

# Oral Health Status in a Group of Patients with Type 2 Diabetes Mellitus



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## Abstract

A prospective observational study was conducted on 40 non-insulin-dependent type 2 diabetes mellitus (T2DM) patients. The objective of this study was to assess the oral health in a group of patients with T2DM by taking into consideration the following aspects:

- 1) The dental and periodontal status evaluated by the DMF-T index, oral hygiene indices, gingival bleeding index and CPITN;
- 2) The oral hygiene devices used by patients;
- 3) The patient awareness of the importance of maintaining oral hygiene given the underlying disease;
- 4) The diabetic patient's knowledge related to oral and general health.

Most patients in the study group were aged between 60 and 69 years and living in urban areas. Examination of oral hygiene showed that 48% of patients had unsatisfactory oral hygiene. Therefore, the prevalence of periodontal disease in the patients included in our study was of 49%. Out of total number of patients, 13% patients were totally edentulous. Only 5% of the patients underwent periodical dental examination. In conclusion, our findings suggest that oral hygiene services provided by dentists could promote better oral hygiene and improved periodontal status in the local community, which might be beneficial for the control of diabetes mellitus.

**Keywords:** Diabetes mellitus; Oral health; Periodontitis; Gingival bleeding; Dental plaque

**Abbreviations:** ADA: American Diabetes Association; AGEs: Advanced Glycation End Products; BMI: Body Mass Index; CP: Chronic Periodontitis; CPITN: Community Periodontal Index Treatment Needs; DM: Diabetes Mellitus; DMF-T: Decay Missing Filled Teeth; GBI: Gingival Bleeding Index; IL-1/IL-6: Interleukin - 1, - 6; IR: Insulin Resistance; HbA1c: Hemoglobin A1c; HDL: High Density Lipoproteins; T2DM: Type 2 Diabetes Mellitus; TLRs: Toll-Like Receptors; TNF- $\alpha$ : Tumor Necrosis Factor Alpha; ROS: Reactive Oxygen Species; OHI: Oral Hygiene Index; WHO: World Health Organization

## Introduction

Diabetes mellitus is a chronic disease caused by inherited and/or acquired deficiency in insulin production by the pancreas, or by the improper response to insulin in the peripheral tissues. These dysfunctions result in increased concentrations of glucose in the blood, which in turn induce multisystem damage, particularly affecting the blood vessels and the nerves. Type 2 diabetes mellitus (T2DM) - formerly named non-insulin-dependent - is characterized by the body's inability to respond properly to insulin produced by the pancreas (insulin resistance). T2DM is much more common than type 1 and accounts for around 90% of all diabetes cases worldwide. It occurs most frequently in adults but has been noted in adolescents as well [1-3]. Due to global

urbanization, the prevalence of DM has increased in the recent years. Globally, 415 million adults have diabetes, and by 2040, this number will rise to 642 million [3,4]. Chronic periodontitis (CP) is one of the most common chronic infectious diseases affecting the periodontium and is characterized by destruction of the supporting structures of the teeth. According to literature, 46% of adults in the United States have periodontitis, and 8.9% have severe periodontitis [4,5].

It is well known that there is a link between T2DM and CP [6-9]. Epidemiological studies have demonstrated that T2DM may increase the risk of CP [10-12]. Nevertheless, CP could be a risk factor in controlling the glycemia levels in diabetic patients

[13,14]. Moreover, the periodontal inflammation is significantly higher in patients with chronic hyperglycemia (patients with prediabetes and with poorly-controlled T2DM) than in healthy controls [15,16]. One explanation is that chronic hyperglycemia increases the expression of toll-like receptors (TLRs) and proinflammatory cytokines (interleukin 1-beta IL-1 $\beta$  and tumor necrosis factor alpha TNF- $\alpha$ ) in periodontal tissues and aggravates periodontal inflammation [17]. Moreover, chronic hyperglycemia can induce oxidative stress that imbalance the production and inactivation of reactive oxygen species (ROS) [18]. Persistent hyperglycemia has been associated with increased formation and accumulation of advanced glycation end products (AGEs) in periodontal tissues resulting in severe periodontal inflammation [19,20].

