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RESEARCH ARTICLE

A REVIEW ON OBTURATING MATERIALS FOR DECIDUOUS DENTITION

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Abstract

In pulpally involved primary teeth, pulp therapy is necessary to preserve the primary teeth leaving the permanent tooth bud undisturbed. And for the successful pulp therapy, ideal obturating material that suit the specific properties of the teeth are necessary. Thus, a pediatric dentist should have a thorough knowledge about the various obturating materials so that the integrity of the dental arch can be maintained. Hence, this article aims to review the various obturating materials with their modifications as well as their advantages and disadvantages.

Introduction:-

Preservation of the primary teeth is very important as they are integral for the harmonious development of occlusion, maintenance of arch length, for optimal function of chewing and speech and preservation of healthy oral environment. Pulp therapy was advised in 1932 that aims to preserve the child's health and to maintain deciduous teeth in a functional state until they are replaced by permanent teeth[1]. Main objective of this treatment is total elimination of micro-organisms from the root canal and the prevention of subsequent reinfection. This can be achieved by careful cleaning and shaping followed by complete obturation of the canals. Howewer, morphology of root canals in deciduous teeth is very complex as it exhibits bizarre internal geometry, functional connections & horizontal anastomoses. So the treatment of primary teeth is considered highly complicated. So in order to increase chances of success, treatment necessitates combination of diversity of factors, such as a precise diagnosis, thorough cleaning and shaping and disinfection with the materials having antibacterial properties followed by 3-dimensional obturation of the pulp space to obtain a hermatic seal followed by adequate final restoration.

Rifkin (1980) identified criteria for an ideal pulpectomy obtudent that includes[2]-Resorbablity, Antiseptic properties, non-inflammatory & non-irritating to the underlying tooth germ, should be radiopaque, should be easy to insert & easy to remove.However, none of the currently available obturating materials meet all of these criteria. The present review seeks to evaluate each of the presently available obturating materials and present a few of the emerging

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concepts related to obturation of primary teeth. Presently, the commonly used materials for primary root canal fillings are zinc oxide Eugenol, Iodoform based pastes and calcium hydroxide.

Discussion:-

Zinc Oxide Eugenol(ZOE)

Zinc Oxide Eugenol is one of the most commonly used materials for root canal filling of primary teeth(Fig.1). Discovered by Bonastre (1837) but used in dentistry by Chisholm (1876)[3]. ZOE was the first root canal filling material to be recommended for primary teeth, as described by Sweet (1930)[1.] Hashieh studied the anti-inflammatory and analgesic properties of Eugenol that are beneficial after a pulpectomy procedure[4]. However it also has some disadvantages like slow resorption rate, irritation to the periapical tissues, necrosis of bone and cementum and alters the path of eruption of succedaneous tooth. Success rates after obturating with ZOE as reported by various authors are as follows: 82.3%- Barr et al, 82.5%- Gould, 86.1%-Coll et al[2]. A study conducted by Chawla et al(2014)[5] , a combination of calcium hydroxide, zinc oxide, and 10 % sodium fluoride solution has been trialed in a clinical study and was observed that the rate of resorption of this new root canal obturating mixture was quite similar to the rate of physiologic root resorption in primary teeth[6].

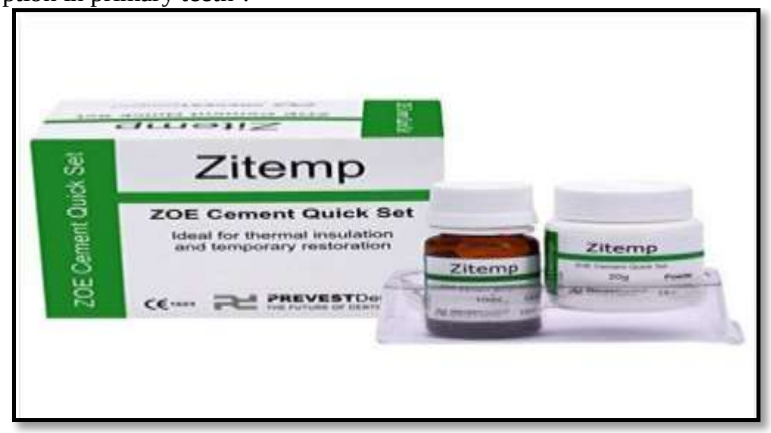

Fig. 1:- Zinc Oxide Eugenol.

