



# **Physicochemical Evaluation of Bioactivated Zinc Oxide and Eugenol Based Sealer Using Cement Bypass Dust**

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## **Dedication**

*I dedicate this work to:*

***My support system my Mother and to my devoted father***

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***My supportive sister and her husband***

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## **List of Abbreviations**

<b>ADT</b>	Agar Diffusion Test
<b>ANSI</b>	American National Standards Institute
<b>Bis GMA</b>	Bisphenol A Glycidal Methacrylate
<b>CBPD</b>	Cement Bypass Dust
<b>CHX</b>	Chlorohexidine
<b>DC</b>	Dimensional Change
<b>DCT</b>	Direct Contact Test
<b>FL</b>	Flow
<b>GP</b>	Gutta percha Points
<b>HCT</b>	Helical Computed Tomography
<b>HEMA</b>	Hydroxy Ethyl Methacrylate
<b>ISO</b>	International Organization For Standardization
<b>MTA</b>	Mineral Trioxide Aggregate
<b>NZOE</b>	Nano Zinc Oxide-Eugenol
<b>PBS</b>	Phosphate Buffer Solution
<b>PC</b>	Portland Cement

<b>PEGDMA</b>	Poly Ethyethylene Glycol Di Meth Acrylate
<b>RD</b>	Radiopacity
<b>SCT</b>	Spiral Computed Tomography
<b>SL</b>	Solubility
<b>ST</b>	Setting Time
<b>TEM</b>	Transmission Electron Microscope
<b>UDMA</b>	Urethan Di Meth Acrylate
<b>XRD</b>	XRAY Diffraction
<b>XRF</b>	XRAY Fluorescence
<b>ZOE</b>	Zinc Oxide- Eugenol

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## **1. Introduction**

Proper cleaning and shaping of the root canal complex followed by obturation are the key of success of a root canal treatment. A 3-D hermetic seal of the root canal system is the main objective of obturation and is reached by the means of a core material mainly gutta percha or Epiphany - resilon in conjugation with a root canal sealer material.

Filling the irregularities between the core material and the dentinal tubules as well as the narrow accessory and lateral canals is the main indication of root canal sealers.<sup>1</sup>

According to Grossman, an ideal root canal sealer should have the following properties; adequate flow, dimensional stability, biocompatibility, slow setting time, adhesiveness, absence of staining, radiopacity, lack of solubility in tissue fluids and bactericidal. Non of the sealers till this day is considered ideal as they lack one or more of the ideal properties.<sup>2</sup>

According to the main chemical constituents, sealers are categorized into zinc oxide eugenol (ZOE), glass ionomer, calcium hydroxide, silicone, mineral trioxide aggregate (MTA), resin, and bio-ceramic-based sealers. Mineralization through forming hydroxyapatite crystals is the new dimension that MTA and bio-ceramic opened besides the creation of a hermetic seal.<sup>3</sup>

Although the combination of gutta-percha core material and conventional zinc oxide eugenol sealer has multiple advantages, it has its own shortcomings; like the inadequate sealing ability, failure to strengthen the root because it doesn't adhere to dentin, can't control microleakage and finally it's solubility that affects the long-term success of the root canal treatment.

Bioactive materials have the ability to induce hard tissue formation in both the bone and the dental pulp, calcium silicate is considered one of these materials. For these materials to seal the apex there should be an interaction between periapical tissues and the root canal filling materials.

One of the byproducts that come out during the manufacture of white Portland cement industry is the cement bypass dust (CBPD). Large quantities of (CBCD) which is a calcium silicate – based material come out as waste dust generated from white Portland cement kilns. CBPD is composed of 50% of Lime (Ca O) and other components include  $\text{SiO}_2$ ,  $\text{Na}_2\text{O}$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{SO}_3$ ,  $\text{MgO}$ , and  $\text{K}_2\text{O}$ ).

Approximately, 2.5-3.0 million tons of cement dust is produced annually in Egypt. It has the potential for reuse in many different channels, but has not yet been used in the medical and dental fields.

Despite the well-known advantages of zinc oxide and eugenol root canal sealer, the introduction of recent bioactive sealers caused a decline in its use.

The aim of this study was therefore be directed towards combining the advantages of a conventional zinc oxide and eugenol root canal sealer with that of the calcium silicate based bypass waste powder; a byproduct of manufacturing Portland cement. This was done in an attempt to bioactivate the commercially available zinc oxide and eugenol based sealer.

## **2. Review of literature**

The three triads of an endodontic treatment are the diagnosis followed by cleaning and shaping and the last step is the obturation. The main goal of obturation is to achieve a hermetic seal to prevent the reinfection of the root canal space. Filling the root canal space is done using a core material mainly gutta percha or resilion and due to their poor sealing ability; it must be used with a root canal sealer to fill the spaces between the gutta-percha and the root canal wall.<sup>4</sup>

Sealers main functions are: (i) sealing of voids, accessory canals, and multiple foramina, (ii) forming a bond between the core of the filling material and the root canal wall, and (iii) acting as a lubricant facilitating the placement of the filling core and entombing any remaining bacteria.<sup>2</sup>

The root canal sealer should be capable of creating an effective bond between the core material and dentine of the root canal thus preventing microleakage. It should also be non-toxic and bioactive having a positive effect on the healing of periapical lesions. According to Grossman; an ideal root canal sealer should have the following properties; adequate flow, dimensional stability, biocompatibility, slow setting time, adhesiveness, absence of staining, radiopaque, insolubility in tissue fluids and bactericidal effect.