Regulation of HbA1c of uncontrolled diabetic type II obese and normal weight patients by oral hygiene performance (Comparative study)

Sana F. Hadratie, B.D.S. [1]
Abdullatif A.H. Al-Juboury, B.D.S., Ph.D. [2]

ABSTRACT

Background: The association between periodontal diseases incidence and development and the metabolic diseases as Diabetes Mellitus and Obesity are recently have attract great deal of researchers attention and investigation. The periodontal health proved to reduce the systemic inflammatory reactions and positively improve the glycemic control of diabetes Type2 patients. The aim of the study was to investigate the influence of oral hygiene control on the glycemic control of obese and normal weight moderately controlled Diabetic Type 2 patients, in addition to study the association of obesity with the gingival inflammation.

Materials and Methods: Cross sectional study of three months duration. Included 30 moderately controlled diabetic type2 patients who attend the Specialist Center for Endocrine and Diabetes diseases Baghdad Al-Russafa administration / Iraqi Ministry of Health, were grouped into two groups, G1 of normal weight diabetics, and G2 obese diabetics according to their BMI level, the oral hygiene status measured by their PLI,GI,BBOP,PDI,CAL was conducted at each of the five visits of three weeks interval between each till the end of three months duration of the study and the level of their glycemic control measured by HbA1c level was conducted at the first and the fifth visit of the research duration , BMI was measured at the first and the fifth visit also. Paired t-test, ANOVA, Qui-square and Pearson correlation statistical analysis was used to investigate the significance of the improved glycemic control after oral hygiene control (OHC) of both G1 and G2.

Results: periodontal parameters of both G1 and G2 were significantly improved after OHC with a significant reduction in HbA1c level of both normal weight and obese patients.

Conclusion: The Oral Hygiene Control (OHC) is sufficient to improve reduction in Diabetes control level with or without overweight.OHC home care and professional measures could improve the gain in periodontal health in normal weight diabetics and overweight diabetics Obesity has an association with the presence of bleeding on probing as an indicator of the gingival inflammation in diabetic Type2 patients.

Key words: Periodontitis, diabetes Type II, oral hygiene. (J Bagh Coll Dentistry 2013; 25(Special Issue 1):102-107).

INTRODUCTION

Diabetes Mellitus, the clinical syndrome characterized by hyperglycemia caused by absolute or relative deficiency of insulin [1].The prevalence of diabetes for all age-groups world-wide was 2.8% in 2000 and estimated to be 4.4% in 2030. The prevalence was higher in men than in women [2]. About 85%-90% of diabetic cases are type 2 DM, while type 1 constitutes 5%-10% of the cases [3].Obesity is a global rising problem all over the world; can be defined as an excess amount of body fat in proportion to the lean body mass [4] to the extent that health is impaired [5]. The world health organization WHO defines obesity as a BMI > 30 [5] which in turn reflected by increased waist circumference [6],Certain ethnic groups seem to be more sensitive than the other to develop its adverse metabolic effects than the others that high levels of diabetes and related diseases are found in south Asia and Arab populations [6]. The Adipose tissue (Body fat) is no longer considered as a storage of Triglycerides, but a complex and metabolically active endocrine organ that secretes numerous immunomodulatory factors collectively called adipokines, where some of them act locally and the others released into the systemic circulation to act as signaling molecules to the liver , muscles , and endothelium [7].Through these immune factors obesity emerged one of the risk factors of developing periodontal diseases, Systemic health problems such as diabetes type 2 and cardiovascular diseases [8].Through these immune factors obesity emerged one of the risk factors of developing periodontal diseases.

The effect of DM on the periodontal diseases development: Although periodontitis is a recognized complication of diabetes, people with well-controlled diabetes who have good oral hygiene are not at increased risk of developing periodontitis. However, their susceptibility to periodontitis is significantly increased when their diabetes is poorly controlled, particularly if they are smokers [9]. In addition they are at high risk of disease progression [10]. Type of microbial oral flora in diabetic was studied by many researchers, Campus et al showed a higher prevalence of *P.gingivalis* was demonstrated in type 2 diabetics compared to non-diabetic control subjects using polymerase chain reaction (PCR) On using checker board DNA-DNA hybridization ,

(1) Master student. Department of Periodontics. College of Dentistry. University of Baghdad.
(2) Professor. Department of Periodontics. College of Dentistry. University of Baghdad.

