addition to the fact that CBCT is fully recommended in such cases by the European Society of Endodontology (20) and Joint American Association of Endodontists/ American Academy of Oral and Maxillofacial Radiology Position on Cone Beam Computed Tomography (21), CBCT can be used to identify the location and extent of resorption more accurately and in detail, enabling clinicians to plan appropriate treatment strategies. With the help of advanced image-processing techniques, CBCT images can be enhanced to improve the visualisation and detection of resorption areas. This has significant implications for the management of patients with root resorption because early detection can lead to improved outcomes and prognosis.
All presented cases were treated in a single visit. Single-visit endodontic management is recommended in cases in which recontamination of root canals can be prevented (11). When ECR is extended and communication with the root canal space occurs during treatment, an interappointment is recommended to obtain the correct coagulation through calcium hydroxide (22); nevertheless, with the use of anatomical instruments, it is possible to clean the root canal space thoroughly and obtain a perfectly dry root canal space in a single visit (23). The use of bioactive filling materials for the root canal space and as dentine substitutes is likely to prevent the osteoclastic activity of any ECR cell possibly remaining at the site during the high phase and thus prevent resorption (24).

It is known that the significnance of case reports and cases series is lower in comparison to clinical trials and RCTs, but ECR is a rare and difficult to treat condidion and data about treatment and survival of resorbed teeth are not really available. Even though there are articles describing management options of different conditions (10, 20), most references about optimal treatment of ECR is bases on case reports. (24-28).

Conclusion

ECR is a severe condition in affected teeth that can lead to tooth loss if not diagnosed on time. Despite the limited number of cases reported, this article underlines the importance of early diagnosis, treatment planning, and appropriate material use for maintaining the function of resorbed teeth in the mouth. Further clinical studies are needed in the future, for a better appreciation of ECR and the treatment options.

Clinical Relevance

Cervical resorption is an invasive and silent wear to sound teeth witch can easily lead to a complete loss. With prompt diagnosis and correct planification, these lesions can be treated maintaining the tooth and sometimes also tooth's vitality.

Conflict of Interest

No conflict of interest present in the current study.

Acknowledgments

The author declares no fundings were provided.

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