Changes in caries diagnostic criteria over time related to the insertion of fillings

A comparative study

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The attitude toward the need for restorative treatment of carious approximal tooth surfaces changed gradually during the 1970s. The depth of the carious lesions and an assessment of their progression rate was recommended to be the basis for decisions of whether preventive measures or restorative therapy should be applied. The aim of this study was to examine whether this new view on caries therapy had influenced the treatment of posterior approximal surfaces and the choice of caries diagnostic criteria in studies on changes in caries prevalence over time. The material comprised posterior bitewing radiographs and records from the annual dental care of two groups of teenagers, born in 1964 and 1971, respectively. By means of an index system every approximal surface from the distal surfaces of the first premolars to the mesial surfaces of the second molars was given a caries diagnostic score on the basis of the depth of the lesions. The fillings inserted during the same treatment period as the radiographs had been taken were then grouped on the basis of the scores. At 13 years of age the percentage of fillings inserted in teeth with carious lesions extending into the outer and those extending into the inner half of the enamel was significantly higher in children born in 1964 than in those born in 1971. This was also the case with fillings inserted at 16 years of age in teeth with lesions extending into the inner half of the enamel. On the basis of these results it was concluded that comparisons between the two groups with regard to approximal caries prevalence has to be based on criteria that cover both fillings and initial and frank carious lesions. This seems to have a general bearing on comparisons between groups of the same age but with different years of birth. □ *Approximal caries; dental enamel; radiographs*

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Up to the 1970s many approximal enamel carious lesions recognized on radiographs were restoratively treated. Then the criteria for filling therapy gradually changed, implying that the depth of the carious lesions and an assessment of their progression rate were recommended to be the basis for decisions on whether preventive measures or restorative therapy should be applied.

This change was due to studies that had shown that the caries development in posterior approximal surfaces is a relatively slow process (1–7) and that fluoride could reduce the progression of caries and favor remineralization of initial carious lesions (8–14).

In 1977 the Swedish National Board of Health and Welfare issued a new system for caries recording (15), to be used within the Public Dental Service. Carious lesions on approximal surfaces recognized on radiographs were divided into initial and manifest caries. Initial caries comprised lesions extending up to two-thirds of the thickness of the enamel. In a later edition (16) initial caries denoted all caries within the enamel and even lesions that penetrated the dentinoenamel junction slightly. It was stressed that use of fluorides could stimulate remineralization of initial carious lesions. Furthermore, at a series of visits to the different clinics in 1977–78 the staff of the Public Dental Service in the city of Göteborg recommended these new principles for treatment of dental caries.

The aim of this study was to examine the changes in caries diagnostic criteria over time related to the insertion of fillings.

Materials and methods

The material chosen for this study has been described in a previous study (17). It comprised bitewing radiographs and notations in the dental records, which documented the treatment of two groups of teenagers, born in the city of Göteborg, Sweden, in 1964 (n = 130) and 1971 (n = 108), respectively.

The following conditions were made for the choice of the material. The children in both groups must always have been living in the same parts of the city, and they must have been treated continuously by the Public Dental Service.

Posterior bitewing radiographs should have been taken at the regular treatment periods at 13 and 16

Table 1. Numbers and percentage of approximal surfaces with caries score 1 which were filled during the treatment periods at 13 and 16 years of age. The differences between the 13-year-olds in the 1964 group and each of the other groups were statistically significant ($P < 0.001$)

Birth year and treatment age	Year of examination	No. of surfaces of caries score 1		Relation filled/total no. of carious surfaces, %	Carious lesions of score 1 per child
		Total	Filled		
1964, 13 years	1977	323	57	18	2.5
1964, 16 years	1980	413	15	4	3.2
1971, 13 years	1984	189	3	2	1.8
1971, 16 years	1987	216	5	2	2.0

Table 2. Numbers and percentage of approximal surfaces of caries score 2 which were filled during the treatment periods at 13 and 16 years of age. The differences between the 13- and 16-year-olds in the 1964 group and the corresponding age groups born in 1971 were statistically significant ($P < 0.001$)

Birth year and treatment age	Year of examination	No. of surfaces of caries score 2		Relation filled/total no. of carious surfaces, %	Carious lesions of score 2 per child
		Total	Filled		
1964, 13 years	1977	62	35	57	0.5
1964, 16 years	1980	81	37	46	0.6
1971, 13 years	1984	56	5	9	0.5
1971, 16 years	1987	157	12	8	1.5

years of age. They should not have been treated with fixed orthodontic appliances, and no permanent tooth should be missing.

