A Compelling Comparative Assessment of the Effectiveness of Non-Surgical Versus Surgical Periodontal Therapy in Patients with Both Controlled and Uncontrolled Type II Diabetes Mellitus, Highlighting the Significance of Tailored Treatment Approaches for Optimal Oral Health Outcomes: An Original Research Study

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Abstract

Aim: This study aims to compare the effectiveness of non-surgical versus surgical periodontal therapy in patients with both controlled and uncontrolled type II diabetes mellitus, highlighting the significance of tailored treatment approaches for optimal oral health outcomes.

Materials and Methods: This study investigated 60 patients with type II diabetes motivated to improve their periodontal health. Of these, 40 patients sought treatment for both diabetes management and periodontal therapy, with strict criteria for inclusion and exclusion. Informed consent was obtained, with detailed information provided on the study's aims and risks. Participants were divided into two groups based on glycaemic control: Group 1 had uncontrolled diabetes (HbA1c above recommended levels), and Group 2 had well-controlled diabetes (HbA1c within target range). Both groups received various periodontal therapies, including nonsurgical interventions like scaling and root planning, and surgical options such as flap surgery. Effectiveness was assessed through clinical evaluations and laboratory measurements of HbA1c and blood glucose levels, aiming to compare the outcomes of nonsurgical versus surgical therapy and highlight personalised treatment strategies for improved oral health.

Statistical Analysis and Results: This study analyzed 40 patients with periodontal disease and type II diabetes to assess the impact of diabetes control on treatment outcomes. The participants consisted of 16 males and 24 females and were divided into two groups: Group 1 included 20 individuals with uncontrolled diabetes (high HbA1c), while Group 2 had 20 with well-controlled diabetes (HbA1c within target range). All patients underwent nonsurgical treatments (scaling and root planing) and some received surgical therapies. In Group 1, nonsurgical treatment showed minimal improvement, with three patients exhibiting changes, averaging HbA1c of 6.4% and fasting blood glucose at 152 mg/dL. Surgical patients in this group also showed no significant clinical changes. Conversely, in Group 2, nonsurgical therapy had more positive lab results with 13 patients showing no significant clinical change but averaging HbA1c of 5.6% and fasting blood glucose of 116 mg/dL. Surgical outcomes in this group showed similar findings with 11 individuals not improving but maintaining average lab values of HbA1c at 5.8% and fasting glucose at 119 mg/dL. A one-way ANOVA analysis provided further insights into the effectiveness of diabetes management on periodontal treatments.

Conclusion: This study found that non-surgical therapy greatly benefits individuals with uncontrolled diabetes by improving oral health and glycemic control, as indicated by reduced HbA1c levels and periodontal inflammation. Effectiveness depends on diabetes severity. While standard treatments are effective, adjunctive therapies like antimicrobials and photodynamic therapy may offer additional benefits, although evidence for these is still emerging.

Keywords: Non-Surgical Periodontal Therapy, Surgical Periodontal Therapy, Diabetes Mellitus, Periodontitis

