Acta Scientific Dental Sciences (ISSN: 2581-4893)

Volume 7 Issue 7 July 2023

Review article

Exploring Emerging Trends and Innovations in Obturating Materials for Pulpectomy: A Comprehensive Narrative Review

Arundhatee Banerjee[1] and Seema Deshmukh[2]*

[1]*Post graduate, Department of Pediatric and Preventive Dentistry, JSS Dental College and Hospital, JSS Academy of Higher Education and Research, Mysuru*

[2]*Associate Professor, Department of Pediatric and Preventive Dentistry, JSS Dental College and Hospital, JSS Academy of Higher Education and Research, Mysuru*

***Corresponding Author:** Seema Deshmukh, Associate Professor, Department of Pediatric and Preventive Dentistry, JSS Dental College and Hospital, JSS Academy of Higher Education and Research, Mysuru.

DOI: 10.31080/ASDS.2023.07.1661

Received: May 30, 2023

Published: June 21, 2023

Abstract

Root canal treatment in primary teeth requires effective obturation materials that can promote successful outcomes. Traditionally used materials such as non-reinforced zinc oxide-eugenol, iodoform-based pastes (e.g., KRI), and combination pastes containing iodoform and calcium hydroxide (e.g., Vitapex®, Endoflax®) have shown reasonable success rates in primary tooth obturation. However, recent developments in natural science have led to the emergence of novel obturating materials with enhanced properties and potential advantages. This review examines the characteristics of these new obturating materials, including. These materials offer improved biocompatibility, antibacterial properties, sealing ability, and bioactive potential, which may positively impact the outcome of root canal treatment in primary teeth. Furthermore, the review discusses the clinical applications and outcomes associated with these new obturating materials, exploring their efficacy in achieving hermetic canal seal, promoting healing of periapical lesions, preventing recontamination, and facilitating the resorption of primary roots for proper eruption of permanent teeth. In conclusion, this review provides valuable insights into the latest advancements in obturating materials for primary teeth, shedding light on their potential benefits and implications for clinical practice. Dental professionals can use this information to make informed decisions regarding the selection of obturating materials, ultimately improving the quality and success of root canal treatment in primary teeth. Further research is warranted to explore the long-term outcomes and comparative effectiveness of these new materials, paving the way for future advancements in pediatric endodontics.

Keywords: Obturating Materials; Primary Teeth; Root Canal Treatment; Pediatric Endodontics; Sealing Ability

Abbreviations

ZnoE: Zinc oxide eugenol; O_3: Ozone; $Ca(OH)_2$: Hydroxide

Introduction

Root canal treatment plays a crucial role in preserving the primary dentition until normal exfoliation occurs, preventing potential complications and maintaining the proper eruption of succedaneous teeth. The success of root canal treatment in primary teeth heavily relies on effective obturation, which involves filling and sealing the root canal system with suitable materials [1]. Over the years, various obturating materials have been utilized, such as non-reinforced zinc oxide-eugenol, iodoform-based pastes, and combination pastes containing iodoform and calcium hydroxide [1,2].

While these conventional obturating materials have demonstrated reasonable success rates, recent advancements in biomaterial science have paved the way for the development of new obturating materials specifically designed for primary teeth [3]. These novel materials offer improved properties, including enhanced biocompatibility, antibacterial activity, sealing ability, and bioactive potential. The emergence of these new obturating materials holds great promise in enhancing the outcomes of root canal treatment in primary teeth [4]. This review aims to provide an in-depth analysis of the latest trends and innovations in obturating materials for primary teeth. It will explore the characteristics, advantages, limitations, and potential clinical implications of these new materials. Additionally, the review will discuss the outcomes and challenges associated with their use, including their impact on periapical healing, prevention of recontamination, root resorption, and the proper eruption of permanent teeth.

Understanding the advancements in obturating materials for primary teeth is crucial for dental professionals to make informed

decisions regarding material selection, ultimately improving the quality and success of root canal treatment in pediatric patients. Furthermore, this review will identify gaps in the existing literature and highlight the need for further research and clinical trials to validate the effectiveness and long-term performance of these new materials.

By exploring the latest developments in obturating materials for primary teeth, this review aims to contribute to the advancement of pediatric endodontics and facilitate evidence-based decision-making in clinical practice.

Literature Review

For this study, a systematic bibliographic search was conducted using PubMed and ResearchGate, without any restrictions on language or publication date. In addition, relevant books were consulted as a supplementary source of information.

