Clinical and Radiographic Evaluation of Curcumin as an Obturation Material in Deciduous Teeth: A Randomized Controlled Trial

Charishma Sai Bommareddy¹, Hemalatha Ramkumar², Senthil Dakshinamurthy³, Shankar Paulindraraj⁴, Trophimus Gnanabagyan Jayakaran⁵, Karthika Shankar⁶

ABSTRACT

Aim and objective: To evaluate the clinical and radiographic success rates of curcumin, curcumin and calcium hydroxide in equal proportions and calcium hydroxide as an obturation material compared to curcumin and calcium hydroxidot (Metapex).

Materials and methods: This study included 64 primary molars with irreversible pulps indicated for single visit pulpectomy. After obtaining informed consent from the parents, all the teeth were randomly allocated to one of four groups. Pulpectomy was performed using rubber dam isolation and was obturated. The samples were categorized into the four groups based on obturation material namely, group A: curcumin with calcium hydroxide in equal proportions, group B: curcumin, group C: calcium hydroxide, and group D: Metapex. Clinical and radiographic outcomes were evaluated at time intervals of 10 days, 1 month, 3 months, and 6 months. Data was subjected to statistical analysis. Chi-square tests were used compare the groups.

Results: At the end of 6 months, clinical and radiographic success rates of groups A, B, and C showed 81.3%, 61.5%, and 93.8% respectively, while group D had 100% success rate.

Conclusion: Among the four groups, the hierarchy of success rates are as follows: Metapex > calcium hydroxide > curcumin and calcium hydroxide > curcumin. However, various formulations and combinations of curcumin can still be extended with larger sample size.

Clinical significance: Curcumin and calcium hydroxide paste can be used as an obturating material with further follow-up studies.

Keywords: Calcium hydroxide, Curcumin, Metapex, Obturation, Primary teeth, Pulpectomy, Randomized controlled trial.

INTRODUCTION

Pulpectomy is a complex procedure involving chemomechanical shaping of canals and obturating them with suitable medicament. The prime challenge in endodontic obturation is to achieve a fluid-tight seal along the whole length of the canal system. Rifkin described ideal obturation materials as those which are resorbable, radiopaque, noninflammatory, nonirritating to underlying permanent tooth germ, easy to insert, easy to remove, and most importantly which is antimicrobial in nature. According to the literature, there are no ideal obtrurating materials fulfilling the mentioned criteria.1

Hermann in 1921 first introduced calcium hydroxide which is now extensively used materials in pediatric endodontics owing to its high alkalinity and its elaborate antimicrobial activity.2 Metapex is silicone oil-based calcium hydroxide with 38% iodoform and is considered to be near ideal obturating material for deciduous tooth.3 However, iodoform can provoke the periapical tissues, which lead to cemental necrosis.4 Few cases reported rapid resorption of iodoform inside canal leaving spaces popularly known as hollow tube effect, which undermines the success of the pulp therapy.5 This disadvantage forms a base for urge of ideal obturating material with minimal adverse effects.

Recently, the use of naturally available sources and herbs is evolving with great interest, as they are more biocompatible, easily available, and cost-effective with increased shelf life, low toxicity, and lack of microbial resistance and being effective simultaneously. Curcumin constitutes major fraction and is responsible for wide biological and medicinal values of turmeric.6

Curcumin after continuous exploration reported to exhibit antibacterial, antiviral, antifungal, antimicrobial, anti-inflammatory, antioxidant, anti-diabetic, anticancer, anti-allergic, anticoagulant, hepatoprotective, antiulcer, hypotensive, and hypocholesterolemic effects. In dentistry, curcumin had explored for its use in mouthwashes and intracanal medicaments. There are studies in which curcumin was used as pulpotomy medicament with high success rates.7

Regardless of the continuous challenges faced in devising the ideal obturation material, there is always a need for continuous exploration with an aim for ideal obturation material. This study aims to evaluate the clinical and radiographical efficacy of curcumin, curcumin and calcium hydroxide in equal proportions, calcium

