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Pulpectomy in hyperemic pulp and accelerated root resorption in primary teeth: A review with associated case report

Tarun Walia

Department of Growth and Development, College of Dentistry, Ajman University of Science and Technology, Ajman, United Arab Emirates

Correspondence Address:

Tarun Walia

Department of Growth and Development, College of Dentistry, Ajman University of Science and Technology, Ajman, United Arab Emirates

Abstract

Persistent hemorrhage after complete amputation of coronal pulp is a common clinical finding during pulpotomy procedure in primary teeth. These teeth are best managed with pulpectomy, but they have hyperemic pulp with some remaining vital tissue. Good chemico-biomechanical preparation of primary canals cannot guarantee complete removal of this vital tissue from inaccessible areas. Use of Ca(OH)₂ containing root filling pastes in vital pulp tissue can cause accelerated resorption of primary roots. The possible mechanism behind such extensive root resorption is discussed with review of literature. A case report of a child with 30 months follow-up is presented and discussed.

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Full Text

Introduction

Successful pulpal treatment of primary teeth depends upon proper case selection, good debridement and choice of root canal obturating material.

In spite of high success rates reported by various studies [1],[2],[3] pulp therapy still remains controversial due to fenestrated and tortuous primary root canal morphology, child's immaturity to adequately relate their symptoms making diagnosis often inadequate, difficulty in obtaining good radiographic view of primary root apices.

Pulpectomy is indicated for treatment of pulpally inflamed primary teeth either with clinical signs of hyperemia-continuous pulpal bleeding more than 5 min with dark color (even after complete removal of coronal pulp during pulpotomy) or with irreversible inflammation determined clinically or radiographically as pulp necrosis. [4] Primary pulp that bleeds profusely after removal of coronal pulp without any other clinical and radiographic signs and symptoms is no doubt inflamed, but it is vital. Pulpectomy procedure should be undertaken in these hyperemic pulps as it is difficult to determine the extent of inflammation in radicular region. [5]

However, complete pulp removal cannot be ensured as the ideal biomechanical debridement of primary root canals is

hard to achieve leading to localization of pulpal tissue remnants in some of the inaccessible areas. [6] This can be of significance particularly in case of hyperemic pulp, where remaining vital tissue can lead to resorption of primary roots, especially if Ca(OH) 2 pastes are used.

There are conflicting studies on the rate of root resorption following pulpectomy. Studies conducted by Howley et al.[7] and Nurko et al.[8] on calcium hydroxide containing iodoform pastes (Metapex ® , Vitapex ®) found that resorption of extruded paste from periapical areas as well as the intracanal areas had no effect on the rate of primary root resorption. However, Peng et al.[9] and Moskovitz et al.[10] concluded that root resorption of primary molars is accelerated following pulpectomy with iodoform containing filling material, leading to their early shedding in comparison with homologous teeth without endodontic treatment.

It is worthwhile to evaluate if there is any relation between the pulp status at the start of treatment, type of root canal obturating material and the primary root resorption rate.

Majority of clinical studies conducted to evaluate the success of obturating material in pulpectomy have mentioned the selection method of necrotic teeth. However, none of these studies have separated and further subdivided selected teeth on the basis of signs of either hyperemia (vital pulp) or pulpal necrosis at the time of pulp treatment [Table 1]. [2], [11],[12],[13],[14],[15],[16],[17],[18],[19]

This case report with 30 months follow-up period highlights the effect of vital pulpectomy on accelerated root resorption along with intraradicular depletion of calcium hydroxide/iodoform paste (Diapex ®).{Table 1}

Case Report

A 3½-year-old female child reported to unit of pediatric dentistry, Department of Dentistry in NMCSPPH, Dubai, United Arab Emirates with a chief complaint of multiple caries in the primary dentition. The medical history was not significant. There was a history of occasional pain in multiple carious primary molars, but the child couldn't localize the pain. Intraoral examination revealed deep multiple caries in all maxillary and mandibular primary molars except incisors. There was no mobility, sinus or tenderness; however, mobility and buccal gingival abscess was associated with tooth no. 54. Intraoral periapical radiographs could not be obtained because of lack of cooperation and X-ray facilities were not available in the operation. Orthopantomogram [Figure 1] was taken that revealed pulpal involvement of all primary molars in both arches with associated root resorption in 54 only. Diagnosis of reversible pulpitis for all carious molars was made except 54 having chronic pulpitis (necrotic pulp).{Figure 1}

Taking into consideration the large amount of child's dental treatment needs and limited cooperation due to very young age of the child, it was planned to perform complete oral rehabilitation under general anesthesia in a single sitting. Initially, pulpotomy was tried for the teeth with reversible pulpitis, but there was profuse bleeding with no homeostasis after removal of coronal pulp; therefore, pulpectomy was performed followed by stainless steel crown.

