Invasive cervical resorption: A description, diagnosis and discussion of optional management — a review of four long-term cases

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Abstract

The external resorptive process of the permanent dentition referred to in this article has been labeled several different names over the years; therefore, some confusion exists. Just a few popular labels are: extra canal invasive resorption (ECIR), invasive cervical resorption (ICR), external cervical resorption (ECR), subepithelial external root resorption, idiopathic external resorption, etc. They all refer to a relatively uncommon form of dental resorption. If left undiagnosed, misdiagnosed, mistreated or untreated, it will usually be quite devastating for a tooth. Australian dentist Geoffrey Heithersay has contributed much to the literature regarding all facets of this type of dental resorption. His work has become the basis of research and treatment. With few changes over the past several years, the etiology, predisposing factors, classification, clinical and radiologic features, histopathology and the treatment of this resorptive process he described are still used without much change in our practice today. In respect, this article will use the same nomenclature appearing in his numerous publications: invasive cervical resorption (ICR).

The author will present treatment of four cases — two class 2 cases, one class 3 and a class 4 — in an attempt to share some experiences, both good and bad, accumulated over the years when dealing with ICR. Hopefully this article will be successful in removing some barriers that may currently prevent the dentist from taking on the challenge presented by the next case of ICR.

Etiology of invasive cervical resorption

Not a common occurrence, ICR is an insidious and often aggressive form of external tooth resorption and can occur in any tooth in the permanent dentition. External resorption can be divided into three broad groups: 1) trauma-induced tooth resorption; 2) infection-induced tooth resorption; and 3) hyperplastic invasive tooth resorption. Invasive cervical resorption is one form of hyperplastic invasive tooth resorption. It results in the loss of cementum and dentine by an odontoclastic type of action.

The ICR lesion begins just apical to the epithelial attachment of the gingiva at the cervical of the tooth, but can be found anywhere on the root. Due to its location, the beginning lesion is difficult or almost impossible to recognize. The exact mechanism of ICR is still not clearly understood. Microscopic analysis

Fig. 1. Invasive cervical resorption: Distribution of potential predisposing factors for patients. (Graphic/Reproduced with permission from Quintessence Publishing.)
of the cervical region of teeth has shown that there appears to be frequent gaps in the cementum in this area, leaving the underlying mineralized dentin exposed and vulnerable to osteoclastic root resorption. It is broadly accepted that either damage to, or deficiency of, the protective layer of cementum apical to the gingival epithelial attachment exposes the root surface to osteoclasts, which then resorbs the dentin. In general, an area of radicular dentin around the cervical area of the tooth may be devoid of the protective covering of cementum, exposing the root surface to be colonized by osteoclast-like cells, allowing the resorptive process to begin. Osteoclastic action on that area of the radicular dentin eventually results in a hyperplastic resorptive lesion containing fibro-osseous tissue. In order for dental resorption to occur, three conditions have to be present: a blood supply; breakdown or absence of the protective layer; and a stimulus. In the case of ICR, the external protective layer is the cementum, and the internal layer is the predentin of the pulp.

Several potential predisposing factors have been identified. They are: trauma, intracoronal bleaching, surgery, orthodontics, periodontics, bruxism, delayed eruption, developmental defects, interproximal stripping and restoration. Heithersay used a group of 222 patients with a total of 257 teeth with various degrees of invasive cervical resorption. From the subjects’ dental histories, it was determined whether there was a sole predisposing factor or a combination of factors. The results are shown diagrammatically in Fig. 1.

The results indicated that a history of orthodontic treatment was the most common sole factor, found in 47 patients, while other factors, mainly trauma and/ or bleaching, were present in an additional 11 subjects. Trauma was the second most common sole factor, with 31 teeth. Intra-coronal bleaching, combined with other factors, had the third most affected teeth. The pulp plays no role in the etiology of ICR and remains normal until the ICR becomes very advanced.

