Single Visit Endodontic Management of a Tooth with Wide Open Apex using Calcium-Silicate Cement

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Abstract

The open apex in permanent teeth is mainly a result of pulpal necrosis before the competition of root development, due to a stimulus that negatively effects the pulp. This can be because of trauma or a carious exposure. Performing and completing an endodontic treatment in a permanent tooth with an open apex is a challenging job when compared to the tooth with a mature root apex. Teeth with wide open apex, such as in immature teeth or those with apical root resorption pose a challenge in terms of immediate treatment and achieving an apical barrier. With the use of mineral trioxide aggregate (MTA) in dentistry, it became possible to shorten the treatment time of these cases by immediate placement of apical plug and the root canal filling. This case report presents a case of wide open apex,

endodontically managed in a single visit by forming an MTA apical plug followed by thermolasticised gutta percha obturation and finally core build up with resin composite.

Introduction

Wide open apices are a challenge for the root canal treatment because of the possibility of irrigating solution and/or sealer leakage into the periradicular tissues, which can impair the apical healing process (1). It also makes it difficult and prevents the achievement of an adequate apical barrier with a suitable material. Apexification is the preferred management for such cases and is defined as 'a method to induce a calcified barrier in a root with an open apex or the continued apical development of an incomplete root in teeth with necrotic pulp (2). Historically, the preferred techniques for management of the open apex in non-vital teeth were limited to custom fitting the Gutta percha (3, 4), paste fills (5) or apical surgery (6).

Apical adaptation of gutta-percha using heat or chemical agents, such as xylene or chloroform, fails to provide required modelling of the apical part, and compromises the apical seal. It might also clear the way for the microbial infiltration or the extrusion of root canal sealer beyond the apex (7). In addition, the chemicals released from these materials/extruded microbes irritate the periradicular tissue (8). Also, since the apical portion of the root is frequently wider than the coronal portion, adaptation of the gutta-percha to the exact apical size becomes near to impossible. Sufficient widening of the coronal segment to approach the apical portion would result in weakening of the root and increase the risk of fracture (9).

Among all the proposed materials, calcium hydroxide has gained the widest acceptance for induction of apical barrier formation. The use of calcium hydroxide was first introduced by Kaiser (10). Though it is recommended for treatment of such cases, its prolonged use may reduce the resistance of root walls to fracture in future (11-13). In addition, multiple treatment visits and the danger of root canal contamination by microbial coronal leakage are few of the posed problems with this technique (14). In addition it is a controversial as to whether or how often the change of calcium hydroxide dressing should be happen. Chawla (15) stated that it is enough to place calcium hydroxide once and wait for radiographic evidence of barrier formation. Supporting this observation, Chosack et al (16) found that repeated root filling with calcium hydroxide either monthly or after 3 months does not provide any positive results.

Surgical intervention poses with the challenge of obtaining the apical seal in teeth with thin, fragile, irregular walls at the root apex. These walls may fracture during preparation of the retrograde cavity or condensation of the filling material (9). Apicoectomy further reduces the root length resulting in a very unfavourable crown root ratio. The limited success of such procedures resulted in significant interest in the approach towards continued apical development or establishment of an apical barrier, first proposed in the 1960s (17, 18).

Although calcium hydroxide has been the material of choice for apexification, a number of materials have been worked on. In order to decrease treatment visits, and to avoid the possible harmful effects of prolonged use of intracanal calcium hydroxide medication, formation of an apical barrier with freeze-dried bone, tricalcium phosphate, dehydrated dentin matrix or more recently, calcium silicate based cements (CSC), such as mineral trioxide aggregate (MTA) and Bio dentine, has been proposed (19-21).

Recently, Mineral trioxide aggregate (MTA) is gaining popularity as the material of choice for apexification. This material was first introduced in 1993 and received Food and Drug

Administration (FDA) approval in 1998. MTA is a powder consisting of fine hydrophilic particles of tricalcium silicate, tricalcium oxide and silicate oxide. It has low solubility and a radiopacity that is slightly greater than that of dentin (22). It has demonstrated good sealability and biocompatibility with a pH of 12.5 after setting, similar to that of calcium hydroxide (23). It has been suggested that this may impart some antimicrobial properties (24). Shababhang et al (25) in their study on comparison of the efficacy of osteogenic protein-1 and MTA with that of calcium hydroxide in the formation of hard tissue in immature roots of dogs concluded that MTA produced apical hard tissue formation with significantly greater consistency.
This report presents single visit management of open apex teeth treated MTA apical barrier prior to root canal filling.

Case report

A 16-year-old male patient reported with a chief complaint of pain and swelling in relation to maxillary right central incisor (#11). History revealed that the patient had suffered trauma at the age of 7 years. The tooth did not show any response to thermal tests and electric pulp test. Radiographic examination revealed an immature tooth with a wide open apex and a radiolucent area in proximity of the apex of the tooth (Figure 1). In addition tooth #21 was observed to be calcified following which pulpal investigations were done for 21 also. It did not show any response on thermal as well as electric pulp testing. However, tooth 11 was tender to percussion.

