BIOCERAMIC-BASED ROOT CANAL SEALERS: A REVIEW

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Abstract*:*

The search for a perfect root canal obturation led to the develop of a new class of materials. Tricalcium silicat base sealer or bioceramic sealers are the answers to some problems that appeared with traditional warm obturation techniques. The aim of this review is to evaluate the new material based on literature findings. An extensive search of the endodontic literature was made to identify publications related to bioceramic-based root canal sealers. The properties, such as adhesion, biocompatibility, solubility, antimicrobial efficiency were evaluated in an laboratory manner. We have a lack of proper evaluation with in vivo studies, thus having an open for further studies.
Keyword: bioceramic, sealer, adhesion, biocompatibility, review

1. Introduction

The purpose of root canal obturation is to seal all "portals of exit" to impede any sort of communication or exchange between the endodontium and periodontium. It must therefore completely and durably fill the root canal space, in which no empty spaces should remain at all[1]. Traditional an obturation material consist in a solid core, ex gutappercha, and sealer. Root canal sealers have been reviewed across a number of studies, either collectively [2] or based on their composition, including zinc oxide eugenol [3], calcium hydroxide [4], glass ionomer [5], and resin-based sealers [6]. A new category of sealers has gain popularity, tricalcium silicat based.

Traditional sealers give good obturation combined with gutta-percha, specially used in warm techniques. But warm techniques are difficult to manage, need expensive tools and have a great learning curve.
Bioceramic root canal sealers are new materials that have been developed that overcome some of these shortcomings. Bioceramics with a perfect combination of sealing ability and biocompatibility and possessing favorable characteristics closer to that of an ideal root canal sealer, have shown promising results7.

The biological and physical properties of bioceramic-based root canal sealers were reviewed based on the ideal root canal sealer properties as described by Grossman [8], as in the following list:

1. It should be tacky when mixed to provide good adhesion between it and the canal wall when set.
2. It should make a hermetic seal.
3. It should be radiopaque so that it can be visualized on the radiograph.
4. The particles of powder should be very fine so that they can mix easily with liquid.
5. It should not shrink upon setting.
6. It should not discolor tooth structure.
7. It should be bacteriostatic or at least not encourage bacterial growth.
8. It should set slowly.
9. It should be insoluble in tissue fluids.
10. It should be well tolerated by the periapical tissue.
11. It should be soluble in common solvents if it is necessary to remove the root canal filling.

2. Ideal root canal sealer properties

2.1 **Adhesion**. Root canal sealer adhesion is defined as its capacity to adhere to the root canal dentin and promote GP cone adhesion to each other and the dentin.[9] There is no standard method used to measure the adhesion of a sealer to the root dentin; therefore, the adhesion potential of the root filling material is commonly tested using microleakage and bond strength tests [10].
Conventional GP does not attach to root canal dentin or root canal sealer[11], this explain why the apical leakage is higher when conventional techniques are used. To combat these situations, we have gutapercha cones that are coated with bioceramic sealer. Bioceramic sealers used with this tipe o cones produce the least amount of apical leakage.[12]
If we take in consideration the dentinal tubule penetration, there were no significant differences between epoxi sealers and bioceramic sealer. [13]
It is well know that bioceramic interact with dentin along the root canal to provide biomineralization[14] and forms a hybrid layer along the dentine which is rich in mineral.The bonding of is postulated to be chemical in nature as opposed to the sealer tags reported for resin-based sealers[15]. A big advantage for bioceramic sealer is the ability to bond in moist dentin[16]. This property was evaluated [17] and bioceramic

sealers show high bond forces in moist dentin, over epoxy reasins.

2.2 **Radiopacity**. Root canal sealers should be sufficiently radiopaque so as to be distinguishable from adjacent anatomical structures. According to ISO 6876/2001, the minimum radiopacity for a root canal sealer is based on a reference standard of 3.00 mm of aluminium. To achieve this standard, producers incorporate radiopacifiers in bioceramic sealers. Studies raveled that this opacifiers doesn't modify the properties of bioeceramic sealers.[18]

2.3 **Solubility.** Solubility is the mass loss of a material during a period of immersion in water. According to ISO specification 6876:2012, the solubility of a root canal sealer should not exceed 3% by mass after 24 hours. A highly soluble root canal sealer would invariably permit the formation of gaps within and between the material and the root dentin, thereby providing avenues for leakage from the oral cavity and periapical tissues,[19] whereas the leaching of chemicals may be irritating to the periapical tissues. [20]

Epoxy resins meet the ISO specification at 24h, at one week they exceed the specification.[21], bioceramic sealers, doesn't meet the iso specification at 24h and show higher solubility. However, the literature contains conflicting accounts that might be attributed to variations in the methods used to dry the samples after having subjected them to solubility testing.