To be included in the review, articles had to meet specific criteria. The study design could be randomized or controlled clinical trials, or *in vitro* antimicrobial studies. The participants had to be children of any age, or in the case of *in vitro* studies, human tooth samples were considered. The intervention involved pulpectomy in deciduous teeth, comparing the use of conventional root canal filling material in one group (control group) with another dental material in the test group. The primary outcome measure was the clinical and/or radiographic success rate at the end of the follow-up period. Only studies written in English and with full-text articles were considered. Exclusion criteria encompassed studies without full-text articles, those lacking a comparison group, and studies written in languages other than English.

Goal of obturation

The goal of obturation in primary teeth is to preserve their function, aesthetics, and space maintenance for permanent teeth. Vital pulp therapy involves the removal of the coronal portion of the pulp, while non-vital or irreversible pulpitis cases require complete removal of the pulp, followed by the placement of suitable material inside the canal [4]. Pulpectomy with a hermetic seal is the preferred method to prevent complications in primary teeth. Achieving a hermetic seal involves proper biomechanical preparation, the choice of obturating material, and minimizing voids. Incomplete obturations can lead to fluid percolation and the growth of microorganisms, resulting in inflammation [5]. Therefore, significant attention should be given to the selection of root canal filling materials and the obturation technique [6]. The ideal material should be cost-effective, easy to manipulate, and provide effective control during obturation. Researchers have explored different materials for obturation, but none have demonstrated all the properties required for an ideal root canal filling material in primary teeth. One key desirable property is a resorption rate that matches the physiological root resorption of primary teeth [4,6].

According to Rabinowitch, the ideal root canal medication should have specific characteristics [3].

- It should not irritate periapical tissues, have stable disinfecting power,
- Be easily resorbed if excess is pressed beyond the apex, be easily inserted and removed,
- Adhere to canal walls without shrinking,
- Be insoluble in water,
- Not discolor the tooth, be radiopaque,
- Promote the sealing of the canal with calcified or connective tissue,
- Be harmless to adjacent tooth germs, and
- Not form a hard mass that could interfere with the eruption of a permanent tooth.

Similarly, Rifkin outlined criteria for an ideal obturating material used in pulpectomy [3],

- Including resorbability,
- Antiseptic properties,
- Non-inflammatory and
- Non-irritating effects on the underlying permanent tooth germ,
- Good radiopacity for visualization on radiographs,
- Ease of insertion and removal.

However, currently available obturating materials do not meet all of these criteria, and they should also not cause tooth discoloration.

Conventionally used obturating materials for primary teeth

Zinc oxide eugenol (ZOE)

Zinc oxide eugenol (ZOE) was discovered by Bonastre in 1837 and later used in dentistry by Chisholm in 1876. It became the recommended root canal filling material for primary teeth by Sweet in 1930 and remained the primary choice until 2008, according to AAPD guidelines [3].

Different studies have provided varying success rates for ZOE (zinc oxide eugenol) root canal therapy. Coll., *et al*. (1985) reported a 77.7% success rate, Nadkarni and Damie (2000) reported 89% success, and Yacobi., *et al*. (2014) reported 84% success after a 12-month follow-up period. Enamel defects in permanent teeth resulting from ZOE pulpectomies have been examined [7].

Coll and Sadrian (1996) found no correlation between pulpectomy of primary teeth and enamel hypoplasia. The occurrence of enamel defects was not influenced by the retention or length of ZOE fillings, or a history of trauma or caries. However, Holan (2011) reported a higher incidence of enamel defects in succeda-

neous incisors replacing primary incisors treated with ZOE pulpectomies compared to normal teeth [8].

ZOE offers several advantages, such as strong antibacterial and analgesic effects (in lower concentrations), good visibility in X-rays, easy handling and filling of the root canal, insolubility in tissue fluids, easy availability, cost-effectiveness, and no tooth discoloration. Disadvantages of ZOE include a slower resorption rate, potential tissue irritation, potential harm to the permanent tooth bud, and alteration of the eruption path [3].

Vitapex

Vitapex is a calcium hydroxide sealer introduced in 1979, containing 40% iodoform and silicone oil. It has advantages such as resorbability, easy delivery, and bone regeneration potential [9]. Studies have shown varying levels of antimicrobial efficacy for Vitapex, with Maisto paste being the most effective and Vitapex showing the least activity [10]. Comparisons with zinc oxide eugenol have shown mixed results, with some studies favoring Vitapex for reducing tooth mobility and bone radiolucency [11]. However, zinc oxide eugenol has demonstrated better outcomes compared to calcium hydroxide-based materials. In terms of antimicrobial activity in pediatric dentistry, endoflas ranked highest, followed by zinc oxide eugenol, calcium hydroxide with chlorhexidine, calcium hydroxide with iodoform and distilled water, metapex, and saline [7].