An interesting study was recently published indicating there might be a connection between human and feline ICR. Four cases of were presented of multiple invasive cervical resorption (mICR). There was direct contact with cats in two cases and indirect contact in the other two cases. Neutralized testing was done for feline herpes virus type 1 (FeHV-1). Two of the cases were neutralized, and two were partly inhibited. The study indicated a possible transmission of FeHV-1 to humans and the possibility of a role as an etiologic (co)factor in ICR. An interesting observation is that even in extensive lesions, the pulp is protected from the surrounding resorptive process by a narrow band of dentin (red arrows). Histologically, the pulp remains intact and is protected from the extensive resorptive lesion by a narrow wall of dentin (a). A low powered photograph shows the walling off of the pulp by dentin, protecting it from the surrounding extensive resorptive process (b). (Slide adaptation reproduced with permission from Dr. Geoffrey Heithersay.)

Fig. 2c. High magnification of the distal orifice of a lower second molar being treated for ICR. The pulp remains intact, encircled by a narrow band of dentin (bottom arrow). The involved dentin (middle arrow) and a possible distal penetration area (top arrow) can be observed. (Slide adaptation reproduced with permission from Dr. Raphael Bellamy.)

**Clinical classification**

Heithersay’s clinical classification was developed as a guideline for treatment planning and for comparative clinical research. The classification is shown diagrammatically in Fig. 5. The classification allows the operator to more precisely determine the probable extent of treatment. The more extensive
Figs. 3a, 3b _Both the clinical picture (a) and histological view (b) show how the dentin has been extensively replaced by a bone-like tissue._

A mass of fibrovascular tissue infiltrated with inflammatory cells is located within a large resorptive cavity that has a wide connection with the periodontal tissue (large arrow). The dentin has been extensively replaced by bone-like tissue. A small section of intact pulp can be seen on the superior aspect of the section (small arrow). Hematoxylin–eosin stain; original magnification X 30. (Reproduced with permission from Quintessence Publishing and Dr. Henry Rankow.)

_Figs. 4a, 4b _Histologic appearance of an extensive invasive cervical resorption with radicular extensions. Masses of ectopic calcific tissue are evident both within the fibrovascular tissue occupying the resorption cavity and on resorbed dentin surfaces. In addition, communicating channels can be seen connecting with the periodontal ligament (large arrows). Other channels can be seen within the inferior aspect of the radicular dentine (small arrows). Hematoxylin–eosin stain; original magnification X 30._

Higher magnification (b) shows communication channels from the periodontal ligament to the resorbing tissue. An island of hard tissue remains (*), consisting of an external surface of cementum and cementoid; some residual dentine; but the bulk has been replaced with a bone-like material with canalicular structure. Although some red blood cells are evident near the deeper channel no inflammatory cells can be seen. Hematoxylin–eosin stain; original magnification X 50. (Reproduced with permission from Quintessence Publishing.)

The lesion, the more complex the treatment options become.

Class 1: Small invasive resorptive lesion with shallow penetration into dentin.

Class 2: Well-defined invasive resorptive lesion close to the coronal pulp chamber.

Class 3: Deeper invasion extending into the coronal third of radicular dentine.

Class 4: A large invasive lesion extending beyond the coronal third of the root.

Normally, a Class 1 lesion can be successfully treated without much difficulty. But Class 2 lesions often require minor gingival flap surgery for retraction to achieve adequate access, removal of the affected dentin and restoration of the defect. Class 3 lesions usually involve a surgical approach and/or orthodontic extraction. Class 1 and 2 lesions can be treated predictably, but the success rate in treating Class 3 and 4 lesions drops dramatically. So, in general, as the classification increases, the prognosis decreases.

**Diagnosis**

The earlier the diagnosis, the more predictable the outcome of treatment will be. Due to the nature of the lesion, treatment based on an incorrect diagnosis will usually result in continued progression of the resorptive process and eventual loss of the tooth.

Unfortunately, the smaller Class 1 lesion is often not discovered due to its location beneath the gingival attachment; but it will usually show a small radiolucency on a radiograph. The dental examination may reveal a slight irregularity in the gingival contour, which will bleed upon probing. It is the author’s experience that Class 1 lesions, at this early stage, are seldom found during routine dental examinations.

One of the problems with early diagnosis is the lesion is asymptomatic and can remain so even in the more advanced stages. Pulp testing will be of no value, because the pulp remains unaffected until late in the process. On the other hand, the larger Class 2 lesion can present with more obvious clinical signs. For example, a patient notices a pinkish area on an anterior tooth. The discoloration is the result of osteoclastic activity replacing the radicular structure of the tooth with reddish granulation tissue that is showing through the more translucent enamel.

