Management of Non-Vital Permanent Central Incisor using Single Calcium Hydroxide Medication
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Case Report
A 14-year-old boy reported to the Department of Pedodontics and Preventive Dentistry with a chief complaint of discolored left upper central incisor (21). He gave a history of trauma to the upper anterior region 5 years back and history of pain on biting from the front tooth. On clinical examination, there was the presence of an uncomplicated crown fracture of incisal edge of 21. The tooth was tender on percussion. There was no intraoral sinus tract related to the involved tooth. The tooth tested negative for the thermal tests and the electric pulp test. Radiographically, the tooth exhibited incomplete root formation, characterized by a wide root canal and an associated periapical lesion with the same (Figure 1). On the basis of the clinical and radiographic findings, a final diagnosis of pulpal necrosis was made. The treatment plan was apexification with Metapex (calcium hydroxide and iodoform) for 21 followed by obturation with gutta-percha after closure of the root apex.

After isolation, access opening was done, and the necrotic pulp tissue was removed. Working length was determined slightly short (2-3 mm) of the radiographic apex. The canal was enlarged till size 70 K-file. Copious irrigation was done with 1% sodium hypochlorite and normal saline solution. The canal was then dried by sterile paper points and calcium hydroxide and iodoform combination (Metapex, META Biomed Co. Ltd., Korea) was pushed into the canals till it

Figure 1: Incomplete root apex and large radiolucency seen irt 21
reached the apex. A radiograph was taken to check the same and then the access cavity was restored with glass ionomer cement (GC 2, GC Corporation, Japan) (Figure 2). The patient was recalled after 1 week and the tooth was found to be completely asymptomatic. Regular follow-ups were done at 1, 3 and 6 months with the help of radiographs (Figures 3 and 4).

After 3 months, the radiolucency had reduced to half of its size as compared to the initial size. Follow-up radiograph at 6 months showed complete healing of the radiolucency and a calcific barrier was visible in the radiograph. The apical closure was confirmed with the help of a size 50 K-file. Metapex was removed from the canal and 21 were obturated with gutta-percha and a full ceramic crown was placed on the tooth (Figure 5).

Discussion
Apexification is the treatment of choice in a non-vital permanent tooth with an immature apex. Apexification is a procedure which aims at formation of an apical barrier to prevent the leakage of toxins and bacteria from the root canal into periapical tissues.\(^1\) This apical barrier can be characterized as dentin, cementum, bone, osteocementum, and osteodentin. The final result is blunting of the root end with apical closure and very little increase in root length.\(^2\) A number of materials have been proposed for the induction of apical barrier formation, which include calcium hydroxide paste, calcium hydroxide powder mixed with different vehicles, tricalcium phosphate, collagen calcium phosphate, osteogenic protein-1, bone growth factor, oxidized cellulose, MTA, calcium-enriched mixture (CEM), Biodentine, Inert material (isobutyl cyanoacrylate and tricalcium phosphate ceramic), ActiveTM BioACTIVE restorative material, Pulpdent (composite resin that are more bioactive and release more fluoride than glass ionomers), MTYA1-Ca filler, tetracalcium phosphate, sol-gel-derived bioactive glass ceramic containing silver ions (Ag-BG), calcium phosphate, novel endodontic cement.\(^3\) A new bio-ceramic material called CEM cement was introduced to dentistry by Asgary \textit{et al.} in 2006. The clinical applications of this cement is said to be similar to MTA, and hence it might be used for single visit apexification. According to its mechanism

\begin{figure}[h]
  \centering
  \includegraphics[width=0.4\textwidth]{figure2.png}
  \caption{Metapex placed in the canal and access opening sealed with GC II}
\end{figure}

\begin{figure}[h]
  \centering
  \includegraphics[width=0.4\textwidth]{figure3.png}
  \caption{Radiograph in relation to 21 three months post-operatively, formation of apical barrier is seen}
\end{figure}

\begin{figure}[h]
  \centering
  \includegraphics[width=0.4\textwidth]{figure4.png}
  \caption{Radiograph with the Master cone GP after complete root formation after six months}
\end{figure}

\begin{figure}[h]
  \centering
  \includegraphics[width=0.4\textwidth]{figure5.png}
  \caption{Radiograph after obturation showing complete healing of periapical lesion and complete apical closure}
\end{figure}
of action, when the CEM is mixed with water-based solution, it forms bioactive calcium and phosphate enriched mixture. However, calcium hydroxide still remains the most promising material to accomplish apical closure due to its high pH and bactericidal effect.

Morse et al., studied five methods for treatment of non-vital teeth with incomplete root formation. They concluded that the success of treatment with apical tissue repair is due to the antibacterial action and the calcification inducing action of calcium hydroxide. Schröder and Granath, have postulated that a layer of firm necrosis is formed underneath the calcium hydroxide paste in the periapical tissues which generates a low grade irritation of the underlying tissue that is sufficient to produce a matrix that mineralizes calcium which is attracted to the area of mineralization of newly formed collagenous matrix. Pisanti and Sciaky have demonstrated that the calcium required for apical bridge formation comes through the systemic route. According to various studies, the use of calcium hydroxide for apical barrier formation is successful in 74-100% of cases irrespective of the proprietary brand used. Hence, in our case we decided to use calcium hydroxide paste (Metapex) for apexification.

Metapex, being oil based calcium hydroxide formulation releases calcium hydroxide slowly and tends to remain in the canal and exert its effects over a considerable period of time. Therefore, the material does not need to be replaced periodically. A number of authors have proposed that calcium hydroxide placed in the canals should be replaced only when symptoms develop or the material appears to have washed out of the canal when viewed radiographically at subsequent follow-up appointments. A study by Ghosh et al., showed a 100% success with non-setting calcium hydroxide with iodoform (metapex) as compared with calcium hydroxide mixed with distilled water and non-setting calcium hydroxide without iodoform. In this case report, glass ionomer cement was used to restore the access cavity after placement of metapex in the root canal. This was done to provide an adequate coronal seal, and prevent any micro leakage. Ray and Trope have also stated that the quality of the coronal restoration is more significant than the quality of root canal treatment in eliminating apical periodontitis. Most of the treatment for immature root apices fail not due to failure to create a sterile field at the root apex to allow for continued root development but due to microleakage from faulty coronal restorations.

The time taken in our case for apical barrier formation with metapex was 6 months, which was similar to the results by de Jesus Soares et al. and Ghosh et al. They conducted a study to evaluate the efficacy of calcium hydroxide in a different formulations to induce apexification and found average time required for apexification was minimum with calcium hydroxide plus iodoform (Metapex) in polysilicone oil base. Age maybe inversely related to the time required for apical barrier formation. In another study, it was advocated that patients who were 11 years or older had significantly shorter treatment times. Walia et al., noted that teeth with narrow open apices in older children took shorter treatment time than in younger children. In our case report, we noticed that a shorter time span of 6 months was sufficient for tooth apical closure as compared to the normal time of 12-18 months advocated for apical closure of non-vital permanent teeth.

**Conclusion**

Apical closure in non-vital permanent teeth can be achieved at the earliest with placement of slowly dissociating calcium hydroxide preparation (Metapex) with an effective coronal restoration. The effectiveness of calcium hydroxide might be attributed to its antibacterial activity and its high pH which has its direct effect on the apical and periapical soft tissues.

**References**