

Frequency and distribution patterns of sealants among 15-year-olds in Denmark in 2003

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Aims: To provide information on the frequency and distribution patterns of sealants in the Public Dental Health Service for Children (PDHSC) in Denmark. A further aim was to determine whether there was a correlation between DMF-S and sealants. **Design:** A cross sectional survey using data from 15-year-old Danes in 2003. **Sample and subjects:** The sample consisted of 50 randomly selected municipalities from the 204 municipalities with public clinics. Thirty-nine municipalities (78%) forwarded useful data. A total number of 3,184 15-year-olds were involved in the study. **Results:** The mean DMF-S was 2.97 (SD=1.40) and 42% had a DMF-S=0. The mean number of sealants was 3.06 (SD=1.60). Two-thirds of all participants had one or more sealed surfaces. At the individual level the correlation coefficient (r_s) between sealants and DMF-S was -0.05 ($p<0.01$). The mean number of sealants in one municipality was 0.26, in another 6.00. The surfaces most often sealed, were the occlusal surfaces on permanent second molars (35%), closely followed by the occlusal surfaces on permanent first molars (32%). Sealants on premolars were rare (1.5%). At the municipality level there was no significant correlation between mean DMF-S, % 15-year-olds with a DMF-S=0 and mean number of sealants ($r_s = 0.02$ ($p=0.90$) and $r_s = 0.06$ ($p=0.73$), respectively). **Conclusion:** The data indicate a high use of sealants on molar teeth, a very large inter-municipality variation, no correlation between sealants and DMF-S. These findings suggest that there are no clear guidelines for use of sealants in the PDHSC in Denmark.

Key words: Children, Denmark, public dental health service, sealants.

Introduction

In the mid 1950s, Buonocore (1955) suggested acid etching of the enamel in order to increase the mechanical adherence of resins to enamel. This technique was the predecessor of sealing surfaces with pits and fissures to prevent caries. Many studies during the '70s and '80s have shown the efficacy of sealing (Thylstrup and Poulsen, 1976; Mitchell and Murray, 1989; Simonsen, 1989). Hence, for the well informed Public Dental Health Service for Children in Denmark (PDHSC), it was natural to introduce sealants as yet another caries preventive method in the late '70s. A meta-analysis (Llodra *et al.*, 1993) supported the contention that fissure sealants were effective in controlling caries on children, while a systematic review from Sweden in 2003 (Mejare *et al.*, 2003) was much more critical of the effect of fissure sealants.

In the late '80s, Ekstrand *et al.*, (1991) used a questionnaire to map the indications for using sealants in the PDHSC. The data revealed that the indications for uses of sealants varied, but poor oral hygiene and present caries status were mentioned most often as indications for placement of sealants. The impression gained was that sealants were widely used, but the questionnaire was not sufficiently adequate to provide a more precise valuation. To the authors' knowledge, the frequency and distribution patterns of sealants in the PDHSC have not been studied. The aims of this study were to provide information on the frequency and the distribution pattern

of sealants in a 15-year-old child population in Denmark. A further aim was to investigate if there was a correlation between caries experience in terms of DMF-S and frequency of sealants.

Material and Methods

Denmark is divided into 271 municipalities. The PDHSC is organised at the municipality level. The PDHSC is free of charge, and since 1986 covers all children and adolescents aged between 0 and 18 years of age. In about 70 municipalities the PDHSC is delivered by private dentists. The population in this study is 15-year-olds in the 201 municipalities where the PDHSC is offered by municipality staff (public clinics).

The PDHSC Act in 1986 describes how children at the ages of 7, 12 and 15 shall have their dental status recorded. Special forms optically read by computers at the National Board of Health are used. Among other oral conditions, the recordings include primary and secondary caries, fillings, extractions and pulp treatment, the latter three conditions due to caries. The unit of measurement is at the surface level. Although it is not obligatory to record sealants, the majority of the municipalities do so (Ekstrand *et al.*, 1991). If caries in a cavitated stage is identified in relation to a sealant or a filling, the final score on the OCR-form will be a cavitated lesion.

For this study, 50 municipalities were selected on a random basis from the municipalities with public clinics.

A letter was forwarded to the chief dental officer in the selected municipalities, which explained the aim of the study and that it had been approved by the Ethical Board. In order to participate in the study, the dental service in the municipality was to record sealants on the ORC forms. That meant that any sealant, incomplete or complete, which the dentist identified during the examination of the participants was to be recorded.

The chief dental officers were asked to forward 1) copies of the OCR forms performed on all 15-year-olds in April – June, 2003; and 2) the number of OCR forms forwarded should either correspond to > 20% of the total number of 15-year-olds in the municipality in 2003, or at least a total number of 30 OCR-forms. Apart from information about gender, all sensitive data was to be erased from the forwarded forms.

