



Review Article

The endo-perio dilemma: Challenges and treatment approaches- A narrative review

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Abstract

This review explores the diagnostic challenges, classifications, and treatment modalities associated with endo-perio lesions, with an emphasis on recent advancements in the field. The endodontic-periodontal (endo-perio) dilemma poses significant diagnostic and therapeutic challenges in dental practice due to the intricate interplay between the dental pulp and periodontal tissues. Understanding this relationship is critical for formulating effective treatment plans. A comprehensive review of the literature, including insights from foundational studies and recent advancements, was conducted. Topics addressed include etiology, pathophysiology, classification, diagnostic strategies, and treatment modalities for endo-perio lesions. Effective management of endo-perio lesions requires an integrated clinical, radiographic, and microbiological approach. Emerging technologies such as cone-beam computed tomography (CBCT), photodynamic therapy (PDT), and stem cell applications offer promising outcomes. The review highlights the complex interrelationship between pulp and periodontal tissues, emphasizing how each influences the other during disease progression. A multidisciplinary approach incorporating advanced diagnostic tools and innovative therapies is essential to address the complexities of endo-perio lesions and improve treatment outcomes.

Keywords: Endo-perio lesions, Pulp-periodontal interactions, Diagnosis, Regenerative therapies, CBCT, Stem cells**Received:** 25-01-2025; **Accepted:** 06-03-2025; **Available Online:** 31-03-2025

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1. Introduction

The term "endo-perio lesion" was first introduced by Simring and Goldberg in 1964 to describe the interrelationship between periodontal and pulpal disease. These lesions arise from an intricate interplay of inflammatory processes that affect both the pulp and periodontal tissues. The simultaneous existence of issues in these structures can complicate diagnosis and treatment planning, making the management of such lesions challenging for dental professionals.^{1,2}

The etiological factors behind endo-perio lesions range from bacterial infections to trauma, root resorptions, and dental malformations. Understanding their development and progression is crucial for accurate diagnosis and effective treatment. This article aims to review the anatomical, diagnostic, and therapeutic aspects of endo-perio lesions while integrating recent advancements in clinical practice.^{3,4}

1.1. Anatomy and pathophysiology

1.1.1. Relationship between pulp and periodontium^{5,6,7}

The embryonic, anatomical, and functional interrelationships between the dental pulp and periodontium establish the foundation for the endo-perio connection. Both tissues originate from ectomesenchymal cells, with the pulp arising from the dental papilla and the periodontium from the dental follicle. Throughout the life of a tooth, these tissues remain connected via pathways such as the apical foramen, lateral and accessory canals, and exposed dentinal tubules.

Studies have demonstrated that periodontal disease can induce degenerative changes in the pulp, including fibrosis, calcifications, and collagen resorption. Conversely, pulpal infections can lead to retrograde periodontitis through the dissemination of inflammatory mediators and microbial byproducts.

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1.1.2. Pathways of communication^{8,9,10}

The anatomical connection between the pulp and periodontal tissues is not just structural but functional as well. As mentioned, both tissues derive from ectomesenchymal cells. Their ongoing interaction throughout life is facilitated by structures like the apical foramen, accessory canals, and dentinal tubules, which can serve as pathways for the transmission of infectious agents, inflammatory mediators, or other damaging factors between the pulp and periodontium.

1. **Apical Foramen:** This is the primary anatomical opening through which the pulp communicates with the surrounding periodontal tissues. Any infection or inflammatory processes affecting the pulp can spread through this foramen, potentially resulting in inflammation or infection of the periodontium.
2. **Accessory Canals:** These canals, located primarily in the apical third of the root, serve as additional pathways for bacterial ingress, making them important in cases where the pulp is infected, leading to periodontitis.
3. **Dentinal Tubules:** In cases of pulp disease, bacteria may invade through exposed dentinal tubules, leading to retrograde periodontitis. This can exacerbate periodontal disease even when the infection originates from the pulp.
4. **Lateral and Cervical Canals:** These structures offer additional routes for bacterial migration and are commonly involved in combined lesions, where both the pulp and periodontal structures are compromised.
5. **Palato-gingival Grooves:** Anatomical defects that facilitate the spread of pathogens.
6. **Cervical Enamel Projections and Enamel Pearls:** Serve as additional communication routes facilitating bacterial movement.

The pathophysiology of endo-perio lesions hinges on the fact that inflammatory mediators, microbial products, and immune responses from one compartment (either the pulp or the periodontal tissues) can influence the other, creating a vicious cycle of disease. For instance, pulpal necrosis may lead to the spread of bacteria into the periodontal area, causing periodontal attachment loss, while periodontal disease can lead to pulp degeneration via inflammatory processes.

