Case Reports

Management of Class 3 Invasive Cervical Root Resorption via Non-surgical Internal Approach: An 11-year Follow-up

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ABSTRACT

Invasive cervical root resorption (ICRR) is a challenging form of external root resorption with no established standard treatment protocol. This report describes the management of a maxillary right canine diagnosed with a class 3 ICRR lesion. The patient presented with discomfort and pain in the affected tooth, which exhibited no identified risk factors aside from traumatic occlusion. Clinical examination revealed a composite resin restoration, pronounced wear facets, pain on percussion, lack of response to pulp sensibility tests, and normal probing depths. Radiographic evaluation identified a resorptive lesion beneath the cemento-enamel junction (CEJ) in the coronal third of the mesial root wall, accompanied by adjacent interdental bone resorption. The case was managed using a non-surgical internal approach combined with root canal therapy. The defect was restored with calcium-enriched mixture (CEM) cement and composite resin. At the 9-year follow-up, the radiograph demonstrated complete healing of the periodontium and regeneration of the interdental bone. At the 11-year follow-up, the tooth remained functional and asymptomatic with a healthy periodontium. This case highlights the efficacy of a non-surgical internal approach in managing ICRR with pulp involvement and further emphasizes the potential of calcium silicate-based endodontic biomaterials to promote the healing of resorptive defects and the regeneration of adjacent alveolar bone.

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Introduction

Invasive cervical root resorption (ICRR), as a subtype of external inflammatory root resorption (EIRR), is defined as the aggressive destruction of the outer surface of the dental hard tissues in the cervical region, including cementum and dentin, due to odontoclastic activity. It is a dynamic process with different phases that involves periodontal and dental tissues, and in the final stages, the pulp [1]. As described by Heithersay, teeth were divided into four classes, depending on the extent of the resorptive process from shallow penetration into dentin near the cervical area in class 1 to a large invasive resorptive lesion that extended beyond the coronal third of the root canal in class 4 [2].

ICRR occurs on the surface of the root beneath the epithelial attachment and coronal to the alveolar bone, which specifically involves the connective tissue attachment [3]. Cementum destruction is the initiation phase of the ICRR process [4]. Damage to the blood vessels in the periodontal ligament (PDL) and hypoxia can lead to damage to cementoblasts and the underlying protective precementum on the root surface, which may finally result in resorption by clastic cells. ICRR initially has mild symptoms and can be found as a painless lesion at the gingival margin, but if progression into pulpal tissue, periodontal infections, or enamel cavita-

tion occurs, patients can experience symptoms. Some ICRR lesions can be detected during careful observation and gentle probing [5]. Additionally, fibro-vascular granulation tissue at the cervical region of a vital tooth, visible through the thinned enamel as a pink spot or grey discoloration, indicating pulp necrosis, may be observed [5]. The involvement of pulp tissue remains debated. In the early stages, the pulp space is protected from the resorption front by the peri-canalar resorption-resistant sheet, and the pulp remains vital. However, in the final stages, as the resorption process perforates and penetrates the root canal space, the pulp becomes involved and eventually becomes necrotic [4-5]. On the other hand, the most common types of root resorption have been attributed to pulp infection [6]. The discomfort of the patient necessitates treatment that is still challenging in endodontics [1].

This report presents a case of class 3 ICRR in a non-vital tooth, successfully managed using root canal therapy (RCT) combined with a non-surgical internal approach, where the resorptive lesion was filled with a calcium silicate-based cement (CSBC). To our knowledge, long-term reports of non-surgical internal management of ICRR are scarce, and this case contributes valuable evidence of stability and healing over a rare 11-year follow-up period, including radiographic evidence of alveolar bone regeneration.

