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MODERN METHODS OF PERIODONTITIS TREATMENT: REVIEW, EFFECTIVENESS, AND PROSPECTS

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Abstract: Periodontitis is one of the most prevalent chronic inflammatory diseases of the periodontium, characterized by progressive destruction of the connective and bone tissues surrounding the tooth. The lack of timely and effective treatment leads to tooth loss, deterioration of oral health, and a significant decline in the patient's quality of life. This article presents a comprehensive review of modern treatment approaches for periodontitis, including mechanical debridement, pharmacological therapy, surgical interventions, and regenerative techniques. Particular attention is paid to the individualization of therapeutic strategies depending on the stage of the disease, the depth of periodontal pockets, the presence of systemic risk factors, and the patient's microbial status. Comparative characteristics of various treatment modalities are provided along with clinical examples of successful implementation of a combined approach. The effectiveness of multistage therapy using advanced technologies such as guided tissue regeneration, laser therapy, and the use of osteoconductive biomaterials is substantiated. The study emphasizes the importance of an interdisciplinary approach and regular supportive care to ensure stable long-term outcomes.

Keywords: periodontitis, scaling, curettage, periodontal surgery, regeneration, biomaterials.

Introduction

Periodontal diseases occupy a leading position among chronic dental pathologies and constitute a significant medical and social problem. Among these, periodontitis stands out as an inflammatory lesion of the supporting tissues of the tooth, accompanied by progressive bone resorption, the formation of periodontal pockets, and increased tooth mobility. According to the World Health Organization, periodontal diseases, including various forms of periodontitis, affect 50–90% of the adult population, with severe forms observed in 10–20% of individuals over 40 years of age [1].

The etiopathogenesis of periodontitis is associated with chronic microbial inflammation induced by dental plaque and aggravated by an imbalanced immune response. In addition to local factors such as oral hygiene status, bite characteristics, and salivary composition, systemic diseases — including diabetes mellitus, osteoporosis, autoimmune disorders — as well as smoking and stress, play a significant role [2,3].

Despite the diversity of known therapeutic approaches, periodontitis treatment remains a challenging task that requires not only the elimination of microbial factors but also the restoration of lost periodontal tissues. Contemporary approaches in periodontology are based on stepwise, comprehensive treatment protocols, including mechanical debridement (scaling and root planing), antibacterial therapy, surgical procedures (open or closed curettage), application of biomaterials, guided tissue regeneration, and supportive periodontal therapy [4,5].

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In recent years, increased attention has been paid to the implementation of minimally invasive and regenerative techniques such as laser therapy, growth factor application, PRF (platelet-rich fibrin), membrane systems, and osteoinductive materials. However, the selection of treatment methods depends on the clinical presentation, pocket depth, extent of bone loss, presence of systemic diseases, and the patient's adherence to treatment protocols.

Thus, the relevance of this topic is determined by the need to systematize existing approaches to periodontitis treatment, evaluate their clinical effectiveness, and select optimal strategies based on the individual characteristics of each clinical case.

Literature Review

In recent decades, understanding of the pathogenesis and therapeutic strategies for periodontitis has significantly advanced due to developments in microbiology, molecular biology, and immunology. Modern research confirms that the primary etiological factor is the dental biofilm, composed of anaerobic and facultative anaerobic bacteria. The most virulent species are members of the so-called "red complex": *Porphyromonas gingivalis*, *Tannerella forsythia*, and *Treponema denticola* [1,2]. These microorganisms induce the release of pro-inflammatory cytokines (IL-1β, IL-6, TNF-α), activate osteoclasts, and contribute to the destruction of alveolar bone [3].

A key role in the pathogenesis of periodontitis is played by individual immune reactivity and the presence of systemic comorbidities. Several studies report that patients with type 2 diabetes mellitus and osteoporosis tend to exhibit more pronounced inflammation and are at greater risk of tooth loss [4]. A clear association has also been established between periodontal infections and systemic conditions such as ischemic heart disease, stroke, and adverse pregnancy outcomes, which underscores the need for an interdisciplinary treatment approach [5,6].