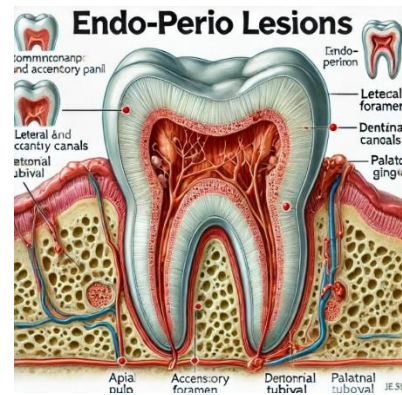


Figure 1: Endo-Perio lesions

1.1.3. Classification of endo-perio lesions^{11,12,13,14} (Table 1, Figure 1)

The Simon, Glick, and Frank classification of endo-perio lesions is a pivotal framework in diagnosing these complex lesions. Each category requires tailored management strategies:

1. **Primary Endodontic Lesions:** These lesions primarily arise from infection within the pulp, leading to periapical radiolucency. Root canal therapy (RCT) is the standard treatment, which focuses on removing the infection and promoting the healing of the periapical tissues.
2. **Primary Periodontal Lesions:** These are typically caused by plaque or calculus-induced periodontal disease. The treatment approach is focused on eliminating the etiological factors, such as bacteria and biofilm, through procedures like scaling and root planing (SRP), periodontal surgery, or regenerative treatments like bone grafting.
3. **True Combined Lesions:** These are the most complex and involve both endodontic and periodontal disease components. Treatment generally requires a two-stage approach: first addressing the pulpal infection with root canal therapy, followed by periodontal therapy (e.g., SRP, flap surgery). Guided Tissue Regeneration (GTR) and bone grafting may be required if significant bone loss has occurred.
4. **Iatrogenic Lesions:** These are caused by dental procedures such as perforations during root canal treatment or excessive force during instrumentation. Treatment focuses on restoring the affected areas, often using biocompatible materials such as mineral trioxide aggregate (MTA) or biodentine to seal perforations and facilitate healing.

Table 1: Classification of endo-perio lesions

Type of Lesion	Primary Etiology	Treatment Approach
Primary Endodontic	Pulpal necrosis, microbial infection	Root canal therapy
Primary Periodontal	Plaque, calculus, periodontal pathogens	Scaling, root planing, periodontal surgery
True Combined	Independent pulpal and periodontal disease	Integrated endodontic and periodontal therapy
Iatrogenic	Procedural mishaps (e.g., perforations)	Sealing, surgical correction

1.2. Diagnostic challenges

The clinical diagnosis of endo-perio lesions is often complicated by the overlap of symptoms between endodontic and periodontal diseases. Both conditions share similar clinical signs like pain, swelling, mobility, and bleeding. Key diagnostic tools include:

1. Clinical Examination:^{15,16} Vitality testing helps to differentiate between pulpal and periodontal origin. Percussion and probing tests can reveal the extent of tissue involvement.
2. Radiographic Imaging:^{17,18} Traditional periapical radiographs are often limited in detecting both pulpal and periodontal issues simultaneously. However, Cone Beam Computed Tomography (CBCT) offers a three-dimensional view that can help identify bone loss, root morphology, and the extent of the lesion, making it invaluable in diagnosing complex cases.
3. Microbiological Testing:^{19,20} Techniques such as polymerase chain reaction (PCR) and next-generation sequencing (NGS) allow for the identification of bacterial species involved in the infection. This can help tailor antimicrobial therapy more effectively, especially in cases where the lesion's origin is unclear.

1.3. Treatment approaches^{21,22,23}

The management of endo-perio lesions requires a strategic approach tailored to the lesion's etiology and severity. An effective treatment plan should address both the pulpal and periodontal components to ensure long-term success. Below are the detailed treatment approaches for each category of endo-perio lesions.

1. Primary Endodontic Lesions

Objective: Eliminate infection and promote periapical healing. Treatment Protocol:

- a. Root Canal Therapy (RCT): Thorough debridement and disinfection of the root canal system using sodium hypochlorite (NaOCl) irrigation and mechanical instrumentation.
- b. Intracanal Medication: Calcium hydroxide (Ca(OH)₂) as an inter-appointment medicament to neutralize bacterial activity.
- c. Obturation: Gutta-percha with a biocompatible sealer to achieve a hermetic seal and prevent reinfection.
- d. Follow-up: Regular radiographic evaluation to monitor periapical healing.

