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Effects of Antimicrobial Photodynamic Therapy in the Treatment of Disease Periodontal Disease in Adults

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SUMMARY

Periodontal disease is a chronic inflammatory condition that affects the tissues of the mouth. It is a vital sign that supports teeth and is considered one of the main causes of tooth loss in adults. Its development is associated with the presence of subgingival bacterial biofilm and to host immunoinflammatory response. Several studies demonstrate that aPDT It can reduce bacterial counts of periodontal pathogens, such as Porphyromonas. gingivalis, Tannerella forsythia, and Treponema denticola. The effectiveness of the therapy, however, It depends on factors such as the type of photosensitizer used and the power of the light source. The luminous coating, the application protocol, and the patient's initial periodontal condition are all factors. Considering its safety and the potential to amplify the effects of scraping and... In root straightening, antimicrobial photodynamic therapy has proven to be a An effective tool in the management of periodontal disease. Although it does not yet replace the In contrast to traditional mechanical approaches, it stands out as a therapeutic complement. which can improve clinical outcomes, reduce drug resistance and promote a A healthier periodontal environment in the long term.

Keywords: antimicrobial photodynamic therapy, periodontal disease, periodontitis.

ABSTRACT

Periodontal disease is a chronic inflammatory condition that affects the supporting tissues of the teeth and represents a significant cause of tooth loss in adults. Evidence from clinical studies indicates that aPDT can significantly reduce periodontal pathogens, improve probing depth, increase clinical attachment levels, and decrease bleeding on probing. These benefits are especially evident when aPDT is used as an adjunct to mechanical debridement. Despite the generally positive findings, inconsistencies among studies highlight the need for greater methodological standardization. Given its safety

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profile and ability to enhance traditional periodontal therapy, antimicrobial photodynamic therapy stands out as a valuable adjunct. Although it does not replace mechanical treatment, it has the potential to produce improved clinical outcomes and long-term periodontal stability.

Keywords: antimicrobial photodynamic therapy, periodontal disease, periodontitis.

INTRODUCTION

Periodontal disease is a chronic inflammatory condition that affects the tissues of the mouth. Supporting structures of the teeth, including the gums, periodontal ligament, cementum, and alveolar bone. Its development is associated with the accumulation of bacterial biofilm, the presence of which triggers an inflammatory response in the host, which, when persistent, can resulting in the progressive destruction of periodontal tissues. In adults with risk factors Risk factors include smoking, diabetes mellitus, stress, genetic predisposition, and poor oral hygiene. If treatment is inadequate, periodontal disease tends to be more prevalent and severe. Furthermore, because it is multifactorial in nature and influenced by systemic factors and environmental factors, their therapeutic approach requires strategies capable of controlling both microbial as well as inflammatory aspects of the process.

Conventional treatment is based on scaling and root planing. A procedure aimed at removing biofilm and subgingival calculus, promoting interruption of the infection and allowing the periodontal tissue to recover (Souza et al., 2025). Although it is a well-established technique and considered the gold standard, its effectiveness may being limited in hard-to-reach areas, such as deep pockets, furcation regions, and defects. specific anatomical features. Given these limitations, there has been growing interest in adjuvant treatments capable of enhancing antimicrobial action and contributing for better clinical outcomes. Among the alternatives studied, the use of Systemic or local antimicrobials have been explored, although they present risks such as side effects, development of bacterial resistance, and impact on the microbiome. Oral and systemic.

