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Radiographic Evaluation of Different Combinations of Zinc Oxide as an Obturating Material in Pulpectomy: A Comparative in Vivo Study

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Abstract

Background and Aims: The success of an endodontic treatment depends on various factors and use of an ideal obturating material is one among that.

The aim of this study was to evaluate and compare the radiographic success of different combinations of zinc oxide as an obturating material in pulpectomy of primary mandibular molars at three and six month intervals.

Treatment success or failure was determined by a combination of clinical and radiographic findings at three and six month intervals.

Results: The results at three and six months follow up yielded statistically significant reduction in size of radiolucency, whereas, the resorption rates of the root and the different materials showed no statistical significance.

Conclusions: All the materials used in the study have potential obturating material property, which shows promising results in preserving the tooth in its dental arch.

Keywords: *Pulpectomy, Obturation, Endoflas, Calcium hydroxide, Sodium fluoride, Zinc oxide eugenol.*

Introduction

Dental caries in primary teeth remains a considerable dental health problem. In an irreversibly affected pulp tissue, either due to caries or traumatic injuries, endodontic treatment is considered as the best option. For the success of an endodontic treatment, numerous materials have been tested as an obturating material but none of these possess all the ideal requisite properties required for obturation in primary teeth; especially with regard to the major desirable property of having a rate of resorption matching that of the physiologic root resorption of primary teeth and faster resolution of furcal radiolucency.[1]

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Material and Method

The present in vivo study was carried out in a clinical set up; on a sample of one hundred and five primary mandibular molars of children in the age group between 4-9 years of both the sexes using simple random sampling technique. A written informed consent and assent were obtained after being advised about the nature of the study according to the protocol approved by the Ethics and review committee. Inclusion criteria were healthy, co-operative children without any systemic disease, history of spontaneous pain with deep carious lesion which is tender on percussion, radiolucency

involving pulp with loss of continuity of the lamina dura, radiolucency in inter-radicular not involving permanent tooth bud, adequate bone support and root length, with no radiographically discernible pathological internal or external resorption, without sinus formation and those children who can report back for the recall visits. Teeth with abnormal mobility other than the normal exfoliation were excluded from the study.

A single sitting pulpectomy was carried out in these samples after administration of local anesthesia using 2% lignocaine with 1:80,000 adrenaline, isolation was achieved with rubber dam during the entire procedure. All the carious tooth structure was removed to gain good access to the coronal pulp. Access opening was done with No. 2 and 4 round diamond burs and the overhanging dentin was removed from the roof of the pulp chamber with Endo-Z carbide bur. Extirpation of pulpal debris from the root canals were done using K and H files of sizes 8 and 10 and copious irrigation with normal saline. After working length determination, the canals were prepared with K-files and H-files and enlarged upto size 40. The root canals were then thoroughly irrigated with normal saline and the final wash of the canals was done with 0.2% chlorhexidine solution and then dried with sterile absorbent paper points of 0.04 taper. The root canals were then randomly filled with the respective obturating materials based on their groups either with endoflas [Group 1], or a mixture of zinc oxide powder, calcium hydroxide paste, sodium fluoride [Group 2] and zinc oxide eugenol [Group3], as per the manufacturer's instructions and were obturated with lentulospirals mounted in a slow speed hand piece. The teeth were then finally restored with glass ionomer cement. After the removal of the rubber dam, immediate post operative radiographs were taken to assess the endodontic fill. The patient was recalled after a week for the placement of preformed stainless steel crowns.

Patients were scheduled for routine recall visits at every three and six month intervals. During the follow up visits, radiographic evaluation was done by measuring the difference in size of radiolucency and also the resorption rate of the material with that of the root using Boley's gauge. [2] A blinded examiner was asked to evaluate the changes and the data was recorded.

The data obtained from this study were tabulated and statistically analyzed using Statistical Package for Social Sciences software (SPSS version 18). Intragroup data comparison was done by using Wilcoxan Signed Rank Test and intergroup comparison using Kruskal Wallis Test to find out the statistical significance of the obtained results. P value of <0.05 was considered to be statistically significant.

