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GINGIVAL CREVICULAR BLOOD AS A NON-INVASIVE DIAGNOSTIC TOOL IN DIABETES MELLITUS - A PILOT STUDY

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Abstract

Background: Diabetes is one of the most prevalent systemic disorder in the world. Incidence of diabetes has increased in the recent years due to the lifestyle changes. Many a times diabetes stay undiagnosed and may cause serious complications on the dental chair. Diabetic patients are prone to many complications one of which is periodontitis. Periodontitis results in loss of gingival attachment, bedding from the gums, increased pocket depth and mobility of teeth in end stages. The aim of the study is to determine the usefulness of gingival crevicular blood in the assessment of an individual's diabetic status as opposed to that of the traditional capillary finger-stick blood test.

Materials and Methods: This study was conducted amongst the out patients of Saveetha Dental College and Hospitals. The subjects were divided into 4 groups; Group 1: Diabetic with periodontitis (n=20), Group 2: Diabetic without periodontitis (n=20), Group 3: Non-diabetic with periodontitis (n=20), Group 4: Non-diabetic without periodontitis(n=20).

Bleeding gingival sites were determined and two sites with profuse bleeding on probing and access for the glucose self-monitoring device were chosen for testing gingival crevicular blood glucose. Random blood sugar of the subjects were recorded both by using the gingival crevicular blood and capillary finger stick blood test using a portable glucometer (Accu-check).

Results: There was no significant difference between the peripheral blood glucose level and the gingival crevicular blood glucose level in all the four groups.

Conclusion: The present study revealed a strong correlation between sulcular blood glucose level and the peripheral blood glucose levels in diabetic and non- diabetic subjects with and without periodontitis and hence can be opted as a chair side, non- invasive diagnostic aid for diabetes mellitus.

Keywords: Gingival crevicular blood; Peripheral blood glucose level; Diabetes mellitus; Diagnostic tool

Introduction

The rapid urbanization that the world has seen in the past few years has led to the exponential increase in the occurrence of diabetes mellitus. Diabetes mellitus is one of the most frequent lifestyle related diseases which occurs due to the defect in the production or function of or both of insulin hormone. The beta cells in the liver are the production site for the insulin hormone which aids in the metabolism of body carbohydrates, proteins and fats, and also regulates the blood glucose levels [1]. Diabetes mellitus can be classified into two types; Type I diabetes is also called as insulin-dependent diabetes mellitus and Type II diabetes is insulin resistant diabetes mellitus.

The former is cause by a deficiency of insulin and affects children and young adults, while the later occurs as a result of peripheral insulin resistance and a insulin secretory defect, and affects the elderly [2], [3]. The global prevalence of Diabetes mellitus in the year of 2000 was estimated to be 2.8% and was expected to increase to 4.4% in the year 2030, of which type II diabetes mellitus is the most prevalent [4]. As per the world health organization, 70% of those affected belong to the developing world. It is deduced that every fifth person with diabetes would be an Indian [5].

Diabetes mellitus is associated with various long term complications such as neuropathy, nephropathy, angiopathy (micro and macro), retinopathy and delayed wound healing [6]. Periodontal disease is now considered the sixth complication of diabetes mellitus [7], [8], [9]. A bi-directional relationship is seen between diabetes mellitus and periodontitis [6]. The asymptomatic nature of diabetes mellitus in the early stages enables the disease to persist for years undetected leading to these complications. Screening and early detection of the disease can help in intervention of the disease progression and prevention of the various complications [10]. Physicians use various diagnostic tests such as oral glucose tolerance test, fasting plasma glucose levels, random plasma glucose level, urine test, glycelated haemoglobin test on a routine basis for definitive diagnosis of diabetes mellitus [11]. But these methods are invasive and require drawing blood

from the patient. The recent advances such as glucometers are also invasive as they require inducing bleeding by lancet prick. Various non-invasive methods of screening for diabetes mellitus have been researched in the past few years and gingival crevicular blood as an alternative for peripheral blood as sample, seems to be a promising alternative [12], [13], [14]. Probing of the gingiva during routine periodontal examination causes gingival crevicular blood to ooze out due to the inflammation present. this could be considered as a comparatively atraumatic alternative source of blood for blood glucose analysis with the glucometer [15], [16]. The aim of the study is to estimate the potential of the gingival crevicular blood to be used as an atraumatic alternative method of measuring blood glucose levels using the portable glucometer (one touch) during or as part of a chair-side routine dental examination.