2. Primary Periodontal Lesions

Objective: Control periodontal infection and facilitate periodontal regeneration. Treatment Protocol:

- a. Scaling and Root Planing (SRP): Mechanical debridement to remove plaque and calculus.
- b. Adjunctive Antimicrobial Therapy: Use of chlorhexidine rinses, systemic antibiotics (in

severe cases), and localized drug delivery systems.

c. Regenerative Procedures:

- i. Guided Tissue Regeneration (GTR): Membrane placement to encourage selective cell repopulation.
- ii. Bone Grafting: Autografts, allografts, or synthetic materials to support bone regrowth.
- iii. Enamel Matrix Derivatives (EMD): Stimulate periodontal ligament fibroblast proliferation and cementogenesis.
- iv. Maintenance Therapy: Long-term periodontal maintenance with regular follow-ups to prevent recurrence.

3. True Combined Lesions

Objective: Sequential treatment of endodontic and periodontal components. Treatment Protocol:

- a. Stage 1: Endodontic Therapy
 - i. Perform RCT to eliminate intraradicular infection.
 - ii. Use intracanal medication for bacterial control.
- b. Stage 2: Periodontal Therapy
 - i. SRP and periodontal debridement to reduce bacterial load.
 - ii. Flap surgery to access deep periodontal defects, if necessary.
- c. GTR and bone grafting in cases of significant bone loss.
- d. Stage 3: Supportive Therapy
 - i. Occlusal adjustments to prevent traumatic forces.
 - ii. Regular follow-ups with professional cleaning and patient education on oral hygiene.

4. Iatrogenic Lesions

Objective: Repair procedural mishaps and restore normal function. Treatment Protocol:

- a. Root Perforations: Sealing with biocompatible materials such as mineral trioxide aggregate (MTA) or biodentine.
- b. Root Resorption Management: Non-surgical RCT for internal resorption; surgical intervention for external resorption.
- c. Cervical Lesions: Restoration with resin-modified glass ionomer or composite resin to prevent microbial ingress.

1.4. Advances in treatment modalities

Recent advancements in endo-perio management focus on regenerative therapies and minimally invasive techniques:

1. Stem Cell Therapy: Mesenchymal stem cells (MSCs) and dental pulp stem cells (DPSCs) have the potential to regenerate both pulp and periodontal tissues. These stem cells, when combined with scaffolds, may facilitate tissue repair and regeneration in endo-perio lesions.

2. Platelet-Rich Fibrin (PRF): PRF is used to enhance wound healing and stimulate tissue regeneration through its growth factors. It has shown promise in improving the prognosis of both endodontic and periodontal regeneration.
3. Laser Therapy: This minimally invasive technique can reduce bacterial load and promote faster healing by stimulating fibroblast activity. It is especially useful in the management of periodontal inflammation and improving tissue regeneration.
4. Photodynamic Therapy (PDT): PDT involves the use of light-activated agents to target and eliminate pathogenic bacteria selectively. It has shown effectiveness in reducing inflammation and bacterial colonization in the treatment of both periodontal and endodontic infections.

By integrating these advanced treatment modalities, dental professionals can enhance the prognosis of endo-perio lesions and improve patient outcomes.

2. Discussion

The endo-perio dilemma highlights the intricate interdependence between the pulp and periodontal tissues, emphasizing the need for a precise and methodical approach to diagnosis and treatment. The shared pathways and overlapping clinical manifestations of endodontic and periodontal diseases pose significant challenges, making accurate differentiation between primary and combined lesions crucial. Misdiagnosis can lead to inappropriate treatment strategies, often compromising the prognosis of the affected tooth.^{28,29}

Emerging diagnostic modalities such as cone-beam computed tomography (CBCT) and advanced microbiological testing have provided clinicians with valuable tools to enhance the accuracy of diagnosis. CBCT, in particular, offers three-dimensional imaging that allows for precise visualization of bone loss, root canal morphology, and lesion extent. Microbiological analyses further aid in identifying the specific bacterial profiles involved, enabling targeted antimicrobial interventions.³⁰

Regenerative therapies and biomaterials have revolutionized the management of complex endo-perio lesions. The use of mesenchymal stem cells (MSCs) and bioactive materials, such as hydroxyapatite and platelet-rich fibrin (PRF), has shown promising results in promoting the regeneration of both pulp and periodontal tissues. These innovations not only address the underlying pathology but also enhance the overall prognosis by restoring structural integrity and functionality.^{31,32}

Minimally invasive techniques, such as laser therapy and photodynamic therapy (PDT), are redefining the treatment landscape. These methods offer enhanced precision in microbial decontamination and promote faster healing with reduced postoperative discomfort. PDT, in particular, has

shown efficacy in selectively targeting pathogenic bacteria while preserving healthy tissue, making it a valuable adjunct to conventional therapies.³³

