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ORIGINAL RESEARCH

Comparative Evaluation of Calcium Hydroxide and Zinc Oxide Eugenol as Root Canal Filling Materials for Primary Molars: A Clinical and Radiographic Study

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ABSTRACT

Aim: The purpose of this study is to compare the efficacy of calcium hydroxide and zinc oxide eugenol as a root canal filling material in primary teeth using endodontic pressure syringe system.

Materials and methods: A total of 40 primary mandibular molars were selected and divided into two groups-group I (calcium hydroxide was used as root canal filling material) and group II (zinc oxide eugenol used as canal filling material). Clinical review was undertaken at 1, 3, 6 and 9 months interval for evaluating pain, tenderness, mobility and any other sign of pathology. Radiographic examination was done at interval of 3, 6 and 9 months for the evaluation of any change in the radiolucency around the apices and inter-radicular space. Resorption of root and filling material was also assessed.

Results: Reduction in the clinical symptoms were noted in both groups ($p < 0.01$). All the 20 cases in group I demonstrated a decrease in size of radiolucency. However in group II, an increase in radiolucency was observed in 2 teeth at 3 months radiographic examination. Further no decrease in the size of radiolucency was noticed at subsequent follow-up visits. Complete resorption of overfilled material was observed at the 3 months radiographic examination for group I whereas partial resorption of overfilled material was seen at 6 months radiographic examination for group II.

Conclusion: The findings of the present study indicate that calcium hydroxide could be used exclusively or as an alternative to zinc oxide eugenol as a root canal filling material for the primary teeth.

Keywords: Primary teeth, Pulpectomy, Root canal filling materials, Calcium hydroxide, Zinc oxide eugenol.

INTRODUCTION

Endodontics is the branch of dentistry that deals with the etiology, diagnosis, prevention and treatment of diseases of the pulp and periapical tissues compatible with good health.[1] Successful root canal treatment enables the tooth to be conserved and retained as a useful member of the dental arch, without constituting a danger either to the health of the supporting structures of the tooth or to the general health of the patient.[2] Premature loss of the teeth due to trauma or dental caries creates a special problem in the child.[3,4] Although space maintenance techniques for children are adequate, many do not restore function, and all require constant monitoring of the appliance following insertion and cooperation of the child.[5,6] Endodontic procedures are preferable to space maintenance after extraction in preserving the arch integrity, if the tooth can be rendered free of pathology and restored to normal form and function.[7]

Pulp therapy in the deciduous teeth has been suggested since 1932 as a method of maintaining primary teeth. Developmental, anatomical and physiological differences between the primary and permanent teeth calls for differences in the criteria for root canal filling materials.[8-10] Specially, the root canal filling material assumes importance, because in addition to other properties, it must be resorbable, anti-bacterial and biocompatible.[11] The commonly used material, zinc oxide eugenol,[12,13] has been reported to be irritating to periapical tissues, causes necrosis of bone, cementum and alter the path of eruption of the succedaneous teeth.[14-17] Calcium hydroxide is a material that has been used virtually as a panacea in dentistry. Its antibacterial properties[18] (attributed to its alkaline pH), resorbable nature[19] and osteogenic potential[20] are well-known. This material has been widely used in permanent teeth[21] but it is only recently that calcium hydroxide has been utilized for filling primary root canals.[23-27] This material is generally not used in pulp therapy for primary teeth due to the fear of internal resorption.[6,8] The possible explanation may be due to its high alkaline pH. It causes metaplasia of undifferentiated mesenchymal cells to odontoclasts leading to resorption.