Figure 1: Preoperative radiograph showing wide open apex in Maxillary right Central Incisor

After careful investigations the tooth #11 was diagnosed as necrosed with symptomatic chronic apical periodontitis whereas tooth #21 was diagnosed as necrosed with asymptomatic chronic apical periodontitis. RCT was advised for both the teeth. The patient was interested in treating 11 only since it was symptomatic.
Endodontic access opening was done under local anaesthesia, and a periapical radiograph was taken to determine the working length. Biomechanical preparation was done using no 80 K-

file using circumferential filing motion. In addition endoshaper file (FKG, Switzerland) due to its 3D spiral structure was used for rotary instrumentation. Root canal debridement was done using alternate irrigation with 2.5% NaOCl, saline and 17% liquid EDTA, Smear Clear (SybronEndo, CA, USA). The root canal was then dried with sterile paper points. The apex could be clearly seen under magnification (Figure 2). Endodontic Plugger was placed 1mm short of the working length in the canal and radiograph was taken (Figure 3).

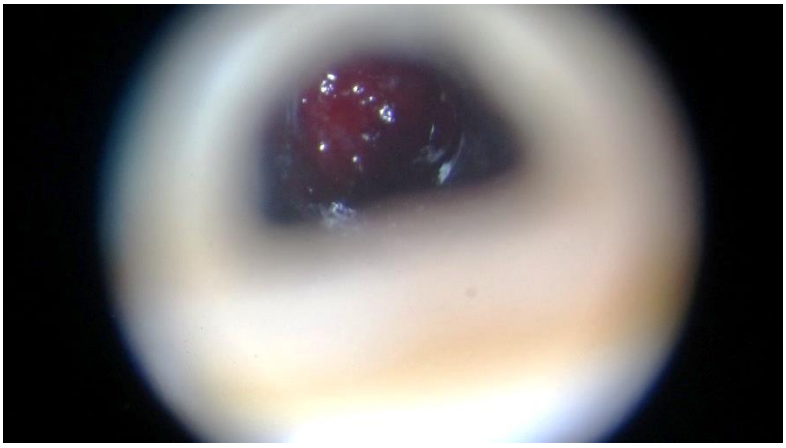

Figure 2: Clinical picture showing the sterile and dried wide open apex

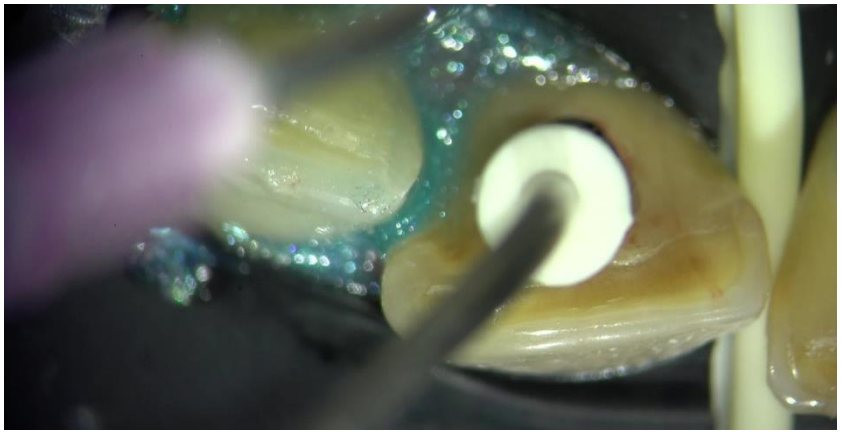

Figure 3: Clinical picture showing the placement of initial increment with the MAP system

After drying the canal completely, MTA was mixed with distilled water and carried into the canal. The first increment of MTA was inserted into the canal using a curved needle of the largest diameter fitting into the canal (MAP-system, PDSA, and Vevey, Switzerland) (Figure 4). The material was then gently pushed towards the apex with a root-canal plugger (Figure 5).

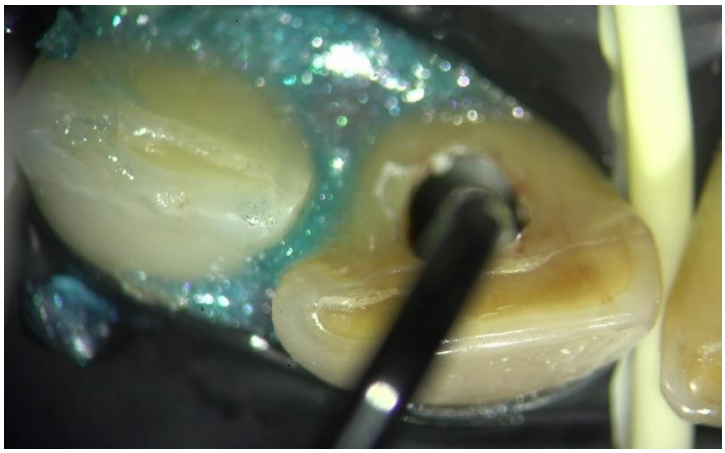

Figure 4: Clinical picture showing the condensation of MTA with endodontic Plugger