Combinations Of Zoe With Other Materials:

Table no 1:- The various combinations of ZOE with several materials to improve its properties are listed in the below.

Combination	Author	Observation
ZoE+$Ca(OH)_2$ +SodiumFluoride	Chawla et al.(2008)[1]	Addition of fluoride was added to give this material a resorption rate same as the resorption rate of primary teeth
ZO+Calen Paste	Pinto.et al.(2011)[1]	Clinical and radiograhic outcomes for calen/ZO were equal to ZOE
ZO + Calcium Hydroxide	Praveen et al.(2011)[1]	Found to resorb at the same rate as that of primary teeth
ZOE + Aldehydes	Praveen et al.(2011)[1]	Addition of these compounds neither increased the success rate nor made the material more resorbable as compared to ZOE alone
ZO + Ozonated Oil	Chandra et al.(2014)[1]	It has biological properties such as, bactericidal action, debriding effect, angiogenesis stimulation capacity and high oxidizing power.
ZO+ Propolis (Zop)	Al-Ostwani et.al.(2016)[1]	There was acceptable clinical and radiographic success rate with faster resorption seen in some cases.

Table 1:- Showing zinc oxide combinations with other materials.

Many related studies has been done by various authors. Some of these has been mentioned below.

Rabinowitz in 1953 first documented the study of ZOE in which he added formocresol & silver nitrate to ZOE as obturating material. Barker and Lockett in 1971 did study on material when extruded from the apex cause a mild foreign body reaction. Barker and Lockett in 1971 stated tht extruded ZOE resisted rsorption and took months or

even years to resorb. Cox et al in 1978 stated that Zinc oxide powder had no inhibitory effect and the addition of eugenol to zinc oxide retarded the growth of only the gram-positive organisms. Coll et al in 1985 reported that when ZOE extrudes it develops a fibrous capsule that prevents resorption of the material.Garcia-Godoy in 1987 reported deflection of developing permanent tooth bud because of its hardness. Coll and Sadrian in 1996 stated that pulpectomized teeth rarely exfoliate later than normal and timing of exfoliation was not related to retention of ZOE paste. Hashieh et al in 1999 studied the beneficial effects of eugenol[1]. Mohammad T in 2021 concluded that ZnOE offers good clinical and radiographical results when compared with Triple mix paste[4]. D Costa H in 2021[7] concluded that the antimicrobial efficacy was highest in ZoE against E faecalis and Candida Albicans followed by Zinc Oxide with Thyme oil.

Calcium Hydroxide:

Introduced by Hermann(1920), this medicament has been known to promote healing in many compromised clinical situations(Fig.2). It has been used either as solitary root canal filling material or in association with iodoform, commercially available as vitapex, metapex. These products resorb easily if involuntarily pushed beyond the apex. However, the rate of resorption of the material is faster than the rate of physiological root resorption. Pitts studied the absorbable nature of calcium hydroxide and found giant cells to be present adjacent to remaining calcium hydroxide, but no imflammatory cells were seen. Various biological properties have been attributed to this substance, such as antimicrobial activity which is primarily due to liberation of hydroxyl ions and inactivation of enzymes in the bacterial cytoplasmic membrane(Bystrom et al. 1985), tissue-dissolving ability (Hasselgren et al. 1988, Anderson et al 1992), inhibition of tooth resorption (Tronstad, 1988) and induction of repair by hard tissue formation (Foreman and Barnes 1990)[1]. But the major disadvantage was high occurrence of internal resorption which led to poor success rates in long term.

Fig.2:- Calcium Hydroxide.

