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Review Article

Modern methods and technology in periodontal treatment: a review article

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ABSTRACT

Periodontal treatment has evolved significantly due to technological advancements and novel methodologies. Between 2020 and 2024, integrating digital technologies, therapeutic innovations, and advanced treatment modalities has transformed clinical practice, improving patient outcomes. This review examines recent developments in periodontal care, focusing on advanced methodologies such as laser therapy, guided tissue regeneration (GTR), and digital imaging. Key technologies analyzed include antimicrobial photodynamic therapy (aPDT), cone-beam computed tomography (CBCT), computer-aided design/manufacturing (CAD/CAM), and 3D bioprinting. The integration of these technologies has enhanced the diagnostic, therapeutic, and prognostic capabilities of practitioners. Additionally, biomaterials and tissue engineering have shown promise in regenerative periodontal therapy, supporting natural healing and minimizing invasive surgical interventions. Modern advancements in periodontal treatment have improved clinical efficacy and patient care. This review highlights the evolution of periodontal techniques, assessing their benefits and limitations in contemporary practice.

Keywords: New, Modern, Technology, Methods, Periodontal, Treatment, Management

INTRODUCTION

Modern techniques are required to treat periodontal disease, a primary global health concern. Mechanical debridement, scaling, root planing, and surgical procedures have been the mainstays of traditional periodontal disease management. However, the introduction of contemporary technology has transformed the treatment of periodontal disease by providing more effective, minimally invasive, and highly accurate therapeutic alternatives. Examining the development of periodontal treatment approaches, this literature review focuses on the benefits, drawbacks, and effectiveness of contemporary techniques and technologies. By examining significant developments in this field, this review draws attention to the revolutionary potential of these inventions and points out areas that require more study.[1-6]

LITERATURE SEARCH

This literature review aimed to identify and evaluate the latest advancements in methods and technologies utilized in periodontal treatment, focusing on their efficacy, applicability, and clinical outcomes.

Framework

The PRISMA (Preferred reporting items for systematic reviews and meta-analyses) framework was followed for article selection to ensure rigor and transparency in the review process.

The PICO (Population, intervention, comparison and outcome) model was also used to formulate research questions and guide data extraction.

Search process

A comprehensive search was conducted using the electronic databases PubMed and Google Scholar. Articles published between 2020 and 2024 were targeted to ensure the inclusion of the most recent studies. The keywords were employed for a systematic literature search: new, modern, technology, methods, periodontal, treatment, and management. We selected these phrases because they most accurately reflected our investigation's aim: to gain additional insight into integrating digital technologies, novel therapeutic approaches, and advanced treatment modalities that have significantly transformed the landscape of periodontal care. Boolean operators (AND, OR) were used to refine search results. For example, combinations such as "modern AND periodontal treatment" or "technology OR methods AND periodontal management" were utilized to maximize relevant results. Filters were applied to narrow down results to English language and free full-text articles.

The search process involved the following steps.

Initial screening: The titles and abstracts of retrieved articles were reviewed to identify those aligned with the review's aim and scope.

Application of inclusion and exclusion criteria: Articles were filtered based on the below criteria.

Full-text review: Articles that passed the screening process were reviewed in detail to extract relevant data.

The PRISMA flow diagram was employed to document the selection process across the following stages:

Identification: Search results were consolidated from the selected databases.

Screening: Titles and abstracts were reviewed to remove irrelevant studies.

Eligibility: Full-text articles were assessed against inclusion and exclusion criteria.

Inclusion: Eligible studies were included for qualitative synthesis and analysis.

The following criteria were applied to include relevant studies in the review: Articles published in English, studies are available as free full texts, articles are classified as clinical trials or randomized controlled trials (RCTs) and research specifically addressing updated methods or technologies in periodontal treatment.

The following criteria were used to exclude articles: Case reports and pilot studies due to limited generalizability, incomplete trials or studies lacking definitive results and articles unrelated to periodontal treatment or technology-focused studies.

Data extraction

Relevant data from the selected articles were systematically extracted, including-

Study design: Type of study, sample size, and methodology.

Intervention: Description of the modern technology or method utilized.

Comparison: Details of the traditional treatment used as a control.

Outcomes: Clinical effectiveness, patient outcomes, and comparative results.

Challenges and limitations: Highlighted drawbacks or gaps noted in the studies.

