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Original Article

Clinical Management of External Apical Root Resorption Using Amnion Membrane Matrix and Bio Dentine

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ABSTRACT

External apical root resorption is characterized by the gradual blunting and shortening of the root, leading to open apices that complicate the achievement of an adequate three-dimensional seal in the root canal system. A common treatment approach for such conditions has been the placement of an apical barrier. This case report demonstrates the innovative use of an amnion membrane matrix combined with Biodentine as an apical barrier to manage apical root resorption. After performing the initial access opening, the root canals were carefully cleaned and shaped. An intracanal medication of calcium hydroxide was applied for two weeks. At the next session, an amnion membrane was placed in the apex to act as an internal matrix, and then a 5-millimeter plug of Biodentine was placed. Post-space preparation was performed, and a glass fiber post was placed with a composite core build-up. The tooth was then restored with a full-coverage porcelain fused to a metal crown. After 18 months, the patient showed no clinical signs or symptoms, with radiographs revealing the development of calcified tissue beneath the Biodentine barrier. These positive results indicate that amnion membrane matrix and Biodentine can be reliably used to manage apical root resorption.

Keywords: External root resorption, Amnion membrane, Biodentine, Roots

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Introduction

External apical root resorption leads to the loss of the apical constriction, making it challenging to achieve a proper apical seal. The primary treatment goal in managing external root resorption is the elimination of microorganisms to promote healing in the periapical area, which is typically accomplished through standard root canal therapy. However, the absence of apical constriction complicates the formation of an effective apical seal, presenting a significant challenge in endodontics. As a different way to conventional root canal treatment, apexification has been recommended for such cases.

Apexification refers to a procedure aimed at stimulating continued root development in teeth with an open apex by inducing the formation of a calcific barrier at the root end [1]. Calcium hydroxide is the preferred material for apexification due to its effectiveness [2]. Although the procedure has shown favorable results, it has several drawbacks, including: a) extended time for apical barrier formation, b) multiple visits, c) patient compliance issues, d) risk of reinfection if coronal restoration fails, and e) potential tooth fracture [2-4]. Additionally, the resulting apical barrier often resembles a porous “Swiss cheese” structure [6]. To address the limitations, the concept of “one-step apexification” was mentioned.

One-step apexification involves creating an artificial apical plug using a biocompatible material that seals the root canal in a retrograde manner [6]. This approach offers several advantages, such as reduced treatment time and the creation of a more reliable apical seal [7-12].

One of the challenges faced in patients with open root apices is the extrusion of materials into the surrounding periradicular tissue, which prevents proper compaction. To address this, an apical matrix is required to control the compaction of materials to the desired level. Various materials have been suggested for use as a matrix, including calcium hydroxide, hydroxyapatite, collagen that can be absorbed, calcium sulfate, and platelet-rich fibrin derived from the patient's blood [13-16].

In recent years, mineral trioxide aggregate (MTA) has become a popular choice for one-step apexification due to its excellent sealing ability, biocompatibility, and antibacterial properties. However, the material's handling challenges, including extended setting times, prompted the development of a more user-friendly alternative. This led to the creation of Biodentine (Septodont, Saint-Maur-des-Fosses, France), a calcium silicate-based material designed to offer the same benefits as MTA but with improved handling characteristics.

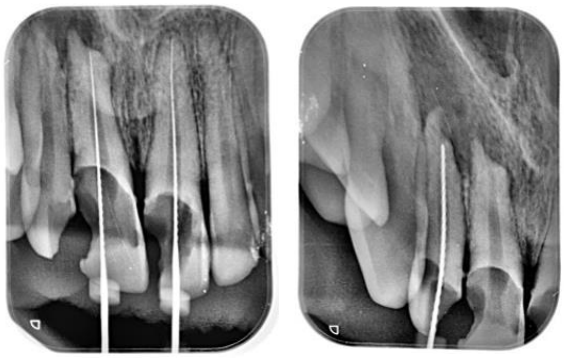
Amniotic membrane-derived cells have multipotent qualities, containing stem cells and growth factors that have been successfully utilized in regenerative medicine. The membrane itself can be separated, sterilized, and stored for later use. According to Sharma and Yadav [17], the amnion membrane functions as a biological matrix that facilitates cell migration.