Radiographically, the smaller Class 1 lesion can be confused with a carious lesion, internal resorption or adumbration (cervical burnout) of the radiograph. If the lesion is a Class 2, Class 3, or Class 4, bitewing radiographs will often present an atypical radiolucency and the examining dentist will be more inclined to believe that it isn’t just a carious lesion. If the lesion is on the proximal of the tooth, the outline of the pulp can usually be observed.

The larger lesions can also be misdiagnosed as caries, or internal resorption. The usual indication that the lesion is not carious is the irregularity of the radiolucency and/or the radiopaque outline of the protective predentin layer of the pulp (Figs. 6a, 6b). By utilizing varying angulation of the radiographs, internal resorption can be ruled out. If the lesion is internal resorption, it will remain centered whatever the direction, or “off-angle,” the radiograph is taken. However, if the lesion is one of ICR, Clark’s Rule, or SLOB Rule, can be used to determine the location of the lesion (the most lingual object moves with the direction of the X-ray head) (Figs. 7a, 7b).

With the advent of cone beam computed tomography (CBCT), the clinician is given the opportunity to view teeth and anatomical entities in three dimensions. Compare with the typical periapical radiographs (Fig. 8a). Even if numerous angles are taken, a complete view of the extent of the lesion cannot be established with any definitive accuracy. The extracted tooth #3 was a hopeless Class 4 lesion involving most of the cervical half of the lingual and extending into the area (Fig. 8b).

Three planes of sections can be evaluated with CBCT: the frontal/coronal (X), sagittal (Y) and axial (Z) (Fig. 8c). The “X”-frontal/coronal plane moves anterior–posterior (B–L in the anterior teeth and M–D in the posterior). The “Y”-sagittal plane moves left–right (M–D in the anterior and B–L in the posterior). The “Z”-axial plane moves coronal–apical for all teeth in the dental arch. Depending on the machine, up to 512 slices of the field of view (FOV) can
be visualized. The slice thickness is variable, again depending on the machine, from nearly 0.1 to several mm. However, generally speaking, the thinner the slice the higher the spatial resolution. When evaluating resorptive defects, higher resolution and three-dimensional images allow the experienced clinician to make a more definitive diagnosis, a confident and realistic plan for treatment, with a higher predictability of success.

So, in a nutshell, the characteristic diagnostic signs that indicate the lesion is a result of ICR are as follows: 1) The tooth is asymptomatic; 2) The pulp tests are within normal limits; 3) The ICR defect moves with varying X-ray angulations; 4) The protective pulpal wall is often intact and can be seen on the radiographs; 5) The portals of entry are near the osseous crest; and 6) The portals of entry are hard to locate clinically.

During the initial dental examination, the author suggests the patients should be asked if any of the three major predisposing factors have occurred in their past dental history: bleaching, trauma or orthodontics. And, as a side note, “Do you have any cats?” ICR can occur in any permanent tooth and once found in a patient, it is important to initiate regular follow-up visits to be sure no further lesions occur.

**Treatment**

After the diagnosis of ICR has been confirmed, the treatment should be scheduled as soon as possible. If, for some reason this is not practical, the tooth should be monitored closely. The lesion can be very aggressive, so best not to “wait and watch” for too long a time, never more than two to three months (Figs. 9a–c).

The Heithersay Classification is of great help to advise the patient of the extent of treatment and get a better idea of the possible prognosis. The patient and doctor together can decide: 1) No treatment and extraction if the tooth becomes symptomatic; 2) Extraction and possible replacement with an implant; or 3) To begin endodontic treatment in an attempt to eliminate the lesion and restore the tooth for as long as possible. In Class 1 and Class 2 cases, the patient is advised the treatment will probably be nonsurgical, but the surgical approach may be necessary. In the more advanced Class 3 and Class 4 cases, the patient is advised that both the non-surgical and surgical approach will be necessary. Dental implants have become popular, and unfortunately, have led to a greater percentage of patients choosing options one and two. However, there are still enough patients who want to save their natural teeth, “no matter what”!

