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Assessment of Periodontal Health Status in Type-2 Diabetes Mellitus Patients with Chronic Periodontitis: An Observational Study

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ABSTRACT

Introduction: Periodontitis is an immuno-inflammatory chronic condition which shows signs and symptoms eventually leading to tooth mobility and loss. Systemic diseases such as diabetes remain the important risk factors for periodontitis. Diabetic patients are in higher risk when compared to non-diabetic patients There is a strong association between glycemic levels and periodontitis, making it an important factor to consider when clinically assessing a patient's dental health. Therefore, this study aimed to study the impact of blood glycemic levels, as determined by HbA1c levels, on several clinical and radiographic indicators in patients with Type 2 Diabetes Mellitus and chronis periodontitis.

Methods: 159 subjects with chronic periodontitis and Type 2 Diabetes Mellitus were selected and sent for HbA1C levels and Orthopantamogram Clinical examination such as recording of Probing Pocket Depth (PPD), Clinical attachment loss (CAL), number of teeth lost, alveolar bone loss in patients was performed. The patients were categorized into good, moderate and poor based on glycaemic control The clinical parameters such as Gingival Index (GI) and Plaque Index (PI) were also assessed.

Results: All the parameters i.e., PI, GI, PD, CAL showed significant reduced values in good glycaemic controlled patients. These include 1.54±0.88, 1.24±0.86, 3.16±1.05 mm, 3.24±1.14 mm for PI, GI, PPD and CAL respectively. Similarly, Schei score and number of teeth lost were higher in poor glycaemic control patients.

Conclusion: This study confirmed that poor glycemic control patients have severe periodontitis. It is very important for clinicians such as endocrinologists and diabetologists to refer diabetic patients with gingival inflammation, partially edentulism to dentists. Diabetes and periodontitis management

Conflict of Interest: None

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protocols should use interdisciplinary collaboration methods. The goal of this team approach would be to identify diabetes individuals who are at risk for periodontal disease (as part of a pre-diabetic screening at the dentist office) and vice versa.

Keywords: Periodontitis, Diabetes, Glycemic levels, Risk factors

INTRODUCTION

Periodontitis is a chronic immuno-inflammatory disease that often progresses without noticeable signs or symptoms, ultimately resulting in tooth mobility and loss. This inflammation is generally caused by bacterial aggregation affecting the gingiva, alveolar bone in either vertical or horizontal manner. It can also be generalized or localized.[1] As periodontitis is multi-factorial in origin, other causes are poor oral hygiene, trauma from occlusion, dental caries leading to endo-perio lesions, hereditary, systemic diseases etc.[2]

Systemic diseases can be major cause of periodontitis in children as well as in adults. These diseases have bidirectional relationship with periodontitis. Systemic diseases such as diabetes remain the important risk factors for periodontitis.[3] Diabetic patients are higher risk when compared to non-diabetic patients. Periodontitis is considered as sixth complication of diabetes[4] and American diabetic association has acknowledged that periodontal disease is most common problem in diabetic patients.[5]

Periodontitis and diabetes mellitus (DM) have two-way connection where in diabetes can lead to periodontitis and periodontitis can lead to diabetes mellitus. The most common changes in oral cavity of diabetic patients are gingival inflammation, hypertrophy, abscess, gingival polyps, teeth loss and, periodontitis.[6]

Uncontrolled diabetes can lead to reduction in immunity leading to destructive periodontitis. Poor hygiene in addition to impaired inflammation can lead to deep periodontal pockets, rapid bone loss, periodontitis in diabetic patients.[7] Hyperglycemia and hyperlipidemia cause chronic inflammation in periodontal tissue, which exacerbates periodontitis by preventing the inflammation from regressing. Insulin resistance i.e., deficiency of insulin function can also lead to the development of diabetes related periodontitis. Gingival fibroblasts and endothelial cells which are periodontal regenerative cells are mostly affected by hyperglycaemia.[8]

