

Dental caries and adolescents with type 1 diabetes

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IN BRIEF

- Investigates the prevalence of caries in adolescents with type 1 diabetes.
- Reports that no subjects with type 1 diabetes presented with an intact caries free dentition.
- Concludes that poor glycaemic control and early onset of diabetes may increase the risk of caries.
- Suggests that good preventive care can control this development.

Aim The aim of this study was to determine the prevalence of dental caries in adolescents with type 1 diabetes mellitus (DM). **Method** A clinical examination was carried out on 259 adolescents with type 1 DM as compared with 259 age- and sex-matched metabolically healthy controls. The DM cases were characterised by postprandial blood glucose and HBA1c levels, duration of the diseases, age at onset and level of control. Dental caries was assessed using the DMFT index. Data were analysed by Shapiro-Wilk's W, ANOVA, Student's t and Tukey's posthoc test. **Results** An intact dentition was found in none of the DM patients. DM adolescents had a higher mean DMFT score ($p < 0.001$), fewer decayed ($p < 0.0001$), and more filled ($p < 0.001$) teeth than in the controls. In the well-controlled DM adolescents, the mean number of decayed (D) teeth was lower ($p < 0.0001$) and the number of filled (F) teeth was higher than in patients with poorer glycaemic control. Early onset of DM was related to fewer decayed and filled teeth, but only if the oral hygiene was adequate ($p < 0.0001$). **Conclusions** Poor glycaemic control and the early onset of DM may increase the risk of dental caries, but appropriate oral hygiene together with satisfactory metabolic control may prevent the development of dental caries in adolescents with type 1 DM.

INTRODUCTION

Epidemiological studies relating to the effects of diabetes mellitus (DM) on the prevalence of dental caries in both children and adults have yielded contradictory results.¹⁻⁶ There have been comparatively few studies of the DM adolescent population, in spite of the fact that caries may be more prevalent in this population group. On the other hand, there seems to be no uniform opinion as to whether control of DM or sucrose-free diet of DM patients tends to promote or inhibit the development of dental caries. Cross-sectional studies have reported a low prevalence of caries in children and adolescents with type 1 DM, and this has mainly been explained by the sucrose-restricted diet, which is a part of the lifelong treatment.^{7,8} According

to Wegner,⁹ the frequency of caries in DM children is at least not lower than in non-DM children. Wegner¹⁰ also observed that, directly after the diagnosed onset of their disease, some young DM patients displayed a higher activity of caries than healthy subjects of the same age, but the frequency of caries gradually diminished in association with dietary restriction and treatment with insulin. Other investigators have related the development of caries to the level of metabolic control,¹¹⁻¹³ indicating a higher incidence of caries in cases with poorly-controlled DM as compared with those with a well-controlled disease. It is well known that adolescents on average clean their teeth less frequently than after adolescence.¹⁴ Behavioral factors such as dental self-efficacy are correlated with DM self-efficacy and adherence.¹⁴ Since there are conflicting reports regarding the dental condition in patients with DM or the effect of early DM manifestation on the dental condition, the aim of the present study was to analyse the dental status (DMFT) and the prevalence of dental caries in adolescents with type 1 DM, and to compare the findings with those from metabolically healthy individuals, in an effort to determine the risk factors that

play a role in the development of dental caries in DM adolescents.

MATERIAL AND METHOD

Patients

A dental clinical cross-sectional examination was carried out on 259 adolescents aged 14-19 years with type 1 DM in comparison with a non-DM group as control. Children who had been under the age of eight at the onset of DM were excluded, as were those with any additional disease or taking other chronic medication. The control group comprised metabolically healthy individuals. The DM patients were classified according to the categories recommended by the World Health Organisation (WHO).¹⁵ The DM patients under care at the First Department of Internal Medicine Semmelweis University underwent dental clinical examination and treatment at the Department of Conservative Dentistry.

Caries was assessed by the DMFT index.¹⁶ Within this index, F was used for the filled teeth. D denoted the number of untreated carious teeth without regard to whether the lesion was enamel or of root. Extractions for orthodontic or periodontal reasons were excluded. The Greene-Vermillion

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Table 1 Mean numbers of decayed (D), filled (F) and extracted (M) teeth and the DMFT score according to gender.