This case report explores the innovative combination of amnion membrane as an internal matrix and Biodentine as an apical barrier for non-surgical treatment of external apical root resorption.

Case Presentation

A 20-year-old male patient presented to the Department of Conservative Dentistry and Endodontics with complaints of decayed upper front teeth. The patient reported experiencing a traumatic injury eight years earlier. His medical history was unremarkable, with no known allergies to medications or other significant dental issues. Upon intraoral examination, decay was observed on the cervical (class V) and proximal (class IV) surfaces of teeth #11, #12, and #21 (**Figure 1**). The affected teeth showed no tenderness upon palpation or percussion, and periodontal probing was within normal limits, with no mobility noted. Electric pulp testing (Parkell Electronics Division, Farmingdale, NY, USA) revealed no response from the affected teeth. Radiographic images showed evidence of external apical root resorption in teeth #11 and #12 (**Figures 2a** and **2b**). Based on the clinical and radiographic findings, a diagnosis of pulp necrosis with external apical root resorption was established. Treatment options were discussed for teeth #11 and #12, with a decision to proceed with the placement of an apical matrix barrier using an amnion membrane, followed by the creation of an apical plug with Biodentine. For tooth #21, standard root canal therapy followed by post and core restoration was planned.

Figure 1. Preoperative image showing decay involving the cervical (class v) and proximal aspects (class IV) concerning teeth #11, #12, and #21



a) b)

Figure 2. a) working length determination of tooth 11 and 21; and b) working length determination of tooth 12

After obtaining informed consent from the patient, decayed tissue was excised using a round carbide, and isolation was achieved with a rubber dam. The working length of the root canal was determined with an electronic apex locator and confirmed via radiographic assessment (**Figures 2a** and **2b**). The root canal was then debrided and shaped with a #80 K-file (Dentsply Maillefer, Tulsa, OK, USA), followed by irrigation with alternating 3% sodium hypochlorite and saline.

After cleaning, the canal was dried using sterile paper points, and calcium hydroxide was placed as an intracanal medicament. The access cavity was temporarily sealed with Cavit G. Two weeks later, the patient returned for the next phase of treatment. The calcium hydroxide was removed with hand H-files while irrigating with alternating 3% sodium hypochlorite and 17% ethylenediaminetetraacetic acid. A final saline rinse was performed.

In the next step, an amnion membrane was injected into the canal and gently compressed beyond the apex with pre-fitted hand pluggers to form a matrix. The canal was then dried again using sterile paper points.

Mothers who consent to donate their amnion and related tissues during an elective cesarean section can provide amnion allografts, following the procurement, processing, and distribution protocols set by the Tissue Bank (Tata Memorial Hospital, Mumbai). As part of the safety process, various tests, including antibody screening for HIV, Hepatitis B, and C, and syphilis, are performed to check for potential infectious diseases. Once the amnion and chorion tissues are separated from the material, the amnion is sterilized, dehydrated, and perforated for use as a barrier.

Biodentine, a new dentin substitute, was introduced into the root canal using a meshing gun. It was then compacted against the amnion matrix with pre-fitted hand pluggers. A 5 mm Biodentine plug was formed, and its placement was verified radiographically (**Figure 3a**). After allowing 15 minutes for setting, the plug's consistency was checked with a hand plugger to confirm the material's hardened state.

For tooth #21, conventional obturation was performed using lateral compaction with gutta-percha cones and AH plus resin sealer (Dentsply DeTrey, Konstanz, Germany). The System B plugger (Kerr Dental, Orange, CA, USA) was utilized to create a 6mm thick apical plug of gutta-percha.

