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Saliva as an Indicator of Diabetes in Oral Cavity

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Abstract

***Contex:** The prevalence of diabetes in Albania in the adult population is 1.9%, which means that here are approximately 60,000 diabetics patients. In fact, the number should be 2-3 times higher, as in some screenings performed in Tirana (in 2004, 2006, 2008, 2009, 2010) the prevalence of undiagnosed diabetes was 3-4%.*

***Aims:** Our study aims to find the possible link between oral lesions and changes in composition and amount of saliva produced in diabetic patients.*

***Materials and Methods:** The study was conducted in 37 patients, of whom 22 were diabetic, regardless of type of diabetes or glycemic control, and 15 were healthy patients. In the study, measurements of stimulated saliva and saliva norms have been selected to compare the median values of these amounts.*

***Results:** The study resulted in 17 patients with xerostomia: 5 patients with xerostomia were from the group of non-diabetic patients and 12 from the group of diabetics. In terms of ions, the differences were slightly larger, but not significant, respectively 17 and 24, while the ions of Cl had a significant difference, respectively 26 and 36. There is a significant difference between salivary pH at diabetic patients (pH = 5.9), compared to non-diabetic patients (pH = 7). The level of glucose in the saliva speaks of large differences, respectively glucose levels in saliva in diabetic patients, were 4,6 and in non-diabetic patients 1,7.*

***Conclusions:** Saliva stimulus is noticeable both in diabetic patients and in control group patients, although in diabetic patients such as saliva and stimulated saliva are reduced, significantly reduced. Collected saliva quantities show significant correlation with patient age and gender, correlations based on literature. Fluctuations in ion, in glucose, in salivary pH lead to the appearance of oral lesions typical of diabetic patients.*

Introduction

The prevalence of diabetes in Albania in the adult population is 1.9%, which means that here are approximately 60,000 diabetics patients. In fact, the number should be 2-3 times higher, as in some screenings performed in Tirana (in 2004, 2006, 2008, 2009, 2010) the prevalence of undiagnosed diabetes was 3-4%. As a result, the approximate figure for diabetics should be 120-150 thousand.(1) The number of deaths in the world caused by diabetes, amounts to 5milion a year, compared with the number of deaths from HIV/AIDS to 1.5 Million, from tuberculosis to 1.5milion and from males 0.6milion a year. There are data released by WHO and IDF in 2015, regarding observations made in 2013.

The unique content of the oral saliva is an element that should be kept immutable, to protect the constituent elements, oral mucous membranes in its integrity. This content is affected by the lack of ion balance, the level of glucose flowing into the oral cavity, saliva or gingival fluid, from the pH level. All three of these elements when are combined together create the appropriate conditions for filling the saliva function in the oral cavity, not only as a lubricant in quantity but also as a food wrap, in quality, and as a primary protector against bacterial, viral attacks and fungus; as a protector of external traumas that cause normal micro trauma in the mucosal layer of oral cavity.

Periodontal tissue health is reflected in evaluation by periodontal indexes. These indices reflect logically all

the changes that periodontal tissues do to the influence of local and systemic factors. The purpose of the study is to evaluate diabetic patients, regardless of the type of diabetes, as systemic illnesses that affected patients suffer in different time periods, and which initially affects the reduced amount of saliva. This reduced amount of saliva, coupled with sensitive ion oscillations, Na, Cl and K, are associated with manifestations of soft tissue lesions in the oral cavities of diabetic patients. The purpose of the study is to first estimate the lubricating function of the saliva. Here begin the immune defense mechanisms to adapt to the minimum amount of saliva produced and the high presence of glucose in the saliva. The interlacing of these elements, which work in time give the typical characteristics of diabetes as a cause of soft tissue lesions in the oral cavity. Our study aims to find the possible link between oral lesions and changes in composition and amount of saliva produced in diabetic patients. In the study, measurements of stimulated saliva and saliva norms have been selected to compare the median values of these amounts to the diabetic patient group and to the healthy patient group.