In the same way periodontitis can also lead to diabetes. Periodontitis can cause poor glycaemic control and can increase the chances of existing diabetic complications. Severe periodontitis can cause initiation of systemic micro-inflammation in patients with obesity and diabetes.[9] Tumor necrosis factor-α (TNFα), interleukin-6 (IL-6), and other inflammatory cytokines are hyper secreted when adipocytes and inflammatory immune cells interact with lipopolysaccharides (LPS) derived from intestinal dysbiotic microbiota and periodontitis-related pathobionts.[10]

A study found out that patients with type II diabetes and with periodontitis had poor glycaemic control. They observed that these patients had high concentration of glucose in gingival crevicular fluid and was attributed to high glucose levels in plasma. The high concentration of glucose in the fluid of gingival crevicular is due to the levels of glucose in the plasma. This weakens the capacity of healing in fibroblasts of the periodontium, which is responsible for the damage in periodontal tissues leading to tooth loss.[9]

Through radiographic evaluation and the effectiveness of periodontal treatments, several literature researches have evaluated

the relationship between diabetes patients and periodontal health. However, the relationship between patients' glycemic levels and their impact on periodontal health is still unclear. The impact of blood glycemic levels, as determined by HbA1c levels, on the several clinical and radiographic indicators of bone loss for periodontal state is studied in this clinical investigation.

METHODS

This is an observational clinical study where a total of 159 subjects who were diagnosed with chronic periodontitis by clinical examination given by American academy of Periodontology and type II diabetes mellitus for past two years or more were recruited. The present study was carried out in the Department of Periodontology, Sibar Institute of Dental Sciences, India during the period of 1st April to 30th June, 2024. This study was approved by the Institutional Ethical Committee of Sibar Institute of Dental Sciences with protocol number Pr.349/IEC/SIBAR/2024. All participants signed an informed consent form. This study was approved by Clinical Trial Registry-India with CTRI Number CTRI/2024/09/074148 registered on 23/09/2024.Data was obtained by recording the probing pocket depth (PPD), clinical attachment level (CAL) given by F Isidor (1984), number of teeth lost and radiographic analysis given by Lawrence J. Emrich (1991). Subjects with age of 35-60 years and with history of diabetes past 2 years or more were included in the study.

The selected subjects were sent for HbA1C levels and OPG. Clinical examination such has recording of PPD, CAL, number of teeth lost, alveolar bone loss in patients with varying glycaemic levels. Subjects using any form of tobacco, under any other systemic diseases and medication, who underwent periodontal therapy past 1 year, history of tooth loss due to trauma or dental caries or orthodontic extractions, who are under medication for Thiazolidinediones, pregnant woman and Lactating mothers were excluded from the study.

The recruited subjects were classified into three groups based on their HbA1C levels.

Group I: Good control: 6- 6.7%

Group II: Moderate control 6.8-7.65 %

Group III: Poor control > 7.65 %

All the groups underwent clinical and radiological evaluation which are as follows.

Diabetic status of the subjects was determined by assessing HbA1C levels and the periodontal status was assessed clinically and radiographically by Schei ruler. Lawrence J. Emrich in 1991 assessed interproximal alveolar bone loss is measured as the percentage of bone loss from the CEJ to the tooth apex using a modified Schei ruler at the deepest point on the mesial or distal of every tooth on a panoramic radiograph.

Bone loss scores (BLS) were categorized as follows:
0= If there was no detectable loss of alveolar crest
1 = If detectable loss was < 25% of the distance from the CEJ to the apex
2 = If the bone loss was 25% to 49%
3 = If the bone loss was 50% to 74%
4 = If the bone loss was > or equal to 75%.

OPG was advised for assessing the periodontal status of the subjects.

Mean and standard deviation for all the parameters in good, moderate and poor control was calculated using descriptive statistical analysis. Similarly, ANOVA was performed to compare the periodontal health status in patients with good, moderate and poor glycaemic controls.

RESULTS

Intergroup comparison of Plaque index, gingival index, pocket depth and clinical attachment loss Table no.1 shows the above-mentioned parameters in good, moderate and poor control patients. All the parameters showed significant reduced values in good glycaemic controlled patients. These include 1.54±0.88, 1.24±0.86, 3.16±1.05 mm, 3.24±1.14 mm for PI, GI, PD and CAL respectively. This is shown in graph 1,2,3,4,5 and 6.

