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IMAGINOLOGICAL ASPECTS OF EXTERNAL CERVICAL RESORPTION: CASES REPORT AND INTEGRATIVE LITERATURE REVIEW

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ABSTRACT

External cervical resorption (ECR) is a rare pathological resorptive process that can lead to tooth loss due to its aggressive yet asymptomatic nature. The aim of this study was to report two clinical cases of external cervical resorption and review the literature regarding the imaging features of this condition. In case 1, the patient radiographically presented an extensive, irregular radiolucent lesion on tooth 46, extending from the crown to the cervical

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third of the root, with preservation of the root canal space. The diagnostic hypothesis was external cervical resorption. Cone-beam computed tomography (CBCT) images revealed the presence of a large, irregular resorptive lesion affecting the mesial and lingual surfaces of the tooth crown, extending to the furcation area and cervical third of the roots. Based on the CBCT images, the ECR lesion in Case 1 was classified according to Patel's system as 3Cp. Due to the extent of the lesion, tooth extraction was recommended. In case 2, the patient exhibited an ECR 2Bd lesion on tooth 37. The resorptive tissue was removed, indirect pulp capping was performed, followed by restoration with glass ionomer cement. After 8 months, a definitive composite resin restoration was placed. With a 3-year follow-up, the patient showed pulp vitality and no signs of ECR progression. In tomographic sections, ECR presents as lesions that may be symmetrical or asymmetrical. The lesion margins can range from well-defined and smooth to poorly defined and rough, with no clear boundaries between the lesion and normal dental tissues. Imaging findings were crucial for diagnosing ECR in these cases, and the use of CBCT was essential in this process, as it enabled a detailed assessment of the condition.

Keywords: External Cervical Resorption. Radiographic Features. Cone-Beam CT.

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INTRODUCTION

Invasive cervical resorption (ICR) or external cervical resorption (ECR) is a pathological resorption process that begins on the external surface of a tooth above the alveolar bone crest and gradually replaces the mineralized dental structure with fibrovascular granulomatous tissue or fibro-osseous tissue (ROTONDI; WALDON; KIM, 2020). It is considered a rare pathology, with a prevalence ranging from 0.02% to 2.3% (ROTONDI; WALDON; KIM, 2020; GIJON *et al*., 2016), but of extreme relevance, as it can lead to tooth loss due to its aggressive yet asymptomatic nature (IRINAKIS *et al.,* 2020).

The etiology remains unclear, although several potential predisposing factors have been identified and associated with this condition (PATEL *et al.,* 2018), indicating that it is a multifactorial entity (IRINAKIS *et al.,* 2020). Factors such as orthodontic treatment (ROMAGNI et al., 2024), a previous history of traumatic injury (luxation and avulsion), restorative and endodontic procedures, internal bleaching with hydrogen peroxide, and dentoalveolar surgery are the main associated factors (TRONSTAD, 1998; MAVRIDOU; HAUBEN; WEVERS, 2016; PATEL *et al.,* 2018; TALPOS-NICULESCU *et al.*, 2021).

Clinically, when the lesion is visible, its appearance can vary from a small defect at the gingival margin to a pinkish discoloration of the tooth crown (GIJON *et al*., 2016; TALPOS-NICULESCU *et al.*, 2021; PATEL *et al.*, 2023). This discoloration is the result of highly vascular granulation tissue (resorption) inside the tooth, which becomes visible through the resorbed dentin and overlying translucent enamel (GIJON *et al*., 2016). Due to its asymptomatic and insidious nature, the lesion is often discovered through imaging performed for other purposes.

From a radiological perspective, lesions can be symmetrical or asymmetrical. Their margins can range from well-defined and smooth to poorly defined and rough, or without clear boundaries between the lesion and normal dental tissues (PATEL, 2015). ECR can appear radiolucent (if the lesion is identified in its active resorption phase), radiopaque (if the lesion is detected in the repair phase as a result of ossification of the granulation tissue), or a combination of both phases (the lesion appearing both radiopaque and radiolucent) (GUNST et al., 2013; MAVRIDOU; HAUBEN; WEVERS, 2016). Periapical radiographs are essential for the diagnosis of ECR. However, it is well-established that they provide limited information on dentoalveolar anatomy due to their two-dimensional nature, geometric distortion, and anatomical noise (PATEL, 2015).

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In light of this, cone-beam computed tomography (CBCT) has become an increasingly important imaging tool in the diagnosis and treatment planning of external cervical resorption. CBCT allows visualization in three planes, without overlap of adjacent structures and geometric distortions (VIANA *et al*., 2023). This enables a detailed assessment of ECR and its geometric relationships (REZENDE, 2022). Preoperative CBCT helps identify the true nature of the resorption, providing valuable information that can aid in establishing an appropriate treatment plan (PATEL *et al.,* 2018).

The treatment of ECR depends on the severity and location of the resorptive defect, as well as the restorability of the tooth (MONA *et al.,* 2021). Depending on the extent of the damage, two main therapeutic strategies can be proposed: internal and/or external repair (ROTONDI; WALDON; KIM, 2020). The external approach consists of surgical treatment, including flap surgery, and non-surgical treatment, such as the topical application of trichloroacetic acid (TCA) to the resorptive lesions (HEITHERSAY, 1999; HEITHERSAY, 2004; LOIOLA et al., 2024). The internal approach is used to access the lesions non-surgically through endodontic access, followed by restoration of the resorptive cavity (ROTONDI; WALDON; KIM, 2020).

Therefore, considering that external cervical resorption is of great clinical relevance and has a multifactorial etiology, the aim of this study was to report two clinical cases of external cervical resorption and analyze the literature on the imaging aspects of this lesion.

