

Evaluation of two methods of scoring denture plaque

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Poulsen, S., Budtz-Jørgensen, E., Knudsen, A. M., Nielsen, L. & Kelstrup, J. Evaluation of two methods of scoring denture plaque. *Acta Odontol. Scand.* 1983, 41, 283–286. Oslo. ISSN 0001-6357.

In a previously published study on the effect of an alcalase on development of denture plaque, two different methods were used to quantify plaque on the fitting surface of maxillary dentures. Both methods were based on scoring of photographs at $\times 10$ magnification. In one of the methods the percentage area was estimated with 10% intervals from 0% to 100%. By the other method dentures were ranked according to cleanliness based on area and on degree of staining of plaque. The number of dentures in each of the 14 treatment periods was 14 or 15. The present study was conducted to determine the reliability of the two methods. Reliability of the two methods was determined by using Pearson's correlation coefficient and Kendall's tau. Both intra- and inter-examiner reliability was high. A high correlation between the two methods was also demonstrated. □ *Indices; photography; reliability*

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Recent epidemiological (2, 11) and experimental clinical (3) studies have demonstrated a relationship between denture plaque and development of denture stomatitis. This has prompted investigations of the effect of various chemical, antimicrobial, and mechanical methods to improve denture cleanliness (5–7, 9). For this purpose denture plaque has to be quantified, e.g. by using a clinical index. Such indices should be valid, reliable, and easy to apply under different conditions. Only a limited number of studies have described and evaluated such indices to measure denture plaque (1, 4, 10).

The purpose of the present study was to test the reliability of two different methods of scoring denture plaque which have been used recently to study the effect of chemical denture cleansers (6, 7). Furthermore, the correlation between the two methods was studied.

Materials and methods

The data for the present study stem from an experiment designed to determine the effect of a protease on formation of denture plaque on the fitting surface of maxillary dentures

(7). A brief summary of the experimental design is given in Table 1.

The enzyme was an unspecific protease (Alcalase®, Novo) hydrolyzing a wide variety of proteins. The amount of enzyme varied from 15 to 1000 mg per tablet. In some of the treatment periods a detergent was also added. Denture brushing was included in three of the periods. A total of 17 subjects wearing complete dentures participated in the study.

At the start of each treatment period the dentures were brushed professionally until they did not show visible plaque after staining with a disclosing solution (4). At the end of each of the 14 treatment periods the dentures were stained again and the fitting surface of the denture was photographed, using a fixed object to film distance with standardized exposure and photographic technique (Medical Nikkor®, Kodak Ektachrome® ER 135–36) (7). For further details the reader is referred to the original publication.

For the present study 5 individuals who had participated in less than 10 of the treatment periods owing to absence were excluded, leaving a total of 12 individuals. Denture plaque was scored in two different

Table 1. Experimental design of the study indicating the different denture cleansing procedures tested

Period	No. of subjects	Alcalase, mg/150 ml	Detergent, mg/150 ml	Denture brushing
A	15	—	—	+
B	14	0	0	—
C	14	0	1000	—
D	14	15	1000	—
E	14	30	1000	—
F	14	60	1000	—
G	14	60	0	—
H	15	100	1000	—
I	15	300	1000	—
J	15	500	1000	—
K	15	500	0	—
L	14	—	—	+
M	14	1000	1000	—
N	14	500	1000	+

ways. Photographs of the dentures were projected at $\times 10$ magnification, and the percentage area of the fitting surface showing plaque was scored with 10% intervals from 0 to 100%.

Furthermore, the photographs from the 14 different treatment periods were re-organized in 5 groups with 4 to 6 periods in each group (see later, in Table 3). Within each of these groups the slides were given a rank in accordance with increasing amount of plaque based on intensity of disclosed plaque and area. All slides were scored twice by two independent examiners (E.B.-J. and A.M.K.) with an interval of 1 month. During the scoring sessions the examiners were unaware of the results of the other examiner and of the results of their own previous scoring in case of a double scoring.

The reliability of the two methods was determined by using Pearson's correlation coefficient for percentage area and Kendall's tau (8) for ranking by plaque.

Inter-examiner reliability and intra-examiner reliability were determined for both methods by means of test and retest data. The inter-examiner reliability was determined by using the test data from each examiner. Furthermore, the two methods were compared by computing the mean percentage area obtained for dentures with different ranks.

Results

Table 2 shows intra-examiner reliability for each of the two examiners, inter-examiner reliability determined on the basis of data from the different treatment periods for each of the two examiners, and inter-examiner reliability determined on the basis of data from the different treatment periods for each of the 12 individuals. Table 2 shows that all correlation coefficients were high; in fact, few were below 0.90. All correlation coefficients were statistically significant ($P < 0.01$).

