10.5005/jp-journals-10052-0144

ORIGINAL ARTICLE

Comparative Evaluation of Gingival Crevicular Blood Glucose Levels Pre- and Postscaling and Root Planing with Capillary Blood Glucose Levels in Diabetic Patients with Chronic Periodontitis: A Clinical Study

[1]Dheeraj Sharma, [2]Varun Dahiya, [3]Pradeep Shukla, [4]Preeti Shukla, [5]Gaurav Malhotra, [6]Chander S Joshi

ABSTRACT

The present study was undertaken to evaluate the efficiency of gingival crevicular blood (GCB) for assessment of blood glucose level as a chairside test in the dental clinics and evaluate the influence of Phase I periodontal therapy on the glycemic control of diabetic subjects. A comparative evaluation of glucose levels of gingival blood and fingerstick capillary blood was done before the periodontal therapy and 45 days after the periodontal therapy. Totally, 50 known diabetic patients having untreated moderate-to-severe periodontitis in the age group of 25 to 60 years from the Department of Periodontology and Implantology, D. J. College of Dental Sciences and Research, Modinagar, India, were selected for the study. Patients requiring antibiotic premedication, any disorder that is accompanied by an abnormally low or high hematocrit, having intake of substances that interfere with the coagulation system, severe cardiovascular, hepatic, immunologic, renal, hematological, or other organ disorders were excluded from the study. Glucose levels were measured from the gingival blood using glucometer and from the capillary blood (finger puncture method) using glucometer during dental examination. Phase I periodontal therapy was carried out in all the patients, and the blood glucose levels were measured at baseline and 45th day after the periodontal treatment. Using statistical analysis, the glucose levels of GCB and capillary blood glucose levels were analyzed and compared. The analysis showed no statistically significant difference in blood glucose levels between the two above-mentioned groups. With this study, we can arrive at the conclusions that GCB can provide an acceptable source for measuring blood glucose in the study's specific glucose self-monitor, and it can be used for the dental office evaluation of blood glucose level. A better glycemic control is observed in diabetic subjects after the Phase I periodontal therapy. Hence, prevention and control of periodontal disease should be considered as an integral part of diabetes control.

Keywords: Capillary blood glucose, Diabetes, Gingival crevicular blood glucose.

How to cite this article: Sharma D, Dahiya V, Shukla P, Shukla P, Malhotra G, Joshi CS. Comparative Evaluation of Gingival Crevicular Blood Glucose Levels Pre- and Postscaling and Root Planing with Capillary Blood Glucose Levels in Diabetic Patients with Chronic Periodontitis: A Clinical Study. Int J Prev Clin Dent Res 2018;5(1):15-20.

Source of support: Nil

Conflict of interest: None

[1]Postgraduate Student, [2,5]Professor, [3]Professor and Head [4]Assistant Professor, [6]Reader

[1-3,5,6]Department of Periodontology and Implantology, Divya Jyoti College of Dental Sciences & Research, Ghaziabad, Uttar Pradesh, India

[4]Department of Biotechnology and Microbiology, IIMT College of Life Sciences, IIMT University, Meerut, Uttar Pradesh, India

Corresponding Author: Dheeraj Sharma, Postgraduate Student, Department of Periodontology and Implantology, Divya Jyoti College of Dental Sciences & Research, Ghaziabad Uttar Pradesh, India, Phone: +918958696227, e-mail: dheeraj.james@gmail.com

INTRODUCTION

Diabetes mellitus is a clinically and genetically heterogeneous group of disorders affecting the metabolism of carbohydrates, lipids, and proteins (abnormal elevation of blood glucose levels). Hyperglycemia is due to deficiency of insulin secretion caused by pancreatic β-cell dysfunction and/or insulin resistance in liver and muscle.[1,2]

Diagnostic criteria: three methods.