All the above, are documented with photos and specimens of saliva collected by the patients involved. In essence, these are elements that stimulate and push us to collect, to select the patients involved in this micro-study, to collect the data according to the diagnostic tools and to produce results that will probably be in the future an incentive to seek further this co-operative link to the destructive processes of soft tissues and the destructive systemic processes of a disease considered to be an epidemic, such as diabetes with typical complexity, with typical orally occurring characteristics, as well as systemic. Glucose levels in diabetes saliva in many studies have been reported to be significantly higher in diabetic patients compared to non-diabetic patients.[2,3,4] The high level of glucose in saliva is a consequence of high glucose levels in the blood plasma, from which saliva is formed. The high level of glucose in the saliva together with the decreased salivary flow has also been reported to be responsible for the dry mouth complaint from diabetic patients.[5]

In addition, high glucose levels in saliva of diabetic patients may contribute to increased sensitivity to oral infections, such as periodontitis and dental care. [6] The hyperglycemic environment can reduce tissue turnover and matrix synthesis from fibroblasts and osteoclasts. As the result of this process, the healing of the wounds is delayed.[7]

Materials and Methods

The study was conducted with 37 patients, of whom 22 were diabetic, regardless of type of diabetes or glycemic control, and 15 were healthy patients. In the selection of patients, we have tried to adapt the age, gender and socio-health status among diabetics and patients of the control group. Every patient involved in the study is well informed, and then agreed with full consensus to become part of the study, and then proceed with the established protocol. Continuous data were presented in average and standard deviation, while discrete data were presented in absolute value and in percentage. Graphs and tables of different types (simple and solid) are used to present the data. Fisher's Test was used to make a comparison in table 2x2, data summarized from excel central table. P values smaller than 0.05 were considered statically important. Statistical analysis was carried out mainly SPSS Modeler Premium Campus Edition version 15 and partly through the MS Excel program.

Changes in the level and balance of ions in the saliva are unclear whether diabetes affects, or not these parameters, despite the fact that there are studies [4-7] where these parameters have been taken into account and their relationship with lesions occurring in the oral cavity. The acidic environment resulting from lowering the pH from high concentrations of glucose in the saliva is a factor that contributes to the mechanism of the appearance of soft tissue lesions in the oral cavity. The purpose of the study is to evaluate the correlation between salivary pH, glucose level in saliva and present ions, with lesions occurring in the oral cavity, making comparisons between diabetic and non-diabetic patients. Measurement and comparison of salivary levels in diabetic patients and non-diabetic patients will be accompanied by the measurement and comparison of ions present in the saliva between diabetic and non-diabetic patients and the measurement and comparison of salivary and glucose pH in both diabetic and non-diabetic patients.

The age of 20 to 80 was set as the age-selective selection of patients because it was perceived as appropriate as it would include the first type of diabetic type as well, while the study was planned on both types of diabetes. The decision for this age group was also based on information obtained from

literature.[8] As exclusion criteria, it was decided for all patients suffering from a general illness that could alter salivary levels besides diabetes, and all patients using media that alter the amount of saliva. Sterile 5ml syringes were finally plugged with wax or burning in the alcohol bulb so that we would never have a leak of the accumulated saliva. The glass hose was disinfected and washed with running water for a minute. This procedure was followed for each patient. After the tools were prepared, the procedure and duration were explained to the patient. Patients were asked to sit in the lowered position with their head bent forward, as this increased the patient's stimulation not to overcome saliva produced. Two pinched syringes were used for each of the patients: one for saliva collection rate and one for stimulated saliva collection. Syringes were chosen for saliva collection because we perform precise measurements, as they are millimeters, and are sterile. The funnel was placed in one of the syringes, and was given the patient in hand together with the syringe, asking to spit whatever was produced in the mouth, inside the hammock for 2 min. The funnel served as a syringe saliva collector, later to serve for transport to the lab. Time was measured with stopwatch and the patient was induced to perform the assigned protocol. After the chronometer scored two minutes, the patient was asked to stop. The syringe was sealed and placed on a sterile holder, while in the lower lip of the patient, at the level of the lower salivary glands, it was sprayed with citric acid and allowed to operate for two minutes. After two minutes, the cotton swab was discarded. The acid served as a stimulant for salivary glands. Figure 1 shows the tools used for carrying out the work protocol. Figure 2 shows some of the analysis of saliva collected.

