

PREVALENCE AND SEVERITY OF PERIODONTAL DISEASES IN TYPE 2 DIABETES MELLITUS OF BAREILLY REGION (INDIA)

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ABSTRACT

Background: Periodontal disease and diabetes share a two way relationship because of common pathways of disease progression.

Aims & Objective: Extensive study on various population worldwide were carried out but there is a limited data for Indian population, Hence, the present study was done to evaluate the prevalence and severity of periodontitis in type 2 diabetes mellitus of Bareilly region of Uttar Pradesh (INDIA).

Material and Methods: 1000 individuals of type 2 diabetes mellitus were categorized as good, average and poor glycaemic control on the basis of glycosylated hemoglobinA1C(HbA1C). Periodontal examination was done by recording oral hygiene index simplified, clinical attachment loss and gingival bleeding index. This periodontal result was correlated with glycaemic status and duration of diabetes since diagnosis.

Results: Results showed a 91.7% prevalence of periodontitis, predominating with 41.3% cases of moderate periodontitis followed by 26.2% of severe and 24.2% of slight and 8.3% of gingivitis cases. In poor oral hygiene strata; the amount of severe periodontitis cases increased from 0% to 26.2% and up to 73.8%; as the glycaemic control deteriorated from good to average to poor. Similar results were reported for good and fair oral hygiene strata.

Conclusion: Results of present study demonstrated that with worsening of glycaemic control, severity of periodontitis significantly increases even when examined for similar oral hygiene status.

KEY-WORDS: Glycosylated Haemoglobin A1C (HbA1C); Type 2 Diabetes Mellitus; Periodontitis

Introduction

Diabetes has emerged as a major health problem in India. According to International Diabetes Federation every fifth diabetic in world would be an Indian by the year 2025.^[1]

Diabetes is associated with various systemic complications.^[2] Periodontitis is the sixth complication of diabetes, which puts Indian population at a higher risk of developing it secondary to diabetic status.^[3] The two way relation of periodontal destruction and diabetes mellitus make diabetic screening essential in periodontitis.^[4]

Various studies have been done to determine the prevalence and severity of periodontitis in diabetics. Type1 as well as type 2 diabetes have been shown to be the major risk factor for the

development of periodontal disease in certain population. Study conducted on Gullah African Americans, Hispanic Americans, France, Jordan, Brazil, Srilanka, Iraq and Finland reported higher prevalence of periodontitis in type 2 diabetes mellitus.^[5-12] Landmark studies of Nelson (1990)^[13]; Emrich (1991)^[14] & Taylor (1996)^[15] on Pima Indians reported a 2.6, 3 and 4 times amount of periodontal destruction in diabetics when compared with non-diabetics respectively. Further the duration of diabetes also affects periodontitis which was evaluated by the Juan Cerda G (1994)^[16] and Khader Y S (2008)^[8] who reported an increase in periodontal tissue destruction when the duration of the diagnosis of type 2 diabetes mellitus was more than five years. Although relationship between diabetes mellitus and periodontitis is well established by various studies in different population, but limited literature is available for Indian population in this

context, hence the present study was planned with the aim of studying the prevalence of periodontitis in type 2 diabetics of Bareilly region of Uttar Pradesh (India) and to correlate the severity of periodontitis with worsening glycaemic status with similar oral hygiene status.

Materials and Methods

The present study was done in tertiary care centre of Bareilly region of Uttar Pradesh (India) in one thousand type 2 diabetics of 35 to 60 years of age group with minimum 20 teeth with ethical approval from institute ethical committee and informed consent with each subject between years 2009 to 2010. Type 1 diabetics, pregnant and lactating females, persons who had gone any type of periodontal therapy at least 6 months prior, smokers, persons on antibiotic therapy prior to study and postmenopausal women were excluded from the study. Each subject was evaluated for diabetic profile and periodontal status. All subjects were verified for diabetic status and duration since diagnosis through their previous records. Glycosylated haemoglobin A1C (HbA1C) was done in all subjects by the method described by Cohen et al.^[17] According to Laboratory Evaluation of Diabetes Control (American Diabetes Association Guidelines) for HbA1C the population were categorized^[18] as normal (4-6%), good diabetes control (<7%), average diabetes control (7-8%) and poor diabetes control (>8%). A comprehensive periodontal examination was done including parameters like Oral Hygiene Index Simplified (OHIS)^[19], Gingival Bleeding Index (GBI)^[20] and Clinical Attachment Loss (CAL)^[21].

