



Evaluation of Oral Health in Type II Diabetes Mellitus Patients

¹Rathy Ravindran, ²MG Deepa, ³AK Sruthi, ⁴Cherian Kuruvila, ⁵S Priya, ⁶S Sunil, ⁷Joseph Edward, ⁸G Roopesh

ABSTRACT

Background: Oral cavity reflects the general health status of a person and diagnosing and treating oral manifestations of systemic disease pose a greater challenge. Even though there is strong evidence that supports the relationship between oral health and diabetes mellitus, oral health awareness is lacking among diabetic patients and health professionals. The present study was undertaken to determine the oral health status in type II diabetic patients and also to compare the oral changes in controlled diabetes and uncontrolled diabetes.

Materials and methods: Study population consists of 60 diabetic patients which is divided into 30 controlled and 30 uncontrolled diabetics; 60 healthy subjects. Each of these diabetic groups were again subdivided according to their duration as patients having a disease duration below 10 years¹⁵ and patients having a disease duration above 10 years.¹⁵ Various oral manifestations were examined and also CPI score and loss of attachment were recorded. Statistical analysis was done.

Results: The most frequent oral signs and symptoms observed in both controlled and uncontrolled diabetic patients was periodontitis followed by hyposalivation, taste dysfunction, halitosis, fissured tongue, burning mouth, angular cheilitis, ulcer and lichen planus. These oral manifestation showed an increase in distribution in diabetic patients when compared to nondiabetic. Community periodontal index (CPI) scores for assessing periodontal status showed higher scores in diabetics than nondiabetics and also in uncontrolled diabetes than controlled diabetes. For periodontal status assessment based on disease duration, patient with higher disease duration showed higher CPI scores than those with a lesser disease duration. Assessment of loss of attachment in our study showed higher values in diabetic patients compared to healthy controls.

Conclusion: From our present study, it was clear that oral manifestations in uncontrolled diabetes are more severe and intense monitoring of prevention as well as early treatment is necessary in both controlled and uncontrolled diabetes.

Keywords: Diabetes mellitus, Oral manifestations, CPI scores, Loss of attachment.

How to cite this article: Ravindran R, Deepa MG, Sruthi AK, Kuruvila C, Priya S, Sunil S, Edward J, Roopesh G. Evaluation of Oral Health in Type II Diabetes Mellitus Patients. *Oral Maxillofac Pathol J* 2015;6(1):525-531.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

The term diabetes mellitus describes a group of disorders characterized by elevated levels of blood glucose and leads to variety of abnormalities of carbohydrate fat and protein metabolism.¹ Diabetic patients are said to exhibit poorer oral health than normal subjects. Oral manifestations of diabetes mellitus have been discussed in the literature for a long time but many controversial aspects of signs and symptoms are reviewed today.

Diabetes mellitus is an established risk factor for periodontitis. Grossi and Genco proposed a model in which severe periodontal disease increases the severity of diabetes mellitus. They describe a 'two-way relationship,' where both periodontal disease and diabetes mellitus interact to increase tissue destruction in periodontitis.² Chronic infection, LPS and AGE result in an increased inflammatory response that accounts for tissue destruction in the periodontium of diabetics.³ However, they also propose that periodontal infection induces a state of chronic insulin resistance that alters the metabolic control of glucose. Thus, a degenerative cycle ensues in which diabetes leads to a decline in the periodontal condition, which, in turn, affects metabolic control of glucose and has a negative impact on the diabetic state.

Evidence that diabetes significantly affects oral tissues is supported by data in an increasing number of publications. Diabetes causes changes in the periodontal tissues, oral mucosa, salivary gland function and oral neural functions. Additionally reproductive hormone changes during pregnancy significantly affect periodontal health in women with pre-existing and gestational diabetes.^{3,4}

The oral mucosa is normally protected by saliva when it is adequate in amount and quality. Because salivary gland function and immune function are negatively affected by diabetes, diabetic patients are at increased risk for mucosal lesions and other disorders.¹

Xerostomia or the sensation of dry mouth is reported to occur in 40 to 80% of diabetic patients and is related to

^{1,7}Professor and Head, ^{2,3}Postgraduate Student
⁴Consultant Physician, ⁵Surgeon, ⁶Professor
⁸Senior Lecturer

^{1-3,6}Department of Oral and Maxillofacial Pathology, Azeezia College of Dental Science and Research, Meeyannoor Kerala, India

⁴Department of General Medicine, Shanker's Institute of Medical Science, Kollam, Kerala, India

⁵Department of Oral and Maxillofacial Surgery, Shanker's Institute of Medical Science, Kollam, Kerala, India