Iodoform-based.pastes

Iodoform-based pastes are commonly recommended as filling materials for primary teeth due to their favorable characteristics. They can be easily resorbed from the periapical area without causing foreign body reactions and possess strong germicidal properties. Iodoform can be used alone or combined with other materials to create non-shrinking and non-soluble paste formulations that are radiopaque and bactericidal [13]. The rate of resorption for iodoform-based pastes is faster than that of zinc oxide eugenol (ZOE) material [14,15].

However, iodoform-based pastes do have some drawbacks. Their resorption rate within the canals is faster than the natural root resorption process, and they can cause yellowish-brown discoloration of the teeth. Some studies have shown that iodoform may be irritating to periapical tissues and could lead to cemental necrosis. There are various formulations of iodoform-containing root canal filling materials available, including KRI paste, Maisto's paste, Guedes-Pinto paste, Rifocort, Endoflas, and Vitapex [15].

Walkhoff paste

For non-vital teeth with large periapical lesions, Walkhoff paste, which contains iodoform, parachlorophenol, camphor, and menthol, is used as an intracanal dressing [7].

KRI paste

KRI paste, consisting of iodoform, camphor, para chlorophenol, and menthol, is a resorbable paste for root canal filling that has shown higher success rates and long-lasting bactericidal potential compared to ZOE [3].

Maisto's paste

Maisto's paste, containing zinc oxide, iodoform, thymol, chlorophenol, camphor, and lanolin, aims to reduce resorption rate and has been successful in treating infected posterior primary teeth [7].

Guedes-Pinto paste

Guedes-Pinto paste, made of rifocort, camphorated para chlorophenol, and iodoform, has been used as a filling material for primary teeth [3].

A systematic review and meta-analysis indicate that calcium hydroxide/iodoform is the preferred filling material for primary teeth nearing exfoliation, while ZOE or ZOE/iodoform combined with calcium hydroxide is recommended for primary teeth with a longer time before exfoliation. The clinical and radiographic success rates of calcium hydroxide/iodoform paste are comparable to ZOE in primary teeth pulpectomy up to an 18-month follow-up [11].

There is a need for innovations in obturating materials for pulpectomy procedures to address certain challenges and improve treatment outcomes. There is a growing trend for natural obturating materials for pulpectomy procedures in dentistry. Natural materials offer several advantages and are preferred by some clinicians and patients for various reasons

- **Biocompatibility**: Natural obturating materials are generally biocompatible, meaning they are well-tolerated by the body and have a minimal risk of adverse reactions or inflammation [3]. This is especially important in pediatric dentistry, where pulpectomy is commonly performed on primary teeth.
- **Safety**: Natural materials are often considered safer compared to synthetic alternatives. They have a lower risk of toxicity or allergic reactions, making them suitable for patients with sensitivities or allergies to certain substances [7].
- **Resorbability**: Some natural materials, such as calcium hydroxide, exhibit resorbable properties. This means they can be gradually broken down and absorbed by the body over time, allowing for proper healing and regeneration of the periapical tissues [3].
- **Antimicrobial Properties**: Certain natural materials, such as propolis or herbal extracts, possess inherent antimicrobial properties. These can help in reducing bacterial growth and preventing reinfection of the root canal system [7].
- **Sustainability**: Natural obturating materials are often derived from renewable sources, making them environmentally friendly and sustainable. This aligns with the growing focus on eco-conscious dental practices [1].

- **Adhesion and Sealability**: Developing obturation materials that can effectively adhere to the root canal walls and create a tight seal. Improved adhesion and sealability can prevent bacterial leakage and improve the long-term prognosis of pulpectomy-treated teeth [3].
- **Radiopacity**: Enhancing the radiopacity of obturating materials to improve their visibility on radiographs. This allows for better assessment of the root canal filling and aids in post-treatment evaluation [5].
- **Standardization and Quality Control**: Establishing standardized protocols for the production and quality control of obturating materials to ensure consistent performance and safety [3].
- **Tissue Regeneration**: Developing obturating materials that not only seal the root canal but also promote tissue regeneration and healing. Materials that stimulate dentinogenesis and support the growth of new tissues can enhance the success and long-term stability of pulpectomy procedures [6].
- **Antimicrobial Properties**: Creating obturating materials with enhanced antimicrobial properties to effectively eliminate bacteria within the root canal system. Materials that have sustained antimicrobial action can reduce the risk of reinfection and improve treatment success rates [7].
- **Resorbable Materials**: Designing resorbable obturating materials that gradually break down and get absorbed by the body over time. Such materials can facilitate the natural resorption process of primary teeth and reduce the need for subsequent removal [11].

