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Apexification Of An Immature Permanent Radix Entomolaris Using Calcium Hydroxide And Iodoform Paste: A Case Report

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Abstract
In the period when the root development of children's teeth continues, trauma or chronic infection to the teeth stops this root development. If the pulp becomes devitalized in immature permanent teeth due to dental trauma or infection, apexification treatment should be performed to continue its root development. The aim of this case report is to present a treatment to promote root-end growth and apical closure in a non-vital immature permanent tooth. In this case, calcium hydroxide and iodoform paste was placed in the root canals of immature permanent tooth using disposable plastic tips. The tooth involved was evaluated radiographically at regular intervals after placement of the paste. At the end of 8 months, tooth showed continued root growth and apical closure (apexification) with no evidence of periapical pathology. Conventional endodontic treatment was then performed.
Keywords: *Apexification, Calcium hydroxide, Iodoform, Radix entomolaris*

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I. Introduction

The completion of root development in permanent teeth takes a minimum of three years after eruption. Consequently, pulpal injury that occurs during this period due to caries or trauma can impair root development and apical closure. When periapical lesion and necrosis develop in an immature permanent tooth whose root apex is open or root development is incomplete, it isn't easy to treat with conventional endodontic treatment methods. Ensuring asepsis in the root canal and creating an apical stop at the root tip are the main elements in the success of endodontic treatment. In cases where apical closure does not occur naturally in an immature permanent tooth, the main purpose is to create a periapical barrier or stop instead of using root canal filling material to prevent excessive extrusion of the tooth. [1,2] For this reason, apexification treatment is performed instead of traditional endodontic treatment. Apexification is a procedure that promotes the formation of an apical barrier to close the open apex of a devital immature permanent tooth so that filling materials can be retained within the root canal space. The capacity of materials such as calcium hydroxide to induce the formation of this calcific barrier at the apex makes apexification possible.

Clinically, when it is understood that the pulp of an immature permanent tooth is devital and the root will not develop further in terms of apical maturation and thickening of the dentin walls, apexification is performed to close the root tip. [3]

Because calcium hydroxide is biologically compatible with pulp and periodontal tissue, it is a successful material that is frequently used in dentistry. Calcium hydroxide was first used by Frank in the treatment of apexification, so it was referred to as the "Frank technique" in the literature. [4] The success of apexification treatment using calcium hydroxide is between 74-100% in studies. This success rate of calcium hydroxide is due to following properties;

• Stimulating apical development by providing asepsis in periapical tissues,
• Accelerating cementogenesis at the apex by transforming undifferentiated mesenchymal cells into cementoblasts,
• Ensuring the development of calcification under the necrosis layer formed due to its high pH,
• The Ca ions it contains have a reducing effect on capillary leakage,
• To prevent granulation tissue from advancing into the canal by filling the canal space,
• It has been observed that while activating alkaline phosphatase and pyrophosphatase enzymes, it inhibits osteoclastic activity and forms a hard tissue barrier with the help of all these mechanisms. [4,5,6] For all these reasons, calcium hydroxide, has gained the widest acceptance in the treatment of apexification, although various materials have been proposed. [6]

Despite its popularity for the apexification procedure, calcium hydroxide has some inherent disadvantages, including variability of treatment time, unpredictability of apical closure, difficulty in patient follow-up, and delayed treatment. [7] Calcium hydroxide also has some tissue-altering and dissolving effects. [8] Therefore, the search continues for procedures and materials that will allow for more natural continued root growth and apical closure in teeth with immature apices.

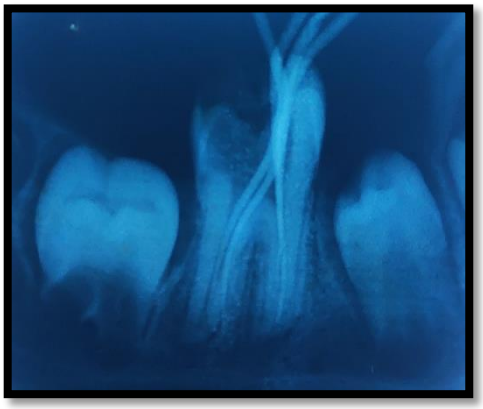
A viscous paste mixture of calcium hydroxide and iodoform has been used as a root canal filling material in primary teeth. Several studies have been conducted, mainly in Japan, [9,10] the United States, [11] and South America, [12] that demonstrated good clinical and radiographic success.

In the presented case, calcium hydroxide and iodoform paste was used successfully to promote root-end growth and apical closure (apexification) in the permanent radix entomolaris.

II. Case Report

A 10-year-old male child with a non-contributory medical history reported to the department of paediatric dentistry, Govt. Dental College and Hospital Srinagar for the management of failed endodontic treatment of the mandibular right first molar. Clinical examination revealed inadequately opened pulp chamber covered with cotton and the tooth was tender to percussion. Proper access opening was done under local anaesthesia and four canals were negotiated. Biomechanical preparation was done up to 2% 25 no. K-file and gutta percha cones were placed in all canals, the patient was advised an IOPAR. Radiographic examination revealed radix entomolaris with incomplete root formation (open apex) associated with periapical pathology [Fig.1]. It was decided to treat the offending tooth with apexification using calcium hydroxide and iodoform paste. Complete pulp removal was performed and biomechanical preparation was done up to 25.06 rotary file in all canals. The canals were irrigated using 2.5% sodium hypochlorite,17% ethylene diamine tetracetic acid (EDTA) and normal saline followed by calcium hydroxide paste as an intracanal medicament for 2 weeks and the access cavity was sealed with temporary restoration.