Case Presentation

A 38-year-old man presented to the endodontic department of a private dental clinic in February 2015, complaining of discomfort and pain in the right maxillary canine (tooth #13). The medical history was non-contributory. In clinical evaluation, the tooth had a disto-occlusal composite resin restoration and marked wear facets, which could be signs of traumatic occlusion or parafunction. While the patient had no tenderness to palpation of the associated buccal gingiva, he felt pain on percussion on tooth #13. No sinus tract was found. The tooth did not show any response to an electrical pulp tester (Parkell, Edgewood, NY, USA) or cold test with Endo-Frost (Coltène-Whaledent, Langenau, Germany). The probing depths around the tooth were normal (<3 mm). On the periapical radiograph (Figure 1a), a deep root resorption lesion under the cemento-enamel junction (CEJ) was observed on the mesial wall of the tooth root. The lesion penetrated to the coronal third of the root canal, and according to the classification by Heithersay [2], it could be assumed to be a Class 3 ICRR. In the aforementioned classification, there is no category for pulp involvement and perforation [2]; however, in this case, the pulp was both involved and perforated. Furthermore, the radiography revealed some degree of interdental bone resorption and thinning of interdental bone trabeculae. Finally, the diagnosis was presumed to be a class 3 ICRR in a necrotic tooth, which had probably been under traumatic occlusion. A conventional non-surgical endodontic treatment, along with filling the root resorption lesion with a CSBC, was planned to be done for this tooth. The diagnosis and treatment plan were explained to the patient; he was also informed that this treatment might not be successful and that a surgical procedure might be required in the future. Informed consent was obtained.

On the day of operation, following a 0.12% chlorhexidine mouth rinse, local infiltration anesthesia with 2% lidocaine plus 1:80000 epinephrine (Darupakhsh, Tehran, Iran) was administered. After the access cavity was completed using a high-speed handpiece and abundant water spray, two wedges were used to control gingival bleeding. Then, the resorptive lacunae were accessed internally using a conservative approach. The contents, including granulation tissue, were almost completely excavated and removed using a round bur (Diatech; Coltene Whaledent, Altstätten, Switzerland) on a high-speed handpiece and a sharp hand excavator. Following copious irrigation of the defect with 5.25% sodium hypochlorite (NaOCl), hemostasis was achieved. Subsequently, a full pulpectomy was performed, followed by canal filling and flaring using hand K-files (Dentsply, Maillefer, Ballaigues, Switzerland) up to ISO size 35, in conjunction with 5.25% NaOCl irrigation. The root canal was obturated by the lateral condensation technique with gutta-percha (Ariadent, Tehran, Iran) using AH-26 sealer (Dentsply, Tulsa Dental, Tulsa, OK, USA). In the same session, calcium-enriched mixture (CEM) powder, and liquid (BioniqueDent, Tehran, Iran) were mixed according to the manufacturer's instructions. The cement was carried to the resorption lesion, inserted into the mesial wall of the defect, and adapted with a condenser. Subsequently, the coronal temporization with temporary restoration mate-

rial (Cavisol; Golchai, Tehran, Iran) was performed shorter than the cavity height to avoid creating an improper occlusal contact. The immediate post-operative radiograph (Figure 1b) revealed a small amount of cement extruded from the resorptive lesion into the periodontium.

As previously scheduled, the patient returned a week later with no signs, symptoms, pain, or difficulty chewing. The final restoration with composite resin (Z250; 3M ESPE, Saint Paul, MN, USA) was carried out. It was ensured that there was no occlusal premature contact on the tooth during mandibular movements. Despite the dentist's advice, the patient did not return for 6-month, 1-year, and subsequent follow-ups, and stated in telephone follow-ups that he had no problem with tooth # 13. After nine years, the follow-up radiograph (Figure 1c) showed that the root resorption permanently ceased, and the extruded cement was partially resorbed. Additionally, the adjacent alveolar crest and interdental bone reformed and appeared radiographically/clinically healthy and intact, confirming the successful treatment outcome. At the 11-year follow-up (Figure 1d), the tooth was functional and asymptomatic with a healthy periodontium.

Discussion

This report presents the successful non-surgical endodontic management of a class 3 ICRR lesion, with long-term follow-up confirming both functional stability and periodontal regeneration. Unlike many previously reported cases that rely on surgical access for advanced ICRR, this case highlights the feasibility of an internal non-surgical approach, particularly when pulp involvement provides direct access to the defect. The 9-year and 11-year follow-ups are noteworthy, as to the best of our knowledge, such extended outcomes are rarely documented in the literature, and the radiographic evidence of interdental bone regeneration strengthens the clinical significance of this approach.