Innovations.in. pulpectomy obturating.materials

A combination of calcium hydroxide, zinc oxide powder, and 10% sodium fluoride was used as a root canal filling material. This mixture provided the benefits of both calcium hydroxide and zinc oxide. The presence of calcium fluoride, a byproduct of the reaction, improved the material's visibility on X-rays. By including fluoride, the material showed a resorption rate similar to primary pulpectomized teeth. However, if the canals were overfilled, the material did not exhibit any signs of resorption even after a two-year follow-up. It is important to be cautious and avoid pushing the material beyond the apex of the tooth. Different concentrations of liquid sodium fluoride were added to the combination of zinc oxide and calcium hydroxide to evaluate the resorption of the root canal filling material in various locations within and around the tooth. The mixture containing 8% sodium fluoride yielded positive results [16].

Endoflas

Endoflas, a resorbable paste available in powder liquid form, has not been widely adopted by clinicians despite its numerous benefits, and the reason for this is unknown. It is often used in combination with other obturating materials. Endoflas is a hydrophilic material consisting of Z.O.E. (56.5%), iodoform (40.6%), calcium hydroxide (1.07%), barium sulfate (1.63%), eugenol, and pentachlorophenol. It provides a good seal in root canals and exhibits broad-spectrum antibacterial activity, which aids in disinfecting hard-to-reach dentinal tubules and accessory canals. The resorption rate of Endoflas is similar to that of natural root resorption, with resorption occurring mainly in the extruded material beyond the apex and not inside the root canal. Compared to zinc oxide eugenol, Endoflas has a higher success rate, clinically proven to be between 93.3% and 95.1%. However, when the material is extruded beyond the apex, the success rate decreases to 58%-76% [17].

The inclusion of three materials (ZOE, Ca (OH)2, and iodoform) in Endoflas may be to compensate for the limitations of individual materials by combining their advantages. The hydrophilic nature of Endoflas makes it compatible for obturation even in mildly humid canals. Its antibacterial properties enable disinfection of dentinal tubules and inaccessible accessory canals that cannot be mechanically cleansed [3].

Several studies have compared Endoflas to other filling materials, demonstrating its superiority. It has shown a success rate of 100% compared to ZOE, and in clinical and radiographic evaluations, it achieved an overall success rate of 95.1% compared to other materials such as Metapex and RC Fill [18].

In a study involving primary teeth, Endoflas demonstrated a success rate of 70%, and any excess filling material was resorbed within 6 months. Endoflas combines zinc oxide eugenol (ZOE), calcium hydroxide (Ca(OH)2), and iodoform to leverage the advantages of each material and overcome their individual disadvantages. The resorption of Endoflas is primarily limited to any extruded excess material around the periapical area within a week, while no resorption occurs within the root canal itself, preventing the formation of a hollow tube effect [19].

Advantages

- Demonstrates excellent healing capabilities, promoting complete bone healing.
- Hydrophilic nature allows its use in mildly humid canals.
- Forms a strong bond with the root canal surface, ensuring a reliable seal.
- Effectively disinfects dentinal tubules and hard-to-reach accessory canals that cannot be mechanically cleansed.
- Resorbs when overextended beyond the apex, promoting favorable healing.
- High pH provides potent antibacterial effects, reducing periapical inflammation.
- Stimulates periapical healing by increasing alkaline phosphatase activity and promoting remineralization of periapical bone.

Disadvantages

- Presence of eugenol can potentially cause periapical irritation.

- Eugenol content may lead to tooth discoloration.
- Does not resorb within the root canal itself.
- Clinically, endoflas has shown a 70% success rate and a 100% decrease in periapical radiolucency

Endoflas-chlorophenol-free (CF)

Endoflas-chlorophenol-free (CF) was developed to address radiolucent lesions observed after endodontic treatment of primary teeth, which may be attributed to phenol-containing filling materials. Endoflas CF is free of chlorophenol, as chlorophenol has a fixation effect that could potentially affect osteoblast cells [20].