1. Symptoms of diabetes and casual (nonfasting) plasma glucose—≥ 200 mg/dL. Casual glucose may be drawn at any time of the day without regard to time since the last meal. Classic symptoms of diabetes include polyuria, polydipsia, and unexplained weight loss.
2. Fasting plasma glucose (FPG)—≥ 126 mg/dL. Fasting is defined as no caloric intake for at least 8 hours before the test.
3. Two-hour postprandial glucose—≥ 200 mg/dL during an oral glucose tolerance test. The test should be performed using a glucose load containing the equivalent of 75 gm of anhydrous glucose dissolved in water.

Categories of fasting plasma glucose include:

- Fasting plasma glucose < 110 mg/dL = normal fasting glucose
- Fasting plasma glucose ≥ 110 mg/dL and <126 mg/d: = impaired fasting glucose

- Fasting plasma glucose ≥ 126 mg/dL = provisional diagnosis of diabetes.

MATERIALS AND METHODS

Criteria for Selection of Patients

Inclusion Criteria

- Patients having untreated moderate (3–4 mm of clinical attachment loss)-to-severe periodontitis (>5 clinical attachment loss).
- Diabetic patients under medication.
- Age group from 30 to 60 years.

Exclusion Criteria

- Requirement for antibiotic premedication for periodontal examination.
- Patients who have undergone antibiotic therapy during the past 6 months.
- Any disorder that is accompanied by an abnormally low or high hematocrit, e.g., polycythemia vera, anemia, dialysis.
- Severe cardiovascular, hepatic, immunologic, renal, hematological, or other organ disorders.
- Sites with suppuration.

Collection of Sample

Procedure

Design of the clinical trial was explained to all the selected patients. Patients signed an informed consent to participate in the study. Known diabetic patients under medication having untreated moderate-to-severe periodontitis were chosen for the study. A study pro forma was used consisting of a brief case history, clinical examination, and recordings of gingival and capillary finger puncture blood levels at baseline and 45th day after the phase I periodontal therapy. Patients were instructed to come for the examination following a minimum of 8 hours of fasting. The maxillary anterior teeth, irrespective of their probing depths, were chosen for collecting the gingival blood. Contamination with saliva was prevented by using gauze and air drying. Any obstructing piece of supragingival calculus was removed with a hand scaler, and the area was wiped clean with the gauze. After site selection, it was isolated with dry cotton and air dried. The test strip was inserted into the digital glucometer with the contact bars facing up, into the meter. When the glucometer was ready for sampling as indicated by the digital display, the labial surface of the maxillary incisor region was probed using a UNC-15 periodontal probe. Once the top edge of the test strip touched the bleeding gingival surface, due to capillary action, the blood was drawn into the test strip until the confirmation window was full. The blood oozing from the gingival crevice was collected with the test strip of the glucometer within few seconds. The blood glucose level shown in the display was recorded immediately. A fleshy area on the fingertip was selected for sample collection for capillary blood glucose analysis with the glucometer. The site was pricked with a lancet provided in the kit. The drop of blood was collected with the test strip, and the blood glucose level displayed by the glucometer was recorded. Fasting plasma glucose measured using glucose oxidase method was expressed in milligrams per deciliter. Phase I periodontal therapy was completed in a single appointment. This was performed under local anesthesia using ultrasonic scaler and curettes. After 45 days of the Phase I periodontal therapy, capillary blood glucose level and gingival blood glucose level were measured. All patients were educated and motivated throughout the study period, and it was made sure that they are under antidiabetic drugs as per physician's advice. The patients were asked to inform any change in the diabetic-treatment regimen. Gingival index (GI) and plaque index (PLI) were calculated at the baseline and 45 days after the Phase I periodontal therapy.

Plaque Index

The PLI was described by Silness and Löe[3] and more fully described by Löe.[4] The PLI is unique among the indices used for the assessment of plaque because it ignores the coronal extent of plaque on the tooth surface area and assesses only the thickness of plaque at the gingival area of the tooth.

Gingival Index

The GI was developed by Löe and Silness,[5] solely for the purpose of assessing the severity of gingivitis and its location in four possible areas by examining only the qualitative changes (i.e., severity of the lesion) of the gingival soft tissue.