The below table 2 shows SCHEI score and number of teeth lost in good, moderate and poor control patients. Number of teeth lost was higher with a mean of 105.6 in poor control patients followed by moderate and good control. SCHEI score was also higher in poor control patients as compared to good control patients.

GRAPHS: The graphs presented illustrate the mean values and ranks of various dental health indices across three control groups: Good Control, Moderate Control, and Poor Control. These indices include Plaque Index Scores, Gingival Index Scores, Pocket Depth, Clinical Attachment Loss, Schei Scores, and the number of teeth lost. The data highlights the differences in dental health outcomes among the groups, with Good Control showing the lowest scores/ranks, Moderate Control exhibiting intermediate values, and Poor Control displaying the highest scores/ranks, indicating poorer dental health. This comparison aims to assess the effectiveness of different control levels on maintaining oral health.

Graph 1: Depicts that Mean plaque index score is highest in poor control group when compared to moderate control and good control groups with mean plaque scores of 2.61, 2.02, 1.54 respectively.

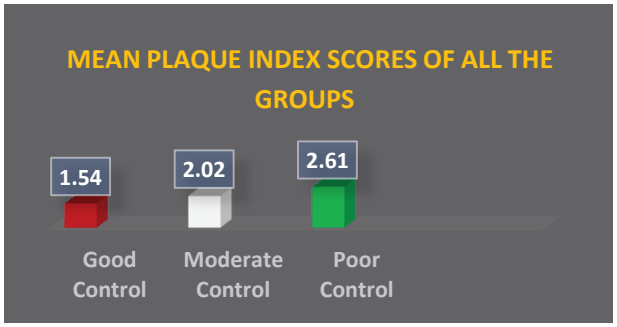
Graph 2: Depicts that Mean Gingival index score is highest in poor control group when compared to moderate control and good control groups with mean gingival scores of 2.44, 1.84, 1.24 respectively.

Graph 3: Depicts that Mean pocket depth score is highest in poor control group when compared to moderate control and good control groups with mean pocket depth scores of 4.49, 3.98, 4.49 respectively.

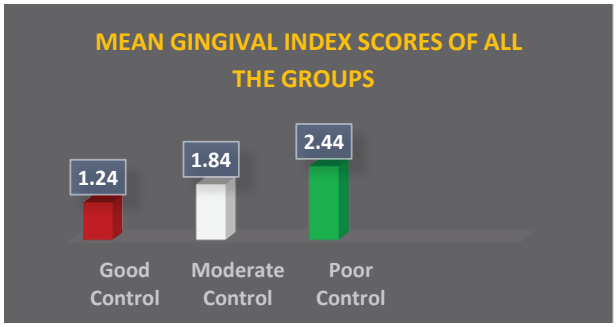
Graph 4: Depicts that mean score of clinical attachment loss is highest in poor control group when compared to moderate control and good control groups with scores of 5.01, 4.26, 3.24 respectively.

Graph 5: Depicts that mean ranks of SCHEI Score is highest in poor control group when compared to moderate and good control groups with scores of 111.39, 78, 50.61 respectively.

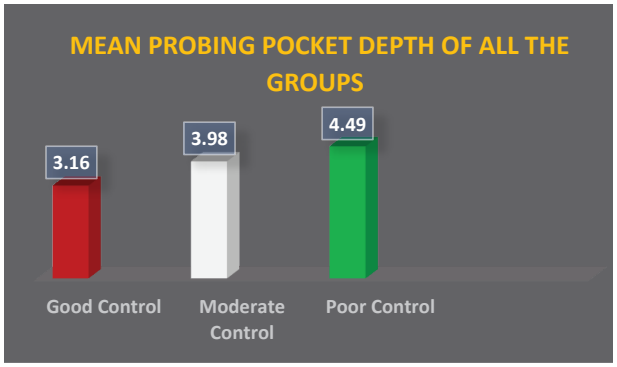
Group 6: Depicts that mean rank scores of NUMBER OF TEETH LOST is highest in poor control group when compared to moderate and good control groups with scores of 105.6, 80.65, 53.75 respectively