METHODOLOGY AND CASE REPORTS

This study is an integrative literature review. A bibliographic search was conducted in April 2024, in the PUBMED and Virtual Health Library (VHL) databases using the descriptors "external cervical resorption," "cone beam computed tomography," and "endodontic," combined with the Boolean operator "AND." A total of 55 articles were found, with 40 in PUBMED and 15 in the VHL. Inclusion criteria were articles published in the last 10 years in English or Portuguese. Case reports/series, duplicate articles, and those unrelated to the topic were excluded. In the end, 8 articles were selected for full-text reading.

CLINICAL CASE 1

A 28-year-old male patient, systemically healthy, was referred for endodontic treatment of the right mandibular first molar (#46) due to deep caries. During the

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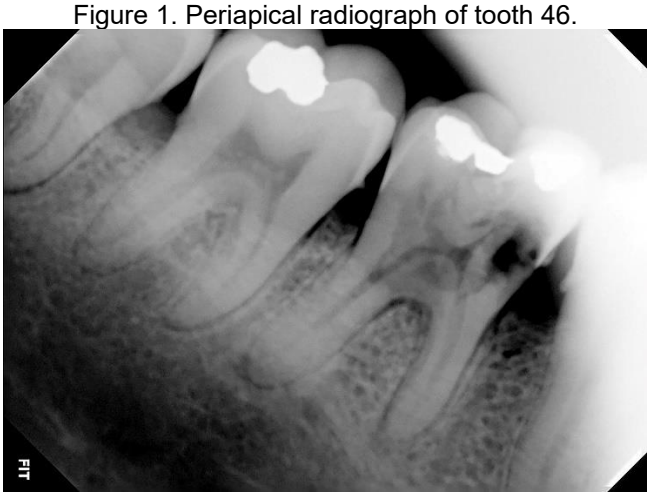
anamnesis, the patient reported wearing orthodontic braces for 4 years and experiencing no pain in the affected tooth. Upon intraoral examination, extensive subgingival tooth loss was observed on the mesial and lingual surfaces of tooth #46, which showed a negative response to cold sensitivity testing (EndoIce; Maquira Indústria de Produtos Odontológicos S.A., Maringá, PR, Brazil) and a normal response to vertical and horizontal percussion tests.

Radiographic examination (Fig. 1) revealed extensive dentinal resorption, with both radiolucent and radiopaque areas affecting the entire crown, the cervical third of the distal root, and the furcation area, while maintaining the integrity of the root canal boundaries. The radiographic analysis suggested a possible entry point for resorption on the mesial surface of the tooth crown, which appeared completely radiolucent, indicating communication with the external environment. Additionally, bone loss was observed in the furcation area, along with apical thickening of the roots. Given the extensive lesion shown on the radiograph, a cone-beam computed tomography (CBCT) scan was requested for better case planning. Based on clinical and imaging findings, the tooth was diagnosed with external cervical resorption.

Figure 1. Periapical radiograph of tooth 46.



Source: own authorship

The 3D reconstruction images from the CBCT of tooth #46 showed significant resorption of dental tissue on the lingual surface, affecting the cervical third of the crown, the furcation area, and the cervical third of both the mesial and distal roots (Fig. 2). The axial CBCT slices revealed extensive dentinal resorption in the middle third of the crown, surrounding the pulp chamber, with an entry point on the mesial surface of the crown (Fig. 3A). Additionally, there was significant resorption of the cervical third of the root on the

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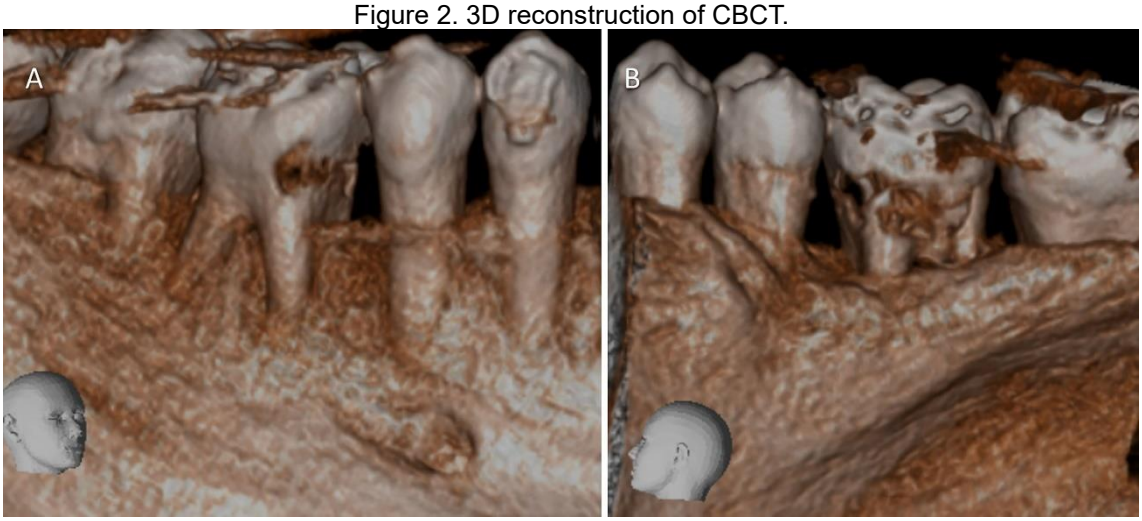
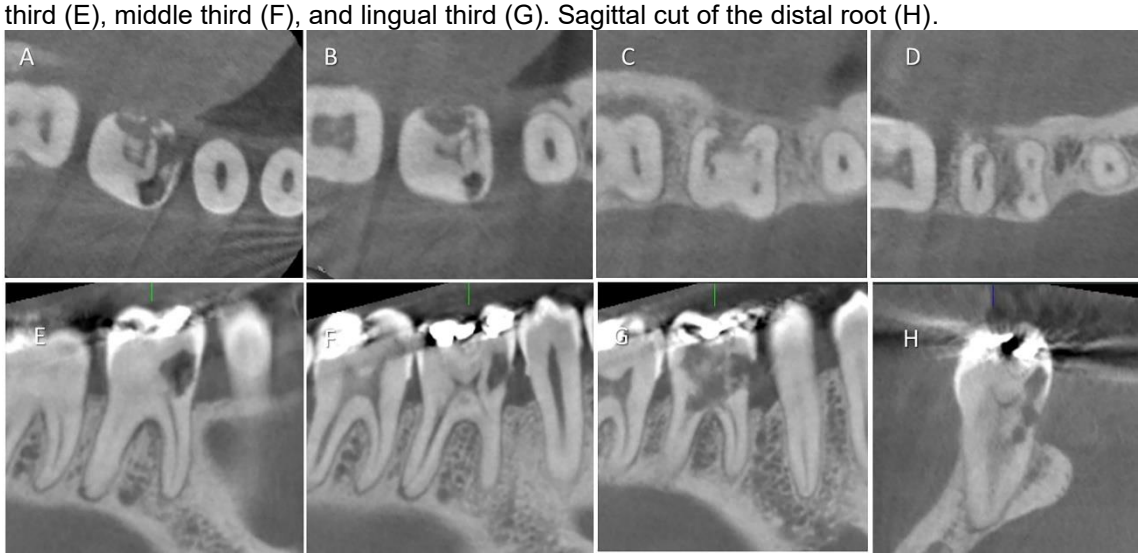
lingual surface (Fig. 3B), the furcation area with communication to the distal root canal (Fig. 3C), and root resorption of the distal root with communication to the periodontium (Fig. 3D). The coronal CBCT slices exhibited resorptive lesions in the buccal and middle thirds of the tooth (Fig. 3D and 3E), as well as extensive resorption affecting the entire lingual surface of both the crown and root portions (Fig. 3F). The sagittal slice revealed dentinal resorption on the lingual surface of the distal root, extending to the middle third of the root (Fig. 3H).