Results

The present epidemiological study of 1000 type 2 diabetic had 477 males and 523 females. Out of 1000 individuals 120 had good, 469 had fair and 411 had poor glycaemic control on the basis of their HbA1C status. Age was similar for all 3 groups and was insignificantly related to glycaemic control (p=0.663). Male to female ratio in good glycaemic control group was 65:55, in average glycaemic control group was 251:218 and in poor glycaemic control group was 207:204. Thus, gender was

found to be insignificantly related with glycaemic status (p=0.588).

Table-1: Demographic Characteristics of the Population under Study

| Variable | Good Control (n=120) | Fair Control (n=469) | Poor Control (n=411) | Statistical Significance | |
|--------------------|----------------------|----------------------|----------------------|--------------------------|-------|
| | | | | X ² /F | p |
| Age (Mean ± SD) | 42.58 ± 6.06 | 43.15 ± 6.43 | 43.15 ± 6.45 | 0.411 | 0.663 |
| Gender Male/Female | 65/55 | 251/218 | 207/204 | 1.063 | 0.588 |

Prevalence of periodontitis in current population was found to be 91.7%. Out of which moderate periodontitis constitute the highest portion of population (41.3%), followed by 26.2% for severe periodontitis and 24.2% for slight periodontitis. 8.3% had gingivitis with no attachment loss. (Table 2)

Table-2: Prevalence of Periodontitis in T2DM Population under Study

| Groups | Males | Females | Total (%) |
|----------------------------------|-------|---------|------------|
| Group I Gingivitis | 46 | 37 | 83 (8.3) |
| Group II Slight Periodontitis | 118 | 124 | 242 (24.2) |
| Group III Moderate Periodontitis | 223 | 190 | 413 (41.3) |
| Group IV Severe Periodontitis | 136 | 126 | 262 (26.2) |

Table-3: Periodontal Parameters

| Variables | | Glycemic Control | | |
|-----------------------------------|-------------------|------------------|--------------|--------------|
| | | Good (n=120) | Fair (n=469) | Poor (n=411) |
| Oral Hygiene Status* N (%) | Good | 36 (30.) | 16 (3.4) | 33 (8.0) |
| | Fair | 24 (20.0) | 76 (16.2) | 125 (30.4) |
| | Poor | 60 (50.0) | 377 (80.4) | 253 (61.6) |
| Bleeding Index** (Mean± SD) | | 97.49 ± 0.88 | 97.48 ± 0.89 | 97.49 ± 0.90 |
| | | | | |
| Clinical Attachment Loss*** N (%) | Normal (< 1mm) | 65 (54.2) | 15 (3.2) | 3 (0.7) |
| | Slight (1-2 mm) | 47 (39.2) | 138 (29.4) | 57 (13.9) |
| | Moderate (3-4 mm) | 8 (6.7) | 253 (53.9) | 152 (37.0) |
| | Severe (≥5 mm) | 0 (0.0) | 63 (13.4) | 199 (48.4) |

* X² = 118.07 (df = 4) & p < 0.001; ** F = 0.040 & p = 0.961;

*** X² = 574.887 (df = 6) & p < 0.001

Out of 120 subjects with good glycaemic control, 36 (30%) had good oral hygiene; 24 (20%) had fair, and 60 (50%) had poor oral hygiene. 469 had average glycaemic control, of which 16 subjects (3.4%) had good oral hygiene; 76 (16.2%) had fair, and 377 (80.4%) had poor oral hygiene. 411 had poor glycaemic control, out of which 8% had good

oral hygiene, 30.4% had fair and 61.6% had poor oral hygiene. Thus, oral hygiene status was significantly related to glycaemic control (p value - 0.001) (Table 3). Bleeding index for good glycaemic control group was $97.49 \pm 0.88\%$; for average control it was $97.49 \pm 0.89\%$ and for poor glycaemic control $97.49\% \pm 0.90\%$. Thus, the bleeding index was almost similar for all the 3 groups with insignificant p value (p - 0.96). (Table 3)