Materials and Methods

The study was conducted amongst 80 subjects from the out-patient wing, Department of Periodontics, Saveetha Dental College. The patients were divided into 4 groups:

1. Group I - Diabetic patients with evidence of associated periodontal disease.
2. Group II - Diabetic patients without evidence of associated periodontal disease.
3. Group III - Non-Diabetic patients with evidence of associated periodontal disease.
4. Group IV - Non-Diabetic patients without evidence of associated periodontal disease.

Patient selection:

Subjects belonging to Group I & II were selected from a random pool of patients who walked in to the out-patient wing, Department of Periodontics, Saveetha Dental College. The major criterion was the presence of diabetes mellitus, which was elicited from the subjects themselves as part of history taking and confirmed with preliminary tests or lab results. Subjects who had other major debilitating diseases such as cardiovascular diseases, haematological disorders, hepatic, renal, immunological disorders, or any other condition that required the subject to be taking medications that may cause alterations in the clotting pathway of blood were excluded from the study. All the test subjects were informed about the procedures to be performed during the study and informed consent obtained. The periodontal health of the patient were evaluated using gingival index, sulcular bleeding index, probing depth, clinical attachment loss and OHI index.

Peripheral blood and gingival crevicular blood sample collection:

All subjects underwent routine oral and periodontal screening using a standard Williams probe. Following probing the gingival margins was observed for areas of bleeding. A site with maximum bleeding and easy accessibility was selected and isolated with cotton rolls to avoid contamination with saliva. The sample of Gingival crevicular blood was collected using a glass capillary tube and then transferred to a OneTouch select simple test strip inserted into a OneTouch Select Simple blood glucose monitoring glucometer system. The peripheral blood glucose levels too were checked piercing the finger tip of the subjects with a fresh and sterile lancet and the sample tested again using the OneTouch Select Simple blood glucose monitoring glucometer system. Each time a pair of readings were obtained for each subject tested and recorded for analysis.

Statistical Analysis:

All the variables were subjected to normality tests like Kolmogrov-Smirnov and Shapiro-Wilks tests and found that they followed parametric distribution. Independent t-test was performed for comparison of peripheral blood glucose and gingival crevicular blood glucose levels among the four groups. P-value<0.05 was considered to be statistically significant.

Results

In the current study a total of 80 patients were screened amongst which 20 were diabetic patients with periodontitis, 20 were diabetic patients without periodontitis, 20 were non-diabetic patients with periodontitis, and 20 belonged to the non-diabetic without periodontitis. Amongst the 40 diabetics screened in the study, 57.5% were males and 42.5% were females [Figure 1]. The age group of the diabetic patients in the current study was found to be 45 years to 70 years. The age and gender distribution of the diabetic in the current study is depicted in [Figure 2]. According to the current study 35% of the diabetic patient with periodontitis was females while 65% were males. In the diabetic patient without periodontitis group there were 50% females and males. the non-diabetic patients with periodontitis group also equal gender distribution while the group with subjects without diabetes or periodontitis had 35% females and 65% males [Table 1]. Figure 3, 4, 5 and 6 depicts the comparison between the peripheral blood glucose level and the gingival blood glucose level in all the four groups. Student independent T- test was done to find the

