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Correlation of Salivary Sodium, Potassium and Glucose Levels with Severity of Periodontitis in Diabetic Patients

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Abstract:

- ***Aim***

Correlation of salivary sodium, potassium and glucose levels with severity of periodontitis in diabetic patients.

- ***Materials and Methods***

Study group consists of 60 patients in which 20 were known diabetic patients with periodontitis in group I,20 patients with periodontitis and without diabetes mellitus in group II,20 non-diabetic patients without periodontitis in group III.

- ***Results***

In this study elevation of salivary glucose in diabetic with periodontitis and periodontitis groups was observed when compared to control group. Elevation of salivary sodium and potassium were also observed when compared to control group. There was no co-relation observed in salivary glucose levels in diabetic with periodontitis and periodontitis groups. Significant association of periodontal index with elevated HbA1c levels was observed. Also significant co-relation between periodontal index and elevated salivary potassium in diabetic group with periodontitis was observed .Inverse relation was seen in between salivary sodium, periodontal index and salivary sodium in periodontitis group And there was no correlation observed between periodontal index and salivary glucose levels in all the groups. Radiovisiography (RVG) showed more than 3mm of bone loss in diabetic group with periodontitis.

- ***Conclusion***

Our study showed that in diabetic patients with periodontitis variations in the levels of salivary sodium, potassium and glucose have a significant association with periodontal disease and saliva can be used as reliable diagnostic tool for the assessment of the same.

Keywords: *Diabetes Mellitu , Periodontitis ,Glycemic Control, Russel's Periodontal Index.*

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I. INTRODUCTION

Diabetes is defined as a clinical condition characterized by excessive excretion of water. The excessive excretion of water is caused by anti-diuretic hormone (ADH) termed as diabetes insipidus and when it is the result of hyperglycemia it is called diabetes mellitus[1].

Diabetes mellitus is classified as type 1 diabetes mellitus (insulin dependent), type 2 diabetes mellitus (non-insulin dependent), gestational diabetes mellitus and other specific types based on the etiology[2]

Hyperglycemia increases glucose levels in gingival crevicular fluid and alters the periodontal wound healing by significantly changing the interaction between cells and their extra cellular matrix within the periodontium[2].

Individuals with periodontitis and diabetes were found to have significantly higher levels of local inflammatory mediators compared to systemically healthy individuals. This

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shows some changes in their salivary biochemical patterns[4]. Changes were also seen in salivary glucose and electrolyte levels of diabetic patients which might contribute to their susceptibility to oral infections and severity in periodontal destruction[5].

Sialochemistry which refers to analysis of salivary composition provides important information in making a diagnosis and understanding the pathogenesis in a variety of oral and systemic condition. It is considered to be a noninvasive and convenient diagnostic tool[6].

It's well known that periodontal disease is a major oral disorder of universal occurrence and indices used in epidemiological studies helps us in the assessment and understanding of the present status of periodontal disease[7].An index is a numerical value that describes the relative status of the populations classified by the same criteria and methods[8].

Periodontal index (PI) developed by Russell A.L in 1956 is one of the most widely used and accepted index in epidemiological surveys around the world[7]. In our study we used Russell's periodontal index to assess severity of periodontitis.

This study was conducted to assess the correlation of salivary sodium, potassium and glucose levels with severity of periodontitis in diabetic patients .

II. MATERIAL AND METHODS

➢ *Source of Data*

Study was conducted among 60 patients who visited the out patients department of Oral Medicine and Radiology, Vinayaka Missions Sankarachariyar Dental College, Salem. The control group was selected among the patients who came for routine examination and oral prophylaxis. The written informed consent was obtained from the patients included in both the study and control group.