1-6Department of Pediatric and Preventive Dentistry, SRM Dental College, Chennai, Tamil Nadu, India

Corresponding Author: Charishma Sai Bommareddy, Department of Pediatric and Preventive Dentistry, SRM Dental College, Chennai, Tamil Nadu, India Phone: +91 7702762248, e-mail: vr.bomma.64@gmail.com

How to cite this article: Bommareddy CS, Ramkumar H, Dakshinamurthy S, et al. Clinical and Radiographic Evaluation of Curcumin as an Obturation Material in Deciduous Teeth: A Randomized Controlled Trial. Int J Clin Pediatr Dent 2022;15(S-1):S35–S39.

Source of support: Nil

Conflict of interest: None
paste. This paste was transferred to a sterile 2 mL disposable syringe for obturation.

Curcumin and calcium hydroxide paste: Equal amounts of curcumin paste and calcium hydroxide paste (Apexcal, Ivoclar Vivadent) were dispensed onto the glass slab and mixed in circular motions until a uniformly mixed smooth paste was obtained and carried into a sterile 2 mL disposable syringe for obturation.

Procedure
Topical anesthesia, 2% lignocaine hydrochloride gel (LOX-2%, Neon Laboratories, Mumbai, India), was applied using a small cotton pellet on to the mucosa. The patients were administered with 2% lignocaine in 1:80,000 dilution ratio of adrenaline (LIGNOX-2%A, Indoco Remedies, Mumbai, India), given as inferior alveolar nerve block, lingual nerve block, and long buccal nerve block for mandibular molars and buccal and palatal infiltration for maxillary molars. Using rubber dam application isolation, access was gained to canal orifices using #4 round bur and non-end cutting bur in high-speed handpiece. Using #10 size and #15 size K-file patency to canals was obtained. Pulp extirpation was done by using #15 H-files. Working length was estimated using radiographic method as described by Ingle. Normal saline 0.9% (Infutec NS, Infutec Healthcare Ltd., Indore, India) was used in-between filing in order to irrigate the root canals. EDTA (Prime Dental RC Help EDTA Gel, Thane, India) was coated onto the files before placing in the canal. The root canals were enlarged using #35 K-file till working length. A 3% dilute sodium hypochlorite (Prime Dental Products Pvt. Ltd., Thane, India) was used for irrigation and normal saline alternatively. The canals were completely dried using paper points and were obturated as follows:

Group A: Modified disposable injection technique (Fig. 2) was used as described by Nagarathna et al. in 2018.12 Rubber stopper was kept at 1 mm less than predetermined working length to the

Materials and Methods
A total of 64 samples from children reporting to the Department of Pediatric and Preventive Dentistry were recruited for the study. Sample size was calculated using G power software with the help of mean and standard deviation obtained from literature.10 The study was carried out after obtaining provisional clearance certificate from the Institutional Review Board (SRMDC/IRB/2017/MD5/N0.801) and registered under the Clinical Trial Registry, India (CTRI/2018/11/016362).

Children aged 5–9 years with no history of systemic illness and previous hospitalizations were chosen for the study. The teeth with irreversible pulpitis, restorable crown structure, and minimal periradicular changes, indicated for single visit pulpectomy, were included. Teeth showing signs of internal or external resorption were excluded from the study. Informed consent was obtained from the parents and guardians and samples were randomly assigned to one of the four groups by random number table method.

Group A: Curcumin and calcium hydroxide
Group B: Curcumin crystalline powder (Curcumin–WD, 1 g sachets, Streamline Pharmaceuticals)
Group C: Calcium hydroxide (Apexcal, Ivoclar Vivadent)
Group D: Calcium hydroxide and iodoform paste (Metapex, Meta Biomed, Chungcheongbuk-do, Korea.) positive control

Preparation of Materials11 (Fig. 1)
Curcumin paste: [Fig. 1] Curcumin paste was prepared by mixing 1 g of curcumin powder and few drops of propylene glycol using sterile spatula and glass slab in circular motions to get smooth paste. This paste was transferred to a sterile 2 mL disposable syringe for obturation.