Parameters examined	Diabetics			Controls	Diabetics/controls	Diabetics Girls / Boys
	Girls X ± SD	Boys X ± SD	Total X ± SD	Total X ± SD		
D	3.7581 ± 3.8711	4.2676 ± 3.0010	3.8900 ± 3.6412	6.3912 ± 3.9521	p < 0.0001	p < 0.001
M	2.0120 ± 2.3001	2.0300 ± 1.8011	3.9012 ± 2.3032	3.8900 ± 3.0921	n.s.	n.s.
F	2.8714 ± 3.0476	4.5643 ± 4.2023	3.3623 ± 3.4811	0.8893 ± 1.5018	p < 0.001	p < 0.001
DMFT	8.6415 ± 2.1321	10.8619 ± 4.900	11.1535 ± 4.2001	9.5623 ± 5.1501	p < 0.001	p < 0.001

Table 2 Mean numbers of decayed and filled (D+F) teeth according to the age of the patient at the time of diagnosis of and the level of oral hygiene

Under 14 years				Over 14 years			
N (Total = 117)	OHI-S	D + F X ± SD	DMFT X ± SD	N (Total = 142)	OHI-S X ± S.D.	D+F X ± SD	DMFT X ± SD
68	2.54 ± 1.12	8.68 ± 2.32	12.17 ± 4.30	79	3.12 ± 1.32	9.02 ± 1.24	12.59
49	0.00	4.68 ± 2.32	8.25 ± 4.30	63	0.00	8.21 ± 1.24	12.59 ± 4.24

<14 years / >14 years: D+F: p < 0.01; DMFT: n.s.
OHI-S = 0 : <14 years / >14 years: D+F: p < 0.0001; DMFT: p < 0.0001

OHI-S index¹⁷ was used to determine the level of oral hygiene.

The DM subjects were characterised according to the following criteria: mean postprandial blood glucose level and during the period of 6 months prior to the dental examination; glycosylated haemoglobin (HbA1c) level; the duration of the DM; and the age at the onset of DM. Concerns by DM control, the ADA (2005)¹⁵ criteria were offered. Diabetes mellitus was well-controlled (210 cases) if six months before the dental examination the mean postprandial blood glucose level of the patients was normal or near normal (below 7.5 mmol/l) there was no glycosuria, HbA1c ≤ 6.5% and severe hypoglycaemia did not occur. Control was taken as poor when the postprandial blood sugar level was ≥ 7.5 mmol/l and/or haemoglobin was > 6.5%, or in cases of patients with asymptomatic hypoglycaemia.

Ethically, the research was conducted in accordance with the Helsinki Declaration as revised in 2002.¹⁸ The appropriate ethical committee give the name and the project number (217/2005) prior to the start of the study and the subjects were volunteers who provided their informed written consent.

Statistical analysis

For continuous variables the results were given by descriptive method as the sample size, means ± SD and their normality was checked by Shapiro-Wilk's W test.

Table 3 DMFT and its components (D, M and F) according to the level of control of DM

	Well-controlled patients with type 1 DM (n = 210) X ± SD	Poorly controlled patients with type 1 DM (n = 49) X ± SD
D	3.4800 ± 2.2212*	5.9823 ± 4.522*
M	4.9822 ± 2.2343**	4.8601 ± 1.6912**
F	4.4611 ± 2.1012*	2.4523 ± 1.1600*
DMFT	12.9112 ± 5.6401**	13.2947 ± 3.2523**

*p < 0.001; ** n.s.

Statistical analysis was performed using two-way analysis of variance (ANOVA) followed by Tukey's posthoc test which was applied if a significant difference among means was detected. The statistical significance of differences between groups was assessed with Student's t-test (comparison of two groups).

Contingency tables were adapted for categorical variables and we used Maximum-Likelihood (M-L) Chi-square test to draw the inferences. Differences were considered to be statistically significant at p < 0.05. Each analysis was performed using the SAS/STAT, (Software Release 9.1.3., SAS Institute Inc., Cary, North Carolina 27513, USA).

RESULTS

An intact dentition (DMFT = 0) was found in 0.0% of the DM patients and in 3.2% of the metabolically healthy adolescents.

The DM adolescents had a slightly higher mean DMFT score than the control subjects. The difference was found to be statistically significant (p < 0.001). When the components of DMFT were considered, there were more filled (F) (p < 0.001) and fewer decayed (D) teeth (p < 0.0001) among the DM adolescents than in the healthy controls. When the number of missing teeth was considered, there were no significant differences between the DM patients and the healthy controls (Table 1).