III. STUDY GROUP

➢ *Sample Size*

- Group I – 20 Patients with diabetes mellitus and periodontitis
- Group II –20 Patient with periodontal disease and without underlying -systemic disease
- Group III -20 subjects without diabetes mellitus and periodontal disease (control)

➢ *Inclusion Criteria*

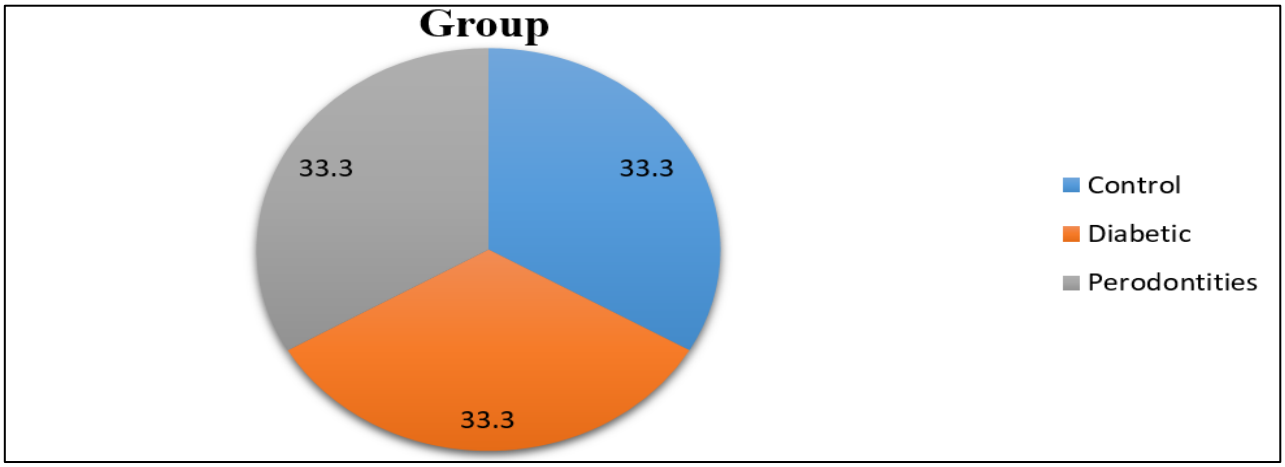
- Age group of 20-75 years, both genders were considered.
- Group I: Diabetes mellitus patients with periodontitis
- Group II: Patient with periodontal disease and without underlying systemic disease.
- Group III: Apparently healthy subjects without periodontitis and with no history of diabetes mellitus.

➢ *Exclusion Criteria*

- Patients with any other systemic disease.
- Patients who have undergone or undergoing any periodontal therapy or antibiotic therapy 6 months prior to the study.
- Patients with any oral lesions.
- Patients with limited mouth opening.
- pregnant women

IV. RESULTS

A total of 60 patients were included in this study. ANOVA test was used to analyze the statistical significance of salivary sodium, potassium and glucose levels in diabetic and periodontitis patients in comparison with the control group. "P" value of less than 0.01 was considered to be statistically highly significant at 1 % level. "P" value between 0.001 - 0.05 was considered to be statistically significant at 5 % level. "P" value greater than 0.05 was considered to be statistically non-significant at 5 % level



Pie Chart 1 Representation of Study Group

The age of the patients included in this study ranges from 20 – 75 years. There were 11 patients up to 30 (18.33 %) years of age.10 patients were present in the age group between 31 – 40 and 41 – 50 years (16.67 %). 15 patients were observed in the age group between 51 – 60 (25 %) years of age and 14 patients were observed in the age group above 60 years (23.33 %) in **table-1**.

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Table 1 Percentage of Age Group

Age	Frequency	Percent
Up to 30	11	18.33
31 - 40	10	16.67
41 - 50	10	16.67
51 - 60	15	25.00
Above 60	14	23.33
Total	60	100.00

The subjects and controls were matched for salivary glucose levels. Among the groups the mean +/- SD of salivary glucose levels for control was 3.5 +/- 2.3.For diabetics and periodontitis it was 5.00 +/- 0.00. Although no statistical significance was observed in diabetic and periodontitis group, salivary glucose has shown increased mean value in diabetic and periodontitis group when compared to control group in table 2,graph-1 .