In this context, Antimicrobial Photodynamic Therapy (aPDT) emerged as a technique. minimally invasive, capable of eliminating pathogenic microorganisms through The combined action of a photosensitizer and a specific light source. When Activated by light, the photosensitizer interacts with molecular oxygen present in

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tissues, forming reactive species that cause irreversible damage to cells.
Bacteria, leading to the death of these cells. Unlike antimicrobial agents
Unlike traditional methods, this therapeutic modality does not depend on biochemical mechanisms.
susceptible to the development of microbial resistance, which represents progress.
significant in controlling the pathogenic flora associated with periodontitis.
In dentistry, aPDT has stood out in cases of periodontitis due to its
ability to reach microorganisms located deep within tissues
inflamed and in anatomical areas that are difficult to access with mechanical instruments (Coelho;
(Paz, 2023). Clinical studies report that, when used as an adjunct to scaling and
In addition to root straightening, photodynamic therapy can promote further reductions in
depth of probing, clinical gains from insertion, and significant decrease in
gingival bleeding (Oliveira; Carvalho, 2025). Furthermore, the technique presents
Advantages include speed of application, absence of systemic effects, and safety for...
patients with contraindications to the use of antibiotics and a low probability of reactions
adverse conditions, making it an attractive alternative for managing adults in different situations.
Stages of periodontal disease.
Understanding the effects of PDT on periodontal tissues and microbiota
Subgingival venous access has been the focus of numerous studies in recent years. It has been observed that...
The therapy not only reduces the bacterial population, but also contributes
for the modulation of local inflammation, as it reduces periodontal pathogens
influences the host's immune response. Therefore, the use of aPDT may favor
a more stable periodontal environment, reducing the risk of disease progression and
supporting the tissue repair process. Despite the promising results, there are still
debates in the literature regarding the standardization of clinical protocols, considering
variables such as the type and concentration of the photosensitizer, the light source used, the
irradiation time, number of sessions, and intervals between applications.
Another relevant aspect is that the effectiveness of the therapy can be influenced by the profile.
Individual clinical assessment of the adult patient (Silva et al., 2025). Factors such as depth
initial periodontal pockets, presence of bleeding, treatment history
Previously, systemic conditions and behavioral habits can influence the
results. Thus, understanding the role of aPDT in different clinical contexts is
Essential for evaluating its effective contributions to periodontal treatment. Therapy

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It has also been investigated as a potential tool in cases of periodontitis.
aggressive, refractory lesions, in periodontal maintenance and in situations where
Drug interactions preclude the use of conventional antimicrobials.
Given this increasing incorporation of aPDT in dental practice and the interest
Scientifically, regarding its clinical and microbiological effects, it becomes necessary to gather...
evidence that clarifies its applicability, advantages, and limitations in the treatment of
Periodontal disease in adults. A study of the effects of photodynamic therapy.
Antimicrobial therapy allows us to understand its relevance as a complementary strategy in
control of periodontal infection and promotion of better therapeutic outcomes.
Thus, exploring this topic contributes to the improvement of clinical practices and
for the development of more effective protocols, reinforcing the importance of innovation.
Technology in contemporary periodontal care.

THEORETICAL FRAMEWORK

Periodontal disease represents one of the main oral health challenges in adults.
characterized as a chronic inflammatory condition resulting from the interaction
complex interaction between bacterial biofilm and the host's immune response.
Epidemiological estimates show that periodontitis has a high prevalence.
in the adult population, being associated not only with the destruction of periodontal tissues,
but also to potential systemic repercussions, such as an increased risk of disease.
cardiovascular, diabetes complications, respiratory conditions, and adverse effects on
pregnancy. Therefore, its clinical approach requires therapeutic strategies capable of
to control local infection and halt the progression of inflammation, preserving the
oral health and contributing to the overall well-being of the individual.
Periodontal treatment was based on the mechanical removal of biofilm and calculus.
subgingival, through scaling and root planing (Oliveira; Carvalho, 2025).
This procedure remains the gold standard in periodontal therapy, with proven effectiveness.
proven to reduce inflammation and improve clinical parameters, such as
Probing depth and clinical insertion level. However, limitations
intrinsic to the mechanical process arise from the anatomical complexity of some
regions, such as irregular root surfaces, molar furcations, deep pockets and
hard-to-reach areas. Furthermore, the persistence of pathogenic microorganisms in

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Protected areas and the epithelial wall of the periodontal pocket constitute a major obstacle.
to complete control of the infection.

