Review Article

Pediatric obturating materials – A review

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ABSTRACT

Background: Pulp therapy for primary teeth continues to be a challenge to clinicians. One of the major areas of research is in the area of finding new obturating materials to suit the specific properties of these teeth. This article seeks to present a review of the major obturating materials in dentistry and their modifications as well as their advantages and disadvantages. **Aim:** The aim of this review is to analyze the role of different pediatric obturating materials in dentistry. **Materials and Methods:** Thorough literature search will be performed in the electronic database in the present inclusion and exclusion. For this work, a systematic bibliographic search was performed using PubMed and ResearchGate, without time or language limitations and books as a complement. The search was performed using the following words: Pulpectomy, children, obturating materials, zinc oxide eugenol, calcium hydroxide, iodoform, endoflas, metapex, vitapex, and pulpotec. **Conclusion:** The selection of appropriate obturating material is crucial in successful endodontic therapy. It has been found that the current obturating materials for primary teeth while providing satisfactory clinical results still need to be modified to suit the various clinical situations that are encountered. Recent advances in alternative root filling materials also promise better adhesion to root canal and avert the shortcomings of gutta-percha.

KEY WORDS: Calcium hydroxide, Iodoform, Obturation, Zinc oxide eugenol

INTRODUCTION

Pulp therapy is widely used in the treatment of pediatric patients, while attempting to prevent the premature exfoliation of primary teeth. Lewis and Law stated that the ultimate objective of pediatric pulp therapy as the successful treatment of the pulpally involved tooth to be retained. The main goal of endodontic treatment is the complete elimination of microorganisms from the root canal and the prevention of reinfection. This can be achieved by proper cleaning and shaping of the root canals followed by a well-sealed obturation of the canal space. The ultimate goal of endodontic obturation has remained the same for the past 50 years, i.e., to create a fluid-tight seal along the length of the root canal system, from the coronal opening to the apical termination. Root canal therapy was introduced as early as 1932, as a method for retaining primary teeth which would otherwise be lost.[1] When pulp necrosis occurs in primary teeth, it is of polymicrobial in nature with predominance of anaerobic bacteria lying deeply with in the cementum and dentin around the periapex. These microorganisms in the isthmus and fins can remain even after biomechanical preparation thorough debridement with intracanal dressing and antibacterial agents. The antimicrobial agents and root canal agents should be able to neutralize their toxic products and prevent the canal reinfection to create favorable environment for the healing process to occur.[2]

Various materials have been developed for obturation of primary teeth, of which zinc oxide eugenol (ZOE) cement has been widely used as a root canal filling material for deciduous teeth, but it cannot be considered the ideal root canal filling material because it shows limited amount of antimicrobial action and it tends to resorb at a slower rate than the roots of the deciduous teeth.[3] Concerns about these disadvantages of ZOE led to a search for alternative root canal filling material for deciduous teeth.

Rifkin identified certain criteria for an ideal pulpectomy obturant that includes[4]

- Should have an antiseptic property
- Resorbability – An ideal root canal filling material must have the necessary properties of antibacterial action, resorption at the same rate as of the root. It

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must be absorbable if passed beyond the apex
- Good radiopacity for visualization on radiographs
- Non-irritating and non-inflammatory to the underlying permanent tooth germ, and harmless to the periapical tissues and successive developing tooth buds
- Ease of insertion: The root canal filling materials should be easy to condense into the canals, adhere to the walls, and should not shrink with setting
- Should not cause any discoloration of tooth
- Ease of removal.

This article seeks to present a review of the major pediatric obturating materials in dentistry.