^{7,8}Department of Oral and Maxillofacial Surgery, Azeezia College of Dental Science and Research, Meeyannoor, Kerala, India

Corresponding Author: Rathy Ravindran, Professor and Head, Department of Oral and Maxillofacial Pathology, Azeezia College of Dental Science and Research, Meeyannoor, Kerala, India Phone: 08281043473, e-mail: rathyravindran27@gmail.com

decreased salivary flow rates.⁴ The mechanism by which salivary flow is affected in diabetic patients is thought to be the result of autonomic nerve dysfunction or microvascular changes that diminish the ability of salivary glands to respond to neural or hormonal stimulation. Other causes may include dehydration or side effects of concomitant drug therapy commonly used in diabetic patients.⁴⁻⁶

Even though there is a strong evidence that supports the relationship between oral health and diabetes mellitus, oral health awareness is lacking among diabetic patients and health professionals. So, there is a need for physicians to be educated about various oral manifestations of diabetes so that they can be diagnosed early and timely referral to oral health specialist can be made. The present study is undertaken to determine the oral health in controlled and uncontrolled diabetic patients.

AIM

Aim was to assess the oral health status in type II diabetes mellitus patients. We compared the oral manifestations between controlled and uncontrolled diabetic patients as well as between diabetic patients and healthy controls. Oral manifestations depending on duration of Type II diabetes mellitus was also assessed.

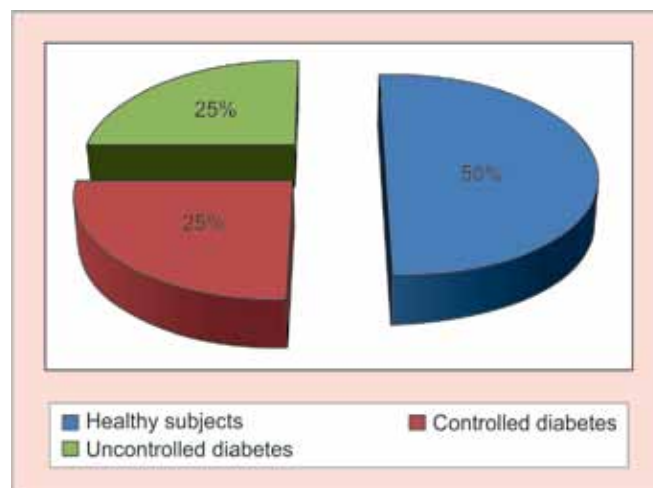
MATERIALS AND METHODS

This is a case control study conducted on patients visiting diabetic clinic in our Medical College. Study was commenced after ethical clearance from institutional board and written consent was obtained from participants. Sample was selected by simple random sampling. Patients with other systemic diseases, newly diagnosed cases with a disease duration of less than 1 year and with smoking and tobacco chewing habits were excluded from the study.

Study population consists of 60 diabetic patients and 60 healthy controls depicted in Graph 1. Diabetic patients were again divided into 30 controlled and 30 uncontrolled diabetics. Each of these diabetic groups were again divided into subgroups with 15 patients having a disease duration below 10 years and other 15 patients having a disease duration above 10 years. Patients were categorized into controlled and uncontrolled diabetics bases on the glycemic status on the day of oral examination as:

- Uncontrolled diabetes mellitus: FBS \geq 140 mg/dl, PPBS \geq 200 mg/dl.
- Controlled diabetes mellitus: FBS < 140 mg/dl and PPBS, 200 mg/dl.

Demographic details, detailed medical history, such as duration of disease, glycemic status-levels of FBS, PPBS, dietary habits, etc. were collected from patients as



Graph 1: Study population including 60 healthy subjects and 60 diabetic patients

well as from medical records. Written informed consent in lay language was obtained from each patient prior to examination.

Complete extraoral and intraoral examination to be done using, artificial light, plain mouth mirrors and probes. Periodontal probe community periodontal index of treatment needs (CPITN) probe to be used to note CPI index to assess the periodontal status. Assessment of xerostomia was done based on the following questionnaire.

- Does the amount of saliva in your mouth seem to be too little, too much, or you do not notice it?
- Do you experience occasional dryness of mouth but never continuous in nature?
- Do you get up at night because of dryness of mouth.