Armamentarium

- Glove
- Mouth mask
- Mouth mirror
- UNC-15 periodontal probe
- Tweezers
- Glucometer
- Test strip
- Lancet
- Sterile cotton
- Ultrasonic scaler
- Gracey curettes (Fig. 1)

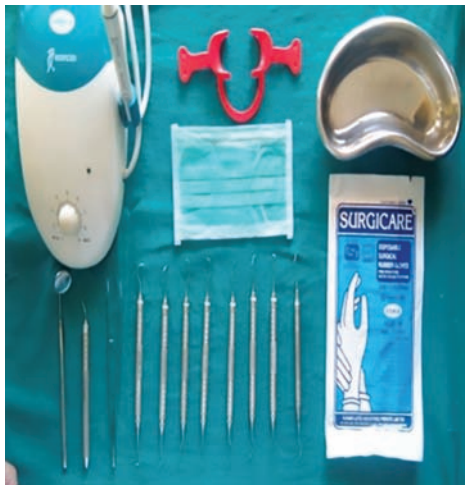


Fig. 1: Armamentarium

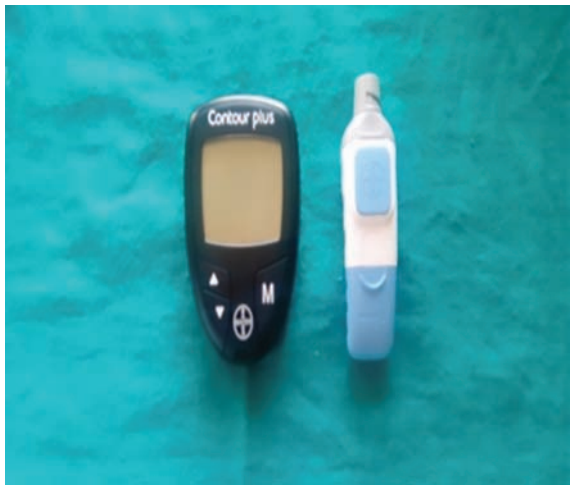
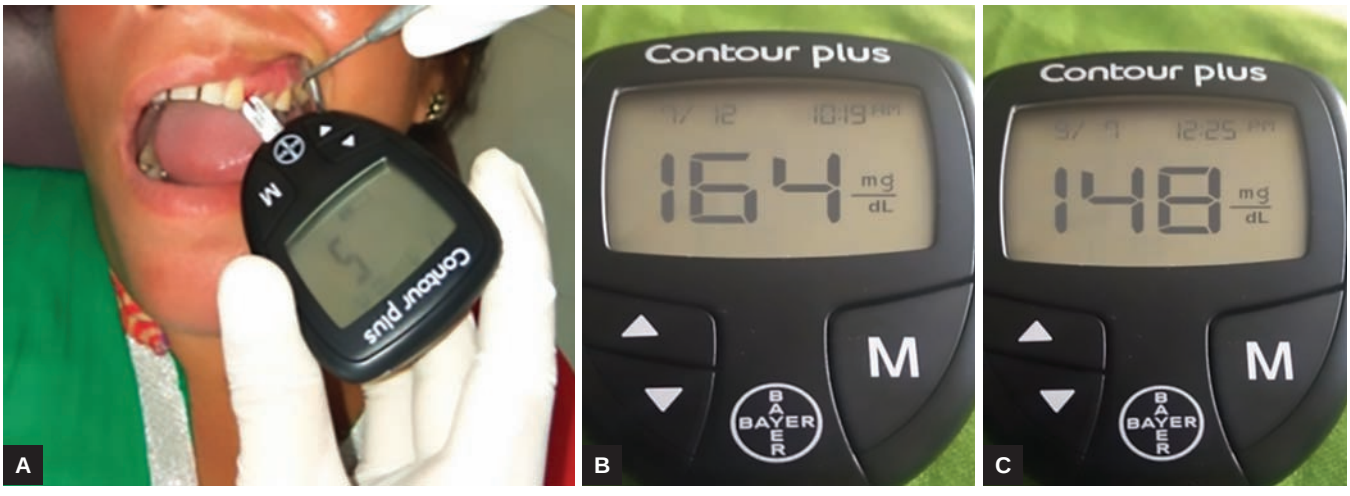
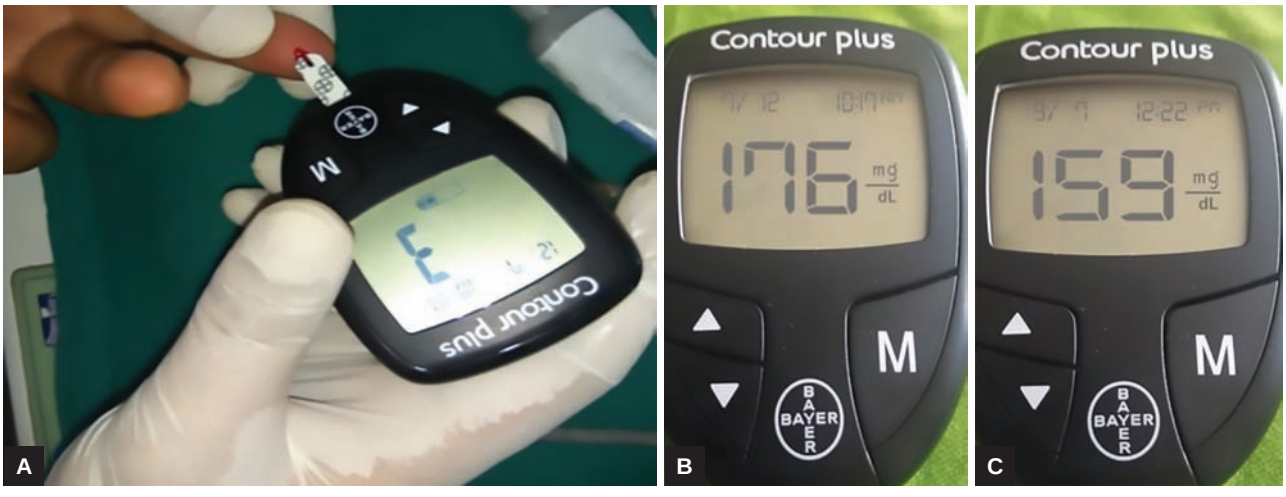