The extracted data were categorized based on themes such as laser therapy, aPDT, digital imaging, GTR, biomaterials technology and minimally invasive therapy. A narrative synthesis was conducted to summarize findings, identify trends, and highlight potential areas for future research.

MODERN METHODS AND TECHNOLOGY IN PERIODONTAL TREATMENT

Laser technology

The application of laser technology in periodontal therapy is among the most noteworthy developments in contemporary dentistry. This cutting-edge method greatly reduces harm to nearby healthy tissues by using the accuracy of lasers to administer targeted treatment to infected tissue.[1] Diode lasers, for example, have been demonstrated to not only lessen bleeding during procedures but also to encourage quicker healing, which lessens the trauma patients endure overall. According to studies, diode lasers are the most widely used laser technologies because of their affordability, portability, and simplicity.[8,19]

These assertions are supported by a research that patients treated with laser therapy experience noticeably less pain and used fewer analgesics, demonstrating how well this technology works to improve patient comfort following surgery than those treated with conventional techniques.[7]

Lasers have become increasingly popular because of their exceptional ability to control bleeding, provide comfort, decreased recovery time, accuracy and reduce postoperative discomfort by interacting with soft tissues enhancing clinical results. Mucosal lesion removal, frenectomies, gingivectomies, dental caries, bone lesions, and periodontal surgery are all performed with lasers in hard tissue surgery.[16,17] Maintaining the integrity of the periodontal architecture depends on the laser treatment's ability to remove diseased tissue selectively while leaving good bone and gum structures intact. According to follow-up studies, patients who received laser treatment had decreased rates of periodontal disease recurrence, demonstrating that this selective method promotes quicker recovery and improves long-term outcomes.[9,10,14] According to a recent study evaluating the clinical effectiveness of propolis gel and 940 nm diode lasers, gingival inflammation was significantly reduced in groups 2 and 3 from baseline to one and three months, while post-treatment sites across all groups demonstrated statistically significant reductions in periodontal index (PI), probing pocket depth (PPD), and clinical attachment level (CAL).[17]

Apart from these advantages, laser technology also helps lower the danger of infection. In periodontal Therapy, where infection management is crucial, the heat effects of lasers can sterilize the treatment region, making it less conducive to bacterial growth. This feature of laser use is consistent with dentistry's increasing focus on minimally invasive procedures that put patient comfort and safety first while producing successful treatment results.[15]

Lasers are essential to periodontal Therapy, even if SRP is still the standard treatment method for periodontal disease. They assist in lowering bacteria and improving human periodontal regeneration without endangering the surrounding bone and pulp tissues.[39,42]

Three studies evaluated diode lasers in conjunction with SRP instead of SRP alone. The clinical parameters (PI, GI, PPD, and CAL) showed a significant decline, and the laser group outperformed the SRP group in all of these areas. Gingival health was restored more successfully in this arrangement.[8,9,40] They all evaluated the use of SRP and erythritol in subgingival air polishing compared to SRP alone. According to this research, all clinical parameters showed a considerable decline.

Onisor et al and Mensi et al on the other hand, evaluated subgingival air-polishing with erythritol and SRP compared to SRP alone.[40,41] They found no appreciable decrease in clinical indices or extra advantages for SRP.

According to research, erythritol breaks down the biofilms that different bacteria, including AA, form. This disruption causes individual bacteria to separate from the biofilm matrix, which may temporarily increase the number of bacteria in the surrounding area.[43,44] However, in the end, this disruption weakens the bacterial community, making it more vulnerable to additional antimicrobial activities, such as those of erythritol or other substances.

These results are consistent with Jentsch et al who evaluated the use of erythritol in treating periodontitis in comparison to SRP alone and found that the count of A.A. and P.G. was significantly lower.[39]

According to research by Resnik et al subgingival air-polishing with erythritol and SRP compared to SRP alone did not significantly lower the number of bacteria (A.A. and P.G.) or provide any further advantages over traditional periodontal therapy.[37] Furthermore, there was no discernible difference between erythritol and laser in terms of PPD and CAL, demonstrating the effectiveness of erythritol as a periodontitis treatment.

