Revista Científica Sistemática
ISSN: 2675-521

INNOVATIONS IN ENDODONTIC PRACTICE: THE ROLE OF BIOCERAMIC CEMENTS

https://doi.org/10.56238/rcsv14n8-002

Date of submission: 03/11/2024 **Date of approval:** 03/12/2024

Waldir Martineli Filho

ABSTRACT

The advancement of bioceramic endodontic cements marks a significant development in endodontics, offering a compelling alternative to traditional materials. These cements are celebrated for their biocompatibility, effective sealing properties, and potential for tissue regeneration, making them particularly advantageous for root canal treatments. Recent studies have demonstrated their ability to promote mineralization and bone regeneration while exhibiting antibacterial properties that help reduce the risk of post-treatment infections, which is crucial for the success of endodontic procedures. Despite the notable benefits, the adoption of bioceramic cements faces challenges, such as the complexity of their application and cost considerations. Nonetheless, ongoing research and technological advancements are fostering greater acceptance and utilization of these innovative materials. Investigations into bioceramic cements reveal that they offer numerous benefits; however, there remains a pressing need for long-term randomized clinical trials to validate their effectiveness and establish clear clinical guidelines for their application. The integration of bioceramic cements into endodontic practice is essential for enhancing treatment outcomes, promoting long-term dental health, and advancing clinical practices in dentistry. The evolving landscape of endodontic materials emphasizes the importance of continuous research and development to ensure optimal patient care and successful interventions.

Keywords: Bioceramic Cements. Endodontics. Tissue Regeneration. Antibacterial Properties. Clinical Outcomes.

Revista Científica Sistemática
ISSN: 2675-521

INTRODUCTION

Bioceramic endodontic cements represent a notable advancement in endodontic practice, providing significant benefits over traditional filling materials. Composed of ceramic components that form a paste when mixed with water, these cements solidify upon curing, exhibiting properties that enhance their applicability in root canal treatments. Their biocompatibility, which ensures they are non-toxic and supportive of dental and periapical tissues, is crucial in procedures aimed not only at removing inflamed pulp but also at promoting tissue regeneration around the tooth root.

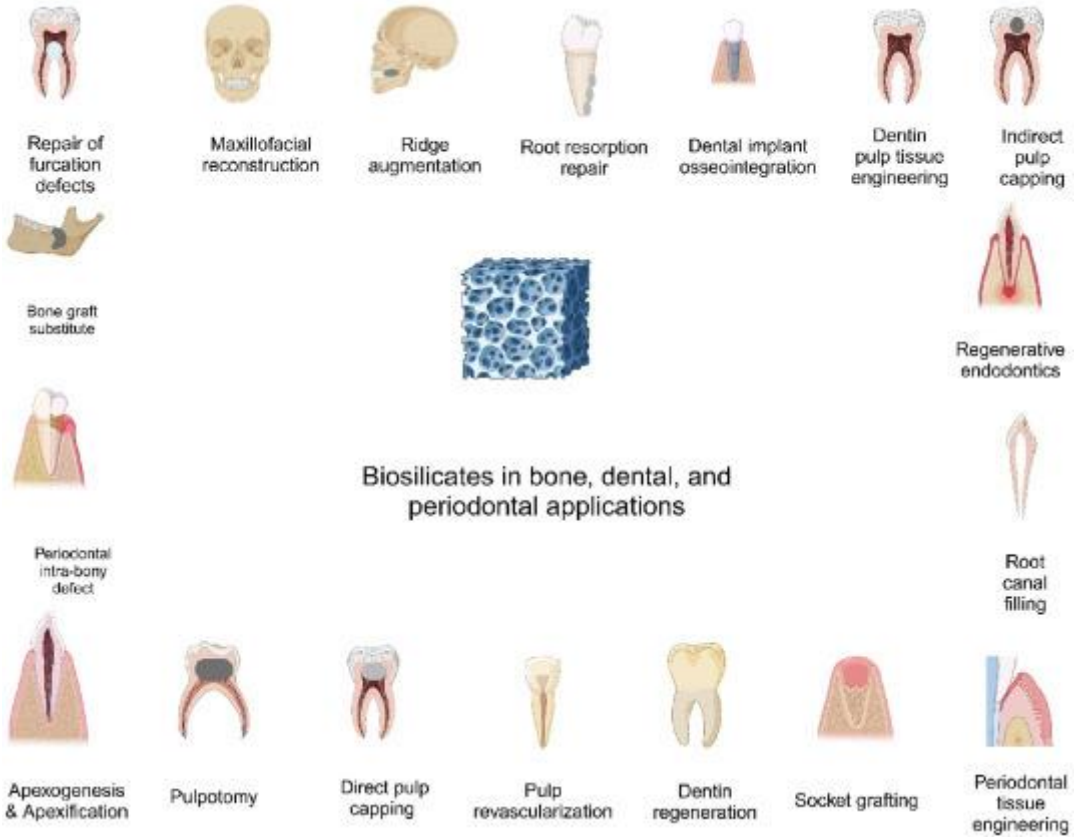
One of the standout characteristics of bioceramic cements is their effective sealing ability. Successful endodontic treatment relies on adequate sealing to prevent the infiltration of fluids and bacteria, which can lead to reinfection. Research indicates that bioceramic cements can conform to the irregularities of root canal shapes, effectively sealing microfissures and contributing to long-term treatment success. Additionally, many of these cements contain components such as calcium hydroxide and tricalcium silicate that encourage bone tissue regeneration, further supporting dental health by stimulating the formation of new bone around the treated tooth.

