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# Correlations between gingival crevicular blood glucose and capillary blood glucose: A preliminary report

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## Abstract:

**INTRODUCTION:** Oral health plays an important role for screening of many systemic diseases. Hence, dentists play an important role in screening for systemic diseases as well. Early diagnosis of any systemic diseases can prevent long-term complications. Diabetic is one of the common chronic diseases. Hence, the study had been undertaken to evaluate whether gingival crevicular blood (GCB) can be used to screen for diabetes during routine oral health checkups.

**MATERIALS AND METHODS:** This analytical study included thirty participants who visited the Department of Periodontics, who fulfilled inclusion criteria and were willing to participate. Blood samples were collected by finger stick method and periodontal probing. The glucose levels of both the samples were estimated using glucometer and correlated the levels from both the methods.

**RESULTS:** Correlation between capillary finger stick blood glucose and GCB glucose was high (0.97) and was significant at 0.01 level.

**CONCLUSION:** Blood oozing during routine periodontal examination can be used for diabetes mellitus screening in dental office.

## Key words:

Diabetes mellitus, gingival crevicular blood, glucometer

## Introduction

Diabetes mellitus is pandemic disease affecting population worldwide, common among Indians where 62.4 million population is affected with this disease<sup>[1]</sup> and every fifth diabetic in the world is an Indian.<sup>[2]</sup> Diabetes mellitus is associated with a wide range of complications such as retinopathy, nephropathy, neuropathy, micro- and macro-vascular disease altered wound healing, and periodontitis.<sup>[3,4]</sup>

Periodontitis is the sixth most common complication of diabetes making it a major risk factor influencing the incidence and severity of periodontal-related problems.<sup>[5]</sup> Periodontitis is one of the chronic disease and could affect 70% of the global population.<sup>[6]</sup> Persons with poorly

controlled diabetes were nearly three times more likely to have severe periodontitis than those without diabetes.<sup>[7]</sup>

The prevalence of diabetes mellitus in patients with periodontitis is greater than in periodontally healthy patients. Therefore, a large number of patients with periodontitis may have undiagnosed diabetes mellitus.<sup>[5]</sup> The well-informed dentist has the opportunity to be at the forefront of diagnosing diabetes.<sup>[8]</sup> The issue of undiagnosed diabetes is especially critical because early treatment and secondary prevention efforts may help to prevent or delay the long-term complications of diabetes that are responsible for reduced quality of life and increased levels of mortality among these patients.<sup>[9]</sup>

The dental visit offers a unique opportunity to screen an especially high-risk population.

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Thus, there is a critical need to increase opportunities for diabetes screening and early diabetes detection.<sup>[10]</sup>

Therefore, in addition to looking after the oral health of people with diabetes, dentists also play a role in screening for disease in the general population.<sup>[11]</sup> Not many studies have been conducted in India in this regard and hence a humble attempt has been made. Hence, the aim of the present study was to evaluate if gingival crevicular blood (GCB) can be used to screen for diabetes during regular periodontal examination, and the objectives were to estimate and correlate the capillary blood glucose level using blood drawn by finger method and GCB during routine periodontal examination and to know if GCB is equally effective in blood glucose estimation.<sup>[3]</sup>

## Materials and Methods

Thirty participants visiting the Department of Periodontics of one of the Dental College and Hospital, Mysore, were examined. The duration of the study was 1 week. Patients aged 35 years and above with untreated moderate-to-severe periodontitis with adequate bleeding on probing, who were previously undiagnosed as diabetic, were included in the study. Participants with bleeding disorder, those taking any medication, those with any systemic disease, and suppuration in the anteriors were excluded from the study. After briefing on the procedure, Participants gave their written consent for participation. Ethical clearance was obtained from the Institutional Ethical Committee Board.

In the patient, full-mouth periodontal examination was done. Gingiva in relation to the upper anterior with adequate bleeding on probing was chosen as they offer the best access for GCB glucose (GCBG) sample collection.

