

STROBE STATEMENT

1.TITLE

Correlation of Periodontal Inflamed Surface Area with glycemic status in patients with controlled type 2 diabetes mellitus and uncontrolled type 2 diabetes mellitus with and without micro-vascular complications.

ABSTRACT

This cross sectional study assessed the proportion of periodontitis and correlation of PISA with glycemic status in controlled, uncontrolled Type 2 Diabetes Mellitus(T2DM) with and without micro-vascular complications.

High proportion and severity of periodontitis, and increased inflamed surface area in uncontrolled T2DM subjects may have contributed to the poor glycemic control and microvascular complications

INTRODUCTION

2.BACKGROUND AND RATIONALE

The bidirectional link between periodontitis and diabetes mellitus has been established. Periodontitis causes systemic inflammatory burden through inflammatory mediators. The currently utilized tools [Clinical Attachment Loss (CAL) and Probing Pocket Depth (PPD)] are linear measurements, that do not exactly quantify the inflammatory burden of periodontitis. Periodontal Inflamed Surface Area (PISA) quantifies the surface area of bleeding pocket epithelium and estimates the inflammatory burden. Studies relating to the periodontal status of diabetic patients with and without microvascular complications are scarce. This study assessed the proportion of periodontitis and correlation of PISA with glycemic status in controlled, uncontrolled Type 2 Diabetes Mellitus (T2DM) with

and without micro-vascular complications.

3.OBJECTIVES

1. To assess the prevalence and severity of periodontitis in type 2 diabetic patients (Well controlled type 2 diabetes mellitus group: (HbA1c \leq 7%), Uncontrolled type 2 diabetes mellitus group: (HbA1c $>$ 7%) without complications, Uncontrolled type 2 diabetes mellitus group: (HbA1c $>$ 7%) with microvascular complications).
2. To assess the correlation between Clinical Attachment Loss (CAL) and HbA1c in patients with controlled type 2 diabetes mellitus and uncontrolled type 2 diabetic mellitus with and without micro-vascular complications.
3. To assess the correlation between Periodontal Inflamed Surface Area (PISA) and HbA1c in patients with controlled type 2 diabetes mellitus and uncontrolled type 2 diabetic mellitus with and without micro-vascular complications.

4.METHOD AND STUDY DESIGN

This cross sectional study was conducted by the Department of Periodontics, Government Dental College Calicut in collaboration with Department of Internal Medicine & Department of Microbiology, Government Medical College, Calicut, Kerala,India.

5.SETTING

The duration of the study was 12 months. 180 T2DM patients were selected from the diabetic clinic of Department of Internal Medicine, Government Medical College, Calicut.

6.PARTICIPANTS

Eligibility criteria:- T2DM patients with age group between 30 to 60 years and with minimum of 20 teeth were included in this study. Patients with known systemic diseases and conditions, pregnant and lactating mothers, patients with acute condition that contraindicate a periodontal examination, patients who received systemic antibiotic therapy within past 6 months, patients who received periodontal therapy (scaling and root planing or surgery) within past 1 year were excluded from the study.

Sources and method of selection of participants :-In this study, 180 T2DM patients were selected from the diabetic clinic of Department of Internal Medicine and divided into three groups based on their Glycated Hb levels(HbA1c) as follows:

Group I- Controlled T2DM group: (HbA1c \leq 7%),

Group II - Uncontrolled T2DM group:(HbA1c>7%) without complications,

Group III- Uncontrolled T2DM group: (HbA1c>7%) with microvascular complications.

7.VARIABLES

Subjects were evaluated using a detailed questionnaire about their sociodemographic characteristics, medical history, oral hygiene practice, history of diabetes and drug allergy.

Exposure variable:- Glycated Hb (HbA1c), Fasting Plasma Glucose (FPG) and Post Prandial Plasma Glucose (PPPG)

Outcome variable :- Probing Pocket Depth (PPD), Clinical Attachment loss (CAL), Bleeding on Probing (BOP), Oral Hygiene Index-simplified (OHI-S index) and Periodontal Inflamed Surface Area (PISA).

