
Endodontic Sealers with Antibiofilm Properties - A Review

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Abstract: Oral bacteria have evolved to form biofilms on hard tooth surfaces and dental materials. Dental materials used in root canal treatment have undergone substantial improvements over the past decade. However, in one place that still has the ability of passage fillings to effectively entomb, kill bacteria, and stop the formation of a biofilm, all of which will prevent reinfection of the root canal system. The most important work of the sealer is to seal the root canal system by removing the remaining bacteria and filling of inaccessible areas of prepared canals. Sealer selection may influence the outcome of endodontic treatment. Endodontics, root canal sealers are from observations of bases and liners containing the material and their antibacterial and tissue repair abilities. There are three types of endodontic sealers: Group 1: Zinc oxide eugenol based sealers, for example, DSI Zoer, Tubli-Seal. Group 2: Calcium Hydroxide based sealers, for example, Sealpex, Group 3: Resin-based sealers, for example, AH26, AH Plus, Diaket, in order to enhance the antimicrobial properties of sealer, nanoparticle has been incorporated into the sealers. It can reduce the microorganism's growth in the canal. The aim of this review article is to convey which endodontic sealer has good antibacterial effect and which has least antibacterial effect, so several articles have been collected and analysed and concluded.

Keyword: Root canal sealer; antimicrobial; biofilm; root canal; microorganisms

INTRODUCTION

Microorganisms and their products are the main etiologic factors responsible for pulpal diseases and periapical lesions (Beyth *et al.*, 2013) (Janani, Palanivelu and Sandhya, 2020). Microorganisms found in root canals are commonly organized biofilms, in which they are more resistant to antimicrobials than bacteria in the planktonic state (Upadya and Kishen, 2010). The objectives of root canal treatment are elimination of infection from the root canal and prevention of its reinfection by filling and sealing the root canal space (Gagliani, Gorni and Strohmenger, 2005) (Hancock *et al.*, 2001). Endodontic sealers play an important role in controlling infection by removing residual bacteria and protecting leakage of nutrients and reinfection of the root canal (Kapralos *et al.*, 2018) (Ramamoorthi, Nivedhitha and Divyanand, 2015).

Previous articles where their views about sealer are listed, Endodontic therapy is a way to eradicate the root canal microorganisms to achieve the fluid tight apical coronal sealers prevent and persist the microbial in root canal elimination in future reinfection (Paz, de Paz and Marsh, 2015). Some of the histological evaluation has failed due to the root canal failure of endodontic therapy that persists the microorganisms within the root canal system after treatment (Ricucci *et al.*, 2009). Endodontic treatment failures due to the dominated anaerobic facultative microorganisms like gram-positive cocci and rods (Grönholm *et al.*, 2013). Last decades shows that intracanal bacteria were organized as biofilm which enables the higher resistance in both antimicrobial agents as well in host defense mechanisms (Gillen *et al.*, 2011). Most endodontic sealers have antibacterial activity that initiates diffusion and tries to inhibit the reinfection. Mixed sealers have some components which are in fluid form like eugenol zinc oxide which contain thymol-para formaldehyde preventing the inflammation of dentin (Kayaoglu *et al.*, 2005). Methacrylate resin based root canal sealers which sometimes can cause inflammation (Ramesh, Teja and Priya, 2018) and can easily adhere to the root dentin which create an impervious seal that prevent microbial progressives in saliva (Kim *et al.*, 2010). There are so many endodontic sealers that among that zinc oxide eugenol has large microbial activity next to it calcium

hydroxide shows large microbial activity. Antibacterial action of calcium hydroxide can release hydroxyl ions which have higher pH (Bodrumlu and Semiz, 2006) can inhibit the growth of the microorganisms. It can be incorporated with chlorhexidine and cetrimide which add more degree of antimicrobial property to the sealer (Siqueirajr *et al.*, 2000). Chemicals like chlorhexidine have effective properties when it is incorporated with neem (Siddique *et al.*, 2019) (Noor, S Syed Shihaab and Pradeep, 2016), benzalkonium chloride can be added to the sealers which increase the antibacterial property. When benzalkonium chloride chemical is incorporated with all the sealer the mechanism of this chemical it can alternate the cell membrane charge distribution and can cause bacterial death (Neff, Layman and Jeansonne, 2002) (Duarte *et al.*, 2010). Sometimes the natural synthesized material can be used as root canal sealer (R, Rajakeerthi and Ms, 2019) (Rajendran *et al.*, 2019).