Table 2 Salivary Glucose Levels in Different Groups

Group		Salivary Glucose (mg/dL)		ANOVA	p
Control	20 N	Mean	SD		
Diabetic with periodontitis	20	3.50[a]	2.35	8.14	0.001**
Periodontitis without DM	20	5.00[b]	0.00		
Total	20	5.00[b]	0.00		
		4.50	1.51		
			2.35		

* Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

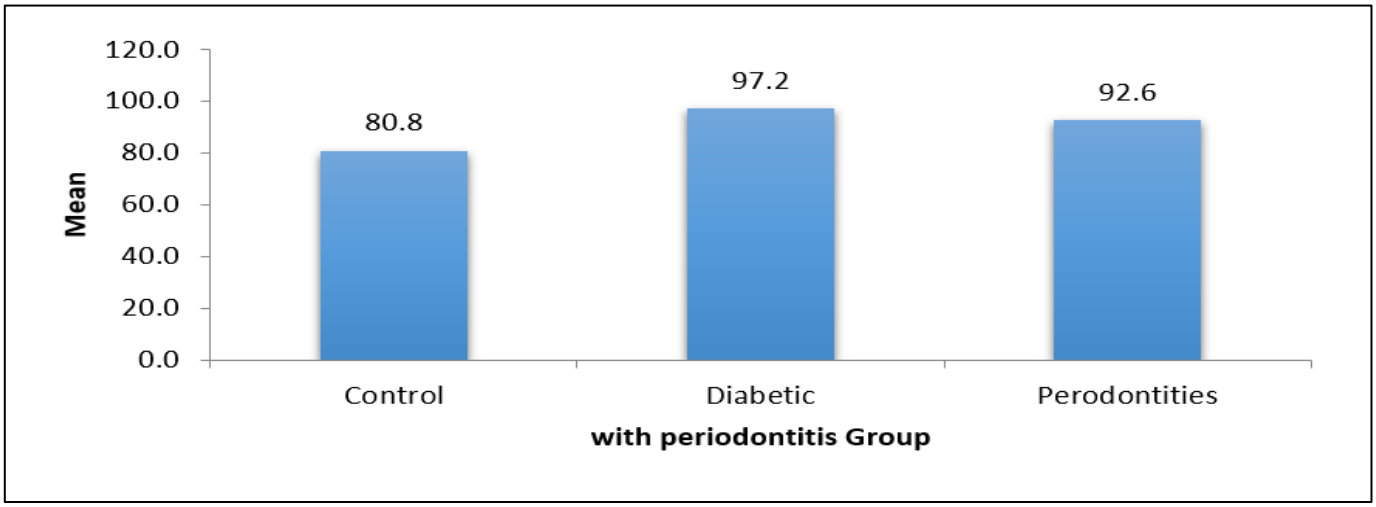
Cannot be computed because at least one of the variables is constant.

Salivary sodium mean values obtained for diabetic and periodontitis were 97.15 and 92.55 respectively which was known to be statistically high when compared to the mean value of control group which was 80.75. The values were found to be statistically significant in table-3, graph 1.

Table 3 Salivary Sodium Levels in Different Groups

Group	N	Salivary Sodium (mmol/L)		ANOVA	p
		Mean	SD		
Control	20	80.75[a]	15.98	5.44	0.007**
Diabetic with periodontitis	20	97.15[b]	16.08		
Periodontitis without DM	20	92.55[b]	16.59		
Total	60	90.15	17.40		

