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Effect of Scaling and Root Planing with and without Diode Laser Application on Glycated Haemoglobin Levels in Type II Diabetic Patients with Chronic Periodontitis

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ABSTRACT

Introduction: Periodontitis and diabetes have a combined systemic and local effect on tooth supporting structure and has been reported for decades. The gold standard treatment protocol would be scaling and root planing (SRP), which when combined with laser therapy has an additional benefit in the reduction of clinical parameters and glycated haemoglobin (HbA1c) levels.

Objective: To evaluate the effectiveness of scaling and root planing with and without Diode laser application on glycated haemoglobin levels in type II diabetic patients with Chronic Periodontitis.

Methods: Twenty eight type II diabetic patients with Chronic Periodontitis recruited by convenient sampling were divided into two groups in this pretest post-test study design. Group A received scaling and root planing (SRP) and Group B received SRP with diode laser (980 nm) application. The HbA1c levels were evaluated at three and six months; and clinical parameters were evaluated at one, three, and six months post-treatment. Data were analysed in SPSS v.20.

Results: Mean values of HbA1c, probing depth (PD), clinical attachment level (CAL), plaque index (PI), and gingival index (GI) reduced significantly after treatment in both treatment groups with more reduction in laser group. However, on intergroup comparison HbA1c and CAL reduction were not significant.

Conclusions: The findings of the current study showed significant improvements in HbA1c and clinical parameters as compared with baseline in patients treated with SRP and SRP + Diode Laser. Thus, use of diode laser showed no significant improvement statistically when used as an adjunct to scaling and root planing.

Keywords: Chronic periodontitis; diabetes mellitus; diode laser; glycated haemoglobin; nonsurgical periodontal therapy.

INTRODUCTION

Chronic periodontitis is caused by various periodonto-pathogenic bacteria resulting in destruction of periodontal tissues.[1]

Apart from local factors, there are multiple risk factors for periodontitis, such as Type II Diabetes Mellitus (DM) that is marked by hyperglycaemia.[2]

A two-way relationship between DM and periodontal diseases exists.[3,4] Increased blood glucose levels in diabetics are reflected in increased levels of gingival crevicular fluid (GCF) glucose. that may adversely affect periodontal wound healing events and host response to microorganisms.[5] Uncontrolled hyperglycaemia increases severity of periodontitis by accumulation of advanced glycation end products.[6]

The elimination of subgingival microorganism and regeneration of lost tissue is considered as the most important goal of periodontal therapy. This can be achieved by scaling and root planing (SRP) which is considered as "gold standard".[7] However, some studies have shown that SRP alone may fail to completely eliminate the pathogenic subgingival microbiota.[8] These limitations of SRP led to other adjunctive measures such as diode laser application, which has become an effective tool when used along with conventional periodontal therapy.[9]

Hence, the aim of this study was to evaluate the effectiveness of SRP with and without Diode Laser on glycated haemoglobin (HbA1c) in Type II Diabetic patients with Chronic Periodontitis.

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METHODS

An experimental study with pretest post-test design (Non-randomised trial) was done to evaluate the effect of SRP with and without diode laser application in type II Diabetic patients with Chronic Periodontitis visiting the Department of Periodontology and Oral Implantology in People's Dental College and Hospital (PDCH), Sorhakhutte, Kathmandu, Nepal from February 2021 to November 2021. Convenience sampling technique was utilised. Ethical approval was obtained from Institutional Review Committee of PDCH (Ref. 1.Ch. No. 28. 2077/2078). Informed consent was obtained from patients.

The sample size was 28 which was obtained in accordance to reference article.

$$n = 2\ [(Z\alpha+Z\beta)^2 * S^2/ D^2]$$

where: $Z\alpha$: 1.96 at 95% Confidence interval

$Z\beta$: 1.65 at 90% Power

According to reference article by Al-Sharif et al.[10]

Mean (D) HbA1c reduction after three months: 1.8

Standard deviation (S) of HbA1c reduction after three months: 1.4

Type II diabetic patients with Chronic Periodontitis aged 45-60 years with HbA1c level 6.5-8 %, probing depth 5-7 mm, Clinical Attachment Level (CAL) 2-4 mm were included in the study. Patients with other known medical conditions as chronic obstructive pulmonary disease (COPD), asthma, coronary vascular diseases were excluded. Similarly, patients undergoing scaling within six months, taking antibiotics within three months, patients changing antidiabetic drugs, Grade II, III mobile tooth, pregnancy, lactating mothers, and smokers were excluded from the study.

