

## Case Report

### Regenerative Endodontic Management of Immature Maxillary Central Incisor Using Novel Bioceramic Material Bio-C Repair – A Case Report

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#### ABSTRACT:

**Introduction:** Immature teeth with open apex have traditionally been treated with apexification which doesn't promote root or apex closure. Newer techniques like regenerative endodontics allow complete root development and apical closure. The aim of this case report is to present such case promoting root development in upper right central incisor following traumatic injury. **Case description:** An 11-year-old boy presented with swelling from a traumatized upper front mucosal region. On clinical and radiological examination, the maxillary right central incisor was diagnosed with immature root with necrotic pulp and acute apical abscess. The patient's father was informed and consent was obtained to perform regenerative endodontic procedure. Local anaesthesia was administered, access cavity was prepared, cleaning and disinfection with sodium hypochlorite and EDTA was done. Intra-canal medicament of calcium hydroxide was placed and Bio-C Repair was placed after one-week. One-year follow-up showed complete root formation, dentinal wall thickening and apical closure of the root canal on periapical radiograph and CBCT images. **Conclusion:** REP with Bio-C Repair showed successful result in continued root development and apical closure of immature permanent central incisor. The procedure can be used to promote root maturation and development in permanent teeth with open apex.

**Keywords:** Regenerative endodontics, Immature pulp, Calcium hydroxide, Case Report, Bio-C Repair

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#### INTRODUCTION

Regenerative endodontic procedures (REP) are biologically based techniques designed to replace damaged dentin and root structures and cells of pulp-dentin complex.<sup>1</sup> This can result in continued root lengthening, wall thickening and apical closure.<sup>2</sup> REP is an exciting, result driven, rapidly progressing treatment modality in the treatment of immature teeth with open apex, infected canals and arrested root development.<sup>3</sup> REPs revolve around the concept of stem cells differentiation, scaffold formation and adequate coronal seal to prevent reinfection. Proper disinfection of the root canal followed by formation of blood clot which introduces the mesenchymal stem cells into the canal plays a pivotal role in continued root development in immature pulps.<sup>4,5</sup>

Endodontic treatment of immature teeth with pulpal pathosis or apical periodontitis has always been challenging due to the fragile anatomy of dentinal

walls and blunderbuss nature of canals.<sup>6,7</sup> This situation commonly arises in upper anterior teeth with trauma or untreated carious lesions.<sup>8</sup> Apexification procedures have been used to treat such cases but they don't promote continuous root development or apical closure. Apexification also produces roots which are thin, fragile and prone to fracture.<sup>9,10</sup> Alternative procedures which aim at revascularization of root canal, continuation of root maturation and formation of apical closure have been indicated to treat such immature teeth. This case report describes such a case of regenerative endodontics in traumatically injured permanent maxillary right central incisor using Bio-C Repair with one-year follow up.

#### PATIENT INFORMATION

A healthy 11-year-old male patient was referred to the private dental clinic in Saudi Arabia. The patient's chief complaint was occasional discharge of pus from

gumboil in the upper anterior region of mouth in the last 3 days. The patient present with mild pain and swelling in the mucosal area of upper central incisors. Medical, family and psycho-social history was non-contributory. Dental history related to the traumatic injury on the upper central incisors was reported.

### CLINICAL FINDINGS

On dental examination, the crown of maxillary right central incisor (#11) was found to be discoloured. No fracture was observed on any of the maxillary anterior teeth. Clinical examination revealed mild pain on palpation, percussion and intra-oral swelling at labial alveolar mucosa corresponding to the right maxillary central incisor. No sinus tract openings were observed. The tooth #11 was unresponsive to cold test compared to other upper anterior teeth. Cold test was performed using Endo-frost Cold Spray (Roeko; Coltene Whaledent, Langenau, Germany). Periodontal probing

was normal for all the teeth. No mobility was observed and gingival tissues were normal for the other unaffected teeth.

### TIMELINE

The patient was accompanied by his father and he provided a history of bicycle fall 2 months before. No treatment/intervention was undertaken by the patient at the time of injury until he reported to us.