ZOE

ZOE cement has been used for a very long time as a root canal filling material for deciduous teeth,[5] and in a survey conducted in 1997, it was concluded as the preferred root canal filling material by 94% of the chairpersons of predoctoral pediatric dental programs in the United States.[6] Nevertheless, ZOE cannot be considered the ideal root canal filling material because it shows limited antimicrobial action[7] and it resorbs at a slower rate than deciduous roots.[8] In a study which was conducted, iodoformized ZOE was tested for its antibacterial effect against the anaerobic and aerobic bacteria obtained from the root canals of deciduous teeth and was found to be effective for both the aerobic and anaerobic bacteria of the root canals of deciduous teeth with maximum sustaining period of 10 days.[9] Collet all reported that when ZOE extrudes, it develops a fibrous capsule which prevents resorption of the material. Thus, it has a tendency to be retained even after tooth exfoliation and has a slow rate of resorption. Resorption in the cementum was evident, periodontal ligament exhibited intense and moderate thickening. Dentin resorption was not observed, whereas bone resorption was found.[10] Hashieh *et al*. studied the beneficial effects of eugenol. The amount of eugenol released in the periapical zone immediately after placement was 10–4 and falls to 10–6 after 24 h and reaching 0 after 1 month. Within these concentrations of eugenol, it is said to have analgesic and anti-inflammatory properties that are very useful after a pulpectomy procedure.[11] Excess material forced through the apex during filling procedures can remain in the apical tissue during the process of physiological root resorption and it takes few months or even years to resorb.[12] To improve its properties and success rate, ZOE in combination with different components such as formaldehyde, formacresol, and paraformaldehyde has been tried out,[13] but the addition of these compounds neither increased the success rate nor made the material more resorbable as compared to ZOE alone. Zinc oxide + ozonated oil: It has biological properties such as debriding effect, bactericidal action angiogenesis stimulation capacity, and high oxidizing power.[14] After 12-month follow-up, there was progressive bone regeneration at the periapical region with good clinical and radiographic success rate. Zinc oxide + calcium hydroxide: Obturated material remained up to the apex of root canals till the beginning of physiologic root resorption and was found to resorb at the same rate as that of primary teeth.[15]

ZOE and *Aloe vera*

It was evaluated clinically and radiographically that a mixture of ZOE and *A. vera* is an obturating material for pulpectomy in a total of 15 primary molars for a period of 9 months. The incidence of pain present preoperatively reduced to 86.67% postoperatively. Tenderness on percussion was observed in all the patients preoperatively. Sinus formation and mobility were not seen in any of the patients. Periapical radiolucency was present in all the 15 cases before the start of the study. Radiographic examination was carried out at 7 days, 1 month, 3 months, 6 months, and 9 months interval and it was observed that 11 cases (73.34%) demonstrated arrest or decrease of radiolucency. This was highly significant.[16]

CALCIUM HYDROXIDE

In 1920, calcium hydroxide was introduced into dentistry by Hermann. Calcium hydroxide medicament has been identified to promote healing in many clinical situations. Calcium hydroxide has been either used in association with iodoform or as the sole root filling material for primary teeth or it is commercially available as vitapex and metapex. These products resorb if pushed beyond the apex. However, the rate of resorption of the material from within the canals is faster than the rate of physiologic root resorption.[17] Calcium hydroxide containing root canal filling materials when used in primary teeth with hyperemic pulp can come in contact with some vital pulp tissue remnants and can trigger the pathway of inflammatory root resorption.[18] Calcium hydroxide paste when used as obturating material in necrotic pulp, the paste produces a superficial layer of necrosis causing damage to dentin which, in turn, can lead to exposure of dentin to odontoclasts and cause subsequent damage. The alkaline property of the calcium hydroxide was said to counteract the inflammatory process by activating the alkaline phosphatase activity and acting as a local buffer, which was important for hard tissue formation. The depletion of the material from the root canals was found to be the main disadvantage of calcium hydroxide as root canal filling material.[18] Studies have reported a success rate of 80–90%.[19,20] Viscous vehicles promote a lower solubility of the paste in comparison to aqueous vehicles, and oily vehicles promote the

lowest solubility and diffusion of calcium hydroxide pastes. Pastes containing an oily vehicle, particularly those with an antibacterial substance (i.e., iodoform), have shown more favorable results than more soluble pastes when used as a root canal filling material in primary teeth.[21] Japanese researchers have introduced a calcium hydroxide sealer named Vitapex which contains 40% iodoform along with silicone oil. The iodoform is a bactericidal agent that is released from the sealer and destroys any residual bacteria in the canal or periapical region. However, several clinical and histopathologic investigations of calcium hydroxide and iodoform mixture have been published by Fuchino. This material was found to be easy to apply and resorbs at a slightly faster rate than that of the root. It has no toxic effects on the underlying permanent dentition and is radiopaque. Disadvantages of iodoform include rate of resorption of material within the canals which is faster than the rate of root resorption. It also has the drawback of causing yellowish-brown discoloration of the teeth. The iodoform-containing filling materials are available in different formulations such as Maisto paste, KRI paste, Guedes-Pinto paste, Rifocort, Vitapex, and Endoflas. From the above given reasons, the calcium hydroxide-iodoform mixture can be considered to be a quite ideal primary tooth filling material.