correlation between the peripheral finger blood glucose level and gingival crevicular blood glucose levels in all the four groups. The difference was found to be statistically insignificant between the peripheral finger blood glucose levels and the gingival blood glucose level in the diabetic with periodontitis (p=0.701), diabetic without periodontitis (p=0.799), Non- diabetic with periodontitis (p= 0.662) as well as in the Non-diabetic without periodontitis groups (p= 0.707). (Table 3, 4, 5, 6). The mean peripheral blood glucose level in the diabetic with periodontitis group was 208.95 mg/dl and that of the gingival crevicular blood glucose level was slightly less 203.4 mg/dl. In the diabetes without periodontitis group the mean value of the peripheral blood glucose level was found to be 191.5 mg/dl and that of the gingival crevicular blood glucose was 187.85mg/dl. The mean values of eripheral blood glucose level and the gingival crevicular blood glucose level in the Non-diabetic with periodontitis group was found to be 116.9mg/dl and 113mg/dl respectively. While in the Non- diabetic without periodontitis group the mean of peripheral and gingival blood glucose levels were 123.8mg/dl and 119.5mg/dl respectively. (Table 2)

Figure 1: Age distribution of diabetes amongst males and females.

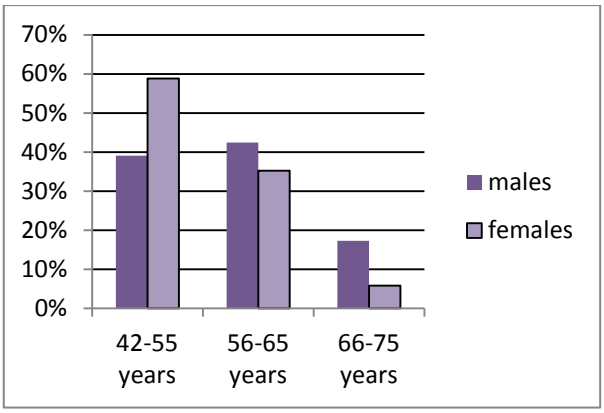

Figure 2: Gender distribution of diabetes.

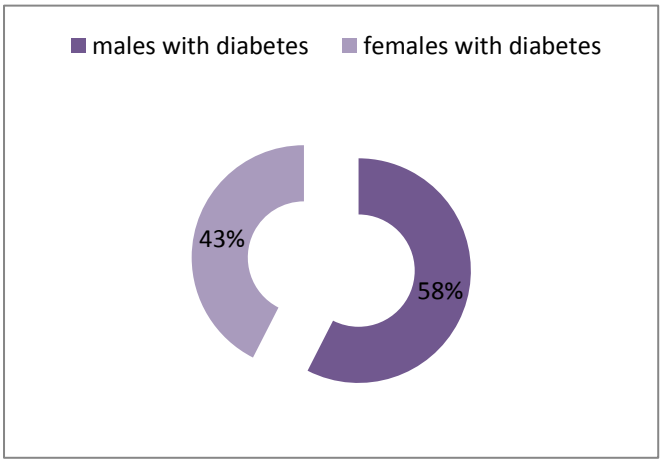

Figure 3: PFBG and GCBG in group 1 - diabetes with periodontitis.