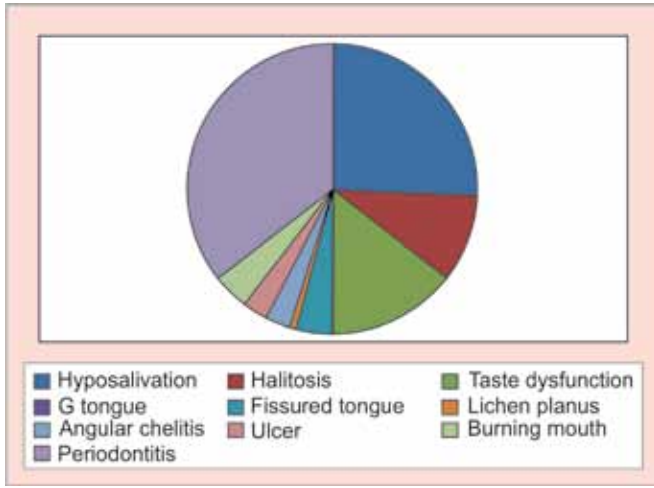
Other oral manifestations like halitosis, taste dysfunction, geographic tongue, fissured tongue, lichen planus, lichenoid reaction, leukoplakia angular cheilitis, ulcer, burning mouth are also recorded. All patient data are recorded in a case record form.

STATISTICAL ANALYSIS

SPSS Software Version 16 was used for statistical analysis. Chi-square test was used to find the significance of frequency distribution of study parameters.

RESULTS

The results show comparison of various oral manifestations observed in diabetic patients and nondiabetic group. Comparison was also done in controlled diabetes group and uncontrolled diabetes group (Graph 2). Chi-square test showed statistical significance between the groups in, halitosis, taste dysfunction, fissured tongue, angular chelitis, burning mouth and periodontitis (tooth loss). The more frequent oral manifestations observed in diabetic patients was periodontitis (85%) followed by hyposalivation (62%), taste dysfunction (35%), halitosis



Graph 2: Distribution of oral diseases and disorders in diabetic mellitus patients

(23.3%), fissured tongue (10%), ulcer (6.7%), lichen planus (1.7%) burning mouth (0.10%), angular cheilitis (Table 1). Common oral manifestations observed in controlled diabetes patients are periodontitis (83%) followed by hyposalivation (60%), taste dysfunction (33%), halitosis (26.7%), fissured tongue (6.7%), ulcer (6.7%), burning mouth (3.3). Oral manifestations in uncontrolled diabetic patients were also periodontitis (86%) followed by hyposalivation (63%), taste dysfunction (33%), halitosis (20%), fissured tongue (13%), burning mouth (17%), ulcer (6.7%) and lichen planus (3%) (Table 2). These oral manifestation showed an increase in distribution in diabetic patients when compared to nondiabetic (Graphs 3 and 4). In the present study, the most frequent oral manifestations observed in both

controlled and uncontrolled diabetic patients was tooth loss followed by hyposalivation, taste dysfunction, halitosis (Graphs 5 to 8). Distribution of oral manifestations according to disease duration in each group were also observed and percentage distribution of each manifestation is given in Table 3.

CPI scores for assessing periodontal status showed higher scores in diabetics than nondiabetics and also in uncontrolled diabetes than controlled diabetes (Tables 4 and 5). For periodontal status assessment based on disease duration, patient with higher disease duration showed higher CPI scores than those with a lesser disease duration (Graphs 9 and 10). Greater number of score 0 or healthy gingival was observed with healthy controls than diabetics. Assessment of loss of attachment in our study showed higher values in diabetic patients compared to healthy controls. Scores 1,2,3,X were more in uncontrolled diabetes compared to controlled diabetes (Tables 6 and 7).

DISCUSSION

Recognizing oral manifestation of an underlying systemic disease is a challenge. Chronic hyperglycemia leads to several events that promote structural changes in tissues and are associated with impaired wound healing, higher susceptibility to infections and micro and macrovascular dysfunctions.⁶ Alterations that are more frequently observed in the oral cavity include increased rate of dental caries, higher prevalence and severity of periodontal disease, impaired healing, burning mouth

Table 1: Distribution of oral lesions in diabetic patients and nondiabetic subjects

Oral manifestations	Diabetic (%)	Nondiabetic (%)	p-value
Hyposalivation	61.7	1.7	0.000
Halitosis	23.3	0	0.000
Taste dysfunction	35	0	0.000
Tooth loss	85	31.7	0.000
Fissured tongue	10	0	0.014
Lichen planus	1.7	0	0.500
Ulcer	6.7	11.7	0.264
Burning mouth	0.10	1.7	0.057
Geographic tongue	0	3.3	0.248

Table 2: Percentage distribution of oral lesions in controlled diabetic patients and uncontrolled diabetic patients

Oral manifestations	Controlled diabetic (%)	Uncontrolled diabetic (%)
Hyposalivation	60	63.3
Halitosis	26.7	20
Taste dysfunction	33.3	36.7
Tooth loss	83.3	86.7
Fissured tongue	6.7	13.3
Lichen planus	0	3.3
Ulcer	6.7	6.7
Burning mouth	3.3	16.7