The main difference between the previous article and this article emphasis the antimicrobial properties of endodontic sealers, where there are some articles which concentrate only on particular sealers whereas it is difficult to find out the good effective antimicrobial endodontic sealer. Our team has rich experience in research and we have collaborated with numerous authors over various topics in the past decade (Deogade, Gupta and Ariga, 2018; Ezhilarasan, 2018; Ezhilarasan, Sokal and Najimi, 2018; Jeevanandan and Govindaraju, 2018; J *et al.*, 2018; Menon *et al.*, 2018; Prabakar *et al.*, 2018; Rajeshkumar *et al.*, 2018, 2019; Vishnu Prasad *et al.*, 2018; Wahab *et al.*, 2018; Dua *et al.*, 2019; Duraisamy *et al.*, 2019; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Gheena and Ezhilarasan, 2019; Malli Sureshbabu *et al.*, 2019; Mehta *et al.*, 2019; Panchal, Jeevanandan and Subramanian, 2019; Rajendran *et al.*, 2019; Ramakrishnan, Dhanalakshmi and Subramanian, 2019; Sharma *et al.*, 2019; Varghese, Ramesh and Veeraiyan, 2019; Gomathi *et al.*, 2020; Samuel, Acharya and Rao, 2020)

Aim of the article is to find out the good effective antimicrobial that inhibits the growth of microorganisms in the root canal, by knowing better properties of sealer we can select the appropriate sealer during treatment properties. It acts as a sealer coat that helps from tooth reinfection.

MATERIALS

Several review were collected from pubmed, Google scholar as it is based on the PMC database which midline embrace and cochrane. Only the antibacterial activity of endodontic sealers were considered whereas other properties of endodontic sealer were not considered

DISCUSSION

Root canal reinfection

The microbial etiology of an organism has ability to survive even in the harsh environmental conditions that are in the tooth which can easily adhere to the root canal, the access opening of the root canal is done by a rotary instrument (Zhang, Du and Peng, 2015) (Ramanathan and Solete, 2015) (Jose, P. and Subbaiyan, 2020). The biofilms of the sealers are more resistant to disinfection and some natural extracted fruits can be used to prevent from the enamel erosion (Neelakantan *et al.*, 2017) (Nasim and Nandakumar, 2018). This disinfection when act in the root canal system can easily accomplish the microbial control phase. The purpose of root canal therapy is to clear up the intra-canal infection and thoroughly sterilize the root canal, and then fill up the root canal system dimensionally, so as to prevent reinfection. From proper disinfection and debridement of canals, there is one more factor which most important is the quality of obturation. For the successful RCT quality of the sealer plays vital role and a veneer is a porcelain restoration covering the front of a tooth. When a veneered tooth is in need of root canal therapy, the endodontist will make an access point on the back side of the tooth then seal with a filling (Tronstad *et al.*, 2000) (Kumar and Delphine Priscilla Antony, 2018; Ravinthar and Jayalakshmi, 2018). A well access opening, cleaning and shaping (Teja and Ramesh, 2019), sealing coronal restoration is essential after the completion of obturation as it would prevent the ingress of any microorganisms from the environment (Kerekes and Tronstad, 1979). Intracanal medicaments have been used to disinfect root canals between appointments and reduce interappointment pain (Manohar and Sharma, 2018).

Pure form of sealers

There are some of the sealers which can be obtained naturally silicate based root canal sealed particles which incementation phase is composed on natural form materials like zirconium, hafnium and oxygen (Camilleri, 2014) and other sealer like MTA Fillapex revealed that its outer layer is rich in carbon, calcium, oxygen, silicon and titanium (Camilleri, 2011). Which especially can bind, one more sealer AH plus resin based sealer which consist of oxygen, calcium, zirconium and tungsten these are the some of sealer which consist of pure of material (Viapiana *et al.*, 2014). Some of the sealer composition is represented as flowchart