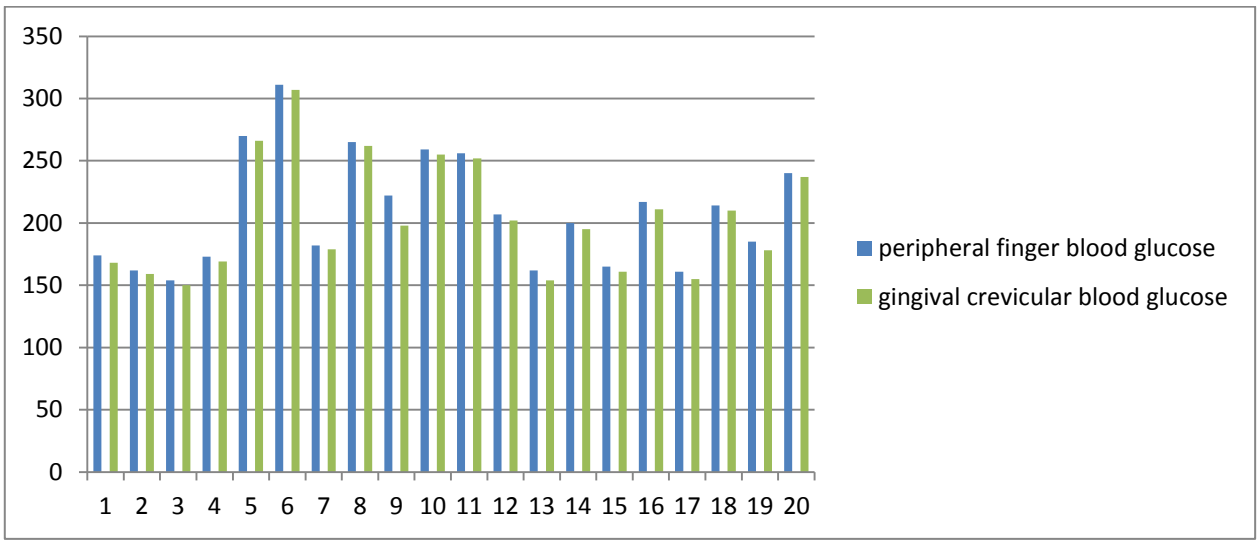

Figure 4: PFBGL and GCBGL in group 2- diabetes without periodontitis.

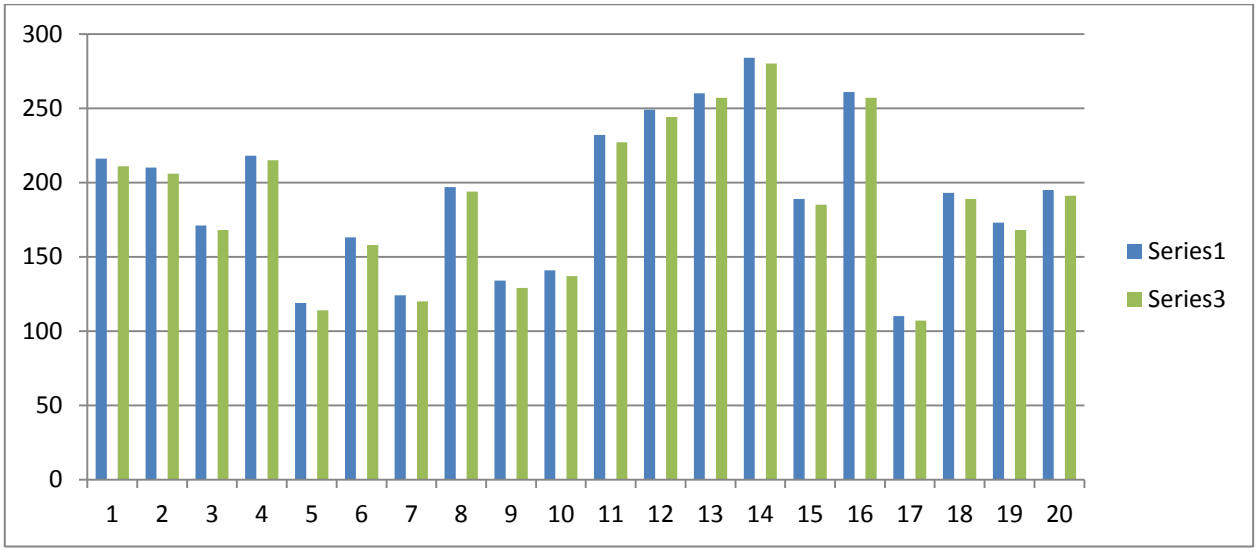

Figure 5: PBGL and GCBGL in group 3- non- diabetic with periodontitis.