However, obstacles to its wider implementation include the high cost of laser equipment, the need for specialized training, and the restrictions of penetration depth.[17-19] With the use of lasers to treat periodontal issues and the integration of lasers with AI in customized dental treatments, the future of laser therapy in dentistry is anticipated to be bright. More sophisticated and individualized dental care is expected due to the combination of AI and lasers. Laser dentistry will keep expanding and become better in the future.[10,11]

Photodynamic treatment

Since photons, or light energy, are used by PBM lasers to modify biological processes, the word "photobiomodulation (PBM)" (also known as low-level laser therapy, or LLLT) defines how these lasers function. PBM activates several transcription factors, including the antimicrobial peptide h-BD-2 (human β-defensin-2). PBM and PDT have a similar mechanism of action. Still, PDT uses a combination of light- and photo-sensitive medications that target chromophores to kill bacteria or cancerous cells. In contrast, PBM promotes wound healing or relieves pain.[13,20, 29]

PBM is becoming an increasingly important part of contemporary dental care, a non-invasive therapeutic method that complements conventional dental procedures. Herpes simplex lesions, temporomandibular joint disorders (TMDs), and recurrent aphthous stomatitis are among the dental treatments used. PBM is a valuable adjunct in many dental procedures since it promotes tissue regeneration and lessens pain and inflammation.[10,24] A 2022 study assessed PBM's impact on bone remodeling and emphasized its advantages for postoperative recovery.[13,16] In an osteoblast-osteoclast co-culture system, PBM has also been demonstrated to enhance bone remodelling in dentistry.[21-23] Additional uses for lasers in minimally invasive dentistry include pain relief, periodontal Therapy, postoperative healing, bone remodelling, root canal cleaning, and aesthetic dentistry.[25]

More recently, PBM has been suggested as a supplement to dental hygiene therapies for periodontal diseases. The local impact of PBM on treating periodontal pockets in patients with type 2 diabetes and periodontitis was examined in a prior study.[27] The PBM protocol was more successful in lowering the proportion of moderate and severe periodontal pockets at 3, 6, and 12 months in patients with type 2 diabetes mellitus, even though it did not significantly alter PPD and CAL in periodontal pockets when compared to mechanical therapy alone. Although no assessments have been done at the 12-month mark, this is consistent with another study that reported a comparable decrease in PPD from baseline to the next six months.[13] However, the previously described study found no discernible differences when comparing PPD and CAL in periodontal pockets treated with PBM or mechanical therapy alone. Because there was no control group exposed to mechanical stress in the current study, no direct comparisons can be established.

Analogous research on betel chewers verified the added benefit of PBM for treating periodontitis compared to SRP alone.[35] Despite the encouraging findings for PBM in the mentioned trials, no solid proof has been shown as of yet. The current evidence is inadequate in terms of PBM dosimetry, which is essential for establishing standardized and thus replicable protocols for therapeutic and research purposes, according to recent and high-quality systematic reviews; furthermore, the significant variations in the methodologies and the high risk of bias evaluated for the included studies have resulted in their classification as low quality.[30]

Clinical trials have evaluated ozone therapy's effectiveness for treating gingivitis, periodontitis, and peri-implantitis in addition to laboratory investigations. Specifically, in a recent study conducted by our team, peri-implantitis patients were enlisted to assess the effectiveness of a treatment procedure that involved using ozonized water instead of clean water to irrigate pathological regions.[26] The study showed a noteworthy decline in PPD, PI, BoP, and bleeding score (BS). Since the control group did not experience this result, ozone's function as an adjuvant agent in an oral hygiene regimen was validated. This outcome is consistent with earlier findings in the literature.[27,28] Furthermore, Rapone et al examined the impact of gaseous ozone therapy as an adjuvant on clinical indices comparable to those discussed in this report, including PPD and BoP.[28] This study shows that both indexes showed a significant decline at six months.