Table 3: Percentage distribution of oral manifestations according to disease duration

Oral manifestation	Controlled diabetes		Uncontrolled diabetes	
	Duration less than 10 years (%)	Duration greater than 10 years (%)	Duration less than 10 years (%)	Duration greater than 10 years (%)
Periodontitis	73	93	80	93
Hyposalivation	66	53	60	66
Taste dysfunction	33	33	33	40
Dental caries	26	33	33	26
Halitosis	26	26	33	13
Fissured tongue	0	13	13	13
Burning mouth	0	6	6	20

Table 4: CPI score for diabetic and nondiabetic

CPI score	Diabetic	Nondiabetic
0	40	161
1	14	9
2	146	103
3	13	4
4	0	0
X	15	1
6	0	2

Table 5: CPI score for controlled diabetic and uncontrolled diabetic

CPI score	Controlled diabetic	Uncontrolled diabetic
0	19	18
1	10	5
2	80	66
3	3	9
4	0	0
X	4	9
6	0	0

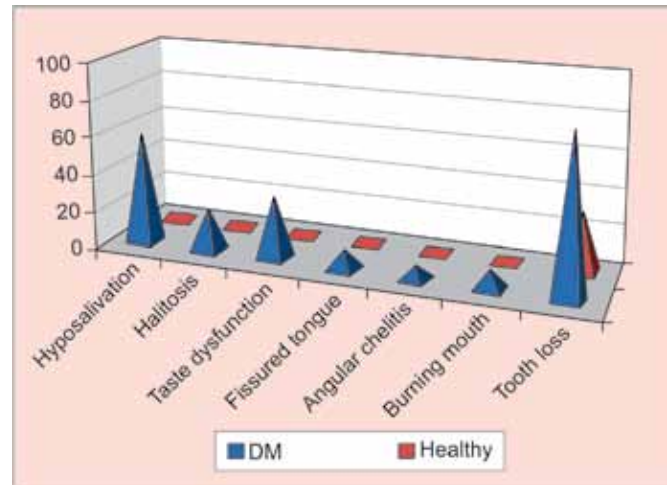
Table 6: Loss of attachment in diabetic and nondiabetic

Loss of attachment score	Diabetic	Nondiabetic
0	39	36
1	45	19
2	25	15
3	6	0
4	6	0
X	15	1
6	0	0

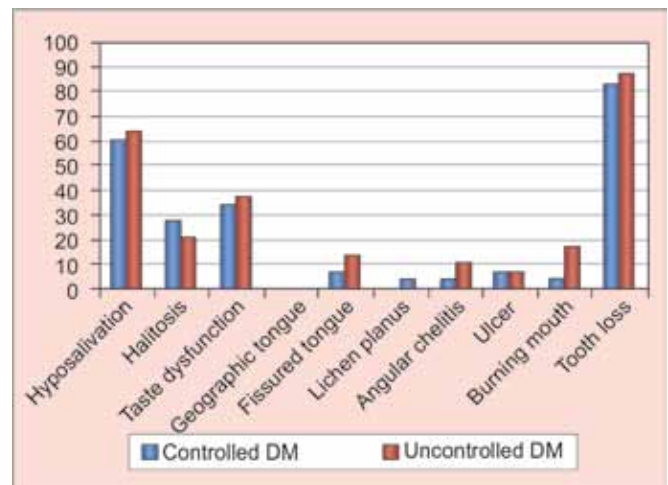
Table 7: Loss of attachment in controlled diabetic and uncontrolled diabetic

Loss of attachment score	Controlled diabetic	Uncontrolled diabetic
0	29	10
1	21	24
2	5	20
3	0	6
4	0	6
X	7	9
6	0	0

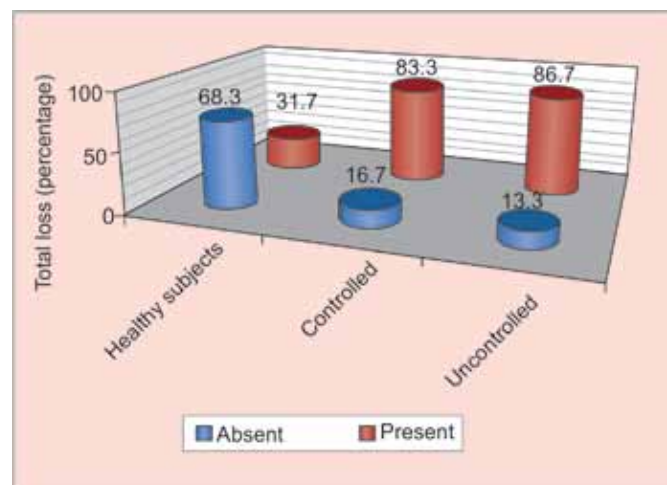
syndrome, salivary flow dysfunction and opportunistic infections.⁷ A high prevalence of oral mucosa alterations in patients with diabetes has been discussed in the literature.^{8,9} Some authors believe that certain oral manifestations are related to inadequate metabolic control of diabetes. Others believe that it might be due to immunological response, such as lower chemotaxis and phagocytosis and involvement of microcirculation with reduction of blood supply which contributes to diabetic patients more prone to infections and alterations in oral cavity.⁷ Oral healthcare workers are often the first to detect undiagnosed or untreated diabetes mellitus because of its oral manifestations.