All Periodontal examinations were done by a single trained examiner (KA).

8.DATA SOURCES/ MEASUREMENT

OHI-S index was assessed using Simplified Green and Vermilion index.

Bleeding on probing

William's graduated periodontal probe is inserted into the "bottom" of the gingival/periodontal pocket by applying a light force and is moved gently along the tooth (root) surface. If bleeding is provoked by this instrumentation upon retrieval of the probe, the site examined is considered "bleeding on probing" (BoP)-positive and, hence, inflamed.

Probing Pocket Depth (PPD)

It was measured with William's graduated periodontal probe. The pocket depth was measured from crest of the free gingival margin to the base of the pocket without penetrating deep into the underlying tissues. Periodontal measurements were performed at the mesiobuccal and midbuccal, distobuccal, mesiolingual, midlingual and distolingual sites of all fully erupted teeth. The mean probing depth per patient was calculated. Also percentage of sites with probing pocket depth $\leq 3\text{mm}$, 4-5mm, and $\geq 6\text{mm}$ was calculated.

Clinical Attachment Loss (CAL)

Is measured as the distance from the cementoenamel junction to the base of the pocket

and the mean clinical attachment loss (CAL) per subject were calculated. Also percentage of sites with $CAL \leq 3mm$, 4-5mm, and $\geq 6mm$ was calculated

Periodontal Inflamed Surface Area (PISA)

PISA was calculated with a Microsoft Excel spreadsheet available from website: www.parsprototo.info. After filling CAL, Gingival Recessions and BOP on six sites per tooth in this spreadsheet, mean CAL and Gingival Recession for each particular tooth was calculated. Linear mean CAL and GR is translated into the Periodontal Epithelial Surface Area (PESA) for each specific tooth. The PESA for a particular tooth consists of the root surface area of that tooth measured in mm^2 , which is covered with pocket epithelium. The PESA for a specific tooth is then multiplied by the proportion of sites around the tooth that was affected by BOP, resulting in the PISA for that particular tooth; and the sum of all individual PISAs around the individual tooth is calculated, rendering the full-mouth PISA value in mm^2 of each participant.

Periodontal disease severity

The periodontal status was measured by Probing Pocket Depth, Gingival Recession and Clinical Attachment Level in millimeters at 6 sites on each tooth using a William's graduated periodontal probe. The periodontal status was then recorded as no/mild periodontitis, moderate periodontitis and severe periodontitis based on the criteria proposed by the CDC Working Group for use in population based surveillance of periodontitis.(CDC 2012 update)

9.BIAS

There was no sources of bias in this study .

10.STUDY SIZE

The formula for sample size calculation is=

$$n = \frac{(Z_a + Z_b)^2 \times pq \times 2}{d^2}$$

where

$Z_a = 1.96$ (constant)

$Z_b = 0.84$ (constant)

p =proportion

$q = 1-p$

d =Effect size (minimum clinically relevant difference between the groups)

In this study p is taken as 82% from reference study.

$$n = \frac{(Z_a + Z_b)^2 \times pq \times 2}{d^2} = \frac{(1.96 + 0.84)^2 \times 82 \times 18 \times 2}{20^2} = 58$$

Keeping in mind the extreme values and variations that can occur we have taken a sample size of 60 in each group, to obtain better result. Study subjects consist of 180 Type 2 diabetic patients taken from Diabetic clinic of Department of Internal Medicine, Government Medical College Kozhikode. The study was approved by the Institutional Ethics Committee Government Dental College Kozhikode (IEC no: 83/2016/DCC) and approved by the Clinical Trial Registry of India (CTRI/2017/10/010217). An informed consent was obtained from the subjects and the study was conducted in accordance with the Helsinki declaration of 1975, as revised in 2000. The duration of the study was 12 months

11. QUANTITATIVE VARIABLES

Mean (\pm SD) was calculated for quantitative variables. Independent t test was used to compare the quantitative variables between controlled Type 2 DM and uncontrolled Type 2 DM groups. Quantitative data (Age, BOP, PPD, CAL, OHI-S, HbA1c, FPG, PPPG) between groups were analysed by ANOVA test.