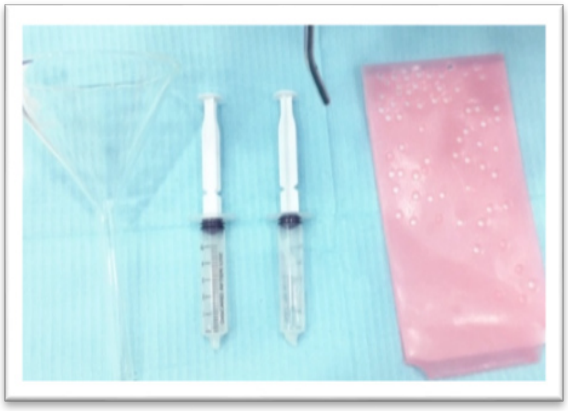


Figure 1. *In this figure are presented all working tools, to apply the defined study protocol.*

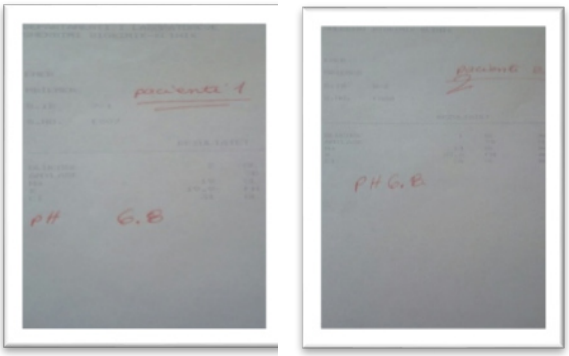


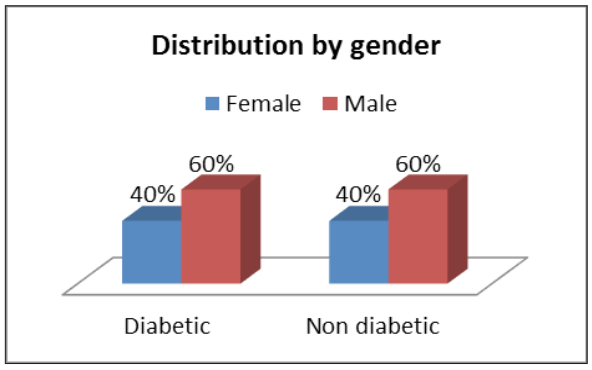
Figure 2. *The figure presents pictures of some of the analysis sheets. It is worth mentioning that patients are marked with their preference numbers, to be identified in the following stages of the working protocol.*

Results

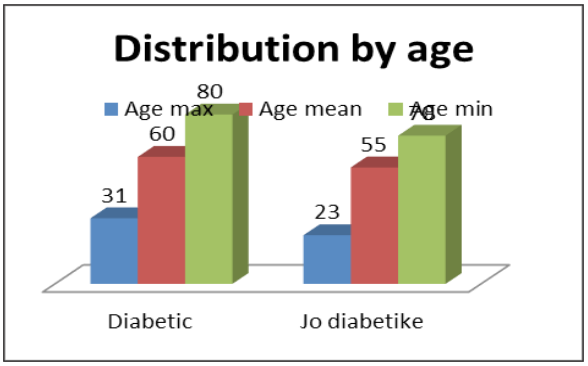
The results collected will be reflected in the relevant tables, according to the specifics of the purposes of this study. Table 1 reflects the data related to the demographic information of patients with diabetic and non-diabetic status. These data are shown more clearly in the Graph 1 for the distribution of patients by gender and diabetic/nondiabetic status.

Table 1. *Demographic information of diabetic and non-diabetic patients included in the study.*

Variables	Category	Non-diabetic n=15		Diabetic n= 22	
		Frequency	%	Frequency	%
Gender	Female	6	40	8	40
	Male	9	60	14	60
Race	White	14	93	21	95,3
	Black	1	7	1	4,7
Age	Min	23		31	
	Mean	55		60	
	Max	70		80	



Graph 1. *The graph reflects the distribution of patients by gender and diabetic/non-diabetic status.*