*Signifcant **Highly Significant



Graph 1 Salivary Sodium Levels in Different Groups

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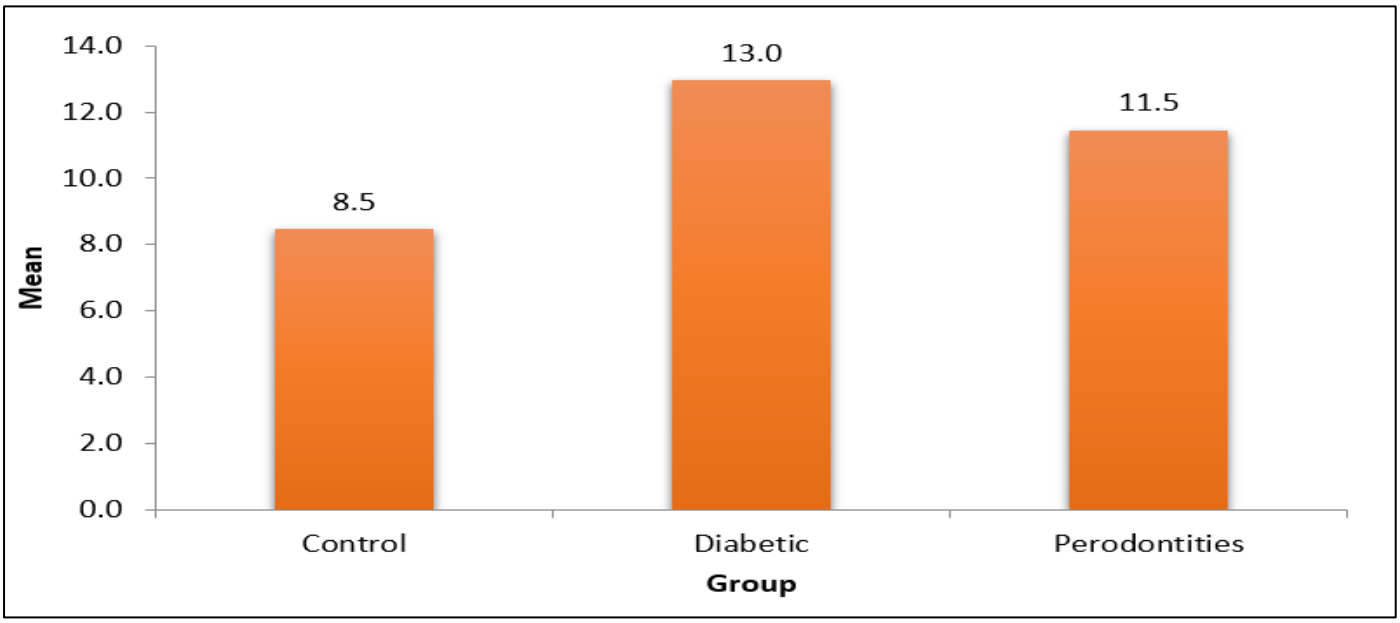
Salivary potassium mean values obtained from ANOVA test for diabetics and periodontitis were 12.95 and 11.46 respectively which was higher when compared to the mean value of control group which was 8.47.The values were found to be highly significant in table-4,graph 2.

Table 4 Salivary Potassium Levels in Different Groups

Group	N	Salivary Potassium (mmol/L)		ANOVA	p
		Mean	SD		
Control	20	8.47[a]	3.72	12.00	< 0.001**
Diabetic with periodontitis	20	12.95[b]	2.81		
Periodontitis without DM	20	11.46[b]	2.07		
Total	60	10.96	3.45		

*Signifcant **Highly Significant

		Periodontal Index	Salivary Glucose (mg/dL)	Salivary Sodium (mmol/L)	Salivary Potassium (mmol/L)	HbA1c (%)
Periodontal Index	Pearson Correlation	1	-.524(*)	.269	.032	.377
	P	.	.018	.252	.894	.102
	N	20	20	20	20	20
Salivary Glucose (mg/dL)	Pearson Correlation	-.524(*)	1	-.095	.010	.199
	P	.018	.	.692	.968	.401
	N	20	20	20	20	20
Salivary Sodium (mmol/L)	Pearson Correlation	.269	-.095	1	-.293	-.017
	P	.252	.692	.	.210	.944
	N	20	20	20	20	20
Salivary Potassium (mmol/L)	Pearson Correlation	.032	.010	-.293	1	.182
	P	.894	.968	.210	.	.444
	N	20	20	20	20	20
HbA1c (%)	Pearson Correlation	.377	.199	-.017	.182	1
	P	.102	.401	.944	.444	.
	N	20	20	20	20	20



Graph 2 Salivary Potassium Levels in Different Groups

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No statistical significance was seen in periodontal index and salivary sodium, potassium and glucose in table-5.