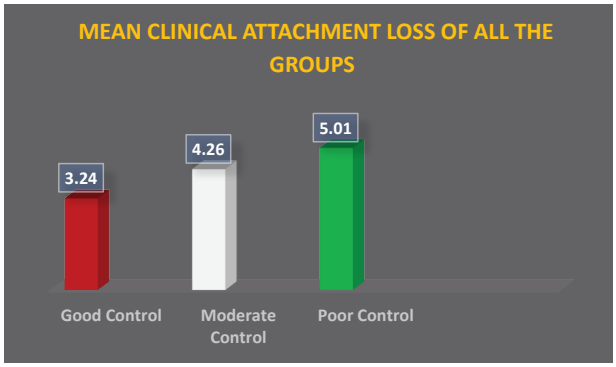
Graph 1: *Mean plaque index scores of all the groups.*



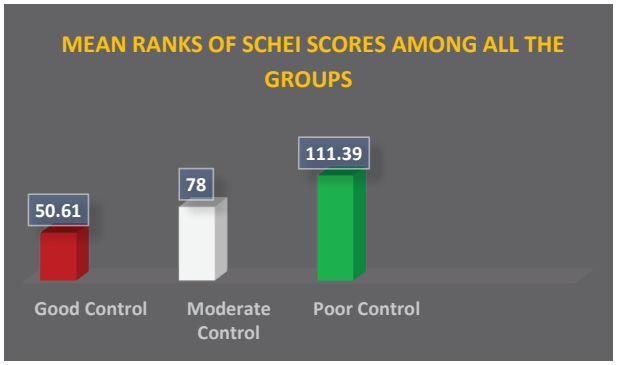
Graph 2: *Mean gingival index scores of all groups*



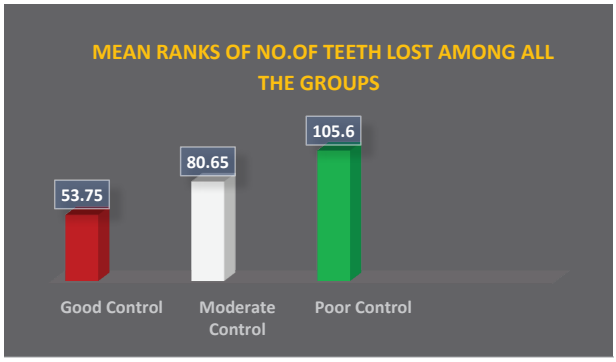
Graph 3: *Mean probing pocket depth of all the groups*



Graph 4: *Mean clinical attachment loss of all the groups*



Graph 5: *Mean ranks of Schei scores among all the groups*



Graph 6: *Mean ranks of number of teeth lost among all the groups*

Table 1: Inter Group comparison of Various variables using ANOVA

VARIABLE	GROUP	MEAN±SD	F VALUE	P VALUE
PI	GOOD CONTROL	1.54±0.88	31.97	0.00*
	MODERATE CONTROL	2.02±0.70		
	POOR CONTROL	2.61±0.38		
GI	GOOD CONTROL	1.24±0.86	39.13	0.00*
	MODERATE CONTROL	1.84±0.72		
	POOR CONTROL	2.44±0.44		
PPD(mm)	GOOD CONTROL	3.16±1.05	17.66	0.00*
	MODERATE CONTROL	3.98±1.16		
	POOR CONTROL	4.49±1.23		
CAL(mm)	GOOD CONTROL	3.24±1.14	20.025	0.00*
	MODERATE CONTROL	4.26±1.52		
	POOR CONTROL	5.01±1.63		

*The statistically significant p values ($p<0.001$) indicate that worsening glycemic control is strongly associated with increased plaque accumulation, gingival inflammation, probing pocket depth and clinical attachment loss.

Table 2: SCHEI score and number of teeth lost in good, moderate and poor control patients.