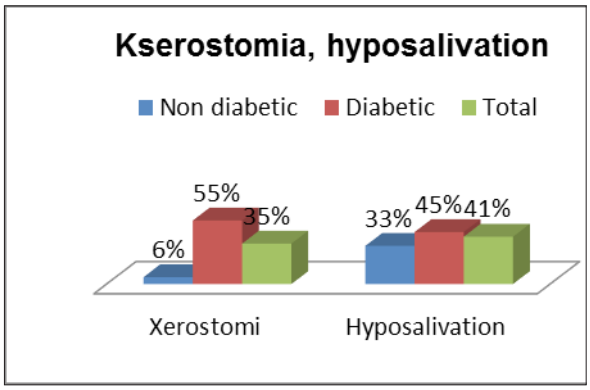


Graph 2. *The graph shows the distribution of patients by age, average and maximum, grouped by diabetic/ non-diabetic status.*

Table 2 and Graph 3 show patients distributed according to the complaint for xerostomia, and according to the hyposalivation observed in the performed measurements. Xerostomia is the subjective feeling of dry mouth when the patient clings to the dry mouth, while hyposalivation is an objective data where the measurement results in a decrease in the amount of saliva. Xerostomia is often associated with hyposalivation, but not always and in many cases xerostomia is presented to patients with normal salivary levels.[4] The study resulted in 17 patients with xerostomia, but 12 of them exhibited hyposalivation. Only 5 patients with xerostomia were from the group of non-diabetic patients and 12 from the group of diabetics; 12 patients with hyposalivation were from the group of diabetics.

Table 2. *Presentation of hyposalivation and xerostomia.*

Pathology	Non Diabetic n=15		Diabetic n=22		Total n=35	
	Frekuency	%	Frekuency	%	Frekuency	%
Hyposalivation	1	6	12	55	13	35
Xerostomia	5	33	10	45	15	41

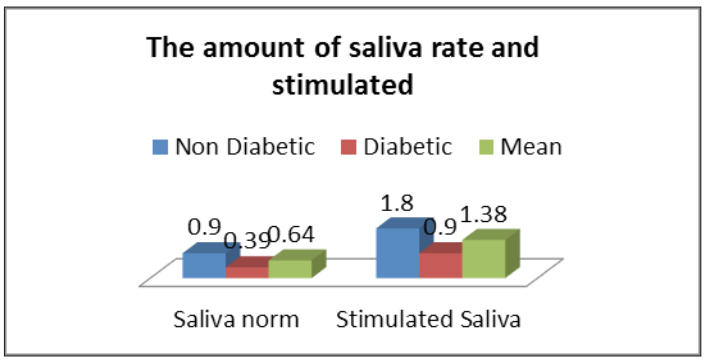


Graph 3. *The graph depicts the presence of xerostomia and hyposalivation by diabetic status.*

In the table below, patients are grouped depending on the amount of saliva (stimulated, or non-stimulated) divided by diabetic status. It resulted in oscillations of stimulated and non-stimulated salivary amounts in both groups. Also, a significant difference was observed between the diabetic and non-diabetic group, where diabetic patients had a lower saline rate, whether stimulated or not, compared with non-diabetic patients.

Table 3. *Patients are grouped in the table depending on the amount of non-stimulated saliva and the stimulated, according to diabetic status.*

	Non diabetic	Diabetic	Mean
Saliva norm ml/min	0.9	0,39	0,64
Stimulated saliva ml/min	0,9	1.8	1,38

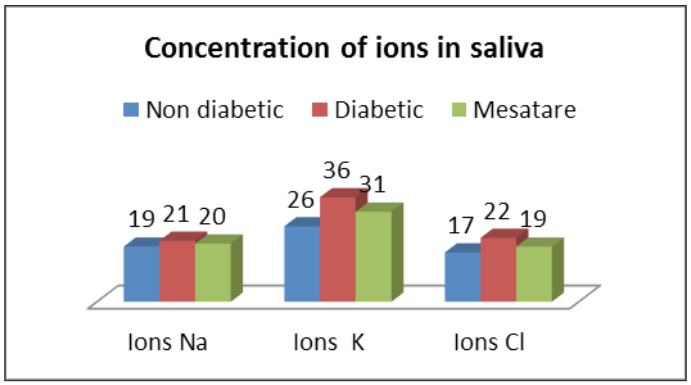


Graph 4. *The chart represents the difference in salivary quantity, whether rate or stimulated depending on diabetic status.*

Table 3 and Graph 5 show changes in saliva component ions, grouped according to non-diabetic and diabetic patients. Differences in the ions of Na between non-diabetics and diabetics were not significant, not significant, respectively 19 and 21. In terms of ions, the differences were slightly larger but not significant, respectively 17 and 24, while the ions of Cl had a significant difference respectively 26 and 36. A larger number of ions were observed for all three variables except in diabetic patients compared to non-diabetic patients.

