Management of Invasive Cervical Resorption: Observations from Three Private Practices and a Report of Three Cases

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Abstract

Invasive cervical resorption (ICR) is a type of external resorption that is not well understood or well known in the dental community. It is often misdiagnosed, leading to improper treatment or unnecessary loss of the tooth. Treatment may involve the periodontium as well as the tooth and pulp, and management can be complex. Early diagnosis and appropriate treatment are the keys to a successful outcome. This article discusses the decision-making process and management of ICR, with emphasis on the restorative aspects of treatment. Three treatment cases are presented that include nonsurgical and surgical approaches, with recalls of 4, 8, and 9.5 years. (J Endod 2010;36:1721–1730)

Key Words
External resorption, extracanal invasive resorption, invasive cervical resorption, trichloroacetic acid

Invasive cervical resorption (ICR) is a common clinical entity. In 2009, the endodontist author and his partner diagnosed ICR 49 times in their private practice. Although common, ICR is not well understood within the dental community and is often undiagnosed or misdiagnosed. Even when diagnosed correctly, there is often disagreement or confusion about the best course of treatment, even within the endodontic community.

ICR invades the tooth from the PDL, apical to the epithelial attachment (1–4), and is not evident clinically in the early stages. In many cases, it is first detected radiographically (1–3) or when the tooth takes on a pink appearance because of deep red granulation tissue showing through the tooth structure (1–3).

On periapical radiographs, ICR may be a barely discernable radiolucency or dramatically evident. The lesions vary from well-delineated radiolucencies that are quite obvious to poorly defined lesions with irregular borders and sometimes resemble caries radiographically. When ICR is superimposed in the pulp space, pulp space anatomy is usually evident (4).

ICR is often seen in the cervical area of the tooth, but because it is initiated apical to the epithelial attachment, it can present anywhere in the root (4). In the early stages, it may be somewhat symmetrical, but the larger lesions tend to be asymmetrical (3). It can expand apically or coronally (Fig. 1; see case 3).

Heithersay (1, 2, 5, 6) wrote a classic series of articles in which he described the features, possible predisposing factors, and recommended treatment regimen for ICR. He described his treatment regimen (2, 6), which included mechanical and chemical debridement of the resorptive lesions, followed by restoration, and analyzed the treatment results. For the small, localized lesions (class 1 or 2), he reported that successful treatment was close to 100%. For the moderate-size lesions (class 3), he reported a 77.8% success rate. For the extensive, class 4 lesions, his success rate was only 12.5%.

Part of the confusion about ICR is that it is identified in the literature by at least nine different names. Heithersay (1) coined the name invasive cervical resorption used in this article. It is sometimes referred to as extracanal invasive resorption based on an article by Frank and Backland in 1987 (7) and was recently labeled as external cervical resorption (ECR) in an excellent review article by Patel et al in 2009 (3).

Much of the literature pertaining to treatment of ICR is in the form of case reports with a short-term follow-up. Hiremath et al (8) described the treatment of a tooth with ICR with 1-year recall, and the restoration of ICR lesions is described in case reports by Baratto-Filho et al (9) with a 2-year recall, Park and Lee (10) with a 27-month recall, and Yilmaz et al (11) with a 1-year recall. The endodontic literature generally lacks long-term follow-up of teeth with the treatment of ICR.

Collectively, the authors, an endodontist, a periodontist, and a restorative dentist, have treated hundreds of patients with ICR, usually with an interdisciplinary approach. This article discusses their observations and provides clinical guidance for clinicians for what is often a difficult clinical challenge. Early diagnosis, elimination of the resorption, and restorative management are the keys to a successful outcome. Three clinical cases are presented using different treatment approaches with recalls of 4, 8, and 9.5 years.

Treatment Planning

When ICR is diagnosed, there are generally three choices for treatment: (1) no treatment with eventual extraction when the tooth becomes symptomatic; (2) immediate extraction; or (3) access, debridement, and restoration of the resorptive lesion.
Dental implants have led to the increasing use of options 1 and 2. If no treatment is chosen, a tooth may go many years without symptoms (Fig. 2). The authors generally recommend options 1 or 2 to their patients for class 3 and class 4 lesions. Also, location and esthetic concerns may dictate option 1 or 2. If the decision is made to pursue option 3, nonsurgical debridement may be possible, or a combined nonsurgical/surgical approach may be required (12). The cases that follow show examples of both.