Graph 3: Oral manifestations in diabetic mellitus and healthy subjects



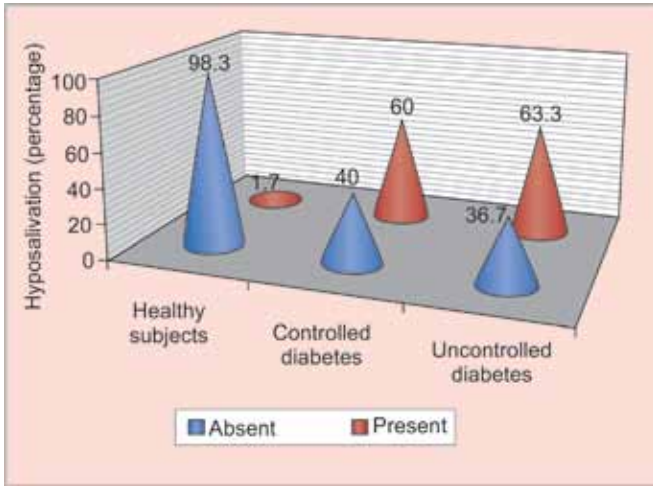
Graph 4: Oral manifestations in controlled diabetes and uncontrolled diabetes patients



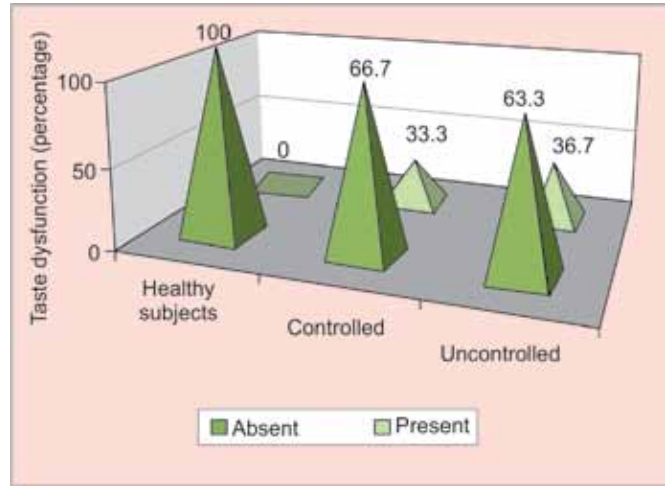
Graph 5: Tooth loss comparing in healthy subjects, controlled and uncontrolled diabetic patients

Some specific oral mucosa alterations have been associated with diabetes mellitus (DM).¹⁰ In the present study, the most frequent oral signs and symptoms observed in both controlled and uncontrolled diabetic patients was tooth loss followed by hyposalivation, taste dysfunction,