Table 3. *The table presents changes in the values of Na, Cl and K ions in diabetic patients and in non-diabetic patients.*

	Non diabetic	Diabetic	Mean
Ions Na	19	21	20
Ions K	17	24	21
Ions Cl	26	36	31

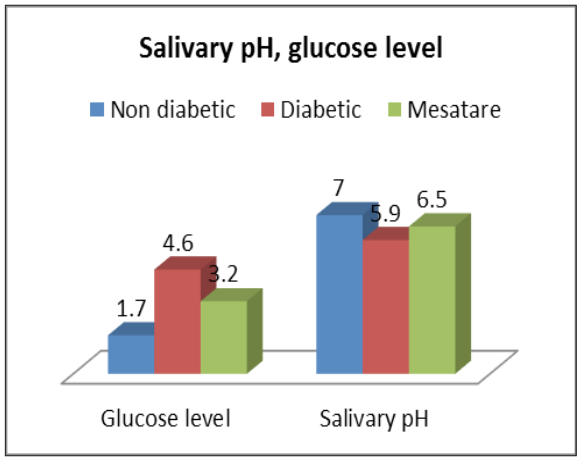


Graph 4. *The graph shows the differences between Na, K, Cl ions grouped by diabetic status.*

In table no. 4 and in Graph no.5 the level of oral cavity pH and the level of glucose present in the saliva are grouped according to the diabetic status. There is a significant difference between salivary pH in diabetic patients in the direction of high acidity, respectively pH = 5.9, compared to non-diabetic patients, where the pH resulted basically pH = 7. Regarding the level of glucose in the saliva, the differences were greater. Glucose levels in saliva in diabetic patients were 4,6 and in non-diabetic patients 1,7. In Table 5 and in Graph 6, the level of oral cavity pH and the level of glucose present in the saliva are grouped according to the diabetic status.

Table 4. *Glucose and pH values of saliva, diabetic and non-diabetic patients are presented in this table.*

Salivary parameters	Diabetic	Non-diabetic	Mean
The level of glucose	1,7	4,6	3,2
Salivary pH	7	5,9	6,5



Graph 5. *At this chart is prescribed the level of glucose and salivary pH grouped by diabetic status.*

Discussions

Female male ratio in diabetic patients was respectively 40% at 60%. This ratio is consistent with the atlas of diabetics, where it is reported that males are more affected by diabetes than women in the 3: 2 ratio.[9] This study showed that diabetic patients complained of dry mouth (xerestomia) diabetic patients and this is consistent with the literature that both types of T1DM and T2DM diabetes mellitus have been associated with many studies with xerostomia.[2,4,8,10,11,12,29] The study showed a higher percentage of diabetics who suffered from hyposalivation compared to healthy patients. Hyposalivation as a criterion was considered only in two studies, both of which showed that diabetic patients suffered more from hyposalivation than non-diabetic patients.[4,11]

Regarding the difference in saliva, whether stimulated or not stimulated, between diabetic and non-diabetic patients resulted that diabetic patients have less salivary amounts, both stimulated and non-stimulated, than healthy individuals. This result is also supported by findings from 15 different studies. [2,4,8,10,11,12,13,14,15,16,17,18,19,20,29] The reasons for these problems may be from damage to the parenchyma, alterations in microcirculation of salivary glands, dehydration and alterations in glycemic control.[22]