Obturating materials in combination with $Ca(OH)_2$:

To improve the properties and success rate of calcium hydroxide, it has been combined with various formulations which are mentioned below.

Table No 2:- Showing Obturating materials in combination with $Ca(OH)_2$.

S.No	Combinations of obturating materials with other materials
1.	Vitapex ($Ca(OH)_2$ + Iodoform)[18],
2.	Endoflas ($Ca(OH)_2$ + ZOE + Iodoform)[13],
3.	$Ca(OH)_2$ mixed with sterilized dentine chips and alkaline blood salts
4.	Another formulation of a paste was composed of calcium hydroxide, methylcresilate and camphorated parachlorophenol
5.	a paste composed of $Ca(OH)_2$ in a 1% aqueous solution of parachlorophenol
6.	a paste containing a 2% aqueous solution of CMCP,
7.	another suggestion was a paste made with $Ca(OH)_2$ and collagen gel, evaluated by Pissiotis & Spangberg (1990),
8.	a proprietary brand named Multical composed of $Ca(OH)_2$ (34%), barium sulphate (15%) and

	chloro-timonol 51% as cited by Webber (1983) and Alliet & Vande Voorde (1988).

Different related studies of Calcium Hydroxide are mentioned below:-
Rochner (1940) and Machida (1960)[1] reported that the healing was accompanied by the formation of a mineralized barrier. Mozayeni MA(2014)[19] presented case reports of successful antibacterial efficacy. Navit S et al in 2016[20] evaluated the antimicrobial efficacy of calcium hydroxide against E. Faecalis. Ayse I. Orhan and Esra C. tatli in 2021[21] concluded that $Ca(OH)_2$ and iodoform-$Ca(OH)_2$ with ultrasonic activation decrease void formation.

Iodoform:
Iodoform paste consist of a basic preparation of iodine[1]. In small doses it relieve pain, acts as a disinfectant having great influence on the nervous system. lodoform paste was suggested initially by Walkhoff in 1928[3]. Castagnola and orlay showed that iodoform pastes are bactericidal to microorganisms in the root canal and lose only 20% of their potency over a period of 10 years. Because of the presence of Iodine, it causes discolouration of the tooth which may compromise the esthetics. Few studies revealed that it is irritating to periapical tissues and can cause cemental necrosis. Commercially available as: Walkhoff paste, Maisto paste, KRI paste, Endoflas, Vitapex, Guides- pinto paste.

Walkhoff paste :
The original Walkoff paste contained parachlorophenol, camphor and menthol which has been reformed by addition of iodoform in KRI paste. Maisto paste contains addition of zinc oxide, thymol and lanolin in Maisto paste. These combination products have shown to be bactericidal, resorbable and harmless to the permanent tooth germs as well as ease of removal. Iodoform containing pastes are readily resorbed from the periradicular region, and do not cause any foreign body reaction[3]. Over filling and resorption of the paste containing Iodoform from the root canals had no effect on the success of the treatment but regarded as having a positive healing effect.

Related studies of Walkhoff paste / KRI Paste are mentioned below:-
Samragni Banerjee et al in 2018[1] found that KRI paste containing Iodoform are bactericidal and are harmless to the permanent tooth germ. Hence it is more beneficial than ZOE and calcium hydroxide paste. Shah SS in 2020[1] compared zinc oxide eugenol and vitapex as the obturating materials in deciduoud non-vital teeth, vitapex showed successful results as a filling material than zinc oxide eugenol.

Endoflas:
Endoflas is a resorbable paste which contains barium sulphate, calcium hydroxide, iodoform and zinc oxide eugenol. The material is hydrophilic and can be used in mildly moist canals. It provides 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[2]. The disadvantages of this material is that its eugenol content cause periapical irritation and it can also causes tooth discoloration.