The antibacterial properties of bioceramic cements enhance their efficacy by inhibiting the growth of harmful microorganisms within the root canal, thereby minimizing the risk of post-treatment infections—a common cause of endodontic failure. Despite these advantages, the adoption of bioceramic cements faces challenges, including potentially complex application techniques and higher costs compared to conventional materials. Nevertheless, ongoing advancements in technology and research are likely to improve the acceptance and use of these innovative materials.

Recently introduced bioceramic calcium silicate cements have shown considerable promise in endodontic treatments. A study by Xavier et al. (2019) highlights that these biocompatible materials promote mineralization and maintain dimensional stability comparable to Fillapex MTA. They possess greater thickness and solubility than AH Plus, primarily because they are water-based. When stored in pre-mixed syringes, they retain a consistent consistency, making them particularly suited for the single cone obturation technique. Their design allows for bioactivity upon contact with tissue fluids, fostering osteoblastic differentiation of periodontal ligament cells and remineralization of dentin, alongside excellent antimicrobial properties. These features position bioceramic calcium silicate cements as an excellent option for achieving comprehensive root canal obturation.

Revista Científica Sistemática
ISSN: 2675-521

Figure 1: Advances in Bioceramic silicates for therapeutic, and regenerative Dentofacial reconstruction.



Source: Atia et al (2022).

Over the past two decades, substantial progress has been made in bioactive ceramics for endodontic applications, as reviewed by Wang (2015). This literature discusses the physico-chemical and biological properties of bioceramic materials, emphasizing their diverse roles in endodontics, including as cements, root repair agents, sealers, and filling materials. These bioceramic materials demonstrate enhanced biocompatibility, increased root strength post-obturation, antibacterial effects, and effective sealing capabilities. New bioceramic products have been developed to overcome limitations of earlier materials, establishing them as a viable choice in clinical settings. While initial in vitro studies have shown positive outcomes for bioceramic materials in endodontics, Wang stresses the importance of conducting randomized, double-blind clinical trials over extended periods to validate their long-term effectiveness.

