ISSN: 0975-766X
CODEN: IJPTFI
Available Online through
www.ijptonline.com
Review Article

BIOCERAMICS IN ENDODONTICS

Karthiga KS[1], Dr. Pradeep.S[2]
[1]Undergraduate, Saveetha Dental College, Chennai.
[2]Department of Endodontics, Saveetha Dental College, Chennai.
Email: karthigasenthil57@gmail.com

Received on 20-08-2018 *Accepted on: 18-09-2018*

Abstract

Aim: The aim of this review is to highlight the applications of bioceramics in endodontics.

Objects: Bioceramics are ceramic materials specifically designed for use in medicine and dentistry. They include alumina and zirconia, bioactive glass, glass ceramics, coatings and composites, hydroxyapatite and resorb-able calcium phosphates, and radiotherapy glasses.

Background: Bioceramic materials are currently available in three forms: sealer, paste, and putty, and have a variety of clinical applications. Some are premixed, and some require manual mixing.

Bioceramics are exceedingly biocompatible, non–toxic, do not shrink, and are chemically stable within the biological environment they do not result in an inflammatory response if an over fill occurs during the obturation process or in a root repair. Another advantage of the material is its ability (during the setting process) to form hydroxyapatite and ultimately create a bond between dentin and the filling material. A significant component of improving this adaptation to the canal wall is the hydrophilic nature of the material. In summary, it is a bonded restoration.

Reason: They have been used in endodontics as pulp capping and apexification material. They function as cements, root repair materials, root canal sealers and filling materials, which have the advantages of enhanced biocompatibility, potential increased root strength following obturation, antibacterial properties and sealing ability.

Introduction

The term ‘bioceramics’ refers to biocompatible ceramic materials, applicable for biomedical or dental use. Bioceramics are exceedingly biocompatible, non–toxic, do not shrink, and are chemically stable within the

biological environment. Additionally, and this is very important in endodontics, bioceramics will not result in a significant inflammatory response if an overfill occurs during the obturation process or in a root repair.[1]

A further advantage of the material itself is its ability to form hydroxyapatite during the setting process and ultimately create a bond between dentin and the filling material. A significant component of improving this adaptation to the canal wall is the hydrophilic nature of the material. In essence, it is a bonded restoration[2]. However, to fully appreciate the properties associated with the use of bioceramic technology, we must understand the hydration reactions involved in the setting of the material[3].

The formation of calcium hydroxide as a by-product of the setting reaction produces a very high pH (12.8) rendering the material anti-bacterial during its setting time (the pH will decrease over the next seven days). This is an important physical property for a cement, because it is being used as an endodontic sealer[4].

Classification

Bioceramics can be classified as the following:

• **Bioinert:** Non interactive with biological systems.

• **Bioactive:** Durable tissues that can undergo interfacial interactions with surrounding tissue.

• **Biodegradable, soluble or resorbable:** Eventually replace or incorporated into tissue. This is particularly important with lattice frame works[5].

Mechanism of Action

Bioceramic sealers use the water inherent in the dentinal tubules for the setting reaction thus beginning the hydration reaction of the material. The setting time is reduced. Dentin is believed to contain about 20 percent water [6]. This water is responsible for the setting of the material. These sealers are available as premixed endodontic cement.

Upon hydration, calcium silicate gel and calcium hydroxide are produced by the calcium silicates in the powder. The calcium hydroxide reacts with phosphate ions and produces the precipitation of hydroxyapatite and water. The hydroxyapatite that is produced can be used for reconstruction material and in bone repair as is nontoxic. The continuous interaction of calcium silicate and water leads to production of calcium silicate hydrate[7].

Bioceramic as Endodontic Sealer

Bioceramics are highly successful endodontic sealers and have several advantages such as improved biocompatibility, sealing ability, anti-bacterial activity, ease of application and an increase in the strength of the root following obturation.

The extreme biocompatibility of bioceramics can also be observed in cases of root repair where there is absence of inflammation and pain or following an overfill during obturation. The bioceramic sealer can be used in the root canal by the use of a premixed syringe. Thus the need for mixing of the sealer is not required which avoids problems such as insufficient and non-homogenous mix. Bioceramics are hydrophilic in nature and have the ability to form hydroxyapatite. They lead to the formation of a chemical bond between the filling material and dentin walls.

This eliminates the presence of any space between the dentinal walls and sealer which enhances the seal. The bioceramic sealer has a particle size of 2 μ aiding in its delivery by the means of a capillary tip. Bioceramics have shown radiopacity and flow and have increased resistance of the fracture of the endodontically treated roots.

Synchronised hydraulic condensation is feature of some bioceramic sealers. This involves the formation of a true bonding between the root canal wall and the master cone. Bioceramic sealer can be placed by the use of intracanal tip. These tips are flexible and allow the user additional benefits such as better access to the root canal. Capillary tips can also be used to place the sealer.