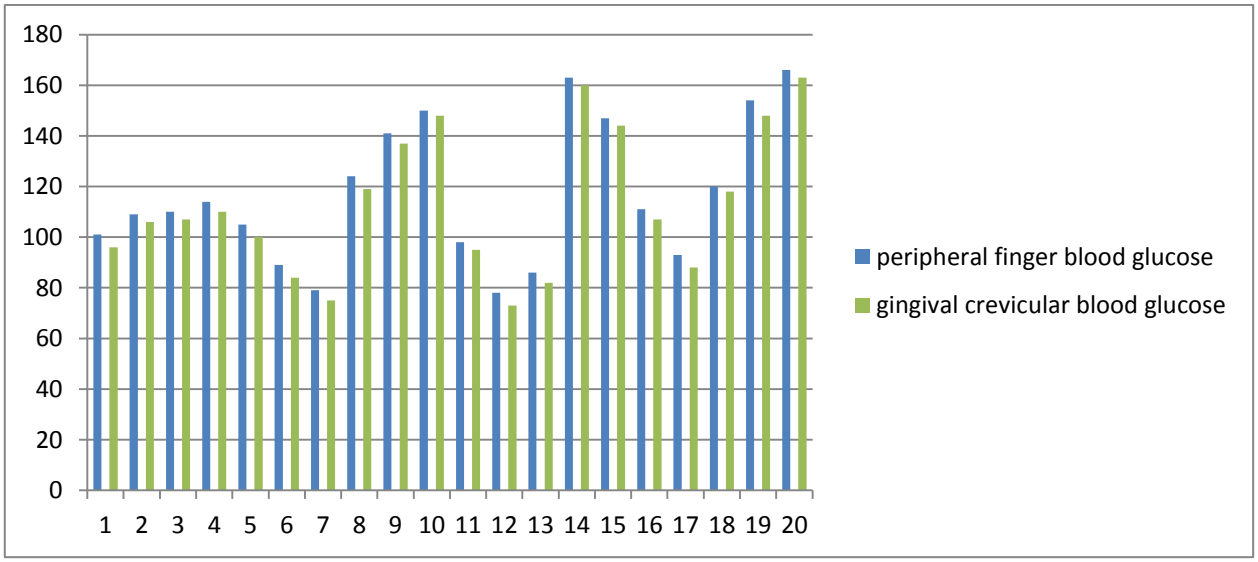

Fig 6: PBGL and GCBGL in group 4- non-diabetic without periodontitis.

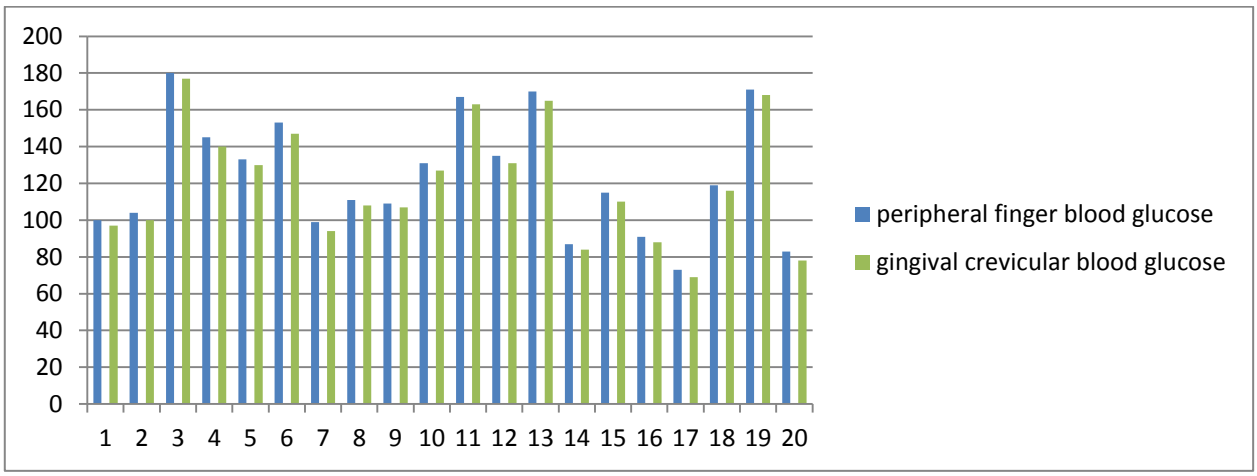

Table 1: Gender distribution in all four groups.

	Female	Male
Diabetic patients with evidence of associated periodontal disease.	35%	65%
Diabetic patients without evidence of associated periodontal disease.	50%	50%
Non-Diabetic patients with evidence of associated periodontal disease.	50%	50%
Non-Diabetic patients without evidence of associated periodontal disease.	35%	65%

Table 2: Mean PBGC and GCCBGL in all four groups.

