Study on cavity induced conditions in diabetic patients

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Abstract

Diabetes mellitus (DM) is a chronic illness with multiple complications including oral cavity components.

The study aims at identifying dental lesions in diabetic patients and assessing correlations between diabetes mellitus and dental caries index (DMF-T Decayed Missing, Filled Tooth).

The analysis includes two patient samples: one with 52 patients previously diagnosed with DM and a control group with 50 patients without diabetes or other systemic illnesses. We assessed the degree of cavity-induced conditions and calculated the DMF-T value for each group of patients. We also evaluated oral hygiene status by calculating the plaque index for all patients. Simultaneously, serum glucose level and glycosylated hemoglobin (HbA1c) value have been measured for all individuals. Values have been compared and statistically analyzed.

Mean DMF-T value has been significantly higher ($p<0.01$) in diabetic patients (11.5±4.3) when compared with controls (5.3±2.1). No significant differences have been obtained concerning glucose or HbA1c levels between patients with IDDM (Insulin Dependent Diabetes Mellitus) or NIDDM (Non Insulin Dependent Diabetes Mellitus). A significant correlation ($R^2 = 0.8116$) has been found between HbA1c value and DMF-T value as well as between HbA1c levels and number of WHO grade IV caries ($R^2 = 0.9124$) for diabetic patients.

Our results show a correlation between the therapeutic control of diabetes evaluated by glycosylated hemoglobin level and severity of dental lesions and suggest a possible pathogenic link between protein glycation and dental conditions in diabetes mellitus.

Key words: Diabetes Mellitus, cavity, DMF-T index, plaque index, HbA1c.

Overview

Diabetes mellitus (DM) is one of the most frequent chronic illnesses with multiple general health complications including hard dental components within oral cavity. DM is a major public health issue worldwide due to the high incidence of both its two types (IDDM – Insulin Dependent Diabetes Mellitus or NIDDM – Non Insulin Dependent Diabetes Mellitus) and the increasing incidence of IDDM in children [1].

Carious disease itself represents a common problem affecting many people throughout the world but rarely being life threatening. For a long period of time this was due to the relatively low priority given to oral health by governments and health-care policy makers [2].

Oral health status of diabetic patients has frequently been studied usually by comparing it with control groups, but results have been inconclusive [3]. No clear mechanism

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inducing pathologic conditions of oral cavity components in diabetic patients have yet been completely identified [4].

Various studies suggest associations between diabetes and periodontitis and the role of DM in dental loss. Most studies on diabetic patients more frequently assessed periodontium pathology while dental conditions have been less studied [5].

Correlations between diabetes and caries or other dental conditions as well as caries induced dental lesions have also rarely been studied [6].

Therefore it is highly important for dental practice to identify and assess oral changes in diabetic patients for both therapeutic and prophylactic purposes.

The aim of dental medical services is not the lack of caries or periodontal disease as much as the mental and social state of health obtained through dental treatment. The patient must be considered as a whole, and the way in which therapeutic decisions will influence the general state of health as well as the quality of life has to be taken into account. [7]

Objectives

Case-control analysis aiming to identify and assess caries induced conditions in diabetic patients as well as the possible correlation between their degree of complexion and diabetes severity.

Total number of caries and absent teeth was identified by calculating the dental caries index (DMF-T Decayed, Missing, and Filled - Tooth).

Materials and methods

The analysis includes two patient samples: one with 52 patients previously diagnosed with one type of DM and a control group with 50 patients without diabetes (two normal consecutive determinations of serum glucose levels) or other systemic illnesses.

Study protocol included detailed history and complete oral examination as well as lab tests (serum glucose level and glycosylated hemoglobin – HbA1c).

We assessed the degree of cavity-induced conditions and calculated the DMF-T value representing the number of caries, absent teeth due to carious lesions and filled teeth and classified carious lesions according to the four WHO grades:

Grade I – enamel caries

Grade II – dentine caries in a small cavity

Grade III – deep dentine caries without pulp inflammation

Grade IV – pulpitis

Subsequently, we calculated the number of absent teeth for each patient and compared the values for the two groups.

We also evaluated oral hygiene status by calculating the O'Leary plaque index (PI) for all patients. We used 2% metil blue solution and assessed medial, vestibular, distal and oral colored surfaces.

O'Leary PI = no. of surfaces with plaque x 100/total no. of dental surfaces

Meanwhile, serum glucose level and glycosylated hemoglobin (HbA1c) have been measured. Glycosylated hemoglobin is produced through non-enzymatic glycation of globin by linking glucose molecules to free protein nitrogen groups. Due to the 120 days lifespan of red blood cells, HbA1c values show information on the degree of therapeutic control of diabetes for longer periods of time (2-3 months). HbA1c value is expressed as percentage of total serum hemoglobin level.

Values have been compared and statistically analyzed using MedCalc and MS Excel. Student t-test has been used for mean comparison. We established the degree of correlation between DMF-T, serum glucose and glycosylated hemoglobin by using Pearson's correlation rank.