Figure 2. 3D reconstruction of CBCT.



Source: own authorship

Figure 3. Axial cuts of the CBCT showing significant dental resorption in the coronal middle third (A), coronal cervical third (B), radicular cervical third (C), and radicular middle third (D). Coronal cuts of the CBCT of the buccal third (E), middle third (F), and lingual third (G). Sagittal cut of the distal root (H).



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Considering Patel´s classification (2018), this lesion can be categorized as 3Cp, as the tomographic sections show lesion extension to the middle third of the root, with circumferential dentin loss between 180º and 207º, and probable pulp involvement.

Given the CBCT findings of this external cervical resorption lesion and the difficult surgical access from the lingual side of the tooth, the patient was informed about the pathology, the complexity of the access, and the tooth's longevity. Extraction was recommended.

CLINICAL CASE 2

A 51-year-old female patient, systemically healthy, was mistakenly referred for endodontic treatment of the left mandibular second molar (#37) due to a radiographic image obtained during pre-extraction examinations for the third molar (#38). The radiograph showed a suspected carious lesion on the distal surface, apparently invading the pulp chamber, and signs of resorption due to the impaction of tooth #38. The patient reported that during an initial intervention, an attempt was made to perform endodontic access, but it was unsuccessful due to intense pain. A few months after this episode, the patient sought treatment in a private clinic. Semiology tests (thermal tests, horizontal and vertical percussion, and palpation) indicated normal pulp health, with no need for endodontic intervention at that time.

In the radiographic examination (Fig. 4), dentinal resorption with radiolucent areas was observed, affecting the cervical third of the distal root of tooth #37, while maintaining the boundaries of the root canals. Radiographic analysis suggested a possible entry point for the resorption on the distal surface of the crown, below the cementoenamel junction. Based on clinical and radiographic findings, the tooth was diagnosed with external cervical resorption. Due to the difficulty of accessing the distal region of tooth #37, as much granulation tissue as possible was removed using long-shank dentin excavators (no. 17) and copious irrigation with saline and 2% chlorhexidine solution. A provisional restoration with glass ionomer cement was then placed to monitor the progression of the clinical condition. Additionally, CBCT images were requested for further evaluation of the case (Fig. 5).

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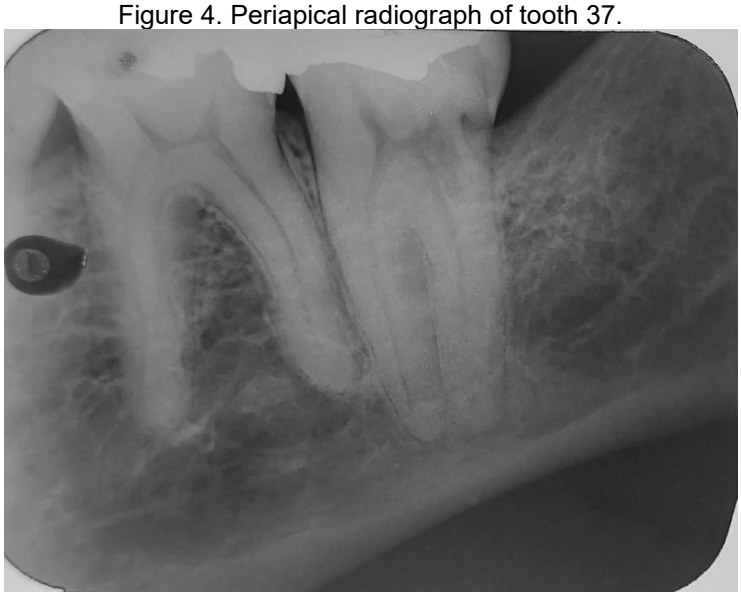
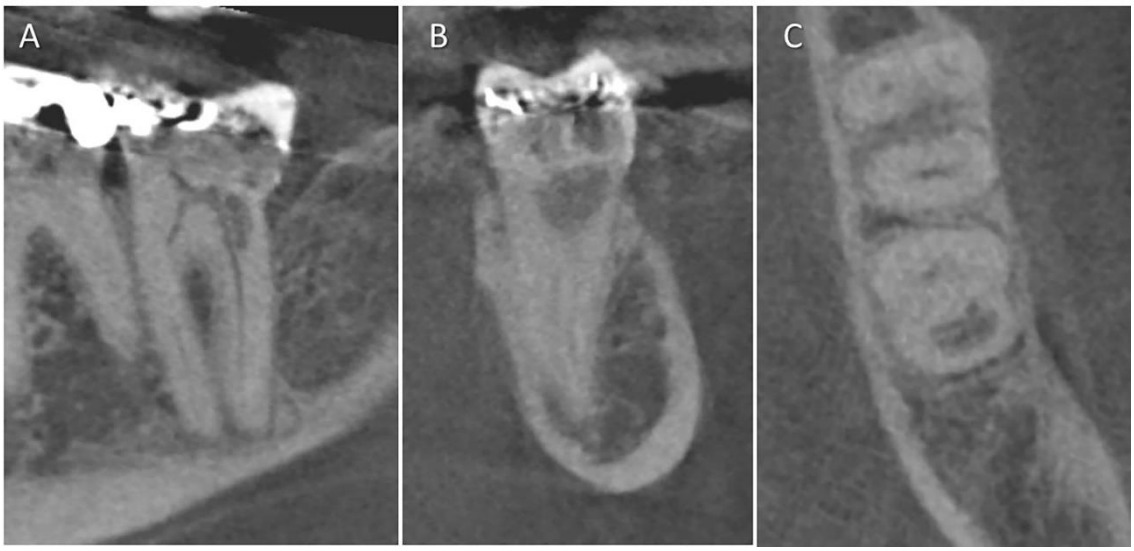
Figure 4. Periapical radiograph of tooth 37.



