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Ortho-Aesthetics: One Solution to External Resorption

When patients present with lesions, which may be of carious, immune-compromised, or traumatic etiology, many variables must be assessed before a definitive treatment can be rendered. The options for teeth that have questionable long-term prognosis due to internal or external resorption¹ include restorative dentistry, fixed partial dentures, removable prostheses, implants with immediate extraction and implant placement, or implants with a staged protocol.

With the plethora of options available, it is incumbent on each practitioner to educate the patient as to the prognosis of each treatment option, as well as the limitations of treatment, and to satisfy requisite patient goals.

This case study will highlight an evidence-based treatment solution to an aesthetically challenging external resorptive defect.

CASE REPORT

A 56-year-old woman presented with a Class II, Division 2, orthodontic classification. She had diastemas distal to her canines and a retroclined anterior maxillary segment (Figure 1). She had been bleaching weekly for more than 20 years. She reported feeling a ledge on the lingual surfaces of her maxillary anterior teeth, and then one day the ledge was gone and she felt “something weird” at the gumline. The etiology of her resorption could have been due to the long-term bleaching activity, as she reported no history of trauma, orthodontics, or any other inci-

dent involving her anterior teeth.

She presented with an external resorptive lesion on the lingual of tooth No. 9, which was assessed as having a fair-to-poor long-term prognosis (see Inset on page 108). A work-up was done to assess her available bone for an implant, abutment, and crown restoration. The patient’s retroclined incisors—coupled with a thin gingival biotype and gummy smile, along with a near translucent enamel shade—necessitated evaluating orthodontics with (or without) a cosmetic rehabilitation of the anterior teeth to restore her teeth and smile to a more ideal level of aesthetics while protecting a severely compromised tooth No. 9 (Figures 2 to 5).

This patient had an orthodontic and orthopedic discrepancy as well as a failing anterior tooth secondary to external resorption. Orthodontic correction would have taken at least 1.5 years, and the forces placed on the teeth could have led to further resorptive changes and the loss of an anterior tooth.²

Extract the Anterior Tooth, or Not?

Complications from the Acute Implant/Abutment Angle

Implant replacement of tooth No. 9, with the resulting abutment/implant angle due to a Class II, Division 2 orthodontic classification, would have made implant placement and prosthetic rehabilitation difficult. Furthermore, if implant placement was to be considered, the thin gingival biotype, quality and quantity of bone, and high smile line would have made this aesthetic rehabilitation challenging. Lastly, the patient’s frequent bleaching and the difficulty in shade matching made the comprehensive aesthetic rehabilitation a more predictable solution to these myriad problems. The use of multiple shade guides could not approximate a close match if a one-tooth solution was chosen (Figure 6).

An endodontic consultation was sought, external resorption was diagnosed, and the patient decided to attempt to save the tooth with endodontic therapy and cosmetic rehabilitation. At the conclusion of the aforementioned treatments, a nocturnal splint would then be made and delivered to help prevent any damage from bruxism or parafunction. Selection of the enamel shades, as a part of the preoperative workup, was completed *prior* to preparation so the enamel would not be dehydrated. Several shade guides were used to assess a natural hue, chroma, and value for the whitened teeth she presented with. After taking photos with the standard shade guide tabs and reviewing them (Figure 6), the laboratory team fabricated several custom shade tabs that were also used for assessing and finalizing the final tooth shades and translucency.



Figure 1. A full-face, preoperative photo of the patient (Class II, Division 2).



Figure 2. The pre-op retracted view.



Figure 3. A pre-op photo of tooth No. 9, showing internal resorption.



Figure 4. A profile view of the smile, displaying retro-inclined incisors.



Figure 5. The right profile view, highlighting a large diastema distal to tooth No. 6.

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INTERNAL RESORPTION: ETIOLOGY, BIOLOGY, TREATMENTS, AND A LITERATURE REVIEW

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The loss of dental hard tissue, such as dentin and cementum due to odontoclastic activity, is known as external cervical resorption (ECR). ECR is the least understood of the resorptive phenomenon. It has been described as invasive cervical resorption, odontoclastoma, peripheral cervical resorption, and subepithelial external root resorption, to name a few.^{3,6}

The etiology of ECR is thought to arise from damage to the protective cementum layer below the epithelial attachment. Then there is a migration of osteoclasts that resorb the root surface and may migrate below and into the clinical crown. In this case, there was no history of trauma, orthodontics, intra-coronal bleaching, or periodontal therapy, which have all been suggested as causes of ECR. However, this patient did engage in extensive bleaching of her vital teeth, and this may have been one etiology of the resorptive process.^{3,7}

Intra-coronal bleaching has been documented as a predisposing factor for ECR. The mechanism by which this happens, according to Rotstein et al,⁷ is that the defects in the CEJ could result in hydrogen peroxide from the pulp chamber in an endodontically treated tooth escaping to the external tooth surface via dentinal tubules that may denature the dentin and provoke an immunological resorptive response. It can be extrapolated that prolonged bleaching for many years with bleaching trays could also irritate exposed root surfaces, leading to ECR via the same mechanism and resultant immunoresponse.^{4,8} Therefore, prolonged bleaching may create the same resorption issues as intra-coronal bleaching (but this requires further investigation).