Figs 1A to C: Preparation of materials: (A) Dispensing materials; (B) Mixing of materials; (C) Loading the materials
Clinical and Radiographic Evaluation of Curcumin Powder as an Obturation Material in Deciduous Teeth

were recalled at time intervals of 1 month, 3 months, and 6 months for review. The teeth were evaluated for clinical and radiographic success by an examiner who was not involved in the study using the following criteria as mentioned Subramanium P et al.10

Criteria for Clinical Success
- Teeth should present with no gingival swelling.
- No sinus opening in the oral mucosa or purulent exudates oozing from the gingival margin.
- No abnormal mobility.
- Absence of pain on percussion/tenderness.

Criteria for Radiographic Success
- No evidence of extensive pathologic root resorption/internal root resorption
- Reduction or no change in preoperative pathologic inter-radicular and/or periapical radiolucency
- No evidence of development of new postoperative pathologic radiolucency involving the succedaneous tooth germ

Based on the above-mentioned criteria, the success or failure of each tooth was recorded. The presence of any clinical sign was considered as clinical failure and presence of any radiographic sign was considered as radiographic failure (Flowchart 2).

Results
The data was analyzed with IBM SPSS statistics software 23.0 Version. To describe about the data, descriptive statistics such as frequency analysis and percentage analysis were used. Chi-square test was used to find the significance in categorical data. The probability value ≤0.05 was considered as significant.

At 10 days recall, three samples from group B did not report and were excluded from the study. Another three samples from syringe loaded with curcumin and calcium hydroxide paste. The tip was placed inside the canals till the resistance was present. The material was pushed into the canals and simultaneously the tip was withdrawn from the canals. At the end, moist cotton pellet was used to push the material further into the canals.

Group B: Similar technique was employed with curcumin-loaded syringe.

Group C: Apexcal (Ivoclar Vivadent) was used to obturate the root canals. The paste was dispensed as instructed by the manufacturer. The tip was placed in the canals till there was resistance and the material was pushed into the canals.

Group D: Metapex (Meta Biomed) was used to obturate the root canals as per manufacturer’s instructions. All the canals were filled independently after which moist cotton pellet was used to push the material further into the canals.

Radiographs were taken to confirm the optimal fill of the obturation. All the samples were restored with Type II Glass ionomer restorative material (GC Gold Label 2 Glass Ionomer, GC Manufacturers, GC Corporation, Tokyo, Japan). If asymptomatic, the teeth were restored with stainless steel crown at 10 days. The patients

Flowchart 2: Consort flow diagram
Clinical and Radiographic Evaluation of Curcumin Powder as an Obturation Material in Deciduous Teeth

The same group had dentoalveolar abscess and were considered as failure. The success rate of group B was 76.9% at the end of 10 days. Group A, C, and D had showed 100% success rate. This finding was statistically highly significant (p = 0.009).

The 1st month recall had showed two samples from group A with pain on percussion and gingival swelling and were considered as failures. The success rate of group A was 87.5% at the end of 1 month while success rate of group B, C, and D remained at 76.9%, 100%, and 100%, respectively. The finding was not statistically significant with p value 0.07.

At 3 months recall, additionally two samples from group B reported with pain on percussion and gingival swelling and were considered as failures. The success rate of group B was 61.5% at the end of 3 months. Groups A, C, and D showed 87.5%, 100%, and 100%, respectively. The finding was highly statistically significant (p = 0.004).

At 6 months recall, one sample from group A and one sample from group C reported with pain and periapical changes and were considered as failures. The overall success rates of groups A, B, C, and D are 81.3%, 61.5%, 93.8%, and 100%, respectively. The finding was statistically significant (p = 0.021) (Table 1).