Heithersay developed what has become the standard guide for the treatment of ICR. Depending on the extent of the lesion, it is accessed either nonsurgically, or surgically. The granulation tissue is removed either with curettes, or a round bur of varying sizes. During the removal of the bone-like tissue, 90 percent trichloroacetic acid (TCA) is applied with a small cotton pellet numerous times, with increasing pressures, to achieve coagulation necrosis.

Using magnification, the fibro-osseous granulation tissue is removed until no communication channels are observed and the defect is lined with unaffected dentin, then restored with an appropriate restorative material. Endodontic treatment is performed when indicated. The basic aim of treatment is to eliminate all active resorbing tissue and restoration of the defect so the tooth can be maintained as long as possible. It has been the author’s experience that all cases of Class 2–4 required endodontic treatment.

The author wishes to make something very clear. In the following cases, the 90 percent TCA was not used. There was absolutely no disagreement about the use of TCA, but at the time the following cases were treated, it was not available. The cases were treated with what was on hand. As a matter of convenience and necessity, Monsel’s Solution (MS), a 72 percent solution of ferric sulfate with sulfuric acid, was used. It had been used for many years as a coagulant while performing apical microsurgery. The use of MS to achieve coagulation necrosis when treating ICR over the years appeared to work just fine. As a result, the use of use of MS was continued.
In 1993, a 62-year-old male presented for an evaluation of tooth #9. His general dentist had recommended the tooth be extracted. At that time, a definitive protocol for the diagnosis and treatment of ICR had not been established. But the patient wanted us to do something to save the tooth, “no matter what!” Sensing the sincerity of the patient, we agreed to attempt the salvation of the tooth, with “no guarantees.” At that time, there were some practicing endodontists participating in clinical research for Dr. Torabinijad using MTA in pulp capping, perforations and root-end fills. The author had used MTA on just a few patients previously and had some confidence it might serve as a “last hope” in this case. The MTA was an easy material to work with and required moisture to reach a complete set. After the access was made, the obvious hemorrhaging was difficult to control whenever more granulation tissue was removed using curettes and a #6 round bur. Ferric subsulfate (Monsel’s Solution) was repeatedly used for hemostasis, then irrigated with 2.6 percent sodium hypochlorite solution (NaCl) and rinsed with sterile water, then gently air dried using the Stropko Irrigator (DCI, Newberg, Ore.).

Hemostasis was achieved and vision was maintained while using an Aus-Jena (East Germany) surgical operating microscope (SOM) fitted with a co-observer tube for the assistant. After shaping to a size 80 Kerr file at the terminus, and removing as much granulation tissue as possible, the canal system and defect was again copiously irrigated and dried as well as possible. Due to the size of the apical opening, extra-large absorbent paper points (Kerr) were used to remove any remaining moisture and the entire case was obturated using MTA. The post-operative radiograph indicated a significant amount of excess MTA was extruded (Fig. 10b). The patient was dismissed and reported no post-op problems.

At the seven-month follow-up visit (FUV), the tooth #9 was totally asymptomatic, but the author was concerned with the appearance of the very obvious overfill on the radiograph and wanted to eliminate the excess MTA with a surgical approach. If the patient was seen by another dental office in the future, one could imagine someone saying, “Who in the heck did this to your tooth?” The lesion was missed during the original nonsurgical treatment. To minimize the vibration that would be created when trimming the excess MTA from the root surface, a high speed surgical handpiece with fiber-optics (Impact Air 45 Star Dental, Lancaster, Pa.), fitted with a surgical length taper fissure #1171 bur (SS White) was used.

After a satisfactory root profile was established, a very small inverted cone surgical length #330 bur (SS White) was used to prepare any of the lesion’s periphery that was missed during the original nonsurgical treatment. The necessary “troughing” was completed, new MTA was added to the originally placed MTA for a more complete seal (Fig. 10d). Sutures were removed in a few days, and healing was uneventful. Regular FUV were scheduled. A radiograph taken at the 44-month FUV was diagnosed as “healing complete with an intact PDL” (Fig. 10e, arrow.)

About four years later, the patient returned with a three-unit fixed bridge replacing tooth #9. The patient stated that “about a year ago the tooth got real wobbly,” and it was removed. The pre-op extraction radiograph was located (Fig. 10f). However, later comparison of the 44-month FUV to the pre-extrac-
tion radiograph indicates a possible continuation of the resorptive process (arrow). Isn’t it amazing what you can see when the light is just right?

