Timing of first fillings on different permanent tooth surfaces in Finnish schoolchildren

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The timing of the placement of first fillings because of caries on different permanent tooth surfaces was determined at three health centers in Finland. The 927 subjects analyzed were born either in 1970–71 or in 1980–81. Basically, two different types of filling placement site were identified: 1) fissures and pits and 2) proximal and smooth surfaces. In some fissures and pits a 'post-eruptive step'—that is, fillings placed in the year of emergence—was observed. This step had decreased markedly in the cohort born in 1980–81. The curves plateaued (retardation phase) at 50–60% for the occlusal surfaces in first molars for the children born in 1970–71 and at 20–30% for the younger cohort. The time without any filling varied from 1 to 7 years on smooth surfaces, and some surfaces remained totally filling-free. The filling placement curves followed the pattern of caries attack and can thus be used as an indicator of dental health. □ *Filling; permanent tooth surface*

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One major problem in applying cross-sectional epidemiologic data in the estimation of whether the dental health status of a child is better than the average is the fact that the timing of tooth eruption varies considerably, as shown in our recent data on Finnish children (1). As a consequence of this variation, the length of the carious challenge in, for example, the canines, premolars, and second molars may vary from 0 to 5 years at the age of 12 years. Although, from the epidemiologic point of view, this variation is not crucial and levels off between cohorts, it should be taken into account in individuals.

To overcome this problem, we conducted a study on the timing of the placement of first fillings because of dental caries, the zero point being the tooth emergence (2). Certain post-eruptive phases could be distinguished in filling curves, and they were termed as follows: i) an 'immediate post-eruptive step', in which the teeth were filled in the year of their eruption, ii) a 'lag phase', which was the stage without filling after the eruption. If fillings were placed, iii) an 'ascending growth phase' was observed after the immediate step or lag phase. In some of the teeth the filling rate plateaued after some years, and this stage was termed iv) 'retardation phase' (2).

It was suggested that the different shapes of the curves might be due to different attack rates on different teeth (molars, incisors, and so forth) and different surfaces (fissures, proximal and smooth surfaces). To determine whether this was the case, the timing of filling placements on different tooth surfaces was analyzed. Thereafter, the differences in patterns of filling placement curves in two cohorts of schoolchildren in Finland separated by one decade were determined.

Materials and methods

This study was carried out at three health centers in rural areas in Finland for all children born either in 1970–71 or in 1980–81. The communities concerned have similar socioeconomic background features, the same basic dental treatment system, and the same dentist-to-population ratio. In all three cases the chief dentist had remained the same the last 15–20 years. One of the communities had endemic fluoride in the ground water; the other two provided fluoride tablets free of charge. The dental health situations in terms of DMF statistics of the health centers were also similar. For example, the DMF values for the health centers in 12-year-olds were 4.0, 4.2, and 3.6, the national mean being 4.0 in 1982 (3), as described earlier (1, 2).

Copies of the oral health records for a total of 937 children were examined in 1991. The annual examinations made by dentists (altogether 12) were documented on standardized records. The timing of the eruption of each individual tooth (1) and the placement of first fillings because of caries on each tooth surface up to 18 years of age were computerized and analyzed. The time elapsing between eruption and placement of the first filling for each tooth surface was determined. Eleven records were excluded because the information was incomplete. The records cover periods ranging from 3 to 21 years.

The public dental care system in Finland follows a uniform set of criteria for filling placements. These are set during biannual national conferences of chief dentists at health centers. The differences between the health centers should be minor, but there is some cause to