The diagnosis of ECR usually starts with a pink spot where soft tissue has invaginated into the defect within the cementum. The patient had a pink discoloration on the lingual of tooth No. 9 that was detected on routine recall. The patient was referred to an endodontist who further used radiographs and CBCT to locate the lesion. The tooth was treated with endodontic therapy and Mineralized Trioxide Aggregate (MTA) to arrest the lesion and to provide a protective area for bonding prior to fabrication of full-coverage restorations.

Diagnosing ECR from root caries can be done clinically by noting that the defect was not sticky to an explorer and caries were not present. The base of the lesion was hard and firm, with a distinct sound upon scraping the dentin vs soft caries.

The use of radiographs with the parallax technique can further help distinguish between external and internal resorption. With an internal resorptive defect, the lesion stays centered within the canal regardless of the angle of

x-ray exposure. The ECR defect will move as the x-ray tube head is moved.^{2,9,10} In diagnosing ECR, it is recommended to take radiographs from multiple angulations to confirm the lesion in mesial, buccal, and distal locations to avoid superimposition over the canal. In external resorption, the root canal can still be traced despite superimposition of the lesion over the canal system.¹¹ The treatment of ECR depends upon the location, severity, and extent of the lesion.¹² The use of CBCT to diagnose and track ECR is increasing and can be of particular importance when diagnosing ECR on the labial and lingual of root surfaces.^{13,14}

Classification of ECR

ECR can be classified, according to Heithersay,³ as follows: Class I lesions are small lesions with minimal penetration into dentin. Class II lesions are well-defined, invasive resorptive lesions that are close to the coronal pulp chamber but with little radicular spread. Class III lesions are deeper, invading coronal dentin and extending into the coronal third of the root structure. Class IV lesions are large lesions that extend well beyond the coronal third or one-third AG of the root canal. By definition, the Class IV defects are nonrestorable and have a poor prognosis (see Table 1. External Resorption).

Treatment Options include:

1. No treatment and monitoring the lesion
2. Immediate or delayed extraction with presence of symptoms
3. Forced orthodontic eruption
4. Restoring the lesions with endodontic therapy if the lesion penetrates to the pulp chamber or canal

The patient here presented with a Class II, Division 2 malocclusion and traumatic occlusion with a severely retroclined dentition. Forced eruption, as well as orthodontic intervention, was ruled out as these forces could exacerbate the resorptive process. The size of this lesion, a Class II lesion

according to Heithersay,³ penetrated close to the coronal pulp with a well-defined resorptive lesion that did not penetrate the radicular root structure (Figures 21 and 22). Heithersay³ has reported a 100% success rate in treatment of Class I and II ECR lesions and a success rate of 77.8% with Class III lesions.

The nature, location, and size of the lesion allowed the endodontist to treat the tooth and repair the defect with MTA prior to prosthetic rehabilitation. There was enough tooth structure to allow for a ferrule of at least 4.0 mm that facilitated the use of all-ceramic crowns to protect the ECR defect.

TABLE 1. EXTERNAL RESORPTION

Favorable Prognosis:

1. Minimal bone loss or loss of tooth structure
2. Located cervically, but above crestal bone
3. Lesion is accessible for repair
4. Absence of radicular symptoms or pathology

Questionable Prognosis:

1. Foundation is poor
2. Crown lengthening required
3. Orthodontic extrusion required
4. Pulpal pathology or necrosis

Poor Prognosis:

1. Compromised structural integrity of tooth
2. Deep pocketing associated with resorption defect
3. Lack of accessibility for repair

Ortho-Aesthetics: One Solution to...