Introduction

Diabetes mellitus (DM) is one of the oldest recognised medical conditions, with type 2 diabetes mellitus being the most common variant among the population. This condition is characterised by persistently elevated blood sugar levels due to insulin resistance and a relative insulin deficiency. The underlying causes of type 2 DM are multifaceted, incorporating a combination of genetic predispositions, environmental factors, and lifestyle choices that collectively contribute to its development.[1,2] Individuals diagnosed with type 2 DM are at a heightened risk of experiencing a variety of complications, both in the short term and long term. These complications can significantly impact their quality of life and can lead to increased morbidity and mortality rates, particularly in low-resource settings where access to healthcare may be limited.[3] Lifestyle factors play a crucial role in the onset of type 2 DM, accounting for an estimated 55% of cases. Key contributors include physical inactivity, use of tobacco products, excessive alcohol consumption, and obesity. The process of diagnosing type 2 DM typically involves a series of blood tests, including fasting blood glucose levels, haemoglobin A1c measurements, and oral glucose tolerance tests, which help to determine an individual's blood sugar control over time.[4,5] Management of type 2 DM is multifaceted, focusing on significant lifestyle modifications, adherence to prescribed medications, and, in some cases, the use of herbal remedies. Patients are often encouraged to adopt healthier dietary patterns, which emphasise a diet high in fibre and unsaturated fats, and to engage in regular physical activity to promote weight loss and improve insulin sensitivity.[6,7] It has been shown that making specific lifestyle changes can significantly reduce the risk of developing type 2 DM. Maintaining a healthy body mass index (BMI), consuming a balanced diet rich in whole grains, fruits, vegetables, and healthy fats, as well as incorporating consistent physical exercise into daily routines are vital strategies for prevention. Additionally, avoiding tobacco use is crucial in mitigating risk factors linked to this disease.[8] The relationship between periodontal disease and diabetes, particularly type 2 diabetes, is intricate and multifaceted. Periodontal disease, a chronic inflammatory condition affecting the gums and surrounding structures of the teeth, can significantly disrupt blood sugar regulation in individuals with diabetes. This disruption creates a vicious cycle: as gum disease progresses, it can lead to increased inflammation and stress on the body, which in turn can worsen glycemic control. Elevated blood sugar levels can exacerbate the severity of periodontal disease, making management more challenging.[9] Effective treatment of periodontal disease is essential not only for maintaining oral health but also for supporting effective diabetes management. Non-surgical interventions, such as scaling and root planing, involve removing plaque and tartar buildup from beneath the gum line to reduce inflammation and promote healing. In cases where the disease is more advanced, surgical procedures may be necessary to restore periodontal health.[10,11] Research indicates that addressing periodontal disease can lead to improved blood sugar control. When periodontal health is restored, it may contribute to a decrease in systemic inflammation, which is critical for individuals managing diabetes. This highlights the need for an integrated approach to healthcare that takes into account both oral health and diabetes management. By fostering collaboration between dental and medical professionals, comprehensive treatment plans can be designed to enhance overall health outcomes for those living with type 2 diabetes. This holistic strategy may not only reduce the incidence and progression of periodontal disease but may also improve the quality of life for these individuals by stabilising their blood sugar levels and mitigating the risk of diabetes-related complications.[12,13] This study aims to compare the effectiveness of non-surgical versus surgical periodontal therapy in patients with both controlled and uncontrolled type II diabetes mellitus, highlighting the significance of tailored treatment approaches for optimal oral health outcomes.

Materials and Methods

This study examined a cohort of 60 patients diagnosed with type II diabetes mellitus in the department of periodontology of the college. Out of this population, 40 patients specifically sought treatment addressing both their diabetes management and periodontal therapy. The inclusion criteria for participants in the study stipulated that individuals must identify as either male or female and possess a confirmed clinical diagnosis of type II diabetes mellitus, which is characterized by insulin resistance and relative insulin deficiency. This broad gender inclusion aims to ensure that the findings of the study apply to the general population affected by this condition. Additionally, the exclusion criteria were meticulously defined to protect the well-being of participants and the integrity of the study's results. Specifically, individuals who are currently pregnant were not eligible to participate, as pregnancy can significantly alter metabolic pathways and complicate the results. Furthermore, those exhibiting signs of mental instability, which may impair their ability to provide informed consent or adhere to study protocols, were also excluded. Lastly, individuals with known allergies to any of the medications that will be utilized throughout the research were not permitted to participate, ensuring safety and minimizing adverse reactions. Before their involvement in the study, informed consent was rigorously obtained from all prospective participants. This process involved providing comprehensive information about the study's objectives, methodologies, potential risks, and