Treponema denticola , streptococcus sanguinis ,prevotella, nigrescens , staphylococcus intermedius and *streptococcus oralis* levels were elevated in supra-gingival plaque of diabetic compared to non-diabetics, although, no significant differences were found in the sub-gingival plaque samples[11].The periodontal tissues with large amounts of AGEs content are characterized by higher shared susceptibility between these two common diseases can be summarized as [12]:

- Role of biochemical changes including hyperglycemia and AGEs formation.
- Role of immunological activity such as cytokines and adipokines (in obese diabetic patients) such as IL-6 and TNF-α.

Role of Advanced Glycation End-products (AGEs): AGEs are the result of non-enzymatic glycation and glycoxidation processes and are formed on proteins ,lipids and nucleic acids in a pro-oxidant environment , their formation is enhanced with concomitant hyperglycemia and delayed macromolecular turnover[13] AGEs may be deposited on mononuclear polymorphonuclear cells, inhibiting their chemotactic and phagocytic capacities and permitting the advance of gram-negative anaerobic bacteria, which explain the high prevalence and severity of periodontal diseases in diabetic patients[14] . Diabetics have defective neutrophil apoptosis which may result in increased retention of PMNL within the periodontal tissues and contribute to tissue destruction by non-specific release of Matrix Metalo-Proteinase MMPs and reactive oxygen species (ROS),providing a further mechanism for increased susceptibility to periodontal diseases In addition , AGE-stimulated macrophages and PMNL cells releasing a larger amount of cytokines and soluble mediators and producing a greater destruction of C.T in these patients as a hyper-response to. The progression of bacterial biofilm [15, 16]

Role of Immunological activity (cytokines and adipokines): Type2 diabetes is proposed to cause substantial changes in immunologically active molecules and perturb the finally ,balanced cytokine networks within the periodontium, which in turn affect the localized immune responses and altered the susceptibility to periodontal diseases.[17] The inflammation associated with the periodontal diseases , characterized by elevated pro- inflammatory cytokines ,innate immune receptor expression (TLR-4) and cellular infiltrate is exacerbated in with type 2 diabetes, with a feed forward loop regulated by poor glycemic control was associated with a loss of mucosal barrier integrity and accumulation of innate immune receptor ligands resulting in an exacerbation of an ongoing inflammation[18]

Effect of periodontitis on diabetes mellitus: Periodontal diseases are prevalent in most populations and may have wide-range of systemic effects in susceptible individuals and may act as a potential independent risk factor for diabetic complication and exacerbating the existing disorder of the patient.[19]Evidence suggests that periodontitis –induced bacteremia cause an elevation in serum pro-inflammatory cytokines (IL-1β and TNF-α) which have been demonstrated to produce alterations in lipid metabolism leading to hyperlipidemia and alternately causing an insulin resistance syndrome and contributing to destruction of pancreatic B-cells leading to the development of diabetes[20] Persistent elevation of IL-1β,IL-6 ,TNF-α in the diabetic state have an effect on the liver ,stimulate the release of acute-phase proteins CRP ,produce the characteristic dysregulation of lipid metabolism associated with type2 diabetes and have an effect on pancreatic B-cells as well.[21]

Obesity and periodontitis:

Obesity has both local and systemic inflammatory networks by which obesity exert its effects on the body systems, these networks governed by the secretion of adipokines, pro-inflammatory cytokines and reactive oxidative species. The first reported observation on the relationship between obesity and the periodontal diseases was made by Perlstein*et al*.in 1977; they observed histopathological changes in the periodontium in hereditary obese Zucker rats. On using ligature-induced periodontitis, they found alveolar bone resorption to be greater in obese animals compared with non-obese rats that the obese-hypertensive rats showed the most severe periodontal response to local irritation [22].