Calcium hydroxide pastes are inherently soluble and might have to be replaced in the future. If, on the other hand the contact area between the root canal paste and the periapical tissue can be reduced, due to working technique and depth, a minimal solubility of the paste can be anticipated.[28,29] This could prove to be a feasible alternative to the materials currently in use and based on that it was proposed to take up the study of evaluation

of calcium hydroxide as root canal filling material in primary teeth. Several techniques have been used for the filling of materials into the deciduous root canals. These techniques are the incremental filling technique using the endodontic plugger; the lentulo spiral technique—paste carried to the pulp chamber and canals by a lentulo spiral for obturation; and the pressure syringe technique—filling material applied to the canals by using an endodontic pressure syringe.[30-32]

Considering the above-mentioned properties of zinc oxide eugenol and calcium hydroxide, it was decided to conduct a study with the objective of evaluating the suitable root canal filling material in primary teeth using endodontic pressure syringe.

An attempt was made to find out if calcium hydroxide could be used as an alternative to zinc oxide eugenol as a root canal filling material by using endodontic pressure syringe system.

MATERIALS AND METHODS

Children with pulpal involvement of the teeth due to caries were selected from the outpatient department, Department of Pedodontics and Preventive Dentistry, Mahatma Gandhi Post Graduate Institute of Dental Sciences, Puducherry. They were in the age group of 4 to 9 years with good general health and having no history of systemic illness. Participation in this study was voluntary and a written consent was obtained from the parents or guardians of the patients before starting the treatment.

A total of 40 primary mandibular molars with carious exposure of pulp showing signs of irreversible pulpitis were selected. Radiographic evaluation was done to exclude teeth showing pathologic root resorption.

Selected teeth were randomly divided into two groups:

Group I: Pulpectomy performed and root canals filled with calcium hydroxide using endodontic pressure syringe.

Group II: Pulpectomy performed and root canals filled with zinc oxide eugenol using endodontic pressure syringe.

Access was gained to the pulp chamber and carious tooth structure was removed. Gross removal of radicular pulp tissue was done using K files. Copious irrigation with normal saline was carried out to remove necrotic debris or the degenerated tissues. The canals were negotiated with appropriate sized K files using care to avoid overextension through the apices and the working lengths were established radiographically. The working length was kept 1 to 2 mm short of the radiographic apex. Shaping of canals was done using K files in pull back motion up to a maximum size of no. 40. Irrigation of the root canals was carried out with normal saline throughout the endodontic procedure. Once the patient is free of all clinical signs and symptoms of infection, the canals were filled using the endodontic pressure syringe system (Pulpdent) following the manufacturer's instructions in all the teeth. The materials—calcium hydroxide paste (RC Cal ; Prime Dental), calcium hydroxide powder (Prime Dental) and zinc oxide eugenol (Pulpdent Root Canal Sealer) were made to putty-like consistency.

The material was then filled into the hub of the needle, the barrel threaded onto the needle and the screw post subsequently inserted. The needle was placed 2 mm short of radiographic apex and quarter turns of screw post expressed material into root canal. One quarter turn of the screw filled the apex with 0.02 mg of material. Before filling the remaining root canal space, the needle was withdrawn slightly to break contact with the canal walls and screw was continuously turned until material appeared at orifice. An immediate postoperative radiograph was taken. Clinical review was undertaken at 1, 3, 6 and 9 months interval. The teeth were evaluated for pain, tenderness to percussion, presence of mobility and signs of pathology. Radiographic examination was done at the interval of 3, 6, and 9 months for the evaluation of increase, decrease or disappearance of radiolucency around the apices and inter-radicular space. Resorption of the root and material was also assessed.

RESULTS

To evaluate the statistical significance of the data, binomial probability density function (WINSTAT) was used.

In group I (calcium hydroxide group), the success of the treatment was 100%, i.e. all 20 teeth were considered successful as these patients were asymptomatic and clinical signs of pathology were absent (Fig. 1). In group II (zinc oxide eugenol group), success was 90%, i.e. 18 out of 20 teeth were considered successful (Fig. 2). The selection of teeth for both groups was unbiased and so any further outcomes between groups can be compared.