Related studies of Endoflas reported by various authors are mentioned below:-
Pelczar et al in 1998[1] observed that the high antimicrobial activity of Endoflas was probably due to the presence of iodoform and eugenol, both of which have antibacterial action. Eugenol acts by protein denaturation, while iodoform is an oxidizing agent.. Hegde et al. in 2012[1] observed that Endoflas moderately inhibited the gram-negative and gram positive organisms and showed strong inhibition of Candida albicans. Ahmed O Shami in 2021 described the use of calcium hydroxide and iodoform paste in inducing the apex development in vital pulp therapy (apexogenesis) in permanent lower molar having pulp polyp.

Vitapex:
Vitapex was introduced by Japanese researchers Kawakami T et al in 1979.Vitapex and metapex are available in preformed syringes, which is directly placed into the canals and the material is extruded by simple pressure. Addition of polysiloxane oil in Vitapex, enhances fluidity and permeability, which also improves the collateral benefit of root canal filling[2].

The fast resorption of vitapex, causes voids in the canal leading to formation of hollow tube. The formation of hollow tube effect is shown in Flowchart No.1:

Hollow tube effect (Goldman and Pearson 1965)

Intra-canal resorption of calcium hydroxide/iodoform paste

↓

Stop disinfection and become a hollow tube (due to loss of paste)

↓

Tissue fluid containing bacteria can fill the space in the unfilled or empty canals

↓

Infection

↓

Shift the pH-value to acidic, dissolving root dentin and cementum initiating the resorptive process. This inflammation also causes transformation of non-differentiated cells of connective pulpal tissue into giant multinuclear cells which are responsible for the resorption process.[26]

Flowchart No 1: Hollow tube effect reported by Goldman and Pearson[1].

Related studies of Vitapex reported by various authors are mentioned below:-

Kriplani et al and Harini priya et al[1] observed that Vitapex has lowest antibacterial activity when compared to ZOE and Calcium hydroxide. However, it showed moderate activity against Streptococcus pyogenes, Staphylococcus aureus, E feacalis, E coli. So, it was concluded from their study that ZOE>vitapex>Ca(OH)2>metapex. Seow et al[1] observed that the weak antimicrobial activity of metapex may be partially explained by the facts that calcium hydroxide, an ingredient of metapex has been demonstrated to interfere with the antiseptic capacity of dyadic combinations of endodontic medicaments. Tchaou et al[1] observed that calcium hydroxide with iodoform had exhibited no antimicrobial activity.

Guedes-Pinto Paste:

Guedes-Pinto Paste was given by Antonio Carlos Guedes pinto et al in 1981. Components of Guedes-pinto paste are Rifocort, camphorated parachlorophenol, Iodoform. Guedes-pinto paste has bactericidal and bacteriostatic effect. Piva F.(2008) evaluated the antimicrobial activity of guedes pinto paste as a root canal filling in deciduous teeth by direct exposure test. Disadvantages are it can induce internal resorption in primary teeth and can even cause necrosis[2].

MTA (Mineral Trioxide Aggregate):

MTA was first developed by Torabinejad et al. in 1995 at the University of Loma Linda. MTA is used as an obturating material in retained primary teeth with no successor. Composition of MTA is Iodoform, Camphorated Para Mono Chlorophenol(Antimicrobial analgesic)and Rifocort(Anti inflammaory antibiotic).Studies demonstrated that it has advantage of cemental repair, formation of bone, and regeneration of the periodontal ligament when MTA is used[8]. It has a disadvantage of long setting time of 3-4 hour. Studies have demonstrated cemental repair, formation of bone, and regeneration of the periodontal ligament when MTA is used[3].

Other Materials Used As Obturating Materials Are:

1.Aloe Vera:

Aloevera is an herbal and naturally found material and its properties made possible its wide usage in dentistry for various therapeutic properties. Priyadarshini P(2020)[9]: found that endoflas powder with aloe vera gel can be used as an alternative and suitable obturating agent in primary teeth due to its wide medicinal properties.