After 2 weeks, it was observed that there was no pain on percussion and palpation in tooth (46). After thorough irrigation and cleaning, calcium hydroxide and iodoform paste (calplus) was placed into the root canals using the disposable plastic tips provided in the kit and the access cavity was sealed with temporary restoration (cavit) and 1mm layer of glass ionomer cement was placed over the cavit [Fig.2]. The patient was recalled after every 3 months for follow-up. Unfortunately, patient didn't report after 3 months and was seen again after long 7 months. A follow-up periapical view was then taken and the patient was clinically examined. Continued root development and closure of apex was evident on radiographic examination without any sign of pathology [Fig.3]. The access cavity was reopened and calplus was removed from all canals [Fig.4]. The canals were irrigated with normal saline and conventional root canal treatment was performed followed by placement of stainless-steel crown [Fig.5a,5b,5c].



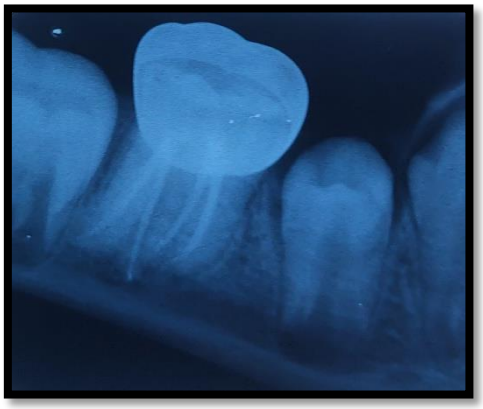
[Fig.1] Periapical radiograph of tooth (46) showing incomplete root formation (open apex) with periapical radiolucency.

[Fig.2] Periapical radiograph after placement of calplus (calcium hydroxide and iodoform paste).

[Fig.3] Continued root formation and closure of apex was evident in this radiograph taken 7 months after placement of calplus.

[Fig.4] Periapical radiograph after calplus removal

[Fig.5a] Postoperative radiograph following completion of conventional root canal therapy.



[Fig.5b] Radiographic view after placement of stainless-steel crown

[Fig.5c] Clinical view after placement of stainless-steel crown

III. Discussion

Conventional root canal treatment cannot be used for endodontic treatment of immature permanent necrotic teeth. Since the apex of these teeth is open, it is difficult to create a barrier at the apical level. Many endodontic treatment methods are used for this: Many procedures can be applied including reverse use of gutta-perchas on anterior maxillary teeth, orthograde use of polyantibiotic drugs or materials such as calcium hydroxide,

retrograde closure of open apexes, and orthograde use of mineral trioxide aggregate in a single session. This form of treatment is called apexification [13].

Use of calcium hydroxide and iodoform in apexification also has been reported [14,15]. Lu & Qin [16] compared an antibiotic paste and Vitapex® paste (calcium hydroxide and iodoform) for their use in apexification. Over a follow-up period of 30 months, they concluded that both the materials showed the same level of radiographic success. But in those cases where periapical inflammation was present, the antibiotic paste produced superior results. In another study, Weng [14] evaluated 64 younger permanent teeth with underdeveloped root apices and necrotic pulps. After the root canals were prepared and sterilized, Vitapex® paste was placed in the canals in an attempt to achieve apexification. All the teeth were observed for three years, and 24 teeth (37.5 %) successfully achieved apexification, 37 teeth (57.81 %) were in the process of root end closure, and only 3 teeth (4.69 %) failed to achieve apexification. The treatment was successful for 61 teeth, for an effective rate of 95.3 %. Weng [14] concluded that Vitapex paste was an effective material for achieving apexification for younger permanent teeth.

In the presented case, chronic apical abscess developed as a result of chronic apical periodontitis, as no treatment was given in the early period. So, it was decided to perform apexification using calplus (calcium hydroxide and iodoform paste).

Holland et al. [17] have demonstrated that the reaction of the periapical tissues to calcium hydroxide is similar to that of pulp tissue. Calcium hydroxide produces a multilayered necrosis and subjacent mineralization. Schroder and Granath [18] have postulated that the layer of firm necrosis generates a low-grade irritation of the underlying tissue sufficient to produce a matrix that mineralizes. Calcium is attracted towards the area and mineralization of newly formed collagenous matrix, initiated from the calcified foci. It appears that the high pH of calcium hydroxide is an important factor to induce hard tissue formation. Javelet et al [19] compared the ability of calcium hydroxide (pH 11.8) and calcium chloride (pH 4.4) to induce formation of a hard tissue barrier in pulpless immature monkey teeth. Periapical repair and apical barrier formation occurred more readily in the presence of calcium hydroxide.

As an alternative to apexification, regeneration is one of the treatment methods applied in immature permanent necrotic teeth. However, regeneration is mostly recommended for short roots with wide-open root tips, thin canal walls and teeth without root formation potential. In addition to these, regeneration is also recommended in cases where the prognosis of the tooth is hopeless despite the apexification procedure.

This case resulted in successful apexification despite of previous endodontic treatment failure and irregular visits of the patient. Since the root formation was incomplete, the Hertwig's epithelial root sheath and (or) its remnants, the cell rests of Malassez may have contributed to the apical closure. Although these cells decrease in number with age [20], they retain the ability to undergo cell division [21]. So, as long as there is a periodontal ligament present anywhere around the root, the formation of a hard tissue barrier is a reality.

IV. Conclusion

The findings in this case report suggest that Calplus (calcium hydroxide and iodoform paste) showed good clinical and radiographic evidence of success in promoting continued root growth and inducing root-end closure in an immature young permanent tooth.

Therefore, Calplus paste can be used as a medicament to promote root growth and apexification.

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