	Mean PBGC	Mean GCbGL
Diabetic patients with evidence of associated periodontal disease.	208.95mg/dl	203.4 mg/dl
Diabetic patients without evidence of associated periodontal disease.	191.5 mg/dl	187.85 mg/dl
Non-Diabetic patients with evidence of associated periodontal disease.	116.9 mg/dl	113 mg/dl
Non-Diabetic patients without evidence of associated periodontal disease.	123.8 mg/dl	119.5 mg/dl

Table 3: Correlation statistics on group 1- diabetic with periodontitis.

	Patients	N	Mean	Std. Deviation	t-value	P value
diabetic with periodontitis	peripheral finger blood glucose	20	208.9500	45.179	0.38	0.701
	gingival crevicular blood glucose	20	203.4000	45.608		

Table 4: Correlation statistics on group 2- diabetic without periodontitis.

	Patients	N	Mean	Std. Deviation	t-value	P value
diabetic without periodontitis	peripheral finger blood glucose	20	191.9500	50.57717	0.256	0.799
	gingival crevicular blood glucose	20	187.8500	50.63936		

Table 5: Correlation statistics on group 3- Non- diabetic with periodontitis.

	Patients	N	Mean	Std. Deviation	t-value	P value
Non- diabetic with periodontitis	peripheral finger blood glucose	20	116.9000	27.82823	0.440	0.662
	gingival crevicular blood glucose	20	113.0000	28.22839		

Table 6: correlation statistics on group 4- Non- diabetic without periodontitis.

	Patients	N	Mean	Std. Deviation	t-value	P value
Non diabetic without periodontitis	peripheral finger blood glucose	20	123.8000	32.18630	0.379	0.707
	gingival crevicular blood glucose	20	119.9500	32.07307		

Discussion

The morbidity of Diabetes mellitus as a disease is a well-known factor, yet detection of the disease remains sub-optimal due mostly to ignorance on the part of the patient population as well as to the elaborate systematic lab procedures. Nearly 33 million people are affected with diabetes in India with an overall prevalence rate of 4.3% [17]. Recent data shows that Type II diabetes is the most common and predicts an increase in incidence by 6% every year [18]. A large number of these patients are undiagnosed. As per the recommendations of the ADA by 2000 every individual must be subjected to screening for Diabetes Mellitus, repeating the test every 3 years in risk free individuals and more often in people with associated risk factors [19].

The diagnosis of diabetes has been through many technological evolutions but a less-invasive diagnostic method still seems to be elusive. The modern glucometer employs pricking the patient's finger to derive the peripheral blood glucose levels. The use of gingival crevicular blood which is a non-invasive alternative has been on the rounds but it still needs more thrust on the research aspect. Many patients who visit the dental clinic with periodontal complaints are mostly undiagnosed diabetic patients [20]. the two-way relationship between diabetes and periodontitis increases the probability and severity of periodontal disease occurrence in individuals with poor blood glucose control (7-9). Studies have also proven that periodontal therapy exerts beneficial effects on the diabetic status of the individual [21]. The above said reasons make screening of Diabetes Mellitus, using a comparatively less-invasive technique, in the dental clinic, performed as a chair-side procedure as part of routine oral and periodontal examination a practical alternative. Although when compared to the established present day procedures of peripheral blood glucose monitoring this requires more extensive research and long-term research based studies to become an established mode of peripheral blood sample collection for recording peripheral blood glucose levels.

Our study included subjects between the age of 20 years - 70 years of age because of the increased incidence of diabetes amongst the younger age groups in India [22], [23]. However, there was no evidence of occurrence of diabetes in that 20-35 years age group in our study, which was in accordance with a study conducted by Shetty N. et al [24]. In the current study diabetes was observed to have a slight predilection towards the males. These results were correlating with those in previous studies [24]. The glycemic levels of the diabetic patients with periodontitis are higher than the glycemic levels of the diabetic subjects without periodontitis hence reinforcing the bi-directional relationship of diabetes and periodontitis.

