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Bioactive Solutions -The Role of Bioceramics in Endo-Perio Management

Hardik Sandhu, Dr. Harpreet Singh, Dr. Parvinder Singh Baweja, Dr. Bhuvanesh Tandon, Tansha Malik, Kriti Dhawan

PG Student, Dept. of Conservative Dentistry and Endodontics, Baba Jaswant Singh Dental College, Hospital and Research Institute, Ludhiana, Punjab, India

Dean, Research, Professor and Head, Dept. of Conservative Dentistry and Endodontics, Baba Jaswant Singh Dental College, Hospital and Research Institute, Ludhiana, Punjab, India

Professor, Dept. of Conservative Dentistry and Endodontics, Baba Jaswant Singh Dental College, Hospital and Research Institute, Ludhiana, Punjab, India

Reader, Dept. of Conservative Dentistry and Endodontics, Baba Jaswant Singh Dental College, Hospital and Research Institute, Ludhiana, Punjab, India

PG Student, Dept. of Conservative Dentistry and Endodontics, Baba Jaswant Singh Dental College, Hospital and Research Institute, Ludhiana, Punjab, India

PG Student, Dept. of Conservative Dentistry and Endodontics, Baba Jaswant Singh Dental College, Hospital and Research Institute, Ludhiana, Punjab, India

ABSTRACT: Endo-perio lesions are a complicated problem that affects both the pulp and periodontal tissues. Successfully managing these lesions often needs a combined approach that deals with both endodontic and periodontal aspects. Recently, bioceramic materials have changed the outlook for these lesions due to their great bioactivity, compatibility with body tissues, and sealing ability. This article outlines the benefits of using bioceramics in treating endo-perio lesions.

I. INTRODUCTION

The term “Endodontic-Periodontic lesion” was first introduced in the American Association of Endodontics’ Glossary of Endodontic Terms in 1998, followed closely by the American Academy of Periodontology, which defined the lesion to be a localized infection originating from the periodontal or pulp tissue. Both endodontic and periodontal lesions are polymicrobial anaerobic infections. The combined Endodontic-Periodontic lesion disease is caused by varying degrees of inflammation of the endodontic system and periodontium.[1]

Etiologic components of predominantly bacterial origin, as well as other factors such as dental malformations, history of trauma, iatrogenic perforations, and external or internal root resorptions, play their part in the progression of Endodontic-Periodontic lesion. Pulp exposures, periodontitis, and caries lesions are of significant importance in the development of periodontal-endodontic lesions.

Suppose the lesions are not well treated and the canals are not disinfected and sealed completely. In that case, they will house bacterial necrotic rests, which account for the progression of the lesion or even for the endodontic reinfection.[2]

Another form of the interrelationship is due to the iatrogenic perforations due by either rotary instruments or improper handling of the endodontic instruments. Vertical root fractures and cracks may serve as a “bridge” for pulp contamination.[1] If the periodontium had a previous inflammation, it may lead to dissemination of the inflammation, which can result in pulp necrosis. Several authors, through their studies, diverge on the routes of contamination.[1,3]

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Tsesis et al.[6] suggested the use of a three-component categorization scheme of endodontic-periodontal lesions, based on the primary etiological factor of the pathology and clinical presentation:

1. Purely endodontic lesion: when the pulp is necrotic and infected, and there is a draining sinus tract coronally through the periodontal ligament into the gingival sulcus.
2. Purely periodontal lesion: when a deep periodontal lesion involves most of the root surface and the dental pulp is vital.
3. Endodontic-periodontal lesion: when the pulp is necrotic and infected, and there is a deep periodontal pocket.

When an endo-perio lesion is diagnosed, both endodontic and periodontal therapy may be required. In this case, the tooth prognosis depends mainly on the success of the endodontic treatment, followed by appropriate supplemental periodontal therapy.[2,3]

Bioceramic materials like MTA, Biodentine, and bioceramic root canal sealers have emerged as valuable tools in managing these lesions due to their excellent sealing ability, bioactivity, biocompatibility, and ability to promote tissue regeneration.

II. RATIONALE FOR THE USE OF BIOCERAMICS IN ENDO-PERIO THERAPY

Bioceramic materials, such as Mineral Trioxide Aggregate (MTA), Biodentine, and newer calcium silicate-based root canal sealers, possess the following physical and biological properties:

1. Biocompatibility

Bioceramics like MTA, Biodentine, Bioaggregate, and Bioceramic Root canal sealers consist of materials like calcium silicates, calcium phosphates. These materials are very compatible with human tissues. When they come into contact with periodontal and periapical tissues, they promote healing. They do this without causing an inflammatory or foreign body response. This makes them suitable for complex lesions that involve both types of tissues.

