External Resorption: Causes and Possible Conservative Treatments with Tricalcium Silicate and Composite

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Root resorption is the loss of hard dental material consisting of cementum and dentin. It entails two stages: injury and stimulation. Injury is associated with non-mineralized tissues covering the outside surface of the root (precementum) or it can involve the interior of the canal. The injury may be a result of mechanical injury as a result of dental trauma, surgical procedures or pressure from an impacted tooth. It also may be initiated by chemical irritation such as bleaching with 30% hydrogen peroxide.

The root resorption is a sequel to odontoclastic activity. The denuded mineralized tissue is invaded by multinucleated cells that start the resorption progression. The resorptive cells require additional stimulation or the process terminates spontaneously. Cementum-like material may mend the injured surface if the area isn't too large. Extensive areas may result in invasion of bone cells that

may attach to the root, resulting in ankylosis. Additional stimulation by factors of infection or pressure will allow active resorptive process to continue.[1] Cementum usually will protect the underlying root dentin. However, damage or lack of this shielding layer below the epithelial attachment allows osteoclasts to resorb the dentin. The anatomic profile of the cementoenamel junction (with frequent gaps of cementum) predispose this area to potential problems.[2]

Root resorption is often classified by its position relative to the root surface. The resorption can be external or internal. External resorption can be further divided into surface resorption, external inflammatory resorption, external replacement resorption, external cervical resorption and transient apical breakdown.

External cervical resorption (ECR) has been extensively characterized by Dr. G.S. Heithersay, who actually prefers the term invasive cervical resorption (ICR). ECR most often occurs immediately below the epithelial attachment and at the cervical area of the tooth.[3] Heithersay divides ICR into four classes according to the degree of damage to tooth structure. Class 1 is a small invasive resorptive lesion near the cervical area with shallow penetration into dentin. Class 2 is a well-defined resorptive lesion close to the coronal pulp chamber with little or no extension into the radicular dentin. Class 3 presents a resorptive defect involving the coronal third of the root. And Class 4 is a resorptive lesion extending beyond the root's cervical third.[4]

continued on page 66

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 continued from page 65

Dental trauma is a problem that most often affects children and adolescents with sometimes devastating consequences. Boys are usually most often affected and the central incisors are commonly involved.[5] Overjet more than 5mm increases the risk factor and falls, crashes, sports, violence and automobile accidents provide causes. Studies have demonstrated posttraumatic injuries to permanent teeth between 3.9 and 58.6 percent.[6] These injuries can result in pulp necrosis, internal or external resorption, calcific metamorphosis and ankylosis.

Clinical case

A 32-year-old male with no significant medical history presented to the Department of Aesthetic Dentistry at NYU College of Dentistry complaining of a discoloration at the gingival margin of his right central incisor. He had a history of trauma to the area when he was a teenager playing soccer. The tooth was asymptomatic. Clinical examination revealed a rosacea-like discoloration under the overlying enamel (Figs. 1 & 2) and a radiograph revealed a radiolucent area in the same location. No similar lesions were present elsewhere.

Periodontal probing the area demonstrated the lesion only extended slightly subgingivally and didn't invade the epithelial attachment. Initially, due to the size of the lesion, endodontic treatment was going to be initiated. The tooth was not sensitive to hot or cold and negative to percussion. However, the recent introduction of bioactive material such as a medical-grade, calcium-silicate–based material like Biodentine from Septodont and Activa Base/Liner from Pulpdent allowed the consideration of a more conservative procedure. It was decided to excavate the lesion and place Biodentine and then a composite resin as the final restoration.

Fig. 1 External cervical resorption
Fig. 2 Pink hue
Fig. 3 Removing granulomatous tissue
Fig. 4 Dispensing Biodentine liquid

Restorative procedure

After patient consent, the patient was anesthetized and then the thin shell of overlying enamel was removed with a high-speed handpiece and water. The dentin (or body) shade was selected from the cervical area or exposed dentin. The Vident's Vitapan classical tooth guide was utilized while the tooth was hydrated. The lesion was carefully hand excavated with a spoon excavator until a hard surface was obtained (Fig. 3).