benefits, thus ensuring that participants were fully aware of what their involvement entailed. This commitment to transparency is vital for ethical research practices. The final study population consisted of 40 patients who were categorized into two distinct groups based on their glycemic control status regarding type II diabetes mellitus. Group 1 included individuals with uncontrolled diabetes, characterized by HbA1c levels exceeding the recommended thresholds, indicating poor metabolic control. In contrast, Group 2 was comprised of patients with well-controlled diabetes, whose HbA1c levels were maintained within the target range, reflecting effective management of their condition. Both groups underwent two different modalities of periodontal therapy to assess the effectiveness of treatment approaches: nonsurgical interventions, which included professional cleaning techniques such as scaling and root planning, and surgical therapies, which might involve procedures like flap surgery or bone grafting aimed at addressing more severe periodontal issues. The efficacy of these therapeutic interventions was evaluated through two primary outcome measures: thorough periodontal clinical evaluations and comprehensive laboratory assessments. The clinical evaluations focused on critical parameters such as bleeding on probing a measure of inflammation in the gums, and probing depth, which assesses the severity of periodontal pockets. Additionally, plaque accumulation was measured across all four tooth surfaces: buccal (facing the cheeks), lingual (facing the tongue), mesial (the surface closest to the midline of the dental arch), and distal (the surface furthest from the midline), providing a detailed picture of oral hygiene and periodontal health. In terms of laboratory evaluations, the study included precise quantification of each patient's HbA1c levels and fasting blood glucose measurements. These assessments aimed to provide a comprehensive view of the patients' metabolic control and its possible impact on their periodontal health. After the completion of both the nonsurgical and surgical periodontal therapies, all resulting outcomes were meticulously recorded and analyzed to discern the effectiveness of each treatment modality in relation to the patients' glycemic control status. This analysis will help draw conclusions on how diabetes management influences periodontal outcomes and inform future treatment protocols. The primary objective of this study was to evaluate and compare the effectiveness of nonsurgical versus surgical periodontal therapy among patients with both controlled and uncontrolled type II diabetes mellitus. This research highlights the importance of personalized treatment strategies in attaining optimal oral health outcomes for individuals with diabetes.

Statistical Analysis and Results

In this study, we used SPSS software for data analysis in social sciences, which helped us efficiently manage our datasets. To determine the significance of our findings, we employed the chi-square test to evaluate differences in proportions among groups. This method allowed us to compare categorical data accurately, ensuring our results reflected important trends and relationships. Our rigorous analysis aimed to provide reliable and meaningful insights within the context of our study.

Results

This study investigated a cohort of 40 patients diagnosed with periodontal disease, specifically in conjunction with type II diabetes mellitus, to understand the impact of diabetes control on periodontal treatment outcomes. The demographic data is summarised in Table 1, which indicates that the cohort consisted of 16 males and 24 females, with the age distribution reflecting a diverse group of participants. The patients were divided into two distinct groups based on their diabetes management: Group 1 included 20 individuals with uncontrolled diabetes, characterized by HbA1c levels that exceeded the recommended thresholds for optimal glycemic control. In contrast, Group 2 included 20 participants with well-controlled diabetes, defined by their HbA1c levels falling within the target range set by clinical guidelines. All patients underwent two types of periodontal interventions. The first included nonsurgical procedures predominantly involving scaling and root planing, aimed at removing plaque and calculus from the tooth surfaces. The second category comprised surgical therapies, which were reserved for patients exhibiting more severe periodontal conditions. These surgical interventions included flap surgery and bone grafting, designed to restore periodontal health in more advanced cases. The effectiveness of these treatments was assessed through comprehensive clinical evaluations. Parameters such as bleeding on probing, probing depth, and plaque accumulation were meticulously measured across all tooth surfaces before and after treatment. Additionally, laboratory evaluations were conducted to monitor glycemic control, specifically measuring HbA1c and fasting blood glucose levels. Table 2 provides detailed outcomes for Group 1 patients with uncontrolled type II diabetes who underwent nonsurgical therapy. A thorough periodontal clinical examination was conducted, and statistical analysis was performed using the Pearson Chi-Square test. The results indicated a lack of significant improvement, with only three participants exhibiting any detectable change following treatment. In conjunction with these clinical outcomes, Table 3 illustrates the laboratory results for this same group, with noteworthy findings that included an average HbA1c level of 6.4% and a fasting blood glucose level of 152 mg/dL, suggesting inadequate glycemic control. For those in Group 1 who received surgical periodontal therapy, Table 4 details their postoperative periodontal examinations. Statistical

