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RESEARCH PAPER

Efficacy of Zinc Oxide Eugenol Mixed with Calcium Hydroxide and Iodoform as Obturation Material in Pulpectomy of Primary Teeth

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Abstract

Background: An ideal obturation material must be antibacterial, compatible with the resorption rate of the deciduous root, and harmless to the periapical tissue and developing tooth bud.

Objective: The objective of this study is to assess the therapeutic efficacy of zinc oxide eugenol mixed with calcium hydroxide and iodoform, through a comparison of clinical and radiological outcomes with those of conventional zinc oxide eugenol in pulpectomy of primary teeth at 3rd and 6th month postoperative period.

Methods: This experimental study was conducted on patients presenting to the Department of Paediatric Dentistry, Bangladesh Medical University (BMU), Dhaka from 1st January to 2019 to 31st December 2019. Ethical approval for the study was obtained from the IRB of Bangladesh Medical University (BMU). According to the inclusion and exclusion criteria selected 90 primary mandibular molar teeth from 4-9 years old patients were randomly divided into two study groups -Group A (Zinc oxide eugenol) as control group and Group B (Zinc oxide eugenol mixed with calcium hydroxide and iodoform) as experiment group, where each group contained 45 teeth. Clinical and radiographic evaluation was done at 3 and 6 months postoperative period. Patients were assessed based on the presence or absence of pain, tenderness on percussion, gingival swelling, and improvement of interradicular radiolucency.

Results: At the 3-month follow-up, postoperative pain and tenderness on percussion were absent in all patients, though the difference between the two groups was statistically significant ($p<0.05$). Gingival swelling was reported by 1 (1.1%) patient in Group-A, while no cases were observed in Group-B, showing a statistically significant difference ($p=0.006$). Radiographically, 6 (6.7%) teeth in Group-A showed no change in interradicular radiolucency, whereas all patients in Group-B exhibited a reduction, which was statistically significant ($p=0.026$). At the 6-month follow-up, no patients in either group reported pain, tenderness, or gingival swelling. Radiographic assessment showed continued reduction in radiolucency for all patients in Group-B, while 6 (6.7%) teeth in Group-A still showed no change.

Conclusion: The current study conclude that zinc oxide eugenol mixed with calcium hydroxide and iodoform can be regarded a better effective alternative to zinc oxide eugenol alone as an obturation material for pulpectomy of primary teeth.

Keywords: Zinc oxide eugenol, Calcium hydroxide and iodoform, Pulpectomy, Primary teeth

Introduction

Paediatric dentistry prioritizes the preservation of primary teeth until their natural exfoliation. Pulpectomy is the recommended treatment for primary teeth with irreversibly damaged and necrosed pulp. It entails removing bacteria and their byproducts while maintaining the hermetic seal of root canals. Thus, primary teeth can perform their tasks while also serving as a natural space maintainer for successor teeth[1].

In the event of a successful pulpectomy therapy, radiographic evidence of infection, as demonstrated by bone deposition in the pretreatment radiolucent areas, ought to subside in six months, whereas pretreatment clinical signs and symptoms should resolve in a matter of weeks. The treatment should allow for physiological resorption of the primary tooth root and filling material, allowing the succedaneums

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tooth to emerge normally[2]. The fenestrated and tortuous structure of the primary root canal makes biomechanical preparation for pulpectomy therapy more challenging in primary teeth[14]. The preparation of the root canal is depended on chemical means rather than mechanical instrumentation[3]. Hence, root canals should be filled with materials that have antimicrobial properties.

The endodontic obturation material should form a fluid-tight closure throughout the root canal, from the coronal opening to the apical termination[4]. Because of physiological root resorption in primary teeth, obturation material can move past the open apex and into the periapical region. If it does not resorb with the root, it may stay as a foreign body in the periapical region. To overcome these difficulties, an ideal obturation material should be antibacterial, biocompatible with periapical tissues, harmless to the developing tooth bud, and resorbable at the same rate as the deciduous root so as not to deflect an erupting successor tooth. An ideal obturation material should stick to the canal wall, quickly fill it without shrinking or expanding after setting, and be easily removed when necessary. If forced beyond the apex, the excess material should simply resorb. It should be radiopaque and not discolor the tooth[5].

