The Comparison of Tooth Pulp Electrical Threshold in Patients with Type II Uncontrolled Diabetes and Healthy Subject

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Abstract

Objective: Diabetic patients suffer from different types of complications associated with peripheral nerves. A clear manifestation of these complications is found in the mouth where neuropathies commonly occur. The measurement of electrical stimulation threshold of teeth signifies premature involvement of peripheral nerves in the teeth. The aim of present study is to compare pulp tester response in uncontrolled type II diabetic (T2DM) patients and people with normal systemic conditions.

Materials and Methods: In this case-control study, 63 subjects in two groups of diabetic patients (n=30) and control (n=33) were studied. For each group, the electrical stimulation thresholds of higher-jaw central teeth were measured and recorded. The collected data was analyzed via SPSS Software (version. 17). The difference between mean thresholds of electrical stimulation of teeth between the two groups was verified based on T-test. In addition, Chi-square test was used for determination of association between qualitative variables. In this study, the significance level was presumed to be *P*-value<0.05.

Results: The mean threshold of electrical stimulation in diabetic patients was 3.8 with standard deviation (SD) 1.01 and in control group was 3.7 (±0.9). The difference between two groups was insignificant (*P*-value:0.483). In addition, the association between age and threshold of stimulation was not significant (*P*-value:0.06).

Conclusion: Despite of observed difference between test and control groups in regard to electrical stimulation threshold, the obtained results were insignificant. This extent of simulation in dental nerves in patients with uncontrolled T2DM and controls was similar.

Keywords: Electrical stimulation threshold, Pulp test, Diabetes, Neuropathy

Introduction

Diabetes is a chronic disease with glucose metabolism or blood sugar dysfunction. (1) Uncontrolled blood glucose is correlated with increased risk of vascular complications, myocardial infarction, stroke, and neuropathy in diabetic patients.

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(1,2) The exclusive characteristics of diabetes include: hyperglycemia, micro-vascular damages (with involvement of retina, renal glomerulus and peripheral nerves) and macro-vascular damages (atherosclerosis, coronary heart disease and stroke). (2)

It is estimated that 20 to 30 million people worldwide are inflicted with symptomatic diabetic neuropathy which will increases 100% until 2030. The risk of diabetic neuropathy increased with long time duration of diabetes and lack of control over blood sugar. Severe diabetic polyneuropathy could be recognized in young patients with type I diabetes (T1DM) with poor blood glucose control during the first months of diabetes diagnosis. (3) Based on world health organization (WHO) reports, the prevalence of diabetes in Iran in 1995 and 2000 were 5.5 percent (1.6 million people) and 5.7 percent (1.9 million individuals). The value is estimated to increase to 6.8 percent (5.1 million people) in 2025. (3-5)

In all patients with type II diabetes (T2DM) and patients with more than five years of diagnosis with T1DM, diabetic neuropathy is possible. Diabetic neuropathy is a common disorder with peripheral nerves disorder in diabetic patients. (6) Diabetic neuropathy is categorized into two major types of sensory-kinetic and autonomic. Diabetic mono-neuropathy often involves third and sixth cranial neurons. (6,7)

The teeth are innervated by alveolar branches of fifth cranial nerve (trigeminal nerve). Maxillary branch innervates upper jaw and mandibular branch innervates lower jaw. Dental pulp is a tissue with abundant nerve cords which include sensory axons of trigeminal. (8,9)

The determination of pulp status is significant for treatment of teeth roots. Determination is done based on existing clinical symptoms, background, signs, diagnostic tests and clinical findings. (7) A sensitive part of an endodontic examination is vitality test of pulp. Even despite of vivid radiographic evidence of periapical pathology, vitality test is essential for determination of dental status. (7,9)

Based on the conducted searches, there was no published study on sensory impairment of dental pulp which signifies neuropathy due to involvement of trigeminal nerve branches among diabetic patient. Therefore, the aim of present study is to compare pulp tester response in uncontrolled T2DM patients and people with normal systemic conditions.

Materials and Methods

In the present control-case study, T2DM patients who were visited in Yazd diabetes research center were included. The control group included healthy individuals who lacked systemic diseases and preferentially visited dentistry faculty of Shahid Sadoughi University of Medical Sciences of Yazd, Iran. The objectives and study procedure were discussed for all participants. They were also told that they could leave the study.

The inclusion criteria for cases were:

- History of T2DM
- Age between 30-50 years
- Lack of history of dental trauma, filling and active caries in examined teeth
- Lack of control over diabetes for minimum 3 months based on measurement of HbA1c (HbA1c>8%: lack of control over diabetes; HbA1c≤7%: control over diabetes) (10)
- Lack of consumption of Tricyclic antidepressants, anticonvulsants such as Gabapentin or Phenytoin and anti-hypertension and a variety of painkillers
- The inclusion criteria for control group were:
- Lack of systemic diseases (diabetes, different types of neuropathies, sensory-kinetic disorder).
- No history of dental trauma, filling in and active caries in examined teeth.
- Lack of consumption of Tricyclic antidepressants, anticonvulsants such as Gabapentin or Phenytoin and anti-

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hypertension and a variety of painkillers.
- Age range of 30-50 years

The fasting blood sugar (FBS) was checked for participants in control group. Participants with FBS less than 140 mg/dl, were included in the study. In addition, the subjects were clinically examined for sensory and kinetic disorders.