Calen paste

Calen paste, when compared to zinc oxide eugenol (ZOE), exhibited a high success rate in preventing pathological root resorption and promoting new bone formation. The incorporation of zinc oxide into the paste improved its consistency. In a study conducted by Pinto, the success rates of ZOE and calen paste thickened with zinc oxide (calen/ZO) were compared, and the calen/ZO material demonstrated a high success rate in preventing pathological root resorption and promoting new bone formation. The addition of zinc oxide improved the consistency of the paste [21].

In another study by Queiroz in 2009, it was observed that calen paste thickened with zinc oxide showed slightly larger zones of bacterial growth inhibition compared to calen paste alone, except for Staphylococcus aureus. This suggests that the addition of zinc oxide as a thickening agent did not interfere with the antibacterial activity of calen paste, as zinc oxide itself possesses antibacterial properties [3].

Pulpotec.

Pulpotec is a dental material that possesses antiseptic, antibacterial, and anti-inflammatory properties. Its main component, iodoform, acts as an antiseptic and functions similarly to an antibiotic paste when applied to the empty root canal. It can be used in teeth with bone lesions to help reduce the clinical manifestations of infection [7]. Clinical and radiological outcomes indicate that Pulpotec could be a viable alternative to traditional endodontic treatment for necrotic primary teeth in the field of pediatric dentistry. Pulpotec demonstrates promising results in reducing clinical signs of infection and can be considered as an alternative to conventional endodontic treatment for necrotic primary teeth in pediatric dentistry [22].

Aloe vera.

Aloe vera has a long history and is known for its beneficial properties. Its name comes from Arabic and Latin words meaning "shining bitter substance" and "true," respectively. Aloe vera is a succulent plant that can survive drought conditions by storing water in its tissues. It has lance-shaped leaves ranging in color from gray to bright pear green [23]. The gel-like substance found in Aloe vera contains amino acids, minerals, enzymes, and sugars, which provide moisturizing, anti-inflammatory, antioxidant, antibacterial, antiviral, and antifungal effects. Aloe vera has various applications in treating skin disorders, arthritis, asthma, digestive and bowel issues, diabetes, and lipid level reduction. It is also used as a detoxifying agent, for burns, immune enhancement, Alzheimer's disease, and in cosmetic and medical products. Aloe vera has been studied in dentistry as well.

Research by Khairwa., *et al*. suggests that a combination of zinc oxide and Aloe vera could be an alternative to zinc oxide eugenol in dentistry [24]. Other studies by Elhamid., *et al*. and Pinto compared the success rates of different obturating materials, including zinc oxide-thickened calen paste, which showed positive results in preventing pathological root resorption and promoting new bone formation [25]. The addition of zinc oxide improved the consistency of the paste. Additionally, Queiroz's study indicated that calen paste thickened with zinc oxide had slightly larger zones of bacterial growth inhibition, showing compatibility between zinc oxide and the antibacterial activity of the paste. In the field of endodontics, Chandra., *et al*. conducted a study evaluating the antibacterial efficacy of Aloe vera extract against resistant microbial strains and found significant inhibition against Enterococcus faecalis, demonstrating its antimicrobial effect [26].

In conclusion, Aloe vera offers various benefits and has been utilized in different fields, including dentistry. Its combination with other materials has shown promising results in clinical and radiographic success rates, and its antimicrobial properties have been demonstrated in studies against different bacteria and yeasts.

Zinc oxide - Ozone oil Mix

Ozone has gained attention due to its notable biological characteristics, including bactericidal action, debriding effects, stimulation of angiogenesis, and high oxidizing power. It is currently being debated as a potential alternative antiseptic agent in dentistry due to its reported antimicrobial efficacy without the development of drug resistance. Studies have shown that ozone in aqueous form exhibits minimal toxicity to oral cells. If a less irritating and biocompatible substitute for eugenol in zinc oxide eugenol (ZOE) could be identified, an ideal obturating material for deciduous teeth could be formulated. Using a material with effective antimicrobial properties and reduced toxicity for root canal obturation may enhance treatment success [3].

Ozone is an energized gaseous form of oxygen that readily dissociates back into oxygen, releasing singlet oxygen, a potent oxidizing agent responsible for its bactericidal and fungicidal effects. Its therapeutic effects are achieved through the production of ozone-generated peroxides, which have been well understood in terms of

their action on living organisms. However, ozone is unstable in its gaseous form [7].

