

The caries-preventive effect of a fluoride varnish in the fissures of the first permanent molar

Gun-Britt Holm, Kerstin Holst and Ingegerd Mejäre
Malmöhus County Council, Lund, and Department of Pedodontics,
Eastman Dental Institute, Stockholm, Sweden

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The aim of the present study was to assess the caries-preventive effect of topical application of Duraphat® on the occlusal surface of newly erupted first permanent molars. A base-line examination was performed on children aged 5 years and 9 months. The children were randomly divided into a Duraphat group and a control group. In accordance with the anatomy of the fissure system, the molars were divided into shallow and deep fissures, respectively. From the time of eruption, 381 molars were examined every 3rd month during 24 months. Duraphat was applied every 6th month, altogether four times. The results showed that in the Duraphat group 35% of the fissures were decayed compared with 80% in the control group. Caries reduction amounted to 56%, and the caries-preventive effect was found in molars with shallow and deep fissures. □ *Dental prophylaxis; fissure caries; topical application*

Ingegerd Mejäre, Eastman Dental Institute, Dalagatan 11, S-113 24 Stockholm, Sweden

In spite of a considerable improvement in the dental health of children in the Scandinavian countries, the incidence of decayed fissures in the first permanent molar is still high. Thus, recent reports (1, 2) show that more than 50% of 7-8-year-old children had one or more decayed first permanent molars. The main reason for this is probably the often complicated anatomy of the fissure system, with deep invaginations of the enamel (3-7), where only a moderate effect is obtained with topical administration of fluoride in the form of gel application, painting, rinsing, or brushing with fluoride dentifrices (8-10). Further, fluoride in the drinking water seems to be of limited value for preventing caries in fissures (11).

These circumstances have led to the recommendation of various preventive methods, such as prophylactic odontomy or application of a fissure sealant. Besides entailing appreciable costs, both these measures require a certain degree of cooperation from the child, including a dry operation field.

Another method that has attracted growing interest in recent years is topical application of fluoride varnishes. Compared with earlier forms of topical application, the varnish gives a longer exposure to fluoride, resulting in a high surface and subsurface incorporation of fluorine in the enamel (12, 13). A caries-

preventive effect has also been observed in fissures (14, 15) in 11-15-year-old children. Only a few studies have been done, however, on the caries-preventive effect on the occlusal surface of the newly erupted first permanent molar. Thus, Murray et al. (16) found a 37% caries reduction in a 2-year clinical trial, whereas Schmidt (17) reported a 61.7% reduction after 1 year.

The purpose of this study was to assess the caries-preventive effect of a fluoride varnish (Duraphat®; Woelm ICN Pharmaceutical, Eschwege, FRG) in fissures of newly erupted first permanent molars.

Materials and methods

The study was carried out in Eslöv, a small industrial town in the south of Sweden. During the spring of 1977 every child aged 5 years and 9 months was recorded until 120 had been obtained, and a base-line registration was performed. Seven children with permanent first molars that had already erupted were excluded from the study. During the study period, two children left the town and two became unwilling to participate. This reduced the material to 109 children. Owing to variation in the time of eruption, 55 molars could not be observed for 24 months. The

final material thus comprised 381 teeth, 195 first maxillary and 186 first mandibular molars. The children had not received any organized pre-school dental care. Since the drinking water in Eslöv contained 0.4–0.9 ppm fluoride, fluoride tablets had not been recommended at the Child Health Center. From the age of 6 years the children received organized dental care and took part in a weekly fluoride rinsing program (0.025% NaF for the 1st year, thereafter 0.2% NaF).

At the base-line registration (5 years and 9 months) the children were randomly divided into a test (Duraphat) group and a control group. Depending on the anatomy of the fissure system, the first permanent molars were divided into two groups: those with shallow and those with deep fissures, respectively. This assessment was made with the unaided eye: the fissure was considered to be shallow if no narrow grooves could be detected, and deep if any part of the fissure system presented a narrow groove. Such a groove is always accompanied by a deep fissure (18).

The examinations were carried out at a Public Dental Clinic with modern equipment, including optimal lighting. All clinical registrations throughout the study were made by one of us (G.-B. Holm). At the base-line registration the primary teeth were examined, and caries was recorded in accordance with the criteria of Koch (10). This was done for the comparison between the Duraphat and the control group.

