Gingival inflammation in diabetic children related to degree of metabolic control

GUNILLA GISLEN, KARL OLOF NILSSON & LARS MATSSON

Department of Pedodontics and Department of Pediatrics, University of Lund, Malmö, Sweden

Gislén, G., Nilsson, K. O. & Matsson, L. Gingival inflammation in diabetic children related to degree of metabolic control. *Acta Odontol. Scand.* 1980, 38, 241 – 246

Earlier studies indicate that diabetic children are less resistant to periodontal disease than healthy children. As the degree of metabolic control of the diabetes ranges widely in a juvenile population, the susceptibility to gingival inflammation may vary. The aim of the present study was to compare the gingival status in diabetic children, subgrouped for control of the disease, with that in non-diabetic children. All comparisons were performed under controlled plaque conditions.

43 diabetic children took part in the study. The controls consisted of age- and sex-matched healthy children. The degree of gingival inflammation and the amount of bacterial plaque were assessed in terms of the Gingival Index and the Plaque Index, respectively. The Plaque Index scores constituted the basis for all comparisons of gingival status. The metabolic control of the diabetics was assessed from the amount of glycosylated hemoglobin fraction HbA_{1c}. For children with the highest Plaque Index scores, diabetics showed statistically significantly higher Gingival Index scores. Only minor differences were seen in the other Plaque Index classes. The diabetic children with poor metabolic control showed a clear tendency towards higher Gingival Index scores than the non-diabetics, while no such tendency was seen between the diabetics with good metabolic control and the non-diabetics.

Key words: Gingivitis; diabetic children; glycosylated hemoglobins

L. Matsson, Odont. D., Dept. Pedodontics, University of Lund, School of Dentistry, S-214 21 Malmö, Sweden

The relationship between diabetes mellitus and periodontal disease has been studied extensively in adults. It is generally held that adult diabetics are more susceptible to gingivitis and periodontitis than healthy adults (2, 5, 6, 8, 15).

In diabetic children, however, studies of gingival inflammation are rare. Bernick et. al. (3) and Ringelberg et al. (13) found a higher degree of gingivitis in children with diabetes than in healthy children. The plaque factor was not assessed in the latter study; in the former the amount of plaque was similar in the two groups and the higher degree of gingivitis in the diabetic children accordingly suggests that such children are less resistant to periodontal diesease than healthy children.

In a juvenile diabetic population there are great differences in the degree of metabolic control of the disease. Therefore, the susceptibility to gingival inflammation may differ not only between dia-

Received for publication, June 4, 1980

betic and healthy children but also within a diabetic population. In the studies referred to above (3, 13) no attention was paid to the relationship between metabolic state and gingival health of the diabetic children. Such information would be valuable for determining if there are patients within the diabetic population who need special dental care to prevent periodontal disease.

The control of the diabetic state is usually gauged by blood or urinary glucose tests, which give just an instantaneous view of the metabolic state. Recently, however, measurements of the glycosylated hemoglobin fraction HbA_{1c} have been suggested as an index of the long-term blood glucose level in diabetic patients. HbA_{1c} is the result of the chemical condensation of HbA_1 with glucose (4). This reaction is only slightly reversible if at all. The percentage fraction of HbA_{1c} thus increases during the life span of the individual erythrocyte and is proportional to the prevailing integrated blood glucose concentration during this period. The measurement of HbA_{1c} thus gives a truer picture of diabetic control during the preceding weeks to months (7, 9, 10).

The aim of the present investigation was to compare the gingival status in diabetic children, subgrouped according to the degree of control of the disease, with that in non-diabetic children. All comparisons were performed under controlled plaque conditions.

MATERIAL AND METHODS

All 43 children (26 males and 17 females) with insulin-deficiency diabetes from 7 to 17 years of age, who were seen at regular intervals at the Diabetic Outpatient Clinic (Department of Pediatrics, Malmö General Hospital), took part in the study. For controls healthy children attending the Departement of Pedodontics at the School of Dentistry in Malmö were selected. Each non-diabetic child was matched to a diabetic child for year and month of birth as well as sex. The distribution of the children according to age is given in Table 1.