12.STATISTICAL METHODS

Mean (\pm SD) was calculated for quantitative variables and frequency was calculated for qualitative variables. Independent t test was used to compare the quantitative variables between controlled Type 2 DM and uncontrolled Type 2 DM groups. Quantitative data (Age, BOP, PPD, CAL, OHI-S, HbA1c, FPG, PPPG) between groups were analysed by ANOVA test. Qualitative data such as Gender, socioeconomic status and proportion and severity of periodontitis, were analysed by Chi-Square test. Correlation between PISA and HbA1c, CAL and HbA1c, were done by Pearson correlation test. The multivariate linear regression model was used to analyse the relationship between PISA and HbA1c

RESULTS

13.PARTICIPANTS

180 Diabetic patients were participated throughout the study

14.DESRIPTIVE DATA

There was no significance difference in the mean age between groups. There was no difference in the gender distribution among the study subjects ($p > 0.05$). Proportion of religion (Hindu, Muslim and Christian) in subjects showed a significant difference between groups ($p < 0.001$). There was a statistically significant difference in the distribution of education level between groups (p value = 0.03). There was no statistically significant difference in the distribution of socio - economic status between groups (p value = 0.06).

15.OUTCOME DATA

180 participants, 60 in each groups

16.MAIN RESULTS

The proportion of periodontitis among the study subjects was 88.6%. There was a statistically significant difference between the proportion of periodontitis in these groups($p < 0.001$).

It was found that a statistically significant positive correlation exist between the mean CAL and HbA1c among study subjects ($r = 0.451$, $p < 0.001$). Positive correlation was found between PISA and HbA1c among the groups ($r = 0.079$, 0.109 , 0.248 respectively). A statistically significant positive correlation had been observed between PISA and HbA1c among study subjects ($r = 0.393$, $p < 0.001$).

17. OTHER ANALYSIS

The proportion of periodontitis among group I, group II and group III was 75%, 93.4% and 96.6% respectively. The proportion of severe periodontitis among group I, group II and group III was 30%, 76.7% and 73.3% respectively. The multivariate linear regression model with dependent variable PISA showed that age, duration of diabetes and HbA1C were significantly associated with PISA. A dose response relationship between PISA and HbA1c had been observed and an increase of PISA with 168 mm^2 was associated with a 1% point increase of HbA1c.

DISCUSSION

18. KEY RESULTS

The proportion of periodontitis among Well controlled T2DM group, Uncontrolled T2DM group without complication, Uncontrolled T2DM group with micro-vascular complications was 75%, 93.4% and 96.6% respectively. The multivariate linear regression model with dependent variable PISA showed that age, duration of diabetes and HbA1C were significantly associated with PISA. A dose response relationship between PISA and HbA1c had been observed and an increase of PISA with 168 mm^2 was associated with a 1% point increase of HbA1c. A statistically significant positive

correlation had been observed between PISA and HbA1c among study subjects ($r=0.393$, $p < 0.001$)

19.LIMITATIONS

One of the limitations of this study was its small sample size

Inflammatory markers like IL-1, IL-6, TNF- α , CRP, MMPs and adipokines were not assessed in this study.

20.INTERPRETATION

Eventhough study subjects had fair-good OHI-S score, significant positive correlation had been found between PISA,CAL ,and HbA1c among study subjects. Metabolic control of diabetes may be an important variable in the progression and aggravation of periodontal diseases. Since a bidirectional relationship between diabetes and periodontal disease is well established, high proportion and severity of periodontitis, and increased inflamed surface area in uncontrolled T2DM subjects may have contributed to the poor glycemic control and microvascular complications.

21.GENERISABILITY

As it is a cross sectional study, it is impossible to confirm the direction of the relationship between periodontitis and type 2 diabetes mellitus with and without microvascular complications. So it is necessary to conduct longitudinal studies to show the direction of the relationship between periodontitis and type 2 diabetes mellitus

22.FUNDING

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