**Treatment**

The authors use the Heithersay approach to debridement of the resorptive lesion. The lesion is accessed, whether internally or externally, and debrided with a carbide round bur in a slow-speed handpiece. All the obvious resorptive tissue is removed until smooth, clean dentin is present, except a few small spots that are discolored or bleeding, which represent communication of the resorption with the PDL (Fig. 3). The dentin is then scrubbed for 1 minute with 90% aqueous trichloroacetic acid (TCA) (2, 6) on a cotton ball. TCA is very caustic and cauterizes the residual resorptive tissue (2, 6), which makes it more obvious under magnification. Additional tooth structure is removed carefully with a slow-speed round bur, and the acid is applied again. This process is continued until all the penetration points are eliminated (in the surgical approach) or perforation through the external root surface is imminent in the nonsurgical approach. For nonsurgical treatment, it is impossible to eliminate all the penetration points, and you must rely on the TCA to cauterize any resorptive tissue that remains. If any of the invading resorptive tissue remains viable, the resorptive process is likely to continue.

**Patient 1: A Moderate-size Lesion Treated Internally without Surgery**

Patient 1 (Fig. 4) was a 47-year-old white man who presented in 2002 with no symptoms. His restorative dentist noted the odd radiographic appearance of the pulp space in tooth #2 and referred him for endodontic evaluation. There was no evidence of the lesion on the external surface of the tooth. The referring doctor’s tentative diagnosis was internal resorption. The patient reported none of the possible predisposing factors for ICR (2, 3, 5), such as orthodontics or trauma. Endodontic testing found that the tooth was nontender to pressure and percussion and responded normally to cold compared with his other teeth. There were no significant periodontal pockets. The

![Figure 1](image1.png)

**Figure 1.** An example of advanced ICR. The resorption has hollowed out the coronal tooth structure but note that the outline of the pulp space is still evident through the resorption. (Courtesy of Dr Tim Silbert, Perth, Australia.)

![Figure 2](image2.png)

**Figure 2.** The progression of ICR is unpredictable. These radiographs of a mandibular right central incisor were taken almost 10 years apart. There is relatively little change of the ICR as compared with the tooth shown in Figures A and B.
endodontic diagnosis was normal pulp and normal periapex. The radiolucent lesion was diagnosed as ICR.

The patient was presented with three options: (1) no treatment with eventual extraction of the tooth when it becomes symptomatic, (2) extraction now, and (3) endodontic treatment followed by internal debridement and restoration. Because of the location and size of the lesion, excessive bone removal would have been necessary for a surgical approach, so this was not considered. The patient opted for option #3.

Access was made into the resorptive lesion through the occlusal surface of the tooth. The lesion was extremely hemorrhagic. Gross debridement was accomplished with a #6 round carbide bur in a slow-speed handpiece. As the bulk of resorptive tissue was removed, the hemorrhage decreased. Periodic radiographs were taken as the external surface of the tooth was approached. The external surface was never penetrated with a bur. Debridement of the lesion was accomplished by alternating the round bur with trichloroacetic acid as previously described.

Numerous small bleeding points were evident in the cervical area after initial debridement. After the dentin was treated with TCA, the bleeding stopped, and the penetration points looked like small dark spots and could be seen clearly under the operating microscope.

The initial debridement caused the pulp to be exposed, and endodontic treatment was initiated. Four canals were located and prepared and dressed with calcium hydroxide paste (Ultracal; Ultradent Products, Provo, UT). At the second appointment, the canals were obturated with gutta-percha and Kerr sealer (Kerr Corp, Orange, CA.), the dentin surface was “refreshed” with a bur, and the lesion and access opening were restored with a “fourth-generation” dentin bonding system (Optibond Dual Cure; Sybron Dental Specialties, Orange, CA) and a dual-cure buildup material (BuildIt; Sybron Dental Specialties, Orange, CA). After a 3-month waiting period in which the tooth remained asymptomatic, it was restored with a metal-ceramic crown. The final radiograph in Figure 4 is an 8-year recall. The patient’s tooth was asymptomatic, and there was no evidence that the ICR had progressed.