All 50 municipalities responded to our contact. However, three municipalities replied that they did not systematically record sealants on the OCR-forms; two municipalities had not planned to fill in any OCR-forms on 15-year-olds in the selected period (April and June); and finally, two municipalities could not participate due to lack of resources.

Forty-three municipalities submitted copies of OCR-forms, but only 39 (78%) returned a sufficient number according to the inclusion criterion 2. The following will deal with data from these 39 municipalities, involving 3,184 15-year-olds, ranging from 18 (>20%) in one municipality to 431 in another municipality.

Analyses disclosed that 16 municipalities were from Jutland, six from Funen, and 17 from Zealand and Bornholm. Both rural and urban areas were included, for example two of the five largest cities in Denmark were included.

The data from the OCR-forms were converted to Excel sheets. The D-component in the DMF-S index corresponded to decay at a cavitated level. The mean DMF-S, median DMF-S and % of 15-year-olds with a DMF-S=0 (%DMF-S=0) were expressed at the sample level and from each selected municipality.

The correlation between sealed surfaces and DMF-S at the individual level was expressed by Spearman's rank correlation coefficient. This statistic was also used to describe the relationship between the mean DMF-S and %DMF-S=0 and the mean number of sealed surfaces between the individual municipalities.

Results

Central tendencies, variations and distribution pattern

The mean number of DMF-S was 2.97 (SD=1.40), ranging from 1.09 in one municipality to 6.11 in another. The median was 1 DMF-S, and on an average 42% of the children had a DMF-S=0, ranging from 11% in one municipality to 70% in another. Eighty-five percent of the DMF-S was related to the F-component, 14% related to the D-component, and 0.005% to the M-component.

Nineteen teeth, of which 16 were permanent first molars, were pulp-treated due to caries. A total of 0.6% of the 15-year-olds had pulp-treated teeth due to caries.

Figure 1 shows the percentage distribution of 15-year-olds related to the absolute number of sealed surfaces. The range was 0-16 sealed surfaces, but very few (<3%) had

more than nine sealed surfaces; these cases are merged in the figure. Thirty-two percent had no sealed surfaces, the other two thirds had one or more sealed surface(s). For example, 45% had four or more sealants.

The mean number of sealants was 3.06 (SD=1.60). The median was three sealed surfaces.

The inter-municipality variation concerning sealants ranged from 0.26 on average in one municipality to 6.00 in another. The percentage of 15-year-olds with no sealed surfaces was 0 in one municipality and 73 in another.

Figure 2 shows the distribution of sealed, filled and decayed surfaces. The number of teeth extracted due to caries was too small to be shown on a figure. As fillings due to caries in incisors and canines were extremely rare, Figure 2 focuses on sealants, fillings and decayed surfaces on premolar and molar teeth. Data regarding left-side and right-side teeth in the upper and lower jaws, respectively, have been merged, as internal analyses disclosed no difference in the DMF or sealants between the left and right sides.

The occlusal surfaces on permanent first molars were the surfaces most often filled (on average 22%). This was followed by the mesial surfaces on permanent first molars (8%), which again was followed by the occlusal surfaces on permanent second molars (6%). The surfaces most often sealed at the age of 15 were the occlusal surfaces on permanent second molars (35%), closely followed by the occlusal surfaces on permanent first molars (sealed in 32%). Sealants on premolars were very rare (1.5%).

Eighteen percent of the 15-year-olds had no sealed surfaces and no DMF-S.

Variation within the same municipality

Among the 39 municipalities, one recorded their data separately in the four different clinics in the municipality.

Table 1 shows data from that municipality as a whole and from each clinic. This municipality is characterized by the fact that all four clinics had a mean DMF-S, which was much lower than the average from the sample (1.55, 1.49, 0.94, 0.70 versus 2.97) and a higher number (%) of children with a DMF-S=0. The mean number of sealants at three of the clinics was markedly higher (>4.6) than the average for the sample population (3.1). On the other hand, at that clinic (clinic 4) with the lowest mean DMF-S and highest number (%) of 15-year-olds with a DMF-S=0, the mean number of sealants was less (2.8) than the average for the sample population.

Correlation between DMF-S, %DMF-S=0 and sealants

Spearman's correlation coefficient between number of sealed surfaces and DMF-S at the individual level was -0.05. However due to the large number of individuals (3,184) the poor correlation was significant (p=0.004). Similar statistical analysis between the mean DMF-S and the mean number of sealants, and between the percentage of 15-year-olds with a DMF-S=0 and the mean number of sealants, but at the municipality level, were 0.02 (p=0.90) and 0.06 (p=0.73), respectively.

