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Research Article

Endo-Periodontal Lesions and the Role of Periodontal Therapy in the Longevity of Endodontically Treated Teeth: A Literature Review

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ABSTRACT

Background: Endo-periodontal lesions represent a complex clinical condition involving pathological communication between the dental pulp and periodontal tissues. Their management remains a diagnostic and therapeutic challenge due to the overlapping etiology and close anatomical interconnection of the pulp and periodontium.

Aim: This review aims to evaluate the influence of periodontal health on the prognosis and long-term survival of endodontically treated teeth (ETT), assess the role of regenerative periodontal techniques in the management of endo-periodontal lesions, and explore the differential diagnosis from other pathological conditions as well as the underlying microbiological etiology.

Methods: A narrative literature review was conducted using electronic databases including PubMed, Scopus, and Cochrane Library, focusing on studies published between 2000 and 2025 in the English language and relevant to this theme. Search terms included "endodontically treated teeth," "periodontal therapy," "endo-periodontal lesions," "apical periodontitis," "regenerative techniques," "periodontal diagnosis," and "microbial etiology."

Results: The literature indicates that poor periodontal status significantly increases the risk of failure in ETT, with deeper periodontal pockets correlating with lower survival rates. Regenerative periodontal approaches, including the use of enamel matrix derivatives, bone grafts, and guided tissue regeneration, have shown promising outcomes in managing advanced endo-periodontal lesions. Success rates of up to 92% have been reported in long-term follow-ups when these techniques are combined with proper endodontic therapy.

Conclusion: Periodontal health plays a pivotal role in the prognosis of endodontically treated teeth. Accurate diagnosis, strategic sequencing of endodontic and periodontal treatment, and the use of regenerative techniques are essential for successful management of endo-periodontal lesions. A multidisciplinary approach enhances treatment outcomes and supports the long-term preservation of natural dentition.

KEYWORDS

Endo-periodontal lesions, Periodontal therapy, Tooth, Root canal therapy.

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Introduction

Endo-periodontal lesions are defined as *pathological communications between the pulp and the periodontal tissues of a tooth*, which may present in either acute or chronic form [1]. The nature of these lesions reflects the close anatomical and pathophysiological relationship between these two tissues, making differential diagnosis and effective treatment particularly demanding processes.

The communication pathways between pulp and periodontium are classified as anatomical, pathological, and iatrogenic. Among the anatomical pathways, the apical foramen is considered the most significant and frequent, allowing, under certain conditions, the migration of bacteria and their byproducts from an infected root canal to the periapical tissues, causing apical periodontitis. Conversely, in cases of advanced periodontal disease, periodontopathogenic bacteria may enter the pulp through the foramen, causing inflammation and potentially pulp necrosis if they overcome the tissue's defense mechanisms [2,3].

Other anatomical pathways include lateral and accessory root canals, found in over 30% of teeth and potentially serving as channels of pathological communication [2]. Additionally, dentinal tubules, which are normally protected by enamel in the crown area and by cementum in the root area, may become exposed due to developmental anomalies or dental interventions such as root planning, thereby contributing to the breakdown of the tooth's natural defenses [3]. Studies have also shown that in the cemento-enamel junction (CEJ) area, in 18% of teeth, and particularly in 25% of anterior teeth, enamel and cementum do not meet, leaving a small area of dentin exposed, where open tubules can serve as a communication route between pulp and periodontal ligament. Developmental grooves, especially on the palatal surface of incisors and in the furcation area of molars, constitute anatomical variations that promote microbial adhesion and the formation of deep periodontal pockets [2,3].

Pathological communication pathways include internal or external root resorption, as well as cracks and fractures, which can result in direct communication between the pulp and the periodontium. Iatrogenic factors, such as perforations during endodontic treatment or incorrect placement of intraradicular posts, are additional contributing mechanisms that not only facilitate bacterial infiltration but also worsen the prognosis of the tooth [3].