The objective of this study was to evaluate the oral health in a group of patients with T2DM taking into consideration the following aspects:

- i. The dental and periodontal status assessed by the DMF-T index, oral hygiene indices, periodontal index and treatment needs for the community periodontal index (CPITN);
- ii. The oral hygiene devices used by patients;
- iii. The awareness of the importance of maintaining oral hygiene due to the underlying disease;
- iv. The knowledge of patients with diabetes related to oral and general health.

### Material and Method

A prospective observational study was conducted on 40 non-insulin-dependent T2DM patients from Medical Center of Diabetology Department. The approval no. 223/17.05.2017 was obtained from the Ethics Commission of UMPH "Iuliu Hațieganu" Cluj-Napoca. The inclusion criteria were: the written consent of the patient; diagnosis of T2DM. The exclusion criteria were: lack of agreement to participate in the study and other type of diabetes. From the patient's medical records, we collected the data about heredo-collateral, physiological and pathological personal history. We also collected data regarding the presence of co-morbidities such as cardiovascular, digestive, respiratory, liver, kidney, nervous system, osteo-articular and dermatological disorders. Exo-oral and endo-oral clinical examinations were performed. The periodontal status was assessed by taking into account the following items:

#### Dental status evaluates and quantifies the dental caries prevalence, DMF-T index and oral hygiene index (OHI)

DMF-T index is the international index used to quantify the carious pathology and represents the number of teeth (T), decays (D), missing (M) and filled (F) from permanent dentition. According to the WHO, this index is quantified as follows: DMF-T

between 0 and 1.1- very low, between 1.2 and 2.6 - low, 2.7 and 4.4 - moderate, 4.5 and 6.5 - high.

OHI (described by Green and Vermillion in 1964) measures the bacterial deposits and tartar deposits. It sums the values diagnosed from each individual 6 dental surfaces from each quadrant: vestibular surfaces of teeth 1.6 to 2.6; lingual surfaces of teeth 3.6 to 4.6; vestibular surfaces of teeth 1.1 to 3.1. Plaque index values were scored as: 0 = no bacterial plaque deposits; 1 = plaque deposit did not cover more than 1/3 of the coronary area; 2 = the plaque deposit covered more than 1/3 but did not exceed 2/3 of the coronary area; 3 = plaque covered more than 2/3 of the dental surface. The values of the tartar index were scored as: 0 = no tartar; 1 = supragingival tartar less than 1/3 of the tooth surface; 2 = supragingival tartar more than 1/3 and less than 2/3 of the tooth surface or presence of subgingival tartar islets; 3 = supragingival tartar more than 2/3 of the tooth surface or continuous subgingival tartar deposits. The OHI hygiene index was obtained by summing the plaque and tartar index values and expressed as follows: OHI between 0 and 1.2  $\Rightarrow$  good oral hygiene, 1.3 and 3  $\Rightarrow$  satisfactory oral hygiene, 3.1 and 6  $\Rightarrow$  unsatisfactory oral hygiene.

#### Periodontal status by evaluating and quantitating the GBI and CPITN.

GBI was the quantification index of inflammation used by Ainamo and Bay (1975). The average score was expressed as a percentage. Score 0: absence of gingival inflammation; a score between 0.1-1.0: mild gingival inflammation; 1.1-2.0: moderate gingival inflammation; 2.1-3.0: severe gingival inflammation.

CPITN It is frequently used in both epidemiological and clinical evaluation. Dentition was divided into six sextants: 1.7-1.4, 1.3-2.3, 2.4-2.7, 4.7-4.4, 4.3-3.3, 3.4-3.7. Each sextant was assigned a code: 0- healthy gum, 1- bleeding at the probing, 2 - the presence of tartar supra and subgingival, iatrogenic marginal irritation, 3- periodontal pocket 4-5 mm, 4- periodontal pocket of 6 mm or more. If a sextant did not contain at least two functional teeth it was not considered. Depending on the value of the code, there was a need for treatment as follows: TN0 - no treatment needed; TN1- patient training for controlling the bacterial plaque and need for observing in time the evolution of the oral-dental hygiene; TN2- professional cleaning (scaling + professional brushing) was required, elimination of factors favoring the plaque retention and oral hygiene training; TN3- periodontal pockets greater than 6 mm were present, treatment in this case was complex and included both therapeutic measures previously described; in case of severe loss of attachment, curettage and other surgical interventions were needed. The main disadvantage was that the gingival retraction was not measured. The dental examination included at least two outstanding teeth.

