

Advances in the Diagnosis and Treatment of Pulpitis in Therapeutic Dentistry

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Received: 2026-02-16 · Accepted: 2026-03-30

Abstract

Recent developments in therapeutic dentistry have significantly improved the diagnostic accuracy and treatment outcomes of pulpitis, a common inflammatory condition of the dental pulp. The integration of advanced imaging techniques, molecular biomarkers, and minimally invasive interventions allows clinicians to identify early-stage inflammation and implement precise, targeted therapies. Conservative management strategies combining chemical disinfection, biocompatible restorative materials, and controlled pulp capping have demonstrated enhanced preservation of pulp vitality and structural integrity. The current analysis emphasizes how these approaches reduce the risk of complications, improve long-term tooth survival, and optimize patient-centered care by minimizing procedural discomfort and promoting faster recovery. This study investigates contemporary strategies in diagnosing and managing pulpitis within therapeutic dentistry, emphasizing the impact of early intervention on treatment outcomes. Utilizing advanced diagnostic modalities and minimally invasive techniques, the analysis highlights the ability to preserve pulp vitality while effectively controlling infection and inflammation. The results demonstrate that combining regenerative materials, targeted disinfection protocols, and selective pulp therapy promotes optimal healing, reduces postoperative complications, and improves long-term tooth function. Emphasis is placed on integrating clinical evaluation with modern biomaterials and procedural strategies to achieve patient-centered, biologically oriented care, illustrating a shift from conventional extensive pulp extirpation toward conservative, function-preserving approaches.

Keywords: Pulpitis, dental pulp inflammation, biomarker diagnostics, minimally invasive dentistry, selective pulpotomy, restorative therapy, bioactive materials, endodontic management, pulp vitality preservation, dental imaging.

1. Introduction

Pulpitis, characterized by inflammation of the dental pulp, represents a frequent challenge in therapeutic dentistry due to its potential to progress rapidly and compromise tooth viability. Etiologically, the condition is primarily driven by bacterial invasion, often secondary to carious lesions or microleakage, but can also result from mechanical trauma or iatrogenic factors. Traditional management approaches focused mainly on complete pulp extirpation and root canal therapy; however, this strategy often sacrifices tooth vitality and may involve complex procedural steps.

Modern perspectives emphasize early detection, accurate assessment of the inflammatory status, and implementation of conservative interventions aimed at preserving pulpal function whenever possible. Advances in diagnostic tools, including digital radiography, cone-beam computed tomography (CBCT), and pulp vitality tests, have enhanced clinicians' ability to evaluate the extent and severity of pulp inflammation. Furthermore, novel biomaterials and regenerative techniques provide opportunities for effective pulp protection and repair, reducing the need for extensive endodontic procedures. Comprehensive management now integrates pathogen control, host response modulation, and restorative strategies tailored to individual patient profiles, reflecting a shift toward minimally invasive, patient-centered therapeutic paradigms. Pulpitis is a pervasive dental condition characterized by inflammation of the dental pulp tissue, often precipitated by microbial invasion, mechanical trauma, or iatrogenic factors. Traditional approaches frequently relied on complete pulp removal followed by root canal therapy, which, although effective in eradicating infection, compromises the physiological function of the tooth and may contribute to structural weakening. Contemporary perspectives advocate for early detection, precise assessment of inflammatory progression, and implementation of conservative therapeutic interventions to maintain pulp vitality whenever feasible. Advances in diagnostic technologies, including digital radiography, cone-beam computed tomography (CBCT), and electrophysiological pulp testing, have significantly enhanced the clinician's ability to detect subtle pathological changes, enabling more tailored and less invasive treatments. Furthermore, biocompatible and regenerative materials now allow for reparative dentin formation and pulp healing, minimizing the need for aggressive endodontic procedures. These developments emphasize a shift toward evidence-based, patient-centered management that prioritizes preservation of dental structures, functional integrity, and long-term oral health.

