



## RESEARCH ARTICLE

## Relationship between Glycemic Control and Coated Tongue in Type 2 Diabetes Mellitus Patients

Dr. Arber Berisha<sup>1</sup>, Dr. Vlora Berisha Salihi<sup>2\*</sup><sup>1</sup> Dental Clinic "Forma Dental Care", Prishtine<sup>2</sup> UBT – Higher Education Institution, Faculty of Dentistry, Prosthodontics Department, Kosovo**ARTICLE INFO**

Received: Oct 23, 2024

Accepted: Dec 11, 2024

**Keywords**

Diabetes Mellitus

Glycemic Index

Tongue Disorders

**ABSTRACT**

Type 2 diabetes mellitus causes qualitative and quantitative changes in the parenchyma of the major salivary glands, leading to hyposalivation. The lack of lubrication and protection from saliva also results in the accumulation of bacteria in the oral cavity, which can then lead to cavities, periodontitis, and tongue disorders, such as a coated tongue. The aim of this research is to examine the relationship between the level of glycemic control and the coated tongue in type 2 diabetes mellitus patients. This study was an analytical survey and oral clinical examination and involved 76 type 2 diabetes mellitus patients, aged between 30 and 89 years old. A diagnosis of diabetes mellitus was determined by Dr. Merita Emini Sadiku in the private diagnostic center "Endoclinic" in Prishtina. The level of glycemic control was measured on the day of the examination and coated tongue was diagnosed during the oral examination. The results showed that the highest prevalence of changes in the oral soft tissues in diabetic patients according to localization was on the tongue. A highly significant association was observed between the coated tongue and type 2 diabetes. There was a weak relationship between glycemic control level and the presence of coated tongue in type 2 diabetes mellitus patients ( $p = 0.597$ ). In this study, DM patients' tongue alterations such as coated tongue, fissured tongue, or migratory glossitis were the most frequent disorders in the oral cavity.

**\*Corresponding Author:**

vlora.berisha@ubt-uni.net

**INTRODUCTION**

Type 2 diabetes mellitus is one of the major lifestyle-related diseases around the world. According to the International Diabetes Federation estimates, 366 million people worldwide suffered from type 2 diabetes in 2011, and it is expected to affect a staggering 552 million people by the year 2030 (Whiting et al., 2011).

Chronic hyperglycemia leads to different complications in various regions of the body including the oral cavity, so blood glucose control is very critical (Cicmil et al., 2017). The intensity of diabetic complications is usually proportional to the degree and duration of hyperglycemia (Mauri-Obradors et al., 2017). Diabetes mellitus is well known to fetch the qualitatively and quantitatively alteration in the parenchyma of major salivary glands leading into hypo salivation (Lin et al., 2002). Hypo salivation is normally coupled with the augmentation of fungi such as *Candida* and other species leading to enhance the chances of oral infections (Pieralisi et al., 2016) (Priya et al., 2012).

The decreased rate of saliva secretion and the low pH value result in chronic cheilitis and glossitis with progressive atrophy of the covering epithelial layer. Additionally, previous studies showed that tongue lesions were more prevalent among patient with type 2 diabetes than healthy controls (Bastos et al., 2011) (Saini et al., 2010), and hyperglycemia was a risk factor for the occurrence of tongue lesions (Mohsin et al., 2014).

## Coated tongue

The tongue appears to be coated with a white layer when the surface is colonized by bacteria or fungi and dead cells become lodged between the papillae. The condition is typically harmless, despite the odd appearance. However, a white tongue can be a symptom of a serious health condition. Conditions such as poor oral hygiene and dry mouth are common. Tobacco usage is known to cause a number of health problems, a white tongue included (Van Tornout et al., 2013). Eating soft foods or long periods of not eating due to illness can also be a contributing factor. Certain medications for a variety of conditions can also cause a coated tongue (Abdollahi et al., 2008).

## Objective

The aim of this study is to see the relationship between the level of glycemic control and the coated tongue in type 2 diabetes mellitus patients.

## MATERIAL AND METHODS

This study was an analytical survey and oral clinical examination and involved 76 type 2 diabetes mellitus patients, aged between 30 and 89 years old. Beside the general questionnaire a specific questionnaire was performed for the diabetes and Glycated hemoglobin (HbA1c) was measured. Respondents were classified according to demographic characteristics (age, gender, level of education, profession), following the procedures and diagnostic criteria recommended by the WHO (the WHO Oral Health Assessment Form). The level of glycemic control was measured on the day of the examination and coated tongue was diagnosed during the oral examination.

The patients were categorized into 3 groups according to their mean HbA1c values recorded.