The diagnostic approach to endo-periodontal lesions requires an understanding of the lesion's pathogenesis and its relationship with the corresponding treatment plan. According to traditional classification [4], endo-periodontal lesions are categorized into the following five groups:

1. Primary endodontic lesion
2. Primary endodontic lesion with secondary periodontal involvement
3. Primary periodontal lesion
4. Primary periodontal lesion with secondary endodontic involvement
5. True combined (mixed) lesions

A **primary endodontic lesion** occurs when there is inflammation or infection of the pulp, without permanent damage to the periodontal ligament. When byproducts of the acute phase of inflammation from a tooth with chronic periapical pathology drain through the periodontal ligament into the gingival sulcus, they create a fistula of pulpal origin that emerges through the periodontal ligament and may mimic a periodontal lesion. A distinguishing feature of these lesions is the presence of a narrow, deep periodontal pocket on one surface of the tooth and a negative response to pulp vitality tests. For diagnostic purposes, a gutta-percha cone is placed in the fistulous tract/pocket, and one or more radiographs are taken to trace its path and confirm its relationship with the periapical lesion. A similar presentation occurs in multirooted teeth in the furcation area when a periapical lesion drains through the periodontal ligament. Endodontic treatment, with proper disinfection and obturation of the root canal, is sufficient for full recovery. The fistula typically heals quickly, and no periodontal intervention is required unless generalized periodontal disease is also present. The prognosis is excellent, assuming accurate diagnosis and timely treatment.

Primary endodontic lesion with secondary periodontal involvement develops when a primary endodontic infection remains untreated, leading to permanent damage to the periodontal ligament and secondary infection of this tissue by periodontopathogenic bacteria. The long-term presence of a draining sinus tract allows colonization of its opening by periodontopathogens, resulting in the development of secondary periodontal disease. Treatment first requires root canal therapy, followed by evaluation of outcomes within 2–3 months. Root canal treatment will lead to healing only of the endodontic component up to the point where the periodontal damage begins. If the endodontic treatment is performed correctly, the prognosis depends on the severity of the periodontal lesion and the effectiveness of periodontal therapy.

Such lesions may also be iatrogenic in origin, e.g., due to root perforation during endodontic treatment or incorrect placement of intra-radicular posts, pins, etc., during tooth restoration. Symptoms may be acute, with the formation of a periodontal abscess, clinically presenting as pain, swelling, formation of a periodontal pocket, and tooth mobility. In cases of root perforation, the most suitable repair materials are bioceramics such as MTA, and immediate restoration is required. The prognosis depends on the size and location of the perforation, the degree of periodontal involvement, and the timing and materials used in its management. Root fractures may also present clinically as primary endodontic lesions with secondary periodontal involvement. Such fractures often occur in endodontically treated teeth (ETT) with posts. Symptoms can range from the presence of a single periodontal pocket to the formation of a periodontal abscess.

Primary periodontal lesion is caused by bacterial infection from periodontopathogens, leading to progressive destruction

of the periodontium and apical extension of inflammation. The pulp remains intact and vital in almost all cases, as blood supply through the apical foramen remains undisturbed. Pulp vitality tests are normal. Treatment is based on the removal of calculus and plaque deposits via scaling and root planning, while in advanced cases, surgical and regenerative periodontal techniques are applied. Prognosis is directly related to the severity of periodontal disease, the ability to control etiological factors, and patient compliance.

Primary periodontal lesion with secondary endodontic involvement develops when pathogenic periodontal bacteria succeed in infecting the pulp via the apical foramen (high probability) or large lateral root canals located on the lateral walls of the root (lower probability). Diagnosis is difficult, especially in the early stages, when the pulp may remain vital. The effect of periodontal disease on pulp vitality remains a debated topic. If blood flow to the pulp remains intact, the pulp retains its vitality (lower likelihood of necrosis due to lateral canal involvement). Usually, pulpal changes are observed only after the apical foramen is affected by periodontal disease. In such cases, bacteria from the periodontal pocket serve as the source of pulp infection. Treatment requires both endodontic and periodontal therapy. The order of intervention depends on the disease stage and whether retrospective diagnosis is needed (endodontic treatment first, followed by periodontal treatment). The endodontic infection can impair healing of the epithelial attachment after periodontal therapy, so endodontic treatment is usually recommended first. Prognosis depends on the severity of the periodontal disease, the periodontal treatment provided, and patient compliance. It is guarded, especially in single-rooted teeth. In multi-rooted teeth, where only one root is affected, root resection may help preserve the rest of the tooth, although it is associated with an increased risk of fracture.

Secondary endodontic involvement can also occur as an undesirable side effect of periodontal therapy. Lateral root canals and dentinal tubules may become exposed after root surface planning and removal of the protective layer of cementum. Thus, during periodontal therapy, not only can a blood vessel bundle supplying a large lateral root canal be severely injured, but the area may also become infected, leading to pulp involvement by bacteria colonizing that region.