Out of 120 individuals with good glycaemic control, 65 subjects (54.2%) had no clinical attachment loss; 47 subject (39.2%) had slight periodontitis; 8 (6.7%) had moderate periodontitis and none had severe periodontitis. 469 subjects had average glycaemic control, out of which 15 (3.2%) had no clinical attachment loss; 138 (29.4%) had slight periodontitis; 253 (53.9%) had moderate periodontitis and 63 (13.4%) had severe periodontitis. 411 persons had poor glycaemic control, out of which 3 (0.7%) had no clinical attachment loss; 57 (13.9%) had slight periodontitis; 152 (37.0%) had moderate periodontitis and 199 (48.4%) had severe periodontitis. Thus, clinical attachment loss was found to be significantly associated with glycaemic control (p value --<0.001). (Table 3)

Table-4: Correlation of CAL & HbA1c, with in Similar Oral Hygiene Group

| Oral Hygiene Group | HbA1c Status | Clinical Attachment Loss N (%) | | | |
|--------------------|--------------|--------------------------------|-------------|-------------|-------------|
| | | Normal | Slight | Moderate | Severe |
| Good* | Good | 36 (72.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| | Fair | 11 (22.0) | 4 (18.2) | 1 (7.7) | 0 (0.0) |
| | Poor | 3 (6.0) | 18 (81.8) | 12 (92.3) | 0 (0.0) |
| | Total | 50 (100.0) | 22 (100.0) | 13 (100.0) | 0 (0.0) |
| Fair** | Good | 24 (85.7) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| | Fair | 4 (14.3) | 30 (68.2) | 38 (32.8) | 4 (10.8) |
| | Poor | 0 (0.0) | 14 (31.8) | 78 (67.2) | 33 (89.2) |
| | Total | 28 (100.0) | 44 (100.0) | 116 (100.0) | 37 (100.0) |
| Poor*** | Good | 5 (100.0) | 47 (26.7) | 8 (2.8) | 0 (0.0) |
| | Fair | 0 (0.0) | 104 (59.1) | 214 (75.4) | 59 (26.2) |
| | Poor | 0 (0.0) | 25 (14.2) | 62 (21.8) | 166 (73.8) |
| | Total | 5 (100.0) | 176 (100.0) | 284 (100.0) | 225 (100.0) |

* $X^2=60.258$ (df=4) & $p<0.001$; ** $X^2=223.64$ (df=4) & $p<0.001$;

*** $X^2=330.97$ (df=4) & $p<0.001$

Among good oral hygiene status; 36 individuals i.e. 42.4% had good glycaemic control; 16(18.8%) had fair and 33(38.8%) had poor glycaemic control. 50 individuals had no attachment loss out of which 36 (72%) had good glycaemic control; 11 (22.0%) had fair and 3 subjects (6%) had poor glycaemic

control. 22 individuals had slight attachment loss, out of which none had good glycaemic control, 4 subjects (18.2%) had average and 18 subjects (81.8%) had poor glycaemic control. 13 individuals had moderate attachment loss out of which none had good glycaemic control, 1 subject (7.7%) had fair and 12 subjects (92.3%) had poor glycaemic control. None of the individuals with good oral hygiene had severe attachment loss. (Table 4) The individuals with fair oral hygiene status; 24 (10.7%) had good glycaemic control; 76 (33.8%) had fair and 125 (55.6%) had poor glycaemic control. 28 individuals had no attachment loss, out of which 24 (85.7%) had good glycaemic control; 4 (14.3%) had fair and none had poor glycaemic control. 44 individuals had slight attachment loss out of which none had good glycaemic control, 30 (68.2%) had average and 14 (31.8%) had poor glycaemic control. 116 individuals had moderate attachment loss out of which none had good glycaemic control, 38 (32.8%) had fair and 78 (67.2%) had poor glycaemic control. 37 individuals had severe attachment loss out of which none had good glycaemic control, 4 (10.8%) had fair and 33 (89.2%) had poor glycaemic control. A significant p value of <0.001 was obtained. (Table 4) Among the individuals with poor oral hygiene status; 60 individuals (8.7%) had good glycaemic control; 377 individuals (54.6%) had fair and 253 individuals (36.7%) had poor glycaemic control. 5 individuals had no attachment loss out of which 100% had good glycaemic control. 176 individuals had slight attachment loss out of which 47 individuals (26.7%) had good glycaemic control, 104 individuals (59.1%) had fair and 25 individuals (14.2%) had poor glycaemic control. 284 individuals had moderate attachment loss out of which 8 individuals (2.8%) had good glycaemic control, 214 individuals (75.4%) had fair and 62 individuals (21.8%) had poor glycaemic control. 225 individuals had severe attachment loss out of which none had good glycaemic control, 59 individuals (26.2%) had fair and 166 individuals (73.8%) had poor glycaemic control. Thus, a significant increase in periodontal destruction with the worsening of glycaemic status was observed, even in the presence of similar oral hygiene status and the relationship was found to be statistically significant with p value of <0.001.

