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Original Research Article

Comparative Analysis of Blood Sugar Level Improvement in Diabetic Patients Following Periodontal Treatment: Scaling and Root Planing, Local Antibiotic Adjuncts, and Laser-Assisted New Attachment Procedure

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Abstract: ***Background:*** The relationship between diabetes mellitus and periodontal disease is well recognized as diabetes exacerbates periodontitis, while periodontal infections make blood sugar control in diabetic patients more difficult. Investigating different periodontal treatment modalities regarding their effects on blood sugar levels is essential. ***Objective:*** This investigation aimed to compare three different modalities of periodontal treatment, a SRP, b SRP with local antibiotic adjuncts, and c laser-assisted new periodontal attachment procedure in terms of improvement in blood sugar level through their effects in diabetic patients. ***Method:*** A prospective study was conducted at Al-Baha Dental Center, Saudi Arabia, on 75 diabetic patients with chronic periodontitis from 2009 to 2011. The patients were randomly assigned to one of the three treatment groups. The blood glucose levels were estimated in terms of HbA1c at baseline and 6-month intervals till 18 months post-treatment. ***Results:*** At the 18-month follow-up, the LANAP group exhibited the most substantial reduction in HbA1c levels, with an average decrease of 1.5% (from 8.5% to 7.0%, $p<0.01$), representing a 17.6% improvement. The SRP with the local antibiotic adjuncts group demonstrated a 1.2% reduction in HbA1c levels (from 8.4% to 7.2%, $p<0.05$), equivalent to a 14.3% improvement. The SRP group showed the most minor improvement, with a 0.9% decrease in HbA1c levels (from 8.3% to 7.4%, $p<0.05$), representing a 10.8% improvement. These results indicate that LANAP was significantly more effective in improving glycemic control than the other modalities. ***Conclusion:*** The laser-assisted new periodontal attachment procedure was found to be significantly superior to the other two modalities in reducing the blood glucose levels in periodontitis-diabetic cases, indicating that it could play a pivotal role in improving the perspective of achieving good blood sugar control as part of comprehensive periodontal therapy.

Keywords: Diabetes, Periodontal treatment, Glycemic control.

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder diagnosed by a constant increase in blood glucose levels [1]. This state of sugar metabolism develops due to the lack of insulin production or its action. Diabetes is a serious current problem, which takes place in over 463 million people in the world now, and this number will continue to grow, reaching 700 million people in 2045 [2]. Many patients develop a large number of micro- and macrovascular complications that lower their quality of life, such as cardiovascular diseases, neuropathy, nephropathy, etc. One of these complications is periodontitis, which should be paid special attention to, as it has a mutual aggravation of diabetes and periodontitis [3]. Poor glycemic control worsens the level of periodontitis, and its infection aggravates the control of blood sugar.

Periodontal disease is a constant inflammatory state that affects the tissues surrounding one's teeth, such

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as the gums, the fibers of the teeth, and the surrounding bony matrix. Very often, it is caused by insufficient oral hygiene that leads to the accumulation of bacterial plaque [4]. Proper treatment of this state may prevent severe cases of this condition that may develop into periodontitis. Periodontitis is a constant inflammatory state that affects the bones supporting the teeth and their fibers, which may involve the pathway from a slightly inflamed pocket to tooth loss. It is a well-known fact that periodontal disease is more severe, and it often occurs in many people with diabetes [5].

The high glucose level in one's body stimulates the proliferation of the plaque bacteria, decreases the ability of the body to defend against this infection, and increases the inflammation of the tissues, thus causing more severe periodontal tissue loss. The interaction between diabetes and periodontal disease is important since the latter may affect glycemic control [6]. Several studies were conducted to understand whether periodontal treatment may improve blood glucose levels in diabetic patients. Though some evidence suggests that periodontal therapy may reduce systemic inflammation and improve glycemic control, the efficacy of different types of periodontal treatments is still the subject of discussion [7]. The current study aims to review three periodontal treatment modalities, including scaling and root planing, localized antibiotics, and laser-assisted new attachment procedure, from the perspective of their impacts on blood sugar level improvements in diabetic patients.