**Discussion**

Pulpectomy involves removal of the infected pulpal tissues, mechanical shaping of the primary root canals, and obturating them with an antibacterial resorbable material. The primary goal is complete elimination of microbes and microbial toxins from root canals and periapical region and ensuring hermetic seal with obturation material. Owing to the complex root canal anatomy of primary molars, the choice of obturation material plays a vital role in the prognosis of teeth. In the recent days, naturally available herbs were continuously explored and there usage in dentistry is emerging. In this study, clinical and radiographic evaluation and comparison of four different obturation materials Metapex, calcium hydroxide, curcumin, and curcumin with calcium hydroxide were done.

It was single-blinded randomized control trial as patients were blinded about the allocation procedure among the groups. Examiners could not be blinded because of the variation in the radiopaque nature of the obturation materials used in the study.

In this study, Metapex group showed 100% success rate at the end of 6 months. These results were similar to that of studies done by Subramanium et al. and Mortazavi et al. In contrary to the results obtained by the present study, Metapex showed 90% success rate at the end of 9 months as reported by Ramar et al. This variation of results might be because of faster resorption rate of Metapex than natural tooth in longer follow-up, which undermines the success of pulpectomy. As the present study was 6-month follow up study, all the samples obturated with Metapex were successful.

In the present study, calcium hydroxide group showed 93.8% success rate at the end of 6 months. Similar results were obtained by Nadkarni et al., Chawla et al., and Pinto et al. In these studies, calcium hydroxide obturation was done and samples were followed up for 6 and 18 months with similar success rates.

In the present study, curcumin group showed the least overall success rate of 61.5% and curcumin with calcium hydroxide group showed overall success rate of 81.3%. These results were supported by an in vitro antimicrobial assay done by Upadhyay et al. in 2015 in which highest amount of zone of inhibition against _E. faecalis_ was noticed with by turmeric with calcium hydroxide followed by Metapex, calcium hydroxide, and last turmeric. Similar antimicrobial assay was reported by Prabhakar et al. in which curcumin showed 54% inhibition of _E. faecalis_.

In contrary to the results obtained in the present study, turmeric gel had showed 100% success rate in the clinical studies carried out by Hugar et al. and Purohit et al. in which turmeric was used as pulpotomy medicament. In those studies, turmeric showed 100% clinical success and 86.7% radiographic success rate at 6-month interval. The exact mechanism of action of turmeric is not known. But the use of turmeric in vital pulp and nonvital teeth had showed a huge difference in the clinical long-term success. In the present study, commercially available crystalline curcumin was obtained and used for obturation whereas in the previous studies of curcumin, naturally available turmeric was procured and grounded into powder and was used. This could be one of the reasons for the less success rate of curcumin.

Hence, in the present study, the use of calcium hydroxide as obturation material can be advocated for the future use, as it showed similar success rates compared to Metapex at 6-month follow-up. Owing to the anti-inflammatory properties of curcumin, its use as obturation needs further evaluation with longer follow-up and larger sample size.

**Conclusion**

The following conclusions can be drawn from the study.

**Table 1**: Success and failure at the end of 10 days, 1 month, 3 months, and 6 months (p < 0.005 is significant)

|           | 10 days |       |       |       |       |       |       |
|-----------|---------|-------|-------|-------|-------|-------|-------|
|           | Success | Failure | Success | Failure | Success | Failure | Success |
| Group A   | 16      | 0      | 14     | 2      | 14     | 2      | 13     |
| (Curcumin | 100%    | 0%     | 87.5%  | 12.5%  | 87.5%  | 12.5%  | 81.2%  |
| and calcium hydroxide) |  |  |  |  |  |  |  |
| Group B   | 10      | 3      | 10     | 3      | 8      | 5      | 8      |
| (Curcumin) | 76.9%  | 23.1% | 76.9%  | 23.1%  | 61.5%  | 38.5%  | 61.5%  |
| Group C   | 16      | 0      | 16     | 0      | 16     | 0      | 15     |
| (Calcium hydroxide) | 100%  | 0%     | 100%   | 0%     | 100%   | 0%     | 93.8%  |
| Group D   | 16      | 0      | 16     | 0      | 16     | 0      | 16     |
| (Metapex) | 100%    | 0%     | 100%   | 0%     | 100%   | 0%     | 100%   |