2.Pulpotec:

Pulpotec has antiseptic, antibacterial and anti-inflammatory properties. The main component of this product is iodoform, and due to its antiseptic properties ,it acts like an antiseptic paste at the entry of the empty root canal. Pulpotec can be used in the teeth showing bone lesion and help in reduction of clinical signs of infection[1]. The clinical and radiological results show that, this procedure could be considered as an alternative to the conventional treatment for necrotic primary teeth in pediatric dentistry[3].

3.Ozone :

Ozone is gaseous, energized form of oxygen, it is unstable and dissociates readily back into oxygen, thus liberating so called singlet oxygen, which is a strong oxidizing agent. They are responsible for remarkable bactericidal and fungicidal effects[1]. Chandra et al., there was good clinical success rate at 12 months follow up, which was attributed to the antibacterial and excellent healing properties of ozone peroxides. Accordingly, the authors have concluded that, it can be considered as a good alternative for ZOE[3].

4.Lesion Sterilization And Tissue Repair (Lstr) /Tripple Antibiotic Paste:

The use of antibiotics was first reported in 1951 by Grossman The theory behind LSTR is that the repair of damaged tissue might occur if lesions are disinfected. So, in case of necrotic primary teeth, LSTR can be used to preserve the tooth[9]. This has also been referred to non–instrumentation endodontic treatment (NIET)[3]. The mix is also called as triple antibiotic paste/ polyantibiotic paste.

Table 8:- Shows comparison of properties of different commonly used obturating materials[2].

Properties	Zinc Oxide Eugenol	Calcium Hydroxide	Vitapex
Resorption As Compared To The Physiological Resorption Of Root	Slow	Faster	Faster
Harmless	Harmful	Harmless	Harmless
Overfill Resorption	Slow Resorption	Resorbs In 1 Month	Resorbs In 1-2 Weeks
Anti-Imflammatory	Yes	Yes	Yes
Easy Removal	No	Yes	Yes
Radiopaque	Yes	Yes	Yes
Discolouration	No	No	No

Table 3:- Properties of obturating materials commonly used in primary dentition.

Conclusion:-

It has been found that the currently employed obturating materials still need to be modified to meet satisfactory clinical results. Due to the shortcomings of ZOE material several other materials have been investigated and various combinations tried with some degree of success. Zinc oxide ozonated oil and ZO added with aloe vera can be used as alternative to ZOE. Endoflas can be recommended in daily practice as it has better antimicrobial property and resorption of only extruded materials. So, based on the observation from the present review, this knowledge can be applied to our daily clinical practice and more randomized clinical trials should be conducted in the field of obturation materials in the future with larger sample sizes with long term follow ups for sound evidence-based practice.

References:-

1. Rajsheker S, Mallineni SK, Nuvvula S. Obturating Materials Used for Pulpectomy in Primary Teeth-A Mini Review. J Dent Craniofac Res. 2018;3(1):3.

2.Jha M, Patil SD, Sevekar S, Jogani V, Shingare P. Pediatric Obturating Materials Pediatric Obturating Materials And Techniques. Journal of Contemporary Dentistry● October-December. 2011;1(2):27.2

3. Manhas S, Haritwal V, Chaturvedi Y, Vyas D, Dalsania R, Chhibber R. Obturating Materials in Pediatric Dentistry: Literature Review. International Journal of Contemporary Research and Review. 2020 Aug 25;11(08).

4.Mohammed T. Assessment of zinc oxide, calcium hydroxide, and sodium fluoride mix versus zinc oxide eugenol mix as obturating materials in deciduous teeth. Al-Azhar Journal of Dental Science. 2021 pApr 1;24(2):225-31.

5. Banerjee S, Imran M, Thakur K, Mazhar S. Obturating Materials in Primary Teeth. Chief Patron. 2018;3(1):18.

6.Ramar K, Mungara J. Clinical and radiographic evaluation of pulpectomies using three root canal filling materials: an in-vivo study. Journal of Indian Society of Pedodontics and Preventive Dentistry. 2010 Jan 1;28(1):25.