Source: own authorship

Figure 5. Coronal cut of the CBCT showing significant dental resorption in the dental crown and cervical third of the root (A). Sagittal cut of the distal root (B). Axial cut showing dental resorption in the radicular cervical third (C).



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Based on the 3D images, it was determined that, according to Patel's classification, this was an External Cervical Resorption (ECR) 2Bd, with a possible entry point on the distal surface due to the impaction of the third molar. Hypodense areas were identified at the subcrestal level, invading the coronal third with circumferential spread > 90º ≤ 180º, showing proximity to the pulp cavity but without pathological involvement. The patient returned 8 months later, asymptomatic, with no signs of possible resorption progression. During this session, a definitive restoration was performed using nanoparticulate composite

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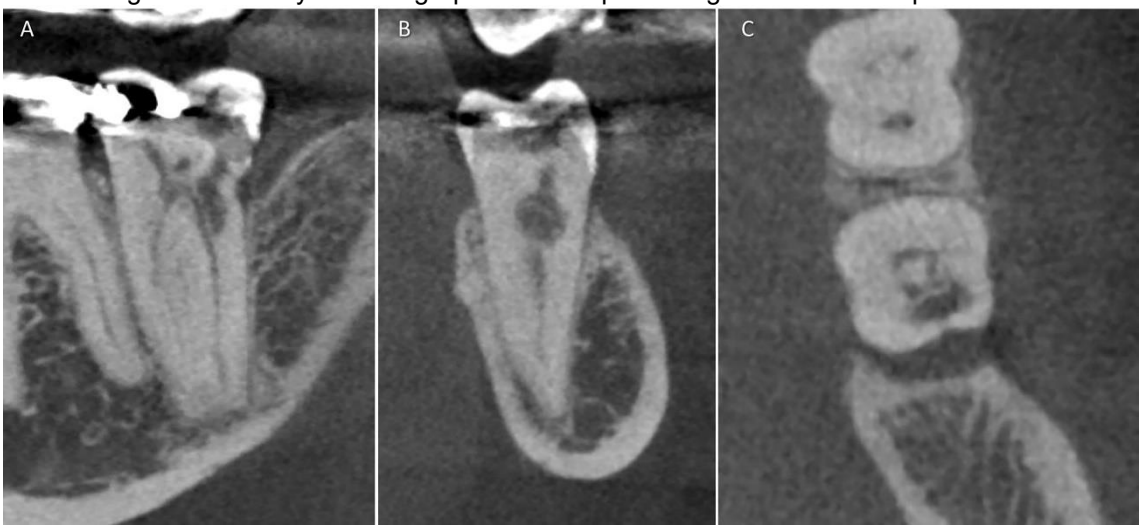
resin (3M™ Filtek™ Z350XT). In subsequent 3-year follow-up appointments, the ECR remained stable and controlled, with the tooth maintaining pulp vitality (Fig. 6).

Figure 6. Three-year tomographic follow-up showing controlled resorption area.



Source: own authorship

RESULTS AND DISCUSSION

All the articles used in this literature review are succinctly described in Table 1.

Table 1. Description of the articles used in the bibliographic review.

Author/Year	Objectives	Conclusion
Vaz de Souza et al., 2016	The aim of this study was to compare the diagnostic efficacy of two cone beam computed tomography (CBCT) units with periapical radiographs (PA) for the detection and classification of simulated external cervical resorption (ECR) lesions.	This study revealed that both CBCT scanners were equally accurate in diagnosing RCT and significantly better than PA radiography. CBCTs were 30% more accurate than periapical radiographs. CT scans were more likely to correctly categorize RCT according to the Heithersay Classification compared with PA radiography.
Gijon et al., 2016	The aim of this study was to perform a brief review of the etiology, pathology, histology, clinical diagnosis and therapeutic options of invasive cervical resorption.	This study concluded that RCE is a difficult pathology to diagnose. Early detection is essential for the best management of resorption; the dentition must be carefully evaluated, along with the identification of etiological factors. CBCT provides the best information about the true extent of the lesions, helping the dentist to recommend the most appropriate treatment without the need for prior surgical exploration. It was also concluded that the treatment of RCE requires the management of a wide range of multidisciplinary techniques