analysis again applied the Pearson Chi-Square test, which revealed no significant changes in clinical parameters among the individuals post-treatment. Complementarily, Table 5 outlines the laboratory assessments for this group, indicating an average HbA1c level of 6.45% and a fasting blood glucose level of 160 mg/dL, underscoring the ongoing challenges of managing diabetes in this cohort. Conversely, Table 6 focuses on Group 2, the well-controlled diabetic patients, who also underwent nonsurgical treatment. Clinical assessments revealed a lack of significant change in 13 out of the 20 cases, consistent with the findings from Group 1, as demonstrated by the application of the Pearson Chi-Square test. Following their treatment, Table 7 presents the laboratory findings for this group, which reflected favourable glycemic control with average HbA1c and fasting blood glucose levels of 5.6% and 116 mg/dL, respectively. Table 8 discusses the outcomes for Group 2 patients who underwent surgical periodontal therapy. Clinical examinations indicated that 11 individuals showed no noticeable change post-treatment, further corroborated in Table 9, which details the corresponding laboratory results. Here, HbA1c and fasting blood glucose levels averaged 5.8% and 119 mg/dL, indicating consistent glycemic control in this subgroup. Finally, Table 10 presents the results of a one-way ANOVA analysis conducted across all study groups, offering a comprehensive assessment of the overall treatment effectiveness. This statistical approach provides insight into the comparative effects of diabetes management on periodontal therapy, contributing valuable knowledge to the intersection of diabetes and periodontal health.

Table 1: Age & gender based statistical description of contributing patients

Age Group (Yrs)	Male	Female	Total	P value
35-40	4	3	7	0.03*
41-45	2	8	10	0.40
46-50	4	5	9	0.07
51-55	3	4	7	0.60
56-60	3	4	7	0.50
Total	16	24	40	*Significant
*p<0.05 significant				

Graph 1: Patients demographic distribution and associated details

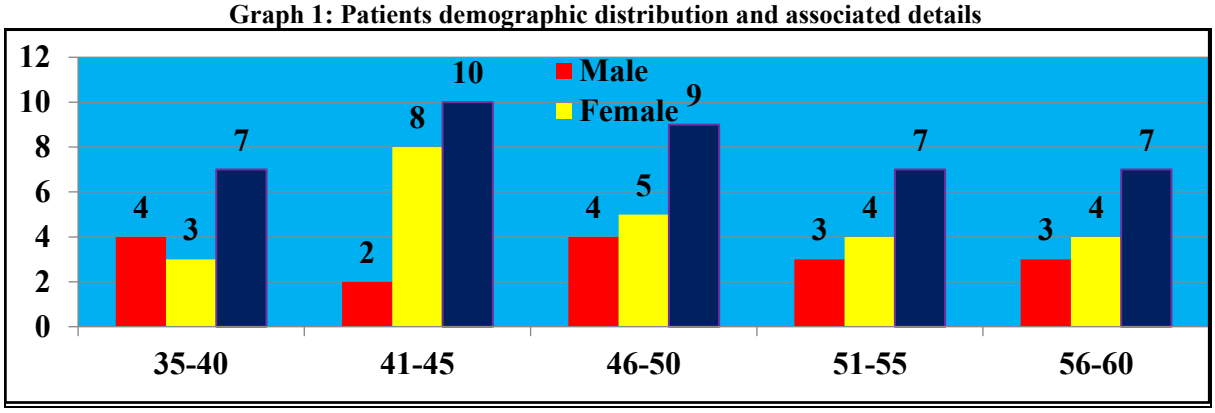

Table 2: Group 1 (n=20) patients with uncontrolled type II diabetes mellitus underwent nonsurgical periodontal therapy. Periodontal clinical examination was conducted, and statistical assessment was performed using the Pearson Chi-Square test at a specified level of significance

Periodontal clinical examination	N	Mean	Std. Dev.	Std. Error	95% CI	Pearson Chi-Square Value	df	p value
Plaque	4	1.10	1.064	1.034	1.31	1.046	1.0	0.10
Bleeding on probing	7	1.25	1.078	1.056	1.32	1.048	1.0	0.03*
Pocket depth	6	1.17	1.055	1.045	1.29	1.034	1.0	0.04*
No change	3	1.07	1.053	1.033	1.05	1.022	1.0	0.02*
*p<0.05 significant								

Table 3: Group 1 (n=20) patients with uncontrolled type II diabetes mellitus underwent nonsurgical periodontal therapy. Laboratory examinations were conducted, and a statistical assessment was performed using the Pearson Chi-Square test at a specified level of significance