7.D'Costa HJ. A Comparative Evaluation of Antimicrobial Efficacy of Zinc Oxide with Thyme Oil, Zinc Oxide with Peppermint Oil and Zinc Oxide Eugenol Sealers and Obturating Materials Against Enterococcus Faecalis and Candida Albicans"-An in-Vitro Study. biofilms.;7:8.

8. Barja-Fidalgo F, Moutinho-Ribeiro M, Oliveira MA, Oliveira BH. A systematic review of root canal filling materials for deciduous teeth: is there an alternative for zinc oxide-eugenol?. International Scholarly Research Notices. 2011;2011.

9.Bogen G, Kuttler S. Mineral trioxide aggregate obturation: a review and case series. Journal of endodontics. 2009 Jun 1;35(6):777-90.
10.Priyadarshini P, Jeevanandan G, Govindaraju L, Subramanian EM. Clinical evaluation of instrumentation time and quality of obturation using paediatric hand and rotary file systems with conventional hand K-files for pulpectomy in primary mandibular molars: a double-blinded randomized controlled trial. European Archives of Paediatric Dentistry. 2020 Dec;21(6):693-701.
11. Lakhani AA, Sekhar KS, Gupta P, Tejolatha B, Gupta A, Kashyap S, Desai V, Farista S. Efficacy of triple antibiotic paste, moxifloxacin, calcium hydroxide and 2% chlorhexidine gel in elimination of E. faecalis: an in vitro study. Journal of clinical and diagnostic research: JCDR. 2017 Jan;11(1):ZC06.
12. Nagarathna C, Vishwanathan S, Krishnamurthy NH, Bhat PK. Primary molar pulpectomy using two different obturation techniques: A clinical study. Contemporary clinical dentistry. 2018 Apr;9(2):231.
13. Sijeria P, Bhartia R, Nanjunda Swamy KV, Kulkarni S, Singla S. Evaluation of root canal filling in primary teeth by volumetric analysis: In vitro study. International Journal of Clinical Pediatric Dentistry. 2018 Sep;11(5):386.
14. Dalmia S, Gaikwad A, Samuel R, Aher G, Gulve M, Kolhe S. Antimicrobial efficacy of different endodontic sealers against Enterococcus faecalis: An in vitro study. Journal of International Society of Preventive & Community Dentistry. 2018 Mar;8(2):104.
15. Rai R, Shashibhushan KK, Babaji P, Chandrappa PM, Reddy VR, Ambareen Z. Clinical and radiographic evaluation of 3Mix and Vitapex as pulpectomy medicament in primary molars: An in vivo study. International Journal of Clinical Pediatric Dentistry. 2019 Nov;12(6):532.
16. Aragão AC, Pintor AV, Marceliano- Alves M, Primo LG, Silva AS, Lopes RT, Neves AD. Root canal obturation materials and filling techniques for primary teeth: In vitro evaluation in polymer- based prototyped incisors. International journal of paediatric dentistry. 2020 May;30(3):381-9.
17. Brar GS, Bajaj N, Bhola M, Brar JK. Clinical evaluation of root resorption and its correlation with obturation quality in pulpectomized deciduous teeth with different obturating materials: An In vivo study. Contemporary Clinical Dentistry. 2019 Apr;10(2):243.
18. Rifkin A. The root canal treatment of abscessed primary teeth-there to four year follow up. J Dent Child 1982; 49: 429-431
19 Mozayeni MA, Haeri A, Dianat O, Jafari AR. Antimicrobial effects of four intracanal medicaments on enterococcus faecalis: an in vitro study. Iranian endodontic journal. 2014;9(3):195.
20. Navit S, Jaiswal N, Khan SA, Malhotra S, Sharma A. Antimicrobial efficacy of contemporary obturating materials used in primary teeth-an in-vitro study. Journal of Clinical and Diagnostic Research: JCDR. 2016 Sep;10(9):ZC09.
21. Orhan AI, Tatli EC. Evaluation of Root Canal Obturation Quality in Deciduous Molars with Different Obturation Materials: An In Vitro Micro-Computed Tomography Study. BioMed Research International. 2021 Jul 3;2021.