Historically, periodontitis therapy was focused on the removal of local irritants through professional oral hygiene, debridement, and periodontal pocket disinfection. However, current evidence demonstrates the insufficiency of isolated interventions. As noted by Chapple et al. (2018), the modern paradigm of periodontal therapy involves a structured step-by-step approach:

1. Control of risk factors;
2. Removal of biofilm and initial debridement;
3. Correction of residual defects;
4. Long-term supportive maintenance [7].

Pharmacological support includes the use of antiseptics (chlorhexidine, essential oils, hydrogen peroxide), systemic and topical antibiotics (metronidazole, amoxicillin), and anti-inflammatory agents. A promising direction is photodynamic therapy, which targets pathogenic microorganisms through the activation of photosensitizers by laser light [8].

Advances in tissue engineering have sparked interest in regenerative therapies such as guided tissue regeneration (GTR), the use of biomaterials (hydroxyapatite, β-tricalcium phosphate), growth factors (PDGF, BMP), platelet-rich fibrin (PRF), and stem cell

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technologies. However, their clinical use is often limited by high cost and technical complexity [9].

Thus, modern approaches to periodontitis treatment aim not only to eliminate etiological factors but also to restore the integrity of periodontal structures. Optimization of clinical protocols requires comparative analysis of available techniques, combined treatment strategies, and long-term outcome evaluation.

Aim and Objectives

Aim of the Study

The aim of this study is to provide a comprehensive and comparative analysis of modern methods of periodontitis treatment, evaluating their clinical effectiveness, applicability at different disease stages, and potential integration into standardized dental care protocols.

Objectives

1. To systematize existing treatment modalities for periodontitis (conservative, surgical, and regenerative).
2. To assess indications and limitations for each method depending on disease severity.
3. To review clinical studies and published literature on the effectiveness of various therapeutic approaches.
4. To analyze the potential of combined and stepwise treatment regimens, including laser and photodynamic therapy, guided tissue regeneration, and biomaterial use.
5. To substantiate the role of individualized and interdisciplinary approaches in improving outcomes and preventing recurrence.
6. To outline future directions for research and propose strategies for optimizing current therapeutic protocols.

Materials and Methods

This study represents a comprehensive analytical review with elements of clinical observation aimed at the systematization and evaluation of modern methods for the treatment of periodontitis. The analysis was based on both literature sources and clinical data collected in practical periodontal care settings.

The informational basis included 52 peer-reviewed national and international scientific publications retrieved from databases such as PubMed, Scopus, Google Scholar, and eLibrary (Russia) from 2010 to 2024. Selection criteria included high levels of evidence, clinical relevance, and compliance with current international guidelines. The clinical standards of the European Federation of Periodontology (EFP), the American Academy of Periodontology (AAP), and the World Health Organization (WHO) were used as methodological references.

The clinical component of the study was based on the observation of 38 patients aged 35 to 65 years undergoing treatment at a municipal dental clinic affiliated with the Department of Therapeutic Dentistry and Periodontology. Inclusion criteria were a confirmed diagnosis of chronic generalized periodontitis (stage II–III), presence of periodontal pockets deeper than

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4 mm, and absence of active systemic diseases. Exclusion criteria included acute forms of periodontitis, oncological conditions, immunosuppressive therapy, pregnancy, and lactation.

Clinical diagnostics included visual examination with periodontal charting and measurement of standard indices:
– PI (Plaque Index),
– GI (Gingival Index),
– PPD (Probing Pocket Depth),
– CAL (Clinical Attachment Level).
Radiological evaluation was performed using intraoral periapical X-rays and panoramic orthopantomograms (OPG).

Treatment was delivered in stages and included mechanical debridement (scaling and root planing), antiseptic rinsing with chlorhexidine (0.12–0.2%), and antibiotic therapy (amoxicillin and metronidazole) when indicated. A portion of patients underwent laser therapy with Nd:YAG laser in low-intensity scanning mode. Surgical interventions (open curettage, flap surgery) were performed when necessary, often combined with the application of collagen membranes and osteoconductive materials (hydroxyapatite, β-tricalcium phosphate). In selected cases with bone defects exceeding 3 mm, guided tissue regeneration (GTR) using resorbable membranes was employed.