Second patient

A 64-year-old male presented for evaluation of tooth #2 because of the unusual appearance on the distal of the tooth. The previous clinical examinations and radiographs during the past 10 months had previously been diagnosed as ICR (Figs. 9a–9c). An updated radiograph was taken, all options were explained to the patient, and endodontic treatment was initiated (Fig. 9a). The tooth was accessed and using curettage, a gross removal of fibrous granulation tissue was achieved. The chamber was copiously irrigated with NaCl, rinsed and dried gently. The ICR dentinal defect and granulation tissue were evaluated to get a better concept of its position in relation to the distal wall of the access and to the pulp tissue (Fig. 9b).

A small micro brush dipped in MS is applied to the involved area (Fig. 9c). The MS is used for coagulation necrosis and to display the affected dentin that needs removal. It is not necessary to use copious amounts when applying the MS (Fig. 11d). Instead it is best to rely more on a sequence of repeated brushing with MS, irrigation with NaCl, rinsing and gentle drying. Study with varying powers of the SOM for involved dentin. Then, if necessary, remove more of the affected dentin using varying sizes of Munce burs (CJM Engineering, Santa Barbara, Calif.) (Fig. 11e). This process is repeated as necessary to achieve adequate vision. The floor of the access should be observed, using varying powers of the microscope, to see if any affected dentin remains. A celluloid strip was placed in the distal sulcus to act as a barrier for the flowable glass ionomer restoration (Fig. 11f). An epinephrine-soaked cotton pellet (EpiDry by Pascal) was also used to maintain hemostasis and enable the attempt of a nonsurgical repair of the defect (Fig. 11g).

The defect was etched and restored with a bonded glass ionomer, allowing the maintenance of sterility in the remaining chamber until the endodontic treatment was completed. The pulp tissue was extirpated and canal system partially shaped. Enough CaOH was injected into the canals to cover the floor of the chamber, capped with a cotton pellet, and sealed with a bonded composite as a temporary restoration.

Two weeks later, the patient was scheduled to complete the endodontic treatment. During the process, a #6 file separated in the apical third of the distal buccal canal and had to be retrieved. At the final visit, the canal system was obturated using the Calamus (Dentsply Tulsa) for the injection of pre-warmed gutta-percha to the terminus. A bonded composite core was placed to seal the rest of the canal system and facilitate future restoration with a crown (Fig. 11h).

The restorative dentist extended the distal margin of the full crown well apical to the distal defect for a good seal. The four-year FUV radiograph demonstrates complete healing (Fig. 11i).

Third patient

A 47-year-old male presented for evaluation of “a small area of tingling, or numbness to the right of the nose.” The initial radiograph was classic for ICR (Fig. 12a). All options were explained, and endodontic treatment was initiated. The tooth was accessed, and as much fibrous granulation tissue was removed as possible. MS was applied using a micro brush to achieve coagulation necrosis. Then the chamber was irrigated with NaCl, rinsed with sterile saline, and gently dried using a Stropko Irrigator.

The floor of the access was observed using varying powers of the microscope to identify any remaining affected dentin, which was efficiently removed with various Munce burs. Then calcium hydroxide (CaOH) was sealed in with a bonded composite as a temporary restoration. Two weeks later, the patient returned for completion of the nonsurgical part of the treatment.

The final shaping and cleaning was done, and the canal was filled to the terminus by injection of pre-warmed gutta-percha using a Calamus. A bonded FibreKor post (Pentron) with a bonded composite...
C.E. article_ invasive clinical resorption

Invasive clinical resorption (Core Paste, DenMat), was placed to seal the rest of the canal system, and DenMat Marathon was used to repair the access opening. Then a simple flap was reflected to expose the lingual defect so it could be prepared and restored with bonded Gerestore (DenMat) (Fig. 12b). Healing was uneventful, and the “numbing” sensation beside the patient’s nose did resolve. The radiograph at the four-year FUV showed uneventful healing (Fig. 12c).