In one study, ozone oil was produced by bubbling ozone gas through vegetable oils containing omega fatty acids. Ozonated water and olive oil can effectively trap and release oxygen/ozone, providing an ideal delivery system. When reacting with oils, ozone breaks the double bonds between carbon atoms, leading to the production of oxygenated compounds like hydroperoxides and polyperoxides, which contribute to its actions. The use of ozone in oily vehicles may offer advantages over gaseous or aqueous media, as the oil can remain in contact with the surface for a longer duration, prolonging its functions [27].

Several studies have evaluated zinc oxide combined with ozonated oil as a filling material for root canal treatment in primary teeth, showing higher success rates. Zinc oxide-ozonated oil demonstrated a 95.5% success rate in one study, consistent with previous research indicating favorable outcomes with this combination. Consequently, the authors concluded that zinc oxide-ozonated oil can be considered a suitable alternative to ZOE [28].

Zinc oxide eugenol propolis

Zinc oxide eugenol propolis (ZOP) was evaluated by Al-ostwani., *et al.* in 2014 as a new paste for pulpectomy of nonvital primary molars. This study compared ZOP with other filling pastes, including endoflas-chlorophenol-free, metapex paste, and zinc oxide eugenol (ZOE) paste as a control. The clinical and radiographic results were assessed at 6 and 12 months. The filling pastes showed similar success rates in terms of clinical and radiographic outcomes over the observation period. The radiolucency in the ZOE group remained stable without significant changes after 6 and 12 months, accompanied by slow resorption of the ZOE paste in 31.3% of cases. In contrast, the resorption rate of ZOP corresponded with root resorption in 62.5% of cases. Both metapex and endoflas-chlorophenol-free showed faster resorption compared to root resorption in 56.3% of cases [20].

Zinc oxide–Ocimum sanctum extract

The use of medicinal agents as obturating materials in primary teeth has been extensively explored. Among the medicinal plants, Ocimum sanctum (commonly known as Tulsi) has been recognized for its therapeutic potential and oral health benefits. The leaves of Ocimum sanctum have been found to be effective in treating common oral infections. The extract of Ocimum sanctum contains approximately 0.7% volatile oil, consisting mainly of eugenol (71%) and methyl eugenol (20%), although in lower concentrations compared to zinc oxide eugenol (ZOE) cement. Therefore, a combination of zinc oxide and Ocimum sanctum extract can be considered as an alternative obturating material for primary teeth, in place of ZOE. Ocimum sanctum extract has demonstrated significant antimicrobial activity, making it a promising herbal compound for use in endodontics. It is readily available, easy to obtain, cost-effective, and has a long history of use with minimal side effects. Its antibacterial efficacy is attributed to its bioactive components, such as eugenol (70%), methyl eugenol (20%), Carracrol, Tetpene, Sesquiterpene B, caryophyllene, and polyphenol rosmarinic acid. The concentration of eugenol in the extract contributes to its antimicrobial efficacy when combined with zinc oxide, while exhibiting fewer toxic effects compared to higher eugenol content in ZOE. The antibacterial effectiveness of Ocimum sanctum extract against E. faecalis is believed to be comparable to that of ZOE [29]. A study conducted by Vachhani., *et al.* in 2022 demonstrated that the use of zinc oxide combined with Ocimum sanctum extract as an obturating material in endodontic therapy for primary teeth resulted in excellent clinical and radiographic success rates, which were comparable to those achieved with the use of ZOE [30].

Chitra hap-fil

In 2014, Jeeva and Retnakumari conducted a study focusing on the use of biomaterials, particularly hydroxyapatite, in dentistry. They developed a new product called “chitra hap-fil” as a potential material for root canal obturation. The study aimed to compare the cellular and microbial response of chitra hap-fil with zinc oxide eugenol and metapex using in-vitro methods. The results showed that metapex had the lowest cytotoxicity, followed by chitra hap-fil, while zinc oxide eugenol exhibited higher cytotoxicity. Chitra hap-fil primarily consists of hydroxyapatite nanoparticles (65%), which is the mineral content found in human bones and teeth. It also contains commercially pure iodoform (32%) to provide antibacterial properties [31]. The ratio of iodoform in the paste is within safe limits. The paste includes a gelling agent (alginate) at 3% and a 0.2% surfactant to bind with calcium ions in the hydroxyapatite. Chitra hap-fil is safe from a toxicological standpoint and is provided in premixed form in syringes for easy delivery into the root canal. The size of hydroxyapatite nanoparticles in chitra hap-fil is similar to tooth crystals, allowing for physiological resorption to align with deciduous teeth roots. Its neutral pH makes it compatible with surrounding cells and tissues [3]. Additionally, chitra hap-fil meets the criteria set by the American National Standard/American Dental Association for root canal filling materials, as it is at least 2mm more radiopaque than dentin. The ingredients of chitra hap-fil are harmless to periapical tissues and developing tooth buds. The paste adheres well to canal walls, does not shrink after filling, and does not react chemically with dentin, preventing tooth discoloration or degradation. It remains in a non-hardened state, allowing potential removal if needed. Overall, chitra hap-fil appears to meet the ideal requirements for a pulpectomy material and shows promise as a candidate [31]. However, further research is necessary to evaluate its long-term effectiveness and success as a pulpectomy material.