Table-5: Correlation of Duration since Diagnosis of T2DM with CAL.

| Clinical Attachment Loss | <5 years (n=360) N (%) | >5 years (n=640) N (%) |
|--------------------------|---------------------------|---------------------------|
| Normal (<1 mm) | 77 (21.4) | 6 (0.9) |
| Slight (1-2 mm) | 114 (31.7) | 128 (20.0) |
| Moderate (3-4 mm) | 141 (39.2) | 272 (42.5) |
| Severe (≥ 5 mm) | 28 (7.8) | 234 (36.6) |

360 individuals had < 5 years of duration of diabetes mellitus since diagnosis; out of which 77 (21.4%) has no attachment loss; 114 (31.7%) had slight attachment loss, 141 (39.2%) had moderate and 28 (7.8%) had severe attachment loss. 640 individuals had > 5 years of duration of diabetes mellitus since diagnosis; out of which 6 (0.9%) has no attachment loss; 128 (20.0%) had slight attachment loss, 272 (42.5%) had moderate and 234 (36.6%) had severe attachment loss. Thus, CAL was found to be directly associated with duration since diagnosis of diabetes mellitus, and the relationship was found to be statistically significant with p value of <0.001.

Discussion

Oral inflammatory diseases such as gingivitis and periodontitis are present in up to 75% of individuals with diabetes mellitus.^[22] Individuals > 45 years old with diabetes are 2.9 times more likely to have severe periodontitis than non-diabetics.^[23] The present study was done in type 2 diabetic of Bareilly region (India) and the prevalence and correlation between severity of periodontal destruction and worsening of glycemic status was recorded. Age and gender was recorded for all the individuals, and was correlated with the glycemic status. No significant association was observed for all the aforementioned demographical variables. In the present study, only clinical parameters i.e. OHI-S, G.B.I. & CAL were recorded to assess the periodontal status. Radiographic examination was not done, which can be justified keeping in mind the large sample size under investigation. Periodontal examination was done by a single examiner to eliminate the inter examiner variability. After periodontal examination of patients; appropriate periodontal treatment was initiated; the same was not recorded as it fell outside the aim and objectives of present epidemiological trial.

The results of present study suggested that 91.7% of the diabetic subjects were having at least some amount of periodontal destruction; supporting the view that considers periodontitis as the sixth complication of diabetes mellitus.^[3] Similar result were procured in trial of Abbas Ali Mansour (2005) and Zang JQ (2009) who reported prevalence of 96.7% and 95.9% of periodontitis in type 2 diabetic population respectively.^[11,24] The reason for higher prevalence in the present study could be explained as a more detailed examination and inclusion of even CAL of one mm as slight periodontitis was made. Whereas, certain studies have reported lesser prevalence as it only recorded periodontitis when CAL exceeded 3 or 4 mm^[25]. Similarly, Carlene Tsai (2002) recorded only severe cases defined by CAL > 6 mm on 2 sites thus not taking in account the amount of moderate attachment loss.^[26] Present study more precisely recorded even the slight attachment loss thus identifying the actual periodontal disease burden in diabetic population. Moderate periodontitis was found to be more prevalent in population under investigation; 41.3% reported moderate amount of clinical attachment loss. These findings are consistent with that of previous studies which reported higher prevalence of moderate periodontitis.^[11,5] The greater percentage of moderate cases can be explained as criteria in present study for moderate destruction was considered as 3-4 mm. Various studies have been done to find the possible association between gingival bleeding and diabetic status. A recent longitudinal study showed more rapid and severe gingival inflammation in adult subjects with type 1 diabetes than in control subjects without diabetes, despite similar qualitative and quantitative bacterial plaque characteristics, suggesting a hyper inflammatory gingival response in people with diabetes.^[27] Ervasti et al (1985) observed greater gingival bleeding in patients with poorly controlled diabetes than in control without diabetes or in well-controlled diabetes.^[28] Cutler (1999) reported that type 2 diabetics had greater gingival inflammation than non-diabetics; the highest level of gingivitis was found in subjects with poor glycaemic control.^[29]