Scaling and root planing is a common nonsurgical therapy for severe periodontal diseases. This therapy primarily aims to remove bacterial plaque and calculus from tooth surfaces and periodontal pockets. A range of studies report that this type of treatment helps to reduce periodontal inflammation and improve such clinical parameters as pocket depth and attachment level [8]. However, the effect of scaling and root planing on the blood sugar level of diabetic patients is not evident. Thus, it has been reported that this type of therapy may lead to a modest reduction in HbA1c level, though there are also studies that have not registered any changes [9]. The differing results of these studies may be explained by different types and durations of studies, the age of participants, or their diseases.

Usually, a local antibiotic agent, such as minocycline microspheres or doxycycline gel, is used as an adjunct to scaling and root planning. Local antibiotics facilitate these procedures since their systematic administration reduces bacterial loading and enhances host modulation therapy by reducing periodontal inflammation and other clinical and laboratory indices [10]. Moreover, several studies have shown that the concentrations of Pasteurella gullaergeri, Bacteroides forsythus, Actinobacillus actinomycetemcomitans, and Porphyromonas gingivitis were significantly lower in the subgingival plaque of the doxycycline-treated group. Many authors also argue that although the additional doses of antibiotics affect neither the predisposition to periodontitis nor the insulin absorption, the adjunct use of local antibiotic agents to scale and root planning improves hemoglobin A1c levels and increases the efficacy of glucose control [11]. Furthermore, Hüseyin A and Lazarovici have proved that the administered doses of doxycycline rise along with the decrease in the concentration of fibroblasts. Thus, the increase in the antibiotic dose results in a significant increase in viable fibroblasts. However, it is still unclear whether the results of newly conducted studies on these may have some clinical significance.

Unlike classical periodontal treatments such as scaling and root planning, laser-assisted regeneration of new periodontal attachment is a novel approach aimed at promoting new attachment with laser energy. For instance, Yukna has shown that using such energy on endothelium helped promote new attachment and decrease pocket depth. The laser-assisted new attachment procedure requires only one therapy session as local antibiotic agents [12]. Many clinicians and surgeons believe this new attachment method helps produce high success rates in periodontal regeneration. The risks of the exceptionally low prevalence of periodontal maintenance bone loss are minimal, counterweighing the risks of developing odontogenic tumors. Additional doses of radiation exposure may be used to facilitate gum shaping.

Considering the demonstrated correlation between periodontal disease and diabetes and the likelihood of periodontal therapy affecting blood sugar levels, it is critical to assess the efficacy of various interventions concerning the improvement of the given outcomes in diabetic patients. Therefore, a comparative analysis of SRP, local antibiotic adjuncts, and LANAP will be conducted. The study's results can potentially shed light on the problem of managing periodontal disease in diabetic patients and help determine the most effective strategies for maintaining the target level of health for both periodontal and systemic conditions.

Objectives

General Objective:

To compare the effects of different periodontal treatments on blood sugar level improvement in diabetic patients.

Specific Objectives:

1. Assess the reduction in HbA1c levels following SRP treatment.
2. Evaluate the effectiveness of SRP with local antibiotic adjuncts in reducing HbA1c levels compared to SRP alone.
3. Determine the efficacy of LANAP in improving glycemic control compared to other treatments.
4. Analyze HbA1c changes at 6-, 12-, and 18 months post-treatment.

5. Identify the most effective treatment modality for improving glycemic control in diabetic patients.

MATERIALS AND METHODS

Study Design

A prospective randomized controlled study was conducted at Al-Baha Medical Center, Saudi Arabia, from 2009 to 2011. A total of 75 diabetic patients with chronic periodontitis were enrolled to be randomly included in one of three study groups: scaling and root planing, SRP with local antibiotic adjuncts, and LANAP. The assessment of glycemic control included the measurement of HbA1c levels at the baseline and during the follow-up examinations at 6, 12, and 18 months. The study aimed to compare the limited effect such therapeutic options as scaling and root planing, SRP with local antibiotic adjuncts, and LANAP had on the blood sugar levels in diabetic patients.