Zinc oxide eugenol is the first obturation material recommended for primary teeth by Sweet in 1930. It is the most widely used material for pulp canal obturation. There is a liquid component and a powder component. Zinc oxide (69%), white rosin (29.3%), zinc acetate (1.0%), and zinc stearate (0.7%) are the contents of the powder. The composition of the liquid is 15% olive oil and 85% eugenol[6]. It's readily available and reasonably priced. Hashieh claims that the anti-inflammatory and analgesic effects of eugenol can persist for up to 30 days following pulpectomy treatment[7]. Maximum radiopacity, insolubility non tissue fluids, and lack of tooth discoloration are some of its additional advantageous qualities[8]. However, it has certain disadvantages like slow resorption rate, irritation of the periapical tissue, bone and cementum necrosis, and deflection of the successor tooth from the eruption path[7] and limited antibacterial efficacy[3].

Nowadays, a zinc oxide eugenol mixed with two others popular obturation materials -calcium hydroxide and iodoform has been suggested as an alternative to its solo use. The rationale behind combining these three popular obturation materials was to compensate the disadvantages of one individual material with the advantage of the others[8]. The mixture is available in the market in a powder liquid form. The powder contains tri-iodomethane and iodine dibutilorthocresol (40.6%), zinc oxide (56.5%), calcium hydroxide (1.07%), and barium sulphate (1.63%). The liquid consists of Eugenol and para-monochlorophenol[7]. Even in moderately humid canals, zinc oxide eugenol combined with calcium hydroxide and iodoform is a hydrophilic substance that can stick firmly to the root canal and offer a good seal. When periapically extruded obturation material is used, it can disinfect dentinal tubules and hard-to-reach accessory canals that cannot be cleaned or disinfected with calcium hydroxide and iodoform. The extra material resorbs after 7 days without causing intracanal washout[9].

In addition to its many benefits, the zinc oxide eugenol combined with calcium hydroxide and iodoform obturation material has certain drawbacks. It causes tooth discoloration. Eugenol, present in the mixture's liquid component, irritates the periapical tissue. According to some studies, the success percentage for overfilling instances is 58%, whereas the success rate for flash or underfilling situations is 83%[7]. Recent studies have revealed that the antimicrobial efficacy of solitary zinc oxide eugenol is inferior to its mixture with calcium hydroxide and iodoform and the difference is statistically significant[10]. Though zinc oxide eugenol mixed with calcium hydroxide and iodoform has many advantages, solitary use of zinc oxide eugenol is practiced more. This study aimed to evaluate the effectiveness of zinc oxide eugenol mixed with calcium hydroxide and iodoform by comparing its clinical and radiographic outcomes with those of plain zinc oxide eugenol in primary tooth pulpectomies at 3 and 6 months postoperative period.

Material and Methods

An experimental study was conducted in Department of Paediatric Dentistry, Faculty of Dentistry, Bangladesh Medical University (BMU), Dhaka, Bangladesh from 1st January,2019 to 31st December 2019 to evaluate the efficacy of zinc oxide eugenol mixed with calcium hydroxide and iodoform by comparing patients with zinc oxide eugenol as obturation material of pulpectomized primary molar tooth. A total of 90 patients aging 4 to 9 years having primary mandibular molar teeth with a history of irreversible pulpitis and pulp necrosis irrespective of sex were taken as study population. The study

population was divided into two groups (Group-A and Group-B) randomly. 45 patients were enrolled in each group. Participants in Group-A were given zinc oxide eugenol and participants in Group-B were given zinc oxide eugenol mixed with calcium hydroxide and iodoform as pulpectomy obturation material. Inclusion criteria of the study population were: 1. Healthy and cooperative children of 4 to 9 years irrespective of sex, 2. Mandibular first and second primary molar teeth with signs of irreversible pulpitis or pulp necrosis, 3. Teeth associated with gingival swelling and 4. Teeth with evident interradicular radiolucency. Patient with a systemic illness where pulpectomy is contraindicated, history of allergy to local anesthetics or any materials associated with pulpectomy, teeth with previously performed pulpectomy treatment, teeth with grade III mobility and primary teeth associated with radicular and/or dentigerous cyst were excluded from the study.