In group I (calcium hydroxide group), complaint of pain was there in 20 patients preoperatively (100%). None of the patients reported with pain at 1, 3, 6 and 9 months clinical follow-up. This reduction in pain was highly significant. In group II (zinc oxide eugenol group), complaint of pain was reported in all 20 patients preoperatively. Incidence of pain was noted in two teeth at the 1 month clinical follow-up. Immediate postoperative radiographic examination revealed overfilling in these two teeth. At the 3-month clinical follow-up, the same two patients reported with occasional pain. But they were asymptomatic at the 6 and 9 months examination.

Incidence of tenderness to percussion was not noted in none of the 20 cases in group I (calcium hydroxide group) at the 1, 3, 6 and 9 months clinical follow-up. This was highly significant (Table 1).

It was seen that all 20 cases in group I (calcium hydroxide group) demonstrated decrease in the size of radiolucency. This decrease in size of radiolucency was observed at 6 and 9 months in group I. However, increase in the size of radiolucency was observed in two teeth in group II (zinc oxide eugenol group) at 3-month radiographic examination. Further no decrease in the size of radiolucency was seen at 6 and 9 months examination. The difference between the two groups was not statistically significant.

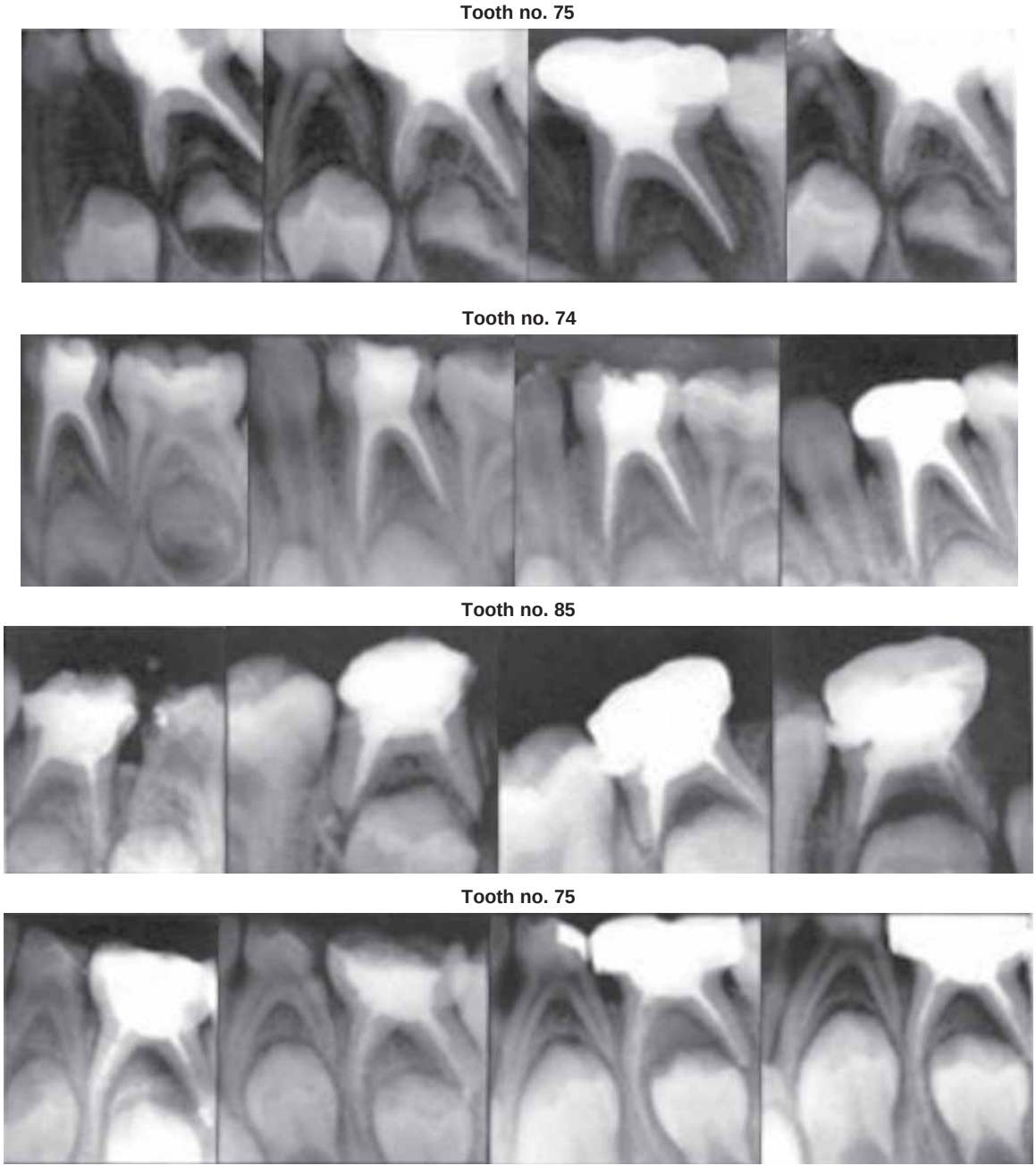


Fig. 1: Group I—calcium hydroxide: Few cases of immediate postoperative radiograph at 3, 6 and 9 months follow-up

Complete resorption of overfilled material was observed at the three months radiographic examination for group I (Figs 3A and B). This highly significant finding was not seen in group II (zinc oxide eugenol group). Partial resorption of overfilled material was seen at 6-month radiographic examination for zinc oxide eugenol in all the five cases that showed overfilling.

Table 1: Comparison of clinical and radiographic success at the end of 9 months between study groups

Response	*Group I calcium hydroxide*	*Group II zinc oxide eugenol*	*Total no. of teeth*
Asymptomatic	20	18	38
Symptomatic	0	2	2
Total no.of teeth	20	20	40
Chi-square	2.11	p = 0.15	

p > 0.05: Not significant

One interesting finding that was seen in group I (calcium hydroxide) was the resorption of calcium hydroxide inside the canal. It was seen in three cases (15%) at 6-month radiographic examination (Figs 4A and B). Delayed resorption of the material was also seen in two cases (10%) when compared to that of physiological resorption of the root in group II (zinc oxide eugenol group).

The difference in success between the two groups was not statistically significant (Table 2).

