



Diagnostic Efficacy of Gingival Crevicular Blood, Venous Blood Andfinger- Prick Blood for Assessment of Blood Glucose Levels in Type II Diabetic Patients: A Cross Sectional Study

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Date of Submission: 17-07-2020

Date of Acceptance: 01-08-2020

ABSTRACT

Due to the close inter-relationship between diabetes and periodontitis, periodontists are more likely to come across the undiagnosed and diagnosed diabetic patients. Early diagnosis of DM however may help to prevent its long-term complications responsible for high morbidity and mortality of diabetic patients. The total of hundred patients in the age group of 35-65 years of either sex with type II diabetes mellitus and periodontal disease were selected. Venous blood was used as a control group, whereas finger- prick blood and gingival crevicular blood constituted the study groups I and II respectively. Blood samples were tested in glucometer to check the blood glucose level. The values obtained by glucometer shows a strongly positive co-relation among each other. Hence gingiva can be used as an alternative site to check blood glucose and gingival wound healing is definitely better than finger prick healing.

I. INTRODUCTION

Diabetes mellitus represents one of the major chronic health problems faced by the society today¹. Its incidence all over the world and especially in India is on a steep rise and is estimated to be 20.2 per 1000 persons and prevalence rate is 12.1 % in adults², of which nearly half the cases are undiagnosed. A large number of patients seek dental treatment being unaware of their undiagnosed diabetes mellitus, thus the dentist may increase his importance as a member of the health team by participating in the search for undiagnosed asymptomatic diabetes mellitus patients. Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both^{3,4,5}. It is associated with a wide range of complications, such as retinopathy, nephropathy, neuropathy, micro- and macro vascular disease and

altered wound healing^{6,7}. In the early 1990s periodontitis was referred to as the 'sixth complication of diabetes'^{8,9,10}.

Diabetes and periodontitis seem to interact in a bidirectional manner^{1,6,11,12}. In 1998, the World Health Organisation adopted the diagnostic parameters for diabetes established by the American Diabetes Association for measuring the fasting blood glucose. But these methods are time consuming, painful and require elaborate equipment. Fasting blood glucose level is considered to be the gold standard for diagnosing diabetes patients. Monitoring their blood glucose during their dental office visit may be a better alternative^{13,14}.

Self-monitoring devices provide a simple method for rapid monitoring of the glucose level in blood by utilizing a blood sample from the finger. But this requires a painful needle puncture of the skin to obtain a drop of blood. With regard to the development of painless and non-invasive methods to measure blood glucose, considerable effort has been made in the past few years.

Recently to overcome all these shortcomings, gingival crevicular blood has been used to access the same. Periodontal examination as a rule comprises of careful probing of periodontal pockets which result in some amount of bleeding from the gingival sulcus. Instead of swabbing and disposing the gingival crevicular blood, this can be employed to assess blood glucose by glucometer. This allows a non-invasive or minimally invasive monitoring of blood glucose, as it requires small amount of blood and is less traumatic compared to finger-puncture with a sharp lancet. Moreover, periodontists feel more secure in collecting blood from gingiva, as compared to other parts of the body used in conventional blood sampling¹⁵. Also, gingival wound healing is definitely better than finger-prick healing.



Hence, the present study was conducted to compare the efficacy of blood glucose level among Venous, Capillary finger - prick and Gingival crevicular blood samples in Type II diabetic patients with periodontal disease in Himachal ethnic population.

AIMS AND OBJECTIVES

1. To evaluate a quick, safe, non-invasive in-office method to measure the blood sugar during regular periodontal examination and treatment.
2. To comparatively evaluate the potential use of Gingival crevicular blood and Capillary finger-prick blood using glucometer for measuring blood glucose levels for screening of Type II Diabetes Mellitus with periodontal disease as an alternate to Venous method based on characteristics of the blood collection site.

II. MATERIALS AND METHODOLOGY

A total of 100 patients within the age group of 35-65 years of either sex with Type II diabetes mellitus having periodontal diseases were selected from the Out Patients Department of Periodontology, Himachal Dental College, Himachal Pradesh. Venous blood was used as Control Group, whereas Capillary finger-prick blood and Gingival crevicular blood constituted the Test Groups I and II, respectively.