Conclusion

In summary, Rifocort is an effective product combining a corticosteroid and an antibiotic for treating pulpal infections in primary teeth. The evaluation of different filling pastes, such as Zinc oxide eugenol propolis and Chitra HAP-Fil, has shown promising results in terms of clinical and radiographic success rates, cytotoxicity, and antibacterial properties. These materials offer potential alternatives for pulpectomy procedures in pediatric dentistry. While newer obturating materials offer these benefits, it is important to note that their effectiveness and long-term outcomes may vary. Further research and clinical studies are needed to evaluate their performance and compare them to synthetic alternatives. By focusing on these areas of innovation, researchers and clinicians aim to enhance the success rates, longevity, and overall outcomes of pulpectomy procedures, ultimately improving oral health and patient satisfaction.

Acknowledgements

My sincere acknowledgements towards Special Interest Group-Quality and Safe Use of Dental Materials for the successful completion of the article.

Conflict of Interest

There was no conflict of interest.

Bibliography

1. Allen KR. "Endodontic treatment of primary teeth". *Australian Dental Journal* 24.5 (1979): 347-351.
2. Goerig AC and JH Camp. "Root canal treatment in primary teeth: a review". *Pediatric Dentistry* 5.1 (1983): 33-37.
3. Rajsheker Srinitya., *et al*. "Obturating Materials Used for Pulpectomy in Primary Teeth- A Review". (2018).
4. Kratunova Evelina and Daniela Silva. "Pulp therapy for primary and immature permanent teeth: an overview". *General Dentistry* 66.6 (2018): 30-38.
5. Primosch Robert E., *et al.* "A retrospective assessment of zinc oxide-eugenol pulpectomies in vital maxillary primary incisors successfully restored with composite resin crowns". *Pediatric Dentistry* 27.6 (2005): 470-477.
6. Fumes AC., *et al*. "Root canal morphology of primary molars: a micro-computed tomography study". *European Archives of Paediatric Dentistry* 15 (2014): 317-326.
7. Chavhan Dr Pankaj., *et al*. "DIFFERENT OBTURATING TECHNIQUES USED IN PRIMARY TEETH: A REVIEW". *European Journal of Molecular and Clinical Medicine* 8.3 (2021): 958-965.
8. Holan G and AB Fuks. "A comparison of pulpectomies using ZOE and KRI paste in primary molars: a retrospective study". *Pediatric Dentistry* 15.6 (1993): 403-407.
9. Mortazavi M and M Mesbahi. "Comparison of zinc oxide and eugenol, and Vitapex for root canal treatment of necrotic primary teeth". *International Journal of Paediatric Dentistry* 14.6 (2004): 417-424.
10. Nurko Carlos and Franklin Garcia-Godoy. "Evaluation of a calcium hydroxide/iodoform paste (Vitapex) in root canal therapy for primary teeth". *Journal of Clinical Pediatric Dentistry* 23 (1999): 289-294.
11. Nurko Carlos., *et al.* "Resorption of a calcium hydroxide/iodoform paste (Vitapex) in root canal therapy for primary teeth: a case report". *Pediatric Dentistry* 22.6 (2000): 517-520.
12. Filho P Nelson., *et al.* "Connective tissue responses to calcium hydroxide-based root canal medicaments". *International Endodontic Journal* 32.4 (1999): 303-311.
13. Cerqueira Daniella Ferraz., *et al.* "Cytotoxicity, histopathological, microbiological and clinical aspects of an endodontic iodoform-based paste used in pediatric dentistry: a review". *Journal of Clinical Pediatric Dentistry* 32.2 (2007): 105-110.
14. Pashley Edna L., *et al.* "Systemic distribution of 14C-formaldehyde from formocresol-treated pulpotomy sites". *Journal of Dental Research* 59.3 (1980): 602-607.
15. Auerbach ChM Moutschen-Dahmen and J Moutschen. "Genetic and cytogenetical effects of formaldehyde and related compounds". *Mutation Research/Reviews in Genetic Toxicology* 39.3-4 (1977): 317-361.
16. Chawla HS., *et al.* "Evaluation of a mixture of zinc oxide, calcium hydroxide, and sodium fluoride as a new root canal filling material for primary teeth". *Journal of Indian Society of Pedodontics and Preventive Dentistry* 26.2 (2008): 53.
17. Fuks, Anna., *et al.* "Root fillings with Endoflas in primary teeth: a retrospective study". *Journal of Clinical Pediatric Dentistry* 27.1 (2003): 41-45.
18. Pandranki Jayalakshmi., *et al.* "Zinc oxide eugenol and Endoflas pulpectomy in primary molars: 24-month clinical and radiographic evaluation". *Journal of Indian Society of Pedodontics and Preventive Dentistry* 36.2 (2018): 173-180.
19. Al-Ostwani Alaa O., *et al.* "A clinical and radiographic study of four different root canal fillings in primary molars". *Journal of Indian Society of Pedodontics and Preventive Dentistry* 34.1 (2016): 55-59.
20. Al-Ostwani Alaa O., *et al.* "A clinical and radiographic study of four different root canal fillings in primary molars". *Journal of Indian Society of Pedodontics and Preventive Dentistry* 34.1 (2016): 55-59.