The examination included posterior bite-wings (Philips Oralix 65). The radiographs were examined simultaneously by two of us (G.-B. Holm and I. Mejäre) with the aid of a special viewing device (19). Double regis-

trations were made on every sixth child. Agreement with the previous registration was 94%. Caries data in the primary dentition are given in Table 1; 12% of the children had one or more primary teeth extracted because of caries; 8% were caries-free.

The clinical criterion for a decayed fissure was that recommended by Møller (20)—that is, the probe point sticks without doubt and requires a definite pull for removal. The probes (Maillefer 4/6) were regularly examined for wear or damage and renewed accordingly. Forty molars were examined twice, with an interval of 14 days: intra-examiner reproducibility was 98%. From the time when the occlusal surface of the first permanent molar was completely visible, the individual tooth was examined every 3rd month during 24 months. The application of Duraphat started when the entire occlusal surface had emerged and was repeated every 6th month, making a total of four times. Before the application, the occlusal surface was cleaned with Duraphat special cleansing powder and a Young Prophy Brush (Young Dental, Box 12806, St Louis, Mo., USA), and the fissure was scraped with a probe. Duraphat was then applied with a pencil on a dry surface, whereupon the probe was passed along the fissure to press the varnish into the fissure. Careful spraying with water ended the procedure. The parents were asked not to give the child hard food or to brush the treated tooth surfaces until the next day.

Statistical methods

The statistical analysis was performed with Student's *t* test and the chi-square test (21). The significance level used was $p < 0.05$.

Table 1. Means and standard deviations (SD) of decayed, missing, and filled surfaces (dmfs values), total and proximal, at the base-line registration of children 5 years and 9 months old

	Dmfs proximal (03 d – 05 d)				Dmfs total			
	Total	Duraphat	Control	Difference	Total (no. = 109)	Duraphat (no. = 50)	Control (no. = 59)	Difference
Mean	4.24	3.50	4.86	1.36; $t = 1.87(\text{NS})$	9.66	8.32	10.80	2.48; $t = 1.555(\text{NS})$
Range	0–17	0–12	0–17		0–36	0–31	0–36	
SD	3.64	3.50	3.67		8.35	8.32	8.27	

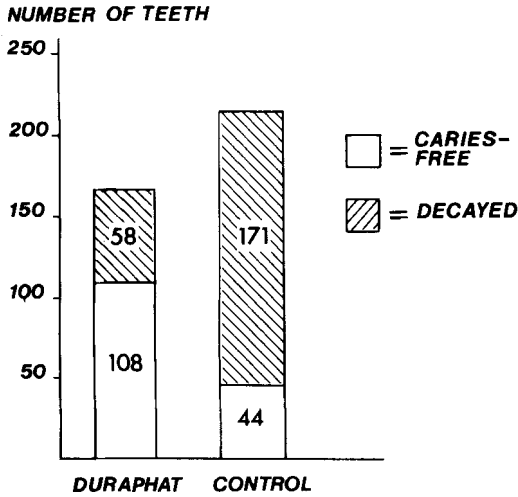
Results

The results are presented in Table 2 and Figs. 1 and 2.

After an observation period for the individual molar of 24 months (the children were 8–10.5 years old, mean 9 years, at the final examination) the caries-preventive effect, expressed as caries reduction, was 56% (Fig. 1). The mean decayed fissures (DF) in first permanent molars in the Duraphat group was 1.44, compared with 3.29 in the control group.

Of the children in the Duraphat group, 28% had all four molars caries-free, whereas in 9% all molars were decayed; the corresponding figures in the control group were 7% and 59%,

respectively. Of the decayed molars, 57% in the Duraphat group became decayed within the 1st year, compared with 68% in the control group (Table 2). A caries-preventive effect was found for both shallow and deep fissures (Fig. 2).