The randomized selection of the primary materials was achieved in the following manner. For the 1971 group all children born on the 10th or 20th of any month of the year 1971 were taken into consideration. The children of the 1964 group had been randomly selected in 1968 for another study (18) and had then been living in the region. The randomization of 1968 comprised every seventh child.

From these two preliminary groups all children were excluded who did not fulfill the conditions given above.

The approximal carious lesions recognized from the distal surfaces of the first premolars to the mesial surfaces of the second molars had been registered by one of the authors of the previous study (17). The findings were scored in the following manner: 0 = intact surface; 1 = lesion restricted to the outer half of the enamel; 2 = lesion extending into the inner half of the enamel; and 3 = lesion extending into the dentin.

The fillings inserted during a treatment period as specified in the dental records were grouped on the basis of the scores of the carious lesions recognized on the radiographs taken at the start of the same treatment period.

The mean number of fillings recognized at base line on the proximal surfaces of the 1964 and 1971 groups were 1.04 (*s*, 1.51) and 0.87 (*s*, 1.35), respectively.

Student's *t* test was used in the statistical analysis. The statistical analysis was performed both on an individual level and on the surface level. No differences were seen between the levels. The results are only given for the surface level.

Results

Tables 1–3 present the numbers and percentages of carious surfaces that had been filled during the treatment periods at 13 and 16 years of age, respectively. The following details were noted:

Carious lesions of score 1 (Table 1)

Among the children born in 1964 the percentage of restorations being made after the examination was lower in the 16-year-olds than in the 13-year-olds ($P < 0.001$). In the 1971 cohort both 13- and 16-year-olds had fewer restorations than 13-year-olds born in 1964 ($P < 0.001$).

Carious lesions of score 2 (Table 2)

Both at 13 and 16 years of age the 1971 groups had significantly lower percentage numbers of fillings being made after the examination than the corresponding age groups born in 1964 ($P < 0.001$).

Carious lesions of score 3 (Table 3)

In contrast to the findings seen for scores 1 and 2 (Tables 1 and 2), no statistically significant differences were found for score 3.

Discussion

Up to the 1970s approximal caries was regarded more or less as a process that only could be treated by

Table 3. Numbers and percentage of approximal surfaces of caries score 3 which were filled during the treatment periods at 13 and 16 years of age, in the 1964 and 1971 groups. No statistically significant differences were found

Birth year and treatment age	Year of examination	No. of surfaces of caries score 3		Relation filled/total no. of carious surfaces, %	Carious lesions of score 3 per child
		Total	Filled		
1964, 13 years	1977	19	15	79	0.1
1964, 16 years	1980	24	18	75	0.2
1971, 13 years	1984	13	9	69	0.1
1971, 16 years	1987	40	26	65	0.4

restorations. X-ray diagnostics therefore usually meant a recording of carious lesions that had to be restored by fillings. Owing to increased knowledge of caries progression and the caries-inhibiting effect of fluoride, the treatment of enamel caries became more preventive. Among others, Gröndahl et al. (6) recommended that the depth and progression rate of approximal carious lesions should be decisive for the choice of preventive measures or restorative treatment. Examination of radiographs with regard to the development of carious lesions therefore became of vital interest for the choice of therapy.

A marked decrease was found in the number of approximal enamel carious lesions (scores 1 and 2) filled in the 1971 group compared with the 1964 group. However, the effect of the change in filling criteria is seen already in the 1964 group, in which a significantly lower percentage ($P < 0.001$) of score-1 lesions was restored at 16 years of age than at 13 years. The results thus indicate that dentists rapidly changed their attitude towards filling therapy, especially with regard to lesions in the outer half of the enamel. To begin with, they were obviously hesitant about leaving deeper lesions in the enamel without restorative treatment (Table 2). These results are in accordance with earlier studies (19, 20).