Chronic periodontitis can be classified by extension or severity (Flemming 1999). Regarding the extension, CP can

be: localized (loss of attachment localized to <30% of locus) or generalized (loss of attachment present to > 30% of the locus); regarding the severity, CP can be: mild - with loss of attachment measuring 1-2 mm, moderate - loss of attachment is 3-4 mm, severe - loss of attachment  $\geq$  5 mm [21].

### Status of oral rehabilitation

Different categories of edentulous patients in our study needed fixed or mobile prosthesis.

### Radiological investigations

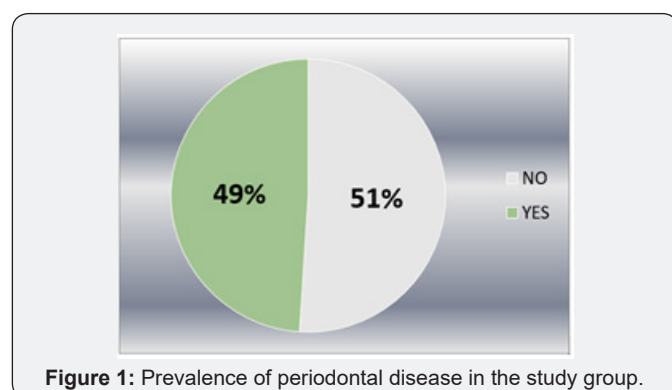
Imaging examinations were not performed; therefore the diagnosis was based mainly on clinical examination.

### Laboratory analyses

According to ADA, the following parameters were assessed: Glycemia (72-108 mg/dL), HbA1c (<7mg/dL), Creatinine (0.6-1.3 mg/dL), Cholesterol (< 150mg/dL), HDL (<40mg/dL in males and <50mg/dL in women) and Triglyceride (<150 mg/dL). BMI (kg/m<sup>2</sup>) was calculated as the ratio between the weight expressed in kilograms and the square of the height measured in meters [22].

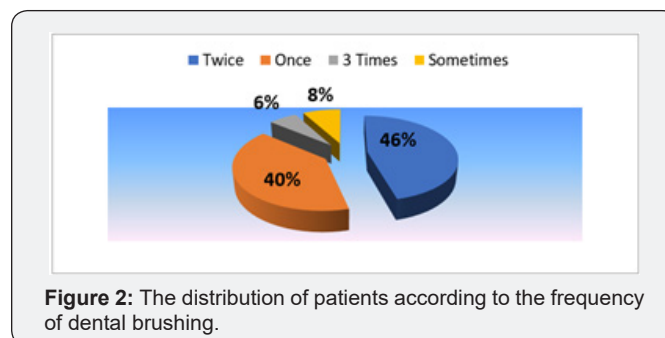
### Results

Of the patients enrolled in the study, 12% were between 40-49 years of age, 25% were between 50-59 years of age, 50% were between 60-69 years of age, 10% were between 70-79 years of age and 3% were between 80-89 years of age. Most patients in the study group were aged 60-69 years. Regarding the living conditions, 75% of patients came from urban areas and 25% of patients came from rural areas. Therefore, a greater proportion of diabetic patients lived in urban areas (about 2/3). Most patients in the study group (88%) were non-smokers and 12% were smokers. Out of total number of patients, 13% patients were totally edentulous.