In the present study, bleeding on probing did not significantly differ with worsening of diabetic control with an average of 97.49% of sites

involved. Variation in results could be explained as the index (Animano and Bay)^[20] used, only showed whether bleeding on probing was present or absent and no details about the severity of inflammation could be extracted. Present study demonstrated that 30% of population with good glycaemic control had good oral hygiene status while only 8% of population with poor glycaemic control. Further an increased amount of local factors as assessed by OHI-S scores was positively associated with clinical attachment loss in type 2 diabetics when compared with gender and age matched non diabetic subjects similar to a study done by Chaveda (1993).^[30]

In an excellent review a "dose response" was proposed and supported with large amount of clinical data i.e. as glycaemic control worsens the adverse effect of diabetes on periodontal health become greater.^[31] Similar relation was procured in present trial, clinical attachment loss was linearly and significantly found to be associated with worsening of glycaemic control; no attachment loss was seen in population with good glycaemic control while 48.4% of population with poor glycaemic control had severe attachment loss (>5mm).

To nullify the confounding effect of oral hygiene status on clinical attachment loss; CAL was correlated with glycaemic level within similar oral hygiene groups. A significant increase in clinical attachment loss was seen, which was positively related with the worsening of glycaemic control, similar to the finding of Sznajder N (1978)^[32] and Bandopadhyay D (2010).^[33] The present epidemiological study was designed with the aim to assess the prevalence and severity of periodontitis in type 2 diabetics hence reporting of OHI-S and HbA1c values after the subject received treatment was out of the scope of the trial, and thus post treatment records were not included in the epidemiological data. Within the subjects with good OHI status when CAL was related with good, fair and poor diabetic control, it was seen that when glycaemic control worsens from good to poor, there was an increase in number of individuals with clinical attachment loss. No periodontal destruction was seen for all categories of periodontitis under good glycaemic control which increased to 81.8% (for slight

periodontitis); 92.3% (for moderate periodontitis) and 0% (for severe periodontitis) under poor glycaemic control; suggesting a direct relationship of CAL with glycaemic status. Fair OHI status related with good, fair and poor diabetic control, it was noticed that with the worsening of glycaemic status the severity of periodontal destruction increased. No periodontal destruction was seen for all categories of periodontitis under good glycaemic control which increased to 31.8% (for slight periodontitis); 67.2% (for moderated periodontitis) and 89.2% (for severe periodontitis) under poor glycaemic control. As the oral hygiene become poor with poor diabetic control the severity of CAL increased with majority of subject falling in moderate periodontitis group. Periodontal destruction was distributed according to glycaemic control of good, average and poor as 26.7%; 59.1% & 14.2% (for slight periodontitis); 2.8% 75.4% & 21.8% (for moderate periodontitis) and none, 26.2% & 73.8% (for severe periodontitis), clearly demonstrating that worsening of glycaemic status had a significant influence in individuals irrespective of their oral hygiene status. An important criterion in analysing the amount of periodontal tissue loss is the duration since the diagnosis of type 2 diabetes mellitus is made. Some cross sectional studies have shown the amount of alveolar bone loss to be higher when duration exceeded 5 years^[13,34] and it increased linearly with increase in the number of year since the diagnosis of type 2 diabetes mellitus.^[25] The present study showed positive association between the severity of periodontitis with duration since the diagnosis of type 2 diabetes mellitus. In the present epidemiological survey 36.6% of population with duration 5 years had severe periodontal loss as compared to only 7.8% in population with duration < 5 years. This could be explained by the amount of chronic hyperglycaemia developed over the preceding years. A high prevalence of 91.7% was found in present epidemiological survey supporting a strong association of periodontitis and Type 2 diabetes mellitus. Also CAL significantly deteriorated with worsening of glycaemic control when individuals of similar oral hygiene status were examined.