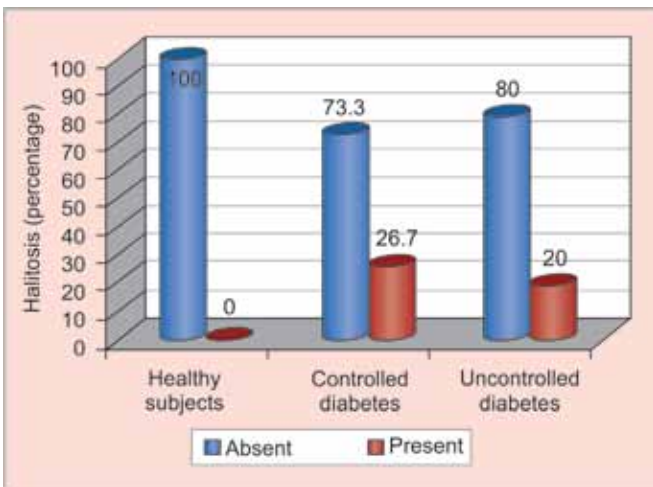




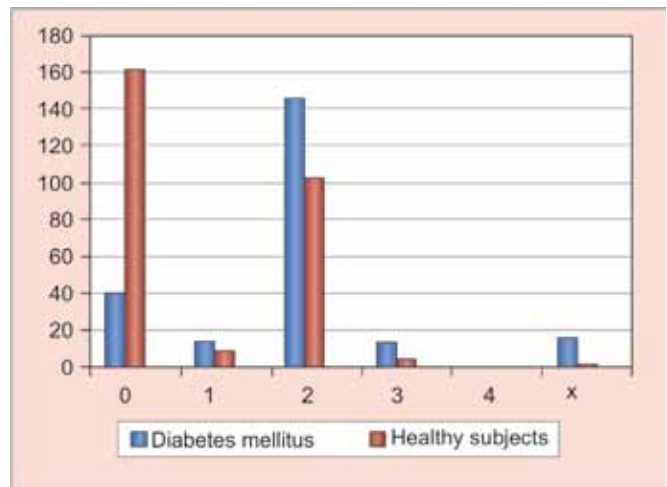
Graph 6: Hyposalivation in healthy subjects, controlled and uncontrolled diabetes



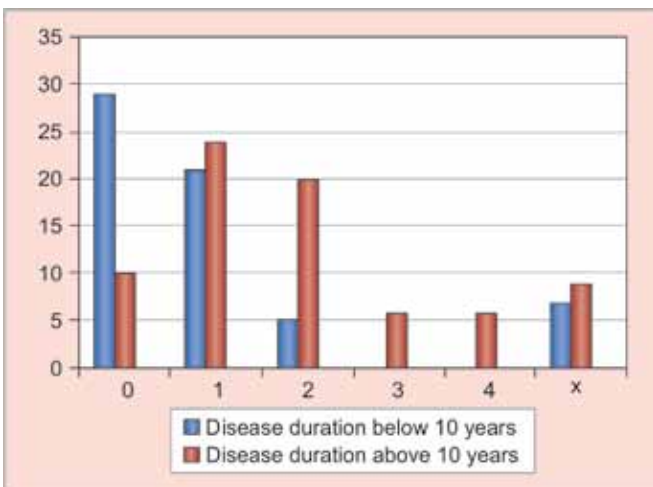
Graph 7: Taste dysfunction in healthy subjects, controlled diabetics and uncontrolled diabetics



Graph 8: Halitosis in healthy subjects, controlled and uncontrolled diabetes patients



Graph 9: Periodontal status in diabetic patients and healthy controls



Graph 10: Periodontal status based on disease duration

halitosis, fissured tongue, burning mouth, angular cheilitis, ulcer and lichen planus. Comparing controlled and uncontrolled diabetes, all these oral manifestations were increased in uncontrolled diabetes patients. Distribution of oral manifestations according to disease duration in

each group was also same. Its similar to study done by Sarita Bajaj and her results included periodontal disease in 34%, oral candidiasis in 24%, tooth loss in 24%, oral mucosal ulcers in 22%, taste impairment in 20%, xerostomia and salivary gland hypofunction in 14%, dental caries in 24%, and burning mouth sensation in 10% cases. In our study CPI scores and loss of attachment are also higher in uncontrolled diabetes.³

Incidence of tooth loss was higher in diabetic patients (uncontrolled –86.7%, controlled –83.3%) on comparing with control in our present study. We found more tooth loss due to periodontal problem in diabetic patients. Periodontal disease is the most frequent oral complications of diabetes as reported by LOE in 1993 who referred it as sixth complication of diabetes.¹ Several studies demonstrate that patients with poorly controlled diabetes have more severe periodontal disease.¹¹ Chandna et al showed periodontitis to be a recognized complication of diabetes.³ Taylor and Borgnakke identified periodontal disease a possible risk factor in diabetic patients.¹ Glavind et al, Bacie et al,