Results

Mean patient age within the two groups was 40.5 ± 11.5 years (48 females, 54

O´Leary plaque index	Diabetics			Non-diabetics	p value (diabetics vs. non-diabetics)
	Total DM	Type I DM	Type II DM		
< 20%	0	0	0	0	-
20-40%	7 6.86%	3 2.94%	4 3.92%	10 9.8%	0.085656 NS
> 40%	45 44.11%	15 14.7%	30 29.4%	40 39.2%	0.892669 NS

Table 1. Plaque index values for diabetics and nondiabetics

males). Mean age for the 52 diabetics was 43.8±15.5 years, 28 of them males and 24 females, while for non-diabetic patients (26 males, 24 females) it was 37.0±6.3 years.

Within the diabetic patients group, 17 had IDDM (DM type I) and 35 were known with NIDDM (DM type II).

Mean DMF-T index value for both groups was 8.5±4.6, with significantly higher values ($p<0.001$) for diabetics (11.5±4.3) compared to non-diabetics (5.3±2.1) (Table 1).

Mean O'Leary plaque index was 61.19±21.55% for diabetics and 60.08±19.93% for controls ($p = 0.7875$), showing poor plaque control in all patients. No patients with PI lower than 20% were identified. Most patients had PI above 40%, irrespective of the study group (85 patients – 45 with DM and 40 without DM). Only 17 patients had the plaque index within the 20-40% range (7 with DM and 10 without DM). No significant PI value differences were found between the samples (Table 1).

Mean serum glucose levels for the two groups was 106.6±35.2 mg/dl (133.4±24.7 mg/dl for diabetics and 78.9±14.4 mg/dl for controls, $p<0.001$).

Mean HbA1c level was 7.6±2.4% (9.4±1.7% for diabetics and 5.6±1.0% for non-diabetics, $p<0.001$) (Fig. 1).

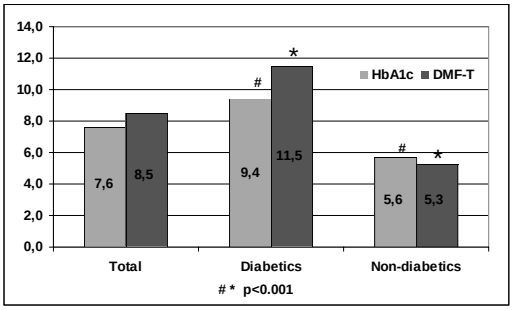

Figure 1. HbA1c and DMF-T values for diabetics and controls

Significant differences of mean DMF-T ($p<0.05$) were found between patients with IDDM (9.8±3.6) compared with NIDDM patients (12.4±4.4) (Fig. 2). No significant differences of mean serum glucose or HbA1c levels were found for these two groups.

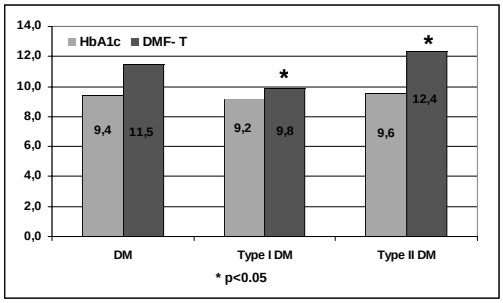

Figure 2. HbA1c and DMF-T values for patients with IDDM and NIDDM

There was a significant correlation (Pearson correlation rank, $R^2 = 0.8116$)

between HbA1c levels and DMF-T index for diabetic patients (Fig.3).

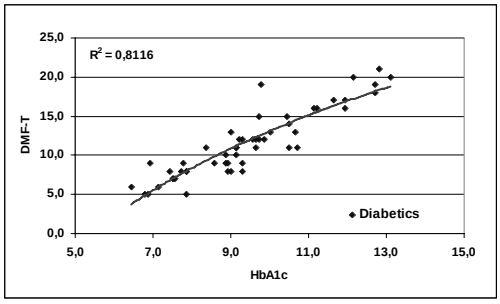

Figure 3. Correlation between HbA1c level and DMF-T values for diabetic patients

A slight correlation (R^2 = 0. 6451) was found between age and DMF-T index for non-diabetic patients (Fig.4).

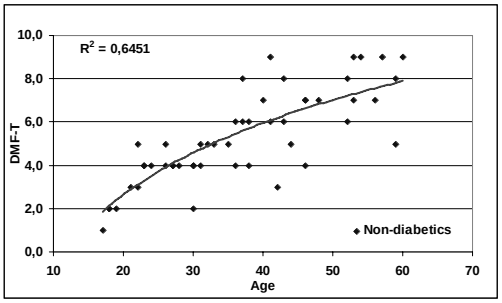

Figure 4. Correlation between age and DMF-T index for non diabetic patients (R^2 = 0. 6451)

Mean caries number for WHO grade IV caries was higher ($p<0.05$) for patients with DM compared to controls. Highly significant difference ($p<0.001$) was found between the two groups for grade IV caries, with mean 2.38 for diabetics and 0.58 for non-diabetics (Fig.5).