True combined lesions are less common and occur when a progressively enlarging endodontic lesion extending coronally joins with a periodontal lesion that progressively moves apically along the root surface. The radiographic appearance of such lesions resembles that of teeth with vertical root fractures. Treatment requires a combined endodontic and periodontal approach, often including surgical intervention. The periapical lesion typically heals following endodontic treatment; however, the periodontal tissues do not always respond as favorably. Prognosis is generally poor, especially for single-rooted teeth. In molars, root resection is a therapeutic option. Treatment decisions should be based on the extent of the lesions and the regenerative potential of the affected periodontal tissue.

More recently, the new classification proposed in 2017 at the World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions categorizes endo-periodontal lesions primarily based on the presence or absence of root damage and secondarily based on the presence of periodontitis and the degree of periodontal tissue involvement [5]. The categories are summarized as follows:

Endo-periodontal lesion with root damage	Root fracture or crack	
	Root canal or pulp chamber perforation	
	External root resorption	
Endo-periodontal lesion without root damage	Endo-periodontal lesion in patients with periodontitis	**Grade 1** – Narrow deep periodontal pocket on one tooth surface
		Grade 2 – Wide deep periodontal pocket on one tooth surface
		Grade 3 – Deep periodontal pockets on more than one tooth surface
	Endo-periodontal lesion in patients without periodontitis	**Grade 1** – Narrow deep periodontal pocket on one tooth surface
		Grade 2 – Wide deep periodontal pocket on one tooth surface
		Grade 3 – Deep periodontal pockets on more than one tooth surface

This classification allows for a better understanding of the pathology of endo-periodontal lesions and contributes to the development of effective treatment strategies, aiming to maintain the long-term functionality and survival of the teeth.

Overall, endo-periodontal lesions require accurate diagnostic evaluation and a strategic sequence of treatment, with clear priority given to endodontic therapy when intraradicular involvement is present. The decision to proceed with periodontal treatment should be based on clinical and radiographic data collected 3 to 6 months after the endodontic therapy. Within an additional 6 months, the healing of the endodontic lesion is typically complete. At that point, the remaining part of the periodontal lesion can be addressed with conventional, surgical, or regenerative periodontal techniques. In many cases, it may take up to 18 months after endodontic treatment to determine whether the overall therapeutic protocol has been successful.

Objectives

The aim of this study is to evaluate the role of the periodontal condition in the prognosis and survival of ETT and to investigate the effect of regenerative periodontal techniques in the therapeutic management of endo-periodontal lesions. Emphasis is also placed on the importance of the differential diagnosis from other pathological conditions, and the microbial background.

Materials and Methods

This study follows a narrative review methodology, carried out through the Medline (PubMed), Scopus, and Cochrane databases. Searches were limited to studies published from 2000 to 2025 in the English language. The main keywords used were: "endodontically treated teeth", "periodontal therapy", "endo-periodontal lesions", "apical periodontitis", "regenerative techniques", "periodontal diagnosis", and "microbial etiology".

Results

Periodontal Condition and Prognosis of Endodontically Treated Teeth

The importance of periodontal health in the prognosis and long-term survival of ETT has been investigated in numerous studies.

In a retrospective study, Skupien et al. [6] analyzed 360 endodontic treatments performed between 2000 and 2011, aiming to explore the relationship between periodontal status and ETT outcome. The probing depth of these teeth ranged from 2 to 10 mm. Results highlighted the importance of periodontal health in ETT prognosis, even more than factors such as the presence of fixed prosthetic restorations. Specifically, it was found that teeth with increased pocket depth had significantly higher failure rates. The relative risk (RR) was calculated at 1.6, indicating that for each additional millimeter of pocket depth, the risk of endodontic treatment failure increased by 60%.

Similarly, the cohort study by Ruiz et al. [7] investigated the impact of periodontal disease on the incidence of apical periodontitis in ETT. The two-year study compared the occurrence of apical periodontitis between periodontally healthy and diseased patients. Findings showed that the likelihood of apical periodontitis was only 3% in patients with healthy periodontium, but increased to 14% in those with periodontal disease. The odds ratio (OR) was calculated at 5.19, highlighting periodontal disease as a major risk factor for endodontic treatment failure.

In a similar context, the 9-year study by Khalighinejad et al. [8] examined the initial periodontal status of teeth scheduled for endodontic treatment as a predictor of long-term success. A total of 315 teeth were analyzed and categorized according to the older periodontal classification into three groups: healthy periodontium, slight periodontitis, and moderate periodontitis. The survival rates of ETT were 90% for teeth with healthy periodontium, 71% for those with slight periodontitis, and 59% for teeth with moderate periodontitis. Additionally, it was found that patients not participating in supportive periodontal therapy programs had a 2.7 times higher likelihood of ETT loss. Specifically, in patients with moderate periodontal disease who did not undergo supportive therapy, the risk of tooth loss was five times higher.