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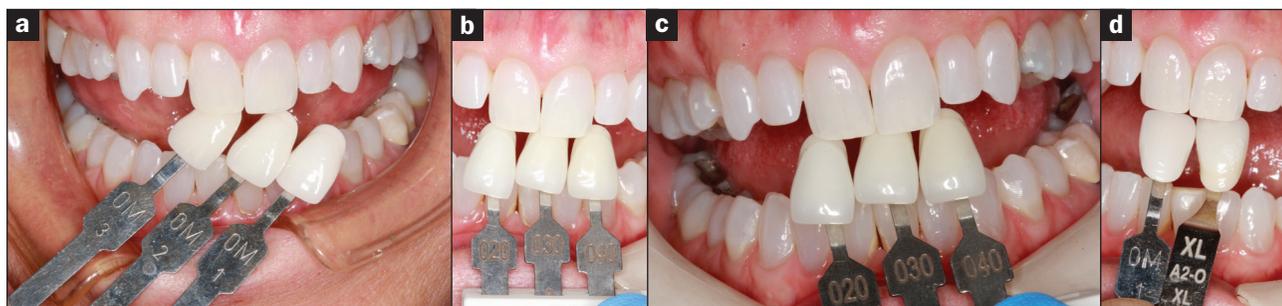
After a facebow transfer and alginate impressions were taken, a diagnostic wax-up (Glidewell Laboratories) was fabricated. A clear pull-down matrix was made over a stone model of the wax-up and was used to assess the teeth and to create a preparation guide prior to initial tooth reduction (Figure 7). This clear template was filled with bis-acryl temporary material (Integrity Multi-Cure

[Dentsply Sirona Restorative]) and seated gently on the teeth. A stick bite, utilizing bite registration material (Blu-Mousse [Parkell]), ensured that the incisal plane would be parallel to the floor and parallel to the interpupillary lines, as well as marking the midlines to provide a means to begin our check-bite process. This was accomplished by squirting Blu-Mousse on the occlusal surfaces and placing an extra bolus anterior to the front teeth. Then, a cotton tip applicator was twirled into the Blu-Mousse and lev-

eled while the patient stared directly at the doctor so it could be parallel to the interpupillary line. A secondary master bite was also made that was altered after every 2 to 3 preparations.

The preparations were completed on the patient's right side, leaving teeth Nos. 8 and 9 unprepared to ensure a positive anterior stop. Then the master bite was trimmed, Blu-Mousse was injected, and the bite was seated to record the newly prepared teeth. The Blu-Mousse bite registration was carefully trimmed, and the proce-

dures were repeated on the patient's left side. Next, teeth Nos. 8 and 9 were prepared and (again) the bite was relined so that there was a segmental bite as well as an untouched stick-bite for the lab team to use for verification of the bite registration (Figure 8). The dentin shades were then captured with photos that included the shade guide tabs (Figure 9). Note the respect that has been paid to the tissues by careful retraction via the use of gingival retraction instruments. Not only were gingival zeniths preserved, but the



Figures 6a to 6d. Shade tab photos for the lab.



Figure 7. A clear pull-down matrix was made from the diagnostic wax-up and is shown here over the teeth.

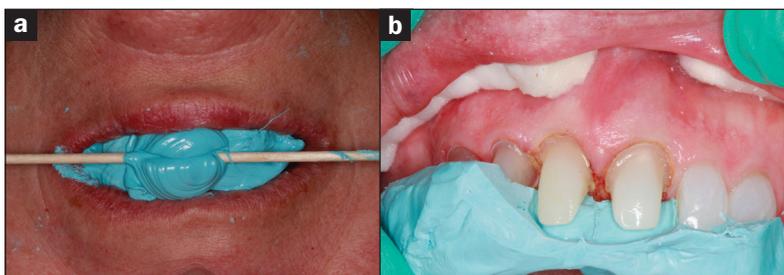


Figure 8a. The stick bite (Blu-Mousse [Parkell]).

Figure 8b. The sequential bite registration (Blu-Mousse).



Figure 9. The stump (stump) shade of preparations.



Figure 10. A tissue retractor guard is used to protect the margination of the preparations.

So the stage has been set for success, and in the event of future failure, we are still set up for success...



Figure 11. The Sil-Tech Putty Matrix (Ivoclar Vivadent) with Integrity Multi-Cure provisional material (Dentsply Sirona Restorative).



Figure 12. Healed tissue, after one month in the provisionals.



Figure 13. The provisionals, prior to staining and glazing.



Figure 14. A vinyl polysiloxane (VPS) impression (Aquasil Ultra Xtra [Dentsply Sirona Restorative]) was taken of the preparations.

interproximal anatomy of the papillae was maintained with gingival retracta-guards (Tanaka Dental) (Figure 10).

The provisionals were made by injecting a bis-acryl provisional material (Integrity Multi-Cure) into a putty matrix (Sil-Tech [Ivoclar Vivadent]) (Figure 11) made from the approved diagnostic wax-up.

The ability to perform predictable aesthetic rehabilitation requires that the soft tissues be given time to heal and mature. Giving provisional restorations a “test drive” allows patients to evaluate aesthetics, phonetics, and function prior to seating the definitive restorations and, in addition, allows for an intraorally confirmed template for the prototypic restoration (Figure 12). This light-cured or dual-cured bis-acryl material is strong, taking on



Figure 15. Lithium disilicate (IPS e.max [Ivoclar Vivadent]) crowns on the day of cementation.

a high shine once polished. Figure 13 shows the contouring of the restorations prior to glazing and polishing.