Patient 2: A Relatively Small Lesion with Easy Surgical Access

Patient 2 (Fig. 5) was a 39-year-old Hispanic woman who presented in 2006 with no symptoms. Her restorative dentist noted a moderate-size oval radiolucency in the cervical area of #23 and referred her for evaluation. He noted a pink discoloration on the labial surface of the tooth and a “catch” in the subgingival area with an
explorer. His tentative diagnosis was internal resorption. Patient 2 had a history of orthodontic treatment as a teenager and could not recall a history of trauma or any of the other possible predisposing factors (2, 3, 5).

Endodontic testing found that the tooth was nontender to pressure and percussion and responded normally to cold compared with the adjacent teeth. The labial gingival tissue was slightly tender to palpation. There were no significant periodontal pockets. The endodontic diagnosis was normal pulp and normal periapex. The radiolucent lesion was diagnosed as ICR.

Treatment options were discussed with the patient. These included (1) no treatment with eventual extraction of the tooth when it becomes symptomatic; (2) extraction now; (3) surgical exposure of the lesion, debridement, and restoration without endodontics; and (4) surgical exposure, debridement, and restoration proceeded by endodontic treatment. After some discussion, the patient decided on option #4. Root canal treatment was completed in two appointments, and the access opening was restored similar to the process described with patient 1. A sulcular incision was made, and a labial flap was reflected to expose the lesion. Because the lesion was coronal to the alveolar bone, it was possible to place a rubber dam with a 212 retainer (Hu-Friedy Corp, Chicago, IL). The lesion was dry and “leathery” in texture with no bleeding present. It had a honeycomb-like appearance and could be peeled off in layers with a spoon excavator. The lesion was debrided first with a round diamond bur in a high-speed handpiece followed by a #6 carbide round bur in a slow-speed handpiece. Once the lesion was debrided to smooth, clean dentin, several small dark “spots” of residual resorptive tissue were evident in the cervical area. The cavity was treated with trichloroacetic acid and debrided further as previously described. Once the lesion was adequately debrided and all the dark spots were eliminated, the dentin surface was “refreshed” with the round bur in preparation for bonding. A “fourth-generation” dentin bonding system (Optibond FL, Kerr) was used following the manufacturer’s instructions, and the lesion was restored with a flowable composite (Voco, Cuxhaven, Germany). The flap was repositioned and sutured.

Substantial tooth structure remained after the conservative access preparation and relatively small restoration. No further restorations were recommended. At the time of this writing, approximately 4 years have passed since the original treatment was performed.

Patient 3: Treatment Heroics for a Compromised Tooth

Patient 3 (Fig. 6) was an 80-year-old white woman and the mother of one of the authors. She presented in 1999 with no symptoms but with a striking pink hue in tooth #9. Clinically, from the labial view, #9
looked like a normal, intact tooth other than the color. From the palatal aspect, the external surface of the tooth had broken down in the cervical area. The radiographic appearance was somewhat shocking. The tooth was nontender, but the pulp was nonresponsive to cold. The endodontic diagnosis was necrotic pulp with a normal periapex. The resorptive lesion was diagnosed as ICR.

After discussion among the authors, the following treatment options were discussed: (1) extraction or (2) heroic efforts to treat the tooth. The patient’s preference was to save the tooth if possible. Because her son was a dentist who would provide close follow-up, heroic efforts were undertaken.

Initial access was made through the palatal surface of the tooth, and initial debridement was completed without reflecting a flap. The resorptive tissue was similar to patient 2 in that it was dry and leathery. Root canal treatment was completed, and the canal was temporarily sealed at the orifice. A palatal flap was reflected, and debridement of the resorptive lesion was completed as previously described. A small amount of alveolar bone was removed in the cervical area on the palatal aspect of the tooth. A post space was created, and a zirconium post (Cosmopost; Ivoclar Vivadent, Amherst, NY) was cemented with Vitremer cement (3M, St Paul, MN). The tooth was restored with an ‘open sandwich’ technique. The dentin was conditioned with 10% polyacrylic acid for 15 seconds. A resin-modified glass ionomer material (Fuji 2 LC; ESPE, St. Paul, MN) was used to restore the majority of the preparation. The incisal one quarter of the restoration was prepared with a bevel of the remaining enamel and was restored with a bonded composite resin (Scotchbond Multipurpose, 3M) and Z100 composite (3M).