In this study, the glucose level in saliva of diabetics was significantly higher than that of non-diabetic subjects, in line with findings from previous studies.[2,3,4,21,23] The high glucose level in the saliva is a consequence of the high plasma glucose level from which saliva is formed. This high level of glucose in the saliva may be associated with the reduced overall salivary flow, which is also reported to be responsible for the complaint of dry mouth or xerostomia by diabetic patients.[5] In addition, the high level of saliva[6] the hyperglycemic environment can reduce tissue turnover and matrix synthesis from fibroblasts and osteoclasts.[6] As a result, tissues are weaker and more susceptible to pathologies and healing of wounds is delayed.[7]

The link between blood glucose levels and glucose level in the saliva is already known[24], but now different studies[25,26] have shown correlation between increased levels of glucose in saliva and the presence of candida and oral candidiasis in the oral cavity and consequently lesions caused by it, thus proving us that diabetes does not affect oral lesions solely systemically, but also through local mechanisms. Regarding potassium, the concentration of this ion has been found to be more adult in diabetic patients compared to non-diabetic patients. Similar findings have been reported by some studies.[10,27,28] The estimation of potassium concentration in saliva of diabetic patients probably results from a secondary complication of diabetes, such as decreased saliva production and not directly.[27]

The current study did not show any significant change in the concentrations of Na, Cl in the saliva of diabetic patients compared to the non-diabetic control group. This is in line with the report in these studies.[27,29] This element may be due to the untouched secretory capacity of salivary gland type II diabetes. In addition, Na ions are measured secreted at concentrations per minute in saliva[30] and this may imply the absence of a significant difference.

References

[1] Bricker, S.L.; Langlais, R.P.; Miller, C.S. Oral Diagnosis, Oral Medicine and Treatment Planning, 2nd ed.; Hamilton, Ont.: London, UK, 2002; p.470-481.

[2] Ben - Aryeh H, Serouya R. Kanter Y, Szargel R, and Laufer D. (1993). Oral health and salivary composition in diabetik patients. J. Diabetes complication; 7(1). 57-62.

[3] A yadin S.A. (2007). Comparison of ghrelin, glucose, alpha amylase and protein levels in saliva from diabetiks. J Biochem Molecular Biol; 40: 29-35.

[4] Vasconcelos A.C., Soares M.M., Almeida P.C., Soares T.C. (2010). Comparative study of the concentration of salivary and blood glucose in type 2 diabetik patients. J Oral Science; 52: 293- 298.

[5] Twetman S, Johansson I, Birkhed D, and in Nederfors T.(2002). Caries incidence patients in relations to metabolic control and caries associated risk factors. Caries Res; 36(1). 312- 335.

[6] Tervonen T., Kunnutila M. (1986). Relation of diabetes control to periodontal pocketing and alveolar bone level. Oral Surg Oral Med Oral Pathol;64:346-349.

[7] Rammamuthy NS and Golub I.M.. (1983). Diabetes increases collagenase activity in extracts of rat gingiva and skin . J Perio Research; 18: 23-30.

[8] Sandberg GE, Sundberg HE, Fjellstrom CA and Wikblad KF. Type 2 diabetes and oral health: a comparison between diabetic and non-diabetic subjects. Diabetes Res Clin Pract.2000; 50:27-34.

[9] International Diabetes Federation, IDF Diabetes Atlas, 7th ed. Chaussée de La Hulpe 166B-1170 Brussels | Belgium 2015.

[10] *Lasisi T.J. and Fasanmade A.A.Salivary flow and composition in diabetic and non-diabetic subjects. Niger. J. Physiol. Sci. 27(June 2012) 079 – 082.

[11] Bernardi M. J., Reis A., Loguercio A. D., Kehrig R., Leite M. F., Nicolau J. Study of the buffering capacity, pH and salivary flow rate in type 2 well-controlled and poorly controlled diabetik patients. Oral Health & Preventive Dentistry. 2007;5(1):73–78. [PubMed]

[12] Sandberg G. E., Sundberg H. E., Wikblad K. F. A controlled study of oral self-care and self-perceived oral health in type 2 diabetik patients. Acta Odontologica Scandinavica. 2001;59(1):28–33. doi: 10.1080/000163501300035742. [Pub Med] [Cross Ref]

[13] Zielinski M. B., Fedele D., Forman L. J., Pomerantz S. C. Oral health in the elderly with non-insulin-dependent diabetes mellitus. Special Care in Dentistry. 2002;22(3):94–98. doi: 10.1111/j.1754-4505.2002.tb01169.x. [PubMed] [Cross Ref]