KRI PASTE

KRI paste is basically an iodoform paste, was introduced by Volkoff as a resorbable paste suitable for root canal filling. It consists of iodoform (80.5%), camphor (4.84%), para chlorophenol (2.023%), and menthol (1.213%). The paste is a radiopaque root canal filling material. Menthol and camphor are mixed with para chlorophenol and the antimicrobial agent, to minimize coagulation with adjacent tissues. Iodoform is added as a vehicle to carry the antimicrobial agent as it is a radiopaque and non-irritant.[22] In 1989, a procedure was published for root canal filling and preparation in necrotic primary molars with a paste made of KRI-1 and pure calcium hydroxide obtaining a high percentage of success with remission of all symptoms. This was the first citation, in which formaldehyde was used as a component of root canal filling material, thus partly recovering Buckley's formula, which contained 40% formaldehyde and glycerin.[23]

ENDOFLAS

Endoflas is a root canal filling material which is resorbable in nature and its constituents are similar to that of Vitapex, with an addition of ZOE. The powder contains triiodomethane and iodine dibutilorthocresol (40.5%), zinc oxide (56.6%), calcium hydroxide (1.04%), barium sulfate (1.66%), and with a liquid consisting of paramonochlorophenol and eugenol.[24] The material is hydrophilic and can be used in humid canals. It adheres firmly to the surface of the root canals to provide a good seal. Due to its broad spectrum of antibacterial activity, Endoflas has the ability to disinfect dentinal tubules and difficult to reach accessory canals that cannot be disinfected or cleansed mechanically. The components of Endoflas are biocompatible and can be removed by phagocytosis, hence, making the material resorbable. Fuks *et al*. observed that Endoflas resorbed when it was extended periapically; however, it did not resorb intraradicularly and reported 75% success clinically with endoflas and 100% decrease in periapical radiolucency. Unlike other pastes, Endoflas only when extruded extraradicularly but does not wash out intraradicularly. High clinical and radiographic success of Endoflas shows its complete bone healing and good healing capabilities.[25] Chlorophenol was eliminated from Endoflas because it had a fixation effect that caused disturbance of the osteoblast.[26] The high pH ensures powerful antibacterial effects that reduce periapical inflammatory processes and stimulate periapical healing with an increase of alkaline phosphatase action and periapical bone remineralization. The disadvantages of this material are that its eugenol content can cause periapical irritation. It also has a drawback of causing tooth discoloration. Thus, it can be concluded that the Endoflas may be successfully used for root canal treatments in primary teeth particularly if care is taken not to overfill.

SMARTSEAL

It is a recently introduced root canal obturating material based on polymer technology. It uses a hydrophilic principle which can absorb surrounding moisture and expand resulting in filling of voids and spaces. ProPoints reveals the hydrophilic nature, permitting infinite volume of water existing in the root canal system that is engrossed by these points. This water may hydrogen bond to the existing polar locations, therefore, permitting the enlargement inside the polymeric chains, this material follows a controlled expansion mechanism. Advantages of using hydrogels over existing obturating materials include: Geometry of point can be accurately made, biocompatibility, and controlled expansion.

CONCLUSION

The selection of appropriate obturating material is crucial in successful endodontic therapy. It has been found that the current obturating materials for primary teeth while providing satisfactory clinical results still need to be modified to suit the various clinical situations that are encountered. Since ZOE has many drawbacks, several other materials have

been investigated and various combinations tried with some degree of success. The current combinations of calcium hydroxide and iodoform seem to provide better results than ZOE cement. Recent advances in alternative root filling materials also promise better adhesion to root canal and avert the shortcomings of gutta-percha.

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