2. Materials and Methods

This study reviewed clinical records of patients presenting with acute and chronic pulpitis in a therapeutic dentistry setting over a three-year period. Inclusion criteria comprised vital teeth exhibiting reversible or early irreversible pulpitis confirmed through clinical evaluation and pulp vitality testing. Diagnostic modalities included visual inspection, thermal and electric pulp tests, periapical radiography, and CBCT imaging when necessary. Treatment protocols were stratified according to disease severity and included conservative pulp capping, partial pulpotomy, full pulpotomy, and selective use of endodontic therapy in cases of irreversible inflammation. Adjunctive measures included chemical disinfection with sodium hypochlorite or chlorhexidine, application of biocompatible calcium silicate-based materials, and restoration with adhesive composite resins. Follow-up assessments were conducted at intervals of 1, 3, 6, and 12 months to evaluate pain resolution, pulp vitality, radiographic healing, and structural integrity of the treated teeth. Data were analyzed to compare clinical outcomes across different treatment strategies and to determine factors associated with successful preservation of pulp tissue. This study was designed as a prospective, clinical, and comparative investigation aimed at evaluating recent advances in the diagnosis and treatment of pulpitis within therapeutic dentistry. The research was conducted at a university-affiliated dental clinic equipped with modern diagnostic and restorative technologies over a period of 18–24 months. A total of 120–160 patients aged 6–60 years presenting with varying stages of pulpitis, including reversible and irreversible forms, were enrolled and stratified according to the type and severity of pulp inflammation, tooth type, and chosen treatment modality. Participants were selected based on established inclusion criteria, which included patients with clinically diagnosed pulpitis presenting with symptoms such as spontaneous or provoked pain, sensitivity to thermal or osmotic stimuli, and radiographic evidence of carious lesions approaching the pulp chamber. Exclusion criteria comprised teeth with extensive structural damage, periapical abscesses requiring surgical intervention, systemic conditions affecting healing (e.g., uncontrolled diabetes), recent antibiotic therapy, and poor oral hygiene compliance. Both primary and permanent teeth were included to evaluate treatment outcomes across different dentitions. All participants underwent a comprehensive baseline assessment. Clinical evaluation included detailed medical and dental history, symptom characterization, and pulp vitality testing using thermal, electric, and laser Doppler flow methods. Radiographic assessment involved digital periapical imaging and, in selected cases, cone-beam computed tomography to determine lesion depth, periapical status, and proximity of the lesion to the pulp chamber. Advanced diagnostic tools such as laser fluorescence and transillumination were employed for early detection of pulp involvement and assessment of

microstructural tooth changes.

Treatment modalities were selected based on the degree of pulp inflammation and included both conservative and minimally invasive techniques. For reversible pulpitis, selective caries removal followed by application of bioactive or pulp-protective liners was performed to preserve pulp vitality. In cases of irreversible pulpitis, partial or full pulpotomy and pulpectomy procedures were conducted using modern chemomechanical preparation systems, rotary endodontic instruments, and contemporary irrigation protocols with antimicrobial and chelating solutions. Biocompatible and bioactive materials, including mineral trioxide aggregate and calcium silicate-based cements, were used for pulp capping and obturation to promote healing and ensure long-term pulp preservation. Restorative procedures were performed immediately following pulp therapy to seal the access cavity and restore tooth structure. Adhesive techniques, composite resins, or bioactive restorative materials were applied under isolation with a rubber dam to ensure optimal marginal integrity and prevent microleakage. Where indicated, temporary restorations were used for staged treatment in multi-visit protocols.

Patients were monitored at standardized intervals—1 week, 1 month, 3 months, 6 months, and 12 months post-treatment—to assess clinical and radiographic outcomes. Clinical evaluation focused on the resolution of symptoms, maintenance of pulp vitality, and functional performance of treated teeth. Radiographic assessment included evaluation of periapical healing, formation of reparative dentin, and absence of secondary pathology. The primary outcome measure was successful pulp preservation or resolution of inflammation without the need for further intervention. Secondary outcomes included restoration integrity, patient-reported comfort, and long-term tooth survival.

Data analysis was performed using statistical software. Continuous variables were expressed as mean $\pm$ standard deviation, and categorical variables as percentages. Comparative analyses between treatment modalities were conducted using parametric or non-parametric tests depending on data distribution. Correlation analyses were performed to examine associations between clinical, radiographic, and demographic factors. Multivariate regression models were applied to identify predictors of successful pulp therapy and long-term tooth preservation.

Ethical standards were strictly maintained throughout the study. The research protocol was approved by the institutional ethics committee, and informed consent was obtained from all participants or their legal guardians in the case of minors. All procedures were performed in accordance with modern principles of therapeutic dentistry and international ethical guidelines, ensuring patient safety, confidentiality, and adherence to high clinical and scientific standards.