The pulpectomies were performed in three-sessions and stainless steel crowns were placed a week after canal obturation. The teeth were isolated with a rubber dam following local anesthesia. After removing all decayed tooth material, access to the pulp chamber was obtained. Barbed broaches were used to remove pulpal debris. Using measurements from a preoperative radiograph, an initial working length was determined, and K-files were placed in each root canal for a diagnostic radiograph, ensuring they stopped 1 mm short of the radiographic apex. Canal enlargement was achieved using K-files ranging from size 10 to 35. Root canals were irrigated using 1% sodium hypochlorite and normal saline (0.9% sodium chloride solution) followed by drying with sterile paper points. They were then filled using zinc oxide eugenol or a mixture of zinc oxide eugenol, calcium hydroxide, and iodoform obturation material, using a finger plugger in an incremental technique. Radiographs were taken to confirm complete filling of the root canals; any incomplete fillings were corrected. Stainless steel crowns were placed on all teeth. At 3 and 6 months post-obturation, another investigator, unaware of the filling material used in each tooth, clinically and radiographically assessed the teeth. The efficiency of zinc oxide eugenol and zinc oxide eugenol mixed with calcium hydroxide and iodoform as pulpectomy obturation material was assessed by following criteria: pain, tenderness on percussion, gingival swelling and interradicular radiolucency.

The ethical clearance of the study was taken from the institutional review board, BMU, Dhaka, Bangladesh and informed consent was obtained from all participating parents or legal guardians. Chi square test and Fisher's exact test was used for statistical analysis. Statistical tests of significance were computed so that a P-value d".05 was considered significant.

Results

All the study population were divided into two groups in Group-A (control group) and Group-B (experiment group). In Group-A (n=45), ZOE (Zinc Oxide Eugenol) was used as pulpectomy obturation material and in Group-B (n=45) ZNO mixed with calcium hydroxide and iodoform used as pulpectomy obturation material. The mean age of the respondents in group-A was 5.89±1.11 years and in group-B was 5.91±1.04 years (Figure- 1). A total of 58.9% of the respondents were male and rests were female (Figure- 2).

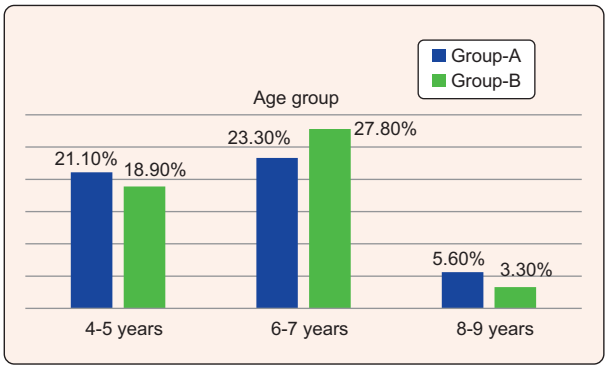

Figure 1: Distribution of respondents by age (N=90)

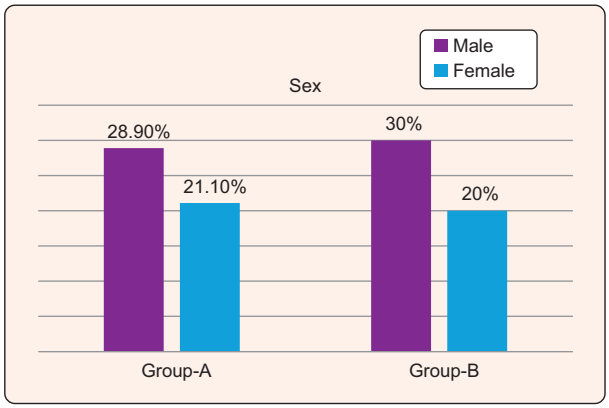

Figure 2: Distribution of respondents by sex (N=90)