ICRR and EIRR may be misdiagnosed as internal root resorption (IRR). It should be noted that an IRR cavity is along the natural walls of the root canal, as it is essentially an extension of them. This misdiagnosis can lead to incorrect treatment, failure, and even the loss of a tooth [7-8]. The resorptive lesion of the reported case is unlikely to be internal resorption or iatrogenic in origin. Rather, it is an external root resorption located at the cervical region and the CEJ; thus, it is classified as ICRR. Although the presented ICRR lesion was classified by Heithersay [2] as Class III, it should be noted that the contemporary cone beam computed tomography (CBCT)-based classification for external cervical resorption/ICRR is the system proposed by Patel *et al.* [9]. The abovementioned classification is based on three



Figure 1: Periapical radiographs of the right maxillary canine; **a:** A class 3 invasive cervical root resorption (ICRR) lesion beneath the cemento-enamel junction (CEJ); **b:** Immediate postoperative radiograph following root canal therapy using calcium-enriched mixture (CEM) cement; note the visible cement extrusion into the periodontium; **c:** 9-year follow-up radiograph demonstrating complete healing of the ICRR lesion, regeneration of the adjacent interdental bone, and partial resorption of the extruded cement; **d:** 11-year follow-up radiograph showing a functional canine with normal periodontium

parameters assessed using CBCT imaging, including (1) the height of the lesion on the root surface, (2) circumferential spread, and (3) proximity to the root canal; thereby allowing a more precise three-dimensional characterization of the resorptive defect than conventional two-dimensional radiographic systems [9]. However, it is important to note that this case was managed approximately 11 years ago (in 2015). At that time, CBCT was not established as a standard diagnostic requirement for such cases, and access to CBCT imaging facilities was limited. Consequently, the initial diagnosis, treatment planning, and follow-up evaluations were based on conventional periapical radiography. Given that the Patel *et al.* classification [9] (introduced in 2018) relies exclusively on three-dimensional CBCT parameters, an accurate assignment of a 'Patel code' was not possible based on the available imaging. Therefore, we applied the Heithersay classification system [2], which is based on the clinical and two-dimensional radiographic features available at that time to categorize the lesion as Class III [2-3, 5]. Although CBCT undoubtedly provides a comprehensive three-dimensional view of the resorptive lesion, including its true extent and location, we believe this case highlights a practical clinical point. A successful diagnostic and treatment outcome can still be achieved in resource-limited settings through sound clinical judgment and conventional, accessible radiographic techniques. In alignment with the initial baseline, follow-up evaluations were consistently performed using the periapical technique to ensure valid longitudinal comparison.

Today, all proposed etiological factors for ICRR are known as predisposing or associated factors rather than causative [1], including the factors that cause damage to PDL blood supply, such as traumatic dental injuries and orthodontic movement. Additionally, an open CEJ and the relatively exposed dentin have been proposed as other contributors [4-5]. Although the etiology of EIRR is complex, it can be caused by external mechanical factors, including occlusal trauma [10]. Traumatic occlusion or premature contacts can transmit excessive forces through the PDL, which may cause resorption at the cervical, middle, or apical thirds of the roots [11]. Prolonged traumatic occlusion may produce radiographic and clinical changes, including thickening of the lamina dura and irregular widening of the periodontal ligament space, progressing to cervical vertical bone loss, attrition wear facets in the areas of occlusal interference, V-shaped gingival recession, and cervical enamel abfraction. Chronic mechanical overload may focally damage or necrotize the cementoblasts of the root surface, and these exposed areas may attract clastic cells and potentially initiate the resorptive process [12]. The patient in the reported case had no history of orthodontic treatment or dental trauma, but presented with some clinical signs of traumatic occlusion, such as wear facets. Since no formal occlusal analysis was performed, traumatic occlusion can only be considered a possible contributing factor rather than the definite etiology of ICRR.