Table 2. Intra- and inter-examiner reliability calculated as Pearson's correlation coefficient from test-retest data on percentage area covered with plaque

Subject	Intra-examiner reliability		Inter-examiner reliability
	Examiner I	Examiner II	
1	0.91	0.96	0.94
2	0.93	0.99	0.96
3	0.97	0.96	0.94
4	0.81	0.83	0.78
5	0.99	0.77	0.97
6	0.97	0.96	0.93
7	0.96	0.86	0.97
8	0.96	0.97	0.91
9	0.99	0.99	0.95
10	0.90	0.97	0.81
11	0.98	0.95	0.94
12	0.91	0.94	0.90

Table 3 shows intra- and inter-examiner reliability of ranking the slides of individual dentures according to amount of plaque. This method of assessing denture plaque also gave a high correlation between the two examiners' ranking and between each of the two examiners' ranking at different occasions ($P < 0.001$).

Fig. 1 shows examples of the correlation between ranking by denture plaque and mean percentage area covered with plaque. Similar patterns were found in the other groups. Both examiners found the same relationship between ranking by denture plaque and mean percentage area covered with plaque.

Discussion

The present study has demonstrated a high intra- and inter-examiner reliability by both methods. Furthermore, a close relationship between the data obtained by the two methods has been demonstrated. This is remarkable, since both methods are subjective and different, one assessing the area of extension of denture plaque while the other included an assessment of the thickness of denture plaque.

Before the study (7) the two examiners had practiced both methods, and the criteria and the scoring methods had been thoroughly discussed. This should be considered when interpreting the results of the present study.

In the hands of experienced examiners both methods proved easy to apply. The time needed to assess percentage or rank a slide was approximately 10 sec. Thus, from

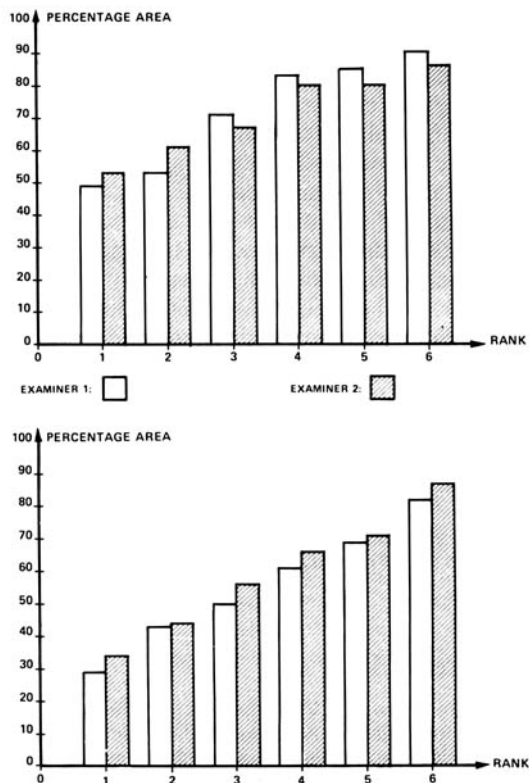


Fig. 1. Mean percentage area covered with plaque in relation to rank of denture by amount of plaque (top: treatment periods B,C,G,K,F,J; bottom: treatment periods A,D,H,J,L,M).

the point of view of time requirement no differences could be found between the two methods. In the original study (7) 14 different treatment periods were included. In the ranking of slides according to amount of plaque, however, it proved difficult to rank

Table 3. Intra- and inter-examiner reliability calculated as Kendall's tau from test-retest data on rank of denture cleanliness

Treatments included	Intra-examiner reliability		Inter-examiner reliability
	Examiner I	Examiner II	
B,C,G,K,F,J	0.86	0.81	0.82
A,J,L,N	0.78	0.66	0.82
B,C,D,E,F	0.80	0.70	0.66
F,H,I,J,M	0.88	0.80	0.79
A,D,H,J,L,M	0.86	0.68	0.79

more than five to six slides at the same time. With more slides, the examiners became confused.

Since a close correlation was found between ranking of dentures according to denture plaque and percentage area covered with plaque, it seems feasible to expect that the results of a given study would most probably be the same irrespective of which of the two methods was used. Obviously, in epidemiological studies in which denture cleanliness is determined for population groups, the percentage area would be the only index of choice. On the other hand, in short-term clinical trials screening different methods of controlling denture plaque, the ranking method might also prove useful.

Acknowledgement.—This study was partly sponsored by Novo Inc., Denmark.

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