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		such as restorative dentistry, endodontics, surgery, implants and prosthetics.
Goodell et al., 2018	The aim of this study was to compare treatment plans for external cervical resorption (ECR) developed from periapical (PA) radiographs and cone beam computed tomography (CBCT). The secondary aim of this study was to test a new classification system for ECR based on analysis of axial CBCT slices.	Interrater agreement was uniformly higher with CBCT images, and treatment plans developed from CBCT scans differed from those developed with PA radiographs in 56.7% of cases. If CBCT imaging is available, the Rohde classification system can help guide treatment planning for RCE cases. This classification consists of: 1. Significant dentin resorption in less than one third of the tooth; 2. Significant dentin resorption in less than one-third of the circumference with a presumed perforation defect of 2.5 mm or greater in any dimension; 3. Significant dentin resorption involving more than one-third of the tooth circumference.
Talpos-Niculescu et al., 2021	The aim of this literature review is to cover the relevant literature relating to the etiology, pathogenesis, clinical and radiological presentation and management of RCTs (based on cone beam computed tomography (CBCT) findings).	External cervical resorption (ECR) remains a relatively uncommon pathology that leads to loss of dental hard tissues due to osteoclastic activity. As its multifactorial aetiology is poorly understood, further research is needed to establish the cause and effect relationship of all aetiological factors. Improved radiographic detection by cone beam computed tomography (CBCT) allows for accurate diagnosis, more precise classification of the lesion and leads to a more predictable treatment plan for the benefit of patients.
Cunliffe et al., 2021	To assess differences in diagnostic ability between dentists and dental students using two different imaging modalities, periapical radiography and CBCT. To investigate differences in diagnosis; and to create a simple and reproducible in vitro model of ECR lesion that will be used to mimic and explore ECR lesion in extracted teeth.	The probability of a case being diagnosed as RCE and actually exhibiting RCE was 79.9% in the case of intraoral radiographs compared with 91.5% in the case of CBCT. The probability of a case not being diagnosed as RCE and actually not exhibiting RCE (NPV) was 19.9% in the case of intraoral radiographs compared with 29.5% in the case of CBCT. The use of intraoral radiographs alone may not be sufficient to correctly identify and diagnose RCE lesions. CBCT may give a better idea about the nature and extent of the lesion.
Rodriguez Mazón et al., 2022	The aim of this study was to determine the influence of CBCT images on clinical decision choices among different specialists (prosthodontists, endodontists, oral	Computed tomography had a significant impact on clinical decision-making in RCE cases evaluated by different specialists. The study suggests that more diagnostic information can be obtained from a preoperative CBCT image than from a preoperative PA radiograph and that this information can directly influence the

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	surgeons and periodontists) in endodontic treatment planning.	practitioner's treatment plan, particularly in highly difficult cases.
Patel et al., 2023	To determine the prevalence of symptoms, clinical signs and radiographic presentation of external cervical resorption (ECR)	RCE appears to be quiescent in nature, with the majority being asymptomatic and incidentally diagnosed by PA or CBCT. When assessed by the Patel classification, most lesions were minimal to moderate in height (1 or 2) and circumferential extent (A or B). However, most RCEs were (proximate to) the pulp. Clinical symptoms and signs were associated with the (probable) pulp involvement rather than the height and circumferential distribution of the lesion. Clinical signs were more frequently associated when the lesion affected multiple surfaces.
Nosrat et al., 2023	The aim of this study was to evaluate the temporal evolution of external cervical resorption (ECR) using a volumetric quantification method.	Fifteen patients with 20 teeth diagnosed with ECR and a mean progression time of 21 months were included. Nine teeth (45%) showed a change in the three-dimensional classification over the progression time. The volume of resorptive defects and the volumetric ratio of resorptive defects/teeth increased over time along with the prevalence of root surface perforations. Thus, if left untreated, ECR defects may increase in size and develop more perforations on the root surface. ECR is dynamic in nature and its volumetric increase over time does not result from uniform/linear expansion of the defects.

Source: own authorship

External cervical resorption (ECR) is a poorly understood and often destructive form of resorption, originating from clastic cells in the periodontal ligament that invade the dentin, forming fibrovascular tissue due to a defect in the cementum layer (VAZ DE SOUSA *et al*., 2017; PATEL *et al*., 2023; NOSRAT *et al*., 2023; MOHAMMAD-RAHIMI *et al.,* 2024). Patel *et al*. (2023) observed in their study that the highest prevalence of external cervical resorption was found in males (54.5%) with an average age of 41.5 years. The most affected teeth were the maxillary central incisors (21.4%) and mandibular first molars (10.2%).

The etiology of ECR remains uncertain and is considered a multifactorial entity (MAVRIDOU; HAUBEN; WEVERS, 2016; VAZ DE SOUSA *et al*., 2017; GOODELL; MINES; KERSTEN, 2018; PATEL *et al.,* 2018; TALPOS-NICULESCU *et al*., 2021). However, several

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predisposing factors have been recognized and associated with this condition, such as orthodontic treatment (GOODELL; MINES; KERSTEN, 2018; NOSRAT *et al*., 2023), a history of traumatic injuries like luxation and avulsion (GIJON *et al*., 2016; GOODELL; MINES; KERSTEN, 2018; TALPOS-NICULESCU *et al*., 2021), parafunctional habits (MAVRIDOU; HAUBEN; WEVERS, 2016), restorative and endodontic procedures (GIJON *et al*., 2016; TALPOS-NICULESCU *et al*., 2021), dentoalveolar surgery (GOODELL; MINES; KERSTEN, 2018; NOSRAT *et al*., 2023), and internal bleaching with 30% hydrogen peroxide (GOODELL; MINES; KERSTEN, 2018; NOSRAT *et al*., 2023). Among the potential predisposing factors, orthodontic treatment and its combinations have been identified as one of the primary risks for ECR (MAVRIDOU; HAUBEN; WEVERS, 2016). Based on the etiological factors found in the literature, orthodontic appliance use could be considered a probable causative factor for the resorption in Case 1, as the patient reported using it for 4 years. Additionally, the patient had undergone restorative treatment and had no prior history of dental trauma.