According to a recent study, periodontal pocket closure and inflammatory indicators could be considerably enhanced by the supplementary use of methylene blue (MB) and toluidine blue O (TBO) photodynamic treatment (PDT).[25]

Biomaterials and regenerative therapy

Even with the most sophisticated tissue engineering techniques, it is still challenging to regenerate the periodontium, the location of periodontal diseases, because it is an incredibly intricate plexus of hard and soft tissues. On the other hand, nanotechnologies have made it possible to create biomaterials and pharmaceutical formulations that can significantly improve the effectiveness of conventional pharmacotherapies and surgical techniques.[37]

Most biomaterials used to treat periodontitis are polymeric, including the first in this fascinating sector. Even though the majority of studies in tissue engineering concentrate on improving upon preexisting paradigms rather than creating groundbreaking new ideas, it is considered that the level of innovation in this discipline is increasing.[51] Polymeric materials are the most promising biomaterials because of their superior compatibility, ease of production, and flexible design to achieve multifunctionality, according to a review that summarizes the design methods of polymeric biomaterials for treating oral illnesses.[36]

These are accomplished through the development of antimicrobial polymers, such as cationic polymers, antimicrobial peptides, and antibiotic-conjugated polymers; the synthesis of anti-inflammatory polymers with phenolic hydroxy and cysteine groups that act as immunomodulators and electron donors to reactive oxygen species to reduce inflammation; and the design of wet-adhesive polymers modified with hydroxy, amine, quinone, and aldehyde groups to provide strong wet-adhesion through hydrogen and covalent bonding, as well as electrostatic and hydrophobic interactions. Antibiotics, immunomodulators, and antioxidants are delivered using technologies with strong wet-adhesion and improved mucosa and biofilm penetration capabilities, including hydrogels, patches, nanoparticles, and microneedles, to achieve therapeutic efficacy.[3,34,36]

Injectable biomaterials are typically chosen over implanted ones in the mouth cavity for regenerative purposes. The viscous formulations known as injectable biomaterials are delivered in a liquid or gel-like state. Their most notable advantage is their ability to be easily administered with a needle, a straightforward and far less intrusive process that reduces collateral damage around the injury site.[33,34] Crystalline calcium sulphate in micro- and nanoformulation has been tried as a potential therapy for intrabony defects. In contrast to the microcrystalline form, the research found that nanocrystalline calcium sulfate demonstrated noticeably improved periodontal regeneration.[51]

In several medical specialties, the relationship between biomaterials and macrophages is a significant subject of study. Using biomaterials to modify macrophage polarization to treat periodontitis has grown popular and demonstrated considerable promise in recent years. Biomaterials can affect antimicrobials, bone destruction, and regeneration in periodontitis by modifying macrophages. Ceramics, polymers, and nanoparticles are the primary biomaterials being researched for periodontal regeneration. Because of their similar composition and mechanical characteristics, ceramics are a component of bone and dental bone regeneration, polymeric biomaterials are primarily used for PDL regeneration, and nanomaterials are used to deliver bioactive substances. Recent studies on periodontal treatment have also employed various cutting-edge antimicrobial techniques in addition to the ones mentioned above, including probiotics and aPDT.[31-34]

Research on stem cells has drawn much interest because of the promising future of periodontal tissue regeneration;

nevertheless, several issues still need to be resolved. Real tissue engineering requires the creation of suitable scaffolds that transport the cells and growth factors even in the context of infectious healing (caused by the oral microbiota). A well-planned approach to the periodontal healing process is required since the benefits of high healing potential and the drawbacks of oral microbial attacks are mixed. Ideal wound healing and tissue regeneration would be more attainable with the current advancements in customized medicine technology, such as next-generation sequencing and three-dimensional printing.[34,45]

The potential to regenerate the entire and functional periodontium is enormous when various approaches are applied. Despite their potential, new technologies have limitations, such as inadequate vascularization and accuracy, which need more extensive adjustment. Therefore, this analysis also highlights potential viewpoints and approaches that target their drawbacks, shedding light on future studies' paths to achieve fruitful clinical situations.[45]

CAD/CAM and 3D bioprinting techniques

The goal of additive manufacturing is to direct the in vivo development of a wholly integrated periodontium-like structure of alveolar bone, periodontal ligament, and cementum/dentin.[52] Moreover, computer-aided design and computation are used to create 3D structures [48]. A variety of printing techniques, including inkjet, laser-assisted, extrusion, microextrusion, and digital light processing, are used in these constructions. These techniques enable the development of intricate and accurate models appropriate for various tissue engineering requirements and other biomedical uses.

In contrast to the inkjet approach, laser-assisted printing is considered a sophisticated and costly process. Furthermore, the cells are not subjected to mechanical stress because there is no direct contact between the bioink and the dispenser. This allows laser-assisted printing to achieve high resolution while utilizing bio-ink with higher viscosity and enhanced cell survival.[54] As this approach is not widely used, more research is necessary to standardize the diameters of the droplets produced.