Endo-Periodontal Lesions and Regenerative Periodontal Techniques

In cases of endo-periodontal lesions, the application of regenerative techniques in combination with endodontic treatment is of particular interest, especially for teeth with a poor prognosis.

The study by Cortellini et al. [9] compared the effectiveness of regenerative therapies versus tooth extraction followed by prosthetic restoration. The study included 50 patients with at least one tooth of poor prognosis. The first group (n=25) underwent regenerative periodontal therapies, which included: Emdogain (n=10), resorbable and non-resorbable membranes (n=4), combination of membrane and bone grafts (n=4), Emdogain with bone graft (n=5), and membrane with Emdogain (n=2). The second group (n=25) underwent extractions followed by restorations such as: implants (n=14), bridges (n=8), and Maryland bridges (n=2), while one patient did not replace the extracted tooth. After the first year, 23 out of 25 teeth in the regenerative group survived, with 19 of them showing pocket depths less than 5 mm. Over the five-year period, no further tooth loss occurred. In the extraction group, two of the 14 implants developed peri-implantitis within the first year and demonstrated bone loss by the five-year follow-up. In conclusion, it seems that regenerative therapies represent a viable alternative to extractions and prosthetic restorations.

The study by Soram et al. [10] evaluated the effectiveness of using demineralized bovine bone matrix (DBBM) with 10% collagen, either alone or in combination with a collagen membrane, in treating endo-periodontal lesions. The study included 52 teeth with probing depths >5 mm and significant bone loss. All cases received endodontic therapy and splinting (in cases of mobility > grade 1), followed by surgical periodontal therapy. In Group 1 (n=29), DBBM with 10% collagen was used without a membrane, while Group 2 (n=23) received the same material with the addition of a collagen membrane. At the 12-month re-evaluation, the average reduction in probing depth was 4 mm in Group 1 and 4.5 mm in Group 2, while the average defect fill was 5 mm, with slightly better outcomes in Group 2. Although the differences were not statistically significant, the overall findings highlighted the value of the regenerative approach in managing endo-periodontal lesions, with a five-year survival rate of 92.31% and confirmation of the osteoinductive capacity of DBBM.

In another retrospective study [1], 39 teeth with endo-periodontal lesions were evaluated. Three months after endodontic therapy, surgical periodontal intervention was performed using DBBM and Emdogain. One year later, the average pocket depth had decreased from 9 mm to 5 mm, and by the seventh year of follow-up, the average defect fill reached 4.7 mm. The five-year survival rate for the treated teeth was 89%.

Finally, the study by Von Arx et al. [11] investigated the use of apicoectomy in combination with Emdogain in endo-periodontal lesions in already ETT. The surgical procedure included the removal of 3 mm of the root apex, ultrasonic retrograde cavity preparation, MTA placement, and application of Emdogain to the root surface after EDTA preconditioning. Of the 17 treated teeth, 14 showed successful outcomes, confirming success rates of 80–87% for this approach.

Differential Diagnosis

Accurate diagnosis is the cornerstone for the proper planning and successful outcome of the therapeutic approach in patients with endo-periodontal lesions. Differential diagnosis is often demanding, as several pathological conditions may present with similar clinical and radiographic features or occur in the same anatomical region as endo-periodontal lesions.

Root Fractures

Root fractures, due to the creation of a communication between the pulp and periodontal space, become foci of microbial colonization, resulting in worsening of the clinical picture. Diagnosis is often difficult, as fractures may not be visible on radiographs and may only be revealed during endodontic access or after tooth extraction.

Periodontal Abscess

This is an acute inflammatory process of the periodontium, often accompanied by localized swelling, tenderness, and mobility. Unlike endo-periodontal lesions, the affected tooth remains vital, without endodontic involvement. The absence of pulp necrosis is a key diagnostic criterion for differentiation.

Lateral Periodontal Cysts

These rare developmental odontogenic cysts are believed to originate from the remnants of Malassez. They are usually found incidentally on radiographs, showing a well-defined radiolucent area on the lateral surface of the root. The associated tooth is often vital and can be retained after cyst enucleation.