It is believed that external cervical resorption occurs in three general stages: an initiation stage, an active resorption stage, and a reparative stage. It is important to note that these three stages can occur simultaneously in different areas of the same tooth (MAVRIDOU; HAUBEN; WEVERS, 2016; GOODELL; MINES; KERSTEN, 2018). In the first stage (initiation), damage occurs to the periodontal ligament, leading to the formation of a blood clot and the initiation of a local inflammatory process, along with granulation tissue formation. The granulation tissue can then reach the dentin, if exposed, making it vulnerable to resorption. The site where the resorption process begins is called the "entry point," which is located beneath the junctional epithelium (MAVRIDOU; HAUBEN; WEVERS, 2016). Subsequently, a stimulating factor is required for resorption to continue, such as infection (bactéria), continuous mechanical force on the PDL (e.g., during orthodontic treatment) (GOLZ; MEMMERT; RATH-DESCHNER, 2015) or intermittent mechanical load (ARNETT; MASSEY; UTTING, 2003).

During the progression of resorption (second stage), the destruction of cementum, dentin, and enamel occurs, advancing toward the pulp and leading to three-dimensional resorption; however, the lesion rarely penetrates the pulp due to a resistant layer known as the pericanalar zone (GOODELL; MINES; KERSTEN, 2018). As the resorptive process progresses, the pulp maintains its vitality, and it is believed that the high resistance of the pericanalar dentin is due to this pulpal vitality and the mineralization gradient of this dentin

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layer (MAVRIDOU; HAUBEN; WEVERS, 2016). In the reparative stage, the reabsorbed dental tissues are replaced by mineralized tissue similar to lamellar bone. The reparative mineralized tissue is gradually formed and fills the resorption cavity from the outside toward the pulp, beginning at the entry point (MAVRIDOU; HAUBEN; WEVERS, 2016).

The diagnosis of ECR is primarily made through routine examinations. Due to its asymptomatic nature, by the time the first clinical signs appear, the lesion is often already in an advanced state. When the lesion is visible, its appearance can range from a defect at the gingival margin to a pinkish coloration on the crown of the tooth (GIJON *et al.,* 2016). This pink coloration is typically the first clinical sign observed by the patient and results from the highly vascular granulation tissue formed in the resorptive area, becoming visible due to the translucency of the enamel (PATEL; FORD, 2007).

In most cases, it remains unnoticed until a pulp or periodontal problem arises (TALPOS-NICULESCU *et al.*, 2021). Additionally, when teeth with external cervical resorption (ECR) are subjected to periodontal probing, they may exhibit a discontinuity in the region and bleeding from the granulation tissue (REZENDE, 2022). According to Patel *et al.* (2023), the diagnosis of ECR was most commonly identified through incidental radiographic findings in 58.1% of cases. Furthermore, among the clinical findings, pulp/periapical disease was observed in 23.3% of cases, and clinical signs were present in 16.7%. Among endodontic lesions, chronic apical periodontitis was the most frequently found (46%), followed by irreversible pulpitis (42%), hypersensitivity, reversible pulpitis, and chronic apical abscess, each with 4%. The most common clinical signs were cavitation (14%), clinical symptoms (10.7%), pink spot (5.1%), and discoloration (2.8%). In the cases described in this article, patients were asymptomatic but showed clinical signs of cavitation and the presence of chronic apical periodontitis (case 1), corroborating the findings in the literature.

The resorptive condition is often detected through routine radiographic examination. Radiographically, ECR presents as a radiolucent image (active resorption phase) in the cervical region of the tooth, which may be well-defined or poorly delineated. However, in more advanced stages (repair phase), it may have radiopaque foci and even a combination of both, and this mottled appearance can be confused with dental caries (GIJON *et al.,* 2016; TALPOS-NICULESCU *et al.*, 2021; PATEL *et al.,* 2023). The contour of the root canal walls should be intact and traceable through the lesion; this distinguishes it from internal inflammatory resorption (PATEL *et al.,* 2018; CUNLIFFE *et al*., 2022).

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Heithersay (2004) developed a classification system to categorize external cervical resorption (ECR) according to its size and proximity to the root canal. The classification is based on conventional radiographs and categorizes ECR according to the penetration of the lesion into the coronal and radicular dentin: Class I, a small cervical lesion with superficial penetration into the dentin; Class II, a well-defined lesion close to the coronal pulp but with little or no extension into the radicular dentin; Class III, deeper invasion of the lesion in the coronal third of the root; Class IV, a lesion that extends beyond the coronal third of the root. This classification is only relevant if the ECR is limited to the proximal aspect of a tooth and can be clearly assessed in two dimensions. It becomes difficult to use when the lesion is located on the buccal/lingual aspect of the root or when assessing circumferential or pulpal involvement of the lesion. According to this classification, case 1 reported here can be considered one of the most severe forms of the disease, a Class 4, as the lesion had already affected the cervical third, extending into the middle third of the radicular dentin and the furcation area. Case 2 can be classified as Class 3, as it presents a lesion in the cervical third of the root

Periapical radiographs have some disadvantages that can lead to incorrect diagnosis, as the extent of the lesion can be distorted, resulting in either underestimation or overestimation of its size. Being a two-dimensional image, only the height and width of the lesion can be analyzed; details regarding depth and circumferential damage are minimal (TALPOS-NICULESCU *et al.*, 2021)**.** These limitations can be overcome with cone beam computed tomography (CBCT), which has proven to be more accurate in confirming the presence of external cervical resorption (ECR) (VAZ DE SOUSA *et al*., 2017; GOODELL; MINES; KERSTEN, 2018).