Blood samples for the determination of HbA_{1c} were collected at a routine visit to the Diabetic Clinic soon after the dental examination. For practical reasons the collection of blood samples and the dental examination could not be performed on the same occasion. HbA_{1c} was determined by thin-layer electrofocusing (9). With this method the individual results are expressed as relative values based on the mean from samples of pooled hemolysates from healthy individuals, the HbA_{1c} content of which is taken to represent 100 %.

The determination of HbA_{1c} constituted the basis for dividing the diabetics into 2 subgroups, 1 with good metabolic control ($HbA_{1c} < 160$) and 1 with poor metabolic control ($HbA_{1c} \geqslant 160$).

The degree of gingival inflammation was studied by determining the Gingival Index score according to Löe & Silness (11). The amount of bacterial plaque was assessed in terms of the Plaque Index (14). The gingival state and the amount of plaque were registered buccally at all teeth except the second and third permanent molars. Deciduous teeth were included when present.

For each child, the mean Gingival Index score and the mean Plaque Index score were calculated. As oral hygiene may vary somewhat from day to day, the Plaque Index score calculations were based on the mean value of 2 registrations, performed 2 weeks apart. All children were told to brush their teeth as usual in the morning on the day of registration, but not immediately before the registration session.

The data from the total diabetic and non-diabetic groups are presented as the correlation between Gingival Index score and Plaque Index score. A conventional linear regression analysis was made. The

Table 1. *Age of diabetic and age-matched non-diabetic children*

	Age in years											
	7	8	9	10	11	12	13	14	15	16	17	7–17
No. of matched pairs of individuals	1	3	2	2	4	1	6	7	6	10	1	43

Table 2. *Mean Gingival Index scores in diabetic and non-diabetic children in different Plaque Index classes*

	Plaque Index class													
	I. (P.I. = 0–0.69)					II. (P.I. = 0.70–1.39)					III. (P.I. = 1.40–2.00)			
	$\bar{x}$	S.D.	n			$\bar{x}$	S.D.	n			$\bar{x}$	S.D.	n	
Diabetics, totals	0.54	0.41	14		N.S.	0.97	0.47	19		N.S.	1.42	0.22	10	
poor metabolic control	0.65	0.33	8	N.S.		1.33	0.30	6	$p < 0.01$		1.40	0.19	7	$p < 0.01$
good metabolic control	0.40	0.49	6	N.S.		0.81	0.44	13	N.S.		1.45	0.33	3	N.S.
Non-diabetics	0.47	0.28	19			0.92	0.22	19			1.15	0.07	5	

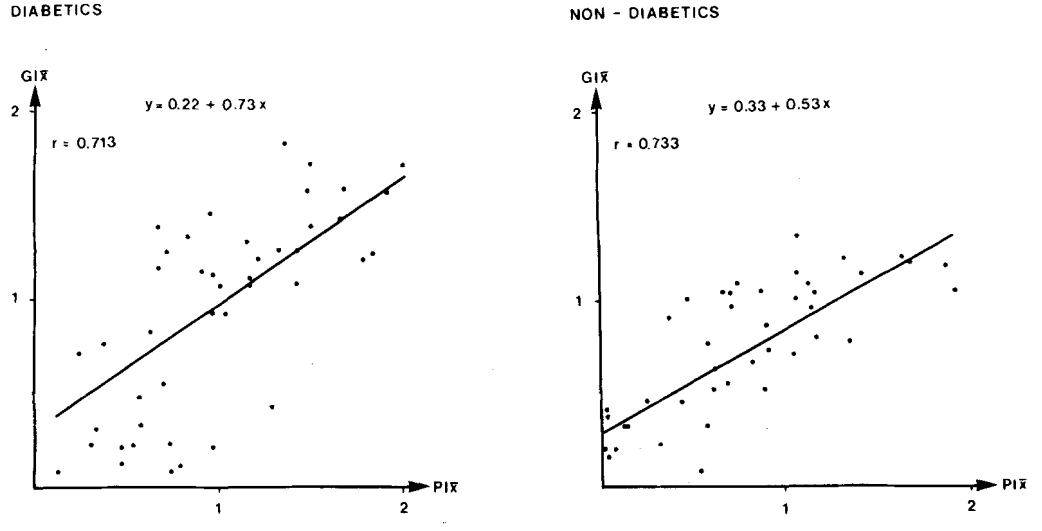

Fig. 1. Regression-analysis of Gingival Index score and Plaque Index score for diabetics and non-diabetics