Fig. 2: Glucometer



Figs 3A to C: Measurement of GCB glucose level



Figs 4A to C: Measurement of finger papillary blood glucose level

RESULTS

When the intergroup comparison between finger capillary blood glucose and GCB glucose levels were studied, it was found that there was glycemic control in the subjects on the 45th day (Fig. 2). As the readings showed by finger puncture or by GCB at the baseline and on 45th day were statistically nonsignificant, thereby, the latter one (GCB) could be an alternative investigation in measuring blood glucose levels (Figs 3 and 4).

DISCUSSION

The periodontist frequently manages diabetic patients using limited information about their blood glucose control. Often, the only information available is from a single laboratory test that may not reflect their current blood glucose status. Monitoring their blood glucose levels during the dental office visit may be a better alternative. Considerable effort has been made in the past few years with regard to the development of painless and noninvasive methods to measure blood glucose. However, until now, none are in routine clinical practice. Since periodontal inflammation with or without the complication factor of diabetes mellitus is known to produce ample extravasate of blood during diagnostic periodontal examination,[6] no extra procedure, e.g., finger puncture with a sharp lancet, is necessary to obtain blood for glucometric analysis. Even in the case of very low gingival crevicular bleeding, a glucose measurement is possible with the used self-monitoring device, as only 3 µL of blood is sufficient to perform the analysis. Moreover, the technique described is more acceptable and less traumatic to the patient than a finger puncture. According to findings of this study, there is a high correlation between fingerstick capillary blood and GCB glucose levels and venous blood glucose level measured in the laboratory (Tables 1 to 6).