To overcome these limitations, systemic and local antimicrobials have become...
incorporated as adjuncts to mechanical therapy. However, their use entails challenges.
important factors, such as the increasing risk of bacterial resistance, changes in the microbiome,
side effects, drug interactions, and contraindications in certain
patients. In this scenario, the search for alternative methods that offer action has grown.
An effective antimicrobial without the negative impacts associated with antibiotics. Among the
Among emerging techniques, Antimicrobial Photodynamic Therapy (aPDT) stands out, which
It has gained visibility in recent years due to its secure profile and action mechanism.
innovative and with the potential to complement conventional periodontal treatment (Souza
et al., 2025).

aPDT is based on the combination of a photosensitizer, applied to the pouch.
periodontal, with an appropriate light source, such as a low-power laser or a
LED. When activated by light, the photosensitizer triggers photochemical reactions.
which lead to the formation of free radicals and reactive oxygen species, promoting
the direct destruction of pathogenic microorganisms (Coelho; Paz, 2023). Because it does not
Because it depends on specific metabolic pathways, the technique reduces the risk of developing
bacterial resistance and exhibits low toxicity to human cells, expanding its
Applicability in different clinical conditions.

Scientific literature reports that PDT has the ability to eliminate not only
Gram-negative and gram-positive bacteria, but also fungi and some viruses, making it-
a versatile tool in the clinical setting. Regarding periodontitis, studies
They show a reduction in the bacterial load of key periodontal pathogens, such as
Porphyromonas gingivalis and Tannerella forsythia, in addition to improvements in indicators.
Clinical periodontal studies. Despite this, the results are not always uniform, since
that the effectiveness of the therapy depends on factors such as the type of photosensitizer, the
concentration used, light fluence, irradiation time, and number of sessions.
therapeutics.

Another relevant dimension of the context is the change in the demographic profile and
epidemiological data on the adult population, which has experienced an increase in life expectancy,
Greater tooth retention over the years and an increasing prevalence of chronic diseases.

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These factors contribute to the persistence or worsening of periodontal disease.
reinforcing the need for therapies that are effective, safe, and adaptable to different needs.
Clinical realities. Elderly patients, those taking multiple medications, and those with systemic diseases.
or those with contraindications to the use of antibiotics, for example, may benefit from
aPDT as an alternative or complement to conventional strategies.
In the technological field, the advancement of optical devices, the development of new
Photosensitizers and the expansion of clinical research have strengthened the basis.
Scientific evidence of photodynamic therapy (Silva et al., 2025). However, further research is still needed.
methodological standardization to establish accepted clinical protocols and
applicable to dental practice. The heterogeneity of the available studies highlights the
importance of further research into its long-term effectiveness, cost-effectiveness,
impact on microbiota and integration with different phases of periodontal treatment,
including initial therapy and maintenance.
Finally, understanding the context in which Antimicrobial Photodynamic Therapy is used is crucial.
The role of the individual in the treatment of periodontal disease in adults is fundamental in recognizing
its transformative potential in contemporary dentistry (Oliveira; Carvalho, 2025).
The technique represents a promising alternative in a scenario marked by limitations.
therapeutics, antimicrobial resistance, and the search for less invasive interventions.
Thus, deepening the understanding of its clinical, microbiological and effects
immunological factors become essential to consolidate their role as a complementary resource.
in the management of periodontitis, contributing to more effective treatments and
customized.

METHODOLOGY

The proposed methodology for investigating the effects of Photodynamic Therapy
Antimicrobial therapy in the treatment of periodontal disease in adults is based on a
A qualitative, descriptive, and analytical approach, based on a literature review.
The study was structured based on the selection, analysis, and synthesis of scientifically relevant data.
articles published in recognized databases, with the aim of gathering evidence.
updated information that allows for an understanding of the contributions, limitations, and clinical applications.
aPDT as adjunctive therapy in the management of periodontitis. The choice of the method of
This review is justified by the wide diversity of research available on the topic and by

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need to integrate results that often present protocols,
distinct instruments and clinical contexts.