21. Pinto Daniela Nunes., *et al.* "Eighteen-month clinical and radiographic evaluation of two root canal-filling materials in primary teeth with pulp necrosis secondary to trauma". *Dental Traumatology* 27.3 (2011): 221-224.

22. Kakarla Pranitha., *et al.* "Dental pulp response to collagen and pulpotec cement as pulpotomy agents in primary dentition: A histological study". *Journal of Conservative Dentistry* 16.5 (2013): 434.

23. Kriplani Ritika., *et al.* "Comparative evaluation of antimicrobial efficacy of various root canal filling materials along with aloevera used in primary teeth: a microbiological study". *Journal of Clinical Pediatric Dentistry* 37.3 (2013): 257-262.

24. Khairwa Abhishek., *et al.* "Clinical and radiographic evaluation of zinc oxide with aloe vera as an obturating material in pulpectomy: an *in vivo* study". *Journal of Indian Society of Pedodontics and Preventive Dentistry* 32.1 (2014): 33.

25. Subramanyam Divya and Sujatha Somasundaram. "Clinical and Radiographic Evaluation of *Aloe vera* vs Formocresol as a Pulpotomy Medicament in Primary Molars: A Double Blinded Randomized Controlled Trial". *International Journal of Clinical Pediatric Dentistry* 13,2 (2020): 138-143. doi:10.5005/jp-journals-10005-1724.

26. Pareek Sonia., *et al.* "Disinfection of dental unit water line using aloe vera: in vitro study". *International Journal of Dentistry* 2013 (2013): 618962.

27. Chandra SP., *et al.* "Success of root fillings with zinc oxide-ozonated oil in primary molars: preliminary results". *European Archives of Paediatric Dentistry* 15 (2014): 191-195.

28. Doneria Divya., *et al.* "Comparative evaluation of clinical and radiological success of zinc oxide-ozonated oil, modified 3mix-mp antibiotic paste, and vitapex as treatment options in primary molars requiring pulpectomy: An: *in vivo*: study". *Journal of Indian Society of Pedodontics and Preventive Dentistry* 35.4 (2017): 346-352.

29. Agarwal Shaili., *et al.* "Comparative evaluation of Ocimum sanctum and calcium hydroxide mix as an obturating material in deciduous molars: an *in vivo* study". *International Journal of Clinical Pediatric Dentistry* 13.6 (2020): 617.

30. Vachhani Krishnaben., *et al.* "An *in vivo* comparative clinical and radiographic evaluation of a mixture of zinc oxide–Ocimum sanctum extract, zinc oxide–ozonated oil, and zinc oxide-eugenol as obturating materials in primary molars". *Journal of Indian Society of Pedodontics and Preventive Dentistry* 40.4 (2022): 398-403.

31. PP Dr Jeeva and N Retnakumari. "*In-vitro* comparision of cytotoxicity and anti-microbial activity of three pulpectomy medicaments- Zinc oxide euginol, Metapex and Chitra HAP - Fill". IOSR Journal of Dental and Medical Sciences 13 (2014): 40-47.