Preoperative pain was present in all patients in both group-A and B. The pain status was evaluated at 3and 6-month follow-up periods in both groups (group-A and group-B). Among 45 cases in group-A, 8 (8.9%) cases complained of pain at 3-month follow-up. Where no one in group-B complained of pain. This difference in terms of pain experience between group-A and group-B is statistically significant (p=0.003). Again, during the second follow-up at 6 months, no one experienced pain in both groups (group-A and group-B) (Table-I).

Preoperative status of tenderness on percussion was present in all patients in both group-A and B. The status of tenderness on percussion was evaluated at 3and 6-month follow-up periods in both groups (group-A and group-B). In group-A 7 (7.8%) cases complained of tenderness on percussion at 3-month follow-up. Where no one in group-B complained of tenderness on percussion. This difference in terms of tenderness on percussion between group-A and group-B is statistically significant (p=0.006). During the second follow-up at 6 months, no one experienced tenderness on percussion in both groups (group-A and group-B) (Table-II).

At preoperative assessment 21 (23.3%) of teeth in Group A and 20 (22.2%) teeth in Group B were associated with gingival swelling. There is no statistically significant difference found between Group-A and Group-B in terms of preoperative gingival swelling (p=0.832). At 3-month follow-up, 1 (1.1%) patient complained of gingival swelling. But no patient complained of gingival swelling at 3-month follow-up in group-B. This difference is statistically significant (p=0.006). During the second follow-up at 6 months, no one complained of gingival swelling in both groups (group-A and group-B) (Table-III).

At preoperative radiological assessment, all cases had interradicular radiolucency in group-A and B. At 3 and 6-month postoperative follow-up in Group-A 39 (43.3%) teeth showed a reduction in the size of radiolucency, and 6 (6.7%) showed no change in the size of interradicular radiolucency. Where in Group-B all of study subjects showed a reduction in the size of radiolucency at 3-month and at 6-month follow-up. This difference in the improvement of the size of the interradicular radiolucency between Group-A and Group-B was statistically significant (p =0.026) in both 3 and 6-month follow-ups (Table-IV).

Table I: Clinical assessment of pain status between two groups in different evaluation periods (N=90)

Pain status	Group A (Zinc oxide eugenol) (n=45) No. (%)	Group B (Zinc oxide eugenol mixed with calcium hydroxide and iodoform) (n=45) No. (%)	Total (n=90) No. (%)	p-value
Preoperative				*
Present	45 (50)	45 (50)	90 (100)	
Absent	0 (0)	0 (0)	0 (0)	
1st follow-up after 3 months				0.003
Present	8 (8.9)	0 (0)	8 (8.9)	
Absent	37 (41.1)	45 (50)	82 (91.1)	
2nd follow-up after 6 months				**
Present	0 (0)	0 (0)	0 (0)	
Absent	45 (50)	45 (50)	90 (100)	

* Statistical analysis could not be performed due to all patients in both groups experienced preoperative pain.
** Statistical analysis could not be done due to no patients in both groups reported pain at the second follow-up after 6 months.

Table II: Clinical assessment of tenderness on percussion between two groups at different evaluation periods (N=90)

Tenderness on percussion	Group A (Zinc oxide eugenol) (n=45) No. (%)	Group B (Zinc oxide eugenol mixed with calcium hydroxide and iodoform) (n=45) No. (%)	Total (n=90) No. (%)	p-value
Preoperative				*
Present	45 (50)	45 (50)	90 (100)	
Absent	0 (0)	0 (0)	0 (0)	
1st follow-up after 3 months				0.006
Present	7 (7.8)	0 (0)	7 (7.8)	
Absent	38 (42.2)	45 (50)	83 (92.2)	
2nd follow-up after 6 months				**
Present	0 (0)	0 (0)	0 (0)	
Absent	45 (50)	45 (50)	90 (100)	

* Statistical analysis could not be performed due to all patients in both groups experienced preoperative tenderness on percussion.
** Statistical analysis could not be done due to no patients in both groups reported tenderness on percussion at the second follow-up after 6 months.