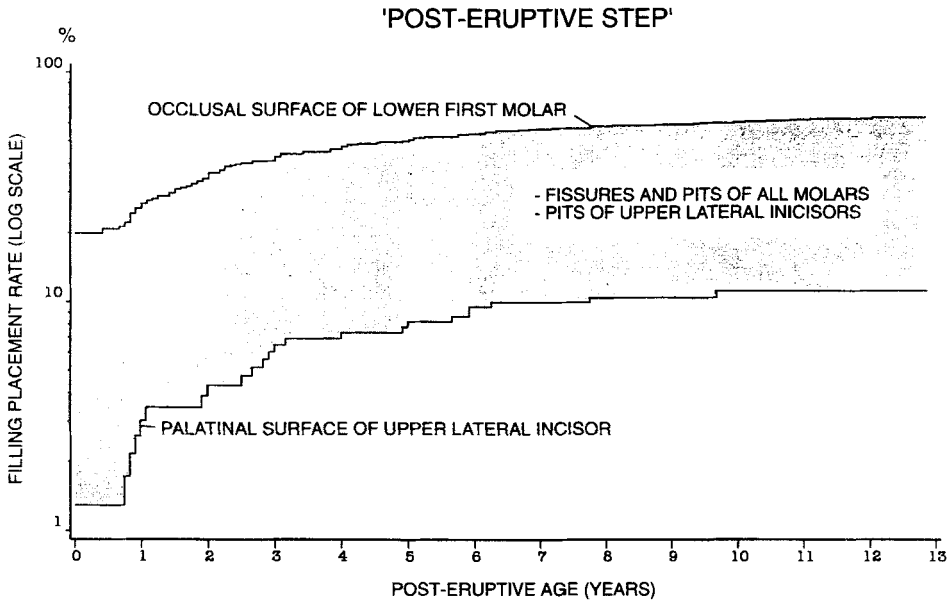

Fig. 1. Annual placement rate of first fillings on the tooth surfaces with a 'post-eruptive step'. The extremes and all other surfaces are indicated in the figure. Semi-logarithmic scale.

doubt that the filling decision was postponed to later stages of the caries attack in the eighties and nineties, as reported by The National Board of Health (3).

Treatment of data and statistical analysis

The timing of the examination, the timing of dental emergence, and the timing of the placement of the first fillings on each surface were recorded. A computer program was constructed to process all the data generated. The SAS statistical software program (4) and the CIA program of Gardner & Altman (5) were used for the statistical analyses. Confidence intervals were used when comparing differences at a specific time. When a zero difference did not fall within the 95% confidence interval (CI), the difference was considered statistically significant.

Methods of survival analysis were applied. The cumulative distribution function (CDF) was estimated using the product-limit method (also called the Kaplan–Meier method). CDF curves were compared by using the log-rank test and the Wilcoxon test.

Results

From 2% to 20% of the following surfaces had a post-eruptive step (they were filled in the year of tooth emergence) in children born in 1970–71: the occlusal, the fissures and pits on the buccal and lingual surfaces of all molars, and the pits on palatinal surface of upper lateral incisors (Fig. 1).

An ascending growth phase of about 6 years was found post-eruptively in first molar fissures and pits. After this phase a retardation occurred (Figs. 1 and 2). The curves plateaued (retardation phase) at about 50–60% for the occlusal surfaces of first molars for the children born in 1970–71. For the occlusal surfaces of second molars the growth phase was at 40–60% at the end of the study period.

Practically no fillings were placed on canines, lower incisors, the mesial surfaces of first premolars, or the buccal and lingual surfaces of premolars (not shown in figures). The stage without fillings (lag phase) varied from 1 to 7 years for the surfaces with filling increments. A lag phase of 1 to 3 post-eruptive years occurred for the surfaces shown in Fig. 3, and a lag phase of more than 3 years occurred in the surfaces shown in Fig. 4.

The rates of first fillings on fissures in first molars were the same for the maxilla and the mandible. For the second molars the rate of filling placements was 10% higher in the mandible. For the proximal surfaces of molars there were slightly more fillings in the mandible, but for the premolars and incisors all the filling increment rates were higher in the maxilla.

The chronologic age of the children at the time of the first fillings was 6.5–7 years for the occlusal surfaces of first molars, 10 years for the proximal surfaces of upper incisors, 12 years for the occlusal surfaces of second molars, and 13 years for the occlusal surfaces of premolars.