Conclusion

A very high percentage (91.7%) of prevalence of periodontitis was found in type 2 diabetic individuals of Bareilly population. A positive correlation of worsening of glycaemic level and increase in periodontal destruction was observed, even in the presence of similar oral hygiene status. Gingival bleeding index was not found to vary with the worsening of glycaemic status. Duration of diagnosis of diabetes mellitus was found to be directly related with periodontal destruction.

Present study was aimed to see the prevalence and severity of periodontitis in type 2 diabetics of Bareilly. After complete periodontal examination, subjects were categorized according to glycosylated haemoglobin level and duration since diagnosis. Periodontal status was examined and categorized as mild, moderate and severe periodontitis. The data was analyzed and arranged to see the influence of oral hygiene index, gingival bleeding index and glycaemic control on severity of periodontitis and glycaemic status and it was compared with same oral hygiene status individuals by removing the confounding factor of oral hygiene. Approximately half of the population with duration since diagnosis more than 5 years receiving treatment had compromised oral hygiene but were not referred to a dentist. Results of present epidemiological study drew attention for oral hygiene in population. It also threw light on the negligence of oral hygiene by the individuals and as well as concerned doctor.

References

- Sicree R, Shaw J, Zimmer P. Diabetes and impaired glucose tolerance. *International Diabetes Federation*;2006:15-103.
- Pickup J, Williams G. The history of diabetes mellitus. *The textbook of diabetes mellitus*, Oxford: Blackwell 1997;1.1-1.19.
- Loe H. Periodontal disease: The 6th Complication of Diabetes Mellitus. *Diabetes Care* 1993;16:329-334.
- Taylor GW. Bidirectional inter-relationship between diabetes and periodontal diseases: an epidemiologic prospective. *Ann periodontal* 2001;1:99-112.
- Jyotika KF, Ryan EW, Carlos FS, Sara GG, John JS, Maria FLV, Elizabeth H. Slate Periodontal Disease Status in Gullah African Americans with Type 2 Diabetes Living in South Carolina. *J Periodontal* 2009;80:1062-68.
- Novak MJ, Potter RM, Blodgett J, Ebersole JL. Periodontal Disease in Hispanic Americans with Type 2 Diabetes. *J Periodontol* 2008;79:629-36.
- Mattout C, Bourgeois D, Bouchard P. Type 2 Diabetes and Periodontal Indicators: Epidemiology in France 2002-2003. *Journal of Periodontal Research* 2006;41:253-58.
- Khader YS, Albashaireh ZS, Hammad MM. Periodontal Status of Type 2 Diabetics Compared with Nondiabetic in North Jordan. *East Mediterr Health J* 2001;14:654-61.
- Aline MS, Andrea MDV, Efigenia FF, Mauro HNGA. Periodontitis in Individuals with Diabetes Treated in the Public Health System of Belo Horizonte, Brazil. *Rev Bras Epidemiol* 2010;13:118-25.
- Preshaw PM, De Silva N, McCracken GI, Fernando DJS, Dalton CF, Steen ND, Heasman PA. Compromised Periodontal Status in an Urban Sri Lankan Population with Type 2 Diabetes. *J Clin Periodontol* 2010;37:165-171.
- Mansour AA, Abd-Al-Sada N. Periodontal Disease among Diabetics in Iraq. *Med Gen Med*.2005;7:2
- Tellervo T, Richard CO. Long Term Control of Diabetes Mellitus and Periodontitis. *J Clin Periodontol* 1993;20:431-435.
- Nelson RG, Shlossman M, Budding LM. Periodontal disease and NIDDM in Pima Indians. *Diabetes care* 1990; 123:836-40.
- Emrich LJ, Shlossman M, Genco RJ. Periodontal disease in non-insulin-dependent diabetes mellitus. *J. Periodontol* 1991; 52:123-31/
- Taylor GW, Burt BA, Becker MP, Genco RJ, Shlossman M, Knowler WC, Pettitt DJ. Severe periodontitis and risk for poor glycemic control in patients with non-insulin dependent diabetes mellitus. *J Periodontol*. 1996; 67:1085-93.
- Cedra J, Vazquez de la Torre C, Malacara JM, Nava LE. Periodontal disease in non-insulin dependent diabetes mellitus (NIDDM). The effect of age and time since diagnosis. *J Periodontol* 1994; 65, 991-95.
- Cohen MP, Witt J, Wu VY. Purified hemoglobin preparations in the evaluation of HbA1c determination by ion exchange chromatography. *Ann Clin Biochem* 1993;30:265-71.
- American Diabetes Association: Clinical Practice Recommendations 2005. Standard of Medical Care in Diabetes. *Diabetes care* 2005; 28:S10-S11.
- Greene JC, Vermillion JR. The Simplified Oral Hygiene Index. *J am dent assoc*. 1964; 68:7-13.
- Ainamo J, Bay I. Gingival Bleeding Index Problems and proposals for recording gingivitis and plaque. *Int Dent J* 1975; 25:229.
- Armitage GC. Periodontal diagnosis and classification of periodontal disease. *Periodontol* 2000.2004; 34L9-21.
- Centers for Disease Control and Prevention. National diabetes fact sheet: national estimates and general information on diabetes and prediabetes in the United States, 2011. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2011. Available at: http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf Accessed June 28, 2011.
- Iacopino AM. Periodontitis and diabetes interrelationships: role of inflammation. *Ann Periodontol*. 2001;6:125-137.

