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CASE REPORT

Iatrogenic Extrusion of Calcium Silicate Cements on Teeth Associated with Large Periapical Lesion: A Case Report with 12-Month Follow-up

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ABSTRACT

Traumatic dental injuries can result in pulp necrosis and apical periodontitis, impairing root development**.** When this condition is left untreated, it causes inflammation in the tissues at the apex, which may lead to significant damage of the periapical alveolar bone. Tooth with open apex may have a risk of iatrogenic error of extrusion material during the stage of root canal obturation. **Objective:** This case report discussed the bone healing of large periapical lesion of an iatrogenic extrusion of calcium silicate cement in an open apex maxillary left central incisor. **Case report:** A 35-year-old female patient presented with a main complaint of a discoloured upper front tooth that was affecting with her appearance. Clinical examination showed her left maxillary central incisor was diagnosed with pulp necrosis and symptomatic apical periodontitis. Periapical radiograph revealed the tooth has an open apex and large periapical lesion. After chemomechanical disinfection, an apical plug was placed with bioceramic material. Periapical radiographs taken postoperatively demonstrated the extrusion of bioceramic material into the periapical lesion. After a year, the tooth does not exhibit any symptoms, and periapical radiographs showed that the periapical region has totally healed. **Conclusion:** Extruded bioceramic material has no detrimental impact on periapical tissue healing, as evidenced by 12-month follow-up observations.

Key words: bioceramic, Iatrogenic extrusion, immature tooth, large lesion, open apex

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INTRODUCTION

Trauma of permanent immature teeth may lead to pulp necrosis and apical periodontitis, resulting arrested root development. The implication of arrested root development includes shortened roots, thin root dentine walls and an open apex, increasing risk of root fracture. These nonvital immature permanent teeth usually present difficulty for endodontic treatment. In such cases, the open apex and the absence of apical constriction might cause root canal fillings being pushed into the periapical space and delay the healing process. Traditionally, apexification procedures have used the intracanal medicament of calcium hydroxide to create an apical barrier prior to root canal obturation.[1] Although calcium hydroxide apexification is successful, long-term usage of calcium hydroxide has a number of drawbacks, including unpredictable apical seal development, the demand for frequent dental visits, and the requirement for excellent patient compliance.[2] Furthermore, prolonged calcium hydroxide placement may increase root fracture risk.[3]

In the field of endodontics, calcium silicate-based cements such mineral trioxide aggregate (MTA) have been suggested as an alternative treatment for calcium hydroxide apexification.[4] This procedure is described as the placement of MTA into the most apical portion of the root canal or the entire root canal in one session to create apical barrier. Clinical trials compared the treatment outcomes of MTA and calcium hydroxide apexification and concluded that MTA resulted in good success rates.[5] Apical plugs with MTA exhibit a number of benefits, including biocompatibility, shorter treatment time, great sealing ability, and providing of an effective apical seal for obturation.[6] Torabinejad et

al. reported in a recent systematic review that the use of an MTA as an apical plug to treat immature teeth with pulp necrosis leads in a 97.1% high survival rate and a 94.6% success rate.[7] Despite the advantage of MTA, a major limitation is the inability to obtain consistent results due to difficulty of handling characteristics while placing the material during treatment and the long setting time.[8] Tooth discolouration has been reported with the use of gray due to the presence of bismuth oxide.[9]

Recently with the advancement of endodontic material, a new calcium silicate-based cement was introduced known as bioceramic. Bioceramic is a mixture of calcium silicate and calcium phosphate that may be utilized for root repair as well as root-end filling. This new material is produced as a premixed material to provide the clinician with a homogeneous and easy to handle material.[10] Unlike MTA, bioceramic is said to be aluminum-free, with a considerable proportion of tantalum and zirconium oxide added as a radiopacifier to prevent tooth discolouration. Bioceramic also has comparable or higher biocompatibility and osteoconductive capability than MTA, as well as causes substantially less discolouration.[11]