Cavity disinfection and control of gingival bleeding was performed with sodium hypochlorite. A capsule of Biodentine was tapped lightly on a hard surface to loosen the powder and then opened and placed on the white capsule holder. A single-dose container of liquid was detached and gently tapped to allow all of the liquid to enter the container. The cap was then twisted open and five drops from the single-dose container were placed into the capsule (Fig.4).

The capsule was placed in a mixing device for 30 seconds at a speed range of 4,000-4,200rpms. The capsule was opened and the consistency verified. A thicker consistency was desired so the material was allowed to sit for 30 seconds. The capsule was opened and the Biodentine removed with the instrument supplied in the box. A plastic instrument was used to carefully place a layer of Biodentine covering the floor of the preparation avoiding entrapping air bubbles.

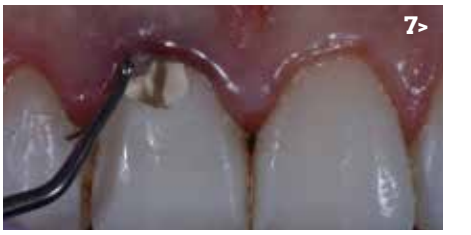
continued on page 68

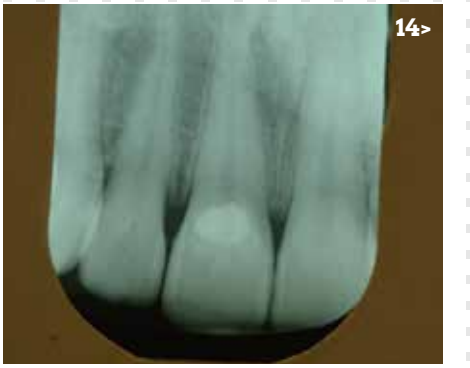
> "Traumatic injury to teeth may present a considerable challenge to the practitioner … The recent introduction of bioactive materials may open a whole new avenue of treatment."

 continued from page 67

The material was flattened without excessive pressure and judiciously adapted to the cavity walls (Fig. 5). Excess was removed with a spoon excavator. The material was allowed to set for 12 minutes. Geristore syringeable by DenMat (Fig. 6) was placed at the cemento-enamel junction (Fig. 7), and after initial set (material will reach final cure in 3-4 minutes from the time dispensed) was light cured. The preparation (10 seconds) and surrounding enamel (15 seconds were etched with 37% phosphoric acid (Fig. 8). Rinsed with a copious stream of water, a high volume vacuum was then used to remove excess water and the area blot dried with a moist cotton pellet. Prime & Bond NT by Dentsply Caulk was then used (Fig. 9) and allowed to remain wet for 20 seconds and then lightly air dried for five seconds.

Fig. 5 Packing Biodentine
Fig. 6 Geristore syringeable
Fig. 7 Geristore syringeable placed at gingival margin
Fig. 8 Tooth etched with 37% phosphoric acid
Fig. 9 Selection of composite
Fig. 10 Application of bonding agent
Fig. 11 Composite is sculpted with a brush
Fig. 12 Trim with scalpel
Fig 13 Final aesthetic result
Fig. 14 Radiograph six months later





The surface had a glossy appearance. The bonding agent was light cured with an Ultradent Valo light for 10 seconds. 3M ESPE's Filtek Supreme Ultra Universal Restorative (Fig.10) A2 dentin, A2 enamel and clear translucent were built up in layers. Septodont's N'Durance, a nano-dimer composite with a low volumetric shrinkage, also available in Vita shades, universal opaque and translucent shades, was an alternative choice. The varying opacities allowed an excellent match to the surrounding tooth structure. Cosmedent Dental Composite Brushes (Fig. 11) allowed contouring and blending to the surrounding tooth structure. 3M ESPE's Sof-Lex Contouring & Polishing Discs were used initially followed by a Diamond Twist SCO — Intra-Oral Polishing Kit, from Premier Dental, to achieve a final polish. Any remaining excess was trimmed with a 12C scalpel blade (Fig. 12). The final aesthetic result restored normal anatomy and emergence profile (Fig. 13). Radiograph taken six months later demonstrated no perapical pathology and no further progression of the lesion. The tooth needs to be closely monitored so that there is no reoccurrence (Fig. 14).