Findings

Out of the treated 105 samples, 34 samples were obturated with Endoflas [Group 1]; 35 samples with a mixture of zinc oxide powder, calcium hydroxide paste and 10% sodium fluoride solution [Group2] and 36 samples with zinc oxide eugenol [Group 3] and were evaluated after three and six months [Figures 1,2 and 3].

In all the three groups, reduction in size of radiolucency was noticed from preoperative, three and six months which was statistically significant except in Group 2 between three and six months [Table 1].

Intragroup evaluation of size of radiolucency and resorption rate among the three groups after 3 and 6 months [Table 2].

The change in size of radiolucency and resorption rates among the different materials after three and six months was statistically not significant [Table 3].

Figure 1: Preoperative and postoperative radiographs of tooth filled with Endoflas:

(a) Preoperative radiograph, (b) Immediate postoperative radiograph, (c) Postoperative radiograph at 3 months, (d) Postoperative radiograph at 6 months

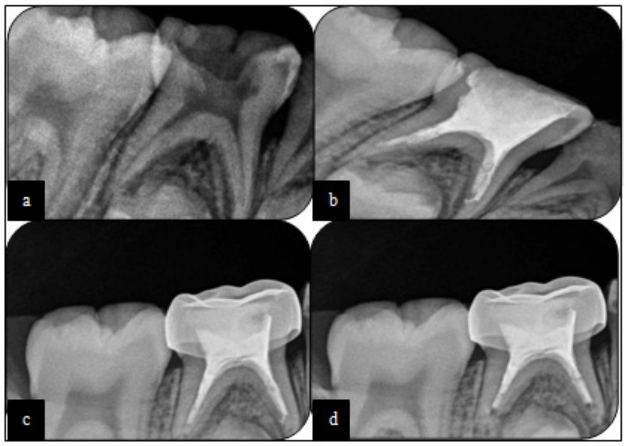

Figure 2: Preoperative and postoperative radiographs of tooth filled with a mixture of zinc oxide powder, calcium hydroxide paste and 10% sodium fluoride solution:

(a) Preoperative radiograph, (b) Immediate postoperative radiograph, (c) Postoperative radiograph at 3 months, (d) Postoperative radiograph at 6 months

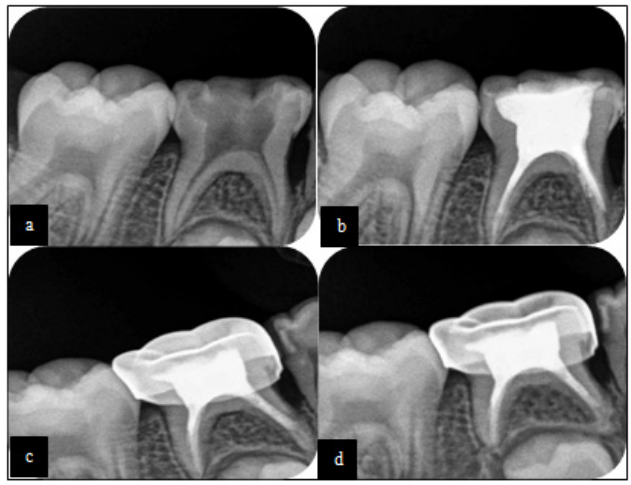

Figure 3: Preoperative and postoperative radiographs of tooth filled with zinc oxide eugenol:

(a) Preoperative radiograph, (b) Immediate postoperative radiograph, (c) Postoperative radiograph at 3 months, (d) Postoperative radiograph at 6 months

Table 1: Intragroup comparison of size of radiolucency among the three groups after 3 and 6 months