The patient had regular follow-ups by her son, and #9 functioned normally until it fractured in 2009. The final radiograph in Figure 6 is the 9.5-year recall.

**Discussion**

Patient 3 is not an example of the typical treatment approach for a patient with such extensive ICR. In most cases, her tooth would be extracted. The circumstances and patient desires strongly influenced the treatment plan. This case shows that even with an extensive lesion, ICR can be arrested and treated successfully over the long-term. The eventual failure was structural and not endodontic or caused by recurrence of the resorption. Not surprisingly, the crown fractured in the cervical area. The post remained cemented in the canal. In retrospect, zirconium was probably not the best choice for a post because it cannot be etched or effectively bonded to

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**Figure 6.** Patient 3. This large lesion was debrided and restored. It lasted almost 10 years before the tooth fractured. A is preoperative, B is during the restorative phase, and C is after endodontic and restorative treatments were completed. D shows the postoperative clinical result. The fact that the labial enamel was intact made an acceptable esthetic result possible. The radiograph in E was taken at the 3-year recall. The tooth fractured shortly after the radiograph in F was taken, approximately 9.5 years after treatment was completed.
cements or restorative materials. Also, resin-modified glass ionomer materials are generally not as strong as composite resins. It is possible that had the tooth been restored with a different type of post in combination with a composite resin material, the restorative treatment might have provided even greater longevity.

Purely internal treatment of ICR is preferable when possible. There is the obvious desire of most patients to avoid surgery, plus there is no need to remove alveolar bone from the treated tooth and adjacent teeth. Although it is impossible to totally eliminate the resorption from inside the tooth, careful mechanical and chemical debridement can stop the resorptive process and result in long-term success as shown with patient 1. This approach is viable only if the external surface of the tooth remains grossly intact.

When an external approach is necessary and the lesion is accessible, a rubber dam can sometimes be used for isolation as shown in patient 2. The trichloroacetic acid is very caustic and will cause burns if it comes in contact with the gingival tissues. The rubber dam also provides better visualization and isolation for the restorative procedures. A rubber dam is always recommended for the endodontic treatment and the internal debridement approach.

Dentin that has been treated with TCA is severely demineralized and is not suitable for bonding with either dentin-bonding agents or glass ionomer materials. It must be “refreshed” with a bur before bonding procedures. Dentin bonding agents rely on a shallow demineralization of the dentin surface, which is infiltrated with a resin to form a hybrid layer with the exposed dentinal collagen matrix. Glass ionomer materials rely primarily on ionic bonding to the calcium in hydroxyapatite. A TCA-treated surface is demineralized to too great a depth for the dentin-bonding agents to fully infiltrate, resulting in a weak, leaky bond. TCA almost totally eliminates the hydroxyapatite from the dentin surface, so there is no calcium available for bonding by glass ionomer materials. Therefore, before any bonding procedures are initiated, the surface should be refreshed with a bur to provide a normal dentin surface.

Mineral trioxide aggregate (Dentsply International, York, PA) has been recommended in several case reports (8–11) as the restorative material of choice because it is “biocompatible.” The authors use resin-modified glass ionomer materials or composite resins because they are stronger, they bond to tooth structure, and they can be exposed to the oral cavity. There are no known benefits to the use of MTA to restore ICR lesions.

The authors have observed three clinical presentations of the resorptive tissue. When entering an intact tooth, the resorptive tissue is usually hemorrhagic and soft. When the external tooth surface has broken down, ICR presents as a dry, leathery lesion with a honeycombed appearance under a microscope, which is sometimes misdiagnosed as caries. Occasionally, ICR looks like bone that has invaded the tooth.

Patient 2 had endodontics performed before restoration of the resorptive lesion. Heithersay (6) reported high success rates without endodontic treatment in type 1 and type 2 cases of ICR. It has been...
the authors’ experience that endodontic treatment is frequently required at a later time unless the lesion is very small, and they generally perform endodontic treatment before treating the resorption.