Laboratory Examination	Values
HbA1c	6.4%
Fasting Blood Glucose	152.0

Table 4: Group 1 (n=20) comprised patients with uncontrolled type II diabetes mellitus who underwent surgical periodontal therapy. Periodontal clinical examinations were conducted, and statistical assessment was performed using the Pearson Chi-Square test at a specified level of significance

Periodontal clinical examination	N	Mean	Std. Dev.	Std. Error	95% CI	Pearson Chi-Square Value	df	p value
Plaque	5	1.12	1.066	1.035	1.32	1.047	1.0	0.12
Bleeding on probing	8	1.27	1.080	1.058	1.35	1.050	1.0	0.05*
Pocket depth	7	1.25	1.078	1.056	1.32	1.048	1.0	0.03*
No change	-	-	-	-	-	-	-	-
*p<0.05 significant								

Table 5: Group 1 (n=20) consisted of patients with uncontrolled type II diabetes mellitus who underwent surgical periodontal therapy. Laboratory examinations were performed, and statistical assessment was conducted using the Pearson Chi-Square test at a specified level of significance

Laboratory Examination	Values
HbA1c	6.5%
Fasting Blood Glucose	160.0

Table 6: Group 2 (n=20) controlled individuals underwent nonsurgical periodontal therapy. Periodontal clinical examination was conducted, and statistical assessment was performed using the Pearson Chi-Square test at a specified level of significance

Periodontal clinical examination	N	Mean	Std. Dev.	Std. Error	95% CI	Pearson Chi-Square Value	df	p value
Plaque	3	1.07	1.053	1.033	1.05	1.022	1.0	0.02*
Bleeding on probing	2	1.05	1.042	1.029	1.02	1.023	1.0	0.01*
Pocket depth	2	1.05	1.042	1.029	1.02	1.023	1.0	0.01*
No change	13	1.32	1.095	1.078	1.42	1.063	1.0	0.09
*p<0.05 significant								

Table 7: Group 2 (n=20) controlled individuals underwent nonsurgical periodontal therapy. Laboratory examinations were conducted, and a statistical assessment was performed using the Pearson Chi-Square test at a specified level of significance

Laboratory Examination	Values
HbA1c	5.6%
Fasting Blood Glucose	116.0

Table 8: Group 2 (n=20) controlled individuals who underwent surgical periodontal therapy. Periodontal clinical examinations were conducted, and statistical assessment was performed using the Pearson Chi-Square test at a specified level of significance

Periodontal clinical examination	N	Mean	Std. Dev.	Std. Error	95% CI	Pearson Chi-Square Value	df	p value
Plaque	4	1.10	1.064	1.034	1.31	1.046	1.0	0.10
Bleeding on probing	3	1.07	1.053	1.033	1.05	1.022	1.0	0.02*
Pocket depth	2	1.05	1.042	1.029	1.02	1.023	1.0	0.01*
No change	11	1.30	1.085	1.068	1.40	1.060	1.0	0.07
*p<0.05 significant								

Table 9: Group 2 (n=20) controlled individuals who underwent surgical periodontal therapy. Laboratory examinations were performed, and statistical assessment was conducted using the Pearson Chi-Square test at a specified level of significance

Laboratory Examination	Values
HbA1c	5.8%
Fasting Blood Glucose	119.0

Table 10: Estimation amongst all studied groups using one-way ANOVA

Variables	Degree of Freedom	Sum of Squares ∑	Mean Sum of Squares m∑	F	Level of Sig. (p)
Between Groups	4	2.304	2.502	1.3	0.01*
Within Groups	16	2.345	2.535	_	
Cumulative	135.14	16.361	*p<0.05 significant		