A highly significant correlation (R^2 = 0.9124) was determined between HbA1c levels and number of WHO grade IV caries was found for diabetic patients (Fig.6).

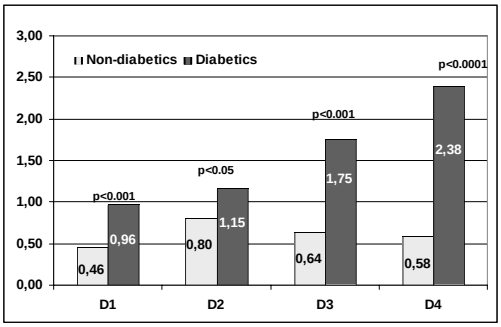

Figure 5. Caries incidence according to WHO grades for diabetics and non-diabetics

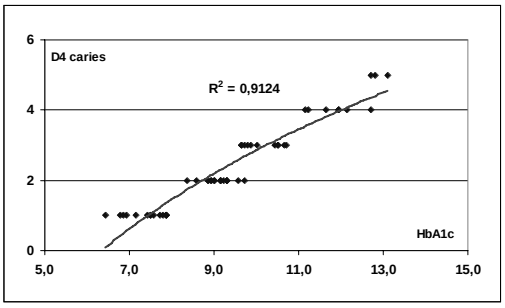

Figure 6. Correlation between HbA1c level and WHO grade IV caries number in diabetic patients (R^2 = 0.9124).

Total number of caries was higher for diabetic patients (6.25) compared with non-diabetics (2.48). Accordingly, significantly higher values ($p<0.001$) were found for the number of absent teeth due to caries complications for diabetics (3.69) compared with controls (1.06) (Fig.7).

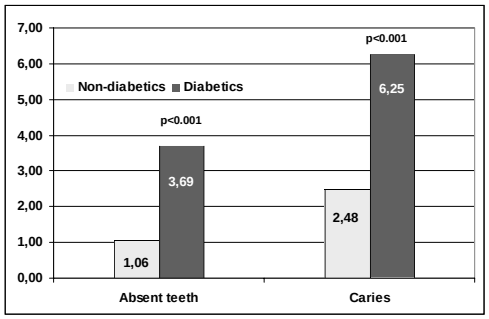

Figure 7. Caries induced modifications for diabetics and non-diabetics

Discussion

Literature results concerning caries severity for diabetics and healthy controls are generally inconclusive. Various studies show similar numbers of caries for diabetics and non-diabetics [8-13].

Other studies prove a higher number of caries for diabetics [14-19] while some papers show, by contrast, an increased number of caries for controls [20-23].

Low metabolic control of diabetes evidenced by high HbA1c levels is usually correlated with caries in most studies [24, 25]. Diabetics with poor disease control have a high salivary glucose level - one of the pathogenic factors for caries development for these patients [26, 27].

Nevertheless, the significant difference of DMF-T index values for patients with IDDM and NIDDM (favoring the latter), suggests that dental lesions are also influenced by other caries risk factors as well: bacterial plaque control, xerostomia, age, feeding habits. More [28] reports a higher prevalence of root caries for patients with type I diabetes. The observation is also correlated with age, gingival recession and diabetic nephropathy.

Diabetes type and evolution are significant predictors for caries development while bacterial plaque control assessed by plaque index was less correlated with DMF-T in diabetic patients [8, 15]. Similarly to our conclusions, other authors found no differences between oral hygiene status (assessed by O'Leary plaque index) between diabetics and controls [29].

Studies proving equal or even lower caries levels at diabetics vs. controls suggest the implication of diet habits in caries development [30]. Diet has an important pathogenic role in caries development by both qualitative and quantitative standpoints [31, 32, 33]. As in diabetics sweets consumption is supposedly lower and depending on the number of years passed since diabetes was diagnosed, starting of the specific diet seems to have an important role in caries prevention. Diabetic diet includes less carbohydrates and sweet drinks with more meals and less snacks [29] as well as much less refined carbohydrates. Therefore, Sterky et al. suggested a lower carious activity for diabetic patients compared with controls [34]. High prevalence of WHO grade IV caries at diabetic patients may be the consequence of protein glycation and its direct implication upon pulp structure and function or due to the effect of the other major chronic complications of diabetes (angiopathies, neuropathies).

Conclusions

Patients with poor diabetes control shown by elevated HbA1c had a higher number of carious teeth.

The study proves the correlation between therapeutic control of diabetes mellitus and severity of dental lesions, suggesting a possible pathogenic link between protein glycation, salivary glucose level and dental conditions in diabetes.

The dentist has to be aware of the metabolic status of diabetic patients before establishing the appropriate treatment plan. Oral conditions in diabetics are therefore to be considered complications of diabetes and should be managed as such.

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