Table III: Clinical assessment of gingival swelling between two groups at different evaluation periods (N=90)

Gingival swelling	Group A (Zinc oxide eugenol) (n=45) No. (%)	Group B (Zinc oxide eugenol mixed with calcium hydroxide and iodoform) (n=45) No. (%)	Total (n=90) No. (%)	p-value
Preoperative				0.832
Present	21 (23.3)	20 (22.2)	41 (45.6)	
Absent	24 (26.7)	25 (27.8)	49 (54.4)	
1st follow-up after 3 months				0.006
Present	1 (1.1)	0 (0)	1 (1.1)	
Absent	44 (48.9)	45 (50)	89 (98.9)	
2nd follow-up after 6 months				*
Present	0 (0)	0 (0)	0 (0)	
Absent	45 (50)	45 (50)	90 (100)	

* Statistical analysis could not be done due to no patients in both groups reported gingival swelling at the second follow-up after 6 months.

Table IV: Radiological assessment of interradicular radiolucency of the study subjects between two groups at different evaluation periods (N=90)

Interradicular radiolucency	Group A (Zinc oxide eugenol) (n=45) No. (%)	Group B (Zinc oxide eugenol mixed with calcium hydroxide and iodoform) (n=45) No. (%)	Total (n=90) No. (%)	p-value
Preoperative				*
Present	45 (50)	45 (50)	90 (100)	
Absent	0 (0)	0 (0)	0 (0)	
1st follow-up after 3 months				0.026
Not Improved**	6 (6.7)	0 (0)	6 (6.7)	
Improved***	39 (43.3)	45 (50)	84 (93.3)	
2nd follow-up after 6 months				0.026
Not Improved**	6 (6.7)	0 (0)	6 (6.7)	
Improved***	39 (43.3)	45 (50)	84 (93.3)	

* Statistical analysis could not be performed due to all patients in both groups had preoperative interradicular radiolucency.
** Not improved indicates no change in size of interradicular radiolucency.
*** Improved indicates reduced in size of interradicular radiolucency or healthy interradicular tissue.

Discussion

An experimental study was carried out on 4-9 years old patients attending the Department of Pedodontics, Bangladesh Medical University (BMU) to evaluate the efficacy of zinc oxide eugenol mixed with calcium hydroxide and iodoform by comparing patients with zinc oxide eugenol as pulpectomy obturation material after 3 and 6-month postoperative -period. A total of 90 teeth, which fulfilled the inclusion and exclusion criteria were randomly allocated to Group A (Zinc oxide eugenol) and Group B (Zinc oxide eugenol mixed with calcium hydroxide and iodoform).

Improvement of pain status of the present study was statistically significant between two groups at 3-month postoperative period (p=0.003). There was total absence of pain both in Group A and B after 6 months. The status of tenderness on percussion was significantly higher (p=0.006) in Group A (Zinc oxide eugenol) at 3-month follow-up but tenderness on percussion was absent in 6-month follow-up in both groups. At the 3-month follow-up a statistically significant difference in gingival swelling was observed between Group A and Group B (p=0.006). By the 6-month follow-up, gingival swelling was absent in both groups. So, by 6-month pain, tenderness on percussion, and swelling were absent in all study subjects of both groups.

This observation coincides with the study of Awad R et al.[11] who conducted a 9-month comparative study between zinc oxide eugenol and zinc oxide eugenol mixed with calcium hydroxide and iodoform. They also found a higher incidence of pain and tenderness on percussion in the zinc oxide eugenol group at 3-month postoperative follow-up. The difference in pain status and tenderness on percussion between the two groups was statistically significant ($p<0.05$) at 3-month follow-up and no incidence of pain and tenderness on percussion at 6-month follow-up. Gingival swelling was not evident in 3 and 6-month follow-ups in either group.