Table 5 Correlations of Periodontal Index with Hba1c, Salivary Sodium, Potassium and Glucose (Control Group)

		Periodontal Index	**Salivary Glucose (mg/dL)**	**Salivary Sodium (mmol/L)**	**Salivary Potassium (mmol/L)**	**HbA1c (%)**
Periodontal Index	Pearson Correlation	1	-.524(*)	.269	.032	.377
	P	.	.018	.252	.894	.102
	N	20	20	20	20	20
Salivary Glucose (mg/dL)	Pearson Correlation	-.524(*)	1	-.095	.010	.199
	P	.018	.	.692	.968	.401
	N	20	20	20	20	20
Salivary Sodium (mmol/L)	Pearson Correlation	.269	-.095	1	-.293	-.017
	P	.252	.692	.	.210	.944
	N	20	20	20	20	20
Salivary Potassium (mmol/L)	Pearson Correlation	.032	.010	-.293	1	.182
	P	.894	.968	.210	.	.444
	N	20	20	20	20	20
HbA1c (%)	Pearson Correlation	.377	.199	-.017	.182	1
	P	.102	.401	.944	.444	.
	N	20	20	20	20	20

* Correlation is significant at the 0.05 level (2-tailed).

*Correlation is significant at the 0.05 level (2-tailed). Significant relation was seen between periodontal index and HbA1c levels.

Also significant co-relation at 0.01 level was seen between periodontal index and salivary potassium. Periodontal index and salivary sodium were found to be inversely proportional to each other in table-6

Table 6 Correlations of Periodontal Index With Hba1c, Salivary Sodium, Potassium and Glucose (Diabetes Mellitus)

		Periodontal Index	**Salivary Glucose (mg/dL)**	**Salivary Sodium (mmol/L)**	**Salivary Potassium (mmol/L)**	**HbA1c (%)**
Periodontal Index	Pearson Correlation	1	.(a)	-.056	.569(**)	.608(**)
	P	.	.	.814	.009	.004
	N	20	20	20	20	20
Salivary Glucose (mg/dL)	Pearson Correlation	.(a)	.(a)	.(a)	.(a)	.(a)
	P	.	.	.	.	.
	N	20	20	20	20	20
Salivary Sodium (mmol/L)	Pearson Correlation	-.056	.(a)	1	-.150	-.013
	P	.814	.	.	.528	.958
	N	20	20	20	20	20
Salivary Potassium (mmol/L)	Pearson Correlation	.569(**)	.(a)	-.150	1	.454(*)
	P	.009	.	.528	.	.044
	N	20	20	20	20	20
HbA1c (%)	Pearson Correlation	.608(**)	.(a)	-.013	.454(*)	1
	P	.004	.	.958	.044	.
	N	20	20	20	20	20

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

A Cannot be computed because at least one of the variables is constant.

Periodontal index and salivary sodium were found to be inversely proportional to each other but periodontal index showed significance correlation with HbA1c% in table-7

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Table 7 Correlations of Periodontal Index with Hba1c, Salivary Sodium, Potassium and Glucose (Periodontitis Group)

		Periodontal Index	Salivary Glucose (mg/dL)	Salivary Sodium (mmol/L)	Salivary Potassium (mmol/L)	HbA1c (%)
Periodontal Index	Pearson Correlation	1	.(a)	-.282	.043	.667(**)
	P	.	.	.228	.857	.001
	N	20	20	20	20	20
Salivary Glucose (mg/dL)	Pearson Correlation	.(a)	.(a)	.(a)	.(a)	.(a)
	P	.	.	.	.	.
	N	20	20	20	20	20
Salivary Sodium (mmol/L)	Pearson Correlation	-.282	.(a)	1	-.197	-.367
	P	.228	.	.	.405	.111
	N	20	20	20	20	20
Salivary Potassium (mmol/L)	Pearson Correlation	.043	.(a)	-.197	1	.060
	P	.857	.	.405	.	.802
	N	20	20	20	20	20
HbA1c (%)	Pearson Correlation	.667(**)	.(a)	-.367	.060	1
	P	.001	.	.111	.802	.
	N	20	20	20	20	20

** Correlation is significant at the 0.01 level (2-tailed).

A Cannot be computed because at least one of the variables is constant.