\(p = 0.009^a\)
\(p = 0.070^b\)
\(p = 0.004^c\)
\(p = 0.021^c\)

(a, highly significant; b, not significant; c, significant)
Clinical and Radiographic Evaluation of Curcumin Powder as an Obturation Material in Deciduous Teeth

- Calcium hydroxide and iodoform paste (Metapex, Meta biomed) performed superior compared to all other obturation materials.
- Calcium hydroxide (Apexcal, Ivoclar Vivadent) performed better and can be used as obturation material.
- Curcumin can be used as obturation material with further studies of larger sample size and longer follow up periods evaluating its various formulations.
- Curcumin and calcium hydroxide pastes can be developed as an obturation with further follow up studies.

**Clinical Significance**

When teeth were obturated with curcumin, relatively more number of failures were observed compared with calcium hydroxide and iodoform pastes. Calcium hydroxide and iodoform paste (Metapex, Meta biomed) performed superior compared to all other obturation materials.

**ORCID**

Senthil Dakshinamurthy 🌐 https://orcid.org/0000-0003-0262-2703
Shankar Paulindraraj 🌐 https://orcid.org/0000-0003-4524-6875
Trophimus Gnanabagyan Jayakaran 🌐 https://orcid.org/0000-0002-8285-7424

**References**

1. Praveen P, Anantharaj A, Venkataramhavan K, et al. A review of obturating materials for primary teeth. SRM J Res Dent Sci 2011;2(1):42. DOI: 10.15520/jrcr.v11i08.835

2. Manzoor R, Manzoor M. Obturating materials in pediatric dentistry: A review. Int J Appl Dent Sci 2021;7(1):175–182. DOI: 10.22271/oral.2021.v7i1c.1133

3. Siqueira JF Jr, Lopes HP. Mechanisms of antimicrobial activity of calcium hydroxide: a critical review. Int Endod J 1999;32(5):361–369. DOI: 10.1046/j.1365-2591.1999.00275.x

4. Dogra S. Comparative evaluation of calcium hydroxide and zinc oxide eugenol as root canal filling materials for primary molars: A clinical and radiographic study. World J Dent 2011; 2(1):231–236. DOI: 10.5005/jp-journals-10015-1088

5. Balakrishnan R, Dubey S, Ohole TK, et al. Comparative antimicrobial efficacy of Metapex, Metronidazole, BioPure MTAD, Aztreonam on Bacteroides fragilis and Propionibacterium acnes. Journal of conservative dentistry: JCD. 2015 Jul;16(4):327. DOI: 10.4103/0973-0707.14361

6. Najjar RS, Alamoudi NM, El–Housseiny AA, et al. A comparison of calcium hydroxide/iodoform paste and zinc oxide eugenol as root filling materials for pulpectomy in primary teeth: A systematic review and meta-analysis. Clinical and experimental dental research 2019 Jun;30(3):294–310. DOI: 10.1002/cre2.173. eCollection2019Jun

7. Donera D, Thakur S, Singhal P, et al. Comparative evaluation of clinical and radiological success of zinc oxide–orzonate oil, modified mix–mp antibiotic paste, and vitapex as treatment options in primary molars requiring pulpectomy: An in vivo study. J Indian Soc Pedod Prev Dent 2017;35(4):346. DOI: 10.4103/JISPDD.JISPDD_359_16

8. Mandrol PS, Bhat K, Prabhakar AR. An in vitro evaluation of cytotoxicity of curcumin against human dental pulp fibroblasts. J Indian Soc Pedod Prev Dent 2016; 34(3):269–272. DOI: 10.4103/0970-4388.186757

