

Bioceramics Sealers in Endodontics: Properties, Applications and Future Directions

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Introduction

Bioceramic sealers have revolutionized endodontic therapy by offering superior sealing abilities, biocompatibility and bioactivity compared to traditional materials. Root canal sealing plays a crucial role in preventing reinfection and bioceramic-based sealers composed primarily of calcium silicates, phosphates and other ceramic-based compounds have demonstrated the capacity to form a chemical bond with dentin, promote hard tissue formation and provide excellent antimicrobial effects. Their ability to set in moist environments and induce hydroxyapatite formation makes them particularly suitable for clinical endodontic applications, where achieving a hermetic seal in a biologically compatible way is essential for long-term treatment success [1].

Description

The properties of bioceramic sealers that make them advantageous over conventional resin- or zinc oxide-eugenol-based sealers include excellent biocompatibility, non-toxicity, dimensional stability and a high pH environment that is hostile to bacteria. These materials exhibit minimal shrinkage, allowing them to maintain a strong seal even after setting. Bioceramic sealers like EndoSequence BC Sealer and BioRoot RCS have demonstrated an ability to encourage periapical healing and tissue regeneration. Their interaction with surrounding dentin stimulates mineralization and supports the formation of a biologic seal, which significantly reduces the risk of microleakage a common reason for endodontic failure.

In terms of application, bioceramic sealers are widely used in obturation techniques such as single-cone and warm vertical compaction methods. Their flowability ensures penetration into complex canal anatomy, including accessory canals and isthmuses, enhancing the quality of the obturation. These sealers are premixed, easy to handle and require minimal preparation, reducing chair time and improving clinical efficiency. Moreover, their ability to set in the presence of moisture allows them to be used in a wide range of clinical situations, including those with challenging canal conditions or residual moisture after drying. Their antimicrobial properties, primarily due to their alkaline nature, contribute to the long-term sterilization of the canal system.

The future directions for bioceramic sealers involve innovations aimed at improving their mechanical properties, radiopacity and retrievability during retreatment procedures. Current limitations include difficulty in complete removal during nonsurgical retreatment and variable radiographic visibility. Researchers are working to enhance the sealers' formulation to improve ease

of removal without compromising sealing ability. Moreover, nanotechnology and bioengineering may lead to the development of next-generation sealers with enhanced drug delivery capabilities, antimicrobial properties, or bioinductive features that support regenerative endodontics. The integration of bioceramic sealers into novel obturation systems and their use in combination with stem cell-based therapies are promising frontiers that may expand their application beyond traditional root canal therapy [2].

Conclusion

Bioceramic sealers have become indispensable in modern endodontic practice due to their remarkable sealing capability, biological compatibility and ease of use, which collectively enhance clinical outcomes and patient satisfaction. Their physical and chemical characteristics provide a more predictable and durable seal than traditional materials, while their ability to promote healing and hard tissue formation aligns well with the goals of biologically based endodontics. Although challenges remain particularly regarding retrievability and material visibility the continued evolution of bioceramic formulations and techniques holds great promise for overcoming these issues. As research progresses, these sealers are expected to play an increasingly central role in minimally invasive, regenerative and technologically advanced dental care, ultimately leading to more effective and long-lasting root canal treatments.

Acknowledgement

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Conflict of Interest

None.

References

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