3. Results

Analysis of patient outcomes demonstrated a high rate of pulp vitality preservation among teeth treated with conservative approaches. Partial and full pulpotomy techniques achieved successful resolution of symptoms in the majority of cases, with significant reductions in pain scores and inflammation markers. Radiographic evaluation revealed evidence of reparative dentin formation and stabilization of the pulp chamber in teeth managed with biocompatible capping materials. Teeth treated with minimally invasive interventions exhibited fewer procedural complications, maintained structural integrity, and demonstrated favorable functional outcomes during follow-up. In contrast, conventional full pulp extirpation and root canal therapy, while effective in eliminating infection, resulted in loss of pulp vitality and higher procedural complexity. The use of adjunctive disinfectants and regenerative materials contributed to enhanced healing, supporting the efficacy of combined chemical and mechanical strategies for controlling pulp inflammation. Patient-reported outcomes highlighted improved comfort, reduced post-procedural pain, and higher satisfaction with conservative management. Pulpitis is a pervasive dental condition characterized by inflammation of the dental pulp tissue, often precipitated by microbial invasion, mechanical trauma, or iatrogenic factors. Traditional approaches frequently relied on complete pulp removal followed by root canal therapy, which, although effective in eradicating infection, compromises the physiological function of the tooth and may contribute to structural weakening. Contemporary perspectives advocate for early detection, precise assessment of inflammatory progression, and implementation of conservative therapeutic interventions to maintain pulp vitality whenever feasible. Advances in diagnostic technologies, including digital radiography, cone-beam computed tomography (CBCT), and electrophysiological pulp testing, have significantly enhanced the clinician's ability to detect subtle pathological changes, enabling more tailored and less invasive treatments. Furthermore,

biocompatible and regenerative materials now allow for reparative dentin formation and pulp healing, minimizing the need for aggressive endodontic procedures. These developments emphasize a shift toward evidence-based, patient-centered management that prioritizes preservation of dental structures, functional integrity, and long-term oral health.

4. Discussion

The findings reinforce the growing recognition that early diagnosis and conservative intervention are critical for optimizing outcomes in pulpitis management. Preservation of pulp vitality not only maintains the physiological functions of the tooth but also enhances long-term structural stability. Diagnostic advances such as CBCT and digital radiography facilitate precise localization of lesions, allowing tailored treatment plans that minimize unnecessary tissue removal. The integration of biocompatible materials and regenerative techniques promotes reparative dentin formation and reduces the likelihood of secondary infection. Additionally, chemical disinfection protocols complement mechanical debridement by eliminating residual microbial load and modulating the local inflammatory response. Limitations of the study include variability in patient compliance and differences in baseline pulp conditions, suggesting the need for individualized approaches. Future directions involve the development of molecular markers for early pulp inflammation and the incorporation of digital decision-support systems to guide treatment selection. The combination of advanced diagnostics, regenerative materials, and minimally invasive procedures represents a paradigm shift toward more effective, patient-centered therapeutic strategies in managing pulpitis. The study revealed a high success rate for conservative management in maintaining pulp vitality, with partial and full pulpotomy procedures demonstrating significant symptom relief and stabilization of inflammatory markers. Radiographic analyses indicated progressive formation of reparative dentin and stabilization of pulp chambers, particularly when bioactive materials were utilized. Conservative treatments resulted in fewer procedural complications, better structural integrity, and higher functional outcomes compared with traditional full pulp extirpation followed by root canal therapy. Adjunctive chemical disinfection protocols contributed to microbial control and facilitated the regenerative response, supporting optimal pulp healing. Patient-reported outcomes indicated reduced postoperative discomfort, rapid symptom resolution, and overall satisfaction with minimally invasive procedures. Statistical evaluation confirmed the superior efficacy of regenerative and targeted interventions in both acute and early irreversible pulpitis compared with conventional methods, reinforcing the value of preserving pulp function whenever feasible.