Based on reviewing the NHANES III, obesity could be a potential risk factor for periodontal diseases especially among younger individuals andthat promotion of healthy nutrition and adequate physical activity may be additional factors to prevent the rate of progression of periodontal diseases. [23] As obesity is generally the first step toward type2 DM, it is possible to find exacerbated periodontal diseases in obese patients [24]. Obese subjects with a high serum triglyceride level and/or a low HDL-cholesterol level could be at higher risk of periodontal infection. And that the association between body weight and periodontal infection was mainly mediated through a mechanism other than serum lipids [25]. The relationship between obesity and periodontal diseases is Dose-dependent relation that, overweight individuals had double the

incidence ,while obese had triple the incidence ,severity and extent of periodontal diseases.[26] Obesity showed correlation with greater attachment loss in obese than in non-obese[27]

Effect of periodontal diseases on obesity:

Some studies suggest that periodontal pathogens can contribute to obesity development. Goodson's et al, suggest three mechanisms by which oral bacteria may contribute to the development of obesity, the first hypotheses suggests that oral bacteria may contribute to increased metabolic efficiency .the second suggest that oral bacteria could increase weight gain by increasing appetite, and the third one suggests that oral bacteria redirect energy metabolism by facilitating insulin resistance through increasing levels of TNF-α or reducing levels of adiponectin. By any of these three mechanisms, even a small calorie consumption with no change in diet or exercise could result in an unacceptable weight gain [28] The effect of oral bacteria on obesity development is further confirmed through the effect of periodontal treatment aimed at elimination of the periodontal -pathogens on the improvement in the lipid profile of treated patients, as was observed by Tandon et al [29]

Effect of periodontal treatment on glycemic control of diabetics: The anti-inflammatory periodontal treatment (scaling and root planning) can be hypothesized to improve insulin sensitivity by reducing the peripheral TNF-α concentration and by which exert a beneficial effect on the metabolic control of Type2 diabetic patients.[30] A meta-analysis of ten intervention studies to estimate the effect of periodontal treatment on HbA1c found a weighted mean reduction of 0.66% in type 2 DM patients ,however, this did notachieve a statistical significance.[31] The prevention of periodontal disease is an important diabetic task , that an aggressive management of oral health and regular check-up in diabetic patients may diminish the inflammatory effects on diabetes control.[32]Reduction of periodontal inflammation either with root planning and systemic antibiotics or with plaque control and sub-gingival scaling significantly reduces CRP levels [33], significant decrease in total and LDL cholesterol levels [34], and decrease in the level of some circulating pro-inflammatory cytokines and may be associated with a decrease in insulin resistance in the obese patients [35].

MATERIALS AND METHODS

After gaining the college ethical committee's approval on the study protocol and the Iraqi Ministry of Health approval on the use of human subjects in this study ,the sample recruited for the study were patients attending the specialized center for Endocrinology and Diabetes ,and Al-Kindy teaching hospital -Baghdad /Al-Russafa administration.30 of moderately controlled diabetic type 2 patients were participated and divided into two groups according to their BMI level into G1 of normal weight (BMI>=22) and G2 obese patients (BMI>=30)both having moderate chronic periodontitis of pocket depths>=4mm and clinical attachment loss >=6.00 mm. both groups participants are uncoholic ,non-smokers ,with no previous periodontal treatment or systemic medication Other than their hypoglycemic drugs for about two months before or during the study. An adequate elimination of the sub-gingival plaque, in addition to the use of Chlorehexidine mouth wash twice a day for the week after scaling).

RESULTS

Both groups were at the same level of the metabolic control at the beginning of the study (day zero) {table 1}. The Oral Hygiene Control (OHC) measures included the daily home care (teeth brushing, flossing and interdental brushing) enforced by the professional scaling at the first visits. PLI,GI,BOP,PDI,and CAL were recorded at day zero and reevaluated for the next four visits (with three weeks interval between each), BMI, and HbA1c levels were measured at day zero and after three months to adjust the effect of the oral hygiene control measures on the glycemic control of each group.After three months of OHC, the HbA1c level showed a highly statistical reduction in both groups(G1 and G2) with no significant reduction in BMI level forboth groups.{table2,3},Oral Hygiene status measured by PLI,GI, and BOP showed Highly significant reduction for both groups {tables 4,5}, The pocket depth index show a highly significant reduction in G1 accompanied by highly significant reduction in CAL {table 4}while, in G2 the highly significant reduction in PDI was accompanied by not significant reduction in CAL {table 5}.The intergroup comparison of the pocket depth reduction showed significant difference after OHC, while attachment gain , PLI ,GI ,and BOP show no significant difference {table 6}. Chi-square analysis of the effect of obesity on the health status of the periodontium of both normal weight and obese diabetic patients calculated by BOP index before and after OHC revealed that Obesity do have an association with the severity of bleeding on propping in both groups {table 7}.