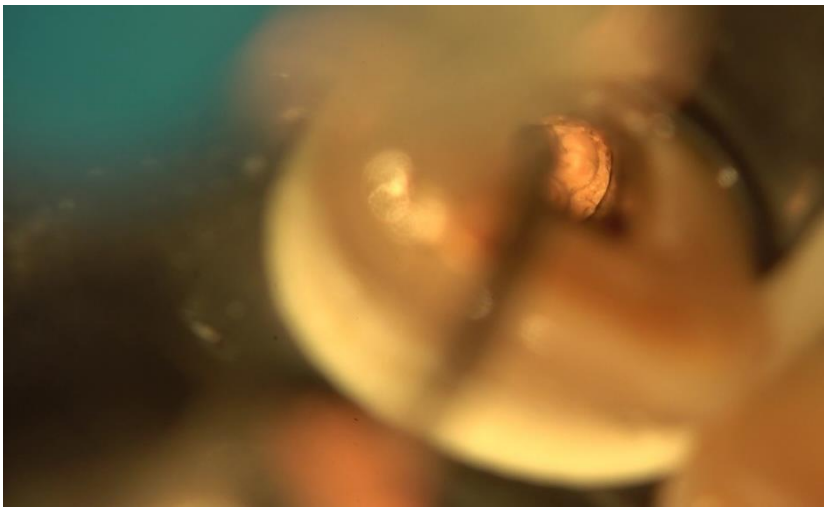

Figure 5: Clinical picture showing the filling of root canal system with thermolasticised gutta percha

Several increments were required to form a plug of adequate thickness (>4 mm). The material was adapted to the walls with gentle condensation with Endodontic plugger and the back head of 80 number paper point. After verifying that the material was hard-set, and waiting for additional few minutes, Gutta-percha backfill was performed using Obtura II (Texceed Co, Fenton, MO, and USA) and the access cavity was sealed using composite resin. A 6 month recall radiograph showed reduction in periapical radiolucency following apexification (Figure 6). Initiation of RCT in tooth #21 in a private clinic can also be seen in the recall radiograph.

Figure 6: Immediate Postoperative radiograph showing the MTA apical barrier along with Gutta percha

Discussion

Wide open apices are associated with thin and weak walls which are susceptible to fracture. Therefore, a well laid treatment plan is essential for managing such teeth. Successful apexification results from the formation of a hard tissue barrier by cells that migrate from the healing periradicular tissues to the apex and differentiate into cells capable of secreting a cementum or osteodentin organic matrix (26). The goal of this treatment is to achieve a hard apical barrier in order to prevent the passage of toxins and bacteria into periapical tissues from the root canal and also to initiate periapical healing. Technically, this barrier is necessary to allow compaction of root filling material (11, 27).

Calcium hydroxide has been traditionally used for the treatment of non-vital teeth with open apices (28) with considerable success, but the time interval for calcium hydroxide apexification has been reported to be variable, ranging from 12 to 24 months. This presents a challenge in regard to patient compliance, reinfection due to loss of temporary restoration, and also tooth fracture (29). Previous studies have described the disadvantages of calcium hydroxide apexification such as failure to control infection, recurrence of infection and cervical fracture (30).

An alternative treatment to long-term apexification procedure is to use an artificial apical barrier that allows immediate obturation of the canal. MTA has emerged as a potential apical barrier material with good sealing ability (23, 31) good marginal adaptation (32), a high degree of biocompatibility (33, 34) and a reasonable setting time(about 4 h) (35). With the MTA apical plug technique, a one-step obturation after short canal disinfection is possible. This technique of one-step obturation offers effective and efficient results in apexification of immature teeth, allows for permanent restorations to be done in a more timely manner, prolonging the longevity of these teeth (36). There is no need for MTA to be pushed beyond the apex, but only fitted by

gently tapping with Schilder's plugger to the wall of the root canal system to prevent the extrusion of the material, as done in this case. With current concepts and armamentarium MTA can be placed without difficulty in root canals in the presence of moisture. The results of the present case, is similar to other clinical reports (35, 37).

For success with this treatment option, care must be taken during the canal preparation and disinfection procedures, knowing that it is impossible to make the root canal system totally free of microorganisms. Wiping the walls with cotton-wrapped broaches, using effective irrigants, and utilizing ultrasonic preparation are few approaches that can be done for optimal canal cleaning (38).

Conclusion

This case report emphasizes the novel approach of using MTA to achieve single visit apexification of the cases with an open apex and periapical lesion. The use of MTA has been demonstrated to induce faster periapical healing for single visit apexification of the cases with large periapical lesions. Although the clinical performance and patient compliance of MTA are found to be much better than that of calcium hydroxide, whether to select MTA or calcium hydroxide depends on cost and number of appointments patient can afford.

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