Inclusion criteria:

1. Patients within the age group of 35-65 years with Type II diabetes mellitus.
2. Patients having gingivitis.
3. Patients having chronic periodontitis with attachment loss more than or equal to 1-2mm.

Exclusion criteria:

1. Any indication for antibiotic prophylaxis.
2. Severe systemic diseases such as cardiovascular, renal, hepatic, immunologic, or haematological disorders.
3. Any medication interfering with the coagulation system.
4. Current treatment for anaemia, polycythemia, gout, dialysis, or any other disorder that can cause an abnormally high or low hematocrit.
5. Sites with suppuration.

III. METHODOLOGY

CONTROL GROUP

ESTIMATION OF VENOUS BLOOD GLUCOSE LEVEL (Figure 7, 8):

A tourniquet was tied around the patient's arm about 3" to 4" (7.5cm to 10 cm) above the venipuncture site. The vein was tapped with index finger to encourage dilation. The area was disinfected with an alcohol wipe in a circular motion. Venous blood sample was drawn from the patient's antecubital fossa with the help of disposable syringe. One drop of venous blood from disposable syringe was transferred onto the glass slide and the test strip pre-loaded in the glucometer was touched to the test end of the strip and readings were recorded.

TEST GROUP I

ESTIMATION OF CAPILLARY FINGER PRICK BLOOD GLUCOSE LEVEL (CBGL) (Figure 3, 4):

The finger tip of the fourth finger on the left hand was wiped with surgical spirit and is allowed to dry and puncture with a sterile lancet. The first drop of blood was wiped away, and the second drop of blood was touched to the test end of the strip. This may reduce the risk of an inaccurate result and CBGL readings were recorded.

TEST GROUP II

ESTIMATION OF GINGIVAL CREVICULAR BLOOD GLUCOSE LEVEL (GCBGL) (Figure 5, 6):

Patients were asked to rinse with 0.2% chlorhexidine mouthwash before the collection of gingival crevicular blood glucose level. The most inflamed site was selected and was freshly isolated with cotton rolls. Sites with suppuration were excluded from the study. Bleeding was induced by UNC-15 periodontal probe until a sufficient quantity of blood (2-3µl) is obtained. The Glucometer monitoring device was loaded with the active test strip and the test end of the strip was kept on to the bleeding site to obtain the blood sample on the test strip without contacting the gingival palatal tissues. The testing time was about 10 seconds. The value displayed on the monitor was recorded.

Glucometer was standardized by known sugar solution after every 10th reading.

The data thus collected was subjected to statistical analysis.