Scaffolds and tissue constructions that closely resemble the natural architecture of periodontal tissues can now be precisely fabricated thanks to advancements in 3D bioprinting. To achieve high-resolution and high-precision bioprinting, methods like inkjet, laser-assisted, extrusion, microextrusion, and digital light processing have proved essential.[54,55] Every technique has its benefits. For example, extrusion-based techniques enable using a broad range of materials, whereas laser-assisted printing offers excellent resolution and cell viability. However, each method has certain drawbacks, such as the mechanical stress placed on cells during extrusion and the high expense and complexity of laser-assisted printing.[52]

Regenerating periodontal tissues, especially the alveolar bone and periodontal ligament, is difficult. For instance, it has been demonstrated that using gingival mesenchymal and periodontal ligament stem cells in bioinks may aid tissue regeneration. Furthermore, it has been discovered that adding nanoparticles such as hydroxyapatite improves the bioinks' mechanical characteristics and osteogenic potential.[54,55]

There is no doubt that regenerative dentistry has progressed a long way, and many groundbreaking discoveries have been made throughout the years. The use of 3D bioprinting technology in periodontal therapy faces challenges such as high costs and the need for customized bio-inks.[53] Regenerative methods, such as growth factors and stem cells, are transforming dental care. Platelet-rich plasma (PRP) promotes tissue regeneration and healing, improving clinical outcomes.[53,56] Stem cell therapy can rebuild alveolar bone and periodontal ligaments, targeting the root causes of periodontal illness. Combining scaffold materials with growth factors like bone morphogenetic proteins (BMPs) can further improve the healing process, facilitating the integration of new tissues into the existing periodontal structure.[48,49]

Most of the studies involving stem cells have halted at the stage of animal studies and have not proceeded to clinical trials due to numerous debatable safety and ethical concerns, particularly when it comes to the administration of stem cells. The potential dangers of undesired tissue formation, tumourigenesis, and metastasis represent a controversial issue that has not yet been resolved.[46,47] Further, the required clinical grade and modern, sophisticated technologies that may be limited to advanced clinics and laboratories may also curb the opportunities for the progression of these approaches from bench to clinic.[49]

Digital imaging techniques

CBCT has revolutionized dental diagnostics, particularly in evaluating periodontal disease. Compared to conventional two-dimensional radiographs, CBCT provides three-dimensional images of periodontal structures, improving the precision of assessing bone loss and the degree of periodontal disease. By determining the location and extent of periodontal pockets and evaluating the shape of alveolar bone, this comprehensive image helps with diagnosis and treatment planning. Studies show CBCT patients have superior clinical results and a greater chance of effective periodontal regeneration. Furthermore, by offering unambiguous visual representations, CBCT promotes cooperative patient treatment by improving patient comprehension and compliance. In conclusion, using CBCT in periodontal diagnostics dramatically increases the precision of assessments and the efficacy of treatments, indicating that our understanding of periodontal health and disease will continue to progress.[58,59]

Minimally invasive surgical technique

Developments in minimally invasive surgical techniques-like the pinhole surgical technique-have been increasingly popular in recent years. This novel method entails the dentist repositioning existing gum tissue over the exposed tooth roots using a tiny, specifically made tool that makes a small pinhole in gum tissue. This procedure is desirable because it does not require donor tissue, frequently attributing their favourable experiences to speedy recovery and instantaneous cosmetic improvements.[56]

Beyond being aesthetically pleasing, the Pinhole Surgical Technique also has practical benefits. For example, by rebuilding the gum line, patients can benefit from improved protection for their teeth against decay and discomfort, which frequently accompany gum recession.[60]Additionally, the minimally invasive nature of the treatment dramatically reduces the risk of problems like infections or delayed healing durations that are usually linked with more invasive operations.[59]

Thick gingival biotype sites showed good root coverage, while narrow gingival biotype sites showed less than ideal outcomes and, in several cases, no root coverage. Soft-tissue growth aided by amniotic membrane's ability to promote fibroblast proliferation/its spacing effect.[57,58]

Artificial intelligence

Artificial intelligence (AI) transforms periodontology by analyzing vast data to identify patterns and predict disease progression. This allows for early intervention and personalized treatment plans. AI can evaluate risk factors, enhancing preventive care strategies. As technology evolves, it will lead to better outcomes for patients with periodontal diseases, improving the efficiency of practices and enhancing patient care.[50]