difference in inclination between the lines of regression was tested two-sidely according to the t-test. In addition, the individuals were classed in 3 subgroups according to their Plaque Index score. Comparisons of the Gingival Index scores were made between the total diabetic group and the non-diabetic group and between each diabetic subgroup and the non-diabetic group within each Plaque Index class. These data were subjected to Wilcoxon's rank sum test. Differences at the 5 % level of probability were considered to be statistically significant.

RESULTS

Fig. 1 shows the results of the regression analysis for the total number of diabetic and non-diabetic children. The inclination of the regression line for the non-diabetic group was somewhat lower than that for the diabetic group, but the difference was not statistically significant.

The comparison between the total numer of diabetic children and non-diabetic children (Table 2) revealed statistically significantly higher Gingival Index scores ($p<0.01$) in the diabetics in Plaque Index class III (P.I. = 1.40–2.0).

The diabetic children with poor metabolic control had numerically higher Gingival Index scores than the non-diabetics in all Plaque Index classes (Table 2). In Plaque Index class II and III (P.I. = 0.70–1.39 and 1.40–2.0) this difference was statistically significant ($p<0.01$).

A comparison between the diabetic children with good metabolic control and the non-diabetics revealed no statistically significant differences.

DISCUSSION

In comparative, epidemiologic studies like the present, there are always difficulties in obtaining adequate reference groups of healthy individuals. Gingivitis is easily influenced by variations in the amount of bacterial plaque on the teeth, which depends in turn on variations in background factors, e.g. preventive measures, socio-economic conditions etc. In the present study the control group consisted of a *selected* sample, i.e. children attending the Department of Pedodontics at the School of Dentistry, Malmö, Sweden. This ruled out a direct comparison of the mean Gingival Index scores between the diabetic and the non-diabetic groups. Instead, statistical comparisons were performed within subgroups, consisting of children with similar plaque conditions. This procedure eliminates conceivable differences in oral hygiene habits. The regression analysis of gingivitis relative to oral hygiene also eliminates a conceivable effect of differences in this respect between the two groups.

In earlier studies of the gingival state in diabetic children (3, 13), the diabetics were not grouped by the degree of metabolic control of the disease. Such an analysis of the data is highly relevant as there are indications that resistance to infections is lowered in diabetics with poor metabolic control compared to well controlled diabetics (1, 12). In the present study higher Gingival Index scores were seen in the diabetic children with poor metabolic control compared with the non-diabetics, within each Plaque Index class. The diabetic children with good metabolic control did not show a similar tendency compared with the non-diabetic children. However, as the material was subgrouped not only by the control of diabetic disease, but also according to the level of oral hygiene, the number of individuals in some of the subgroups turned out to be low. The comparatively high Gingival Index score seen in Plaque Index class III of the diabetics with good metabolic control probably reflects these circumstances.

Several methods are available for studying the degree of diabetic control. Chemical variables reflecting the metabolic state, for instance glucosuria, blood glucose levels or ketonuria, have frequently been used, as have indices based on clinical observations. In the present study the amount of the glycosylated hemoglobin fraction HbA_{1c} was used to assess the metabolic control of the diabetics. This method gives a measure of the integrated glucose level of the individual over the preceding weeks to months (7, 9), while other chemical variables like glucosuria, blood glucose or ketonuria give just an instantaneous view of the diabetic state. Thus, the measurement of glycosylated hemoglobin presumably gives a truer picture of the diabetic state of the individual, than any other method of measuring, not being influenced by isolated fluctuations. This method is probably also superior in objectivity to the clinical indices.

In the present study a mean Gingival Index score and a mean Plaque Index score were calculated for each individual, forming a basis for all comparisons. In principle, this procedure may be less suitable as there is no proof that equidistance exists between the different index classes. However, the procedure seems to be the most sufficient when individual values of the degree of gingivitis and amount of plaque are needed to distribute the individuals by subgroups.