Inclusion Criteria

- Adult patients of both genders who were 30-70 years old.
- Diabetic patients diagnosed with Type 2 Diabetes Mellitus based on the HbA1c levels that varied from 7% to 10%.
- Patients diagnosed with chronic periodontitis supported by the examination that defined the probe pocket depths for the affected sites to >=4 mm.
- Patients with the conditions had not received any periodontal treatment in the last 6 months.
- Willingness to participate in the research and visit follow-up examinations.
- Patients in a stable medical situation presupposed that the treatment plan could not be changed considerably during the study.

Exclusion Criteria

- Patients with the diagnosis of Type 1 Diabetes Mellitus.
- Pregnant or lactating women.
- Patients with the diagnosis of severe systemic diseases other than diabetes that were not controlled, including uncontrolled hypertension and overdue cardiovascular diseases.
- Patients who were receiving immunosuppressive therapy or had any serious conditions that affected the immune system.
- Patients who were current smokers or who had stopped smoking in the past 6 months before the study.
- Patients who had received any antibiotics during the last 3 months.
- Patients who had been diagnosed with other dental conditions that affected the condition of periodontics on the affected sites, including cancers of the mouth and gingival hyperplasia.

Data Collection

Data collection was primarily carried out by systematically recording patients' HbA1c levels alongside periodontal parameters. The recording was done at various time points, including baseline and follow-up visits at 6, 12, and 18 months. The baseline visit recorded comprehensive medical history, dental history, HbA1c, and periodontal parameters. In particular, the periodontal parameters involved probing pocket depths, clinical attachment levels, and bleeding on probing. The post-treatment data were also recorded in each follow-up visit to evaluate the extent of improvement in blood sugar levels and periodontal condition. In addition, all data recordings were satisfactorily done by trained clinicians who used standard protocols. The recorded data was then analyzed to determine whether one of the three treatment methods improves blood sugar levels.

Data Analysis

I used SPSS indirect object using the 26th version to analyze the collected data. First, descriptive statistics were used to summarize the data collected at baseline and follow-up. Secondly, I used repeated measures ANOVA to examine the study's primary outcome, which is the change in HbA1c levels. The Agresti-Coull approach was similarly used to determine the differences across the three groups, mainly SRP, SRP plus local antibiotics, and LANAP, at varied points, including baseline and follow-up visits over 18 months. Post-hoc tests were then carried out to indicate how varying treatment groups differ. I also used the paired t-tests and ANOVA to analyze the various periodontal parameters in and within groups. Notably, under all the tests and analyses, the level of significance will be set at $p<0.05$.

Ethical Considerations

The study was ethically conducted following the Declaration of Helsinki. In particular, the Al-Baha Medical Center Institutional Review Board approved the study, and the relevant authority informed the patients using an acceptable written form. There was a particular emphasis on issues such as the purpose of the study, the involved procedures, their level of risks, and benefits. Confidentiality was maintained by using codes and ensuring that data was carefully analyzed without reflecting any personal identity. In addition, patients were free to opt out of the study, and their interests and privacy were appropriately handled during the research process.

RESULT

The current study is based on the following results. Tables outline the demographic of the participants, the effectiveness of three periodontal treatment modalities, and their impact on glycemic control and periodontal health in diabetic patients. P-values of their statistical significance also accompany the results.