The present study is in agreement with the previous study, which also demonstrated a strong correlation between GCB and fingerstick capillary blood by Parker et al[7] and Beikler et al.[8] The clinical values of GCB glucose level was consistently found to be slightly lower than the capillary blood glucose level, which could be due to slight dilution of the blood sample by gingival crevicular fluid (GCF). In contrast to the previous study,[7] however, the sampling procedure that was applied in the present

Table 1: Plaque index

Score	*Criteria*
0	No plaque
1	A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may be seen only by running a probe across the tooth surface
2	Moderate accumulation of soft deposit within the gingival pocket, on the gingival margin, and/or adjacent tooth surface, which can be seen by naked eye
3	Abundance of soft matter within the gingival pocket and/or on the gingival margin and adjacent tooth surface

Table 2: Gingival index

Score	*Criteria*
0	Absence of inflammation/normal gingival
1	Mild inflammation, slight change in color, slight edema; no bleeding on probing
2	Moderate inflammation; moderate glazing, redness, edema and hypertrophy, bleeding on probing
3	Severe inflammation; marked redness and hypertrophy, ulceration, tendency to spontaneous bleeding

Table 3: Comparison of GI scores between two intervals showing a statistically significant result

	Mean	*Standard deviation*	*Paired difference*	*t-value*	*p-value*
Baseline	1.75	0.38	1.018	27.932	0.001
45 days	0.73	0.29			

Thus, the mean reductions in the GI scores at baseline and 45 days are as follows: (a) Baseline: 1.75. (b) 45 days: 0.73; The p-value was found to be 0.001, which was statistically significant

Table 4: Comparison of PLI scores between two intervals showing a statistically significant result

	Mean	*Standard deviation*	*Paired difference*	*t-value*	*p-value*
Baseline	1.64	0.39	0.892	28.083	0.001
45 days	0.75	0.28			

Thus, the mean reductions in the PLI scores at baseline and 45 days are as follows: (a) Baseline: 1.64. (b) 45 days: 0.75; The p-value was found to be 0.001, which was statistically significant

Table 5: Intergroup comparison between finger capillary blood glucose and GCB glucose levels

	Groups	*Mean*	*Standard deviation*	*t-value*	*p-value*	*Significance*
Baseline	Figure capillary blood	159.52	37.02	0.614	0.541	NS
	GCB	155.24	32.58			
45 days	Figure capillary blood	152.50	32.62	0.989	0.325	NS
	GCB	146.62	26.52			

NS: Nonsignificant

Table 6: Intragroup comparison of glucose levels in finger capillary blood and GCB between two intervals showing statistically significant result (p-value 0.001)

	Groups	*Mean*	*Standard deviation*		*t-value*	*p-value*	*Significance*
Figure capillary blood	Baseline	159.52	37.02	7.02	6.222	0.001	S
	45th day	152.50	32.62				
GCB	Baseline	155.24	32.58	8.62	6.492	0.001	S
	45th day	146.62	26.52				

S: Significant

study is much easier to perform and less time-consuming, since no additional tools are necessary to collect GCB.

This study is not in agreement with a previous study by Muller and Behbehani[9] in which the method of measuring blood glucose levels using GCB was not found to be accurate. In the study, there was no effort made to prevent contamination of the sample, and site was not specifically chosen to eliminate salivary contamination. In our study, only maxillary anterior teeth were selected for sampling to eliminate salivary contamination. Also, the site was isolated with gauze and air dried before sampling. Any patients having a disorder that is accompanied by an abnormally low or high hematocrit, e.g., polycythemia vera, anemia, dialysis, are excluded because these conditions with very high or low hematocrit values give false readings with glucometer.

The majority of periodontal therapy produces extravasated blood from the gingival crevice due to inflammation. Using the method described in this study, the periodontal therapist can rapidly measure blood glucose many times using the GCB. Multiple measurements of a diabetic patient's blood glucose allow the periodontist to better assess the patient's diabetic control as the treatment progresses.

The results of the present study indicate that GCB collected during diagnostic periodontal examination may be an excellent source of blood for glucometric analysis. In addition, the technique described is safe, easy to perform, and comfortable for the patient and might, therefore, help to increase the frequency of diabetes screening in dental offices.