A literature review by Jitaru et al. (2016) explored the primary bioceramic materials utilized in endodontics and their distinctive characteristics. Their research underlined that bioceramics are produced through various chemical processes, exhibiting excellent biocompatibility due to their resemblance to biological materials like hydroxyapatite. This similarity facilitates a regenerative response in the body, which is vital for endodontic applications. The authors conducted a comprehensive review of international databases,

particularly PubMed, focusing on studies from the past decade using keywords related to bioceramics in endodontics. Their findings noted that while traditional endodontic sealers, such as those containing zinc oxide and calcium hydroxide, have been clinically used for many years, newer biocompatible materials designed for specific situations—such as root resorption and apexification—are emerging, including ProRoot MTA, Biodentine, Endosequence BC sealer, Bioaggregate, and Generex A. Although the existing literature generally supports the effectiveness of these bioceramic materials, the authors emphasize the limited availability of products in the market and call for additional research to confirm reliable clinical outcomes as new options become available.

Relan et al. (2021) highlight the rapid expansion of the field of Endodontics, driven by advancements in materials, especially bioceramics. This category includes various substances like alumina, zirconia, bioactive glass, and hydroxyapatite, which are recognized for their biocompatibility and effectiveness in endodontic procedures. Bioceramics are particularly effective at sealing dentinal tubules and filling voids between dentinal walls and obturating materials. Their bioactivity fosters bone repair and new tissue formation through interaction with periapical tissues, making them highly valuable in endodontic treatments. The authors stress the necessity of understanding these newer bioceramic materials to ensure their proper selection based on specific clinical scenarios. Their review aims to provide guidance for practitioners in choosing the most suitable materials for successful endodontic outcomes.

Neto et al. (2020) tackled an essential issue in regenerative dentistry by assessing the properties of bioceramic cements that aid in periradicular and root regeneration. Their study aimed to compare endodontic treatments of necrotic teeth using PBS HP CIMMO® cement, which does not involve gutta-percha, against traditional treatments filled with gutta-percha. Conducted as a two-arm, double-blind, single-center, randomized, and prospective clinical trial (NCT03514264), the research adhered to CONSORT guidelines, enrolling 86 patients aged 18 to 60, each receiving treatment for one tooth. Group A underwent traditional gutta-percha thermoplasticization and vertical hydraulic compression with AH Plus®, while Group B was treated in a single session with PBS HP CIMMO®. Clinical examinations and CT imaging performed one year post-treatment assessed the presence of periradicular lesions. The results revealed significant differences between the groups, with Group B exhibiting a higher rate of periradicular regeneration (p=0.0004). These findings suggest that using bioceramic cement (PBS HP CIMMO®) for endodontic filling can

Revista Científica Sistemática
ISSN: 2675-521

effectively rehabilitate necrotic teeth in a single session, offering a promising alternative to conventional methods.

Finally, the study by Santana, Botelho, and Barros (2021) examines bioceramic cements as a viable alternative to traditional dental materials in endodontics, emphasizing their benefits compared to non-bioceramic cements used in root canal filling. The authors aimed to conduct a literature review on bioceramic cements in endodontics and analyze their genuine advantages and disadvantages relative to conventional cements. They consulted databases such as Pubmed, Scielo, Science Direct, and Google Scholar for their research. Their literature review concluded that bioceramic cements offer advantages, including enhanced biocompatibility, improved radiopacity, and favorable working times. However, they also identified drawbacks related to their clinical use and the lack of extensive studies addressing their specific applications in endodontics. These results underscore the necessity for additional research to validate the clinical use of bioceramic cements.

The evolution of bioceramic endodontic cements represents a significant milestone in endodontic practice, providing an innovative and promising alternative compared to traditional materials. With their biocompatibility, effective sealing properties, and potential for tissue regeneration, these cements stand out as a beneficial option for root canal treatments. Recent studies highlight their capabilities to promote mineralization and bone regeneration, as well as demonstrate antibacterial activities that can mitigate the risk of post-treatment infections, a crucial factor for the success of endodontic interventions.