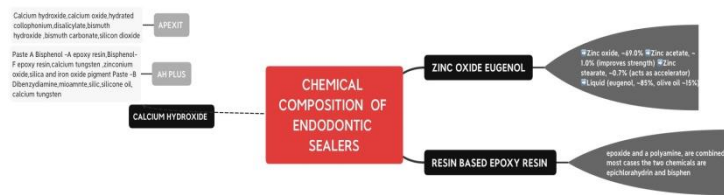


Fig.1: Composition of sealers

Sealers with antimicrobial properties

The most successful sealer is zinc oxide eugenol which has antimicrobial properties and its widely used among the clinicians especially used with thermoplasticized obturation technique(Gutmann and Rakusin, 1987). Zinc oxide eugenol sealer with paraformaldehyde is both cytotoxic and mutagenic,inflammation with zinc oxide eugenol sealers has been seen, both in soft tissue and in the bone(Zander, 1939). Calcium hydroxide sealers exhibit antimicrobial activity and have osteogenic-cementogenic potential. Addition of calcium hydroxide to the sealers,it is used as bases or liner antibacterial and tissue regenerating ability, the release of calcium hydroxyl ions through leaching to the surrounding tissue(Miletić *et al.*, 2000). Sealapex is a kind of sealer that is made of calcium hydroxide ,that undergoes several cytotoxic activities that probably resulted from components/additives such as polymethylene methyl(Nasim *et al.*, 2018)(Bouillaguet *et al.*, 2006). Resin based sealers like AH26 is a slow setting epoxy resin that was found to release formaldehyde when setting.The modification formulation of AH Plus is AH 26 if formaldehyde is removed .

Antimicrobial effectiveness

In some article they have performed the antimicrobial activity within zinc oxide eugenol,calcium hydroxide ,resin based,AH 26 and Apexit.This activity results that zinc oxide eugenol has largest zone of inhibitory whereas epoxy resin based sealer have lesszone of inhibitory than zno E followed by calcium hydroxide(Orstavik, 1981) whereas AH 29 exhibited the zone of bacterial growth inhibition(Grossman, 1980) whereas the Apexit sealers do not show any antimicrobial activity(Spångberg, Barbosa and Lavigne, 1993). Antimicrobial growth of the sealer emphasizes the good ability of antimicrobial effect. Thus for the optimum growth of the microorganisms require several parameters like temperature,PH,time etc(Meyer *et al.*, 2007). Antimicrobial activity of some of the sealer results are given in the flowchart form

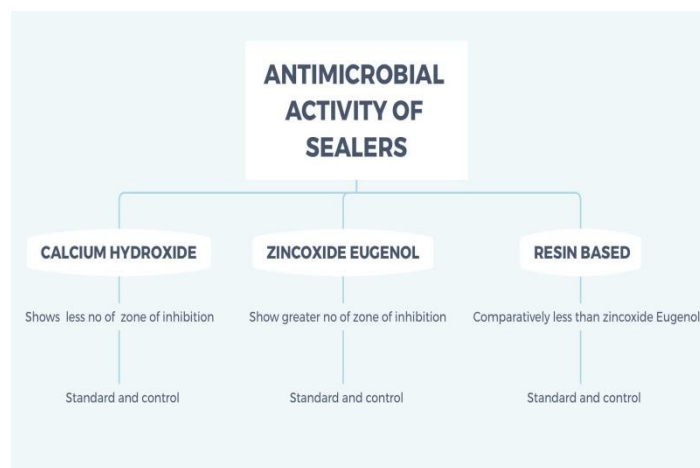


Fig.2: Antimicrobial activity performed by sealer

The limitation of this study is that only few sealers were analysed for the antimicrobial property,the further scope of this studies naturally healing sealers can be found in order cause less reinfection in the root canal.Our institution is passionate about high quality evidence based research and has excelled in various fields (Pc, Marimuthu and Devadoss, 2018; Ramesh *et al.*, 2018; Vijayashree Priyadharsini, Smiline Girija and Paramasivam, 2018; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Ramadurai *et al.*, 2019; Sridharan *et al.*, 2019; Vijayashree Priyadharsini, 2019; Chandrasekar *et al.*, 2020; Mathew *et al.*, 2020; R *et al.*, 2020; Samuel, 2021)

CONCLUSION

Zinc oxide Eugenol has large microbial activity whereas epoxy resin based sealer has least antimicrobial activity than calcium hydroxide based root canal sealer shows most least antimicrobial activity. With the help of review article we can able to conclude that zinc oxide eugenol has large microbial activity so that can be used as endodontic sealer. This zinc oxide eugenol can be recommend for obturating material which has less toxic effect, that causes no reinfection in the canal .

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