### DIAGNOSTIC ASSESSMENT

Following clinical examination, periapical radiograph was performed. It revealed incomplete root development in #11, thin root dentinal walls, wide open apex along with periapical radiolucency as shown in Figure 1. Based on history, clinical assessment and radiographs, a diagnosis of immature permanent tooth with necrotic pulp and acute apical abscess was established.



**Figure: 1** Periapical radiograph of maxillary right central incisor showing incomplete root development and radiolucency.

### THERAPEUTIC INTERVENTION

The patient and his father were informed about the diagnosis and treatment plan. Their consent was obtained for the same. The patient was scheduled for appointment and was administered with 3% Mepivacaine (Dentsply Pharmaceutical, York, PA). Rubber dam isolation was done, proper access cavity was performed and root canal was accessed. The working length was determined by placing a K-file in the canal and a periapical radiograph was taken as shown in Figure 2. Over-instrumentation was avoided owing to large size of the apex. The root canal was irrigated by 20 mL of 1.5% sodium hypochlorite solution for 10 minutes and dried with paper points. Calcium hydroxide (AH Temp, Dentsply, York, PA) dressing was placed in the canal and the tooth was restored with Cavit (3M ESPE, St Paul, MN, USA) as

shown in Figure 3. Patient was recalled after one week for re-evaluation. The tooth and surrounding mucosa were found to be asymptomatic. No sign and symptoms of any disease were observed. The access cavity was reopened and calcium hydroxide was washed out by using 20 mL of 1.5% sodium hypochlorite solution. The canal was then irrigated with 20 mL of 17% EDTA and dried by paper points. A 25-K file (Dentsply Maillefer, Ballaigues, Switzerland) was inserted 2 mm beyond apex to induce bleeding. Blood clot was allowed to form and settle in and around the canal. The canal was then sealed with Bio-C Repair (Angelus) using MTA micro-carrier (Angelus) and condensed with pluggers. The tooth was restored with composite restoration (3M Filtek P60; 3M ESPE, St Paul, MN, USA) as shown in Figure 4.



**Figure: 2** Periapical radiograph showing access cavity and determination of working length in first visit.



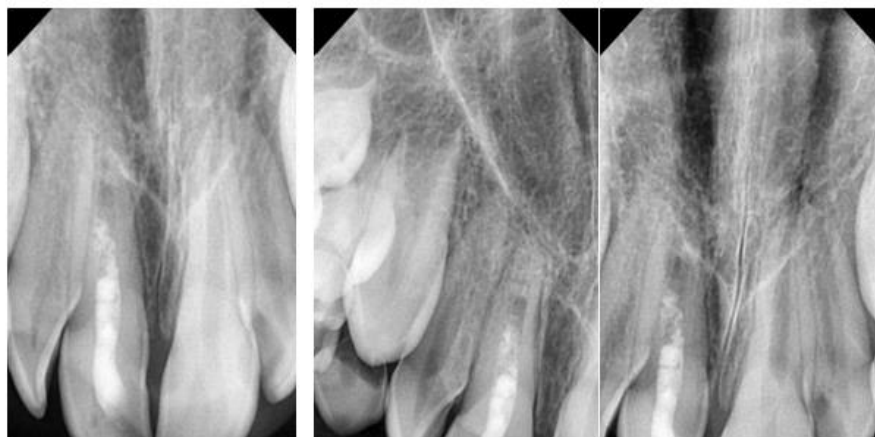
**Figure: 3** Periapical radiograph showing placement of calcium hydroxide with Cavit in first visit.



**Figure: 4** One week later periapical radiograph showing #11 after the placement of Bio-C Repair.

#### **FOLLOW UP AND OUTCOMES**

Recall appointments were scheduled at 6 and 12 months. No sign of inflammation or infection was observed clinically. Radiographic evaluation with periapical radiographs (IOPA) and CBCT images revealed complete healing of periapical tissues, increased root length and thickness along with apical closure after 1 year as shown in Figure 5 and 6 respectively.



**Figure: 5** Periapical radiograph showing #11 post-operative after one-year. Complete apical closure, root development and thick dentinal walls can be seen.