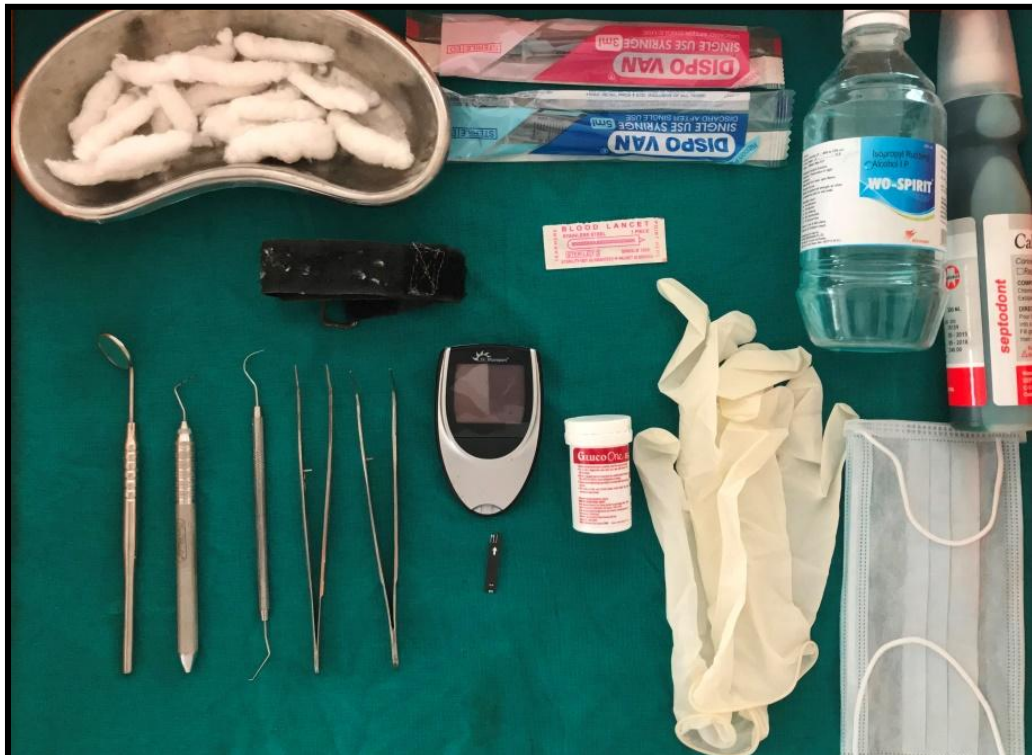


FIGURE 1: ARMAMENTARIUM



FIGURE 2: SELF-MONITORING GLUCOMETER

**PROCEDURE IN TEST GROUP I
(CAPILLARY FINGER – PRICK BLOOD)**



FIGURE 3: BLEEDING INDUCED FROM FINGER



FIGURE 4: FIGURE SHOWING CAPILLARY FINGER-PRICK BLOOD READING

**PROCEDURE IN TEST GROUP II
(GINGIVAL CREVICULAR BLOOD)**



FIGURE 5: BLEEDING ON PROBING



FIGURE 6: FIGURE SHOWING GINGIVAL CREVICULAR BLOOD READING

**PROCEDURE IN CONTROL GROUP
(VENOUS BLOOD)**

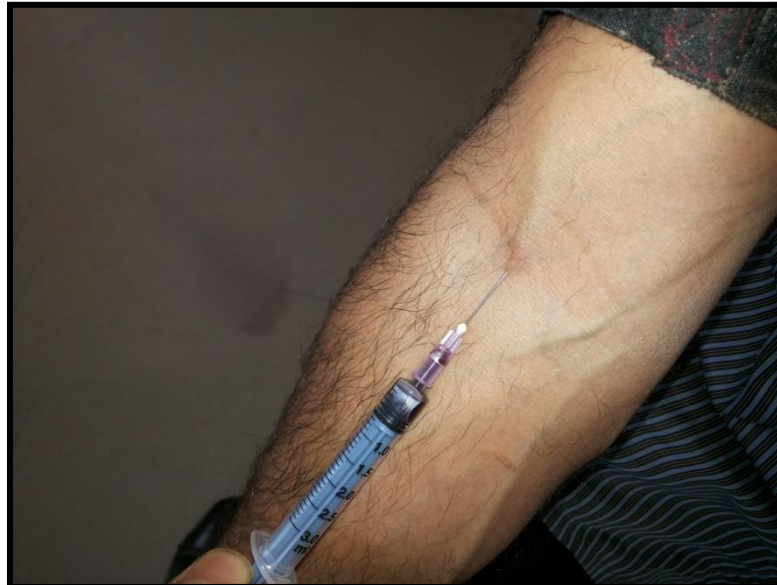


FIGURE 7: VENOUS BLOOD COLLECTION

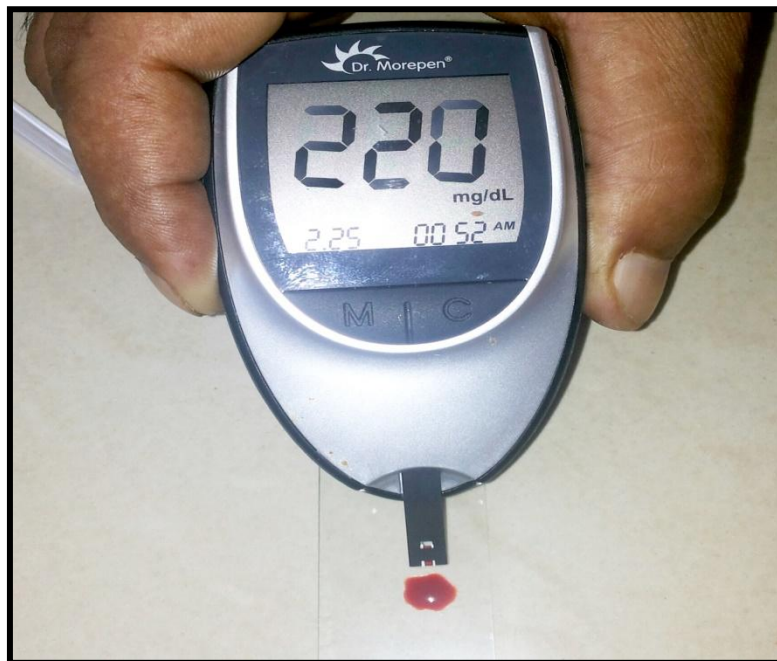


FIGURE 8: FIGURE SHOWING VENOUS BLOOD READING

STATISTICAL ANALYSIS

Statistical analysis was done using Statistical Package of Social Science (SPSS Version 16; SPSS Inc., Chicago, IL, USA).

- Data comparison was done by applying specific statistical tests to find out the statistical significance of the comparisons.
