

Progression of proximal enamel caries in early teens related to caries activity

LARS GRANATH, ANNIKA KAHLMETER, LARS MATSSON & ULLA SCHRÖDER

Department of Pedodontics, University of Lund, School of Dentistry, Malmö, Sweden

Granath, L., Kahlmeter, A., Matsson, L. & Schröder, U. Progression of proximal enamel caries in early teens related to caries activity. *Acta Odontol. Scand.* 1980, 38, 247 – 251

Posterior bite-wing radiographs were available from 3 annual check-ups of 126 individuals 12 – 13 years of age at the start of the study. Enamel caries was defined according to Granath et al. (2), the lesions graded and the progression largely scored (score = transition between grades) according to Gröndahl et al. (4). About 400 surfaces were observed for 2 years and approximately 950 for 1 year (year 1 or year 2). After subdivision, 2-year observations were included in the 1-year observations. The radiographic interpretation was made simultaneously by 2 examiners. A double determination revealed 86% agreement with the first registration. The individual caries activity during the 1-year period under consideration was expressed as the percentage of surfaces that had become carious during the period out of the number of available surfaces at the end of the period minus those that had been carious and filled at the start. The material was subdivided into 5 activity classes. In the 1-year material, there was a statistically significant relation between progression and caries activity ($p < 0.01$). In the lowest interval, 62% had score 0, 33% score 1, and 5% score 2; in the highest interval, these figures were 43, 54, and 2%, respectively. 8% of shallow enamel lesions advanced into the dentin or the surface were restored; the corresponding figure for deep lesions was 35%. In the 2-year material, 37% of the surfaces had score 0, 49% score 1, and 14% score 2. 24% of shallow enamel lesions reached into the dentin or the surface were restored; the corresponding figure for deep lesions was 58%.

Key-words: Proximal enamel caries; progression; permanent teeth

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

Only a few studies seem to have been published where the progression of already established proximal enamel caries lesions has been followed in children and adolescents (1, 5, 6, 7, 10). Zamir et al. (10) found a statistically significantly faster progression in 14–15 year olds compared with 20–24 year olds, while Gröndahl et al. (5) observed that the slighter the lesion at the first examination, the slower was the progression. According to

Berman & Slack (1) and Gröndahl et al. (5), progression of caries in the enamel is a slow process, but this is a matter of debate.

Hollender & Koch (7) found that 40–50% of surfaces with caries confined to the enamel showed progression into the dentin or became filled during 3 years in children 10 years of age at the start. The progression was related to whether the subjects were exposed to topical appli-

cation of fluorides or not. Berman & Slack (1) reported a corresponding figure of 47 % for first permanent molars (223 surfaces) as well as for second permanent molars and premolars (176 surfaces) in children about 11 years of age at the start. Zamir et al. (10), pooling their age groups, found that of 63 shallow enamel lesions, 83 % had increased to at least deep enamel lesions and that 33 % had reached the dentin, or the surfaces had been restored during a 2-year period. The corresponding figures for 52 lesions during a 3-year period were 84 and 57 %, respectively. Gröndahl et al. (5) followed adolescents from 16 to 19 years of age and found regarding the whole dentition that of 768 shallow enamel lesions, 38 % remained unchanged and 35 % advanced into the dentin, or the surfaces became filled. The corresponding figures for 469 deep enamel lesions were 18 and 82 %, respectively.

It seems as if the clinical age of the tooth is of minor importance for the progression of carious lesions in enamel once these are established. On the other hand, according to our interpretation of the referred data, the rate of progression is substantial, at least for lesions that have passed more than halfway through the enamel. But in none of the studies cited, except what Hollender & Koch (7) found about the effect of fluorides, was the carious lesion studied in relation to the caries activity of the individual, a matter of conceivable clinical importance for the prediction of caries progression and thus for the planning of treatment. Consequently the purpose of the present investigation was to study radiographically the progression of caries in the enamel of premolars and molars in early teens and relate the findings to caries activity during the observation period.

MATERIAL AND METHODS

Bite-wing radiographs were available

from 3 annual check-ups of 126 children from 6 schoolclasses from 1 school in Malmö (3). The children were 12–13 years of age at the start of the study. The annual examination was not an integral part of the treatment provided by the School Dental Service.

Two films had been taken on each side at each examination by one person. Orthoradial projection had been used against the contact between the first and the second premolar and either between the second premolar and the first molar or the first molar if the second molar had erupted. Proximal caries was defined as radiolucent areas that could not be related to normal anatomy or hypoplasia (2).

In the previous study (3) all films had been evaluated for caries–not caries, from the distal surface of the first premolar to the mesial surface of the second molar. This judgement was accepted for the present study, where the lesions were graded and progression was scored largely according to Gröndahl et al. (4), Table 1. In the reduction of data, reversals were counted as unchanged surfaces, and restored surfaces were given the diagnosis 03 according to Wagg (9).