These were:

- Well-controlled HbA1c < 7.5%
- Moderately controlled HbA1c = 7.6% to 8.9%
- Poorly controlled HbA1c > 9%

Extra and intraoral examination was realized, dental status was recorded and prosthodontic rehabilitation need has been analyzed. Extra and intra oral digital photographs have been taken. In all respondents we realized screening examination with VELscope for early detection of premalignant and malignant soft tissue changes. VELscope offers non-invasive, painless, a quick diagnosis which does not require drugs and the visit barely takes 10 minutes (Figure 1). It is also designated by the WHO as an efficient tool for diagnosis and prevention of oral cancer. The VELscope uses a blue light source with a wavelength of 400 to 460 nm to highlight anomalies in the oral mucosa through direct tissue autofluorescence. When viewed through a filter at these exciting wavelengths, normal oral mucosa exhibits a green fluorescence. In contrast, diseased tissue shows a reduction in autofluorescence and appears darker.

## Compliance statement

In conducting this observational study, we adhered strictly to ethical standards and institutional guidelines. All procedures and methods employed in this study were carried out in accordance with the relevant protocols and regulations governing human research. Specifically, the study was approved by the private endocrinological clinic ENDOCLINIC in Prishtina. The study was conducted in full accordance with the ethical principles of the World Medical Association Declaration of Helsinki, and all participants provided informed consent prior to their involvement.

## Statistical processing

The data analysis was performed in the statistical program Statistica 7.1 for Windows and SPSS Statistics 25. The data distribution was tested with: Kolmogorov-Smirnov test; Lilliefors test; Shapiro-Wilks test (p). Significance is determined by  $p < 0.05$ .

## RESULTS

The results showed that the highest prevalence of changes of the oral soft tissues in diabetic patients according to the localization is on the tongue. The most common changes recorded during the

examination are: coated tongue (Figure 2), fissured tongue, ulcus traumaticus and migratory glossitis.

Changes such as fissured tongue were seen in 18 (20%) patients, plaque or coated tongue in 27(30%), dorsal tongue fibroids side 3 (3.3%). Burning sensation of the tongue (glossopyrosis), with papillary atrophy and smooth tongue was observed in 30 (33.3%) patients.

The highest percentage of coated tongue was observed in the group with good glycemic control, as shown in Table 1. There was not significant relationship between glycemic control level and the presence of coated tongue in type 2 diabetes mellitus patients ( $p = 0.597$ ).

There is no statistically significant difference between the tongue hygiene and coated tongue in diabetic patients.

### Evaluation of the tongue with VELskop

The VELscope fluorescence of a healthy tongue appears as a light green color. This green fluorescence indicates normal tissue, while any abnormalities may show a reduction in fluorescence and appear darker.

Infection with the fungus *Candida* - PF (porphyrin autofluorescence): a positive finding indicating the presence of infection with *Candida albicans* strains. Red and orange autofluorescence is common in the oral cavity, and is most often localized on the dorsal part of the tongue, but its etiology is not fully understood, it is also associated with nutritional deficiency (iron deficiency), the present oral biological film (bacteria and fungi) and some pathological changes. The presence of only red fluorescence is a sign of the presence of bacterial plaque, and red and orange of combined bacterial and fungal colonization (Figure 3).

## DISCUSSION

A number of specific oral mucosal alterations have been associated with type 2 DM, which included coated tongue, fissured tongue, angular cheilitis and denture stomatitis (Skamagas et al., 2008). A highly significant association was observed between coated tongue and type 2 diabetes in this study, which was in accordance with other studies (Su et al., 2013) (Liao et al., 2014). The highest percentage of the coated tongue was recorded in the group with a good glycemic control level. There was not significant relationship between glycemic control level and the presence of coated tongue in type 2 diabetes mellitus patients ( $p = 0.597$ ). An association between diabetes and fissured tongue has been reported in a previous study ((Bastos et al., 2011) with a prevalence of 17.8% among patients with diabetes. In this study also, this alteration was more common in patients with diabetes (20%) than that in the nondiabetics. The presence of fissured tongue is higher in males than in females (OR=0.691, 95%CI= 0.237, 2.020).

## CONCLUSION

This study found that alterations in the tongues of diabetes mellitus (DM) patients, such as coated tongue, fissured tongue, and migratory glossitis, were the most commonly observed disorders in the oral cavity. These findings highlight the importance of regular oral examinations for DM patients to identify and manage these conditions effectively.

**Author contributions:** A. Berisha, contributed to conception and design, data acquisition, analysis, and interpretation, drafted the manuscript; V. Berisha Salihi contributed to design, data interpretation, critically revised the manuscript. All authors gave their final approval and agree to be accountable for all aspects of the work.

**Declaration of conflicting interests:** The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Founding:** This research was conducted without financial support from external sources.