Table1: the intergroup comparison of the metabolic control of both groups

	At Day zero mean±SD	Sig. P-value	3 months after treatment mean±SD	Sig. P-value
HbA1c	0.593±1.255	0.857 NS	0.357±1.327	0.315 NS

Table2: Analysis of the metabolic parameters of G1 (normal weight) before and after OHC:

Metabolic parameter	Time of reading	mean ±SD	t-test	P- value
HbA1c	**day zero** **3 mon. later**	8.457±0.897 7.519±0.977	3.283	0.005 HS
BMI	**day zero** **3 mon. later**	24.128±0.997 23.866±1.435	1.69	0.112 NS

Table 3: Analysis of the metabolic parameters of G2 (Obese) before and after OHC.

Metabolic parameter	Time of reading	Mean ±SD	t-test	P-value
HbA1c	**day zero** **3mon. later**	8.397±0.70 7.233±0.72	7.41	0.001 HS
BMI	**day zero** **3mon.later**	32.246±2.17 32.264±2.2	0.213	0.834 NS

Table 4: Analysis of the periodontal parameters of G1 (Normal weight) before and after OHC.

	Time of reading	Mean ±SD	t-test	df	P value
PLI	**At day zero** **3 mon. later**	1.031±0.47 0.096±0.06	7.843	14	0.001 HS
GI	**At day zero** **3 mon. later**	1.451±0.58 0.065±0.48	6.206	14	0.001 HS
BOP	**At day zero** **3 mon. later**	0.68±0.36 0.09±0.18	6.286	14	0.001 HS
PDI	**At day zero** **3 mon. later**	5.024±1.25 3.257±1.18	12.9	14	0.001 HS
CAL	**At day zero** **3 mon. later**	6.684±1.30 5.788±1.44	5.214	14	0.001 HS

Table 5: Analysis of the periodontal parameters of G2 (Obese) before and after OHC.

	Time of reading	Mean ±SD	t-test	df	P-value
PLI	**day zero** **3mon. later**	1.082±0.37 0.054±0.07	10.823	14	0.001 HS
GI	**day zero** **3mon. later**	1.453±0.40 0.467±0.38	8.787	14	0.001 HS
BOP	**day zero** **3mon.later**	0.54±0.36 0.007±0.02	5.730	14	0.001 HS
PDI	**day zero** **3mon. later**	4.649±0.77 2.293±1.01	10.28	14	0.001 HS
CAL	**day zero** **3mon. later**	5.788±1.44 4.842±1.30	2.123	14	0.049 NS

Table 6: Intergroup comparison between the periodontal parameters before and after OHC.

Periodontal parameter	At Day Zero Mean difference ± SD	Sig. (p-value)	3 months later Mean difference ± SD	Sig. (p-value)
PLI	-0.506±0.726	0.791 NS	0.416±0.105	0.149 NS
GI	-0.020±0.695	0.991 NS	0.191±0.405	0.89 NS
BOP	0.144±0.56	0.337 NS	0.085±0.16	0.062 NS
PDI	0.374±1.468	0.34 NS	0.964±1.453	0.022 S
CAL	0.896±1.684	0.058 NS	0.946±1.952	0.082 NS

Table 7: Chi-square analysis of association of BOP and Obesity before and after OHC.

BMI	BOP scores Before OHC				Chi-square	df	P-value at 0.05	Sig.
	0		1					
	No.	%	No.	%				
Normal weight	412	33.22	828	66.77	33.88	1	3.84	S
obese	630	49.14	652	50.85	0.059			NS

BMI	BOP scores After OHC				Chi-square	df	P-value at 0.05	Sig.
	0		1					
	No.	%	No.	%				
Normal weight	1146	92.41	94	7.58	77.87	1	3.84	S
obese	1274	99.37	8	0.62	98.13			S