The study aimed to evaluate the efficacy of multimodal-sensing toothbrushes with AI (AI-MST) in treating periodontitis. One hundred patients with stage II/III periodontitis participated in the trial. They were given a digital intervention using AI-MST, remote micro messaging, or a regular dental hygiene regimen. After six months, the results indicated a considerable decrease in inflammatory periodontal pockets.[11]

AI, in conjunction with these molecular and cellular components, offers tremendous potential for creating diagnostic instruments. Real-time information about periodontal health can be obtained using AI-driven analysis to improve the identification and measurement of particular biomarkers in saliva.[11] Combining machine learning algorithms with salivary diagnostics can investigate new avenues in predictive modelling, early identification, and individualized treatment plans for periodontal diseases. In addition to taking advantage of saliva's biological complexity, this method opens the door for novel uses in oral health care.[2,50] Because AI systems can collect and analyze data more quickly than humans, they can make more accurate diagnoses and schedule treatments, increasing dental procedures' dependability.

Table 1: Applications.

Laser therapy	Scaling, root planing, soft tissue management
aPDT	Refractory periodontitis, peri-implantitis
Biomaterials	Tissue regeneration, peri-implantitis
CAD/CAM and 3D printing	Implant prosthetics, surgical guides
Artificial intelligence	Disease detection, risk assessment, remote monitoring
Minimally invasive techniques	Gum recession, root coverage

Table 2: Key benefits and limitations.

Technology	Benefits	Limitations
Laser therapy	Reduces bacteria, promotes healing	High cost, thermal damage risk
aPDT	Targets bacteria, minimally invasive	Limited studies, variable outcomes
Biomaterials	Enhances healing, drug delivery	Biocompatibility issues, cost
CAD/CAM and 3D printing	Precision, efficiency	Expensive, limited availability
Artificial intelligence	Accurate diagnosis, personalized care	Bias risk, data privacy concerns
Minimally invasive techniques	Faster recovery, aesthetic benefits	Variable results, material shrinkage

Table 3: Future directions.

Technology	Future focus
Laser therapy	Cost reduction, clinician training
Antimicrobial photodynamic therapy	Long-term trials, standardization
Biomaterials	Bioactive materials, drug delivery
CAD/CAM and 3D printing	Cost efficiency, 3D prototyping
AI	Advanced imaging, predictive modeling
Minimally invasive techniques	Technique optimization, new materials

Furthermore, AI systems can be taught to carry out more tasks. Moreover, AI systems can be trained to carry out extra tasks. They can be used with imaging methods like magnetic resonance imaging (MRI) and computed tomography (CBCT) to identify subtle changes that might not be visible to the human eye. Because of this, AI is a valuable adjunct tool for doctors, helping them identify periodontal disease, increasing patient awareness, and promoting prompt treatment.[60]

CONCLUSION

From minimally invasive procedures to state-of-the-art technologies, the developments in contemporary periodontal treatment have profoundly changed clinical results and patient care. With the help of advancements in biomaterials like amniotic membranes and platelet concentrates, techniques like the pinhole surgical technique have demonstrated encouraging outcomes in treating gum recession with less discomfort, quicker recovery, and improved appearance. Similarly, combining digital technologies and AI has transformed patient interaction, tailored treatment planning, and diagnostics, increasing the accuracy and efficiency of periodontal procedures.

Using regenerative therapies, such as GTR, growth factor applications, and stem cell-based treatments, shows promise for previously unheard-of breakthroughs in tissue regeneration and repair.

Nevertheless, issues with cost, accessibility, clinical outcome variability, and the want for additional long-term research continue to exist across various modalities. The significance of standardization and optimization is highlighted by the fact that variables like biotype variability, material handling, and placement difficulties affect the efficacy of some procedures, such as the usage of amniotic membranes.

The combination of individualized care, cutting-edge imaging technologies, and novel biomaterials backed by artificial intelligence will shape periodontal therapy in the future. More studies on regenerative therapies and minimally invasive procedures should produce more consistent and long-lasting results, raising the bar for oral health and patient satisfaction. Contemporary techniques and technologies offer a more patient-centred, effective, and efficient way to manage periodontal disorders, representing a paradigm change in periodontal care.

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