Apexification with calcium hydroxide and mineral trioxide aggregate: Report of two cases

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ABSTRACT

The completion of root development and closure of the apex occurs up to 3 years after the eruption of the tooth. The treatment of pulpal injury during this period provides a significant challenge for the clinician. The importance of careful case assessment and accurate pulpal diagnosis in the treatment of immature teeth with pulpal injury cannot be overemphasized. The treatment of choice for necrotic teeth is apexification, which is induction of apical closure to produce more favorable conditions for conventional root canal filling. The most commonly advocated medicament is calcium hydroxide, although recently considerable interest has been expressed in the use of mineral trioxide aggregate (MTA). We report a case series wherein calcium hydroxide and MTA were used successfully for one step apexification in teeth with open apex.

KEY WORDS: Apexification, calcium hydroxide, mineral trioxide aggregate, young permanent teeth

Traumatic injuries to young permanent teeth affect 30% of children. These injuries often result in pulpal inflammation or necrosis and subsequent incomplete development of dentinal wall and root apices.[1] The golden rule in the practice of endodontics is to debride and obturate the canals as efficiently and three dimensionally as possible in an amount of time and appointments that are reasonable to the patient.[2] Before 1966 the clinical management of the "Blunder buss" canal usually required a surgical approach for the placement of an apical seal into the often fragile and flaring apex. Apicoectomy further reduces the root length resulting in a very unfavorable crown root ratio.[3] The treatment of choice for necrotic young permanent teeth is apexification.[4] The most commonly advocated medicament is calcium hydroxide.

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The use of calcium hydroxide was first introduced by Kaiser in 1964 who proposed that this material mixed with camphorated parachlorophenol (CMCP) would induce the formation of a calcified barrier across the apex. Calcium hydroxide can be mixed with a number of different substances (camphorated mono chlorophenol, distilled water, saline, anesthetic solutions, chlorhexidene and cresatin) to induce apical closure.[3] In recent times, interest has centered on the use of mineral trioxide aggregate (MTA) for apexification. It has been used in both surgical and non-surgical applications.[4]

Case Reports

Case 1

A 9-year-old female patient reported complaining of pain in the upper front tooth since 3 days. There was a history of trauma to the same tooth due to fall about 4 days back. On clinical examination, Elli's Class III fracture in permanent maxillary right central incisor was evident. Periapical radiograph showed incomplete root formation with wide open apices for the same tooth [Figure 1]. Apexification with calcium hydroxide dressing was planned. In the first visit, an

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access cavity was prepared with a straight line entry into the root canal. The working length was established within one mm of the radiographic apex by using size 30 Hedstrom file. Next, pulp extirpation and complete debridement of the canal was done using H file number 40 followed by copious irrigation with normal saline. After drying of the canal using paper points, calcium hydroxide powder was mixed with normal saline and this mixture was placed into the canal and pushed to the short of apex using plugger. Access opening was restored with glass ionomer cement [Figure 2]. Patient was called after 3 months. After 3 months when patient came back, a periapical radiograph was taken, which showed complete formation of the root apex in maxillary right central incisor, without any signs and symptoms and periapical radiolucency. Clinically, apical barrier formation was confirmed by using a size 30 Gutta-percha (GP) point to check for the presence of a resistant "stop" and absence of hemorrhage, exudates or sensitivity [Figure 3]. In the next visit, complete obturation was carried out with GP using lateral condensation technique [Figure 4] followed by composite restoration.

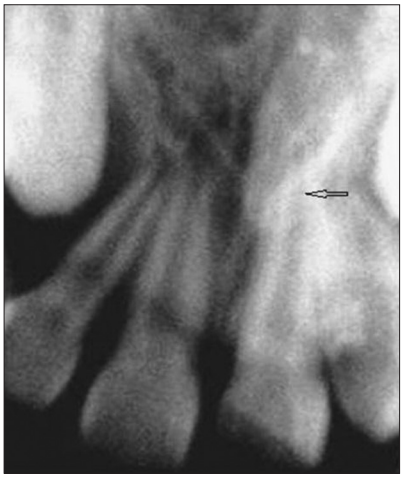


Figure 1: Case 1: Periapical radiograph showing wide open apex in relation to 21 (arrow)

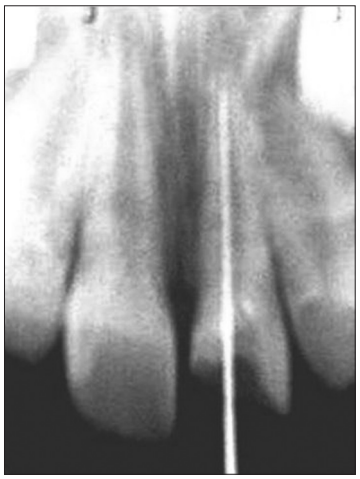


Figure 3: Case 1: Periapical radiograph taken after 3 months shows confirmation of apical barrier with gutta-percha point