DISCUSSION

As periodontal infections contributed to elevated serum inflammatory mediators such as TNF-α, IL-6 and PGE_2, as an innate inflammatory hyper responsiveness to the bacterial challenge, TNF- α and IL-6 proved to induce Insulin Resistance and worsen the hyperglycemic state of the diabetics. Obese diabetic patients have high levels of serum TNF- α and other inflammatory mediators that affect the diabetic control and the periodontal health as well.In our study, 30 patients of moderately controlled type 2 diabetes were participated ,divided into two groups according to their BMI level, as G1 , consist of 15 normal weight diabetics and G2 consist of 15 obese diabetics. Both of G1 and G2 were instructed to the proper daily oral hygiene performance, reinforced at different intervals through the visits of the study according to the patients need and scaling to eliminate the bacterial plaque and calculus as a professional partof OH performance. The effect of OH performance and control on the glycemic control of diabetics is measured by HbA1c test before and after three months of scaling and OH performance. Both groups were at the same OH status before treatment, After three months of OHC measures, PLI, GI and BOP showed insignificant difference in intergroup analysis indicating an equal OH status and patients' compliances to the OH instructions , that both G1 andG2 showed a highly significant reduction in PLI , GI and BOP as described in {tables 4,5} . PDI showed significant difference in the intergroup analysis {table 6} with no significant difference in CAL between the two groups after three months of OHC, Which could indicate a slight difference in the inflammatory response between the groups, That the insignificant difference in intergroup analysis of the CAL with difference in the PDI means that the pocket formed due to enlarged inflamed gingival tissues despite the loss of attachment present as a destructive periodontal disease progression in both groups. The insignificant difference in CAL between the groups {table 6} indicates that obesity showed insignificant effect on the outcome of the periodontal treatment of diabetic patients. The_improvement in the oral hygiene status was accompanied by a significant reduction in HbA1c in both groups. BMI level of G1 showed slight but not significant reduction after three months of treatment {table 2}, that indicates the presence of weight-loss due to the lipolysis that resulted from uncontrolled hyperglycemia of the diabetic and insulin resistance state. While G2 showed slight but not significant elevation of BMI after three months of the study, which could be resulted from the improved periodontal inflammation that enabled the patients to eat better than before {table 3}. Chi-square test {table7} of BOP of both groups before and after the OHC showed that obesity could have an association with the gingival inflammation measured by the presence of the bleeding sites of both groups. As a conclusion, the Oral Hygiene Control (OHC) is sufficient to improve the Diabetes control level with or without overweight. and the improvement in the OH status was accompanied with a highly significant reduction in HbA1c in both groups. Obesity has an association with the presence of bleeding as an

indicator of the gingival inflammation in diabetic Type2 patients.