Isolation of the site was done with cotton rolls and dried with compressed air. Periodontal probing was done using a periodontal probe and the blood oozing from the gingival tissues was used. Following the crevicular blood, capillary finger stick blood (CFBG) sample was drawn from the fourth finger. The pad of the finger was wiped with alcohol, allowed to dry, and then punctured using a disposable sterile lancet and a drop of blood was placed on the test strip of the glucose monitoring device.<sup>[12-14]</sup>

The glucose levels were estimated using glucometer. The glucometer used in this study was a commercially available portable monitor called as Accu-Chek Sensor (Roche Diagnostics, Germany) that works on enzyme electrode principle. The system consists of a meter and dry reagent test strips designed for capillary blood glucose testing by people with diabetes or by health-care professionals. The test strips used in this evaluation are calibrated to report plasma glucose values.

The glucose in the blood sample mixes with the enzyme glucose dehydrogenase on the test strip and is converted to gluconolactone which generates an electrical charge. The strength of these charges changes with the amount of glucose. The electrodes incorporated in the test strip measure the charge and give a digital read-out.<sup>[15,16]</sup>

The reagent test strip is inserted into the test port of the glucometer. A symbol of blinking drop appears on the monitor suggesting that the meter is ready for use. The reagent strip is then placed against the bleeding site in the mouth [Figure 1a]. The blood is automatically drawn into the reaction cell of the strip by capillary action. The system requires a blood volume of 4  $\mu$ L. The blood is drawn into the test strip, and a yellow window at the test strip must be completely filled with blood. If the window is not completely filled, more blood can be applied within 15 s. The result is provided within 26 s. The meter is then turned off, and the test strip is disposed. Following the GCB glucose measurement, CFBG level was estimated [Figure 1b].<sup>[15]</sup>

Later, the patients were checked for venous blood sugar levels just to confirm patient's diagnosis of diabetes. Descriptive statistics and Pearson's correlation coefficient were used for statistical analysis. All the data were subjected to SPSS for Windows version 11 (SPSS Inc., Chicago, IL) and  $P < 0.05$ .

## Results

The percentage of males was 46.7% ( $n = 14$ ) and the percentage of females was 53.3% ( $n = 16$ ). The mean age group of the study participants was  $45.73 \pm 7.25$  years, and the ranges of readings obtained were between 71 and 301 mg/dl. The maximum difference between capillary and crevicular blood glucose level was 15 mg/dl.

The sensitivity of the test was found to be 88.8% and the specificity of the test was 100%, and prevalence of diabetes mellitus was found to be 27% ( $n = 8$ ). These eight patients were diagnosed as diabetes with gold standard method (fasting and postprandial venous blood glucose levels).

The results showed a strong correlation ( $r = 0.97$ ,  $P < 0.01$ ) between GCBG and CFBG glucose [Table 1].

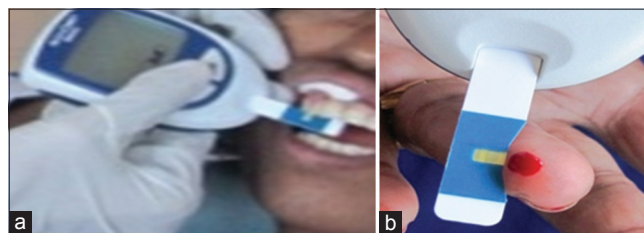


Figure 1: (a): Glucose measurement using gingival crevicular blood, (b) glucose measurement using finger stick blood

## Discussion

Diabetes mellitus is one of the most frequent metabolic disorders with an estimated prevalence of 7% in industrialized countries, of which nearly half the cases are undiagnosed.<sup>[3,17]</sup>

Certain systemic conditions are believed to be additional and important factors that influence the relative risk for periodontal diseases. Diabetes mellitus has long been considered to be one such systemic condition.<sup>[18]</sup> In view of the bidirectional relationship between periodontitis and diabetes,<sup>[19-21]</sup> the dental office may offer a largely untapped opportunity for diabetes screening.<sup>[22]</sup>