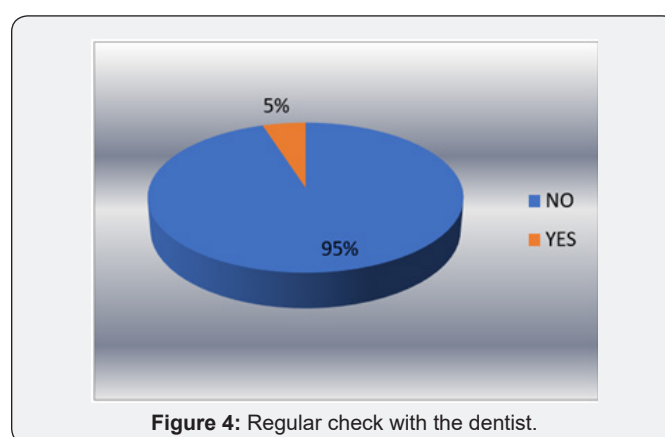
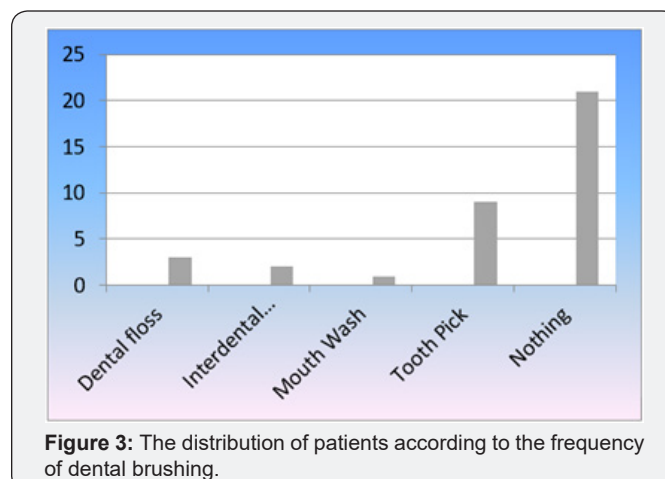


The prevalence of carious lesions was 58%. Twelve patients had superficial occlusal cavities, six had class 2 dental cavities and six had extensive carious lesions. Regarding the oral hygiene, we found that 48% had unsatisfactory oral hygiene. Patients with unsatisfactory oral hygiene stated that they brushed their teeth twice a day, which led to the conclusion that they had been properly advised about the brushing frequency, but they

did not apply the correct brushing technique. The prevalence of periodontal disease in the patients included in our study was of 49% (Figure 1).



Out of the 35 dentate patients, 40% brushed their teeth once a day, 46% twice a day, 6% three times a day, and 8% brushed their teeth randomly, from time to time (Figure 2). Regarding the auxiliary oral hygiene methods used, 58% patients used none, 8% patients used dental floss, 6% used interdental brushes, 25% patients used toothpicks and 3% used mouthwash (Figure 3).



Only 5% of the patients underwent periodical dental examination (Figure 4). In the last year, 37% of the patients reported having been examined by the dentist, 7% of the patients had been examined only 1-2 years in advance, 13% of the patients had been examined only 3-5 years in advance, and

most patients (43%) had not been examined over the last 5 years. In the study, 31% of patients responded that they observed and worried about the gums bleeding during brushing, 17% were aware of the dental mobility, 26% noticed the presence of the dental cavities, 4% noticed that they had bad breath and 22% of patients did not report any changes in the oral cavity (Figure 5).

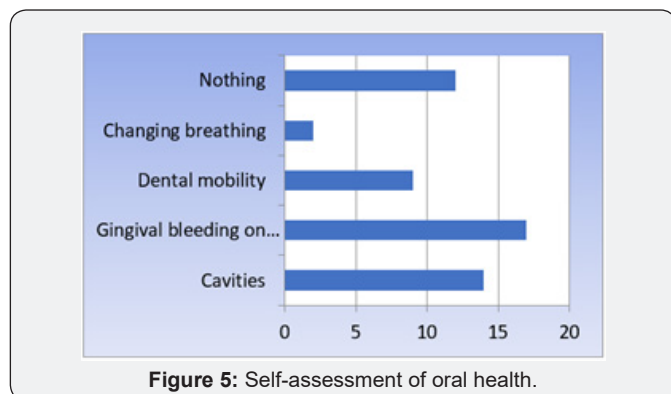


Figure 5: Self-assessment of oral health.

Upon examination of the periodontal status according to GBI bleeding index, in 18% of patients no gingival inflammation was registered, 44% of the patients had mild gingival inflammation, 32% had moderate gingival inflammation and 6% had severe gingival inflammation. The CPITN was Code 2 in 55% of patients, who had supragingival and subgingival dental plaque or iatrogenic marginal irritation, and Code 3 in 21% of patients who had periodontal pockets of 4-5 mm. Regarding the treatment recommended by the CPITN, most patients required professional hygiene (professional scaling and brushing), the elimination of factors that increased the bacterial plaque retention, plaque control and time tracking of the correctness of oral hygiene (Figure 6).