Iatrogenic errors in endodontics may represent a risk to the treatment outcome, and if this complication is not well managed, it may lead to treatment failure. Iatrogenic errors can be happen in any stage of endodontic treatment, including root canal obturation such as underfilled, overfilled or extruded obturation material. Teeth with an incomplete form of root apex are prone to higher chances of overfilling or material extrusion through the periapical area due to the absence of apical constriction and high pressure during the delivery of obturation material. Extruded filling material has been shown to have an adverse effect on the outcome of endodontic treatment in several clinical investigations. According to these findings, it may act as a foreign body, irritating the periradicular tissues, as evidenced by clinical signs and symptoms or radiological evidence of periradicular lesion.[12] In situations in which a huge quantity of root filling material has been extruded, endodontic microsurgery may be indicated.[13]

This case report discusses the iatrogenic error of extrusion of bioceramic material on endodontic treatment of pulp necrosis of a maxillary central incisor with an open apex and periapical healing of a large periapical lesion after 12-month follow-up.

CASE REPORT

A 35-year-old female patient was referred for endodontic management of her maxillary left central incisor associated with an immature apex. The patient has no known medical illness and drug allergy. Discoloured tooth 21 was her chief complaint. For several months, the patient suffered occasional and spontaneous discomfort in that location. The patient reported she had been in an accident twelve years ago that resulted in a direct hit on her upper front teeth.

An intra-oral examination showed tooth 21 presented with yellowish discolouration and the crown was intact. The buccal sulcus was tender to palpation and the tooth is tender to percussion (Figure 1). There was no evidence of a sinus tract or a deep pocket surrounding the tooth. While tooth 22 was tender to percussion, no other sign or symptom was present. Cold and electric pulp sensibility tests on both teeth 21 & 22 were not responsive. Periapical radiograph investigation confirmed that tooth 21 had an open apex with a large cystic-like periapical radiolucency that extended into the periapical area of tooth 22 (Figure 2). The diameter of the apical foramen was approximately 2 mm mesiodistally. The clinical diagnosis of both teeth 21 and 22 were pulp necrosis with symptomatic apical periodontitis. After examining the risks and advantages, the associated costs, and the prognosis of the various treatment choices with the patient, the patient opted for an apical plug with bioceramic material.

Access cavity preparation on the teeth 21 and 22 was performed after administered of local anesthesia with mepivacaine (Scandonest 2%, Septodont, USA) under the magnification dental operating microscope. After locating the pulp chamber and root canal, the canal was irrigated with 2.5% sodium hypochlorite and activated with Endo Activator (Dentsply Maillefer, Switzerland). Pre-operative periapical radiograph was used to calculate the estimated working length and was confirmed with a periapical radiograph with a size 70 K-file for tooth 21 and size 20 K-file for tooth 22 (Figure 3). Tooth 21 was thoroughly instrumented using a size 50 K-file with a circumferential filing technique. While the canal instrumentation for tooth 22 was completed with the Protaper Next rotary system (Dentsply Maillefer, Switzerland). Then, both teeth were dressed with non-setting calcium hydroxide (Calasept, Directa AB, Sweden). The access cavities were double sealed with Cavit (3M ESPE, St Paul, MN) and IRM (Dentsply Caulk, Milford, USA) as the inter-appointment temporary restoration.

Patient was recalled after 2 weeks and both teeth were clinically asymptomatic. Teeth 21 and 22 were isolated with a dental dam after administration of local anaesthesia. Irrigation with sodium hypochlorite at a concentration of 2.5% was carried out, and this was followed by the activation of Endo Activator (Dentsply Maillefer, Ballaigues, Switzerland) in order to eliminate the calcium hydroxide residual as thoroughly as possible from the canal. A final rinse with 17% EDTA solution (Canal Pro, Coltene, Whaledent, Germany) and 2% chlorhexidine (CanalPro CHX