An individual occlusal stent of self-curing acrylic resin was fabricated for each site to create fixed landmarks and to standardise the location of the periodontal probe. The occlusal stent was made to cover the occlusal surface of the tooth being treated, as well as the occlusal surfaces of at least one adjacent tooth in the mesial and distal directions.

Proper history taking and clinical examination was done. Patient education, motivation and detailed oral hygiene instructions were given. Patients were motivated to perform proper brushing technique (Modified Bass) prior to the commencement of the study.

Before treatment, each patient was thoroughly explained about the nature, risks, and benefits of the clinical procedure. Patients were advised for testing HbA1c. Patients with values more than included range were advised to consult the physician and assured treatment after the level came in controlled range. If patient fell under included range of HbA1c, patient was chosen. Patients were evaluated for pocket probing depth and clinical attachment level.

Patient falling under the inclusion criteria were chosen conveniently as a sample and divided into two equal groups, and treatment plan was allotted. Every odd number of patients were allotted into group A and even number were allotted into group B. Patients falling under Group A were treated with Scaling and root planing alone. Patients falling under Group B were treated with SRP and Diode Laser (SIRO Laser Advance) application on same day.

The laser therapy was given with a 980 nm diode laser with parameters as follows: Power = 1.5 Watts; Mode = Pulse; Frequency = 10Hz; Duty cycle = 50.

Appropriate laser safety measures were taken. On the affected pocket site, a wavelength of 980 nm, fibre-optic tip 320 µm delivery system was introduced parallel to the root surface, moved laterally and apically along the lateral pocket wall eventually reaching close to the base of pocket in a "paint brush" like stroke for 20 seconds per site. The laser tip was withdrawn 1 mm from the base and activated. The less than 1 mm value was obtained using an endodontic stop on the fibre. Care was taken to avoid any contact to the root surface or the alveolar bone. Reinforcement for diode laser was done on third and seventh day.

Patients were reevaluated for HbA1c at three months and six months; and for clinical parameters (Probing Depth, Clinical Attachment Level, Gingival Index, and Plaque Index) at one month, three months and six months.

Data were entered, cleaned, and coded in Microsoft Excel Sheet 2016. Data were then transported to IBM SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, N.Y., USA) for further analysis. Independent t-test was used for intergroup comparison of mean HbA1c (baseline, three months, and six months); CAL, probing depth, plaque index, and gingival index (baseline, one month, three months, and six months) between the two groups of study participants. Paired t-test was used for intragroup comparison of mean HbA1c (baseline, three months, and six months); CAL, probing depth, plaque

index, and gingival index (baseline, one month, three months, and six months) between the two groups of study participants. The P value <0.05 was set as level of significance.

RESULTS

The mean age of the study participants was 51.96±5.26 years with minimum of 45 years and maximum of 60 years. Mean age of study participants in group A was 51.14 years and in group B was 52.79 years. Gender wise distribution of study participants showed that majority were males in both the groups (64.3% in group A, 57.1% in group B).

Among the study participants, there was a statistically significant difference in mean glycated haemoglobin at baseline, three months and six months (Table 1). Among the study participants, there was a statistically significant difference in mean probing depth at baseline, one month, three months, and six months (Table 1). Among the study participants, there was a statistically significant difference in mean clinical attachment level at baseline and one month (P value <0.001 for both group A and group B), at baseline, one month, three months and six months.

The difference in mean glycated haemoglobin level between group A and group B was not found to be statistically significant at baseline, three months and six months of intervention (Table 2). The difference in mean probing depth between group A and group B was found to be statistically significant at baseline, one month, three months and six months of intervention. The difference in mean clinical attachment level between group A and B was not found to be statistically significant at baseline, one month, three months and six months of intervention.

The difference in mean probing depth between group A and group B was found to be statistically significant at baseline, one month, three months and six months of intervention (Table 3). Similarly, the difference in mean probing depth between group A and group B was found to be statistically significant at baseline, one month, three months and six months of intervention (Table 4).

Table 1: Intragroup comparison of glycated haemoglobin level, probing depth, and clinical attachment level.