Periodontitis is a complex, multifactorial disease. Similarly, diabetes mellitus is a complex metabolic syndrome. It is the complexities of both of these disease processes that may contribute to the controversy found in the literature. Several reports have been published regarding the favorable effect of nonsurgical periodontal treatment, i.e., oral hygiene education, scaling and root planing, and on periodontal healing.[10-12] Studies had demonstrated that the clinical severity of periodontitis reduced significantly 1 month following the initial nonsurgical periodontal therapy,[13] whereas some others suggest that healing after nonsurgical therapy is a gradual process taking place over several months. In the present study, the response to oral hygiene instructions and single instrumentation was assessed 3 months after completion of the therapy. Moreover, many studies failed to prove the influence of periodontal treatment on the metabolic control in diabetics[14-17] and few other studies contradicted those findings. They have proved a positive effect of periodontal treatment on the glycemic control in diabetics.[18-20]

Most of the surfaces showed bleeding on probing at initial examination. Increased inflammatory periodontal changes were observed in subjects with poorly controlled diabetes than well-controlled disease. After periodontal therapy, there was marked reduction in bleeding on probing. Periodontal pocket depth was also reduced markedly after the therapy. Few tooth surfaces still showed bleeding after the treatment, which was directly proportional to the depth of residual periodontal pocket.

The healing response to the periodontal treatment was better in diabetic patients under control. Delayed healing response was seen in those subjects who had poorly controlled diabetes, although the difference was significant. The mean blood glucose values in the examined diabetic patients in finger puncture capillary blood and GCB at baseline were 159.52 ± 37.02 and 155.24 ± 32.58 respectively. It was reduced to 159.52 ± 37.02 and 155.24 ± 32.58 on the 45th day of periodontal therapy. This shows that the subjects had achieved a transient glycemic control. This may be because the factors like diet, physical activity, compliance with medication, etc., have a marked effect on the glycemic control. During the study period, the patients were educated about the importance of diet control and physical activity, and they were motivated to follow their physician's instructions on hypoglycemic drugs. Moreover, much emphasis was given on maintaining the oral health. In poorly controlled diabetic subjects, there was reduction in the blood glucose levels, but most of it had not reached within the normal values (normal fasting plasma glucose level: 60–110 mg/dL). Better controlled diabetic patients with moderate-to-severe periodontitis maintained the normal blood glucose level for a period of 45 days. Both these groups had shown a highly statistically significant reduction in GI and PLI over a period of 45 days after the periodontal treatment.

When the intergroup comparison between blood glucose and GCF glucose levels were studied, it was found that there was glycemic control in the subjects on the 45th day. As the readings shown by finger puncture or by GCB at the baseline and on 45th day were statistically nonsignificant, thereby, the latter one, i.e., GCB, could be an alternative investigation in measuring blood glucose levels.

This is in agreement with an earlier study by Tervonen et al.[18] Within the limitations of this study, it can be concluded that nonsurgical periodontal therapy has a significant effect on the glycemic control of the diabetic patients. This study emphasizes on the importance of periodontal treatment in the diabetic subjects.

Although using gingival blood as a chair-side test to monitor patients is painless, safe, and less time-consuming, we cannot deny the chances of contamination of gingival blood with supragingival and subgingival calculus and plaque. Furthermore, patients visiting dental clinics without fasting may limit the use of gingival blood

for screening of diabetes mellitus in dental clinics. Comparison of gingival blood with more accurate parameters like hemoglobin A1c also has to be considered and longitudinal follow-up is required to evaluate the long-term outcome in relation to periodontal health.

CONCLUSION

- 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 described in this study.
- When compared with the finger puncture capillary blood and GCB, it was estimated that there was no statistically significant difference between the GCB and blood glucose level.
- According to this study, Phase I periodontal treatment resulted in a better glycemic control in diabetic patients.
- Thus, GCB can be used as an alternative for estimation of blood glucose level during routine dental procedure.