Pulpectomy procedure

Isolation was carried with a rubber dam followed by caries removal and pulp extirpation. Canals were debrided using standard endodontic k-files or hedstrom files (up to at least size 30) along with thorough irrigation with 3% sodium hypochlorite and finally root canal obturation was done with Diapex ® paste using a maillefer lentulo spiral (Dentsply, Tulsa, Oklahoma).

Diapex ® (DiaDent Group International Inc. Burnaby, B.C Canada) is silicone oil based calcium hydroxide paste premixed with iodoform and is available in convenient prefilled syringes. It comprises of calcium hydroxide-30.3%, iodoform (purest grade)-40.4%, silicone oil (Medical Grade)-22.4% and inert 6.9%.

In some teeth, canals could not be dried completely before obturation as there was little amount of bleeding. Access opening was restored with ketac silver restoration (3M ESPE, St. Paul, Minn). Crown reduction was performed for placement of stainless steel crown (3M ESPE, St. Paul, Minn) and cemented by luting glass ionomer cement (Ketac Cem ® , 3M ESPE, St Paul, Minn). Primary maxillary right first molar was extracted.

One week follow-up

Recovery was uneventful, band and loop space maintainer was cemented by luting glass ionomer cement for 54. Orthopantomogram (OPG) [Figure 2] revealed extrusion of Diapex ® material into periapical areas in some of the pulpectomized teeth.{Figure 2}

Six months follow-up

Clinically, the child was asymptomatic with no new carious lesions. OPG [Figure 3] was taken that revealed the complete resorption of overfilled Diapex ® paste from the periapical areas.{Figure 3}

Twelve months follow-up

There was Grade I mobility in the majority of treated teeth but without any pain or tenderness with all stainless steel crowns intact. OPG [Figure 4] showed resorption of part of Diapex paste from canals along with root resorption in teeth that were mobile, however, remaining treated teeth showed no mobility or resorption. There was no periapical radiolucent area. Child was advised to come back if there is any pain or swelling otherwise to come for 6 months follow-up. No active intervention for retreatment for teeth undergoing resorption was undertaken as parents were not interested with the child being asymptomatic. However, they were informed about the prognosis and asked to come for regular follow-ups.{Figure 4}

Thirty months follow-up

The child didn't report for next 18 months as there were no complaints. After 2½ years follow-up, there was mobility in almost all teeth that were treated with pulpectomy, with some showing buccal gingival abscesses. There was space loss in 54 areas as space maintainer was lost around a year ago and parents were not interested in space regaining treatment. Moreover, both distal tooth (55) and mesial tooth (53) to space loss area were undergoing root resorption and any space regaining method would have not been possible. OPG [Figure 5] revealed complete root resorption in remaining primary first molars with early eruption of succedaneous teeth. Parents were informed about the situation, and it was decided to keep teeth with resorbed roots as such until they become symptomatic, thereby allowing them to act as natural space maintainer.{Figure 5}

Discussion

Primary teeth which exhibit only deep colored, excessive hemorrhage that cannot be controlled within few minutes, might have extensive inflammation but pulp is hyperemic and vital. Total removal of the pulp tissue from the root canals of primary teeth cannot be achieved because of their complex and variable morphology. Factors such as an increased number of accessory, ribbon-like canals, foramina and porosity in pulpal floors of primary teeth makes complete canal debridement difficult leading to incomplete extirpation of pulp remnants. Thereby implying that in hyperemic pulp, vital pulp can remain in these inaccessible areas.

Ca(OH) 2 containing root filling pastes used in primary teeth with hyperemic pulp can come in contact with some vital pulp tissue remnants and can trigger the cascade of inflammatory root resorption. The coronal part of the pulp is usually necrotic, while the apical part of the pulp can remain vital for the resorptive process to initiate and progress. [12] The mechanism is similar to the one that is seen more commonly in pulpotomy with calcium hydroxide leading to internal root resorption. [20] Ravi and Subramanyam have stated that Ca(OH) 2 induces chronic inflammatory response that influences the macrophages to fuse and form odontoclasts. Second, there is always a natural predilection in primary pulp to form odontoclasts. [21]

In the present case, pulpectomy was performed on vital teeth with intact roots and hyperemic pulp (initially indicated for pulpotomy). As the child was treated under general anesthesia in a single sitting, canals were not ideally dry and had little oozing of blood in some teeth. By using calcium hydroxide containing root canal filling material (Diapex ®), the presence of a remaining blood clot between the paste and the wound surface can enhance the inflammatory root resorption process. [8] Ca(OH) 2 paste produces superficial layer of necrosis causing damage to predentine, which in turn can lead to exposure of dentine to odontoclasts. [21] On the contrary, in the case report by Nurko et al. [8] there was extra as well as intraradicular resorption of vitapex paste, but without any concurrent root resorption. The teeth were involved by decay process and not necrotic as in our study. However, teeth were primary maxillary incisors in Nurko's case report where root canal morphology is less complex as compared to primary molars in the present child.