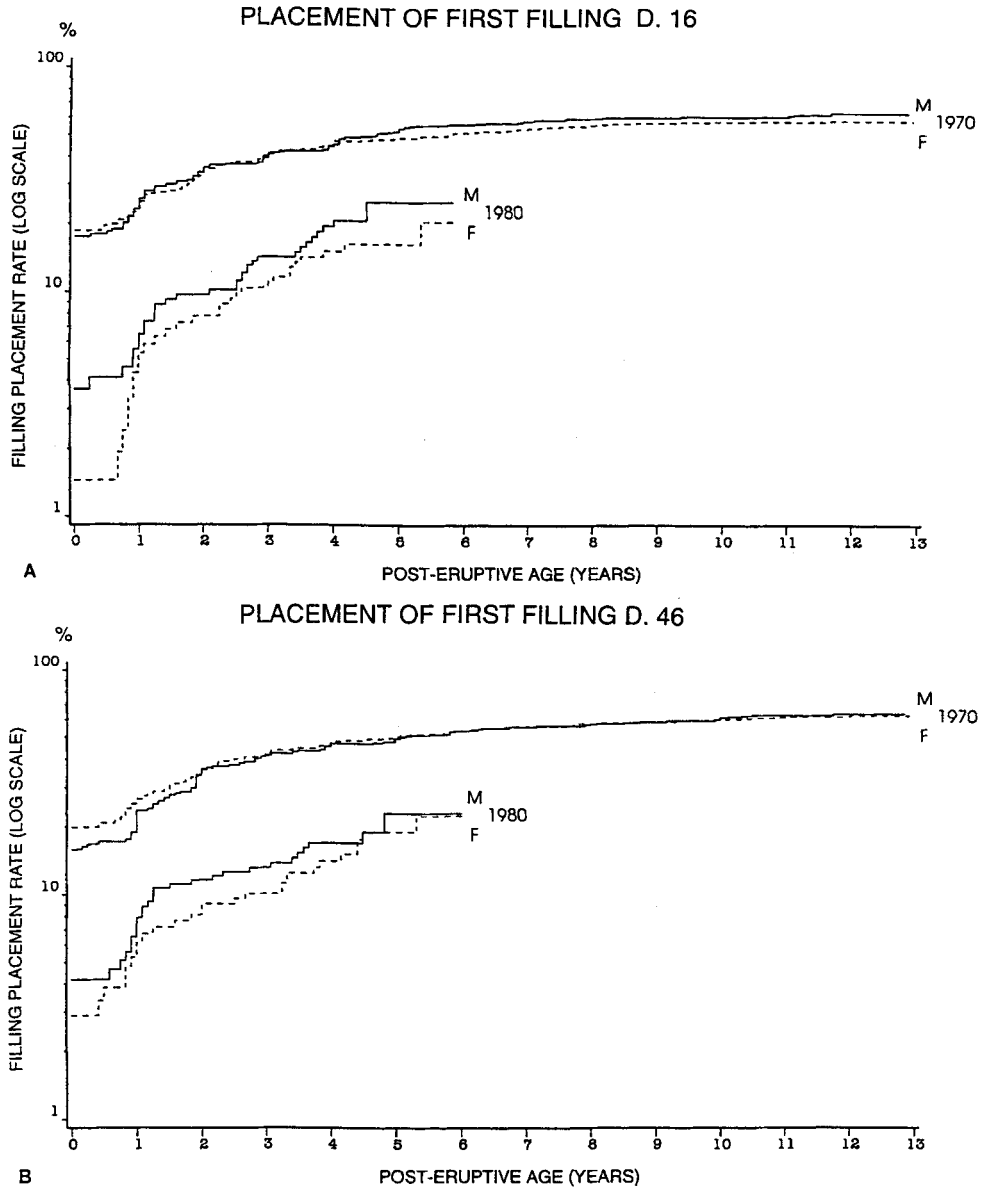

Fig. 2A. Annual placement rate of first fillings on the occlusal surface of the first permanent molar in the maxilla. Males and females born in 1970–71 and 1980–81 in Finland. 2B. Annual placement rate of first fillings on the occlusal surface of the first permanent molar in the mandible. Males (M) and females (F) born in 1970–71 and 1980–81 in Finland. Semi-logarithmic scale.