Treatment effectiveness was evaluated at baseline, and at 4 weeks, 3 months, and 6 months post-therapy. Data analysis was conducted using SPSS Statistics v.26.0. The Shapiro–Wilk test was used to assess normal distribution. Statistical significance was determined using paired t-tests and Pearson's χ^2 tests for categorical data. A p-value < 0.05 was considered statistically significant.

Results and Discussion

The results of the conducted analysis and summarized clinical observations confirmed that the effectiveness of periodontitis treatment directly depends on the stage of the disease, the depth of periodontal tissue damage, the individual microbial profile, and the patient's adherence to therapy. Among the observed patients (n = 38), 100% presented with clinical signs of chronic inflammation at the initial examination: bleeding on probing, dental plaque, gingival hypertrophy, grade I–II tooth mobility, and deep periodontal pockets with a mean depth of 5.8 ± 0.9 mm. The baseline plaque index (PI) averaged 2.3, and the gingival inflammation index (GI) was 2.0.

Following the initial four-week course of antibacterial therapy (mechanical and pharmacological debridement), there was a statistically significant reduction in clinical indicators of inflammation: the plaque index decreased to 1.2, the gingival index to 0.9 ($p < 0.01$), and the average pocket depth was reduced to 4.1 ± 0.7 mm. In 18 patients with residual pockets ≥5 mm after initial therapy, surgical intervention was performed using open curettage. Eight of these patients also received guided tissue regeneration (GTR) with bioresorbable membranes and hydroxyapatite-based bone graft material.

Three months after surgery, patients who had undergone flap surgery with GTR showed more pronounced positive dynamics: the pocket depth decreased to 3.4 ± 0.6 mm, and the

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clinical attachment level improved by an average of 1.5 mm. In contrast, patients treated only with conservative methods showed an average attachment gain of 0.8 mm. Moreover, patients who received regenerative treatments exhibited better gingival margin stability and no signs of recession.

It is also worth noting that patients who underwent laser therapy (n = 10) experienced not only reductions in pocket depth and microbial load, but also subjective improvements including decreased tooth sensitivity, elimination of halitosis, and improved overall well-being. These observations are consistent with international data highlighting the adjunctive benefits of laser and photodynamic therapy in microbial suppression and tissue healing [1, 2].

Overall, the results demonstrate that the most effective outcomes are achieved through multistage, combined treatment strategies, which include initial debridement, surgical correction, and the use of regenerative techniques. Conservative therapy alone proves insufficient for pockets deeper than 5 mm, which aligns with literature reports on the limited efficacy of closed curettage in advanced cases [3].

It is essential to emphasize that clinically meaningful and stable results can only be achieved through regular patient participation in supportive care, including professional hygiene and home maintenance. A lack of follow-up and poor compliance significantly increases the risk of recurrence, as evidenced in clinical practice.

Thus, the findings confirm the value of a personalized, stepwise approach to periodontitis treatment. The proper use of modern technologies—such as guided tissue regeneration, laser therapy, and osteoconductive materials—not only eliminates inflammation but also contributes to the restoration of periodontal structural integrity. The integration of digital monitoring systems and telemedicine platforms holds promise for improving long-term adherence to periodontal maintenance protocols.

Conclusion

Periodontitis is a multifactorial chronic disease that requires a comprehensive and stepwise therapeutic approach. The analysis demonstrated that conservative methods, including professional oral hygiene, scaling, root planing, and antiseptic therapy, are most effective during the early stages of the disease and for periodontal pockets up to 4–5 mm deep. In cases of more advanced tissue destruction, surgical intervention is justified, including the use of guided tissue regeneration and osteoplastic materials.

Regenerative techniques—such as GTR, membrane systems, and hydroxyapatite—and adjunctive modalities like laser and photodynamic therapy enhance the primary treatment outcomes and promote soft tissue reattachment. However, the achievement of stable clinical results is contingent upon active patient participation, consistent follow-up, and individually tailored therapy, taking into account clinical severity, systemic risk factors, and motivation.

Therefore, modern periodontitis management must be based on the principles of evidence-based medicine, interdisciplinary collaboration, and the implementation of innovative

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technologies to ensure both inflammation control and long-term restoration of periodontal structural integrity.

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