Majority of studies conducted with iodoform based Ca(OH) 2 obturating paste have shown its resorption from periapical areas in cases of overfilling [Table 2]. It has been reported that when vitapex is extruded outside into furcal or apical areas it can be either diffused away [22] or resorbed in part by macrophages within a short time of 1-2 weeks. [23] A clinical trial by Howley et al.[7] showed complete resorption of material from the canals with no signs and symptom clinically or radiographically. In fact intra-radicular resorption occurred before the physiologic root resorption of the treated teeth started.{Table 2}

In spite of no clinical or radiographical problems due to early intraradicular resorption of Ca(OH) 2 paste, it still may stop disinfection and become a hollow tube where the tissue fluid containing bacteria can fill the space in the unfilled or empty canals to induce re-infection. [24] This infection will shift the pH-value to acidic, dissolving root dentin and cementum initiating the resorptive process. This inflammation also causes transformation of nondifferentiated cells of connective pulpal tissue into giant multinuclear cells, which are responsible for the resorption process. [24]

It is also worthwhile to note that all clinical studies conducted on iodoform containing Ca(OH) 2 paste had two things in common - (1) sample size consisted of pulpally involved primary teeth with both hyperemic and necrotic pulp, (2) occurrence of intraradicular paste resorption except study conducted by Mortazavi and Mesbahi [13] who treated children in two visits, performed formocresol pulpotomy on the first visit and then preparation and obturation of the canals on the second. It is possible that foreign body giant cells may have been chemically fixed, thus losing their ability to resorb the vitapex paste in the root canals.

Primary teeth show less protection against root resorption when compared with permanent teeth. [25] Higher inflammation tendency of primary pulps can be attributed to higher vascularity of pulp. Factors such as reduced dentin thickness, greater permeability, lower hardness and strength of primary roots, further contributes to more rapid spread of infectious processes in the pulp tissues that can trigger an inflammatory process and root resorption. [26] Vieira-Andrade et al. [27] studied associated factors for root resorption in primary molars and found out that pulpectomy procedure posed the greatest risk, with these teeth having fivefold greater chance of having root resorption when compared to teeth undergone pulpotomy.

In our case, root resorption following pulpectomy occurred in almost all primary molars with permanent successors seem to be erupting early. There is contrasting literature regarding the effect of pulpal treatment in primary teeth on the rate of root resorption. Moskovitz et al. [10] compared the degree of root resorption in endodontically treated primary molars with that of homologous teeth without root canal treatment and concluded that there is accelerated root resorption in root canal treated teeth leading to early eruption of permanent successors. However, in another study conducted by van Amerongen et al. [28] showed no difference in the exfoliation time of primary teeth with or without pulpal treatment.

Since there is minimal microbial attack in hyperemic primary pulp, the use of intracanal medicaments containing Ca(OH) 2 and iodoform is not as necessary as for infected primary roots, which have much wider range of organisms present inside the canals. [29] These teeth can be more successfully managed with ZnOE pastes rather than iodoform containing Ca(OH) 2 pastes. There are lot of studies on clinical and radiographic comparative success rates of ZOE and Ca(OH) 2 paste obturating materials. Barcelos et al. [1] in their systematic review on comparing ZOE paste versus vitapex and sealapex pastes pulpectomies in primary teeth with irreversible pulpitis as regards to clinical and radiographic outcomes after 12 or more months concluded ZOE pulpectomies yielded similar outcomes as with vitapex and sealapex although there was no agreement with regards to filling materials resorption.

However in a comparative study [13] done on ZOE and vitapex of root canal treatment of necrotic primary teeth, vitapex was found to be significantly successful filling material and overfilled vitapex material resorbed more successfully without the loss of root filling itself. Ozalp et al. [2] concluded that both ZOE and vitapex were 100% successful, but in vitapex group, six teeth needed retreatment because of complete resorption of the extruded material. Another clinical study by Trairatvorakul and Chunlasikiwan [11] on success of pulpectomy with ZOE versus vitapex in infected primary molars reported both materials yielded similar results after 12 months. However, Subramaniam et al. trial [17] showed more success rate (both clinically and radiographically) for metapex when compared to endoflas and ZOE after 18 months when used as primary root canal filling materials.

Conclusion

The state of pulp before the treatment and type of obturating paste can be a factor in the accelerated root resorption in primary teeth undergoing pulpectomy. Clinical trials need to be conducted comparing primary teeth pulpectomy in hyperemic and necrotic pulp (separately) and its effect of on root resorption. Longer follow-up is also recommended to study the effect of iodoform containing Ca(OH) 2 based root filling materials in primary teeth with vital pulp.

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