Vaz de Souza *et al*. (2017) compared the diagnostic efficacy of periapical radiographs with CBCT in detecting and classifying simulated ECR lesions using an ex vivo model based on Heithersay's classification. This study confirmed that CBCT had significantly higher sensitivity, specificity, and overall accuracy than periapical radiographs when assessing the size and location of ECR by 30%. The computed tomographies were more likely to correctly categorize ECR according to Heithersay's Classification compared to periapical radiography. These results raise questions about the validity and reliability of Heithersay's classification and may be explained by the limitations of using a two-dimensional examination to classify complex three-dimensional ECR lesions.

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Cone beam tomography allows ECR to be visualized in any plane without overlapping structures and geometric distortion (PATEL *et al.,* 2018)**.** According to Patel *et al.* (2015), ECR appears on CBCT as lesions that may be symmetric or asymmetric. Their margins can vary from well-defined and smooth to ill-defined and rough, or without clear boundaries between the lesion and normal dental tissues. For the assessment of ECR based on CBCT slices, two classifications have been proposed: those by Patel *et al*. (2018) and Rodhe (GOODELL; MINES; KERSTEN, 2018)**.**

Patel *et al.* (2018) proposed a new three-dimensional classification of external cervical resorption (ECR) based on the height of the lesion, circumferential extent, and proximity to the root canal. The height (coronal-apical extension) of the lesion is graded according to its maximum vertical extent within the root surface and at the level of the crestal bone. The level of the crestal bone in relation to the lesion is relevant for treatment planning. The root is divided into coronal, middle, and apical thirds, using the cemento-enamel junction and the apex as fixed reference points. The height of the lesion was categorized using periapical radiographs and coronal and sagittal slices from CBCT into: 1 - at the level of the cementoenamel junction or coronal to the crestal bone (supracrestal), 2 - extending to the coronal third of the root and apical to the crestal bone (subcrestal), 3 - extending to the middle third of the root, and 4 - extending to the apical third of the root. The circumference of the lesion was graded according to its maximum spread within the root through axial slices of the CBCT into A: ≤ 90°, B: > 90° and ≤ 180°, C: > 180° - ≤ 270°, and D: > 270°. The proximity of the lesion to the root canal was assessed using axial slices of the CBCT and categorized into d: lesion confined to the dentin and p: probable pulp involvement. This new three-dimensional classification of ECR aims to provide a precise diagnosis of the lesions, assess the follow-up of the treatment, and evaluate prognostic factors concerning the three-dimensional nature of ECR. Taking into account this tomographic classification by Patel et al.[5], we can categorize the lesion in case 1 reported in this study as 3Cp, since the tomographic slices show an extent of the lesion to the middle third of the root, with circumferential dentin loss between 180° and 207°, and probable pulp involvement. Case 2 presents a classification of 2Bd with a possible entry point through the distal aspect due to the impaction of the third molar. Hypodense areas are observed at the subcrestal level invading the coronal third with circumferential spread > 90° ≤ 180° near the pulp cavity.

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Goodell *et al.* (2018) also proposed a new classification system based on the analysis of axial slices from CBCT. This classification system, called the Rohde classification system, takes into account two important aspects of external cervical resorption (ECR): the amount of dentin loss in the cervical area and the amount of dentin loss on the outer surface of the tooth. The Rohde classes can be defined as Class 1: significant dentin resorption (resorption of more than half the original thickness of the axial wall) in less than one-third of the tooth's circumference; Class 2: significant dentin resorption in less than one-third of the tooth's circumference with a presumptive perforation defect of 2.5 mm or greater in any dimension, based on the expected dimensions of a perforation and/or communication with the periodontal ligament if repair were attempted; and Class 3: significant dentin resorption involving more than one-third of the tooth's circumference. In the axial slices of case 1 reported here, there is evidence of dentin loss in more than one-third of the tooth's circumference, classifying it according to Rohde as Class 3. Case 2 can be classified as Class 2.

The treatment plan for ECR mutually depends on a well-elaborated diagnosis with the aid of imaging examinations using periapical radiographs and/or cone-beam computed tomography (CBCT) **(**GOODELL; MINES; KERSTEN, 2018)**.** The use of CBCT for diagnostic evaluation and treatment has been demonstrated to be more effective through various studies (CUNLIFFE *et al.,* 2022; MAZON *et al*., 2022). The objective of treating ECR lesions is to allow the affected tooth to remain healthy and functional in the oral cavity while improving aesthetics when necessary. To achieve this, curettage of the resorptive tissue, sealing of the resulting defect and the entry point, and prevention of recurrence are performed (ROTONDI; WALDON; KIM, 2020; TALPOS-NICULESCU *et al.*, 2021), as done in case 2 of this article.

Factors related to the severity and location of the resorption defect, accessibility to the resorptive tissues, as well as the viability of dental restoration are essential for assessing treatment possibilities (MONA *et al.,* 2021). In this context, treatment can take an external approach with or without endodontic treatment and/or an internal approach with endodontic treatment, preservation, or tooth extraction (PATEL *et al.,* 2018). When a tooth has extensive ECR deemed untreatable, preservation may be proposed until the tooth becomes symptomatic or extraction may be considered (GIJON *et al.,* 2016). According to the clinical and imaging characteristics of case 1 reported in this study, which presents an extensive lesion in the furcation area affecting the cervical and middle thirds of the root, with

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subgingival involvement on the lingual surface of the tooth, extraction was suggested as the treatment due to the difficulty of accessing the resorptive area and significant dental compromise.

CONCLUSION

Although external cervical resorption is considered a rare pathology, it deserves special attention in the clinic because it has variable forms and may resemble other dental pathologies. ECR is dynamic in nature and increases over time, which can negatively impact the prognosis of the tooth. A thorough clinical examination, combined with tomographic examination, allows for a detailed assessment of the extent and location of this type of lesion, leading to an accurate diagnosis and identification of its evolutionary stage, which can define the best therapeutic approach.

CONFLICT OF INTEREST

none.