Machenz and Milford in their studies found that there is increased tooth loss in diabetic patients.^{3,12} Maike et al from his study suggested that incidence and severity of periodontitis are influenced by presence or absence of DM as well as severity of hyperglycemia.³ Diabetes with severe periodontal disease have higher risk of renal and cardiovascular complications.¹³ Increased caries incidence in diabetic patients has been attributed partially to decreased salivary flow and increased level of carbohydrates in the parotid saliva. High concentrations of salivary calcium and glucose, hyperglycemia and a lower resistance to infections, are main factors contributing to periodontal disease and dental caries, so prevalence of caries and periodontal disease among diabetes mellitus were increased, and because dental caries and periodontal disease are main reason for tooth extraction and so tooth loss.^{13,14} Diabetes mellitus especially when poorly controlled increases the risk of periodontitis periodontitis also progresses more rapidly in poorly controlled diabetics.^{15,16} Higher percentage of tooth loss may suggest that diabetic patients are not aware of oral health and necessity of oral control by which the risk of tooth loss can be decreased irrespective of type and duration of diabetes.^{17,18} For periodontal status assessment based on disease duration, patient with higher disease duration showed higher CPI scores than those with a lesser disease duration. Greater number of score 0 or healthy gingival was observed with healthy controls than diabetics whereas codes like 1,2,3, X were more in diabetic. CPI scores for codes 3 and X were higher in uncontrolled diabetes compared to controlled diabetes. Chuang et al have also assessed CPI scores and was similar to our findings.^{14,19} Assessment of loss of attachment in our study showed higher values in diabetic patients compared to healthy controls. Scores 1,2,3,X were more in uncontrolled diabetes compared to controlled diabetes. This is in accordance with many studies. Severity of periodontal destruction accelerated as diabetic progresses. This periodontal destruction was in accordance to studies done by Rosental et al, Novaes et al and Albercht et al.¹⁹⁻²² Lalla et al have also done a study on periodontal disease and relationship with diabetes mellitus incorporating attachment loss and gingival bleeding and found greater prevalence in children with diabetes mellitus.¹

Hyposalivation is another most common oral manifestation of diabetes. In the present study, hyposalivation is higher in uncontrolled diabetic (63.3%) when compared to controlled diabetes (60%). In Shrimati et al study, he noted hyposalivation as most common oral manifestations (68%) followed by halitosis (52%) and then periodontitis and all these manifestations were more in uncontrolled diabetes.²³ Sreebny et al and

von Bültzingslöwen et al, in his study got xerostomia as one of the oral manifestation of diabetic patients.¹² Hyposalivation is very common and seems to be related to polyuria and the involvement of the parenchyma of major salivary glands.¹⁰ It is suggested that the substitution of the functioning tissue by adipose tissue modifies qualitatively saliva production facilitates hyposalivation and burning mouth symptoms as studied by Russoto, Murrah, Gibson and Zachariasen.²³ On the other hand, the use of some medications, mainly diuretics, also seems to be directly associated to this condition. It is well known that most important function of saliva is the maintenance of microbiota equilibrium in the oral cavity. When saliva is decreased the pathogenicity of some species will be increased and development of new species might occur so opportunistic infection will be increased.²²

Taste alterations may be more common in people with uncontrolled diabetes mellitus and in our study taste alteration was noted 36.7% in uncontrolled diabetic patients. There are several factors contributed to taste dysfunctions. Altered taste sensation was noted in study by Sidharta et al and Wallace et al.^{22,24} Halitosis in controlled diabetes (26.7%) was more than uncontrolled. It is primarily caused by bacterial putrefaction and generation of volatile sulfur compounds.^{20,25,26}

Other oral manifestation fissured tongue, burning sensation, angular cheilitis were also noted more in uncontrolled diabetes compared to controlled diabetes in our study. This was in accordance with study done by Sidharth et al, Basker et al, Gibson et al and Collin et al.²⁶ Both lichen planus and recurrent aphthous stomatitis were statistically insignificant in our study. Lichen planus can be correlated with diabetes for academic interest alone. Studies done by Sidharta et al and Vandis et al also suggests the same.^{26,27} It is importance for dental professionals to raise the awareness of diabetic patients of their increases risk of oral diseases and impact of oral health on their general health.^{24,28}

CONCLUSION

Knowledge of oral comorbidity among people with diabetes is generally poor and suggests the need for appropriate health education and health promotion to improve oral health of diabetic patients. In order to promote oral health and to reduce the risk of oral diseases, health professionals in both dental and medical fields need to educate the public about the oral manifestations of diabetes and its complication of oral health. From our present study it is clear that oral manifestations in uncontrolled diabetes are more severe and intense monitoring of prevention as well as early treatment is necessary in both controlled and uncontrolled diabetes.