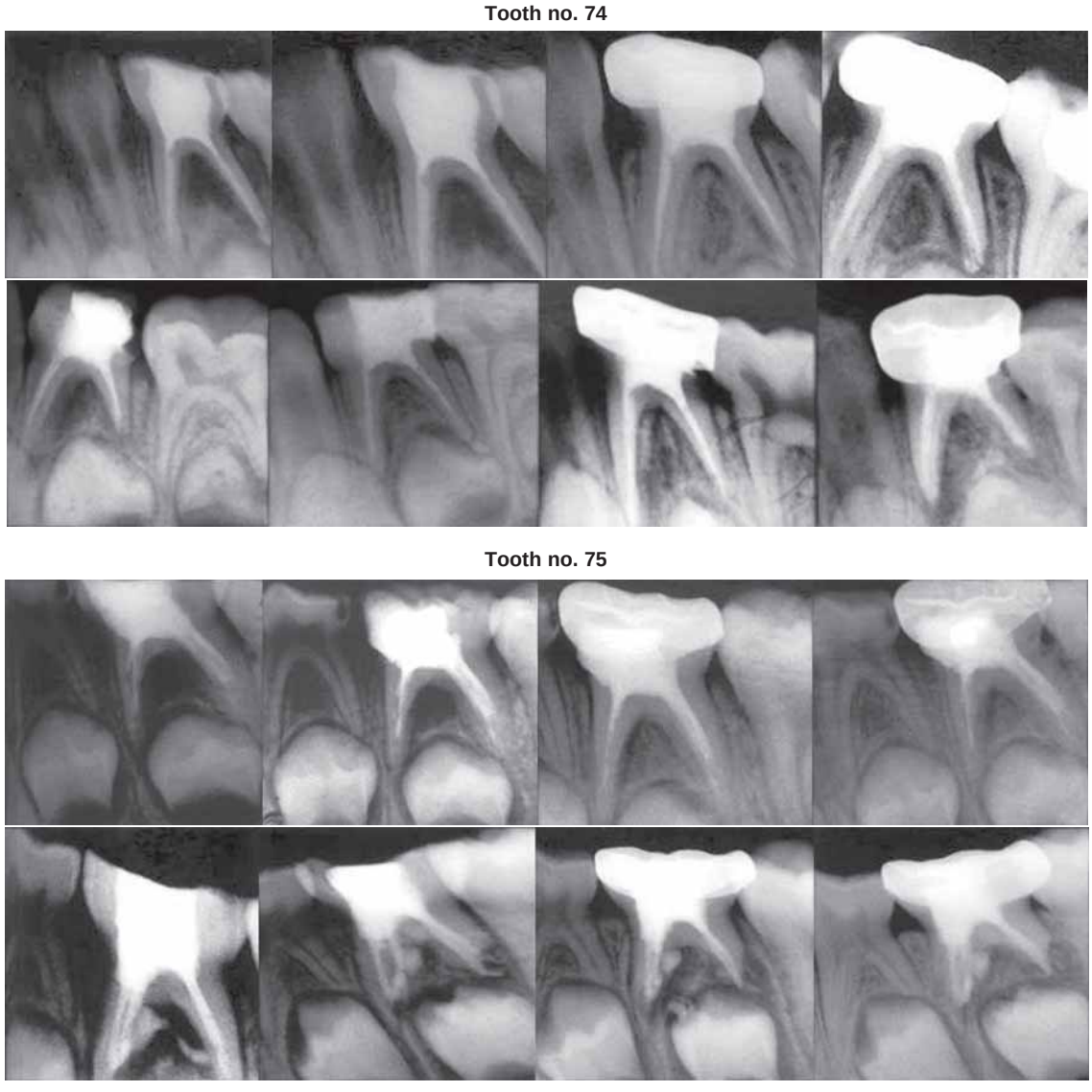


Fig. 2: Group II—zincoxide eugenol: Few cases of immediate postoperative radiograph at 3, 6 and 9 months follow-up

DISCUSSION

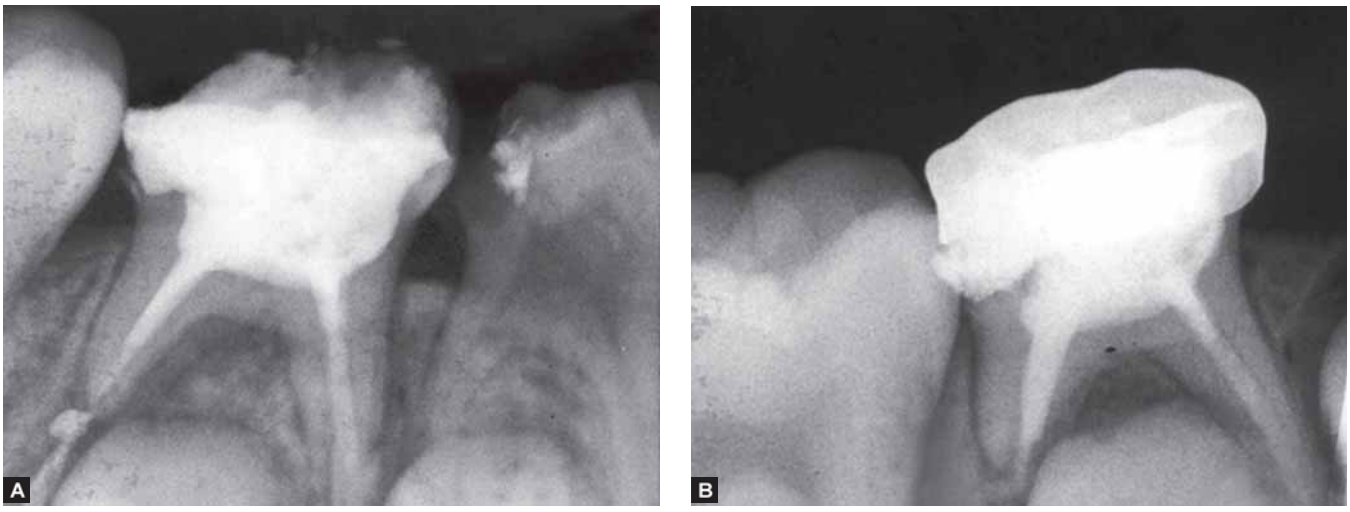
The results of the present study are comparable to Nadkarni and Damle (2000) who reported a success rate of 94.28% with calcium hydroxide and 88.57% with zinc oxide eugenol. Coll et al (1985) has found 86.1% success with zinc oxide eugenol. Nurkos and Garcia Godoy F[33](1999) have reported almost 100% success with the use of calcium hydroxide/iodoform paste.