**Figure: 6** CBCT images showing #11 post-operative after one-year. Complete apical closure, root development and thick dentinal walls can be seen.

## DISCUSSION

REPs are novel techniques to treat immature necrotic teeth, allowing them for continued root development and apical closure which was not observed with traditional techniques like apexification and artificial apical barrier. The primary objective of REPs is to completely remove infection from the canal allowing repair of the periodontal tissues through the mesenchymal cells of the pulp-dentine complex.<sup>11</sup> Intra-canal irrigants and medications are the foremost source of disinfection of the root canal systems. Due to the immature dentinal walls and anatomy of such teeth, cleaning and disinfection requires special care and attention.<sup>12,13</sup> Although many studies and protocols have been proposed to clean and disinfect root canals, most of the research has found sodium hypochlorite as the best irrigating solution.<sup>14,15</sup> In this study, root canal was irrigated with 1.5% sodium hypochlorite to remove the necrotic tissue and debris. In the second appointment, 17% EDTA was used to clean dentinal walls. Use of EDTA is suggested in the treatment of immature teeth with open apex as it promotes adhesion, migration and differentiation of stem cells of apical papilla (SCAP) towards dentin.<sup>16</sup>

After the cleaning and disinfection of the root canal systems, bleeding was induced in the apical region by passing the file 2 mm beyond apex. This leads to the migration of stem cells of apical papilla, periodontal stem cells and mesenchymal stem cells of bone marrow into the apex region. All these cells play a pivotal role on pulpal regeneration, thickening of dentinal walls and continued root formation.<sup>17,18</sup> Induction of bleeding in the apical regions leads to 600-fold increase in stem cells markers in canal blood compared to blood in systemic circulation.<sup>19</sup> This scaffold of blood clot rich in stem cells and growth factors facilitate the epithelial cell rests of Malassez and remnant of Hertwig's epithelial root sheath for radicular development.<sup>20,21</sup> Although, many other medicaments like mineral trioxide aggregate, bio-dentine, triple antibiotic paste (TAP) have been used for REPs<sup>5</sup>, in this study Bio-C Repair was used. Bio-C repair is a novel ready to use putty bioceramic material which exhibits tissue regeneration properties like cell viability, cell adhesion, bioactivity and cytocompatibility.<sup>22</sup> Calcium is the principal component of Bio-C Repair which possess excellent tissue healing and repair capabilities.<sup>23</sup> Calcium hydroxide possesses strong anti-microbial properties

and promotes hard-tissue deposition. The high pH at the apex facilitates mineralization and calcification of the collagenous matrix.<sup>24</sup> Calcium hydroxide also promotes the proliferation of SCAP and increases the level of growth factors.<sup>25,26</sup> Studies have demonstrated significant increase in root length in teeth medicated with calcium hydroxide. A median increase in the dentinal wall thickness of 53.8% was observed when calcium hydroxide was placed in only coronal part of root canal.<sup>27</sup> In this case, after a period of one-year noticeable root development and apical closure was observed on periapical radiograph. The dentinal root walls were thickened, no sign or symptom of any infection disease were observed. The follow-up indicated a successful regenerative endodontic procedure based on clinical and radiographic evaluation of the patient. This case involved a traumatic injury leading to infection of the periradicular area. The success of revascularization and revitalization procedures depends upon the effective disinfection of root canal and also the time between trauma and quality of root development. Longstanding infection destroys the cells responsible for pulpal regeneration.<sup>28,29</sup> Hence prompt treatment increases the rate of success of REPs.

## CONCLUSION

This case report presents a case of successful regenerative endodontics in an immature central incisor with open apex with one-year follow-up. Sodium hypochlorite and EDTA were used to clean and disinfect the root canal. Putty based novel bioceramic material Bio-C Repair was placed in the canal just beneath the restoration. One year follow-up on IOPA and CBCT images shows complete root formation, dentinal wall thickening and apical closure of the root canal. Authors recommend REPs using Bio-C Repair on immature permanent teeth with open apex and apical periodontitis.

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