Discussion

External cervical resorption as a consequence of dentoalveolar trauma may result in functional and aesthetic modifications of the patient's dentition. Sometimes a multidisciplinary treatment may be required. Endodontic treatment and reconstructive periodontal surgery are often required. Dental trauma is often the chief element that predisposes the development of ECR. In this case report, the development of ECR was possibly related to the trauma the patient was subjected to during a soccer game. Invasive cervical resorption is often challenging to both diagnose and determine the extent of the lesion.[8]

Different approaches have been advocated for treatment of ECR. Initially the application of trichloractic acid to the resorptive tissue and curettage are recommended.[9] Calcium-silicate-based cements were first introduced by Dr. Mahmoud Torabinejad in 1993 as a root end filling for endodontic surgery, mineral trioxide aggregate (MTA). Since that time, MTA has also been used as a pulp capping material with great success.

In 2011, Biodentine, a highly purified tricalcium silicate prepared in the lab, was introduced by Septodont. Additionally, Biodentine contains di-calcium silicate, calcium carbonate and zirconium oxide as a radiopacifier. Calcium-silicate-based cements set through a hydration reaction. The hydration reaction starts with the fast dissolution of the tri-calcium silicate particles and this allows the relatively quick setting reaction. Calcium chloride in the liquid speeds up the hydration and the absence of calcium sulphate that acts as a retarder.

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continued on page 70

 continued from page 69

The alkaline caustic effect of the calcium of the calcium silicate hydration products results in a degradation of the collagenous section of interfacial dentin. This creates a porous structure and allows increased concentration of Ca2, OH- and CO 3 2- ions, resulting in increased mineralization in the mineral infiltration zone.[10]

The use of hydraulic calcium silicate cement stimulates pulpal recruitment and differentiation up regulates gene transformation factors and promotes dentinogenesis.[11] Recent introduction of Biodentine with dentin-like properties and the ability to stimulate tertiary dentin formation, may allow a more conservative biomimetic treatment of ECR. The restoration of choice in resorption lesions should strengthen remaining tooth structure, have a thermal expansion close to that of tooth structure and be biocompatible. Biodentine as a dentin substitute in areas under the CEJ performed well without conditioning treatment[12] and when covered by composite, was well tolerated as a dentin substitute.[13] Biodentine can also be used for pulp capping as it enhances the spread, movement and adhesion of human dental pulp stem cells.[14]

The resin ionomer Geristore has been used extensively for root perforation repairs. Geristore is a dual cure (both self and light-curing), hydrophilic, nonaqueous polyacid modified composite resin composed of fluoride-releasing glass, mainly barium fluorosilicate, and a polymerizable organic matrix (modified Bis-GMA, including 2-HEMA) combined with a photoinitiator. Advantages of these materials include insolubility in oral fluids, increased adhesion to tooth structure, dual-cure capabilities, low-cure shrinkage, low coefficient of thermal expansion, radiopacity, fluoride release and biocompatibility. Several clinical studies have demonstrated Geristore could repair subgingival and subosseous defects and could be used as a barrier for guided tissue regeneration.[15,16] Gingival fibroblasts attached to Geristore in an integrin-independent manner indicating that integrins (transmembrane receptors that mediate the attachment between a cell and its surroundings) do not directly mediate attachment to this material.[17]

Conclusion

Traumatic injury to teeth may present a considerable challenge to the practitioner. Proper diagnosis and appropriate treatment sequence are critical to success. At times, surgical, restorative, endodontic and orthodontic approaches are required. Treatment should be evidenced based and biomimetic. The recent introduction of bioactive materials may open a whole new avenue of treatment. ■

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