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REFERENCES

1. Arnett, T. R., et al. (2003). Hypoxia is a major stimulator of osteoclast formation from human peripheral blood. *Calcified Tissue International, 72*, 345–346.

2. Cunliffe, J., Al-Hadidi, A., et al. (2022). Comparison of imaging modalities in the diagnosis of external cervical resorption (ECR): An in vitro study. *Odontology, 110*(1), 157–163.

3. De Souza, D. V., et al. (2016). External cervical resorption: A comparison of the diagnostic efficacy using two different cone-beam computed tomographic units and periapical radiographs. *Journal of Endodontics, 43*(1), 121–125.

4. Gijón, V. R., et al. (2016). Aetiological, histopathological, clinical, diagnostic and therapeutical features of idiopathic cervical resorption. *Dental Update, 43*(10), 964–970.

5. Goodell, K. B., Mines, P., & Kersten, D. D. (2018). Impact of cone-beam computed tomography on treatment planning for external cervical resorption and a novel axial slice-based classification system. *Journal of Endodontics, 44*(2), 239–244.

6. Gölz, L., et al. (2015). Hypoxia and *P. gingivalis* synergistically induce HIF-1 and NF-κB activation in PDL cells and periodontal diseases. *Mediators of Inflammation, 2015*(1), 438085.

7. Gunst, V., et al. (2013). External cervical resorption: An analysis using cone-beam and microfocus computed tomography and scanning electron microscopy. *International Endodontic Journal, 46*(9), 877–887.

8. Heithersay, G. S. (1999). Invasive cervical resorption: An analysis of potential predisposing factors. *Quintessence International, 30*(2).

9. Heithersay, G. S. (1999). Treatment of invasive cervical resorption: An analysis of results using topical application of trichloroacetic acid, curettage, and restoration. *Quintessence International, 30*(2).

10. Irinakis, E., et al. (2020). External cervical resorption: A retrospective case-control study. *Journal of Endodontics, 46*(10), 1420–1427.

11. Li, M. L., et al. (2016). Compression and hypoxia play independent roles while having combinative effects in the osteoclastogenesis induced by periodontal ligament cells. *The Angle Orthodontist, 86*(1), 66–73.

12. Loiola, M., et al. (2024). Cirurgia parendodôntica: Um relato de caso. *ARACÊ, 6*(4), 12064–12073.

13. Mavridou, A. M., et al. (2017). Análise descritiva dos fatores associados à reabsorção cervical externa. *Journal of Endodontics, 43*(10), 1602–1610.

Revista ARACÊ
ISSN: 2358-2472

14. Mavridou, A. M., et al. (2016). Understanding external cervical resorption in vital teeth. *Journal of Endodontics, 42*(12), 1737–1751.

15. Mazón, M. R., et al. (2022). Influence of cone-beam computed tomography in clinical decision-making among different specialists in external cervical resorption lesions: A before-after study. *Journal of Endodontics, 48*(9), 1121–1128.

16. Mona, M., et al. (2021). A bioinformatics systems biology analysis of the current oral proteomic biomarkers and implications for diagnosis and treatment of external root resorption. *International Journal of Molecular Sciences, 22*(6), 3181.

17. Niklas, A., et al. (2013). The role of hypoxia in orthodontic tooth movement. *International Journal of Dentistry, 2013*(1), 841840.

18. Nosrat, A., Dianat, O., Verma, P., & Levin, M. D. (2023). External cervical resorption: A volumetric analysis on evolution of defects over time. *Journal of Endodontics, 49*(1), 36–44.

19. Patel, S. (2007). Is the resorption external or internal? *Dental Update, 34*(4), 218–229.

20. Patel, S., et al. (2018). External cervical resorption-part 1: Histopathology, distribution, and presentation. *International Endodontic Journal, 51*(11), 1205–1223.

21. Patel, S., et al. (2018). External cervical resorption: A three-dimensional classification. *International Endodontic Journal, 51*(2), 206–214.

22. Patel, S., et al. (2015). Cone beam computed tomography in endodontics–A review. *International Endodontic Journal, 48*(1), 3–15.

23. Patel, S., Abella, F., et al. (2023). Clinical and radiographic features of external cervical resorption – An observational study. *International Endodontic Journal, 56*, 1475–1487.

24. Rezende Soares, A. (2022). Diagnóstico e tratamento de reabsorção cervical invasiva: Relato de caso. *Brazilian Journal of Surgery & Clinical Research, 41*(1).

25. Rodríguez Mazón, M., Garcia-Font, M., Durán-Sindreu, F., & Abella, F. (2022). Influence of cone-beam computed tomography in clinical decision-making among different specialists in external cervical resorption lesions: A before-after study. *Journal of Endodontics, 48*(9), 1121–1128.

26. Romagni, G. P., Rossato, M. D. S., & Poli, R. C. (2024). Association of vitamin D receptor gene polymorphism with external apical root resorption in orthodontically treated patients. *ARACÊ, 6*(3), 7732–7741.

27. Rotondi, O., et al. (2020). The disease process, diagnosis, and treatment of invasive cervical resorption: A review. *Dentistry Journal, 8*(3), 64.

28. Talpos-Niculescu, R.-M., et al. (2021). External cervical resorption: Radiological diagnosis and literature. *Experimental and Therapeutic Medicine, 22*(4), 1065.

Revista ARACÊ
ISSN: 2358-2472

29. Tronstad, L., et al. (1988). Root resorption—Etiology, terminology, and clinical manifestations. *Dental Traumatology, 4*(6), 241–252.

30. Vaz de Souza, D., et al. (2017). External cervical resorption: A comparison of the diagnostic efficacy using two different cone-beam computed tomographic units and periapical radiographs. *Journal of Endodontics, 43*(1), 121–125.

31. Viana, F. L. P., et al. (2023). Periapical surgery with transsurgical filling of a tooth with extensive periapical lesion: Case report. *Arquivos de Ciências da Saúde Unipar, 27*, 2569–2582.