Bioceramics as a Root Repair Material

Endo Sequence Root Repair material specifically has been created as white premixed cement for both permanent root canal repairs and apicoretrofillings. As a true bioceramic cement, the advantages of this new repair material are its high pH (pH >12.5), high resistance to washout, no shrinkage during setting, excellent biocompatibility. It has a compressive strength of 50-70 MPa, which is similar to that of root canal repair materials, ProRoot MTA (Dentsply) and BioAggregate (Diadent). The most significant feature with this material is its particle size(less than 2 μ, which allows the premixed material to be extruded through a syringe rather than inconsistent mixing by hand and then placement with a hand instrument. Some of its usesas a root repair material is that it is Radiopaque and no mixing is required.

Pulp Capping With Bioceramics

Bioceramic sealers can be used by syringe having a capillary tip due to its small particle size. Thus pulpal therapies or pulp caps in young patients can be better managed and with ease. It can also be used for direct pulp cappping. The procedure begins with the isolation of the tooth by the rubber dam. After this disinfection of the exposure site is carried out by NaOCl and cotton. The exposure site can be covered by bioceramic in putty form or in the premixed form. The bioceramic material can then be covered by glass ionomer restoration or Compomer. Finally the restoration is done. Etching if required can be carried out. Single visit pulp capping may be carried out.

Conclusion

In conclusion, bioceramic materials have excellent biocompatibility and material properties that render them ideal for endodontic care. The EndoSequence BC sealer and root repair material, in particular, demonstrate favorable clinical properties for their use as either an endodontic sealer or root repair material. Furthermore, the improved efficiency and mode of delivery offered by this system, makes it far easier to use than the previous bioceramic systems for both surgical and non-surgical applications.

References

1. A. Kaur, N. Shah, A. Logani, and N. Mishra, "Biotoxicity of commonly used root canal sealers: a meta-analysis," *Journal of Conservative Dentistry,* vol. 18, no. 2, pp. 83–88, 2015.
2. D. Orstavik, "Materials used for root canal obturation: techni- cal, biological and clinical testing," *Endodontic Topics*, vol. 12, no. 1, pp. 25–38, 2005.
3. K. Markowitz, M. Moynihan, M. Liu, and S. Kim, "Biologic properties of eugenol and zinc oxide-eugenol. A clinically oriented review," *Oral Surgery, Oral Medicine, Oral Pathology,* vol. 73, no. 6, pp. 729–737, 1992.
4. S.DesaiandN.Chandler,"Calciumhydroxide-basedrootcanal sealers: a review," *Journal of Endodontics*, vol. 35, no. 4, pp. 475– 480, 2009.
5. R. A. Buck, "Glass ionomer endodontic sealers—a literature review," *General Dentistry*, vol. 50, no. 4, pp. 365–368, 2002.
6. Y. K. Kim, S. Grandini, J. M. Ames et al., "Critical review on methacrylate resin–based root canal sealers," *Journal of Endodontics*, vol. 36, no. 3, pp. 383–399, 2010.

7. L. L. Hench, "Bioceramics: from concept to clinic," *Journal of the American Ceramic Society*, vol. 74, no. 7, pp. 1487–1510, 1991.
8. S.M.Best,A.E.Porter,E.S. ian,andJ.Huang,"Bioceramics: past, present and for the future," *Journal of the European Ceramic Society*, vol. 28, no. 7, pp. 1319–1327, 2008.
9. K.KochandD.Brave,"Anewdayhasdawned:theincreaseduse of bioceramics in endodontics," *Dentaltown*, vol. 10, pp. 39–43, 2009.
10. K. C. Saikia, T. D. Bhattacharya, S. K. Bhuyan, D. J. Talukdar, S. P. Saikia, and P. Jitesh, "Calcium phosphate ceramics as bone gra substitutes in lling bone tumor defects," *Indian Journal of Orthopaedics*, vol. 42, no. 2, pp. 169–172, 2008.
11. R. LeGeros, A. Chohayeb, and A. Shulman, "Apatitic calcium phosphates: possible dental restorative materials," *Journal of Dental Research*, vol. 61, article 343, 1982.
12. K. F. Krell and J. S. Wefel, "A calcium phosphate cement root canal sealer—scanning electron microscopic analysis," *Journal of Endodontics*, vol. 10, no. 12, pp. 571–576, 1984.
13. K. V. Krell and S. Madison, "Comparison of apical leakage in teeth obturated with a calcium phosphate cement or Grossman's cement using lateral condensation," *Journal of Endodontics*, vol. 11, no. 8, pp. 336–339, 1985.
14. A. A. Chohayeb, L. C. Chow, and P. J. Tsaknis, "Evaluation of calcium phosphate as a root canal sealer- ller material," *Journal of Endodontics*, vol. 13, no. 8, pp. 384–387, 1987.
15. A. Jean, B. Kerebel, L.-M. Kerebel, R. Z. Legeros, and H. Hamel, "E ects of various calcium phosphate biomaterials on reparative dentin bridge formation," *Journal of Endodontics*, vol. 14, no. 2, pp. 83–87, 1988.
16. E. Pissiotis and L. S. W. Spngberg, "Biological evaluation of col- lagen gels containing calcium hydroxide and hydroxyapatite," *Journal of Endodontics*, vol. 16, no. 10, pp. 468–473, 1990.

Corresponding author:

Karthiga KS,

Email: karthigasenthil57@gmail.com