REFERENCES

1. Mealey BL, Oates TW; American Academy of Periodontology. Diabetes mellitus and periodontal diseases. J Periodontol 2006 Aug;77(8):1289-1303.
2. Moore PA, Zgibor JC, Dasanayake AP. Diabetes: a growing epidemic of all ages. J Am Dent Assoc 2003 Oct;134(Spec No):11S-15S.
3. Silness J, Löe H. Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. Acta Odontol Scand 1964 Feb;22:121-135.
4. Löe H. The gingival index, the plaque index and the retention index systems. J Periodontol 1967 Nov-Dec;38(6 pt 2):610-616.
5. Löe H, Silness J. Periodontal disease in pregnancy: I. Prevalence and severity. Acta Odontol Scand 1963 Dec;21: 533-551.
6. Evasti T, Knuutila M, Pohjama L, Haukipuro K. Relation between control of diabetes and gingival bleeding. J Periodontol 1985 Mar;56(3):154-157.
7. Parker RC, Rapley JW, Isley W, Spencer P, Killoy WJ. Gingival crevicular blood for assessment of blood glucose in diabetic patients. J Periodontol 1993 Jul;64(7):666-672.
8. Beikler T, Kuczek A, Petersilka G, Flemming TF. In-dental-office screening for diabetes mellitus using gingival crevicular blood. J Clin Periodontol 2002 Mar;29(3):216-218.
9. Muller HP, Behbehani E. Methods for measuring agreement: glucose levels in gingival crevice blood. Clin Oral Investig 2005 Mar;9(1):65-69.
10. Torfason T, Kiger R, Selvig KA, Egelberg J. Clinical improvement of gingival conditions following ultrasonic versus hand instrumentation of periodontal pockets. J Clin Periodontol 1979 Jun;6(3):165-176.
11. Lindhe J, Westfelt E, Nyman S, Socransky SS, Heijl L, Bratthall G. Healing following surgical/non-surgical treatment of periodontal disease. J Clin Periodontol 1982 Mar;9(2):115-128.
12. Badersten A, Nilveus R, Egelberg J. Effect of nonsurgical periodontal therapy I. Moderately advanced periodontitis. J Clin Periodontol 1981 Feb;8(1):57-72.
13. Preber H, Bergstrom J. The effect of non-surgical treatment on periodontal pockets in smokers and non-smokers. J Clin Periodontol 1986 Apr;13(4):319-323.
14. Tervonen T, Knuuttila M, Pohjamo L Nurkkala H. Immediate response to nonsurgical periodontal treatment in subjects with diabetes mellitus. J Clin Periodontol 1991 Jan;18(1):65-68.
15. Aldridge JP, Lester V, Watts TL, Collins A, Viberti G, Wilson R. Single-blind studies of the effects of improved periodontal health on metabolic control in Type 1 diabetes mellitus. J Clin Periodontol 1995 Apr;22(4):271-275.
16. Jones JA, Miller DR, Wehler CJ, Rich SE, Krall-Kaye EA, McCoy LC, Christiansen CL, Rothendler JA, Garcia RI. Does periodontal care improve glycemic control? The Department of Veterans Affairs Dental Diabetes Study. J Clin Periodontol 2007 Jan;34(1):46-52.
17. da Cruz GA, de Toledo S, Sallum EA, Sallum AW, Ambrosano GM, de Cássia Orlandi Sardi J, da Cruz SE, Gonçalves RB. Clinical and laboratory evaluations of nonsurgical periodontal treatment in subjects with diabetes mellitus. J Periodontol 2008 Jul;79(7):1150-1157.
18. Tervonen T, Lamminsalo S, Hiltunen L, Raunio T, Knuuttila M. Resolution of periodontal inflammation does not guarantee improved glycemic control in type 1 diabetic subjects. J Clin Periodontol 2009 Jan;36(1):51-57.
19. Russel AL. The periodontal index. J Periodontol 1967;38: 586-591.
20. Terry C Simpson et al. Treatment of periodontal disease for glycemic control in people with diabetes, Australian Dental Journal 2010; 55(4):472-474.