- Quantitative variables were compared using mean values and standard deviations. Descriptive data are presented as mean \pm standard deviation (SD) and range values.

- To compare the mean values of gingival blood glucose levels and capillary blood glucose levels between the test groups and control group, Student's independent t-test and p values were calculated.
- Karl Pearson's product-moment correlation was used.
- For all the comparisons, p-value of 0.05 or less was used for statistical significance.

IV. RESULTS



The results thus obtained are shown in table I-IV and graphs I-III.

The following results were observed: -

1. COMPARISON OF BLOOD GLUCOSE LEVELS IN TEST GROUP I AND CONTROL GROUP

For Test Group I, the mean value was found to 205.72 ± 83.64 and for Control Group, the mean value was 202.86 ± 87.88 .

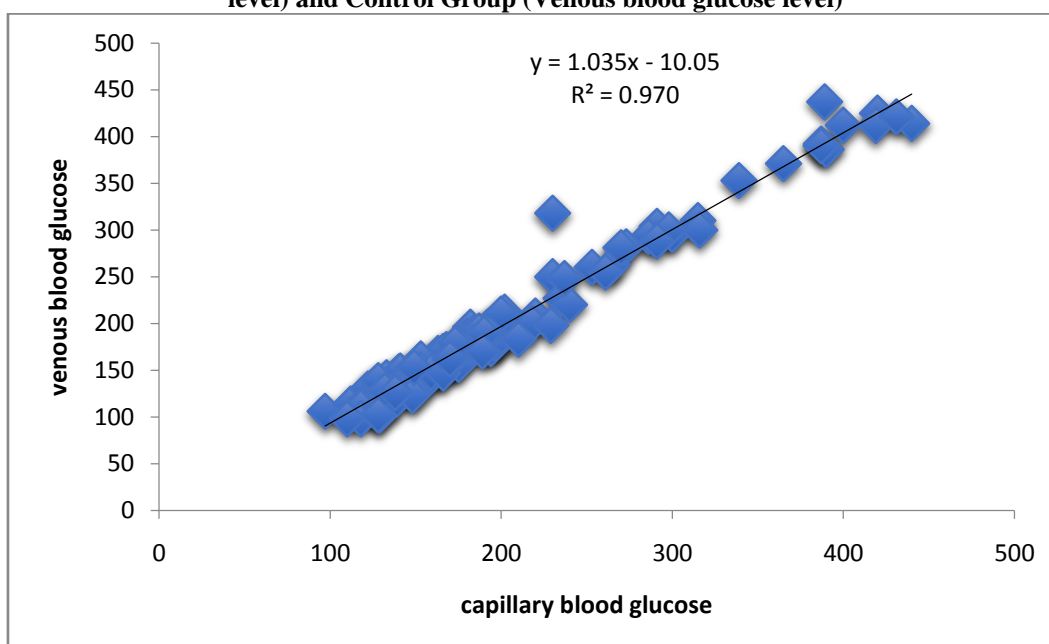
The t value was 0.23 and the p value was 0.41 which was found to be statistically non-significant ($p \leq 0.05$).