For the children born in 1980–81 less than 5% of the occlusal fissures of the first molars and the buccal pits of the lower first molars were filled in the year of tooth emergence. The reduction in the height of this step was 75–90% for children born in 1980–81 compared with those born a decade earlier (Fig. 2A and B). The reduction was statistically highly significant. For example, for the occlusal surface of D.16 for girls the 99% confidence interval for the difference between proportions is 10–24%.

After the low post-eruptive step, however, the slope of the curve of the younger cohort was steeper than that for those born a decade earlier, and the level where the curve plateaued, at 20–30%, was about 50% lower than in the older cohort (Fig. 2A and B). Apart from the fissure and pit type of fillings for those born in 1980–81, very few fillings on proximal and other smooth surfaces were found during the study period.

No sex difference was found post-eruptively in either age cohort when filling increments were analyzed for

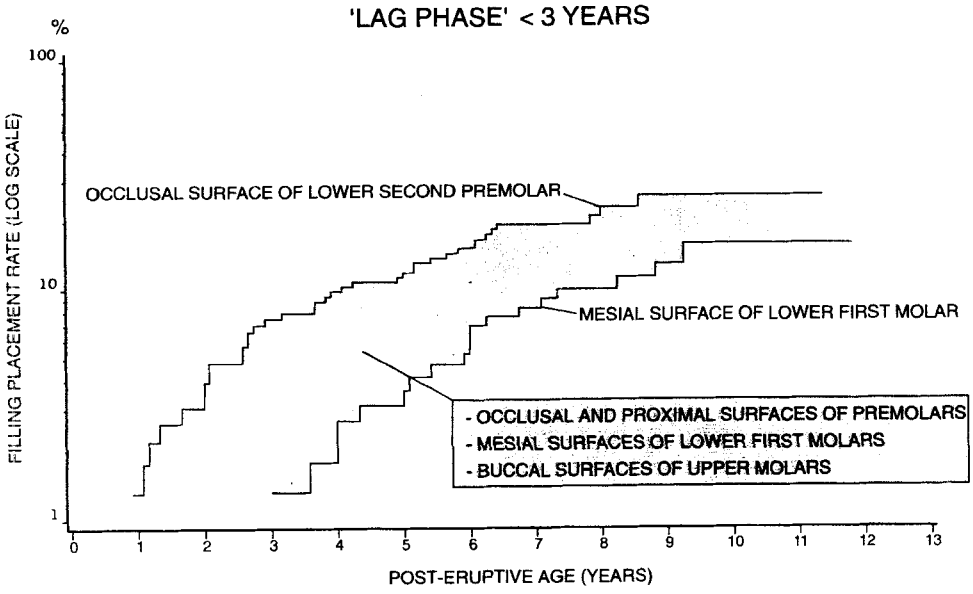

Fig. 3. Annual placement rate of first fillings on the tooth surfaces with a 'lag phase' <3 years. The extremes and all other surfaces are indicated in the figure. Semi-logarithmic scale.