In the present study a regression analysis of gingivitis relative to oral hygiene was performed. Linearity was checked by fitting second degree polynomials. In the non-diabetic group a slight departure from linearity was seen, and here the linear relationship represents an approximation.

Bernick et al. (3) and Ringelberg et al. (13) showed a higher degree of gingivitis in children with diabetes compared with healthy children. In those studies all data was presented as totals for the groups, and no subgrouping according to Plaque Index classes was performed. Consequently the results from those studies cannot be directly compared with the present findings. However, the present study indicates that the diabetic child in general cannot be considered more susceptible to gingival inflammation than the healthy child. The subgrouping procedure used here indicates that diabetic children with good metabolic control show a similar gingival status to that of healthy children, while diabetic children with poor metabolic control tend to be more susceptible to gingivitis than healthy children, even with relatively good oral hygiene. The results from the present study may constitute a basis for selecting patients who risk getting gingival inflammation, and in the long run periodontitis, within a diabetic child population.

REFERENCES

1. Bagdade, J. D., Root, R. K. & Bulger, R. J. Impaired leukocyte function in patients with poorly controlled diabetes. Diabetes 1974, 23, 9 – 15
2. Belting, C. M., Hiniker, J. J. & Dummett, C. O. Influence of diabetes mellitus on the severity of periodontal disease. J. Periodontol. 1964, 35, 476 – 480
3. Bernick, S. M., Cohen, D. W., Baker, L. & Laster, L. Dental disease in children with diabetes mellitus. J. Periodontol. 1975, 46, 241 – 245
4. Bunn, H. F., Haney, D. N., Kamin, S., Gabbay, K. H. & Gallop, P. M. The biosynthesis of human hemoglobin A_{1c}: slow glycosylation of hemoglobin in vivo. J. Clin. Invest. 1976, 57, 1652 – 1659
5. Cohen, W., Friedman, L., Chapiro, J., Kyle, G. & Franklin, S. Diabetes mellitus and periodontal disease: two-year longitudinal observations, Part I. J. Periodontol. 1970, 41, 709 – 712
6. Finestone, A. J. & Boorujy, S. R. Diabetes mellitus and periodontal disease. Diabetes 1967, 16, 336 – 340
7. Gabbay, K. H., Hasty, K., Breslow, J. L., Ellison, R. C., Bunn, H. F. & Gallop, P. M. Glycosylated hemoglobins and long-term blood glucose control in diabetes mellitus. J. Clin. Endocrinol. Metab. 1977, 44, 859 – 864

8. Glavind, L., Lund, B. & Löe, H. The relationship between periodontal state and diabetes duration, insulin dosage and retinal changes. J. Periodontol. 1968, 39, 341 – 347
9. Jeppsson, J.-O., Franzén, B. & Nilsson, K. O. Determination of the glycosylated hemoglobin fraction HbA_{1c} in diabetes mellitus by thin layer electrofocusing. Science Tools 1978, 25, 69 – 72
10. Koenig, R. J., Peterson, C. M., Jones, R. L., Saudek, C., Lehrman, M. & Cerami, A. Correlation of glucose regulation and hemoglobin A_{1c} in diabetes mellitus. N. Engl. J. med. 1976, 295, 417 – 420
11. Löe, H. & Silness, J. Periodontal disease in pregnancy. I. Prevalence and severity. Acta Odontol. Scand. 1963, 21, 533 – 551
12. Niethammer, D., Heinze, E., Teller, W., Kleihauer, E., Wildfeuer, A. & Haferkamp, O. Impairment of granulocyte function in juvenile diabetes. Klin. Wschr. 1975, 53, 1057 – 1060
13. Ringelberg, M. L., Dixon, D. O., Francis, A. O. & Plummer, R. W. Comparison of gingival health and gingival crevicular fluid flow in children with and without diabetes. J. Dent. Res. 1977, 56, 108 – 111
14. Silness, J. & Löe, H. Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. Acta Odontol. Scand. 1964, 22, 121 – 135
15. Sznajer, R., Carraro, J. J., Rugna, S. & Sereday, M. Periodontal findings in diabetic and nondiabetic patients. J. Periodontol. 1978, 49, 445 – 448