2%, Coltene, Whaledent, Germany) was performed. Obturation of tooth 22 was performed utilising a warm vertical compaction technique and AH plus sealer (Dentsply Maillefer, Ballaigues, Switzerland). Apical plugs for tooth 21 were incrementally placed using Bioceramic iRoot BP Plus putty (Innovative Bioceramix, Vancouver, Canada) in the apical third of the canal with a thickness of 5 mm using a Micro-Apical Placement (MAP) System (Dentsply Tulsa Dental Specialties, TN, USA) and endodontic pluggers (Dentsply Maillefer, Ballaigues, Switzerland). The bioceramic was placed without the use of a collagen matrix. A post-operative periapical radiograph was immediately taken and it was observed that the bioceramic material was extruded unintentionally beyond the root apex (Figure 4). The access cavity was temporarily closed with double seal technique using Cavit & IRM.

The setting reaction of bioceramic was evaluated a week after the previous visit. Then, the canal was back-filled with thermoplastic gutta-percha and AH Plus sealer to the level 2 mm below the CEJ (Figure 5). To improve the color of the tooth, a non-vital bleaching procedure was carried out. The initial shade of the tooth was taken at A3.5 as a baseline. Flowable bulk composite (SDR® Flow, Dentsply, Germany) was placed as a protective seal over the gutta percha and cervical area. Non-vital bleaching was performed by the placement of a bleaching agent containing 35% hydrogen peroxide (Opalescence Endo, Ultradent Products, USA) and the access cavity was temporized with reinforced zinc oxide eugenol cement (IRM, Dentsply Caulk, Milford, USA). After two weeks, the patient was returned for a review. The tooth color was evaluated and the bleaching procedure was repeated. After two sessions, a satisfactory result was achieved (Figure 6). Finally, the tooth was restored with resin composite (Filtek™ Z250 XT, 3M ESPE, Germany) three weeks after bleaching treatment was completed. Post-operative restoration was confirmed radiographically (Figure 7).

The patient came in for a follow-up appointment exactly one year later. Intraoral clinical examination revealed teeth 21 & 22 had no tenderness to palpation or percussion, and both teeth were fully functional with normal periodontal probing depth. Periapical radiographs at 12-month revealed significant reduced periapical radiolucency suggesting bony healing (Figure 8).

DISCUSSION

Trauma to developing permanent anterior teeth can result in pulp necrosis, as the pulp may be unable to

Figure 1. Pre-operative clinical photograph demonstrates dark yellowish discolouration on Tooth 21