Despite the challenges related to application complexity and cost, the growing acceptance and utilization of these technologies are driven by ongoing research and advancements in the field. Investigations reveal that, although bioceramic-based materials offer numerous advantages, there is still a need for long-term randomized clinical studies to consolidate their effectiveness and establish clear guidelines for their application. Thus, the implementation and understanding of these new materials are essential to optimize the outcomes of endodontic treatments, contributing to long-term dental health and the evolution of clinical practices in dentistry.

REFERENCES

1. Atia, G. A. N., Mohamed, S. Z., Halim, H. A., Ghobashy, M. M., Foda, T., Shalaby, H. K., ... & Khan, F. S. (2024). Advances in bioceramic silicates for therapeutic, and regenerative dentofacial reconstruction. *Ceramics International*.

2. Jitaru, Ș., Hodisan, I., Timiș, L., Lucian, A., & Bud, M. (2016). The use of bioceramics in endodontics - literature review. *Clujul Medical, 89*, 470-473. https://doi.org/10.15386/cjmed-612

3. Relan, K., Chandak, M., Nikhade, P., & Chandak, P. (2021). Bio ceramics: A modern approach to cements in endodontics. *International Journal of Current Research and Review*. https://doi.org/10.31782/IJCRR.2021.131019

4. Neto, J., Boczar, R., Veiga, D., Juliano, Y., & Schnaider, T. (2020). Bioceramic cement in endodontic fillings: A randomized clinical trial. *Journal of Dental Health, Oral Disorders & Therapy*. https://doi.org/10.15406/JDHODT.2020.11.00523

5. Santana, P., Botelho, E., & Barros, D. (2021). O uso de cimentos biocerâmicos em endodontia. *Revista de Odontologia e Ciências, 5*, 63-68. https://doi.org/10.31991/V5N12021ROCCIMENTO

6. Wang, Z. (2015). Bioceramic materials in endodontics. *Endodontic Topics, 32*, 3-30. https://doi.org/10.1111/ETP.12075

7. Xavier, V., Moreira, L., Xavier, D., Xavier, J., & Steine, W. (2019). Bioceramic cements in endodontics. *Oral Diseases*. https://doi.org/10.5772/intechopen.89015

8. Filho, W. M. (2024). Advances in bone remodeling and clear aligners in orthodontics. *International Seven Journal of Multidisciplinary, 3*(1). https://doi.org/10.56238/isevmjv3n1-027

9. Alves, L. D. (2024). Angled dental implants: Implications for clinical practice and biomechanical considerations. *International Seven Journal of Multidisciplinary, 3*(1). https://doi.org/10.56238/isevmjv3n1-026

10. Lopes, A. R. (2024). Previsibilidade em implantes dentários na área estética. *Revista Sistemática, 14*(5), 1355–1364. https://doi.org/10.56238/rcsv14n5-025

11. Lopes, A. R. (2024). Cirurgia tradicional e cirurgia guiada: Uma abordagem comparativa. *International Seven Journal of Multidisciplinary, 2*(6). https://doi.org/10.56238/isevmjv2n6-020

12. Bonon, M. R. C. D. (2024). Polidesoxirribonucleotídeo (PDRN): Inovações e potencial na regeneração e cicatrização tecidual. *International Seven Journal of Multidisciplinary, 1*(1). https://doi.org/10.56238/isevmjv1n1-011

13. Silva, S. C. R. (2024). O papel vital da saúde periodontal no controle do diabetes. *International Seven Journal of Multidisciplinary, 1*(1). https://doi.org/10.56238/isevmjv1n1-012

14. Pessoa, E. G., Feitosa, L. M., Pereira, A. G., & e Padua, V. P. (2023). Dimensionamento de uma barragem de terra. *Brazilian Journal of Development, 9*(10), 28232–28248. https://doi.org/10.34117/bjdv9n10-053

15. Pessoa, E. G. (2024). Conventional treatment in the removal of microcontaminants. *Seven Editora*. Disponível em: https://sevenpublicacoes.com.br/editora/article/view/5037. Acesso em: 20 nov. 2024