Variables	Mean			Standard Deviation			P value		
	Grp1	Grp2	Grp3	Grp1	Grp2	Grp3	Grp1	Grp2	Grp3
Pre-OP	0.36	0.27	0.34	0.658	0.617	0.759	0.003* (S)	0.007* (S)	0.007* (S)
Three Months	0.10	0.08	0.18	0.318	0.289	0.476			
Pre-op	0.36	0.27	0.34	0.658	0.617	0.759	0.003* (S)	0.007* (S)	0. 007* (S)
Six Months	0.01	0.01	0.10	0.086	0.068	0.273			
Three Months	0.10	0.08	0.18	0.318	0.289	0.476	0.041* (S)	0.102 (NS)	0.041* (S)
Six Months	0.01	0.01	0.10	0.086	0.068	0.273			
P≤ 0.05 is significant, NS- Not significant, HS- Highly significant									

Table 2: Evaluation of size of radiolucency and resorption rate among the three groups after 3 and 6 months

Study Group	Time Interval	Size of Radiolucency	Resorption Rate			
			Root>Material	Root<Material	Root=Material	No Resorption
Group 1 (N=34)	Three months	Decrease (n=9)	01	00	00	08
		No radiolucency (n=25)	02	01	01	21
	Six months	Decrease (n=2)	00	01	01	00
		No radiolucency (n=32)	03	03	10	16
Group 2 (N=35)	Three months	Decrease (n=7)	00	01	00	06
		No radiolucency (n=28)	01	06	00	21
	Six months	Decrease (n=1)	00	01	00	00
		No radiolucency (n=34)	03	08	06	17

Study Group	Time Interval	Size of Radiolucency	Resorption Rate			
			Root>Material	Root<Material	Root=Material	No Resorption
Group 3 (N= 36)	Three months	Decrease (n=9)	01	00	00	08
		No radiolucency (n=27)	01	00	00	26
	Six months	Decrease (n=6)	03	00	01	02
		No radiolucency (n=30)	02	00	00	28

Table 3: Intergroup comparison of size of radiolucency and resorption rate between three materials at 3 and 6 month intervals

Variables	Time Interval	Group	N	Mean Rank	P Value
Size of Radiolucency	Three Months	1	34	55.82	0.217 (NS)
		2	35	54.71	
		3	36	48.67	
		Total	105		
	Six Months	1	34	52.04	0.886 (NS)
		2	35	53.60	
		3	36	53.32	
		Total	105		
Rate of Resorption	Three Months	1	34	53.06	0.993 (NS)
		2	35	53.20	
		3	36	52.75	
		Total	105		
	Six Months	1	34	51.16	0.657 (NS)
		2	35	55.79	
		3	36	52.03	
		Total	105		
P ≤ 0.05 is significant, NS- Not significant, HS- Highly significant					

Discussion

A wide variety of materials have been used for obturation of primary teeth with varying success. Among these, the most commonly used is zinc oxide eugenol, sets into a dense mass which irritates periapical tissues,[3] causes necrosis of bone and cementum,[4] resists resorption and has a tendency to be retained even after tooth exfoliation causing deflection of the path of eruption of the succedaneous tooth.[1,2,4,5,6]

Calcium hydroxide is virtually an all purpose medicament in dentistry.[1] Despite its antiseptic and osteoinductive properties, it is not generally preferred in pulp therapy due to fear of internal resorption as its alkaline pH causes metaplasia of undifferentiated mesenchymal cells to odontoclasts leading to resorption.[7] It has a tendency to get depleted from the canals earlier than the physiologic resorption of roots,[1] resulting in a "hollow tube" effect within the canal wherein the unfilled area is permeated with tissue fluid that eventually becomes a site for infection.[8]

A commercially available product- Endoflas, is highly effective against resistant endodontic pathogen, E. Faecalis, so can be used for management of infected primary molars.[9] It is a hydrophilic material, which when used in humid canals, provides a tight seal, biocompatible in nature with antibacterial properties. According to Pandranki J et al,[9] it reduces periapical inflammatory processes and stimulate periapical healing with increased alkaline phosphatase action thus showing excellent healing capabilities and bone regeneration with 95%-100% success rates. When Endoflas was extruded into the dental follicle, it irritates the follicle and causes intense inflammatory reaction resulting in accelerated root resorption. The use of iodoform containing products

raises the safety issue of iodoform being allergic, causing discolouration of teeth and encephalopathy leading to coma.[1]