In cases, sampling was done sequentially during study among diabetic patients who fulfill the inclusion criteria, including HbA1c>8% and their files had been registered in Khani Diabetes Center. Two groups matching was done according age.

For determining electrical stimulation threshold of subjects' teeth in both groups, electric pulp tester (Parkell Digitest II, Model: D640, USA) with numerical range of 1-64 was used.

To reach satisfying level for significance results at least 30 teeth should studied in each group due to statistical formula to calculating sample size.

In this study sixty central teeth of upper jaw were examined in each group (30 teeth per each side). The data was registered in two steps. First, a clinician registered demographic information and systemic condition of patients from viewpoint of blood sugar control in a checklist. Next, for blinding the test was done by another clinician. After pulp test the electric stimulation threshold for each examined tooth of each subject was recorded in terms of type of tooth and intensity of electrical current of stimulation threshold.

The surface of teeth was initially dried and then, the teeth were isolated. Electrocardiography gel was used as conductive material in electric pulp tester. Based on a study by Bender et al on anterior teeth, the results suggested placing pulp tester electrode on the incisor edge of anterior teeth causes response with minimum level of electric current compared with other parts such as cervical, middle and incisor one-thirds. (11)

The collected data was analyzed by SPSS Software (version. 17). The difference in mean threshold of electrical stimulation of teeth between the two groups was defined based on independent T-test. In addition, Chi-square test was used for determination of association between qualitative variables. In this study, level of significance was presumed to be *P*-value <0.05.

This study was approved by ethical committee of Shahid Sadoughi University of Medical Sciences.

Results

In the present study, 63 individuals in two groups of diabetes (n=30) and non-diabetes (n=33) were examined. For each, the electrical stimulation threshold of central teeth of higher jaw was measured and recorded.

The mean age of studied subjects was 38 ranging from 30 to 49. In this regard, 34 individuals were male (58%) and 29 subjects were female (46%).

In diabetic group, the mean age was 39 years rage from 30 to 49. In non-diabetic group, the mean age of subjects was 38 (30-48). There was not statistical significant difference between two groups in age (*P*-value: 0.0796).

Among 30 diabetic patients, 16 subjects were male (53.3 %) and 14 subjects were female (46.7%). In non-diabetic control group, 18 subjects were male (54.5%) and 15 subjects were female (45.5%) which statistical analysis reveal standard distribution in variable of sex. (*P*-value: 0.892)

Tables 1 and 2 represent sex and age distribution of studied population in two groups. The groups were properly matched and insignificance of two groups after conducting the test signified matching status of the two groups and insignificant effect of age and sexuality on results of the study.

The mean level of electrical stimulation threshold in diabetic group was 3.8 mA with standard deviation (SD) of 1.01 while in control group, the threshold of electrical stimulation and SD was reported to be 3.7 mA and 0.9 respectively. The difference was evaluated to be insignificant after conducting the test. (Table 3)

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Table 1. Mean electrical stimulation threshold of teeth in terms of age

Sex	Groups		Total
	Diabetes Mellitus	Control	
Male	32	36	68
	53.3%	54.5%	54.0%
Female	28	30	58
	46.7%	45.5%	46.0%
Total	60	66	126
	100.0%	100.0%	100.0%

Table 2. Mean Electrical Stimulation of Teeth in Terms of Sex

Group	Sex	Number	Mean	SD	*P*-value
DM		32	3.8	0.97551	
Control	Male	36	3.9	0.92410	0.764
total		68	3.9	0.94214	
DM		28	3.7	1.06657	
Control	Female	30	3.4	0.85836	0.170
total		58	3.6	0.97224	

Discussion

In diabetic patients, the involvement of neural cords in oral regions could lead to burning mouth syndrome which is a sensory nerve disorder in orofacial area. (3,7) Another problem is disorder in the sense of taste which is manifested in patients. In diabetic patients inflicted with neuropathy, a higher prevalence of certain symptoms such as dry mouth and decreased salivary flow is reported. (7,12,13)

Determination of pulp condition is a critical step in diagnosis before conducting restorative treatments or endodontics. (10) Specific tests such as thermal test, electrical test of pulp, laser Doppler flowmetry and pulse-oximetry are used for diagnosis of this condition. (14) Electric pulp test is widely used as a diagnostic instrument for diseases that involve pulp and periapical tissue. (15)

Studying electrical stimulation threshold of teeth in diabetic patients and its consequences could contribute to early identification of involvement of nerves innervating oral area. This could also lead to some complications too. There are rare studies with the same title of present paper on measurement and evaluation of electrical stimulation threshold of teeth in diabetic patients. One of the common complaints of diabetic patients is burning mouth syndrome in orofacial area which is accompanied by feeling of two-sided burning of oral mucosa without explicit clinical findings.