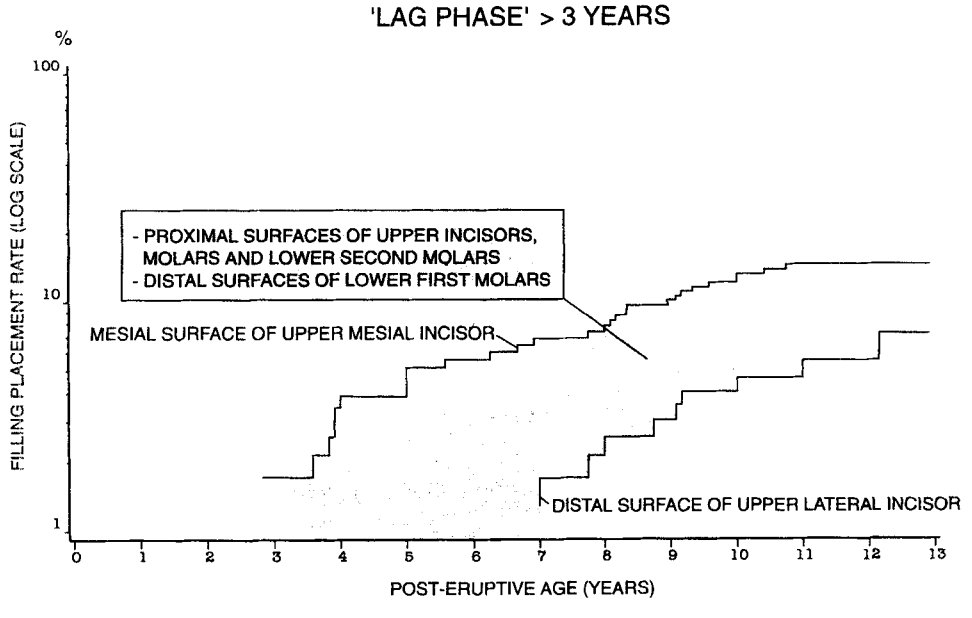

Fig. 4. Annual placement rate of first fillings on the tooth surfaces with a 'lag phase' >3 years. The extremes and all other surfaces are indicated in the figure. Semi-logarithmic scale.

fissures in molars (Fig. 2), but for some of the surfaces with a lag phase boys had a shorter lag phase and slightly more fillings than girls. A difference in favor of girls was observed for the proximal surfaces of upper incisors. For the mesial surface of the upper lateral incisor, for example, the lag phase was 2–3 years shorter, and the difference between increments at 10 years was 10%.

Discussion

We recently demonstrated that the annual patient

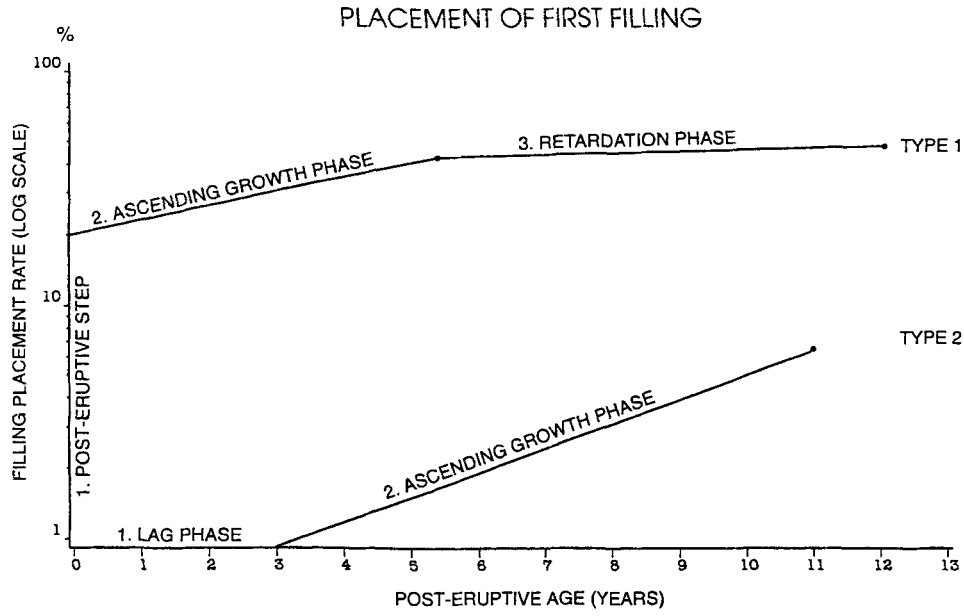

Fig. 5. A schematic diagram of two types of placement rates of first fillings because of dental caries on tooth surfaces.

records are accurate enough for a determination of the timing of tooth eruption (1). A deduction of 0.5 years could be made from the mean ages in view of the examination interval. Here, similarly, a deduction of 0.5 years could be made from the mean timing of the first fillings. Thus, the estimate for the time at risk for filling is more precise than the timing for tooth emergence used earlier (1).