Table I: Comparison of blood glucose levels in Test Group I and Control Group

SD- Standard Deviation, $P < 0.001$ - Highly Significant (HS), $P \leq 0.05$ Significant, $P \geq 0.05$ - Non-significant (NS)

Graph I: Scatter plot of linear relationship between Test Group I (Capillary finger-prick blood glucose level) and Control Group (Venous blood glucose level)

	MEAN \pm S.D.	t- VALUE	p- VALUE	SIGNIFICANCE
TEST GROUP I	205.72 ± 83.64	0.23	0.41	NS
CONTROL GROUP	202.86 ± 87.88			



2. COMPARISON OF BLOOD GLUCOSE LEVELS IN TEST GROUP II AND CONTROL GROUP

For Test Group II, the mean value was found to 205.71 ± 82.61 and for Control Group, the mean value was 202.86 ± 87.88 .

The t value was 0.22 and the p value was 0.41 which was found to be statistically non-significant ($p \leq 0.05$).

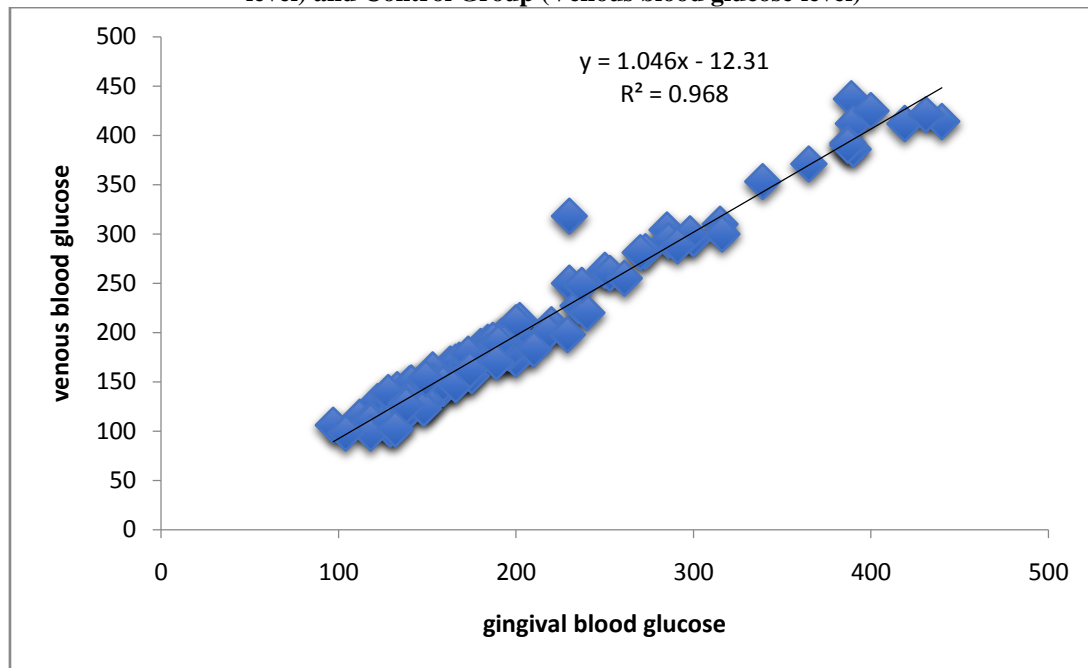
	MEAN \pm S.D.	t- VALUE	p- VALUE	SIGNIFICANCE
TEST GROUP II	205.71 ± 82.61	0.22	0.41	NS
CONTROL GROUP	202.86 ± 87.88			

Table II: Comparison of blood glucose levels in Test Group II and Control Group

SD- Standard Deviation, $P < 0.001$ - Highly Significant (HS), $P \leq 0.05$ Significant, $P \geq 0.05$ - Non-significant (NS)



Graph II: Scatter plot of linear relationship between Test Group II (Gingival crevicular blood glucose level) and Control Group (Venous blood glucose level)



3. COMPARISON OF BLOOD GLUCOSE LEVELS IN TEST GROUP I AND TEST GROUP II

For Test Group I, the mean value was found to 205.72 ± 83.64 and for Test Group II, the mean value was 205.71 ± 82.61 .