[14] Javed F., Sundin U., Altamash M., Klinge B., EngstrÖm P.-E. Self-perceived oral health and salivary proteins in children with type 1 diabetes. Journal of Oral Rehabilitation. 2009;36(1):39–44. doi: 10.1111/j.13652842.2008.01895.x. [PubMed] [Cross Ref]

[15] Edblad E., Lundin S.-Å., Sjödin B., Åman J. Caries and salivary status in young adults with type 1 diabetes. Swedish Dental Journal. 2001;25(2):53–60. [PubMed]

[16] de Lima D. C., Nakata G. C., Balducci I., Almeida J. D. Oral manifestations of diabetes mellitus in complete denture wearers. The Journal of Prosthetic Dentistry. 2008;99(1):60–65. doi: 10.1016/s0022-3913(08)60010-4. [PubMed] [Cross Ref]

[17] Chavez E. M., Taylor G. W., Borrell L. N., Ship J. A. Salivary function and glycemic control in older persons with diabetes. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics. 2000;89(3):305–311. doi: 10.1067/moe.2000.103287. [PubMed] [Cross Ref]

[18] Alves C., Menezes R., Brandão M. Salivary flow and dental caries in Brazilian youth with type 1 diabetes mellitus. Indian Journal of Dental Research. 2012;23(6):758–762. doi: 10.4103/0970-9290.111254.[PubMed] [Cross Ref]

[19] López M. E., Colloca M. E., Páez R. G., Schallmach J. N., Koss M. A., Chervonagura A. Salivary characteristics of diabetik children. Brazilian Dental Journal. 2003;14(1):26–31. doi: 10.1590/s0103-64402003000100005. [PubMed] [Cross Ref]

[20] Belazi M. A., Galli-Tsinopoulou A., Drakoulakos D., Fleva A., Papanayiotou P. H. Salivary alterations in insulin-dependent diabetes mellitus. International Journal of Paediatric Dentistry. 1998;8(1):29–[PubMed]

[21] Dhanya M, Hedge S. salivary glucose as a diagnostic tool in Type II diabetes mellitus: a case control study. Niger J Clin Pract. 2016, Aug:19(4):486-90

[22] Mjeksia Orale,Mealey,DDS,MS kap. "Diabeti Mellitus",fq. 651-665

[23] Gibson J, Lamey PJ, Lewis M, Frier B. Oral manifestations of previously undiagnosed non-insulin dependent diabetes mellitus. J Oral Pathol Med 1990;19:284–7.

[24] Dhanya M, Hegde S. "Salivary glucose as a diagnostic tool in Type II diabetes mellitus: A case-control study". Niger J Clin Pract 2016;19:486-90.

[25] Kumar S, Padmashree S, Jayalekshmi R. Contemp Correlation of salivary glucose, blood glucose and oral candidal carriage in the saliva of type 2 diabetiks: A case-control study. Clin Dent. 2014 Jul; 5(3):312-7.

[26] Sashikumar R, Kannan R. Salivary glucose levels and oral candidal carriage in type II diabetiks. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2010 May; 109(5):706-11.

[27] Mata A.D., Marques D., Rocha S., Francisco H., Santos C., Mesquita M.F., Singh J. (2004). Effects of diabetes mellitus on salivary secretion and its composition in human. Molecular and cellular Biochemistry; 2: 137-142.

[28] Yavvzyilmaz E., Yumak O., Akdoganli T, et al.(1996). The alterations of whole saliva constituents in patients with diabetes mellitus. Australian Dental Journal; 41: 193-197.

[29] Dodds M.W.J., Yeh C.K., Johnson D.A. (2000). Salivary alterations in type 2 (non-insulin dependent) diabetes mellitus and hypertension. Community Dentistry and Oral Epidemiology, 28: 373-381.

[30] Karin M. Hold Bs, Daouwe de Boer, Jan Zuidema, Robert A.A. Maes; "Saliva as an analytical tool in Toxicology"; International journal of drug testing; Vol:1 Issue:1 Dated:1999 Pg:1 to 36.

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