Atypical or Systemic Conditions

Some lesions may lack characteristic endodontic or periodontal etiology and fail to respond to conventional treatment. In such cases, additional diagnostic investigations, including cone-beam computed tomography (CBCT) or even histopathological examination (biopsy), are necessary to rule out systemic diseases. Rare pathologies such as scleroderma, metastatic neoplasms, or osteosarcomas may mimic endo-periodontal lesions radiographically and should raise clinical suspicion in the absence of a clear etiology [12].

Iatrogenic Lesions

These include endodontic complications such as perforations, overfilling, leakage from restorations, trauma, resorptions, and the use of intracanal medications. Vertical root fractures, especially in ETT, represent a particularly complex diagnostic and therapeutic issue [13].

Microbiology of Endo-periodontal Lesions

Endo-periodontal lesions result from microbial infection of tissues that are anatomically and biologically interconnected (pulp and periodontal ligament). The anaerobic conditions present in both compartments favor the development of a similar microbial flora. The presence of microanatomical communications (lateral and accessory canals, apical region, resorptive defects) allows for the transfer of microorganisms between the two spaces, making endo-periodontal lesions polymicrobial in nature [14].

These lesions are recognized to involve a complex microbial community characterized by both synergistic and antagonistic interactions among species [15]. Accurate identification of the pathogenic agent is challenging, as the microflora also includes non-pathogenic colonizers [14]. The presence of bacteria in dentin or the periodontal pocket does not necessarily indicate a pathological response from the pulp.

It is important to note that microbial invasion of the dentin-pulp complex does not always result in irreversible damage. Histopathologically, findings such as fibrosis, calcification, or vascular hypoplasia in the pulp indicate a defensive tissue response rather than extensive necrosis [16]. It has been suggested that irreversible damage to the pulp occurs when inflammation extends to the apical vasculature, emphasizing the significance of the proximity of inflammation to the root apex in prognosis [14].

The most commonly isolated microbial species in endo-periodontal lesions include:

- **Enterococcus faecalis**: A Gram-positive, facultative anaerobic coccus capable of surviving under extreme conditions. It is frequently associated with failed endodontic treatments and recurrent apical periodontitis [17].
- **Fusobacterium nucleatum**: A Gram-negative anaerobe, key in biofilm formation. It plays an active role in the pathogenesis of endodontic infections and pulp necrosis [18].
- **Porphyromonas gingivalis**: A major endodontic and periodontal pathogen capable of penetrating dentinal tubules. It is often found in chronic endodontic lesions and is a hallmark species of the "red complex," associated with advanced periodontal disease [19].

Bacteria associated with periodontal disease have been classified into microbial complexes by Socransky:

- **Red Complex**: *Porphyromonas gingivalis*, *Treponema denticola*, *Tannerella forsythia* – highly pathogenic species strongly associated with periodontal tissue destruction.
- **Orange Complex**: *Fusobacterium spp.*, *Campylobacter spp.*, *Parvimonas micra*, *Prevotella intermedia*, *Prevotella nigrescens*, *Streptococcus constellatus*, *Eubacterium nodatum* – facilitate an environment conducive to the colonization of red complex bacteria [16].

Discussion

This literature review clearly highlights the importance of periodontal health as a critical factor for the prognosis and long-term success of ETT. The presence of deeper periodontal pockets has been associated with a significantly increased risk of endodontic treatment failure, with each additional millimeter in pocket depth appearing to raise the risk of failure by up to 60% [6]. Additionally, the absence of supportive periodontal therapy increases the likelihood of tooth loss in ETT by up to five times [8]. The incidence of apical periodontitis in already ETT was found

to be lower in patients with periodontal health compared to those with periodontal disease [7]. Accurate diagnosis of endo-periodontal lesions is particularly important, as it influences both the therapeutic approach and prognosis.

The integration of regenerative techniques, including the use of bone graft materials, enamel matrix derivative (Emdogain), and resorbable membranes, appears to significantly improve the prognosis of teeth affected by endo-periodontal lesions, even in cases initially considered to have a poor prognosis. The survival rates of teeth treated with such approaches reach up to 92% over a five-year period, making regenerative techniques a powerful tool in the management of these lesions [10].

Conclusions

The presence of periodontal disease appears to negatively affect the prognosis of endodontically treated teeth, while the success of their treatment depends on accurate diagnosis and a timely, combined therapeutic approach. The use of regenerative techniques has significantly improved the management and prognosis of advanced endo-periodontal lesions. However, due to the complexity and variability of these lesions, further research is needed to enable more targeted treatment strategies based on accurate diagnosis and continuously evolving therapeutic protocols.

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