Another common problem is taste feeling disorder which is manifested in the patients. (7) Kannan et al did a case study and reported burning of oral mucosa in a diabetic patient due to consuming hot food as a result of sensing disorder of oral mucosa. (16) A study by Bajaj et al (2012) in diabetic patients suggested that higher FBS is associated with increased oral complaints, including impairment of taste and burning sensation of the mouth. (12) Catanzaro et al (2006) in a

Table 3. Mean electrical stimulation in test and control group in regard to location of teeth

Location of Teeth	Group	Number	Mean (mA)	SD	95% Confidence Interval for Mean		*P*-value
					Lower Bound	Upper Bound	
	T2DM	60	3.8	1.01	3.5	4.0	
Total	Control	66	3.7	0.92	3.4	3.9	0.483
	Total	126	3.7	0.96	3.5	3.9	
	T2DM	30	4.1	0.88	3.7	4.4	
Left	Control	33	3.7	0.94	3.3	4.0	0.112
	Total	63	3.9	0.92	3.6	4.1	
	T2DM	30	3.5	1.07	3.1	3.9	
Right	Control	33	3.6	0.91	3.3	4.0	0.605
	Total	63	3.6	0.98	3.3	3.8	

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study on animal models found out that diabetes affects oral tissues significantly and caused increased inflammatory mediators in pulp. (13)

In the present study, the mean and SD between two test and control groups had insignificant difference. There was difference between mean 3.8 in diabetic group and mean 3.7 in control group. However, after conducting the test the association was insignificant. The obtained difference in results is dependable considering the volume of sample.

Conclusions

Also results of this study reveal the association between age and electrical stimulation threshold of teeth. A little difference between age groups was observed in regard to electrical stimulation threshold of teeth. This signifies that increased age leads to reduced sensitivity of teeth due to decreased size of pulp chamber. (15,17) The reduction of pulp nerves in permanent teeth of older individuals is concomitant with their reduced sensitivity of teeth in comparison with young individuals. (18) Increased size of sample in future studies might support this association further.

References

1. Association AD. Diagnosis and classification of diabetes mellitus. Diabetes care. 2014;37(1):81-90.
2. Stratton IM, Adler AI, Neil HAW, Matthews DR, Manley SE, Cull CA, et al. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. Bmj. 2000;321(7258):405-12.
3. King H, Aubert RE, Herman WH. Global burden of diabetes, 1995–2025: prevalence, numerical estimates, and projections. Diabetes care. 1998;21(9):1414-31.
4. Control CfD, Prevention. National diabetes statistics report: estimates of diabetes and its burden in the United States, 2014. Atlanta, GA: US Department of Health and Human Services. 2014;2014.
5. Federation ID. IDF diabetes atlas. Brussels: International Diabetes Federation. 2013.
6. Bansal V, Kalita J, Misra U. Diabetic neuropathy. Postgraduate medical journal. 2006;82(964):95-100.
7. Leite RS, Marlow NM, Fernandes JK. Oral health and type 2 diabetes. The American journal of the medical sciences. 2013;345(4):271.
8. Abd-Elmeguid A, Yu DC. Dental pulp neurophysiology: part 1. Clinical and diagnostic implications. Journal of the Canadian Dental Association. 2009;75(1).
9. Modaresi J, Heshmat Mohajer AR, Aghili H, Khorshidi M, Rostami Chavoshlo F, Mahabadi A. Effect of pulp tester probe placement site on the response of maxillary anterior teeth. Journal of Dental Medicine. 2012;25(3):196-201.
10. Kalhoro FA, Rajput F, Sangi L. Selecting the appropriate electrode placement-site for electrical pulp testing of molar teeth. JPDA. 2011;20(03).
11. Strassler HE. Assessment and diagnosis of pulp vitality: the role of electric pulp testing. Available at cdeworld com/courses/4462-Assessment_and_Diagnosis_of_Pulp_Vitality: The_Role_of_Electric_Pulp_Testing Accessed March. 2014;10.
12. Bajaj S, Prasad S, Gupta A, Singh VB. Oral manifestations in type-2 diabetes and related complications. Indian journal of endocrinology and metabolism. 2012;16(5):777.
13. Catanzaro O, Dziubecki D, Lauria LC, Ceron CM, Rodriguez RR. Diabetes and its effects on dental pulp. Journal of oral science. 2006;48(4):195-9.
14. Gopikrishna V, Pradeep G, Venkateshbabu N. Assessment of pulp vitality: a review. International Journal of Paediatric Dentistry. 2009;19(1):3-15.
15. Lin J, Chandler N. Electric pulp testing: a review. International endodontic journal. 2008;41(5):365-74.
16. Kannan S, Chandrasekaran B, Muthusamy S, Sidhu P, Suresh N. Thermal burn of palate in an elderly diabetic patient. Gerodontology. 2014;31(2):149-52.
17. Bernick S, Nedelman C. Effect of aging on the human pulp. Journal of Endodontics. 1975;1(3):88-94.
18. Bernick S. Effect of aging on the nerve supply to human teeth. Journal of dental research. 1967;46(4):694-9.

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