2. Release of Calcium and Silicon ions

Calcium ions enhance hydroxyapatite formation on the material surface. Silicon promotes angiogenesis and fibroblast activity. This leads to mineralization and tissue regeneration. (Figure 1)

3. Bioactivity and Regeneration

It can also form hydroxyapatite and create a chemical bond between dentine and appropriate filling materials. Biomineralization is likely to facilitate healing at the material-tissue interface, resulting in the elevation of local pH, the release of mineral ions, and the formation of apatite-like structures. The apatite crystals grow within collagen fibrils, promoting controlled mineral nucleation on dentin and triggering the formation of an interfacial layer at the material-dentin interface.[4] This is crucial in endo-perio lesions where structural tissue loss is often extensive. (Figure 1)

4. Antibacterial property

Bioceramic materials produce an alkaline pH, which creates an unsuitable environment for bacteria to thrive, resulting in depletion of the bacterial load within the root canal.[5] This, along with a good coronal seal, promotes good periapical healing over time.

5. Superior sealing capability

Microleakage is a major concern in endodontics and can exacerbate endo-perio lesions. Bioceramics can form hydroxyapatite and create a chemical bond between dentine and appropriate filling materials. Bioceramics set in the presence of moisture, which facilitates the hydration reactions of calcium silicates to produce calcium silicate hydrogel and calcium hydroxide, which partially react with the phosphate to form hydroxyapatite and water. Bioceramics provide an excellent apical and lateral seal.[5] Prevents reinfection by blocking microbial ingress through apical foramen or lateral canals. This minimizes bacterial penetration and creates a hermetic seal, contributing to long-term success.

6. High flow and Adaptability

Bioceramic sealers have high flow and adaptability, sealing even complex anatomy.

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These attributes make them suitable for procedures where tissue regeneration and sealing are crucial, such as perforation repair, root-end filling, and root resorption cases associated with endo-perio lesions.[4]

7. Moisture Tolerance and Easy Handling

Unlike traditional materials that require a dry field, bioceramics perform well in moist environments, common in endo-perio lesions. This property improves clinical efficiency and reduces the risk of procedural failure due to compromised moisture control.[5,7]

8. Long-Term Stability and Dimensional Integrity

Bioceramics are dimensionally stable and resistant to dissolution over time, unlike some conventional materials. This ensures the integrity of the repair and promotes long-term success in the healing of both pulp and periodontal tissues.

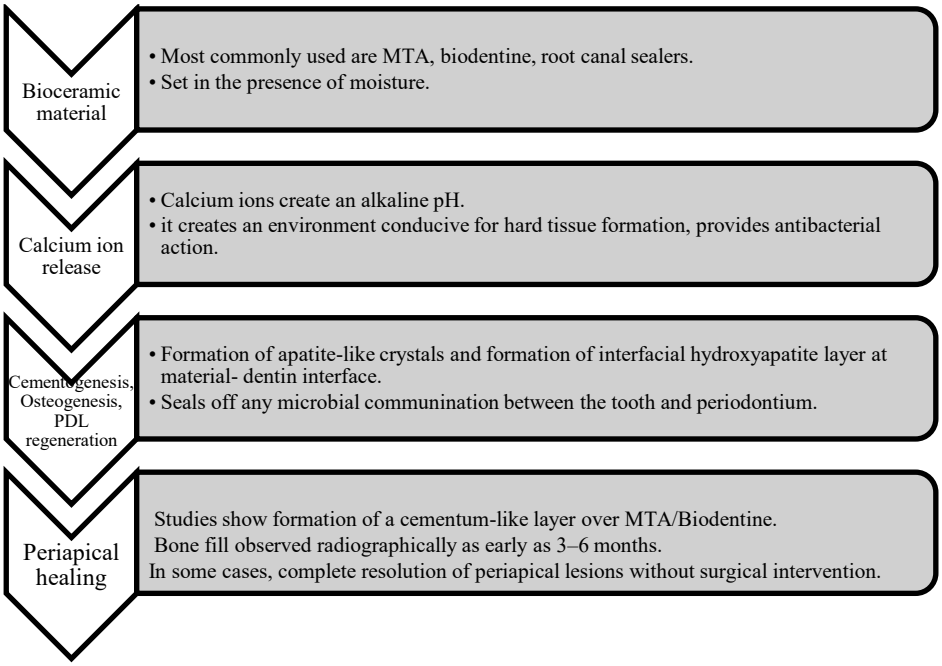

Figure 1: The mechanism of action of bioceramics.