REFERENCES

1. Lamster IB, Lalla E, Borgnakke WS, Taylor GW. The relationship between oral health and diabetes mellitus. *JADA* 2008; 139(Suppl 5):19S-24S.
2. Debora C, Matthews D. The relationship between diabetes and periodontal disease. *J Can Dent Assoc* 2002;68(3): 161-164.
3. Bajaj S, Prasad S, Gupta A, Singh VB. Oral manifestations in type 2 diabetes and related complications. *Ind J Endo Metab* 2012;16:777-779.
4. Gandara BK, Morton TH Jr. Nonperiodontal oral manifestations of diabetes: a framework for medical care providers. *Diabetes Spectrum* 2011;24(4):199-204.
5. Álamo SM, Soriano YJ, Pérez MGS. Dental considerations for the patient with diabetes. *J Clin Exp Dent* 2011;3(1):25-30.
6. Asha V, Latha S, Pai A, Srinivas K, Ganapathy KS. Oral manifestations in diabetic and nondiabetic chronic renal failure patients on hemodialysis. *JIAOMR* 2012;24(4):274-279.
7. Alliny de Souza Bastos A, Andressa Rosa Perin Leite A, Rubens Spin-Neto A, Patrícia Oehlmeyer Nassar B, Elaine Maria Sgavioli Massucato, Silvana Regina Perez Orrico A. Diabetes mellitus and oral mucosa alterations: Prevalence and risk factors, diabetes research and clinical practice 2011;92:100-105.
8. Rozeli M, Esther G, Claudate R. Oral manifestations of diabetes mellitus in controlled and uncontrolled patients. *Braz Dent J* 1995;6(2):131-136.
9. Hamadneh S, Dweiri A. Oral manifestations in controlled and uncontrolled diabetic patients—a study in Jordan. *Pakistan Oral Dental J* 2012;32(3):456-460.
10. Al-MAweri SAA, isMAil MN, isMAil AR, Al-GhAshM A. Prevalence of oral mucosal lesions in patients with type 2 diabetes attending Hospital Universiti Sains Malaysia. *Malays J Med Sci* 2013 Jul-Oct;20(4):39-46.
11. Bharateesh JV, Ahmed M, Kokila G. Diabetes and oral health: a case control study. *Int J Prev Med* 2012;3(11):806-809.
12. Busato IMS, Machado MAN, Brancher JA, de Lima AAS, Deantoni CC, Réa R, Azevedo-Alanis LR. Impact of hyperglycemia on xerostomia and salivary composition and flow rate of adolescents with type 1 diabetes mellitus. *Pontifical Catholic University of Paraná Brazil* 2007;434-439.
13. Alex C, Bandar M, Juliana. Oral health knowledge in children with type 1 diabetes. *Ind J Pas Med* 2007;3:806-809.
14. Chuang SF, Sung JM, Kuo SC, Huang JJ, Lee DSY, Tainan. Oral and dental manifestations in diabetic and nondiabetic uremic patients receiving hemodialysis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2005;99:689-695.
15. Abobakir A, Bakhtiar. Oral manifestations of type 2 diabetes mellitus. *Kurdistan Academicians J* 2006;4(1):95-109.
16. Southerland JH, Taylor GW, Offenbache S. Diabetes and periodontal infection: making the connection. *Clinical Diabetes* 2005;23(4):171-178.
17. Straka M. Oral manifestations of diabetes mellitus and influences of periodontological treatment on diabetes mellitus. *Bratisl Lek Listy* 2011;112(7):416-420.
18. Moore PA, Weyent RJ, Beth M, Karen D, Guggenheimer J, Harvey M Block Heidi Huber, Type 1 diabetes mellitus and oral health: assessment of periodontal disease. *J Periodontol* 1999;70(4):411-416.
19. Khader YS, Albasbarrah, Haminanad. Periodontal status of type 2 diabetics compared with nondiabetics in north Jordan. *East Mediterr Health J* 2008 May-Jun;14(3):654-661.
20. Murali P, Narasimhan M, Periasamy S, Harikrishnan TC. A comparison of oral and dental manifestations in diabetic, and nondiabetic uremic patients receiving hemodialysis. *JOMFP* 2012;16:374-378.
21. Kaisa K. Periodontal diseases, dental caries, and saliva in relation to clinical characteristics of type 1 diabetes. *Acta Univ Oul D* 2000;587:10-23.
22. Awatif Y, Masoud Y, Salem. Oral manifestations and complications of diabetes mellitus. *Squ Med J* 2011;11:180-186.
23. Shrimali L, Astekar M, Sowmya GV. Correlation of oral manifestations in controlled and uncontrolled diabetes mellitus. *Int J Oral Maxillofac Pathology* 2011;2(4):24-27.
24. Eldarrat A. Diabetic patients: their knowledge and perception of oral health. *Libyan J Med* 2011;6:5691-5699.
25. Khalid A, Abdulrahman B. Diabetes Mellitus and its oral complications: A brief review. *Pakistan Oral and Dent*, 2006; 26:97-104.
26. Gupta S, Kumar AC. A comparative study on oral manifestations of controlled and uncontrolled type 2 diabetes mellitus in South Indian patients. *J Ind Acad Oral Med Radio* 2011;23:521-526.
27. De Menezes MG, De Lisboa A, Roncalli AG. Clinical study of oral manifestations and related factors in Type 2 diabetes patients. *Braz J Otorhinolaryngol* 2011;77(2):145-149.
28. Jonathan a Ship. Diabetes and oral health: overview. *JADA* 2003;134:54-59.