In the authors’ experience, ICR is often misdiagnosed as internal resorption or external inflammatory resorption. Two of the three patients presented in this article were initially misdiagnosed with internal resorption. Internal resorption originates in a vital pulp, Figure 9. (A and B) ICR can expand rapidly. These bitewing radiographs were taken 18 months apart. In most cases, it is not recommended to “watch” ICR unless the eventual treatment plan is for extraction.

Figure 10. An example of extreme destruction in multiple teeth by ICR.
spreads laterally, and is usually centered symmetrically on the root canal (Fig. 7). Canal anatomy is not visible in the lesion. ICR is typically not centered, and canal anatomy is visible if the lesion is superimposed on the canal (4). External inflammatory resorption occurs in response to a necrotic, infected pulp after a traumatic injury (13), whereas teeth with ICR typically provide a normal response to pulp tests when compared with the patient’s other teeth (4). Inflammatory resorption is found on the lateral borders of the root and produces a “moth-eaten” appearance (Fig. 8).

ICR can be found in one or multiple teeth (14, 15). When it is diagnosed in one tooth, it is important to carefully examine the rest of the teeth clinically and radiographically for additional occurrences.

**Figure 11.** (A and B) Periapical radiographs generally do not show the full extent of ICR. CT scanning provides a more accurate estimate of the destruction inside the tooth. (Courtesy of Dr Michael Pascal, Washington, DC.)

**Figure 12.** Before considering surgery, CT imaging was used to locate the lesion accurately and to determine the relationship between the lesion and alveolar bone. In this case, the CT images showed there was no bone over the lesion, which helped in the decision process of whether to attempt surgery. The existing endodontic treatment was completed in 1990.
of ICR. If a lesion is diagnosed when it is small, it can be treated with minimal morbidity, whereas large lesions may be untreatable. When a small lesion is diagnosed in an accessible location, immediate treatment is recommended because the lesions sometimes spread rapidly (Fig. 9A and B) and can be extremely destructive (Fig. 10). It is not a good idea to tell the patient, “We’ll watch it,” unless the plan is for extraction at a later time.

Computed tomography (CT) scanning can be very useful in treating ICR. Periapical radiographs tend to underestimate the size of the resorptive lesion. CT scanning gives a more accurate estimate of lesion size (16, 17) and, in some cases, may discourage treatment (Fig. 11A and B). CT images also provide the precise location of the lesion in three dimensions and the relationship to the surrounding bone, which can be very helpful in decision making (Fig. 12). A common finding in the larger lesions is finger-like projections from the main body of resorption that extend apically and out to the PDL (4), which can make it difficult to eliminate all the invading resorptive tissue. An example is shown in an extracted tooth in Figures 13 and 14.

Orthodontic extrusion is sometimes helpful in patients with ICR. Extrusion provides better access to ICR lesions and allows the final boney and gingival architecture to be more ideal when surgery is necessary (12). ICR is by far the most diagnosed type of resorption in the endodontist author’s private practice. In 2009, he and his partner

**Figure 13.** Clinical and radiographic views of an extracted tooth with ICR. Note how the resorptive tracts spread apically and out to the PDL. (Courtesy of Dr Gary Carr, San Diego, CA.)

**Figure 14.** The same tooth as shown in Figure 13 after clearing. (Courtesy of Dr Carr.)
diagnosed ICR 49 times, as previously stated. By comparison they diagnosed internal resorption three times and inflammatory resorption 11 times.

These three cases show that ICR can be arrested using the "Heithersay approach" to treatment (ie, mechanical debridement, treatment with TCA, and restoration). Prudent case selection and proper execution can lead to the successful treatment and long-term retention of the tooth. The keys are the location, size, and accessibility of the lesion and the structural integrity of the tooth and periodontium after treatment is completed.

It is important for endodontists to understand the periodontal and restorative aspects of treating ICR. Teeth with ICR are often structurally compromised and may eventually fail even though the endodontic treatment is successful. The endodontic treatment is irrelevant if the resorption is not eliminated, and the restorative aspects are not managed properly. Proper management requires knowledge and skills in endodontics, surgery, and restorative dentistry, and elimination of the resorption is performed most effectively under a microscope. Even if the endodontist does not perform all the treatment, he/she must be knowledgeable of all aspects of the treatment to direct the treatment team. Frequently, nobody else is quite sure what to do with ICR.

References