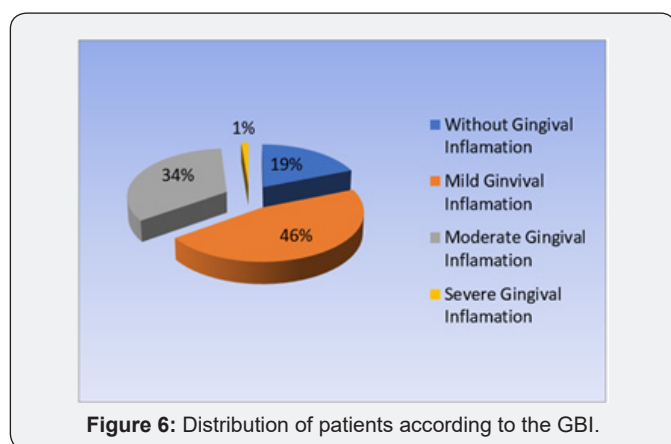


Figure 6: Distribution of patients according to the GBI.

## Discussion

Periodontal diseases are chronic microbial inflammations that affect the dental supporting structures [23]. The most common forms of periodontal disease are: gingivitis, which is present almost in all individuals, and periodontitis, a more severe form that affects 5%–15% of the global population. Periodontitis etiology is associated with the presence of dental plaque and calculus deposits in the periodontal tissues [24].

Recent data show that the periodontal disease could increase the risk of systemic diseases such as diabetes, because the presence of periodontal inflammation could be related to glycemic control in patients with type 2 diabetes mellitus. However, both healthy individuals and diabetic patients exhibit similar outcomes after periodontal therapy [24-26]. In the early 1990s, Loe [27] referred to periodontitis as the “sixth complication” of diabetes. Diabetes mellitus could induce various blood diseases, such as anemia and hemoglobinopathies [28-30].

It is believed that pro-inflammatory mediators, such as TNF- $\alpha$  and IL-6, are over-expressed at the inflamed periodontal sites due to the microbial factors or because of the host response. These mediators enter the systemic circulation, influence the function of insulin receptors and thus alter the insulin signaling [14]. In the 1990s, TNF- $\alpha$  was the first inflammatory marker that was thought to play a role in the development of obesity-induced insulin resistance [31]. Some studies have suggested that treatment with anti-TNF- $\alpha$  antibody could improve insulin sensitivity in IR patients [32,33]. Recently, a meta-analysis of 6 randomized-controlled trials and 3 controlled clinical trials revealed a significant difference in the action of TNF- $\alpha$  regarding the periodontal intervention versus the control group [34]. In a prospective blind intervention trial, the level of IL-6 exhibited a significant decrease after periodontal treatment [35]. These results indicate that periodontal therapy can improve the quality of periodontium in the medium and long term, and can decrease the proinflammatory, insulin-antagonizing adipokines.

Furthermore, frequent scaling and professional dental brushing performed in the dental office is essential for the oral health of patients with T2DM [36]. A randomized clinical trial on T2DM patients demonstrated that, even if they were fit for periodontal surgery, the patients could be treated non-surgically by regular scaling and professional brushing [37]. Zare Javid, et al. [38] propose, as an adjuvant therapy for non-surgical periodontal treatment, the consumption of cranberry juice enriched with omega-3, which could be beneficial for improving the periodontal status in patients with T2DM and periodontal disease. In our study, related to the age and sex of patients, there was a low association with the periodontal disease and the presence of type 2 diabetes. Similarly, a recent review did not report a significant association between age, gender and medication adherence in diabetic patients [39]. Another study observed a significant effect of the education level on the rate of change in medication adherence [40]. These results are consistent with previous findings showing that people with lower education level had better adherence. It has been hypothesized that educated patients might have less trust in advice coming from physicians than patients with less education [41].

## Conclusion

In summary, the close relationship between chronic periodontitis and the presence of type 2 diabetes in patients could be the trigger factor for both dental and periodontal



problems. Prophylaxis and treatment of dental caries and periodontal disease are crucial for maintaining the oral health in patients with diabetes mellitus. The medical advice and the professional teeth cleaning provided by dentists could promote better oral hygiene, and improved periodontal status in the local community, and might also be efficient for monitoring type 2 diabetes mellitus.

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