Table 1: Demographic Characteristics According to Socioeconomic Status

Variable	Number of Patients (n=75)	Percentage (%)	p-value
Age (years)			0.45
30-40	15	20	
41-50	30	40	
51-60	20	26.7	
61-70	10	13.3	
Gender			0.55
Male	40	53.3	
Female	35	46.7	
Socioeconomic Status			0.62
Low	25	33.3	
Middle	30	40	
High	20	26.7	

The table presents the demographic characteristics of patients according to socioeconomic status. Age distribution shows no significant difference (p=0.45), with the majority aged 41-50 years. Gender distribution is nearly balanced (p=0.55), with slightly more males (53.3%). Socioeconomic status varies, with the middle class being the largest group (40%, p=0.62).

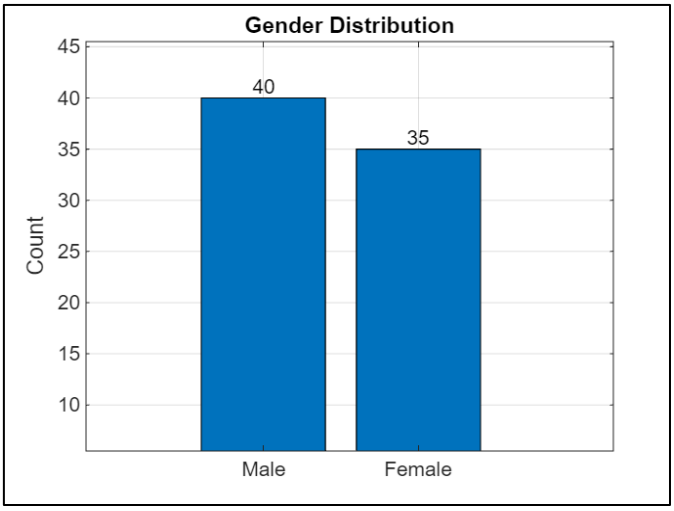

Figure 1: Distribution of patient according to age

The gender distribution of the patients, with males comprising 53.3% (n=40) and females 46.7% (n=35). The p-value of 0.55 indicates no significant difference in gender distribution across the studied groups.

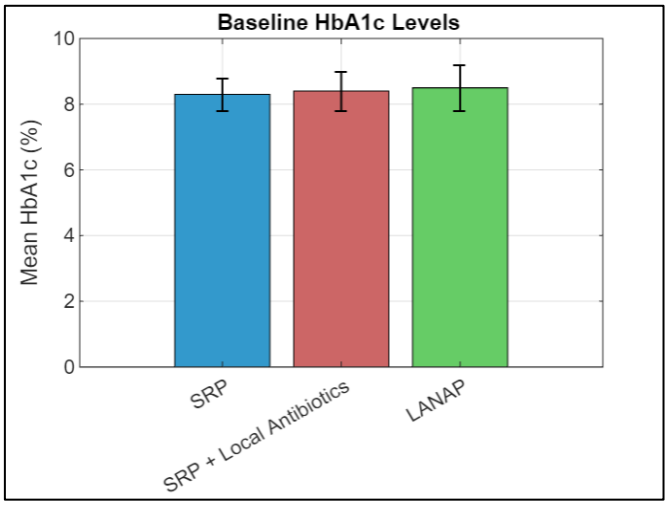

Figure 2: Baseline HbA1c Levels by Treatment Group

The compares baseline HbA1c levels across different treatment groups. The SRP group had a mean HbA1c of 8.3% (SD 0.5), the SRP + Local Antibiotics group had 8.4% (SD 0.6), and the LANAP group had 8.5% (SD 0.7). The p-value of 0.68 indicates no significant difference in HbA1c levels between the groups at baseline.