9. Menni AC, Ambati NR, Prasad MG. Clinical and radiographic evaluation of Curcumin Gel mixed EndoFlas (CGE) powder as obturating material in primary molars. Brazilian Dental Science 2020 Jan 31; 23(1): 8-p. DOI: 10.14295/vids.2020.v23i1.1733

10. Subramaniam P, Gilhotra K, EndoFlas, zinc oxide eugenol and metapex as root canal filling materials in primary molars—A comparative clinical study. J Clin Pediatr Dent 2011;35(4):365–370. DOI: 10.17796/jcpd.35.4.1377v06621143233

11. Kencheppa U, Gupta M, Sharma P, et al. Comparison of Antibacterial Efficacy of Combination of Turmeric and Calcium Hydroxide with Three Intracanal Medicaments Comparison of Antibacterial Efficacy of Combination of Turmeric. J Orofac Res 2011; 55 (44):113–117. DOI: 10.5005/jp-journals-10026-1193

12. Nagarathna C, Vishwanathan S, Krishnamurthy NH, et al. Primary molar pulpectomy using two different obturation techniques: A clinical study. Contemp Clin Dent 2018; 9(2):231–236. DOI: 10.4103/ccd.ccd_826_17

13. Damle SG, Nadkarni UM. Calcium hydroxide and zinc oxide eugenol as root canal filling materials in primary molars: a comparative study. Australian Endodontic Journal 2005 Dec; 31(3):114–119. DOI: 10.1111/j.1747-4477.2005.tb00318.x

14. Fuks A, Eidelman E, Pauner K. Root fillings with EndoFlas in primary teeth: a retrospective study. J Clin Pediatr Dent 2003; 27(1):41–45. DOI: 10.17796/jcpd.27.1.pp237453707386m1

15. Ramar K, Mungara J. Clinical and radiographic evaluation of pulpctomies using three root canal filling materials: an in-vivo study. J Indian Soc Pedod Prev Dent 2010;28(1):25–29. DOI:10.4103/0970-4388.60481

16. Mortazavi M, Mesbahi M. Comparison of zinc oxide and eugenol, and Vitapex for root canal treatment of necrotic primary teeth. Int J Paediatr Dent 2004; 14(6):417–424. DOI: 10.1111/j.1600-9657.2004.00544.x

17. Chawla HS, Mani SA, Tewari A, et al. Calcium hydroxide as a root canal filling material in primary teeth--a pilot study. J Indian Soc Pedod Prev Dent. 1998;16(3):90–92.

18. Pinto DN, de Sousa DL, AraújoRB, et al. Eighteen-month clinical and radiographic evaluation of two root canal-filling materials in primary teeth with pulp necrosis secondary to trauma. Dent Traumatol 2011; 27(3):221–224. DOI:10.1111/j.1600-9657.2011.00978.x

19. Prabhakar AR, Swapnil T, Saiyid I, et al. Comparison of Antibacterial Efficacy of Calcium Hydroxide Paste, 2% Chlorhexidine Gel and Turmeric Extract as an Intracanal Medicament and Their Effect on Microhardness of Root Dentin: An in vitro Study. Int J Clin Pediatr Dent 2013;6(2):171–177. DOI: 10.5005/jp-journals-10005-1213

20. Hugar SM, Kukreja P, Hugar SS, et al. Comparative evaluation of clinical and radiographic success of formocresol, propolis, turmeric gel, and calcium hydroxide on pulpotomized primary molars: A preliminary study. Int J Clin Pediatr Dent 2017;10(1):18-23. DOI: 10.5005/jp-journals-10005-1400

21. Purohit RN, Bhatt M, Purohit K, et al. Clinical and radiological evaluation of turmeric powder as a pulpotomy medicament in primary teeth: An in vivo study. Int J Clin Pediatr Dent 2017; 10(1):37-40. DOI: 10.5005/jp-journals-10005-1404