Despite the clinically high success rate (90%) of root canal treatment using zinc oxide eugenol as obturating material in the present study, radiographic evaluation revealed only partial resorption of the overfilled material. Delayed resorption of the material (10%) was also seen when compared to that of physiological resorption of the root. This is in accordance with the study done by Woods et al[34] (1984), Chawla et al (2000) and Coll et al (1985). Complete resorption of overfilled material

Table 2: Comparison of clinical and radiographic success at the end of 9 months between study groups

Response	*Group I Calcium hydroxide*	*Group II Zinc oxide eugenol*	*Total no. of teeth*
Asymptomatic	20	18	38
Symptomatic	0	2	2
Total no. of teeth	20	20	40
Chi-square	2.11	p = 0.15	

p > 0.05—Not significant



Figs 3A and B: (A) Tooth 85 immediate postoperative radiograph demonstrating overfilled calcium hydroxide, (B) tooth 85, 3 months postoperative radiograph demonstrating complete resorption of overfilled material

Figs 4A and B: (A) Tooth 74 immediate postoperative radiograph demonstrating root canal filling done with calcium hydroxide, (B) tooth 74 6 months postoperative radiograph demonstrating resorption of material inside the mesial canal

was observed at the 3-month radiographic examination for calcium hydroxide. Partial resorption of overfilled material was seen at 6-month radiographic examination for zinc oxide eugenol. This is similar to the findings of Nadkarni et al (2000) and Chawla et al who observed complete resorption of overfilled material in 2 to 3 months.

In this study endodontic pressure syringe was used for filling the root canals. Greenberg M (1961) first recommended filling root canals of primary teeth with thick mixes of resorbable pastes utilizing the injection technique. Dandashi[32]et al (1993) in an *in vitro* study have found the pressure syringe system to yield fewest voids. The advantage of using endodontic pressure syringe system as seen in this study was that it was less time consuming and easy to use. The disadvantage seen was that one assistant was required for stabilizing the wrench while obturating the canals.

The present investigation indicated that reduction in clinical signs and symptoms, and healing of periapical pathology as evidenced by resolution of radiolucency was present with both the materials used. However, a faster resorption of overfilled material was observed with calcium hydroxide. This finding is comparable with that of Chawla et al, Nadkarni et al, Nurkos C and Garcia Godoy. Since statistically no difference was seen between the two materials, in order to arrive at a definite conclusion, the teeth treated in the study need to be monitored until their exfoliation and a further longitudinal study involving a larger sample size requires to be carried out.

CONCLUSION

The findings of the present study indicate that calcium hydroxide could be used exclusively or as an alternative to zinc oxide eugenol as a root canal filling material for the primary teeth. This could avert the cytotoxic effects of eugenol and also could prevent the deflection of the succedaneous tooth bud.

Endodontic pressure syringe is a less time consuming and easy method of filling root canals in primary teeth.

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