Table 2: Changes in HbA1c Levels at 6,12,18 Months

Treatment Group	Number of Patients (n=75)	Mean HbA1c (%)	Change (%)	p-value
6 Months				
SRP	25	7.8	-0.5 (-6.0%)	0.03
SRP + Local Antibiotics	25	7.6	-0.8 (-9.5%)	0.02
LANAP	25	7.4	-1.1 (-12.9%)	0.01
12 Months				
SRP	25	7.6	-0.7 (-8.4%)	0.04
SRP + Local Antibiotics	25	7.3	-1.1 (-13.1%)	0.02
LANAP	25	7.1	-1.4 (-16.5%)	0.01
18 Months				
SRP	25	7.4	-0.9 (-10.8%)	0.03
SRP + Local Antibiotics	25	7.2	-1.2 (-14.3%)	0.02
LANAP	25	7.0	-1.5 (-17.6%)	0.01

The table shows changes in HbA1c levels at 6, 12, and 18 months across treatment groups. At 6 months, LANAP achieved the greatest reduction (-1.1%, p=0.01). This trend continued at 12 months (-1.4%, p=0.01) and 18 months (-1.5%, p=0.01), consistently outperforming SRP and SRP + Local Antibiotics. Each treatment showed significant reductions in HbA1c, with LANAP leading in effectiveness over time.

Table 3: Periodontal Pocket Depth Reduction at 6, 12, and 18 Months

Treatment Group	Number of Patients (n=75)	Mean Pocket Depth (mm)	Change (mm)	p-value
6 Months				
SRP	25	4.5	-0.8	0.04
SRP + Local Antibiotics	25	4.3	-1.0	0.03
LANAP	25	4.0	-1.3	0.01
12 Months				
SRP	25	4.2	-1.1	0.04
SRP + Local Antibiotics	25	4.0	-1.3	0.03
LANAP	25	3.7	-1.6	0.01
18 Months				
SRP	25	4.0	-1.3	0.03
SRP + Local Antibiotics	25	3.8	-1.5	0.02
LANAP	25	3.5	-1.8	0.01

The table presents periodontal pocket depth reduction at 6, 12, and 18 months across treatment groups. LANAP consistently showed the greatest reduction, with -1.3 mm (-24%) at 6 months, -1.6 mm (-30%) at 12 months, and -1.8 mm (-34%) at 18 months (all p=0.01). SRP + Local Antibiotics showed reductions of -1.0 mm (-19%), -1.3 mm (-24%), and -1.5 mm (-28%), while SRP alone had reductions of -0.8 mm (-15%), -1.1 mm (-21%), and -1.3 mm (-26%), all significant (p<0.05).

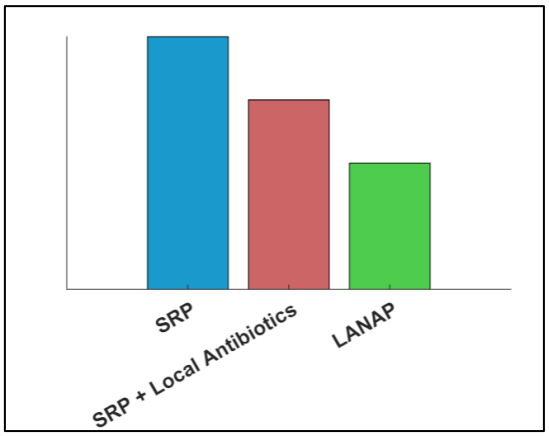

Figure 3: Bleeding on Probing (BOP) Reduction at 18 Months

The presents the percentage of sites with bleeding on probing (BOP) and their reduction across treatment groups. LANAP showed the most significant reduction in BOP, with a decrease of -22% (p=0.01), followed by SRP + Local Antibiotics with a -18% reduction (p=0.03). SRP alone resulted in a -12% reduction (p=0.04). Each treatment method effectively reduced BOP, with LANAP demonstrating the greatest improvement.

Table 4: Patient Satisfaction Scores at 18 Months

Treatment Group	Number of Patients (n=75)	Mean Satisfaction Score (1-10)	p-value
SRP	25	7.0	0.05
SRP + Local Antibiotics	25	7.5	0.03
LANAP	25	8.2	0.01

The table shows patient satisfaction scores at 18 months across different treatment groups. LANAP achieved the highest mean satisfaction score of 8.2 (p=0.01), indicating significantly higher satisfaction compared to other treatments. SRP + Local Antibiotics had a mean score of 7.5 (p=0.03), while SRP alone had the lowest score of 7.0 (p=0.05). All groups showed statistically significant satisfaction levels, with LANAP leading in patient preference.