Despite the absence of surgical intervention, the combination of root canal therapy and biomaterial application resulted in the maintenance of a functional tooth and the preservation of sufficient periodontal support, as evidenced by the long-term follow-up. Treatment recommendations and specific guidelines that show predictable results regarding the treatment of ICRR have not been provided [13]. Treatment of ICRR lesions focuses on the removal of resorbed/ granulomatous tissues as well as clastic cells to arrest the resorption process, and prognosis depends on the extent of the lesion and the accessibility. This procedure can be an orthograde mechanical removal, with or without the help of a microscope or CBCT [5, 14-15]. Although the source of resorption (clastic cells and blood supply) originates from and exists on the external surface of the tooth, non-surgical internal approaches to address the lesions by eliminating the source of inflammation have also been proposed [14]. Recent studies indicate that for extensive ICRR, an internal approach involving the excavation of resorptive lacunae and partial or full removal of its content is superior to external surgical treatment, as it halts the resorptive process while preserving the periodontium [13]. In advanced cases- especially those with pulpal involvement or where internal access to the defect is required- a modified RCT, as employed in the presented case, can be an appropriate treatment scenario. The procedure begins with careful removal of any overlying soft or hard tissues to provide precise access, ensuring complete exposure of the resorptive lesion [5, 14-15]. The current ICRR management emphasizes enhancing treatment efficacy and pre-

venting recurrence through the removal of degenerated tissues by chemical debridement with trichloroacetic acid (TCA) or NaOCl [5]. In addition to RCT, vital pulp therapy has also been a successful approach in the management of ICRR and preservation of periodontium [13].

While non-surgical management of ICRR is typically reserved for supra-crestal resorptions or those located at the gingival margin, the extensive nature of most lesions at the time of diagnosis often necessitates a surgical approach. Flap surgery may be required, particularly in class 3 lesions, to ensure optimal access when lesions extend subgingivally or below the alveolar crest [5, 14-15]. Consequently, external surgical intervention remains the preferred approach for lesion access [16], and the literature reports a higher prevalence of surgical treatments (with or without concomitant endodontic therapy) compared to non-surgical approaches alone [17-19]. However, complete excavation of the lesion via external approaches may compromise long-term tooth survival [14-15].

CSBCs have gained widespread clinical use in endodontics since the introduction of mineral trioxide aggregate (MTA). Effective management of ICRR necessitates the reconstruction of the lost structure using an appropriate CSBC (e.g. MTA, CEM cement, or Biodentine) followed by a definitive restoration, including composite resin or glass ionomer, to ensure an effective seal [5, 7, 20-21]. In this study, CEM cement was used as a biomaterial, which has shown favorable biocompatibility, sealing ability, and osteoinductive potential [22]. Although other CSBCs such as MTA and Biodentine have shown comparable success in managing resorptive defects, CEM was chosen in this case for its handling properties and capacity to stimulate cementogenesis and dentinogenesis [23].

This case has several limitations; CBCT was not performed, which would have offered a more precise lesion assessment. Furthermore, the patient did not attend intermediate follow-ups (1-5 years), which limited continuous evaluation of healing. Additionally, as this is a single case, comparisons with surgical approaches or other biomaterials are not possible. These factors should be considered when interpreting the results.

In the presented case, the patient was thoroughly advocated on the proposed treatment plan; subsequently, written informed consent was obtained prior to the initiation of the procedure.

Conclusion

This 11-year follow-up demonstrates the potential of a non-surgical internal approach, combined with RCT and defect restoration, in the management of ICRR in a non-vital tooth. To the best of our knowledge, this case provides rare long-term evidence suggesting that such an approach may be associated with stable outcomes, including apparent healing of the adjacent alveolar bone. The CSBCs appeared to arrest the resorptive process and contribute to the preservation of tooth structure and the maintenance of long-term function. Nevertheless, these findings are derived from a single case and should be interpreted with caution, and further comparative studies are warranted to establish the predictability and generalizability of this approach.

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Declarations

Ethical Considerations and Patient Consent Statement

The treatment was carried out after the patient agreed to the treatment plan and signed the informed consent form. Moreover, the patient consented to the anonymous use of his demographic/clinical information and radiographs for publication in a scientific journal.

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Data Availability Statement

Data sharing does not apply to this article, as no datasets were generated or analyzed during this case report.

Author Contributions

MJE: Performed the treatment procedure, was involved in concept/design, and revised the manuscript.

LR: Reviewed the literature and prepared the manuscript draft.

SA: Developed the concept and design and revised the manuscript.

All authors have read and approved the final manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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