24. Zhang JQ, Pan YP, Ma L, Tan LS, Liu JB, Wei JJ. A survey on the periodontal status in type 2 diabetic patients. *Zhonghua Kou Qiang Yi Xue Za Zhi*. 2009; 44:668-71.
25. Morton AA, Williams RW, Watts TLP. Initial study of periodontal status in non-insulin-dependent diabetics in Mauritius. *J Dent* 1995; 23: 343-45.
26. Selwitz RH, Albandar JM, Harry HI. Periodontal disease in diagnosed diabetes: US population 1988-1994. *J Dent Res* 1998; 77:2139.
27. Salvi GE, Kandylaki M, Troendle A, Persson GR, Lang NP. Experimental Gingivitis in Type 1 diabetics: a Controlled Clinical and Microbiological Study. *J Clin Periodontol* 2005; 32:310-16.
28. Ervasti L, Knuuttila M, Pohjamo L, Haukipuro K. Relation between Control of Diabetes and Gingival Bleeding. *J Periodontol* 1985; 56:154-57.
29. Cutler CW, Machen RL, Jotwani R, Iacopino AM. Heightened Gingival Inflammation and Attachment Loss in Type 2 Diabetics with Hyperlipidemia. *J Periodontol* 1999; 70:1313-21.
30. Taylor GW, Burt BA, Becker MP, et al. Non-insulin Dependent Diabetes Mellitus and Alveolar Bone Loss Progression Over 2 Years. *J Periodontol* 1998; 69:76-83.
31. Taylor GW. Bidirectional Interrelationships between Diabetes and Periodontal Diseases: an Epidemiologic Perspective. *Ann Periodontol* 2001; 6:99-112.
32. Sznajder N, Carraro JJ, Rugna S, Sereday M. Periodontal Findings in Diabetic and Nondiabetic Patients. *J Periodontol*. 1978; 49: 445-48.
33. Bandopadhyay D, Nicole MM, Jyotika KF, Renata SL. Periodontal Disease Progression and Glycaemic Control Among Gullah African Americans with Type-2 Diabetes. *J Clin Periodontol*. 2010;37:501-09.
34. Sukhdeep S, Veerendra K, Sheela K, Anitha S. The effect of periodontal therapy on the improvement of glycemic control in patients with type 2 diabetes mellitus: A randomized controlled clinical trial. *Int J Diabetes Dev Ctries*. 2008; 28:38-44.

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