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Recent Advances In Non-Surgical Periodontics: A Review

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Abstract
Non-surgical periodontal therapy (NSPT) remains the foundation of periodontal treatment. Recent advances — including minimally invasive instrumentation, biologic adjuncts, periodontal endoscopy, biomarker-based diagnostics, metabolomics, and photonic therapies — are reshaping non-surgical approaches. This review summarizes evidence published between 2022 and 2025, highlighting clinical applicability, benefits, and limitations of current innovations.

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I. Introduction

Periodontitis is a chronic inflammatory condition characterized by progressive destruction of periodontal tissues. Conventional non-surgical periodontal therapy (scaling and root planing, SRP) remains the gold standard for initial management [1]. However, the past decade has witnessed major innovations aimed at enhancing clinical outcomes, improving patient comfort, and personalizing treatment. Advances include minimally invasive non-surgical therapy (MINST), adjunctive biologics, salivary and gingival crevicular fluid (GCF) biomarkers, metabolomic profiling, periodontal endoscopy, and photonic therapies. This review provides a summary of the most recent evidence regarding these developments.

II. Methods

A narrative review of PubMed, Scopus, and Web of Science databases was conducted for studies published from 2020 to mid-2025. Search terms included "non-surgical periodontal therapy," "MINST," "biologics," "hyaluronic acid," "periodontal biomarkers," "saliva metabolomics," "periodontal endoscopy," "photodynamic therapy," and "laser adjuncts." Randomized controlled trials (RCTs), systematic reviews, and cohort studies were prioritized. Selected representative studies are cited using Vancouver style.

Advances in Non-Surgical Periodontics

Minimally Invasive Non-Surgical Therapy (MINST)

MINST utilizes micro-instruments, enhanced visualization, and reduced tissue trauma to optimize biofilm removal. Multicentre studies demonstrate significant probing depth reduction and clinical attachment gain with MINST compared to conventional SRP [2,3]. Patient comfort and aesthetics are improved, though response varies with defect morphology.

Adjunctive Biologics and Local Agents

Hyaluronic acid (HA) gels have shown clinical and radiographic benefits when combined with mechanical debridement, especially in patients with diabetes [4]. Locally delivered antimicrobials remain useful but concerns about resistance encourage selective use [5].

Periodontal Endoscopy and Non-Incisional Techniques

Endoscopy-assisted non-incisional regenerative therapy allows direct visualization and debridement without flap reflection. Retrospective studies report pocket reduction and bone fill comparable to surgical outcomes, with less morbidity [6].

Chair-Side Biomarkers and Point-of-Care (POC) Tests

Biomarkers such as active matrix metalloproteinase-8 (aMMP-8) measured in saliva or GCF show fair diagnostic accuracy for periodontitis [7,8]. Combining aMMP-8 with IL-1β and microbial markers enhances sensitivity and specificity [9].

Saliva Metabolomics and Microbiome Profiling

Metabolomics can differentiate healthy, gingivitis, and periodontitis states. Metabolic shifts following therapy suggest utility for treatment monitoring [10,11]. Integration with microbiome data shows promise for personalized, non-invasive diagnostics.

Photodynamic Therapy (PDT) and Laser Adjuncts

Adjunctive antimicrobial photodynamic therapy (aPDT) and laser modalities (diode, Er:YAG, Nd:YAG) yield modest additional improvements in probing depth and bleeding indices [12,13]. Benefits vary with protocol and operator experience.

Artificial Intelligence in Diagnostics

AI-enhanced imaging tools are increasingly capable of automated bone loss measurement and staging of periodontitis. Although promising, external validation is required before routine clinical adoption [14].

III. Discussion

Recent advances in non-surgical periodontics provide clinicians with a broader therapeutic arsenal. MINST and biologic adjuncts improve outcomes in intrabony defects and compromised patients. Biomarker-based chair-side diagnostics and metabolomics enable earlier detection and monitoring. Endoscopic and photonic modalities offer minimally invasive alternatives for selected cases. However, evidence heterogeneity, short follow-ups, and cost barriers limit widespread adoption. Large multicentre RCTs and standardized diagnostic thresholds are needed to validate these innovations.

IV. Conclusion

Non-surgical periodontics has entered an era of biologically enhanced, precision-driven care. Integration of minimally invasive techniques, biologics, biomarkers, and advanced diagnostics allows clinicians to improve outcomes while minimizing invasiveness. Future research should focus on standardization, cost-effectiveness, and long-term evaluation to translate these advances into routine practice.

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