% 15-yr-olds

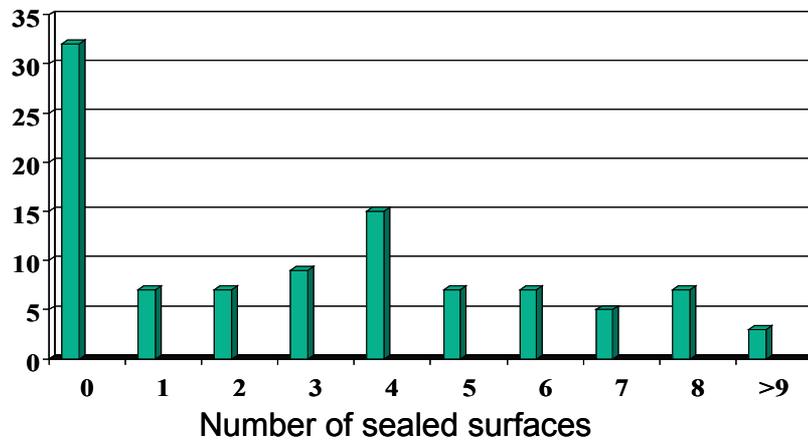


Figure 1. Percentage of 15-year-olds and absolute number of sealed surfaces.

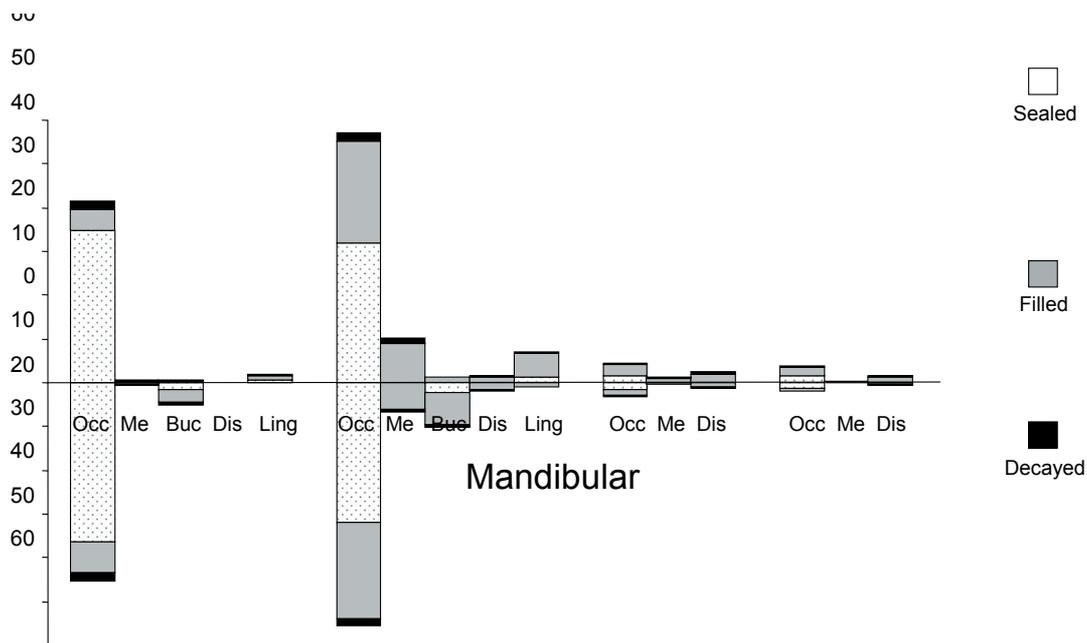


Figure 2. Frequency (%) of sealants, fillings and decayed surfaces in posterior teeth.

Discussion

Data from the Danish National Board of Health show that the mean DMF-S at the national level for 15-year-olds in 2003 was 3.04, and that the percentage of 15-year-olds with a DMF-S=0 was 37.9% (see www.nexodent.dk). Furthermore, according to the National Board of Health, amongst 15-year-olds very few teeth were extracted because of caries, and the F-component contributes more than 80% of the mean DMF-S. Hence, it can be concluded that the caries status of our sample corresponds to that of the population.

In the authors' opinion Heidmann *et al.*, (1985) illustrated in the mid 80's that the reliability of data from the OCR-forms was adequate for epidemiological

investigations when the crude DMF-components were the unit of measurement. Recently, Hausen *et al.*, (2001) concluded that DMF-data obtained from public health records in Finland – similar to those used in the present study – corresponded reasonably well with figures obtained by trained examiners. They suggested therefore that data obtained from patient records could replace the more costly and time-consuming data from trained and calibrated examiners. In the planning phase of this study, we decided to follow the advice by Hausen *et al.*, (2001). As only those municipalities, which stated that they recorded sealants systematically, were involved in this study, the authors consider the reliability of the recorded sealants to be high.

Sealants placed from the age of about six to the age of 15, which were totally lost or replaced by fillings, have not been recorded in this study. To state this differently, the study indicates the minimum number (frequency) of sealants placed on permanent teeth up to the age of 15.