Carefully fabricated provisionals allowed for custom anterior guide tables to recreate proper lingual contours in the approved provisionals and the final restorations. The use of a double-cord technique, a quality vinyl polysiloxane (VPS) material (Aquasil



Figure 16. A 3-year postoperative photo of the lithium disilicate (IPS e.max) restorations.

Ultra Xtra [Dentsply Sirona Restorative]) that exhibits hydrophilicity and high tear strength, and a working time that gives the operator a full 5 minutes to carefully inject the material in a wash/tray application provided an excellent master impression (Figure 14). In addition, a stick bite, a master bite, and stump (stump) and enamel shade photos provided the dental labo-



Figure 17. The occlusal view of the 3-year-old restorations.

ratory team with everything needed to create the ideal restorations.

Immediately after cementation, the layered lithium disilicate (IPS e.max [Ivoclar Vivadent]) restorations displayed symmetry of form and function with no bleeding and well-healed gingival tissues (Figures 15 to 18). However, since this case cannot be stated as a successful resolution of this patient's



Figure 18. The smile view at 3 years post-op.



Figure 19. The canine guidance right at 3 years post-op.



Figure 20. The canine guidance left at 3 years post-op.

problem without demonstrating longevity of the work accomplished, the 3-year postoperative photos are shared here to document the morphologic balance, bilateral canine guidance (as designed and tested in provisional restoration), and anterior guidance achieved for the patient (Figures 19 and 20). The patient's soft-tissue contours have remained stable, and the occlusal view displays normalized contours and maintenance of cuspal integrity. The patient was as pleased with the aesthetics of her rehabilitation at 3 years post-op as she was when it was first cemented (Figures 16 to 20). The periapical radiograph and CBCT, taken 3 years post-op, demonstrate the lack of spread of the ECR as well as intimate coverage by the all-ceramic (IPS e.max) crowns (Figures 21 to 22). The 3-year post-op photos shared here demonstrate the well-maintained cosmetic rehabilitation of this complex and aesthetically compromised case (Figure 23).

CLOSING COMMENTS

Some patients have aesthetic problems that are not easily amenable to implant therapy due to unfavorable tooth position. Creative mindsets can often offer solutions that will mask orthodontic or orthopedic malpositions while facilitating desired aesthetic outcomes.

Whether this case would have been restored with a single tooth implant or the way it was restored with endodontic treatment, an external cervical resorption (ECR) restoration and traditional crowns depend on training, skill, philosophy, and judgment. However, when also considering the patient's aesthetic desires, the solutions become more *patient centered*. Now, if the central incisor fails, the shade of the teeth has already been documented and recorded, and a custom porcelain shade tab was fabricated and preserved to mimic her most difficult porcelain shade. The emergence angle and profile of tooth No. 9 is a *positive emergence angle and*



Figure 21. The 3-year post-op periapical radiograph, taken after repair of resorption and restoration.

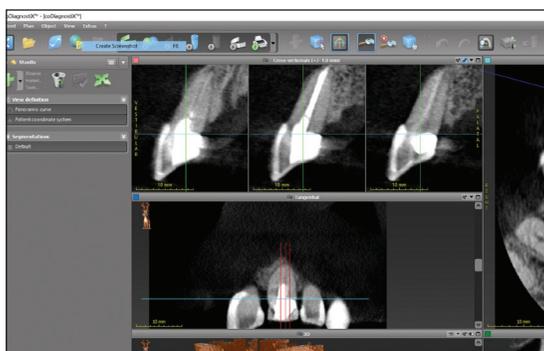


Figure 22. A CBCT showing the extent of the Class II external cervical resorption.



Figure 23. Pre- and post-op photos of the cosmetic rehabilitation.

profile, so it will make implant rehabilitation easier without having to create an acute angle between the implant and the abutment in the future.

Lastly, and perhaps most importantly, protective canine guidance has been created that will pave the way for a successful implant restoration without traumatic occlusion or parafunction as she had presented with initially. So the stage has been set for success, and, in the event of future failure, we are still set up for success should an implant rehabilitation be required. Remember, if one fails to plan, a case may fail. This arti-

cle demonstrates how *upgradeable dentistry*¹⁵ can be built into a current treatment plan to help the patient achieve predictable results now and into the future, should the initial design fail.

The evaluation of the literature on ECR provided a cogent etiology of this patient's lesion as well as an evidence-based analysis of prosthetic treatment options. This patient was instructed to stop bleaching her teeth and to wear her mouthguard to prevent parafunction that could compromise the success of her aesthetic and functional rehabilitation. ♦

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