_Fourth patient_

This 64-year-old male was referred by his general dentist because of the “unusual radiographic appearance” of tooth #27 (Fig. 13a). Even though there were no symptoms present, the referring doctor was concerned about the integrity of the tooth. Routine off-angled periapical radiographs were taken. The distal off-angled radiograph clearly indicated the lesion was on the lingual of the tooth (Fig. 13b). Both radiographs clearly showed the thin predentin-dentin wall protecting the pulp. The past dental history revealed that the patient had complete orthodontics during his early teens. He said that tooth #27 “came out of alignment” about 20 years ago. To correct the misalignment, the doctor “sliced some off of each side of the tooth” and repositioned it with a removable appliance.

Clinical examination was essentially within normal limits, except a 4-6-4 mm periodontal probing of the lingual tissue resulted in moderate bleeding. All teeth in the posterior quadrants had been restored with full porcelain coverage, and the occlusion was a normal Class 1 molar relationship. All pulp tests were within normal limits. The diagnosis was clearly a Class 3 invasive cervical resorption. All things were explained to the patient, and we agreed to be as conservative as possible during treatment. At the time, the author had no idea what a learning experience this case would be.

At the first visit, the initial access confirmed the diagnosis. The granulation tissue consisted of granules of bonelike hemorrhagic tissue (Fig. 13c). The pulpal wall was very thin, and pieces would come out with the granulation tissue. During the curettage, the fibrous tissue resembled a “crumbling sponge made of bone that was soaked with blood.” Pieces of tissue were sent to an oral path lab for the following definitive diagnosis:

_Microscopic description:_ Histologic examination reveals multiple pieces of soft and hard tissue composed chiefly of inflamed granulation and fibrous connective tissues with bone and tooth structure. The fibrous and granulation tissues consist of interlacing bundles of dense to more delicate collagen fibers supporting varying numbers of fibroblasts, fibrocytes and small blood vessels. A mild infiltrate of chronic inflammatory cells, chiefly lymphocytes and plasma cells, is present within this tissue. Also prominent within our specimen are scattered trabeculae of bone containing osteocytes within lacunae as well as fragments of dentinal tooth structure and calcified debris.
Diagnosis: Right posterior mandible, lingual aspect of tooth No. 27, Histologic findings consistent with idiopathic external resorption.

Gradually, as more of the tissue was removed, the bleeding noticeably decreased, but hemostasis was not achieved. As an interim medication, a thick mixture of white MTA was firmly placed into the chamber, covered with a sterile cotton pellet and temporarily restored with a bonded composite (Fig. 13d). During the initial examination, pulp testing indicated a normal pulp, and now the author was wondering if the vitality of the tooth could possibly be maintained. All options, including the possible need for conventional root canal treatment, were explained. Both the doctor and patient agreed to attempt to maintain the vitality of the tooth. The patient was rescheduled for a second visit in about two weeks.

During the second visit, the chamber was reopened, the MTA was eliminated and more granulation tissue and affected dentin, more solution was applied from the previous use of Monsel’s Solution (Fig. 14a). Gradually, as more of the tissue was removed, the bleeding noticeably decreased, but hemostasis was achieved. At this time, the operator was able to identify the remaining pulp tissue was identified. After irrigation with NaCl, rinsed, gently dried and etched with 35 percent phosphoric acid gel (Ultra-etch by Ultradent). A bonded core was placed, and access restored with a bonded composite (Fig. 13g). The patient was placed on a two-month schedule for an FUV.

At the two month FUV, the periapical radiograph revealed the response to treatment was not as expected. The ICR lesion had significantly progressed in that short time (Fig. 13h). All options were discussed with the patient, but there was no doubt that conventional endodontic treatment, followed by surgical repair of the lesion, would be necessary.

During this visit, an adequate access was created to remove the previously placed MTA. Using Gates Glidden burs and a #4 round bur, more involved dentin was removed in the coronal aspect of the canal. The canal system was then shaped and cleaned to the terminus, and CaOH was sealed in with a bonded composite temporary (Fig. 13i). After about 10 days, the canal system was obturated by the injection of pre-warmed gutta-percha to the terminus, and CaOH was sealed in with a bonded composite temporary (f).

A sulcular flap was reflected enough to adequately access the ICR lesion. The lesion was at the lingual crestal bone and had been slightly stained from the previous use of Monsel’s Solution (Fig. 14a). After gross removal of the remaining granulation tissue and affected dentin, more solution was applied
Invasive clinical resorption

After a few days, the chamber was irrigated, a bonded core was placed and was finished with a bonded composite (DenMat) (g). The two-month FUV radiograph showed the attempt to maintain the vitality of the tooth was not successful (h).