III. APPLICATIONS IN TREATMENT OF ENDO-PERIO LESIONS

The various applications of bioceramics in the treatment of endo-perio lesions have been described in Figure 2:

APPLICATION	CLINICAL SCENARIO	METHOD OF USE
Repair of perforation- pulpal, furcal	Root canal perforation communicating with periodontium.	After cleaning, MTA is packed into the perforation defect. Requires proper moisture control.
Retrograde filling	Failed root canal treatment or re-treatment cases, apicoectomy.	After apicoectomy, the root-end cavity is filled with MTA or Biodentine. Promotes periapical healing.
Obturating root canals in endo-perio lesions	To prevent microbial leakage and promote periapical healing.	Used with single cone or warm vertical compaction. Bonds to dentin and gutta-percha.
Aberrant anatomy of root canals	Complex root morphology with potential accessory canals to	Bioceramic sealers flow into lateral canals, sealing

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	periodontium.	connections between pulp and periodontium.
Re-treatment cases	Previously failed endodontic cases with periodontitis.	After thorough disinfection, use bioceramic sealers to promote healing and seal the apical third.
Root resorption	Internal or external resorptive defects are associated with periodontal breakdown.	conservatively treated using bioceramic putties or pastes.
Intrabony defects adjacent to endodontic lesions	Intrabony defects causing endodontic lesions	Most commonly used is MTA Putty.

Figure 2: The applications of bioceramic materials in various clinical scenarios involving the endodontic-periodontal spectrum of lesions.

IV. DISCUSSION

The management of endo-perio lesions is a clinical challenge due to their complex causes and the ways the disease progresses. Traditionally, treating these lesions requires a team approach that includes both endodontic and periodontal therapy. However, the introduction of bioceramic materials like Mineral Trioxide Aggregate (MTA), Biodentine, and bioceramic-based sealers has significantly improved the outcomes for these cases. These materials promote more reliable healing through better biocompatibility, bioactivity, and sealing properties.

Bioceramics have changed regenerative endodontics and are particularly helpful in handling the dual-origin issues of endo-perio lesions. A key feature of these materials is their ability to promote hard tissue formation. For example, MTA and Biodentine encourage the release of growth factors from dentin, such as BMPs and TGF-β.[5,6] This promotes the differentiation of stem cells into tooth-like cells. This biological activity is crucial in areas with periapical and periodontal damage, where regeneration is the main goal.

In cases of primary endodontic lesions with secondary periodontal issues, using bioceramic sealers in root canal therapy has shown better results than traditional materials. These sealers create a tight seal, reducing microleakage, and have natural antibacterial properties because of their high pH. They can set in wet conditions and maintain their shape, which improves their effectiveness in treating accessory canals and resorptive defects that link endodontic and periodontal tissues.[7]

When dealing with combined lesions or primary periodontal lesions with secondary endodontic issues, bioceramics have also shown good results in procedures like root perforation repair, root-end filling, and sealing furcation involvement. Their properties help form a biological seal that aids both periodontal reattachment and periapical healing.

Several studies have shown that MTA and Biodentine are better at promoting periapical healing compared to conventional calcium hydroxide. Furthermore, bioceramic sealers have improved long-term success rates in root canal treatments, especially in teeth with existing periodontal issues.[8] These materials also lower the chances of needing retreatment by reducing apical leakage and bacterial growth, which are key factors in recurring endodontic infections.[6] Despite these positive results, there are some limitations. The handling and setting times of certain bioceramic materials can be less favorable than traditional options. Their higher costs may also restrict their use in everyday practice. Nevertheless, ongoing improvements in materials and application methods continue to address these challenges.[7]

In conclusion, using bioceramic materials in treating endo-perio lesions provides a biologically friendly and clinically effective alternative to traditional options. These materials not only tackle the microbial causes but also support tissue regeneration, which enhances the overall outlook for teeth affected by complicated endo-perio issues. Future research and long-term studies are crucial to further confirm and refine their use in different clinical situations.[8]

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V. CONCLUSION

The management of endo-perio lesions demands materials that are biologically active, clinically reliable, and capable of promoting healing in complex tissue environments. Bioceramics fulfill these criteria and offer several advantages over traditional materials. Their use represents a paradigm shift in the interdisciplinary management of endo-perio lesions, improving outcomes and long-term prognosis.[9]

The application of bioceramics in the treatment of endo-perio lesions provides enhanced clinical results because of their regenerative capacity and low cytotoxicity. They are not only fillers or sealers but also active agents in the process of healing by stimulating the formation of hard tissue and inhibiting bacterial penetration.[9,10]

The treatment procedures for endo-perio lesions have been redesigned thanks to bioceramic materials. They are essential for producing predictable and biologically sound results because of their special qualities. Their function in connecting periodontal and endodontic treatments will only grow as research advances.

VI. LEGENDS FOR FIGURES

Figure 1: The healing mechanism of bioceramics.
Figure 2: Applications of bioceramic materials in various clinical scenarios involving the endodontic-periodontal spectrum of lesions.

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