REFERENCES

1. Nicki RC, Brian RW, Stuart HR. Davidson's Principles and Practice of Medicine 21th ed. Churchill Livingstone; 2011.
2. Wild S, Gojka R, Anders G et al. Global Prevalence of diabetes, Estimates for the year 2000 and projections for 2030. Diabetes Care 2004; 27(5):1047-53.
3. National Diabetes Fact Sheet, Centers for disease control and prevention. Accessed on dec.27, 2005. www.cdc.gov/diabetes/pubs/estimates.htm.
4. Alba F, Eduardo M S et al. inflammation, oxidative stress and obesity. Int J Mol Sci 2011; 12(5):3117-3132.
5. Ritchie CS. obesity and periodontal disease. Periodontol 2000; 44, 2007:154-163.
6. Naveed S, Mike L. ABC of Obesity. Black wheel; BMJ Books, 2006.p.640.
7. Trayhurn P, Wood IS. Adipokines: inflammation and the pleiotropic role of white adipose tissue. Br J Nutr 2004; 92: 347-355
8. Saito T, Shimazaki Y. metabolic disorders related to obesity and periodontal diseases. Periodontaol 2000, 2007; 43: 254-266.
9. Hirsch R. Diabetes and periodontitis. Aust Prescr 2004; 27:36-8.
10. Heitz-Mayfield LJ. Disease progression: indentification of high risk groups and individuals for periodontitis. J Clin periodontal 2005; 25(suppl.6):196-209.
11. Hintao J, Teanpaisan R, Chongsuvivatwong V et al. The microbiological profiles and saliva, supra-gingival and sub-gingival plaque and dental caries in adults with and without type 2 diabetes mellitus. Oral Microbial Immunol 2007; 22:175-81.
12. Preshaw PM, AlbaAL, Herrera D. et al. periodontitis and diabetes: a two – way relationship. Diabetologia 2012; 55:21-31.
13. Thornally PJ. Cell activation by glycated protiens AGE receptors, receptor recognition factors and functional classification of AGEs. Cell Mol Biol 1998; 44:1013-1023.
14. Grossi SG, Genco RJ. Periodontal diseases and diabetes mellitus: a tow-way relationship. Ann periodontal 1998; 3: 51-61.
15. Lalla E, Lamster IB, Stern DM et al. Receptor for advanced glycation end products, inflammation, and accelerated periodontal diseases in diabetes: mechanisms and insights into therapeutic modalities. Ann Periodontol 2001; 6:113-118.
16. Lamster IB, Evanthia L, Wenches B et al. The relationship between oral health and diabetes mellitus. J Am Dent Assoc 2008; 139: 19S-24S.
17. Wassall RR, Preshaw PM. Type 2 diabetes mellitus as a risk factor for periodontal diseases. Perio 2006; 3(4): 243-252.
18. Amir J, Mathew W, Jeffrey T et al. The role of hyperglycemia in mechanisms of exacerbated inflammatory responses within the oral cavity. Cellular Immunol 2011; 272(1): 45-52.
19. Tara B, Taiyeb A, Renukanth P. et al. Relationship between periodontal diseases and diabetes mellitus: an Asian perspective. Periodontology 2000; 56:258-268.
20. Iacopino AM. Periodontitis and diabetes interrelationships: role of inflammation. Ann Periodontol 2001; 6(1):125-37.
21. Grossi SW. Treatment of periodontal diseases and control of diabetes: an assessment of the evidence and need for future research. Ann Periodontol 2001; 6(1):138-45.
22. Perlstein MI, Bissada MF. Influence of obesity and hypertension on the severity of periodontitis in rats. Oral Surg Oral Med Oral Pathol 1977; 43:707-719.
23. Al Zahrani MS, Nabil FB, Elaine AB. Obesity and periodontal disease in young, middle aged and older adults. J Periodontal 2003; 74:610-615.
24. Gursoy UK , Marakoglu I, Ersan S. periodontal status and cytoplasmic enzymes activities in gingival crevicular fluid of type2 diabetic and /or obese patients with chronic periodontitis. J Int Acad periodontal 2006; 8(1): 2-5.
25. SaxlinT, SuominenTL, Kattainen A. et al. Association between Serum lipid levels and periodontal infection. J Clin Periodontol 2008; 35(12):1040-7.
26. Iacopino AM. Current concepts in oral-systemic health. JCDA 2009; 75(2): 496-7.
27. Chaffee BW, Weston SJ. Association between chronic periodontal disease and obesity: a systematic review and meta-analysis. J Periodontal 2010; 81(12):1708-24.
28. Zuzu EP, Barroso EM, Carrareto AL. et al. The role of obesity as a modifying factor in patients undergoing non-surgical periodontal therapy. J Periodontal 2011; 82(5):676-82.
29. Tandon S, Dhingra MS, Lamba AK, et al. Effect of periodontal therapy on serum lipid levels. Ind J Med Specialities 2010; 1: 19-25.
30. Nishimura F, Murayama Y. Periodontal inflammation and insulin resistance, lessons from obesity. J Dent Res 2001; 80(8): 1690-4.
31. Janket S J, Wightman A, Baird AE, Van Dyke TE, Jones JA. Does periodontal treatment improve glycemic control in diabetic patients? A meta-analysis of intervention studies. J Dent Res 2005; 84:1154-1159.
32. Schulze A, Busse M. Periodontal diseases in diabetic: relationship, prevention and treatment. CSMI 2008; 1(2):1-4.
33. Nestor T, Lopez AQ et al. Effects of periodontal therapy on systemic markers of inflammation in patients with metabolic syndrome: a controlled clinical trial. J Periodontal 2012; 83:267-278.
34. Gul OS, Fentoglu O et al. Beneficial effects of periodontal treatment on metabolic control of hypercholesterolemia. Southern Medical J 2007: 100(7):686-691.
35. Gurgan CA, Altay U, Agbaht K. Changes in inflammatory and metabolic parameters after periodontal treatment in obese and non-obese patients. J Periodontal 2012; PMID: 22348694.