The MTA was removed, the canal shaped, and Ca(OH)2 sealed with a bonded temporary (i). The canal was obturated with gutta-percha, a bonded fiber post with a composite core was placed (j).

After a surgical flap was raised, the ICR lesion was observed at the lingual crest of bone. The “X” is the glass ionomer placed at the pre-surgical appointment (a). After each application of Monsel’s solution, the granulation tissue was removed with various sizes of Mucne burs. The apical portion of the preparation is shown (b).

A bonded glass ionomer was placed and cured (c). Immediate surgical post-op radiograph (d). Radiograph from a distal off-angle shows integrity of the post and core (e).

The diagnosis of ICR is made more precise with currently available radiographic technology. Digital radiographs and cone beam computerized tomography (CBCT) have set a new standard of clinical management, allowing more predictable results with less stress. The three dimensional view presented by CBCT, removes a lot of the “what ifs” from the diagnosis.

In today’s world, the use of a surgical operating microscope (SOM) is essential to enable the operator to overcome the difficulty of treating ICR cases. The variable magnification and superior lighting of the SOM gives the operator the enhanced vision necessary to treat ICR cases with less stress and a higher probability of success. Having a dental assistant involved, using a co-observer tube during any dental procedure, is an incredible help because now the assistant is able to “see what you see at the same time you see it” and better anticipate what is needed next.

In all cases presented, MS was used successfully for coagulation necrosis. Based on an early report, the author used it routinely during microsurgery for crypt management.14 As a result, when the first case of ICR presented for treatment, 90 percent TCA acid was not a familiar alternative protocol. Having never used TCA, the author can offer no comparison or comment. The original protocol for clinical management of ICR using 90 percent TCA, suggested by Heitnersay in 1999, is still the most popular and well documented.

There are various techniques to restore a tooth with ICR, as previously described in the literature that are different from what is presented in this article. However, the real purpose in the treatment of ICR was, and still is, to eliminate as much of the involved dentin...
As humanly possible. If is not achieved, the process will progress and be a disaster for the tooth.

Since mineral trioxide aggregate (MTA) was extensively used in the first case presented (Figs. 10a–f.), the author does not intend to suggest the use of it as a material for the repair of ICR defects. The author did that case almost 20 years ago. Today the materials of choice would be bonded glass ionomers or composites for their strength and adhesiveness. MTA is currently used as a pulp capping material, perforation repairs or as a restorative material for the repair of a radicular defect that is apical to the osseous crest.

It is important to remember that unless the challenge is accepted to treat a seemingly hopeless or extremely difficult case, the opportunity to learn what can be accomplished is lost. Experience has shown that in those “basket” cases there have been more pleasant and favorable surprises than unpleasant results. As William F. O’Brien said, “It is better to try and fail, than to not try at all.” Hindsight is always 20–20, and it is one of the best teaching tools we always have at our disposal. The important thing is to learn from our mistakes and those of others.

If a tooth can be saved for only a few years, the rapid advancement of technology will permit a significantly better treatment in the future. So, if an opportunity is presented to save the tooth, then why not? If the question still remains, the words of Dr. Herbert Schilder are pertinent, “Make yourself the patient, and you have the answer!” The important consideration is what is in the best interest of the patient. Remember, an implant can always be done, and should be the last resort.

In conclusion, the quote from Dr. Henry Rankow gives the best explanation of the predicament presented for the clinical management of this lesion, “ICR is an ‘outside-in’ problem that is very difficult to treat ‘inside-out’!”

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Editorial note: A complete list if references is available from the publisher.

Figs. 14f,14g. The eight-year FUV indicates healthy tissue on both the buccal (f), and the lingual views (g). Note the slight gray shadow left as the result of using gray MTA at the beginning of the nonsurgical treatment.

Figs. 14h,14i. Radiographs taken at the normal angle (h) and taken at a mesial off-angle (i) also indicate complete healing of tooth #27. However, note the arrows pointing to a previously unnoticed ICR lesion. The various off-angles of these radiographs indicate the lesion is on the buccal surface. This should serve as a good example about the “tunnel vision” we sometimes catch ourselves doing!