Glucometer is commonly used by diabetic patients for home monitoring of their blood glucose levels using a single drop of blood from a finger stick. This procedure is of interest to the dental practitioner since it is simple, relatively inexpensive, and of sufficient accuracy to serve

as an in-office screening device for patients suspected to have diabetes.<sup>[23,24]</sup>

The glucometer used in our study was Accu-Chek sensor (Roche Diagnostics, Germany). Testing the crevicular blood glucose level with Accu-Check self-monitoring device is sensitive since it provides results with just 3–4  $\mu$ L of blood within seconds. With regard to the development of painless and noninvasive methods to measure blood glucose level, considerable efforts have been made in the past few years. Since periodontal inflammation with or without the complicating factor of diabetes mellitus is known to produce ample extravasate of blood during diagnostic periodontal examination, no extra procedure, for example, finger puncture with a sharp lancet is necessary to obtain blood for glucometric analysis.<sup>[5]</sup>

The accuracy of the readings from the individual patients was verified by correlating glucose readings obtained using the patients GCB with those obtained through a traditional finger stick sample from the patient. While some investigators<sup>[3,10,25-27]</sup> have found a correlation of these readings, our study has shown that correlation of these two readings is high ( $r = 0.97$ ) for patients with adequate bleeding on probing. This shows that gingival crevicular fluid can be used for screening diabetes in a dental office which was in agreement with other studies.<sup>[12]</sup> In contrast to our study, other studies<sup>[25,28,29]</sup> reported that GCB cannot be used for screening blood glucose during periodontal examination. Diabetes increases inflammation in the periodontal tissues. Hyperglycemia can result in the activation of pathways that increase inflammation, oxidative stress, and apoptosis. For example, gingival crevicular fluid (GCF; a fluid exudate that flows from the gingival margins) levels of prostaglandin E2 and interleukin 1 (IL-1 $\beta$ ) are higher in Type 1 diabetic patients with either gingivitis or periodontitis compared with those in nondiabetic individuals with the same level of periodontal disease. Whereas among Type 2 diabetic patients, those with hemoglobin A1c (HbA1c) >8% had a significantly higher GCF IL-1 $\beta$  level compared with patients with HbA1c <8%, and both HbA1c and random glucose were independent predictors of an elevated GCF IL-1 $\beta$  level.<sup>[30-32]</sup>

The use of dental visit as an opportunity to screen for diabetes would require a change in the confidence and mind set of dental providers regarding their role in the screening and control of diabetes. Dental providers can perform the diabetes screening using risk factor information provided by patients or by measuring the glucose from finger stick blood sample. This latter approach is currently being employed in some Minnesota dental practitioners. Alternatively, because bleeding on probing in this with periodontitis produce ample amount of blood for glucose measurement, researchers have used GCB from persons with periodontal disease.<sup>[22]</sup> This is safe, easy to perform, and comfortable for the patient and might, therefore, help

**Table 1: Distribution of participants according their finger stick capillary blood and gingival crevicular blood glucose level (mg/dL)**

Serial number - assigned patient number	Capillary finger stick blood glucose level (mg/dL)	Gingival crevicular blood glucose level (mg/dL)
1	91	85
2	116	112
3	170	170
4	83	82
5	113	113
6	109	99
7	97	93
8	238	230
9	110	106
10	180	173
11	90	78
12	150	139
13	147	144
14	120	111
15	100	92
16	100	97
17	142	136
18	301	298
19	82	71
20	91	87
21	167	158
22	122	115
23	86	80
24	120	126
25	135	130
26	132	120
27	118	109
28	115	111
29	110	106
30	170	155

to increase the frequency of diabetes screening in dental offices. Although not a test to diagnose diabetes, such screening is an important aid in identifying those for whom follow-up tests regarding possible diabetes are warranted.

## Conclusion

The results suggest that the GCB is one of the earliest sources for screening diabetes mellitus in dental office but not as an alternative to standard aids.<sup>[12]</sup>

## Limitations and recommendations

Smaller sample size and the accuracy of glucometer are still questioned. Further suggestion includes studies on larger sample size and using standard laboratory tests for comparison.

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## Conflicts of interest

There are no conflicts of interest.

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