It is known that the criteria for a filling have changed over time (6–8). In this study the timing of the first fillings because of dental caries was recorded retrospectively. This allows discrimination between restorations due to caries and those due to, for example, tooth fractures. This is possible only rarely in scientific cross-sections. The filling (F) and missing (M) components of the DMF indices are always based on decisions made by unstandardized clinical dentists. Thus, the D component of the DMF is the only one for which the standardization of examiners is possible in practice.

The filling component predominates in the DMF and DMFS scores in industrialized countries (9–11). A 3-year longitudinal study showed that the reduction in the DMF value was mainly due to a reduction in the number of extractions and fillings and only to a minor extent to a decrease in real caries during the late 1970s in Finland (8).

Basically, two different types of filling placement site were identified: 1) fissures and pits and 2) proximal and other smooth surfaces (Fig. 5). If the pattern of restorations provided around the mouth is similar to the pattern of carious attack, which is the case in Scottish children (12, 13) and is expected to be the case in the Finnish health care system, too, only these two caries attack sites could be distinguished in children and adolescents.

In a surface-specific caries attack study by Li et al. (14) based on two National Surveys of U.S. schoolchildren's caries sites (1979 and 1987), the permanent dentition was divided into three categories: 1) pits and fissures, 2) approximal surfaces of posterior teeth, and 3) all other surfaces. The percentage reductions in the attack proportions for the permanent teeth between the 1979 and 1987 cross-sections were largest for the category 'all other surfaces' (59%) and for the approximal surfaces of posterior teeth (52%), followed by pit and fissure surfaces (31%). Our findings of the reductions in filling placement rates for children born in 1970 or 1980 are in line with the cross-sectional caries attack study quoted above (14), giving further support to the view that in the Finnish health care system the filling placement pattern follows caries attack sites.

Different teeth and tooth surfaces are affected differently at various levels of dental caries (14–16). It has been stated that as caries prevalence decreases, the number of least susceptible sites (proximal and smooth surfaces) decreases most, whereas the number of most susceptible sites (occlusal) decreases least (15). This was the case with our filling curves, too.

The shapes of the filling placement curves for the first permanent molars for the two cohorts born a decade apart were found to differ from each other: there was a significant reduction in the height of the post-eruptive step and a slightly faster rate of filling placements for

the cohort born in 1980–81 (Fig. 2A and B). These might indicate either a reduced rate of caries progression or a delayed decision by the dentists to make a restoration in the younger cohort. Also, faster caries progression or too early filling placement decisions in the older cohort are possible.

A relatively high proportion of teeth still had occlusal fissure caries in Finnish adolescents, as also reported in a longitudinal study in the USA (17). Several studies have demonstrated that the occlusal surface of the first permanent molar is most frequently attacked by dental caries (18, 19). This tooth is susceptible during the process of eruption or soon after eruption (19, 20).

The finding of an immediate filling need and the occurrence of a retardation phase for the fissure type of filling increments after the 6 post-eruptive years is similar to the earlier results from Finland (21). We believe that this retardation is due to the termination of tooth development at that moment and to the still ongoing post-eruptive maturation of enamel. No retardation in the occurrence of caries on the occlusal surfaces of the first molars during a follow-up of 10 years after tooth eruption was recently observed (17). This indicates that the maturation of teeth is not the only factor affecting the rate of filling increment.

In conclusion, since restoration was made because of caries, the rate of proximal caries has decreased markedly in children born in 1980–81 compared with children born in 1970–71. Other smooth surface caries had disappeared completely in these children during the observation period of more than 10 years. The filling rate in fissures is still relatively high. The post-eruptive filling placement curves evidently follow the pattern of (the late stages of) the caries attack and can thus be used as sensitive indicators of dental health.

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