Group			SE	t value	95% Confidence interval		P value
					Lower bound	Upper bound	
HbA1c (%)							
A	Baseline	3 months	0.045	2.610	0.020	0.215	0.02
		6 months	0.029	7.274	0.153	0.283	<0.001
B	Baseline	3 months	0.053	3.031	0.046	0.273	0.01
		6 months	0.050	7.430	0.265	0.482	<0.001
Probing depth (mm)							
A	Baseline	1 month	0.062	9.290	0.439	0.704	<0.001
		3 months	0.120	9.618	0.897	1.417	<0.001
		6 months	0.109	2.228	1.094	1.563	<0.001
B	Baseline	1 month	0.112	14.480	1.384	1.869	<0.001
		3 months	0.074	27.213	1.854	2.174	<0.001
		6 months	0.082	26.906	2.049	2.406	<0.001
Clinical attachment level (mm)							
A	Baseline	1 month	0.049	4.837	0.132	0.345	<0.001
		3 months	0.065	6.352	0.271	0.550	<0.001
		6 months	0.052	9.834	0.398	0.623	<0.001
B	Baseline	1 month	0.035	4.837	0.095	0.248	<0.001
		3 months	0.062	5.444	0.202	0.469	<0.001
		6 months	0.049	8.742	0.328	0.543	<0.001

Table 2: Intergroup comparison of glycated haemoglobin level, probing depth, and clinical attachment level.

	Group	Mean±SD	t value	95% Confidence interval		P value
				Lower bound	Upper bound	
HbA1c (%)						
Baseline	A	7.10±0.30	0.320	-0.225	0.308	0.75
	B	7.15±0.38				
3 months	A	6.99±0.29	0.000	-0.266	0.266	>0.99
	B	6.99±0.39				
6 months	A	6.89±0.29	-0.810	-0.404	0.176	0.43
	B	6.77±0.44				
Probing depth (mm)						
Baseline	A	5.62±0.29	-1.255	-0.320	0.077	0.22
	B	5.50±0.22				
1 month	A	5.05±0.26	-11.193	-1.393	-0.961	<0.001
	B	3.87±0.29				
3 months	A	4.46±0.42	-7.849	-1.235	-0.722	<0.001
	B	3.49±0.21				
6 months	A	4.29±0.39	-9.012	-1.254	-0.788	<0.001
	B	3.27±0.17				
Clinical attachment level (mm)						
Baseline	A	3.68±0.17	-1.803	-0.237	0.016	
	B	3.57±0.16				
1 month	A	3.44±0.21	-0.674	-0.176	0.089	0.51
	B	3.40±0.11				
3 months	A	3.27±0.18	-0.622	-0.154	0.082	0.54
	B	3.24±0.12				
6 months	A	3.17±0.15	-0.710	-0.139	0.068	0.49
	B	3.14±0.11				

Table 3: Intergroup comparison of plaque index of the study participants at baseline, one month, three months, and six months of intervention.

Group	Group	Mean±SD	t value	95% Confidence interval		P value
				Lower bound	Upper bound	
Baseline	A	1.61±0.03	0.637	-0.016	0.030	0.53
	B	1.62±0.03				
1 month	A	1.41±0.06	-4.051	-0.121	0.039	<0.001
	B	1.33±0.04				
3 months	A	1.26±0.04	-10.992	-0.169	-0.116	<0.001
	B	1.12±0.03				
6 months	A	1.21±0.03	-15.217	-0.184	-0.140	<0.001
	B	1.05±0.02				

Table 4: Intergroup comparison of gingival index of the study participants at baseline, one month, three months, and six months of intervention.

Group	Group	Mean±SD	t value	95% Confidence interval		P value
				Lower bound	Upper bound	
Baseline	A	1.58±0.03	-0.072	-0.021	0.019	0.94
	B	1.58±0.02				
1 month	A	1.38±0.08	-6.430	-0.205	-0.105	<0.001
	B	1.22±0.03				
3 months	A	1.21±0.05	-8.847	-0.143	-0.089	<0.001
	B	1.09±0.01				
6 months	A	1.16±0.03	-15.243	-0.155	-0.118	<0.001
	B	1.03±0.02				

DISCUSSION

Periodontitis and diabetes mellitus are common chronic diseases worldwide. There is substantial evidence supporting influence of diabetes mellitus on periodontal health and vice versa.[11,12]