A similar result was reported by Rewal et al.[3] who compared 54 primary molars obturated with either zinc oxide eugenol or zinc oxide eugenol mixed with calcium hydroxide and iodoform where follow-ups were done at 3,6 and 9 months. At the 3-month postoperative follow-up visit, the status of pain and tenderness on percussion were significantly higher in the zinc oxide eugenol group compared to the zinc oxide eugenol mixed with calcium hydroxide and iodoform group ($p < 0.05$) and no gingival swelling was present in 3- and 6-months follow-up visits.

Studies by Awad R et al.[11] and Rewal et al.[3] reported immediate post-operative extraction of teeth obturated with zinc oxide eugenol due to failure of treatment. They explained that this could be a possible outcome of periapical tissue irritation by extruded sealer material or re-infection caused by entrapped micro-organisms in the root canal system. Zinc oxide eugenol has a slow resorption rate and extruded material causes foreign body reactions in the periapical tissue. However, the present study had no incidence of extraction due to deterioration of the clinical condition.

In postoperative radiographic assessment at 3-month follow-up, 43.3% of teeth Group A (Zinc oxide eugenol) showed a reduction in the size of the radiolucent area. But in Group B (Zinc oxide eugenol mixed with calcium hydroxide and iodoform) all study subjects showed a reduction of size in interradicular radiolucency in 3 months. At the end of 6 months, 6.7% of study subjects did not show a decrease in the size of interradicular radiolucency in Group A (Zinc oxide eugenol) whereas in Group B the radiographs showed almost healthy interradicular tissue. The difference in radiological status was statistically significant (p=0.026) between the two groups in both 3, and 6-month follow-up visits.

Radiographical findings of another similar study conducted by Rai TS et al.[12] showed 100% reduction of size in interradicular radiolucency in teeth treated with zinc oxide eugenol mixed with calcium hydroxide and iodoform (Endoflas) in 9 months. Where only 45% of teeth treated with zinc oxide eugenol showed a reduction of size in interradicular radiolucency. The status of inter radicular radiolucency at 3- and 6-month intervals showed a significant difference ($p<0.05$).

The outcome of radiographic assessment of the study conducted by Rewal et al.[3] is similar to this study. They reported that 30% of teeth treated with zinc oxide eugenol showed a reduction in the size of interradicular radiolucency at the 3-month postoperative visit, which increased to 45% cases at the 6-month visit. Zinc oxide eugenol mixed with calcium hydroxide and iodoform showed 73.1% and 80.8% cases with reduction of interradicular radiolucency in 3-month and 6-month visits respectively. These difference in the status of interradicular radiolucency was statistically significant in both 3 and 6-month visits ($p<0.05$).

The study conducted by Pandranki et al.[13] reported a contrasting clinical and radiological picture with the current study. In their randomized control trial on pulpectomized teeth from 4-9 years old children, obturated with zinc oxide eugenol and zinc oxide eugenol mixed with calcium hydroxide and iodoform, clinical and radiological evaluations were done in 0,3,6,12 and 24 months postoperative follow-up period where they found 100% absence of postoperative pain and tenderness on percussion and swelling at 3-month where zinc oxide eugenol and zinc oxide eugenol mixed with calcium hydroxide and iodoform was used as obturation material. In case of tenderness recurrence occurred at the 6-month follow-up visit, and in terms of interradicular radiolucency, the difference was not evident between the two study groups at any follow-up visits.

Conclusion

Considering the performance of zinc oxide eugenol mixed with calcium hydroxide and iodoform in the present study, it can be regarded a better effective alternative to zinc oxide eugenol alone as an obturation material for pulpectomy of primary teeth.

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Conflict of Interest: No conflicts of interest.

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Ethical Clearence: The study protocol was ethically approved by the Institutional Review Board of Bangladesh Medical University (BMU), Dhaka, Bangladesh.

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