The only significantly influencing factor on the HbA1c (%) is found in Diabetic mellitus with periodontitis group & in Periodontitis Group is Salivary Potassium (mmol/L) in table-8

Table 8 HbA1c

	Regression coefficient					
	Control		Diabetic mellitus with periodontitis		Periodontitis without DM	
	B	p	B	p	B	p
(Constant)	5.242	0.000	-5.137	0.345	2.787	0.351
Salivary Glucose (mg/dL)	0.068	0.035*	0.006	0.836	-0.016	0.323
Salivary Sodium (mmol/L)	-0.002	0.608	0.135	0.497	-0.003	0.979
Salivary Potassium (mmol/L)	0.009	0.579	1.808	0.046*	0.867	0.005**
Periodontal Index	0.352	0.013*	-5.137	0.345	2.787	0.351

** Correlation is significant at the 0.01 level.
* Correlation is significant at the 0.05 level

V. DISCUSSION

This study was done to assess the correlation of salivary sodium, potassium and glucose levels with the severity of periodontitis in diabetes.20 patients in each diabetes with periodontitis and periodontitis group were included. Unstimulated whole saliva was taken, and salivary sodium, potassium and glucose levels were compared with the control group of 20 patients.

HbA1c level was also estimated to confirm diabetes in diabetes with periodontitis group and to rule out diabetes in periodontitis and control groups.

The study suggested significant results of elevated salivary glucose when group-1 and group-2 were compared with group-3. This was consistent with the finding of Lasisi T.J. et al[46] who stated that high salivary glucose level is a consequence of high plasma glucose level from which saliva is formed, and it might contribute to the susceptibility to oral infections such as periodontal diseases.

The study was also in accord with the finding of Rafah et al[45] who suggested that elevated glucose level may diminish the ability of periodontal fibroblast to contribute in periodontal healing and also responsible for bacterial substrate plaque formation. Ira et al[44] suggested that increased glucose was found to be responsible for the formation of advanced glycation end product which causes pro inflammatory events which leads to diminished repair and destruction of periodontal tissue.

Martin.S.Greenberg[2] also mentioned that hyperglycemia increases glucose levels in gingival crevicular fluid which significantly changes the interaction between cells and their extra cellular matrix within the periodontium.

The study did not show any significant difference between the salivary glucose levels in group-1 and group-2.

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This result was contradictory to the finding of Anita Navalkar et al[5] in 2011 who obtained high levels of salivary glucose in diabetic patients when compared with the periodontitis group.

This study also gives strong direct association of elevated salivary sodium and potassium levels in group-1 and group-2 which is in favour of study done by Anita Navalkar et al[5] and Arati .c et al[34].According to Anita et al[5], increase concentration of salivary sodium is a result of local etiology and diabetes mellitus added to its severity and elevated levels of salivary potassium in diabetic group is associated with autonomic neuropathy and sympathetic and parasympathetic imbalance due to which a continuous stimulation of salivary gland results in increased levels of potassium in saliva. Whereas Arati.C et al[34] explained that due to alveolar bone destruction increased quantity of sodium may enter extra cellular compartment and to gingival fluid and saliva and may cause increase in salivary sodium level.

These results were contradictory to the results obtained by Andelski et al[43] who found about marked reduction in salivary sodium in diabetic group when compared to control group. His result was in favour with respect to salivary potassium which in his study showed increased level in diabetic patients with periodontitis. He concluded that biochemical composition of saliva may affect the oral health status of an individual.

Also when periodontal index was correlated with the values of salivary sodium ,potassium and glucose in all the groups it showed significant relation with salivary potassium levels in group-1 and group-2 suggestive of periodontitis as one of the cause in elevation of salivary potassium levels or vice versa. Periodontal index showed an inverse relation with salivary sodium levels in group-1 and group-2 showing no signification of salivary potassium in periodontal destruction.

In this study results suggested highly significant relationship of periodontal index in group-1 when compared to group-2 and group-3. The results obtained were very much similar to one of the studies conducted by Shahla Kokoie[49] who suggested that increased periodontal problems in diabetic individuals could be due to saliva protection impairment, acidogenic microorganism and poor oral hygiene and plaque accumulation. This finding was also in accord with the statement given by Brian et al[23] that diabetes increases the risk of periodontitis in diabetic individuals.

Higher level of local inflammatory mediators in patients with diabetes mellitus and periodontitis were believed to be the cause of variations in salivary electrolytes (sodium and potassium) and glucose concentrations in diabetic patients with periodontitis. In our study the results showed that there is a strong co relation between elevated sodium and potassium levels in the saliva of diabetic patients and their potential risk in causing periodontitis.

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