Discussion

Choudhary N et al reviewed in their study that type 2 diabetes mellitus (T2DM) is a multifaceted metabolic disorder characterised by two primary phenomena: insulin resistance and insufficient insulin secretion. These interrelated dysfunctions lead to chronic hyperglycaemia, which poses significant health risks. The underlying mechanisms of T2DM are complex and involve a variety of factors, including genetic predispositions and lifestyle determinants. Key lifestyle factors that contribute to the development of T2DM include obesity, lack of physical activity, and poor dietary habits, all of which play a crucial role in the epidemiology of the disease.[14,15] Lakshmi J et al showed in their study that the management of T2DM primarily emphasizes lifestyle modifications that seek to improve overall health and glycaemic control. These interventions include promoting a balanced diet rich in whole foods, Fiber, and healthy fats while minimizing processed foods and sugars. In addition to dietary changes, increasing physical activity is paramount; health authorities recommend aiming for at least 150 minutes of moderate-intensity aerobic exercise each week. However, lifestyle modifications alone may not suffice for all patients, which is where pharmacological treatments come into play. Options such as oral hypoglycaemic agents, which stimulate insulin production or enhance insulin sensitivity, and insulin therapy may be necessary to maintain blood glucose levels within target ranges.[16,17] Areosa SA et al included in their study that the pathophysiology of T2DM encompasses several key elements that contribute to disease progression. Insulin resistance occurs when body cells become less responsive to insulin, resulting in elevated blood sugar levels. This condition is often exacerbated by excess abdominal adiposity, which contributes to systemic inflammation and further impairs insulin signalling. Additionally, beta-cell dysfunction, where the pancreas fails to secrete adequate amounts of insulin, plays a critical role in the progression of T2DM.[18] Muñoz-Carrillo JL et al reviewed in their study that several risk factors can elevate the likelihood of developing T2DM. These include obesity, particularly central obesity, sedentary lifestyles that limit physical activity, unhealthy eating patterns characterised by high caloric intake and low nutritional value, genetic predispositions favouring diabetes, and pre-existing conditions such as gestational diabetes, hypertension, and dyslipidaemia. Furthermore, exposure to environmental toxins may also be implicated in the pathogenesis of the disease.[19,20] Pardo A et al included in their study that early manifestations of T2DM are often subtle, making early diagnosis challenging. Patients may experience symptoms such as increased thirst (polydipsia), frequent urination (polyuria), excessive hunger (polyphagia), unexplained fatigue, blurred vision, and delayed wound healing. If left unmanaged, persistent hyperglycaemia can lead to severe long-term complications including diabetic nephropathy (kidney disease), retinopathy (eye complications) and a heightened risk of cardiovascular diseases. There exists a well-established bidirectional relationship between T2DM and periodontal disease. Inadequate glycemic control can worsen periodontal health, while periodontal disease, driven by chronic inflammation, has been shown to worsen insulin resistance, creating a vicious cycle. Hence, effective management requires a comprehensive approach that maintains rigorous blood glucose levels and incorporates good oral hygiene practices to mitigate the risks associated with periodontal conditions.[21,22] Seniya KM et al reviewed in their study that non-surgical periodontal therapy (NSPT), especially through procedures like scaling and root planing, has demonstrated significant effectiveness in alleviating periodontal inflammation. This reduction in inflammation is particularly beneficial for patients with Type 2 diabetes mellitus (T2DM), as it can lead to improved glycemic control. For individuals grappling with more advanced stages of periodontal disease, surgical interventions may become necessary. These surgical treatments can provide additional benefits by further diminishing systemic inflammation, ultimately promoting better overall health. Such comprehensive management

strategies are essential not only for addressing the oral health needs of patients but also for enhancing their overall quality of life, particularly for those dealing with the dual challenges of T2DM and periodontal disease.[23,24]

Conclusion

In this study, the authors conducted a comparative analysis of the efficacy of non-surgical versus surgical periodontal treatment in patients with controlled and uncontrolled type II diabetes mellitus. The findings emphasize the importance of individualized treatment strategies to achieve optimal oral and systemic health outcomes. Non-surgical periodontal therapy has been shown to significantly benefit patients with uncontrolled type II diabetes, leading to improvements in both oral health and glycaemic control. Specifically, treatment has been associated with reductions in HbA1c levels and fasting blood glucose, decreased periodontal inflammation, and enhanced overall oral health. However, the effectiveness may vary depending on the severity of the diabetes. While standard non-surgical interventions yield positive results, the incorporation of adjunctive therapies—such as local antimicrobials or photodynamic therapy may offer additional advantages for certain patients. The supporting evidence for these adjunctive treatments is still emerging. These results highlight the critical need for further investigation to clarify the underlying mechanisms at play and to refine clinical practices within the periodontal field moving forward.

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