Case 2

An 11-year-old male patient reported with a chief complaint of discolored right maxillary central incisor with a history of trauma 1 year back. The concerned tooth did not respond to both electric and heat test. The periapical radiograph revealed a large blunderbuss canal of the same tooth [Figure 5]. On clinical examination, Ellis Class IV fracture in permanent right maxillary central incisor was evident. Apexification with MTA was planned. Access opening was prepared under rubber dam isolation and working length was determined. Pus was extruded from the root canal immediately after the access preparation; irrigation was done with saline. Biomechanical preparation was carried out using 80 size k file with circumferential filing motion. Root canal debridement was done using alternative irrigation with 2.5% NaoCl and saline. Calcium hydroxide was placed in the root canal and patient recalled after 5 days. At subsequent appointment, canal was irrigated with 2.5% NaoCl and 2% chlorhexidine. The canal was dried with paper points and MTA placed with pluggers until thickness of 6 mm [Figure 6]. A wet cotton pellet was placed in the canal and access cavity was sealed



Figure 2: Case 1: Periapical radiograph showing placement of CaOH dressing



Figure 4: Case 1: Radiograph showing complete obturation of 21

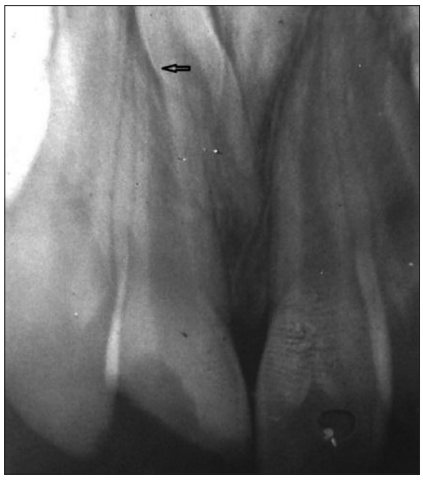


Figure 5: Case 2: Periapical radiograph showing wide open apex in relation to 11 (arrow)

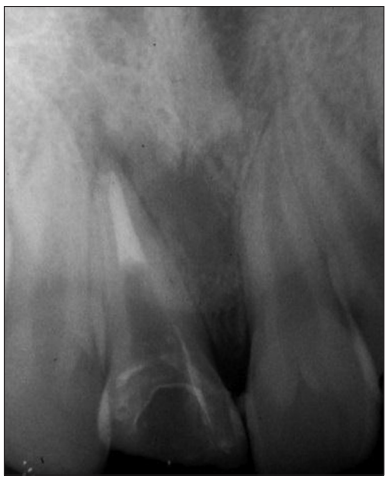


Figure 6: Case 2: Radiograph showing placement of mineral trioxide aggregate

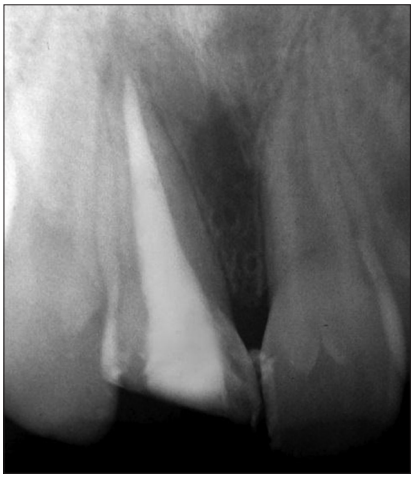


Figure 7: Case 2: Radiograph showing complete obturation of 11

with temporary cement. In next appointment, root canal was obturated with GP using lateral condensation technique. Access cavity sealed with glass ionomer cement [Figure 7].

Discussion

The goal of apexification is to obtain an apical barrier to prevent the passage of toxins and bacteria into periapical tissues from root canal.[5] In the literature, many materials have been used for apexification, such as calcium hydroxide in combination with sterile water, saline, local anesthetic, CMCP, zinc oxide paste with cresol and iodoform,[6] polyantibiotic paste[7] and tricalcium phosphate.[8] Calcium hydroxide is one of the most important medicaments used in treatments of pulp conditions and apical periodontitis.[9] The use of CaOH in apical barrier formation has shown promising results. Because of its enhanced success rate, easy availability for the clinician and affordability for patients, it has gained widest acceptance in the literature.[10]

Some of the postulated mechanisms of CaOH are as follows:[1]

1. Presence of high calcium concentration increases the activity of calcium dependent pyrophosphatase
2. Direct effect on the apical and periapical soft-tissue
3. High pH, which may activate alkaline phosphatase activity
4. Antibacterial activity.

Sheehy and Roberts reported that the use of calcium hydroxide for apical barrier formation was successful in 74-100% of cases and the average time for apical barrier formation was ranging from 5 months to 20 months.[11] In the present case, the apical barrier formation was evident in 3 months [Figure 4]. There are new strides in the apexification procedure with MTA. MTA as an apexification material represents a primary monoblock. Appetite like interfacial deposits form during the maturation of MTA result in filling the gap induced during material shrinkage phase and improves the frictional resistance of MTA to root canal walls. MTA has superior biocompatibility and it is less cytotoxic due to its alkaline pH and presence of calcium and phosphate ions in its formulation results in capacity to attract blastic cells and promote favorable environment for cementum deposition. A total of 5 mm barrier is significantly stronger and shows less leakage than 2 mm barrier.[5] In the present case, MTA was placed for around 6 mm in the apical region.

Conclusion

Based on the existing literature and our present cases, both MTA and calcium hydroxide can be used efficiently for apexification procedure. Considering the time duration for the apex closure MTA has superior properties when compared with calcium hydroxide. Long-term clinical trials and investigations are further required.

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