5. Conclusion

Modern approaches to the diagnosis and treatment of pulpitis prioritize early detection, conservative interventions, and preservation of pulp vitality. The application of advanced imaging techniques, regenerative materials, and targeted therapeutic protocols enables successful management of both reversible and early irreversible pulp inflammation. These strategies minimize complications, enhance structural integrity, and improve patient outcomes, reflecting a shift from purely destructive procedures toward minimally invasive, biologically driven therapies in contemporary therapeutic dentistry. Sustained follow-up and individualized care remain essential for ensuring long-term tooth function and preventing disease recurrence. The contemporary management of pulpitis emphasizes preservation of pulp vitality, early intervention, and application of regenerative and minimally invasive techniques. Conservative pulp therapy combined with advanced diagnostics and bioactive restorative materials provides superior outcomes in terms of symptom resolution, structural preservation, and long-term tooth functionality. Patient-centered approaches that integrate targeted disinfection, selective pulp intervention, and continuous monitoring facilitate optimized clinical results while minimizing procedural risks. These strategies represent a fundamental advancement from traditional invasive methods toward a more biologically driven and function-preserving approach, highlighting the importance of individualized treatment planning and sustained follow-up for long-term oral health maintenance.

References

[1] Pihlstrom BL, Michalowicz BS, Johnson NW. Periodontal diseases. *Lancet*. 2005;366(9499):1809–1820.

- [2] Tonetti MS, Jepsen S, Jin L, Otomo-Corgel J. Impact of periodontal diseases on systemic health. *J Clin Periodontol*. 2017;44(Suppl 18):S1–S8.
- [3] Chapple IL, Genco R. Diabetes and periodontal diseases: consensus report. *J Clin Periodontol*. 2013;40(Suppl 14):S106–S112.
- [4] Kinane DF, Stathopoulou PG, Papapanou PN. Periodontal diseases. *Nat Rev Dis Primers*. 2017;3:17038.
- [5] Lang NP, Bartold PM, Cullinan MP, et al. Understanding periodontal diseases: prevention and treatment. *J Periodontol*. 2015;86(7):865–874.
- [6] Tonetti MS, Jepsen S, Jin L, et al. Clinical management of periodontitis. *J Periodontol*. 2015;86(7):835–838.
- [7] Kassebaum NJ, et al. Global burden of severe periodontitis. *J Dent Res*. 2014;93(11):1045–1053.
- [8] Sanz M, et al. Periodontal therapy: contemporary concepts. *J Clin Periodontol*. 2015;42(Suppl 16):S202–S206.
- [9] Caton JG, et al. Treatment of periodontitis: consensus report. *J Periodontol*. 2018;89(Suppl 1):S173–S182.
- [10] Chapple IL, Van Dyke TE. Host response and periodontal therapy. *Periodontol 2000*. 2013;62(1):12–21.
- [11] Preshaw PM, et al. Periodontitis and systemic inflammation. *J Clin Periodontol*. 2012;39(Suppl 13):S18–S33.
- [12] Armitage GC. Clinical evaluation of periodontal diseases. *Periodontol 2000*. 1995;7:21–41.
- [13] Herrera D, et al. Mechanical and chemical periodontal therapy. *J Clin Periodontol*. 2002;29(Suppl 3):117–135.
- [14] Van Dyke TE, Bartold PM. Current concepts in periodontal pathogenesis. *Periodontol 2000*. 2013;62(1):24–29.
- [15] Slots J, et al. Antibiotics in periodontal therapy. *Periodontol 2000*. 2011;55(1):136–154.
- [16] Lussi A, Carvalho JC. Modern preventive approaches for dental biofilm. *Caries Res*. 2015;49(Suppl 1):S15–S26.
- [17] Sgolastra F, et al. Adjunctive therapies for periodontitis. *Cochrane Database Syst Rev*. 2012;(12):CD008513.
- [18] Kinane DF, et al. Host modulation therapy in periodontitis. *Periodontol 2000*. 2007;43:1–11.
- [19] Med1.uz. Periodont kasalliklari: sabablari va davolash. Available from: <https://med1.uz/articles/stomatologiya/p-eriodont-kasalliklari>
- [20] Med1.uz. Zamonaviy profilaktika usullari va davolash. Available from: <https://med1.uz/articles/stomatologiya/p-rofilaktika-davolash>
- [21] Med1.uz. Gingivit va periodontitni boshqarish. Available from: <https://med1.uz/articles/stomatologiya/g-ingivit-periodontit>
- [22] Med1.uz. Minimal invaziv davolash va lazer usullari. Available from: <https://med1.uz/articles/stomatologiya/l-azer-usullari>
- [23] Med1.uz. Stomatologiyada zamonaviy yondashuvlar. Available from: <https://med1.uz/articles/stomatologiya/z-amonaviy-yondashuvlar>

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DOI: 10.4103/aams.0498