The changes in criteria for insertion of fillings ought to be considered when parameters are chosen for comparative studies on caries prevalence over time. This necessity is clear from the results of this study. The fact that initial carious lesions (scores 1 and 2) more seldom were filled in the 1971 group than in the 1964 group will as a consequence give comparatively lower caries prevalence figures for the 1971 children, provided either of the following caries parameters has been used: 1) surface with a filling, 2) surface with either a filling or a carious lesion of score 3, or 3) surface with either a filling or a carious lesion of score 2 or 3. Low figures would also have been achieved if in reality the two groups had had identical caries development. In comparisons over time, therefore, the criterion for diagnosis of proximal caries should be a surface displaying either a filling or a radiographically visible carious lesion. On the other hand, if this parameter is used to evaluate the effect of a caries-preventive program, figures calculated for the caries reduction over time may be too low, as some remineralized incipient carious lesions still may be counted as carious. However, the identification of a lesion as remineralized seems to require long observation periods, certainly longer than the 3 years between 13 and 16 years of age.

References

1. Backer Dirks O. Longitudinal dental caries study in children 9–15 years of age. Arch Oral Biol 1961; Suppl 6:94–108.
2. Backer Dirks O. Posteruptive changes in dental enamel. J Dent Res 1966;45:503–11.
3. Berman DS, Slack GL. Caries progression and activity in approximal tooth surfaces. A longitudinal study. Br Dent J 1973; 134:51–7.
4. Marthaler TM, Wiesner V. Rapidity of penetration of radiolucent areas through mesial enamel of first permanent molars. Helv Odontol Acta 1973;17:19–26.
5. Haugejorden O, Slack GL. Progression of approximal caries in relation to radiographic scoring codes. Acta Odontol Scand 1975;33:211–17.
6. Gröndahl H-G, Hollender L, Malmcrona E, Sundquist B. Dental caries and restorations in teenagers. II. A longitudinal radiographic study of the caries increment of proximal surfaces among urban teenagers in Sweden. Swed Dent J 1977;1:51–7.
7. Gröndahl H-G, Hollender L. Dental caries and restorations. IV. A six year longitudinal study of the caries increment of proximal surfaces. Swed Dent J 1979;3:47–55.
8. Bergman G. The caries inhibiting action of sodium fluoride [dissertation]. Acta Odontol Scand 1953;11 Suppl 12.
9. Sundvall-Hagland I. Sodium fluoride application to the deciduous dentition [dissertation]. Stockholm: University of Stockholm, 1955.
10. Feagin FF, Phantumvanit P. Remineralization in enamel. J Dent Ass Thai 1976;26:77–83.
11. Torell P. Reversals in caries diagnosis. Acta Odontol Scand 1967;25:191–203.
12. Hollender L, Koch G. Influence of topical application of fluoride on rate of progress of carious lesions in children. Odont Rev 1969;20:235–44.
13. Socialstyrelsen. Odontologisk rådgivning vid barnavårdscentral. Bilaga till socialstyrelsens författningssamling. Stockholm: Socialstyrelsen, 1978:32–4.
14. ten Cate M. Remineralization of enamel lesions [dissertation]. Groningen: University of Groningen, 1979.
15. Socialstyrelsen. Socialstyrelsens anvisningar för journalföringen inom folktandvården. Stockholm: SOSFS(M), 1977:94.
16. Socialstyrelsen. Socialstyrelsens allmänna råd om diagnostik, behandling och registrering av karies på approximalytor samt rutiner för överföring av patient till annan tandläkare. Stockholm: SOSFS, 1984:3.
17. Edward S, Eliasson G-B, Torell P. Caries experience in teenagers

related to changes in a dental health programme. Swed Dent J 1992;16:101–8.
18. Torell P. Göteborgsförsöket med hälsokontroll av 4-åringar. VI. Den odontologiska undersökningen. Lakartidningen 1972;69: 1904.
19. Heidmann J, Helm S, Helm T, Poulsen S. Changes in prevalence of approximal caries in 17-year-olds and related restorative treatment strategies over 6-year period. Community Dent Oral Epidemiol 1988;16:167–70.
20. Heidmann J, Hølund U, Poulsen S. Changing criteria for restorative treatment of approximal caries over a 10-year period. Caries Res 1987;21:460–3.

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