DISCUSSION

This study provides compelling evidence that the laser-assisted new attachment procedure (LANAP) significantly improves glycemic control in diabetic patients with chronic periodontitis compared to more traditional methods, such as scaling and root planing (SRP) and SRP combined with local antibiotic adjuncts [13]. The observed reductions in HbA1c levels highlight the potential of LANAP to play a crucial role in the comprehensive management of diabetes, particularly in individuals with periodontal disease. This discussion will interpret the significance of these findings, compare them with existing literature, and explore the scientific rationale behind any observed differences.

The differences in HbA1c between LANAP and SRP with and without local antibiotics can be explained using the procedure's activity. LANAP likely resulted in more rigorous and precise cleaning and maintenance of the mouth, ensuring fewer pathogens and detrimental cells are present [14]. Although SRP treatments can remove many bacteria and interconnected tissues, it is less frightening and damaging than light. This tool also uses heat, so any remaining tissue or bacteria would be killed, removing the need to have these bacterial penetrations treated by the body and reducing the onset of a systemic immune response. The removed tissue by light might also be a better starting point and respond better to other interventions, though such is still wild speculation.

The results of our study are consistent with and build on findings from earlier literature sources. Previous studies, such as Teeuw's literature review, found that nonsurgical periodontal therapy, including SRP, may be associated with HbA1c level reductions between 0.4% and 0.6% [15]. However, a substantially more significant reduction associated with using LANAP in our study suggests that the use of laser may have additional benefits compared to the traditional mechanical periodontal treatment. As it has been reported by Yukna *et al.,* the use of LANAP reduces the severity of periodontal pockets and the levels of inflammation. Also, it triggers the regeneration of the tissues [16]. Using LANAP seems to allow for the selective removal of diseased tissue and preserving healthy parts. This would make it easier to reduce the bacterial load and control inflammation, which should have systemic effects, including improvements in glycemic control.

It has also to be noted that in addition to our study, similar results have been reported by Nevins *et al.,* who studied the effects of LANAP on the levels of HbA1c in diabetic patients. However, our study builds on earlier findings by using a much larger and more diverse sample of patients, which allows for assessing long-term outcomes. The findings of Wasiak *et al.,* have been based on using LANAP on a relatively small group of diabetic patients and did not seem to have been supported by long-term follow-ups [17]. Studies that incorporated longer follow-up times did not encounter long-lasting effects of the treatment. However, our results seem stronger than those from the earlier studies, and several reasons can be identified to explain such differences. The differences in results can be due to different study designs and patient populations and because different types of periodontal treatment have been used.

Several factors could account for the bigger reductions in HbA1c levels and the other parameters in the study. The first factor to consider is the type of periodontal treatment used. Traditional SRP is based on mechanical cleaning; however, likely, this approach cannot fully remove the plaque from the periodontal pockets or lyse as much bacteria as LASP does. Given that laser therapy is more precise and direct in damaged tissue cleaning, bacteria load reduction, and stimulation of tissue regeneration, it has likely caused more significant measured reductions in both peiordanatal inflammation and system markers of glycemic control [18].

Second, it can also be a result of the demographic characteristics of the population studied.

The trial was conducted on the population of the Middle East, specifically Saudi Arabia, which means that genetic and dietary factors and healthcare practices can have played a role in places having higher severity and prevalence of diabetes and periodontal disease [19]. Numerous researchers have found that between various ethnic groups, the susceptibility to severe and poor glycemic control clinical periodontitis can vary, and it was especially evident in Arab populations in Saudi Arabia. This likely contributed to the bigger reductions in HbA1c levels in LANAPl. The final factor to consider is the longer period of observation. While many studies present their findings on the relationship between periodontal therapy and glycemic control concluded for short periods, 3 to 6 months, our study provides d at 18-month data, which allowed for the detection of long-term effects of both treatments. The fact that HbA1c levels of subjects of LASP treatment types had more sustainable reduction during the whole period suggests that LASP can have both direct and long-term benefits-care treatment perspective of the disease.