A number of possible mechanisms have been proposed by which diabetes may affect the periodontium which includes changes in subgingival microbiota, The GCF glucose levels, periodontal vasculature, host response, and collagen metabolism. Elevated GCF glucose leads to decreased chemotaxis of periodontal ligament fibroblasts to Platelet Derived Growth Factor (PDGF) adversely affecting periodontal wound healing. There is increased thickness of perineural vasculature in diabetics which impairs oxygen diffusion altering normal periodontal tissue homeostasis.[11]

Studies have demonstrated a two-fold increase in Advanced Glycated End Products (AGEs) accumulation in diabetics which increases the oxidative stress, altering collagen metabolism eventually leading to altered wound healing. Altered host defenses leads to defects in polymorphonuclear leukocyte (PMN) adherence, chemotaxis, and phagocytosis in diabetic and studies have suggested Receptor Activator of Nuclear Factor-κB Ligand : Osteoprotegerin (RANKL: OPG) ratio alteration in periodontal tissues resulting in alveolar bone destruction. Further, persistent gramnegative periodontal infection have been shown to increase insulin resistance and aggravate glycaemic control.[12]

Scaling and root planing being a basic procedure in the treatment of periodontitis, aims at the removal of the subgingival biofilm, eliminating subgingival microorganism and reducing inflammation thus restoring insulin sensitivity over time.[13] Additionally, studies have demonstrated that diode laser facilitates reduction in subgingival pigment producing microbes such as Porphyromonas gingivalis or Prevotella intermedia from periodontal pockets, retards colonisation, reduces the hyperinflammatory status, gingival crevicular fluid Interleukin-1 (IL1 β, IL6, and IL8), C-Reactive Protein, Prostanoids, Matrix Metalloproteinase-8, and thus reduces insulin resistance.

So, this study was carried out to determine the effect of scaling and root planing with and without diode laser application on glycated haemoglobin level in type II diabetic patients with chronic periodontitis.

The current study shows reduction of HbA1c in both treatment groups. There was better reduction of HbA1c levels, in SRP+DL treated group than in SRP alone after three and six months but this reduction was not statistically significant on the intergroup comparison which is in accordance with previously reported studies.[14,15] However, this is in contradiction to a study by Koçak et al. (2016) which showed SRP+ Diode laser group showed statistically significant improvement in glycaemic control (HbA1c) than in SRP group in patients with DM2 and chronic periodontitis.[16]

In the current study, type II diabetic patients showed significant improvements in all clinical periodontal parameters at one, three, and six months after SRP or SRP +DL treatments compared to baseline in intragroup comparison. However, there was no significant reduction in CAL in intergroup comparison, which is in accordance to study done by Kocak et al. (2016),[16] Kreisler et al. (2005).[17]

Similarly, Al-Sharif, et al. (2019)[10] and Faria-Almeida et al. (2006)[18] evaluated the effect of laser and scaling and root planing on HbA1c, PD, GI, PI, and showed significant

reduction in both the groups with more reduction in laser group at three months post treatment, which is in accordance to the current study.

Similarly, Chandra et al. (2019),[19] Dengizek Eltas et al. (2019),[20] and Paul, et al. (2018)[21] evaluated the effect of diode laser in the treatment of type II diabetic patients with chronic periodontitis and result showed significant reduction in HbA1c and clinical parameters (PD, CAL, PI, GI) at three months post treatment. The reduction in HbA1c was significant in intragroup comparison only which is in accordance to current study.

However, Caruso et al. (2008),[22] De Micheli et al. (2011)[23] suggested that Diode laser did not provide any additional clinical benefit when compared with conventional treatment. These controversial reports might be the result of different wavelengths, application, power densities, type of laser fiber, and application time.

Though scaling and root planing is considered as "gold standard", the advantage of laser include better accessibility into periodontal pockets due to thin and flexible fibers, haemostasis, less post-operative pain and swelling, pocket sterilisation. Moreover, no detrimental effects were reported with the use of diode laser in follow-up clinical examinations. This is consistent with the histological study done by Castro et al. (2006).[24]

CONCLUSION

The findings of the current study showed significant improvements in HbA1c, probing depth, clinical attachment level, plaque index, gingival index as compared with baseline in patients treated with SRP and SRP + DL. The reduction in parameters were more in patients treated with diode laser. However, the difference in the improvement of HbA1c and Clinical attachment level between the groups was not significant. Thus, use of diode laser therapy did not show significant improvement when used as an adjunct to scaling and root planing in treatment of type II diabetic patients with chronic periodontitis.

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