Blood glucose levels can be measured using capillary or venous blood. Rather extensive research has been done to formulate a non-invasive screening method for diabetes mellitus. Some studies have compared the glucose levels of the lacrimal fluid with that of the peripheral blood in diabetic individuals, concluding that the glucose levels of the lacrimal fluid was much higher than that of the peripheral blood [25], [26], [27]. In our study, the correlation between the glucose levels of the gingival sulcular blood and the peripheral blood in diabetic patients. In accordance with previous studies the difference between the glucose levels were statistically insignificant in all the four categories [11], [24]. In the current study the blood glucose levels

were assessed with the help of portable self- monitoring glucose meters whose predictability is shown to fall within the prediction error of 15% of the laboratory standard recommended by the American Diabetes Association [28].

Several factors influence the correlation between sulcular blood glucose level and the peripheral blood glucose level. One of the major factors affecting the assessment of glucose level from the sulcular blood is the method of procurement of the sample. Contamination of the blood sample with saliva during collection of sulcular blood results in alteration of the glucose levels obtained owing to a misdiagnosis. In contrast to the previous studies where the blood was directly wiped on to the test strip or transferred on to the test strip via a blood laden dental curette, in the present study blood was collected from an area isolated with cotton gauze in a glass capillary tube and then transferred to the test strip [29]. The advantages of the method used in our study over direct rubbing of blood is that when the blood is directly wiped on to the test strip do not produce a uniformly timed reaction and hence may damage the strip leading to a failure of estimation of blood glucose levels using the glucometer. Transfer of blood using a curette was also not adopted as contamination of the blood with saliva, dental plaque, calculus and debris and crevicular fluid present on the dental curette [24].

We recognize the restrictions in the present research. To start with, as was valid for the examinations by Beikler et al.,[30] Khader et al.[29] and Müller and Behbehani,[31] we didn't gather venous blood tests, the highest quality level with which to quantify glucose in the research facility, nor did we gather copy GCB and slim finger-stick blood samples, as was done in the investigation by Parker et al.,[13] However, when utilizing the mean of the copy measures of the GCB and CFB glucose readings, Parker et al.,[13] confirmed that it was not superior to anything a solitary estimation in deciding the relationship, predisposition, exactness and expectation blunder of the GCB and CFB glucose measures. Additionally, similar to the case with the investigations by Beikler et al.,[30] and Müller and Behbehani,[31] our members were not fasting, nor were the outcomes balanced in light of the time since the members last ate. Outstandingly, albeit some research [32,33] found that the simultaneousness of glucose measures from CFB and from exchange testing locales is reduced in the postprandial period, other studies[34] neglected to find that the timeframe since last nourishment consumption influenced this simultaneousness.

Diabetes is still the most prevalent disease condition with increased rates of morbidity. The late diagnosis of diabetes mellitus has resulted in a significant reduction in the quality of life of the affected individuals. Within the limitations, the results of this study cannot be generalized and an increased sample size with specificity and sensitivity testing is required to validate the use of gingival crevicular blood as a diagnostic tool for diabetes mellitus. But, these study findings suggest that gingival crevicular blood can be a non-invasive, cost-effective alternative to peripheral blood glucose testing and more research thrust can be focussed on this area for future developments in this field.

Conclusion

The after effects of the present investigation show that GCB gathered amidst symptomatic periodontal examination might be a fantastic wellspring of blood for glucometric examination. What's more, the strategy portrayed is sheltered, simple to perform and agreeable for the patient and may in this way help to build the recurrence of diabetes screening in dental workplaces. In spite of the fact that not a test to analyze diabetes, such screening is a vital guide in recognizing those for whom follow-up tests in regards to conceivable diabetes are justified. Besides, the expenses related with the buy of a promptly accessible glucometer and individual test strips are to a great degree humble. Along these lines, with insignificant cost and a constrained venture of time for patients and clinicians, dental experts can assume a basic part in supporting their patients' general well-being.

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