VARIABLE	GROUP	MEAN RANK	P VALUE
SCHEI Score	GOOD CONTROL	50.61	0.00*
	MODERATE CONTROL	78.00	
	POOR CONTROL	111.39	
No.of Teeth Lost	GOOD CONTROL	53.75	0.00*
	MODERATE CONTROL	80.65	
	POOR CONTROL	105.60	

DISCUSSION

This is an observational study done on 159 patients who were diagnosed with chronic periodontitis and having diabetes. It is a known fact that diabetes and periodontitis have a bidirectional relationship. Diabetes causes hyperglycaemia which in turn is responsible for exposure of neutrophils to high glucose induced oxidative stress. This causes disruption of immune system and eventually leads to chronic inflammation in periodontal construction cells such as gingival fibroblasts and connective tissue cells. [4,5]

According to Frantzis et al., people with diabetes have thicker gingival capillaries, which may restrict the passage of nutrients and oxygen, hence reducing the immune system's ability to fight off infections in the periodontal tissues.[10]

Our findings align with R A Kayal's research, which utilized alveolar bone level and missing teeth counts to assess diabetes' impact on periodontal health in a Saudi population. Statistically significant shifts were observed across both genders ($p = 0.001$) and in individuals over 45 ($p < 0.05$), with a notable shift also evident in those over 55 with fewer than 10 teeth, likely significant at $p < 0.05$, indicating worsened periodontal health with age and poor control.[11]

According to J J Yoo et al (2018), individuals with diabetes exhibited a higher likelihood of tooth loss compared to those without the condition. The risk of tooth loss increases with the severity of diabetes. The risk of tooth loss decreased as the frequency of dental visits rose.[12]

Our findings were similarly consistent with those of Ariel P. Greenblatt, who examined the relationship between diabetes mellitus and tooth loss among Hispanic/Latino people from a variety of ethnic groups living in the United States in 2016.[13]

According to the American Diabetes Association's standards for fasting glucose and glycosylated hemoglobin (HbA1c), as well as medication use, glycemic status was classified as diabetes, impaired glucose levels, or normal levels of glucose. Individuals with uncontrolled diabetes had a significantly higher likelihood of being edentulous and having lost more than nine teeth than those with normal glycemic status.[5] The number of teeth lost and Scehi score was higher in poor control patients rather than good and moderate control diabetic patients. This can be attributed to the damage of periodontal constructive cells or through production of protein glycation. These advanced glycation products (AGE) induce inflammatory response and oxidative stress leading to formation of inflamed periodontal tissue.[14]

However, neither controlled diabetes nor impaired glycemia were associated with tooth loss in adjusted models. They concluded that since these problems may cause edentulousness

and impaired oral function, which can lead to poor nutrition and diabetic effects, dentists should be aware of whether their patients have diabetes and if it is under control by observing the oral status.[15]

Osteoclast induced bone resorption is another reason for impaired wound healing which is caused by alteration and apoptosis of gingival fibroblasts. This leads to periodontitis and eventually tooth mobility and loss.[16,17]

Inflammatory response change can also lead to diabetic patients prone to severe periodontitis and tooth loss.[18] Systemic low-grade inflammation is indicated by higher blood levels of inflammatory cytokines, including TNFα and interleukin 1β (IL-1β), as well as the inflammatory marker C-reactive protein (CRP). These pro-inflammatory mediators are responsible for increase in periodontitis in diabetic patients.[19,20]

Glycemic levels of patient pose a very important parameter for the dentists to analyze and assess the periodontal status of partially or completely edentulous patients.

CONCLUSION

Diabetes is the most common condition where more than 75% are suffering globally. Periodontitis is the sixth complication of diabetes and have a independent associations. It is very important for clinicians such as endocrinologists and diabetologists to refer diabetic patients with gingival inflammation, partially edentulous teeth to dentists. Diabetes and periodontitis management protocols should use interdisciplinary collaboration methods. The goal of this team approach would be to identify diabetes individuals who are at risk for periodontal disease (as part of a pre-diabetic screening at the dentist office) and vice versa. Patients should also be educated for the awareness of diabetes and its complications. Cross-training and inter professional education can help to some extent to prevent edentulousness in diabetic patients.

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