The DM boys had a slightly higher mean DMFT score (p < 0.001) than the DM girls (p < 0.001). More decayed (D) (p < 0.001) and filled (F) teeth were found among the DM boys than among the DM girls (p < 0.001). As regards the number of extracted (M) teeth, there were no significant differences between the boys and the girls (Table 1).

The age of the patient at the onset of DM was correlated to the caries condition

(D). This suggested that the early onset of DM (before the age of 14) was related to significantly fewer decayed and filled teeth compared with the patients in whom DM had developed after age 14 years ($p < 0.01$). However, in the adolescents with good oral hygiene (OHI-S = 0), there was a significant differences ($p < 0.0001$) (Table 2).

A positive correlation was found between the level of control of the DM and the dental condition. In the well-controlled DM adolescents, the mean number of decayed (D) teeth was lower ($p < 0.0001$), but the number of filled (F) teeth was higher than in patients with poorer glycemic control ($p < 0.001$) (Table 3).

DISCUSSION

This study of adolescents with type 1 DM demonstrated that none of the subjects had intact dentitions. Similar results have been found^{11,12,19} in investigations of the prevalence of intact dentitions in relation to the DM status. The present observations support the suggestion that intact dentitions are less frequent only at an earlier stage of their lives among DM adolescents than among metabolically healthy subjects.

The results indicated differences in respect of the DMFT index regarding the condition of the teeth of adolescents with type 1 DM aged 15–19 years, compared with non-DM individuals. Earlier reports partly affirm this,²⁰ whereas others diverge from our present study results^{21,22}. In latter studies authors found lower DMF index values for DM adolescents, although only when the manifestation of DM preceded any dental change. Several authors consider that DM manifested in childhood has a favorable influence on dental status,^{22,23} with less caries developing in the case of teeth growing in the presence of a DM-related metabolic disorder.²⁴ Others²⁵ have reported that the frequency of caries is lower only when DM is manifested before the age of 7.

The results of the present study suggest that early DM manifestation has a favorable influence in respect of caries prevention, but only for patients with impeccable oral hygiene. It is known that, apart from genetic factors, caries development is also influenced by a number of local factors, such as eating habits and the composition and level of secretion of the saliva.

DM patients are known to exhibit hyposalivation with a decrease in the saliva secretion rate,^{6,26,27} this changing as a function of the metabolic care. Lower saliva secretion and pH also tends to promote the growth of acidogenic microorganisms such as lactobacilli, mutans streptococci and Candida, as a consequence of diminished mechanical cleaning, increased dental plaque,²⁸ a long-lasting acidic milieu, and the faulty self-cleansing of the teeth, which all favour caries development.²⁸ Opinions vary as to whether the sucrose-free diet of DM patients reduces caries formation or not. Despite sucrose-free diet, the adolescents who did not clean their teeth adequately had more decayed teeth than their healthy peers. Faulty tooth cleaning and the removal of clinically evident dental plaque, or the insufficient metabolic care of the DM, all result in a decrease in local pH and in the cleansing effect of the saliva, and these altered conditions tend to favour the development of dental caries. In general, most data point to the elimination of sucrose from the diet as being unfavourable for the proliferation of cariogenic microorganisms.^{7,24} Other reports, however, conclude that adult DM patients are more susceptible to caries despite their sucrose-free diet.²⁵

Our results suggest that the early manifestation of DM may play a role in the prevention of tooth decay but only if dental and metabolic care are adequate. Our finding that the studied individuals had fewer decayed and more filled teeth simply reflects the fact that, owing to their general care, DM patients probably get to the dentist sooner, and hence their carious teeth are taken care of at an early stage.

The higher number of decayed and filled teeth among the DM boys implies that DM boys pay less attention to dental care and therefore have more decayed teeth than DM girls, in contrast to our observations on the healthy population. At this age, adolescent girls generally have more decayed teeth than boys, which correlates with the earlier eruption of their teeth, as well as with the more frequent gingivitis-related tooth debris formation due to the monthly hormonal change and faulty teeth cleaning. Tooth extraction because of periodontal disease is not common in DM patients at this age, which is consistent with our earlier study results.²⁹

Overall, it is clear from our findings that the dental condition of DM adolescents is better than that of their healthy controls only if proper metabolic care is taken and their oral hygiene is adequate.^{6,30}

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