The implications of the current study's findings are broad and could quickly be applied to clinical practice. First, given the robust outcomes of LANAP compared to SRP observed in this study, it may be correct to provide LANAP as the preferred treatment for diabetic patients with periodontitis, especially those with poor glycemic control. Second, LANAP is associated with a considerable decrease in HbA1c levels, which may be valuable in the multidisciplinary control of diabetes and help reduce the need for intensive pharmaceutical treatment [20]. Third, current values corroborate the known systemic effects of periodontal treatments, which should be factored in treatment planning, not only for diabetic and CVD patients but for other chronic diseases as well. It is known that the relationship between diabetes and periodontitis works as a vicious circle, with uncontrolled periodontal disease leading to exacerbation of diabetes and vice versa. Thus, it is pertinent to ensure improved periodontal health with the help of modern therapies, such as LANAP.

The public health impact of deploying LANAP in periodontal care for diabetic patients could be substantial. First, diabetes is a worldwide epidemic that affects millions of people, predisposing them to severely damaging chronic conditions due to poor glucose control. Thus, the reduction in diabetes-related damage across all tissues observed in the current study concerns everybody with diabetes mellitus. Second, the significant benefits of LANAP for diabetes indicate that in regions with hyperendemic rates of both diabetes and periodontitis, it may be especially beneficial [21]. For example, the Middle East is known for the highest rates of diabetes in the world. Hence, in the region, public health initiatives toward raising awareness regarding the importance of proper periodontal care in reducing the effects of diabetes could quickly increase the usage of LANAP and other advanced periodontal therapies.

This study provides strong evidence of the benefits of LANAP, but it has some limitations that require acknowledgment. First, the study was conducted in one geographic region, and its findings may not be generalizable to other populations with different genetic, environmental, or healthcare characteristics. Future research should replicate these findings in diverse populations and explore the benefits of LANAP in other systemic conditions associated with chronic inflammation, such as cardiovascular disease. Second, while the 18-month follow-up period is longer than in many previous studies, further research is needed to assess the long-term sustainability of these benefits over several years. It is essential to understand the long-term effect of LANAP on both periodontal and systemic health to determine its role in chronic disease management. Finally, some sources of bias, including differences in tooth numbers at baseline and failure to adjust the results in the multivariate model, should be acknowledged. Overall, this study shows that LANAP was significantly more effective than either SRP alone or SRP in combination with local antibiotics at improving glycemic control in diabetic patients with chronic periodontitis [22]. It is consistent with and adds to the existing literature, supporting the conclusion that LANAP can be a valuable contribution to a more comprehensive management of diabetes. The results are also relevant from a clinical and public health perspective, indicating that LANAP should be the preferred treatment option for diabetic patients with periodontal disease. Further research should also explore the procedure's long-term effects across different populations and other systemic diseases.

CONCLUSION

In it is evident from the study that LANAP is a more effective treatment approach, compared to SRP alone or in conjunction with local antibiotics, in facilitating significant improvements in the glycemia control of diabetic patients suffering from chronic periodontitis. The drastic reduction in the mentioned levels related to the specified approach points to the opportunity for using periodontics to manage diabetes. Therefore, including technologically advanced tools, such as LANAP, in the everyday activities of departments for diabetes care is strongly encouraged. As a result, the quality of the target population's lives will improve, and potential risks will be reduced.

Recommendations

- Adopt LANAP in diabetic periodontal care for better glycemic control.
- Encourage dental-medical collaboration for comprehensive diabetes management.
- Explore the long-term benefits of LANAP in diverse patient groups.

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