The t value was 0.0127 and the p value was 0.49 which was found to be statistically non-significant ($p \leq 0.05$).

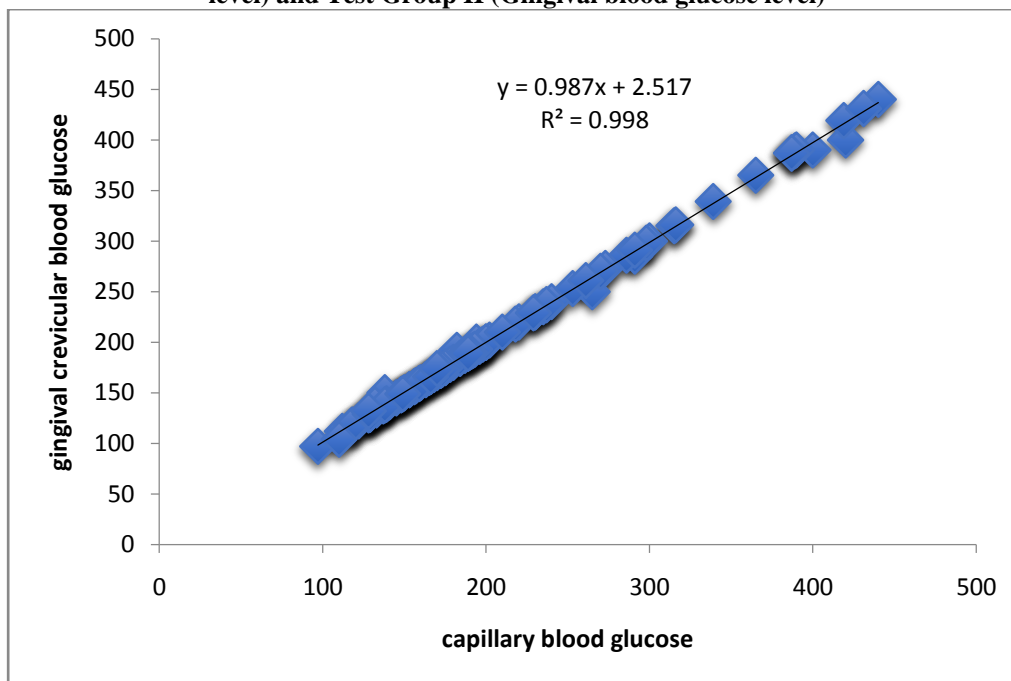
Table III: Comparison of blood glucose levels in Test Group I and Test Group II

SD- Standard Deviation, $P < 0.001$ - Highly Significant (HS), $P \leq 0.05$ Significant, $P \geq 0.05$ - Non-significant (NS)

	MEAN \pm S.D.	t- VALUE	p- VALUE	SIGNIFICANCE
TEST GROUP I	205.72 ± 83.64	0.0127	0.49	NS
TEST GROUP II	205.71 ± 82.61			



Graph III: Scatter plot of linear relationship between Test Group I (Capillary finger-prick blood glucose level) and Test Group II (Gingival blood glucose level)



4. KARL PEARSON’S PRODUCT-MOMENT CORRELATION (R) FOR ALL GROUPS

The Pearson correlation coefficient R was counted to measure the strength and direction of the relationship between two variables. The R value

between Control Group and Test Group I was 0.985, the R value between Control Group and Test group II was 0.984 and the R value between two Test Groups was 0.999 and it shows a strongly positive co-relation (Table IV).

Table IV: Karl Pearson’s product-moment correlation (R) for all groups

	Correlation (R)
Control Group and Test Group I	0.985
Control Group and Test Group II	0.984
Test Group I and Test Group II	0.999

Shows a strongly positive co-relation.