The literature search was conducted in databases such as PubMed, SciELO, and Google.
Scholar, Scopus, and Medline, considering publications from recent years that address the...
Application of photodynamic therapy in adults with periodontitis. Keywords used
They included terms such as antimicrobial photodynamic therapy, periodontal disease,
Photosensitizers, periodontitis, low-power laser, and subgingival biofilm were used.
including clinical studies, controlled trials, systematic reviews, narrative reviews
and experimental articles that presented relevant information about parameters
clinical aspects, microbiological effects, application protocols, advantages and limitations of
Technical studies were excluded that addressed PDT in other areas of the field.
dentistry, studies conducted on animal models, and research that did not present
Clear methodology or data applicable to periodontal treatment.
After the initial identification of the studies, the titles and abstracts were read, as well as...
as well as from the full texts, to select those aligned with the research objectives.
The relevant information was extracted and organized in a systematic way.
prioritizing data related to clinical efficacy, reduction of periodontal pathogens, and
influence on inflammation, comparisons with conventional treatments, and variations
Methodological differences exist between the studies. The analysis of the results was carried out using the
comparison of the findings, highlighting the convergences and divergences observed in
literature. This process allowed for the identification of trends, gaps, advances, and challenges.
related to the use of aPDT in adult patients with periodontal disease.
In addition to the literature review, guidelines and recommendations were considered.
scientific entities in periodontics, aiming to situate aPDT within clinical practices
recognized and to understand their current level of evidence. The methodology adopted sought
to ensure rigor, clarity, and objectivity, allowing the results presented to reflect...
the current state of scientific knowledge on the subject and contribute to understanding
Critique of the role of photodynamic therapy in periodontal treatment. Therefore, the
This study provides theoretical support for future research and clinical practice.
reinforcing the importance of integrating scientific evidence and decision-making.
professional decision.

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RESULTS

The analysis of the selected studies shows that Photodynamic Therapy
Antimicrobials show positive clinical results when used as an adjunct.
to conventional periodontal treatment in adults. Most of the studies
Reviewed studies demonstrate a significant reduction in periodontal pathogens after application of
aPDT with species associated with the red complex, such as Porphyromonas gingivalis,
Tannerella forsythia and Treponema denticola (Coelho; Paz, 2023). This decrease
Microbial contamination was observed in both short-term studies and assessments.
performed weeks after treatment, which indicates that the therapy has the potential to
to improve control of subgingival infection. In some clinical trials, the reduction
bacterial contamination after the use of aPDT proved superior to that obtained with scraping alone and
root straightening, suggesting relevant complementary action.

From a clinical standpoint, the results indicate a consistent improvement in the parameters.
Periodontal. Probing depth showed a more pronounced reduction in the groups
treated with aPDT combined with mechanical treatment, in moderate and
deep. The clinical level of insertion has shown additional benefits in several studies.
in the first few weeks after therapy, indicating a positive influence on the process of
tissue healing. Another frequent finding was a decrease in bleeding.
Probing, observed significantly in patients who received the therapy.
photodynamic therapy, which reflects a reduction in the local inflammatory process. In some studies,
These benefits were maintained throughout the maintenance consultations, although they varied.
according to the adopted protocol and the individual characteristics of the patients (Souza et al.,
2025).

Despite the promising results, there was variability among the studies analyzed.
Some authors have reported modest differences between the groups treated with aPDT and the
subjected only to mechanical treatment (Silva et al., 2025). This heterogeneity
This is associated with several factors, such as differences in the photosensitizers used.
in the type of light applied, the irradiation time, the number of sessions, and the severity.
initial stages of the disease. Even so, the general trend indicates that photodynamic therapy,
When repeated in more than one application, it produces more consistent effects and
lasting, reinforcing the importance of appropriate and standardized protocols.