**REFERENCES**

- Abdollahi, M., Rahimi, R., & Radfar, M. (2008). Current opinion on drug-induced oral reactions: A comprehensive review. *Journal of Contemporary Dental Practice*, 9, 1–15.
- Bastos, A. S., Leite, A. R., Spin-Neto, R., Nassar, P. O., Massucato, E. M., & Orrico, S. R. (2011). Diabetes mellitus and oral mucosa alterations: Prevalence and risk factors. *Diabetes Research and Clinical Practice*, 92, 100–105. <https://doi.org/10.1016/j.diabres.2011.01.011>
- Cicmil, A., Govedarica, O., Lečić, J., Mališ, S., Cicmil, S., & Čakić, S. (2017). Oral symptoms and mucosal lesions in patients with diabetes mellitus type 2. *Balkan Journal of Dental Medicine*, 21, 50–54.
- Liao, P. Y., Hsu, P. C., Chen, J. M., Chiang, J. Y., & Lo, L. C. (2014). Diabetes with pyogenic liver abscess— A perspective on tongue assessment in traditional Chinese medicine. *Complementary Therapies in Medicine*, 22, 341–348. <https://doi.org/10.1016/j.ctim.2013.12.009>
- Lin, C. C., Sun, S. S., Kao, A., & Lee, C. C. (2002). Impaired salivary function in patients with noninsulin-dependent diabetes mellitus with xerostomia. *Journal of Diabetes and its Complications*, 16, 176–179.
- Mauri-Obradors, E., Estrugo-Devesa, A., Jané-Salas, E., Viñas, M., & López-López, J. (2017). Oral manifestations of Diabetes Mellitus: A systematic review. *Med Oral Patol Oral Cir Bucal*, 22, e586–e594.
- Mohsin, S. F., Ahmed, S. A., Fawwad, A., & Basit, A. (2014). Prevalence of oral mucosal alterations in type 2 diabetes mellitus patients attending a diabetic center. *Pakistan Journal of Medical Sciences*, 30(4), 716–719.
- Pieralisi, N., de Souza Bonfim-Mendonça, P., Negri, M., Jarros, I. C., & Svidzinski, T. (2016). Tongue coating frequency and its colonization by yeasts in chronic kidney disease patients. *European Journal of Clinical Microbiology & Infectious Diseases*, 35, 1455–1462. <https://doi.org/10.1007/s10096-016-2684-y>
- Priya, B. M., Shivakumar, V., Anitha, V., & Shanmugam, M. (2012). Diabetes and dental diseases. *CHC Medical Journal*, 1(4), 188–191.
- Saini, R., Al-Maweri, S. A., Saini, D., Ismail, N. M., & Ismail, A. R. (2010). Oral mucosal lesions in non-oral habit diabetic patients and association of diabetes mellitus with oral precancerous lesions. *Diabetes Research and Clinical Practice*, 89, 320–326. <https://doi.org/10.1016/j.diabres.2010.04.016>
- Skamagas, M., Breen, T. L., & Leroith, D. (2008). Update on diabetes mellitus: Prevention, treatment, and association with oral diseases. *Oral Diseases*, 14(2), 105–114. <https://doi.org/10.1111/j.1601-0825.2007.01425.x>
- Su, K., Zhu, F., Guo, L., Zhu, Y., Li, W., & Xiong, X. (2013). Retrospective study on Professor Zhongying Zhou's experience in Traditional Chinese Medicine treatment on diabetic nephropathy. *Journal of Traditional Chinese Medicine*, 33(2), 262–267. [https://doi.org/10.1016/S0254-6272\(13\)60137-5](https://doi.org/10.1016/S0254-6272(13)60137-5)
- Van Tornout, M., Dadamio, J., Coucke, W., & Quirynen, M. (2013). Tongue coating: Related factors. *Journal of Clinical Periodontology*, 40, 180–185. <https://doi.org/10.1111/jcpe.12031>
- Whiting, D. R., Guariguata, L., Weil, C., & Shaw, J. (2011). IDF diabetes atlas: Global estimates of the prevalence of diabetes for 2011 and 2030. *Diabetes Research and Clinical Practice*, 94, 311–321. <https://doi.org/10.1016/j.diabres.2011.10.029>

**APPENDIX: 01****Table 1: Glycemic control levels**

Table 1 displays the glycemic control levels of diabetic patients.

Glycemic control level	Coated tongue YES		Coated tongue NO		TOTAL		P-VALUE
	N	%	N	%	N	%	
Good	12	15.8%	36	47.4%	48	63.2%	0.597
Moderate	4	5.3%	8	10.5%	12	15.8%	
Poor	6	7.9%	10	13.2%	16	21.1%	
Total	22	28.9%	54	71.1%	76	100%	

**Figure 1: Intraoral examination with VELscope device**

Figure 1 illustrates an intraoral examination using the VELscope device.

**Figure 2: Coated tongue**

Figure 2 depicts the coated tongue of a diabetic patient.

**Figure 3: Red fluorescence with VELscope**

Figure 3 shows red fluorescence of the tongue as observed with the VELscope device.