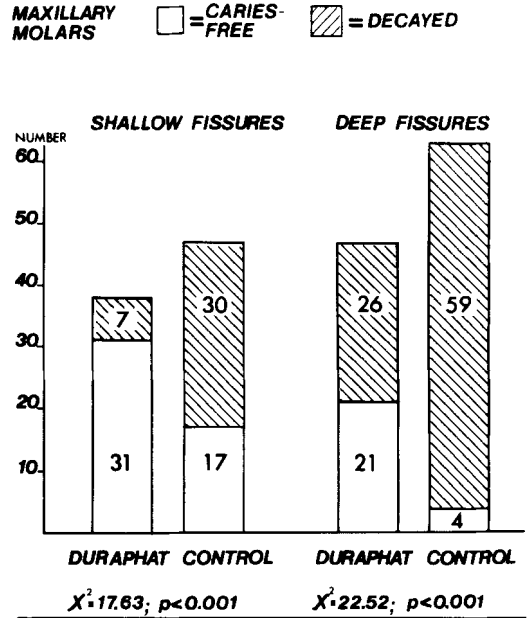


PER CENT DECAYED

DURAPHAT : 58/166 = 35%

CONTROL : 171/215 = 80%

Fig. 1. Distribution of caries-free and decayed occlusal fissures of 381 first permanent molars after 24 months. Comparison between the Duraphat group and the control group.



CORRESPONDING FIGURES FOR MANDIBULAR MOLARS

	Shallow fissures		Deep fissures	
	Duraphat	Control	Duraphat	Control
caries-free	26	19	30	4
decayed	4	14	21	68
total	30	33	51	72

Statistical significance: $\chi^2=6.516; p<0.05$ (Shallow), $\chi^2=42.35; p<0.001$ (Deep)

Fig. 2. Distribution of decayed occlusal fissures of first permanent molars with respect to the anatomy of the fissure system. Comparison between the Duraphat group and the control group.

Table 2. Distribution of decayed molars with respect to time in months between eruption (the entire occlusal surface had emerged) of the molar and occurrence of caries in the fissure

No. of decayed molars in the	Time elapsed, in months									
	0	3	6	9	12	15	18	21	24	Total
Duraphat group	0	1	5	16	11	5	9	9	2	58
Control group	8	18	32	35	23	17	14	12	12	171

Percentage decayed within 12 months: Duraphat group, 33/58 or 57%; control group, 116/171 or 68%.

Discussion

The diagnostic problems associated with fissures are well known. Microscopic evaluation of clinically sound fissures often reveals initial carious lesions (4, 6, 7, 22). It is therefore very probable that several fissures classified as caries-free had initial lesions and that the so-called caries-preventive effect of Duraphat in many cases was rather a matter of suppressed progression.

Only two studies dealing with the caries-preventive effect of Duraphat in fissures of newly erupted first permanent molars were found in the literature. Thus, Schmidt (17) reported a caries reduction of 61.7%. However, at the start of that study the children were 7 years and 9 months old, and at that time 33% of the molars were already filled or decayed. Most of the teeth were treated only once with Duraphat, and the observation period was only 1 year. Thus, the most caries-susceptible surfaces were already decayed at the start, and the results cannot be compared with those of the present study.

Our experimental design resembles more the one used by Murray et al. (16), who reported a 37% caries reduction in a 2-year clinical trial. However, only about half of the molars received more than two applications, which may account for the discrepancy with our results. As pointed out by Maiwald et al. (15), the caries-preventive effect of Duraphat is related to both the frequency and the techniques of application. The careful application procedure in our study (pressing down the varnish with a probe) may partly explain the relatively better caries-preventive effect. A further explanation is probably the different caries experiences of the two populations. Thus the children in our study had substantially more caries than the English children, which should result in a comparatively greater caries reduction in our study (23). The mean decayed, missing, and filled surfaces at the base-line examination in the present material was also higher and the percentage of caries-free children lower than in other parts of Sweden (24, 25). Further, the increment of caries of the first permanent molar was greater than found both by Murray et al. (16) and by Månsson (2).

The relatively high fluoride content of the drinking water in Eslöv (0.4–0.9 ppm) seemed to have had only limited caries-preventive effect, since the mean DF of the first permanent molar in the control group was 3.29.

The significance of the caries activity of the individual child for prediction of fissure caries of the first permanent molar could not be evaluated in the present study. The anatomy of the fissure, however, seemed to be of importance in this respect.

Topical application of a fluoride varnish is a simple and relatively cheap procedure that requires only limited cooperation by the child. The finding that application of Duraphat was effective in both deep and shallow fissures implies that the method might be used as a preventive measure for newly erupted first permanent molars.

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