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In addition to the microbiological and clinical benefits, the studies did not record any adverse events. Significant adverse events occurred (Oliveira; Carvalho, 2025). The therapy was well tolerated by Adult patients, with no reports of pain, sensitization, or damage to periodontal tissues. Another important finding relates to the low risk of bacterial resistance, since that aPDT acts through photochemical mechanisms that do not depend on pathways specific metabolic processes of microorganisms. This makes it a safe alternative for patients who cannot use antibiotics or who have systemic diseases that Caution is required when using medications.

The results of the analyzed research indicate that Photodynamic Therapy Antimicrobial therapy is effective as a complementary method in the treatment of the disease. periodontal disease in adults, promoting a further reduction in microbial load, improving clinical parameters of periodontal therapy and therapeutic safety. Although it does not replace the In contrast to conventional mechanical treatment, it presents itself as an adjuvant strategy. promising, capable of enhancing clinical outcomes and offering advantages. important in the context of periodontitis.

DISCUSSION

The results from the literature demonstrate that Antimicrobial Photodynamic Therapy This represents a promising complementary strategy in the treatment of the disease. Periodontal treatment in adults is effective, but its effectiveness depends on multiple clinical factors and methodological. The main strength of PDT lies in its ability to promote reduction. additional periodontal pathogens when associated with scaling and root planing radicular, contributing significantly to the control of subgingival infection. This This advantage is important in a scenario where antimicrobial resistance has become... This has become a growing problem, making it necessary to search for alternatives. Therapeutic methods that do not depend on the continuous use of antibiotics. Photochemical action, responsible for generating reactive oxygen species that are lethal to microorganisms, This prevents the development of resistance, which puts aPDT in a position to A highlight among modern adjuvant therapies.

Although many studies demonstrate clinical benefits, there are still disagreements regarding... findings, which reflects the lack of standardization in the protocols used. Variables such as the type of photosensitizer, the fluence and wavelength of the light, the intensity of

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Whether using a laser or LED, the irradiation time and the number of applications can influence...
significantly the results (Souza et al., 2025). This methodological heterogeneity
It makes direct comparison between studies difficult and prevents the establishment of a...
definitive consensus on the ideal protocol. Thus, although the data point to trends.
While positive, there is still a need for more robust, standardized, and multicenter studies.
that consolidate the scientific basis of photodynamic therapy in the periodontal context.
Another important aspect to be discussed concerns the clinical response of adults.
Patients undergoing aPDT, which can vary depending on the severity of periodontitis,
The depth of the periodontal pockets, the presence of active inflammation, and the conditions
systemic factors of the patient. In individuals with advanced periodontitis or with risk factors
Risk factors, such as smoking, diabetes, or poor oral hygiene, can affect the response to therapy.
to be less predictable, requiring more intensive monitoring and repeated applications.
from aPDT (Silva et al., 2025). Still, many studies indicate that, even in these
In some cases, photodynamic therapy contributes to the reduction of inflammation and blood load.
bacterial, reinforcing its importance as a complementary tool, especially in
clinically challenging situations.
Photodynamic therapy also stands out for its good acceptance by patients and for...
Safety demonstrated in numerous clinical studies, with no significant reports of
adverse effects. This characteristic expands its possibilities for use, including in
patients sensitive to medications, taking multiple medications, or with contraindications to the use of
antibiotics. However, it is necessary to consider that PDT, although it has advantages, does not
It replaces conventional mechanical treatment and should not be used in isolation.
Its role is to reinforce the therapeutic effect, maximizing the impact of shaving and straightening.
radicular and contributing to more consistent clinical results (Coelho; Paz, 2023).
Finally, the discussion on the applicability of Antimicrobial Photodynamic Therapy in
Treatment of periodontitis should take into account the need for ongoing education of...
professionals and the updating of clinical protocols as new evidence emerges.
Scientific studies are produced (Oliveira; Carvalho, 2025). The increasing availability of
More efficient optical devices and photosensitizers suggest that the technique may
to become increasingly integrated into clinical practice. With this, it is expected that, in the future, the
aPDT should be incorporated into expanded periodontal care, offering benefits.
Sustainable and safe for adult patients.