Post and core restoration was planned for the affected teeth. The RelyX™ glass fiber post (3M ESPE, Seefeld, Germany) was selected for its ease of use, as it doesn't require canal treatment like etching or bonding, thus reducing chairside time. A size 2 post, with an apical diameter of 0.80 mm and a coronal diameter of 1.60 mm, was chosen. The post was cemented using RelyX™ Unicem, a self-adhesive universal resin cement, light-cured for forty seconds (**Figure 3b**). The core was built using direct composite resin (Gradia Direct, GC Corporation, Tokyo, Japan). In the subsequent visit, a full veneer porcelain fused to a metal (PFM) crown was placed to restore the tooth (**Figure 3c**).

At the two-year follow-up, the Biodentine barrier placed at the apex showed the formation of a calcified tissue layer, improving both the function and aesthetics of the tooth (**Figure 3d**).

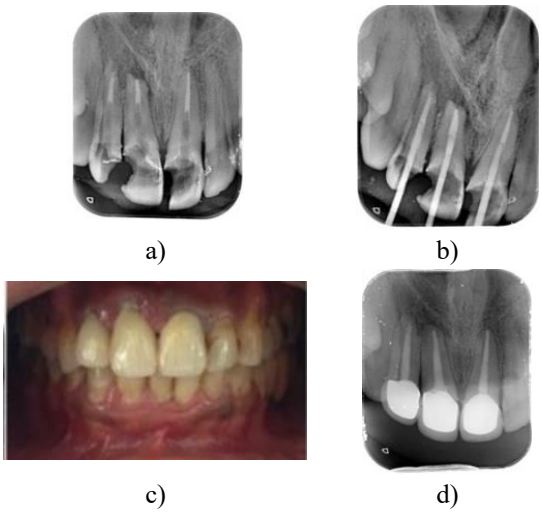


Figure 3. a) radiograph showing a 5 mm biodentine plug at the apical portion; b) radiographic image showing the placement of fiber post; c) postoperative Image; and d) radiographic image of 2 years follow-up which shows the formation of the calcific barrier in the apical end

Results and Discussion

A significant challenge in treating teeth with an open apex is the risk of root-filling material being pushed beyond the apex. To address this issue, using an internal apical matrix helps prevent extrusion into the surrounding periapical tissues, allowing the periodontal tissues to heal appropriately.

In the current case, a novel approach was utilized by employing an amnion membrane as an internal apical matrix. While this material is widely used in periodontics for guided tissue regeneration and root coverage [18], its application in endodontics remains undocumented. Previous reports have highlighted the use of autologous platelet-rich fibrin as an internal matrix [19-21], which, despite providing favorable outcomes, carries certain drawbacks. The limited availability of autologous tissue increases patient morbidity and prolongs treatment time.

In contrast, amniotic epithelial cells are immunologically inert, minimizing the risk of rejection or immune reactions [22]. The amnion membrane has shown the ability to form a physiological barrier that can help prevent bacterial infection. Additionally, it has been observed to modulate the host's immune response, reducing the migration of polymorphonuclear cells through mechanisms reported

in various studies [23]. The amnion functions as a biological scaffold, promoting cellular migration while supplying abundant stem cells and growth factors [24]. For one-step apexification, mineral trioxide aggregate (MTA) has been the material of choice. However, MTA presents some challenges, including a lengthy setting time, poor handling characteristics, low compressive strength, limited flow ability, vulnerability to washout before setting, and the potential for discoloration, in addition to the release of arsenic [25]. Biodentine, surpasses MTA in mechanical properties as it closely resembles natural dentine. It is easier to handle, sets more quickly, forms a stronger seal, and exhibits higher radiopacity, with greater stability and less solubility compared to other sealants [26].

The clinical and radiographic results of this case were considered successful, as there were no clinical symptoms and a calcified tissue layer formed apically to the Biodentine barrier during the two-year follow-up period. However, additional studies are required, particularly those with long-term follow-up and a larger sample size using standardized techniques.

Conclusion

The favorable clinical results observed in this case demonstrate that external apical root resorption can be effectively treated with the innovative combination of amnion membrane matrix and Biodentine, as long as all safety protocols for the use of this new biological membrane are followed.

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Conflict of Interest: None

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Ethics Statement: None

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