V. DISCUSSION

Diabetes mellitus (DM) and periodontal disease are both multifactorial diseases with a high prevalence rate worldwide. Many diagnostic tests viz. oral glucose tolerance test, fasting plasma glucose test, random blood glucose test, urine test, glycated hemoglobin are the complex tests used by physicians for definitive diagnosis.

Glucose monitoring system needs only 3µl of blood and may actually allow for totally painless testing of blood oozing from the gingival crevices of patients with mild or moderate gingivitis or periodontitis during routine periodontal examination **Beikler T (2002)¹⁶, Tharakeswari R (2015)¹⁷**. This might be of considerable interest to the dental practitioners since this glucometer, is accurate,

simple and relatively inexpensive and can be used as an in-office screening device for any patient, suspected to have diabetes, or a way to monitor blood sugar levels in known diabetics.

The primary objective of this study was to evaluate the gingival crevicular blood glucose so as to reach a fast, safe, noninvasive, and convenient method to assess the diabetic status via periodontal examination¹⁸. In this study, the gingival crevicular blood glucose value was compared with the capillary finger stick blood glucose value and venous blood glucose value to ascertain whether the former relates to the latter, and thus whether it could serve as an alternative to measure the blood glucose value.



We have incorporated the non-invasive method where the blood oozing out during routine periodontal examination is checked for diabetes because majority of the patients are usually apprehensive whenever invasive techniques are used. This is supported by **Sibyl S et al (2017)**¹⁹, **Wesley Sj (2015)**²⁰, induced bleeding by periodontal probing. In contrast to our study, **Stein and Nebbia (1969)**²¹ used the interdental gingival papilla prick method with test strips to screen patients with high gingival blood glucose and, more recently, **Shetty and Kohad (2011) et al.**²², studied a previously unsuspecting periodontal population for diabetes using the same method.

According to the findings of our study there is a strongly positive co-relation between capillary blood glucose level and gingival crevicular blood glucose level and venous blood glucose level measured with glucometer (Table IV). Moreover, the stronger correlation obtained in this study might be due to the elimination of sample contamination with gingival crevicular fluid. Also, improved performance of the second-generation monitors used in this study compared with first-generation monitors used in earlier studies might have been responsible for the better results.^{23, 24}

This study is in agreement with the previous studies which also demonstrated a strong correlation between Gingival crevicular and Capillary finger-prick blood by **Meti et al (2010)**²⁵, **Muller HP (2005)**²⁶, **Wu CZ (2008)**²⁷, **Ardakani M.R.T (2009)**²⁸.

This study is not in agreement with a previous study by **Muller HP (2004)**²⁹, **Debnath P (2015)**³⁰ and **Kandwal et al (2014)**³¹ in which the method of measuring blood glucose levels using gingival crevice blood was not found to be accurate. As there was no effort made to prevent contamination of the sample and site was not specifically chosen to eliminate salivary contamination³².

Therefore, the results of present study indicate that the Gingival crevicular blood collected during diagnostic periodontal examination may be an excellent source of blood for glucometric analysis. In addition, the technique described is safe, less time consuming, cost effective, easy to perform and comfortable for the patient and might therefore help to increase the frequency of Diabetes screening in dental offices.

VI. CONCLUSION

1. The method of evaluating glucose level from the blood oozing from gingival tissues using a glucometer during routine periodontal

examination was found reliable under the criteria's described in this study.

2. When compared with the other routine methods of blood sugar estimation there was no statistically significant difference between the gingival crevicular blood and blood glucose level measured by finger prick blood and venous blood as the sample was collected from the capillaries on the outer surface of the gingiva, thus eliminating the possibility of contamination with crevicular fluid.
3. The technique is safe, easy to perform, non-invasive and comfortable for the patient and no complications have been reported after sampling by this method. Therefore, helps to increase the frequency of diagnosing diabetes during routine periodontal therapy. Thus, the periodontist may increase his importance as a member of the health team by participating in the search for undiagnosed asymptomatic diabetes mellitus.

Within the limits of the study, it is concluded that the Gingival crevicular blood can be used as a screening tool for diabetes. Additional studies should be planned that refine this technique and use larger sample size is recommended, so that the study outcomes can be assessed for positivity and negativity on a larger scale.

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