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CONCLUSION

Antimicrobial photodynamic therapy represents a significant advance in the field of periodontics, especially in the treatment of periodontal disease in adults, by offering an alternative therapy capable of overcoming some limitations of the methods traditional methods. Analysis of the literature demonstrates that PDT promotes beneficial effects in both in microbiological control as well as in periodontal clinical parameters, contributing for the reduction of pathogens associated with periodontitis and for the improvement of inflammation. gingival. These results reinforce its importance as an adjuvant method, capable of to enhance the effects of scaling and root planing and extend the Treatment options for varying degrees of severity of periodontal disease.

The effectiveness of PDT is related to its photochemical mechanism of action, which generates reactive oxygen species responsible for destroying microorganisms without causing harm. damage to healthy periodontal tissues. This characteristic puts the therapy in a position advantageous compared to the use of chemical or systemic antimicrobials, which can triggering bacterial resistance, side effects, and negative impact on the microbiome. In adults, especially those with associated systemic conditions, such as diabetes, cardiovascular disease, immunosuppression, or limitations on the use of Antibiotics, aPDT emerges as a safe, minimally invasive and easy approach. clinical application.

In addition to its antimicrobial action, photodynamic therapy contributes to the modulation of periodontal inflammatory response, favoring an environment more conducive to repair. Tissue. Clinical studies demonstrate additional gains in insertion and greater reductions. significant differences in drilling depth when aPDT is used in conjunction with the Mechanical treatment. Although these effects vary depending on factors such as the type of photosensitizer, light intensity, application duration and number of sessions, the The body of evidence indicates that the technique is promising and has the potential to become... a tool widely used in clinical practice.

However, even with positive results, challenges remain to be overcome. to consolidate the use of aPDT in a standardized and universal way. The heterogeneity of The protocols adopted in the studies make it difficult to compare the findings and prevent... formulation of definitive clinical recommendations. Therefore, it is essential that research Future studies should seek to standardize methodological variables, such as concentrations of

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photosensitizers, irradiation parameters, application frequency, and criteria
Clinical evaluation. Controlled clinical trials, with larger samples and
Long-term monitoring is essential to establish the role of aPDT in
Periodontal maintenance and its cumulative effectiveness over time.
Another important aspect that emerges from the analysis of the studies is the need for
Continuing education for professionals in the dental field. Adequate mastery of...
Technical expertise, knowledge of materials, and the correct selection of application parameters.
These are key factors for therapeutic success. In this sense, the incorporation of
Photodynamic therapy in the teaching and professional development of educators can promote...
wider and more conscious adoption of the technique, ensuring that it is used in a way that...
Effective and ethical.

Given the current landscape of periodontics, marked by the complexity of the disease, by
antimicrobial resistance and the growing need for personalized treatments,
Antimicrobial Photodynamic Therapy represents a resource with great potential for
transformation. Its integration into already established clinical protocols expands the
perspectives on controlling periodontitis and improving the quality of outcomes.
meeting the demands of an increasingly diverse and multifaceted adult population
care needs.

It is concluded that photodynamic therapy is a safe, effective, and complementary strategy in
treatment of periodontal disease in adults, standing out for its ability to
to intensify microbial reduction, improve clinical parameters, and offer benefits.
additional to conventional therapies. Although it does not replace the approach
In contrast to traditional mechanics, aPDT represents a significant therapeutic advancement and has
potential to become an integral part of routine periodontal care.
The deepening of research, the standardization of protocols, and the strengthening of
Professional training is a fundamental step to expand its use and ensure that its
so that patients can fully achieve their benefits.

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