2.4 **Setting time**. Ideal sealer should have a setting time that allows the operator to do all the procedures. Higher setting times could bring irritants to the apical tissues Bioceramic sealers show higher setting times despite the manufacturers indicate. [22] [23]

2.5 **Touth discoloration**. Root canal sealer, ideal, should not produce modification in teeth color. If not proper cleaned bioceramic sealer produce some color modification [24]. specially in the cervical root third

2.6 **Retreatability.** Root filing create a good barrier between bacteria and apical tissue, preventing apical inflammation. Despite a high success rate, some time we have to do retreatment's, and during retreatment most of the time old sealer remains in the endodontic system.[25] Multiple studies [26],[27],[28],[29] show that bioceramic sealer compare the same with epoxi sealer. Even using US to remove higher percent, still in the apical part we can observe sealer remnants.

2.7 **Fiber post placement**. Every endodontic treatment must be finished by a proper coronal seal. This is usually done by bonding composite material or by placing fiber post in teeth that are more compromise. When one needs to place a fiber post, he needs to remove the filing material from cervical or middle part. The remaining sealer and it's composition affects the bond strength of the fiber post luting cement.[30],[31],[32],[33]. Bioceramic sealers are easy to remove compared with epoxy resin and the adhesion of the luting cement is higher, specially when the post space is cleaned using ultrasonic.[34]

2.8 **Strengthening effect**. In most of the time, preparation of the root canal system doesn't waken the tooth. Internal resorption is a pathology that weakens the root walls and strength. In this situation one needs a material that give strength to the root. Gutapercha, used for obturation, is very soft, adapts well to root walls and give a hermetic seal, but it doesn't give strength to the tooth. Glass-ionomer cement is used to fill root

resorptive defects and root perforations due to its biocompatibility and antibacterial effects. It provides a satisfactory clinical performance when used as a root canal sealer or as an orthograde filling material because of its good adhesion and strength, which increases the resistance of the teeth to vertical fractures.[35] Bioceramics give the same adhesion and tooth strength when was compared with GIC and higher then gutapercha and epoxy sealer. [36],[37]

2.9 Biocompatibility and Antimicrobial Properties.

Biocompatibility is defined as the ability of a material to achieve a proper and advantageous host response in specific applications**.** When one tries to make a perfect obturation, often we se overfilling. In most of the cases, sealer reasorbtion by the organism is observed. To evaluate biocompatibility of bioceramic sealer, most of the time in vivo studies have been used, using osteoblast culture cell.

Bioceramic sealers can produce an alkaline pH after mixing, due to the presence of calcium hydroxide on its composition, calcium release is important for the bioactivity of this sealer class. [38]

Compared with epoxiresin sealers and MTA Fillapex, bioceramic sealers show less citotoxicity. As ISO 10993-514 [39] accepts as cytocompatible sealers, materials that have viability values superior to 70%, it is possible to affirm that the tested materials provided positive results, emphasizing BC Sealer that presented a greater percentage of cellular viability and wound closure faster than the other sealers tested [40].

Many commercial sealers claimed to have antimicrobial properties. It is important for a sealer to have these properties because it can help eliminating residual bacteria that escape chemo mechanic procedures. Bioceramic sealers have high PH and release calcium ions, which is key for antimicrobioal activity.

Evaluation of the antimicrobial activity is made using direct contact with biofilm or agar diffusion. Unfortunate this are in vitro test which have show some degree of activity for bioceramic sealers, but we don't have sufficient information about invivo action of them.

De Deus [41] also recommended that the conditions used should be similar to those in the

filled root canal. Hence, older tests like aggar diffusion test and direct contact test should be replaced with newer methodology.

3. Conclusion.

Introduction of the bioceramic sealer brought to as a new, great material with high biocompatibility. Evaluating them using actual methodology give us discrepancies in some aspects that define the ideal sealer properties. There for, we need more information and new studies to understand how this material work and how to improve them.

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