The radiographic interpretation was made simultaneously by 2 examiners (AK and LM) with the aid of a magnifying viewer (8). The complete material of pictures from the initial examination was evaluated first, followed by that from the second and so on, in order to avoid an influence from the previous registration in the individual case. A double determination of every fifth case in the file (the first one chosen by lot in the range from number 1 to number 6) was done after 2 months.

The observation time was 1 or 2 years, depending on whether caries was present in year 0 or year 1. Two-year observations were subdivided and included in the 1-year observations.

Caries activity during the 1-year period

Table 1. *System for evaluation of progression of proximal enamel caries by radiographs; slight modification of the method advised by Gröndahl et al. (4)*

Grades	Score - Transition
01 = lesion in the outer half of the enamel (shallow)	0 all unchanged diagnoses 01, 02→R
02 = lesion more than halfway through enamel (deep) but not past the dentin-enamel junction	1 01→02; 02→03 02→F
03 = lesion extending into the dentin but not more than halfway through to the pulp; F	2 01→03 01→F

F = restored surface; R = reversal

Table 2. *Progression of proximal enamel caries during 1 year in 125 young teenagers, expressed as scores in relation to caries activity; scores according to Table 1; for caries activity see Material and Methods*

Caries activity in percentage	Lesions with score			Total number of surfaces
	0	1	2	
0-19	243 (62 %)	127 (33 %)	20 (5 %)	390
20-39	180 (54 %)	139 (42 %)	14 (4 %)	333
40-59	87 (50 %)	81 (46 %)	7 (4 %)	175
60-79	23 (43 %)	29 (55 %)	1 (2 %)	53

Chi square = 13.16; d.f. = 3 (score 1 and 2 pooled at test); $p < 0,01$

under consideration was expressed as the percentage of surfaces that had become carious during the period out of the number of available surfaces at the end of the period minus those that had been carious and filled at the start. The material was subdivided into 5 caries activity classes, 0-19, 20-39 and so on. At the treatment of data, the 80-100 activity class was discarded because of the low number of observed surfaces.

RESULTS

The double determination showed 86% agreement with the first registration.

The distribution of scores in the 1-year observation material in relation to caries activity is shown in Table 2. The percentage of score 1 increased with increasing caries activity. The dependence of score on activity was statistically significant at the 1% level. In the lowest activity inter-

val, 62 % of the surfaces had score 0, 33 % score 1, and 5 % score 2; in the highest interval 43 % had score 0, 54 % score 1, and 2 % score 2.

In the 2-year observation material as a whole, 37 % of the surfaces had score 0, 49 % score 1, and 14 % score 2.

Table 3 is a cross-tabulation of the data at the start of the caries registration and 1 year later. It is seen that of 530 shallow enamel lesions, 51 % progressed and 8 % advanced into the dentin, or the surface was restored. The corresponding figure for deep lesions was 35 %.

Table 4 presents the 2-year data in the same way as in Table 2. Of 236 shallow enamel lesions, 67 % progressed and 24 % reached the dentin, or the surface was restored. The corresponding figure for deep lesions was 58 %.

DISCUSSION

The results reveal a high progression rate of radiographically detectable enamel lesions in posterior teeth, as was expected from earlier reports in the literature. When the proximal lesion has penetrated more than halfway through the enamel there seems to be more than a 50 % chance that it will extend into the dentin within a period of 2 years. Already after 1 year a considerable number of lesions (35 %) had reached this stage. The finding by Gröndahl et al. (5) that the rate of progression is related to the size of the lesion was not confirmed.

Although progression was apparent also in the lowest caries activity class, it is obvious that possibilities exist of influencing further development by means of preventive measures, and that early lesions in individuals with a high caries activity call for particular attention.

Two problems arise when utilizing the present data for clinical purposes. First, in the clinical situation one has to predict the caries activity when the early enamel lesion is diagnosed; this calls for other methods than those used here for estimat-

ing the activity. Second, from a cariologic viewpoint it is of paramount importance to know whether a radiolucency in the radiograph represents a clinical cavity or just a demineralized area. As this differential diagnostics has been neglected in our study as well as in the previous investigations, more research has to be done before definite recommendations can be advocated for operative intervention.

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Table 3. Progression of proximal enamel caries during 1 year among 126 young teenagers related to initial size of the lesion; radiographic diagnostic levels according to Table 1

Year 1 Start	01	02	03	R	F	Total number of surfaces
01	228 (43 %)	230 (43 %)	27 (5 %)	31 (6 %)	14 (3 %)	530 (100 %)
02		229 (54 %)	65 (15 %)	48 (11 %)	84 (20 %)	427* (100 %)

* one surface reached a more advanced stage than 03

Table 4. Progression of proximal enamel caries during 2 years among 126 young teenagers related to initial size of the lesion; radiographic diagnostic levels according to Table 1

Year 2 Start	01	02	03	R	F	Total number of surfaces
01	68 (29 %)	101 (43 %)	26 (11 %)	10 (4 %)	31* (13 %)	236 (100 %)
02		56 (35 %)	16 (10 %)	12 (7 %)	76** (48 %)	160 (100 %)

* 10 surfaces were filled during the first year

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