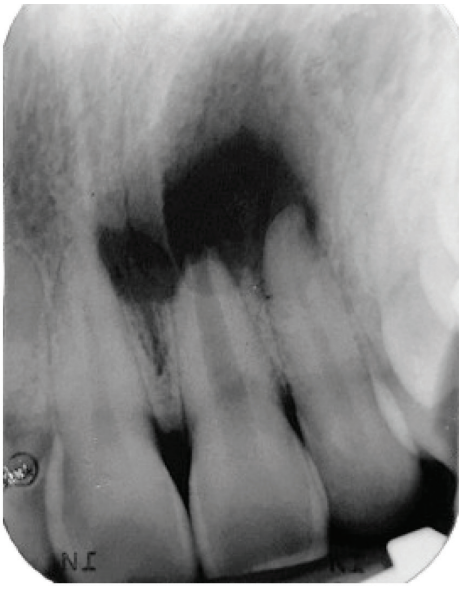

Figure 2. Pre-operative periapical radiograph

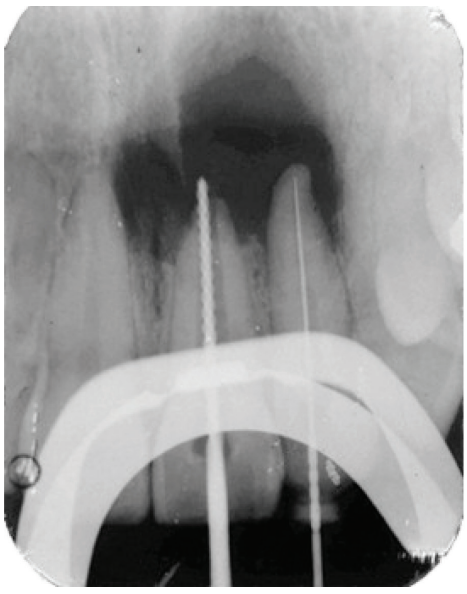

Figure 3. Working length radiograph

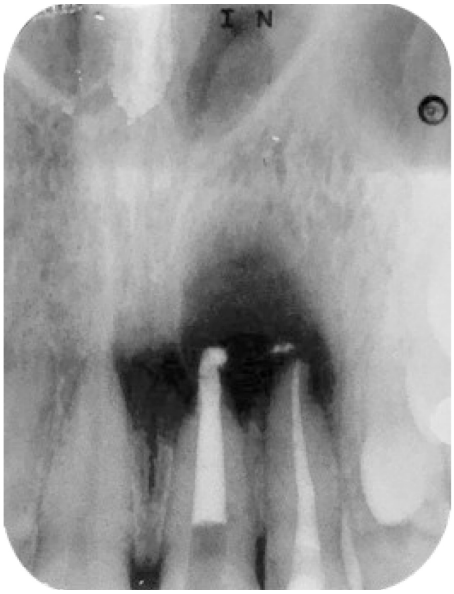

Figure 4. Post obturation and Bioceramic placement periapical radiograph

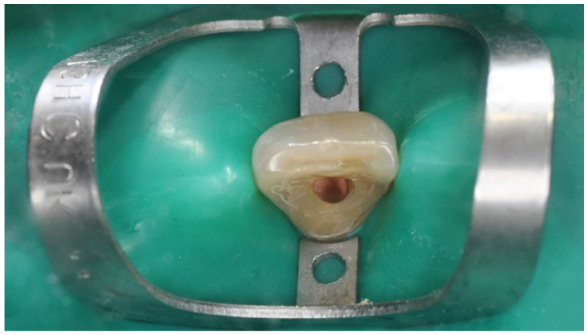

Figure 5. Back-filled with thermoplastic gutta-percha to the level 2 mm below the CEJ

Figure 6. Post-operative clinical photograph. Shade achieved, A1 after second cycle of internal bleaching

Figure 7. Post-operative periapical radiograph

Figure 8. A 12-month radiographic evaluation demonstrated completely heal of periapical lesion

sustain the impact, leaving the tooth with thin root walls, blunderbuss canals, and infection, which results in root resorption and periradicular disease.[3] One of the alternative to endodontic management for these cases is apexification.[14] According to the American Association of Endodontic Glossary term, apexification is defined as "a method of inducing a calcified barrier in a root with an open apex or the continued apical development of an incompletely formed root in teeth with necrotic pulp".[13] Calcium hydroxide has been used successfully as an apexification treatment strategy. Although calcium hydroxide apexification has a high clinical success rate, the long-term disadvantage has prompted clinicians to consider other materials for the apical barrier, such as calcium silicate-based cement.

MTA was the first formulation of a calcium silicate-based cement to be introduced into dentistry in the 1990s by Mahmoud Torabinejad.[8] There is no doubt that when MTA is used in apexification procedures, it provides various benefits. However, it does have poor handling characteristics, due to its sandy like mixture,

long setting time, potential to discolour teeth and high cost. To overcome this problem, a recent edition of calcium silicate-based cement was introduced called Bioceramic. In this case, iRoot BP Plus Root Repair Material was used as an apical plug. It is a calcium silicate-based cement that has been manufactured as a ready to use syringeable putty consistency that is easier to handle and apply than MTA. The chemical composition mainly includes tricalcium silicate, dicalcium silicate, calcium phosphate and zirconium oxide. Biological properties, sealing ability and antimicrobial efficacy is similar to MTA.[11,16] Bioceramic material putty has a greater release of silicon (Si) and calcium (Ca) ions in an acidic environment that simulates an infectious acidic environment. Higher Si and Ca ion concentrations may enhance periapical tissue healing by promoting osteoblast growth and suppressing osteoclastogenesis.[17]