It was not surprising to observe that the occlusal surfaces on permanent first molars were the surfaces most often filled in a Danish child population as it corresponds to data from other countries (Bjarnason *et al.*, 1992; Nugent and Pitts, 1997). On the other hand, it was a very positive observation that only 18 15-year-olds out of 3,184 (0.6%) had a pulp-treated permanent tooth due to caries.

Expressed by the mean and median, the frequency of fissure sealants among 15-year-old Danes were 3.06 (SD=1.60) and 3, respectively. Whether this is high or low, has increased or decreased compared with the past, cannot be answered objectively, as there are no previous data from Denmark to compare them with. However, due to the fact that two thirds of the 15-year-olds had one or more sealed surface(s), and 45% had four or more sealed surfaces, it is obvious that sealants are used widely in the PDHSC for the control of occlusal caries.

The data showed a large inter-municipality variation, expressed both by means (ranging from 0.26 to 6.00) and by the percentage of 15-year-olds with no sealants (0-73%). There was also a large variation between clinics within the same municipality (Table 1).

The data disclosed that few sealants were recorded on the occlusal surfaces on pre-molar teeth. In contrast, about one third of the occlusal surfaces on permanent first and second molars were sealed. The buccal and lingual pits on molar teeth were also seldom recorded as sealed (<3% of the surfaces) (Fig. 2).

What the data do disclose for certain is that the occlusal surfaces on permanent second molars are often sealed within a couple of years after they have emerged. In a recent study, Ekstrand *et al.* (2003a), described the time of emergence of the first of the permanent second molars and the duration until full occlusion of these teeth. The mean time of emergence was 11.3 years and 12.0 years for girls and boys, respectively. The mean duration time of the eruption period was about 2.3 years. Thus, at the age of 15 many children had just recently got their permanent second molars into full occlusion.

Marthaler (2004) discusses the influence on sealants on the reduction of DMF-S on children and adolescents in industrial countries over the last 20 years. He speculates that sealants might have an effect in countries with low caries experience in children and adolescents such as in Denmark (Ekstrand *et al.*, 2003b), as caries

predominantly affects pits and fissure surfaces. In this study we therefore expected to find at least a moderate negative correlation, thus a high frequency of sealants, and a lower mean DMF-S. The present data showed that there were no such correlations in the PDHSC, either at the individual level or at the municipality level. This is, however, not the same as stating that fissure sealants are not effective in the PDHSC, as we do not know how many of the sealed teeth would have been filled if they had not been sealed.

The large inter-municipality variation in the use of sealants and the corresponding lack of correlation between DMF-S and sealants indicates that there are no agreed indications for the use of sealants in the PDHSC in Denmark. This may reflect the fact that research has shown sealants to be effective both as a preventive tool (Raadal *et al.*, 1984) and as a therapeutical tool (Handelman *et al.*, 1985; Leverett *et al.*, 1983). The dentists in the PDHSC may therefore use sealants on a wide range of indications. Some dentists seal clinically sound surfaces, some seal surfaces with initial caries or even mature caries, and some seal both sound surfaces and surfaces with caries.

The data revealed that up to the age of 15, about 25% of the occlusal surfaces of permanent first molars develop caries to a stage where fillings are required on children who have participated in the comprehensive PDHSC in Denmark all their lives. Furthermore, the data revealed that about one third of the occlusal surfaces on the molar teeth were sealed. Such data indicate that each chief dental officer and the staff in the public clinics would benefit from revising their strategy of how to control caries on the occlusal surfaces of molar teeth, in particular the occlusal surface of permanent first molars. Sealants should be an integrated tool in that strategy.

In this perspective the authors want to draw attention to a non-operative caries treatment programme (NOCTP) used in the PDHSC in Nexö, Denmark, where sealants are used as a therapeutic tool, only after several tooth-brushing instruction sessions and fluoride applications have failed to arrest incipient occlusal lesions (Ekstrand and Christiansen, 2005). The mean DMF-S, %DMF-S=0 and the mean number of sealants on 15-year-olds in 2003 were 0.7, 74% and 2.8.

Conclusion

The data indicate a high use of sealants on molar teeth, a very large inter-municipality variation, no correlation between sealants and DMF-S. These findings suggest that there are no clear guidelines for use of sealants in the PDHSC in Denmark.

Table 1. Mean DMF-S, %DMF-S=0 and mean number of sealants within different clinics in one municipality.

Municipality	n	Mean DMF-S	%DMF-S=0	Mean number of sealants
The municipality	n=149	1.09	64	4.28
Clinic 1	n=35	1.49	63	5.17
Clinic 2	n=22	1.55	50	4.73
Clinic 3	n=49	0.94	61	4.69
Clinic 4	n=43	0.70	74	2.84

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