However, the management of endo-perio lesions is not without its challenges. Patient compliance plays a pivotal role in the success of treatment, particularly in cases requiring long-term maintenance and follow-up. The high costs associated with advanced diagnostic tools and regenerative therapies may also limit their accessibility, underscoring the need for cost-effective solutions.³⁴

The management of endo-perio lesions requires not only technical expertise but also collaboration among different dental specialists, including endodontists, periodontists, and microbiologists. The use of advanced diagnostic tools such as CBCT and microbiological testing is essential for accurate diagnosis, while regenerative therapies like stem cell applications offer new opportunities for tissue repair.³⁵

Despite the advances, challenges remain, especially regarding patient compliance, the cost of advanced treatments, and accessibility to sophisticated diagnostic tools. Additionally, the high complexity of true combined lesions requires a multidisciplinary approach for optimal management.

Overall, the integration of advanced diagnostic tools, regenerative approaches, and minimally invasive techniques represents a significant step forward in addressing the complexities of the endo-perio dilemma. Ongoing research and clinical trials are essential to further refine these strategies and enhance their efficacy, ultimately improving patient outcomes.³⁶

2.1. Future perspectives^{37,38,39}

As dental science continues to evolve, the future management of endo-perio lesions will likely be shaped by innovations in diagnostic tools, therapeutic techniques, and material science. Several key areas hold promise for transforming how these complex lesions are diagnosed and treated:

2.1.1. Artificial intelligence (AI) in diagnostics

Artificial Intelligence (AI) is rapidly transforming medical and dental fields, and its potential in the diagnosis of endo-perio lesions is vast. AI can be used for:

1. Automated Radiographic Analysis: AI algorithms can analyze CBCT scans and traditional radiographs, providing precise assessments of bone loss, root morphology, and the identification of pathological changes in pulp and periodontal tissues. AI can help differentiate between endodontic and periodontal lesions by learning from large datasets, enabling faster and more accurate diagnoses.
2. Predictive Modeling: By analyzing large amounts of clinical data, AI systems could predict the progression of endo-perio lesions based on patient-specific factors (e.g.,

age, medical history, and oral hygiene). This would allow clinicians to personalize treatment plans with greater accuracy.

3. **AI-Assisted Treatment Planning:** AI could suggest the most effective treatment protocols for endo-perio lesions, considering both the pulpal and periodontal aspects of the lesion. This would support dental practitioners in making evidence-based decisions that optimize treatment outcomes.

2.2.2. 3D Bioprinting and customized scaffolds

The potential for 3D bioprinting in regenerative dentistry is immense. The technology allows for the creation of customized scaffolds that can mimic the architecture of natural pulp and periodontal tissues. These scaffolds can be seeded with stem cells or growth factors to promote tissue regeneration. Some promising applications include:

1. **Custom Pulp Regeneration:** Using bioprinted scaffolds in combination with dental pulp stem cells (DPSCs), researchers are exploring ways to regenerate pulp tissue in a more natural and biologically compatible manner. This can help restore the lost pulp function and prevent tooth loss in severe endo-perio lesions.
2. **Periodontal Tissue Engineering:** 3D bioprinting can be used to create personalized bone grafts or periodontal ligament scaffolds for patients with severe periodontal tissue loss. By using the patient's own cells or bioactive materials, these bioprinted structures can support the regeneration of lost periodontal tissues, including bone, ligament, and cementum.
3. **Regenerative Composite Materials:** Bioprinting can also be used to develop composite materials that combine hydroxyapatite (for bone regeneration) and collagen (for soft tissue regeneration), which are ideal for promoting both pulp and periodontal tissue repair.

3. Conclusion

The endo-perio dilemma remains one of the most complex challenges in dental care, requiring a multifaceted approach to diagnosis and treatment. As our understanding of the intricate relationship between pulpal and periodontal tissues grows, so does our ability to develop more effective, targeted, and personalized treatments. The integration of advanced diagnostic tools, regenerative therapies, and minimally invasive techniques holds great promise for improving the prognosis of endo-perio lesions and the overall quality of patient care.

Ultimately, the key to successful management lies in the adoption of a multidisciplinary approach, involving endodontists, periodontists, microbiologists, and researchers to develop comprehensive treatment protocols. The integration of these cutting-edge technologies will enhance patient outcomes, reduce treatment times, and preserve the

functionality of the affected tooth, thereby preventing the need for extraction.

While challenges remain—such as cost, accessibility, and patient compliance—the ongoing advances in technology and research will likely bring about a new era of holistic dental care for patients with endo-perio lesions, offering the promise of improved health and longevity for both pulpal and periodontal tissues.

4. Source of Funding

None.

5. Conflict of Interest

None.

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