The absence of the apical constriction makes the adaptation of root filling material to the root canal more difficult. Root canal filling material extrusions such as gutta percha, sealer or calcium hydroxide might cause a variety of symptoms, including moderate to severe irritation, allergic reactions, and neurotoxic consequences when they touch the periradicular tissue.[18] Iatrogenic extrusion of this material into vital anatomical structures, such as the mandibular canal, may result in unintended problems, such as paresthesia.[19] However, according to Tahan et al.[20] when calcium silicate cement is extruded into the periradicular lesion of necrotic teeth, it does not cause any complications, which is in accordance with our present case. Calcium silicate cement has a number of favourable features, including low cytotoxicity and the induction of mineralization, both of which may explain the biocompatible nature of this biomaterial.[11]

In the present case, the bioceramic material was accidently extruded into the periapical area during placement. It may be due to the bioceramic being pushed actively beyond the apical due to the wide apical foramen. Several cases reported favorable clinical outcomes when MTA accidentally extruded beyond the apical foramen during the apexification procedure.[20-22] However, there are no documented long-term case reports of bioceramic material extrusion into periapical lesions. In the present case, the follow-up period was one year, and during this period the extrusion of bioceramic did not prevent the periapical healing, showing bone deposition without an inflammatory response. This clinical result is consistent with examples of MTA apical plug treatments in necrotic teeth with open apices and periapical lesions that were described in the past and were shown to be effective.[20,21,23,24]

Having said that, even though bioceramic is a biocompatible material, it should be restricted to the root canal space, and gentle pressure is advocated in order to prevent bioceramic from being pushed beyond the apex. Special delivery systems instrument such as the Micro-Apical Placement (MAP) System (Dentsply Tulsa Dental Specialties, TN, USA) could be used with the aid of magnification and illumination of an operating dental microscope. A resorbable matrix, such as calcium sulphate, collagen, freeze-dried demineralized bone, or hydroxyapatite, has been proposed for improved length control and the avoidance of overfilling.[2] However, in this case report, no resorbable matrix was used to prevent extrusion.

The patient's complaint of discoloured teeth was treated via non-vital bleaching procedure. Non-vital bleaching is a minimally invasive treatment that can be used to restore the aesthetic appearance of discoloured non-vital tooth. Prior to placement of the bleaching agent, it is essential to seal the root filling with a base. In order to avoid bleaching agent leaking into the periodontium, a sealing material such as glass-ionomer cements, resin composites and zinc oxide–eugenol cement should be placed to the level of the epithelial attachment or the cemento-enamel junction (CEJ).[25] The use of hydrogen peroxide as an effective bleaching agent has been reported as a successful technique. Nonetheless, high concentrations should be used with caution to prevent root resorption.[26]

The findings of this case report revealed that when bioceramic is extruded into a periapical lesion, the healing of the periapical tissues is unaffected. At 12 months, the periapical radiograph confirmed complete osseous healing of the preoperative periapical pathosis. The periapical region remained healthy, with no pathology seen on radiography or clinical examinations, and the tooth remained asymptomatic. Thus, it appears that the advantages of these bioceramic material can fulfill clinical application in providing an apical seal in the management of teeth with an open apex.

CONCLUSION

This case report demonstrated remarkable healing of a large periapical lesion after apexification in a pulp necrosis of the maxillary central incisor with bioceramic material. Extruded bioceramic material has no detrimental impact on periapical tissue healing, as evidenced by 12-month follow-up observations. Published clinical studies and high levels of evidence for these bioceramic material as an apical plug are limited and insufficient at this point. This case necessitated a long follow-up to determine the long-term success of bioceramic as an apical plug in the management of non-vital immature teeth with an open apex.

CONFLICT OF INTEREST

The authors declare no conflict of interest related to this case report.

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