To overcome the drawbacks of calcium hydroxide and zinc oxide eugenol, a few drops of 10% sodium fluoride solution was added to this mixture in a previous study. It was suggested that this obturating material could leach out fluoride which will be beneficial to the erupting tooth and a reaction product of calcium fluoride was formed that added radiopacity to the material without the addition of another radiopaque material.[1]

The present study was done to evaluate and compare the radiographic success of Endoflas, a mixture of zinc oxide with calcium hydroxide paste & 10% sodium fluoride solution and zinc oxide with eugenol as an obturating material in pulpectomy of primary mandibular molars.

According to Chawla H.S. et al,[1] on obturating with a mixture of zinc oxide powder, calcium hydroxide paste and 10% sodium fluoride solution, a reaction product of calcium fluoride is formed that added radiopacity to the material. In the present study it was noted that, even though the same quantity of ingredients were used for obturation, the radiopacity of the Group 2 mixture in the immediate postoperative radiograph was nearly similar to that of the dentin, making it difficult to appreciate the length of fill of the material in the canals. Hence, it is advisable to add a radiopacifier for optimum evaluation.

In Group 1, all the 34 samples, showed statistically significant reduction in size of radiolucency from preoperative and at 3 and 6 months [Table 1]. Similar to our study, there was 100% reduction in furcation radiolucency with excellent healing capabilities.[10,11] The disparity in the resorption rates noticed in the present study [Table 2], can be attributed to the influence of various factors such as individuals body resistance;[9] preoperative pathologic condition[12] and periapical pathology.[9]

In Group 2, all the 35 samples showed statistically significant reduction in size of radiolucency from preoperative to 3 and 6 months interval but not between 3 and 6 months [Table 1]. This result suggests that maximum resolution of the radiolucency occurs within the first 3 months and the resolution rate lessens by the end of 6 months. Similar to our study, complete obliteration of the radiolucent area and regaining of normal bony trabecular pattern was noticed by about 4 to 6 months.[13] On evaluating the resorption rates [Table2], Chawla et al,[1] reported that the resorption of the material matched the physiologic root resorption at the end of two years which is contrary to our study.

In Group 3, all the 36 samples showed statistically significant difference in size of radiolucency from preoperative, 3 and 6 months and also between 3 and 6 months [Table 1]. Radiolucency was noticed in 9 samples preoperatively which showed decrease in its size at the end of 3 months and only 3 samples among them showed complete resolution at the end of 6 months [Table 2]. Similar to our study Pandranki et al,[9] and Rewal,[14] showed only 45% reduction in size of radiolucency with pre existing pathosis at the end of 9 months. On evaluating the resorption rates [Table 2], similar to our study, Barr et al,[5] Chawla et al,[1,13] Dogra S [7] and Pandranki [9] showed delay in resorption of zinc oxide eugenol to that of the root and contrary to our study, Nadkarni and Damle,[15] and Coll,[16] reported 88.5% and 86.1% success respectively.

There was no statistical significant difference on comparing the size of radiolucency and the resorption rates of the three materials with that of the root at the end of 3 and 6 months [Table 3].

Conclusion

Although the results did not show any statistically significant difference, the success rate of all these materials are quite promising in reduction of the infection rate and can be considered as a valuable material for obturating deep carious tooth. However, a longer follow up period with sufficient sample size is necessary to reach sound conclusions regarding their resorption rates, effect on the succedaneous tooth and the overall radiographic success as an obturating material in primary teeth.

Ethical clearance- All the clinical procedures were carried out following the protocols approved by the Ethics and Review Committee of Sri Siddhartha Dental College and Hospital, Tumkur (IEC 11/2016).

Conflict of Interest: None.

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