

Dental caries on adjacent approximal tooth surfaces in relation to order of eruption

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The occurrence of dental caries on adjacent approximal molar and premolar tooth surfaces was examined on posterior bitewing radiographs. More distal surfaces of the first permanent molars were decayed than adjacent mesial surfaces of the second molars. The appearance of dental caries on adjacent premolar surfaces was related to the order of eruption; the surface that had erupted first was likely to be decayed first. Reports from other studies on adjacent approximal surfaces indicate that this conclusion has a general bearing. It therefore seems important to increase the caries resistance of already erupted teeth by preventive means before and during the eruption of adjacent teeth. □ *Approximal caries; dental enamel; order of eruption; radiographs*

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Data from several studies on approximal caries indicate that the distal surface of the first permanent molars is more frequently decayed than the mesial surface of the second molars (1-7). This seems to be in contrast to common views, according to which the surface of an erupting tooth is less resistant to dental caries than the surface of a tooth that already has matured in the mouth for some time (8, 9).

The cause of a difference in the appearance of caries on the adjacent approximal surfaces of the first and second permanent molars has been discussed in some papers. According to Backer Dirks (2), it may depend on the different anatomic forms of the two surfaces. A more rounded form of the distal surface of the first permanent molar should make it more difficult to detect small carious lesions on this surface than on the mesial surface of the second molar. Burchell (4) writes that 'in this case it appears that the more mature enamel is more caries susceptible'. Nordblad & Larman (5) presumed, on the basis of their study, that the caries development on approximal surfaces is not dependent on the time of eruption or on post-eruptive maturation. Thus no common opinion has been offered. In the light of this, the aim of the present study was to explore further the occurrence of caries on adjacent approximal tooth surfaces. The study deals not only with the first and second permanent molars but also with the first and second premolars.

Materials and methods

The study is based on radiographs and dental records, documenting the regular dental care given by the Public Dental Service to two different groups of children, cohorts I and II. The constitution of these cohorts has

been described in previous studies (10, 11). However, the following abbreviated information is of value.

Cohort I comprised 130 randomly selected children who were born in 1964 and had always lived in the city of Göteborg. They had not been treated with fixed orthodontic appliances, and no permanent teeth were missing. They had been given fortnightly mouth rinses in school with a 0.2% sodium fluoride solution.

Cohort II comprised 108 children, born in 1971 and randomly chosen from the same part of the city as cohort I. Otherwise the conditions given above were also valid for the children in cohort II. However, unlike cohort I they had as small children participated in the dental health program at the Child Health Centres. In addition, they had been subjected to preventive programs from the age of 4 years and had received regular dental care from the age of 3 years.

All bitewing radiographs taken in the course of the dental treatment between 9 and 16 years of age had been examined in connection with the studies mentioned above. Recordings of approximal DF surfaces thereby recognized were scored as follows: 0 = intact surface; 1 = surface with a carious lesion present in the outer half of the enamel; 2 = surface with a carious lesion extending into the inner half of the enamel; and 3 = surface with a filling or a carious lesion extending into the dentin.

The caries situation on the distal surface of each of the first permanent molars was compared with that of the adjacent mesial surface of the second molars. Comparisons were based on the radiographically recognized extent of the carious lesions (score 1-3).

The time between the eruption of the second permanent molar according to the records and the appearance of carious lesions on the yearly radiographs was noted for cohort I. Owing to incomplete series of

Table 1. Radiographic examination of 130 16-year-old individuals in cohort I (born in 1964). Caries scores recorded for contacting approximal surfaces of first and second permanent molars

Caries score, mesial surface second molar	Caries score, distal surface first molar	No. of tooth pairs	
		Upper jaw	Lower jaw
0	1,2, or 3	34	27
1	2 or 3	10	15
2	3	3	5
		47	47
1,2, or 3	0	5	12
2 or 3	1	2	3
3	2	0	0
		7	15
Equal scores on both molars (1-1,2-2,3-3)		15	51

Summary:

Score on 1st molar versus 2nd molar	Higher	Lower	Equal	Total
Upper jaw	47 (68%)	7 (10%)	15 (22%)	69
Difference high score versus low score	58% \pm 6.7 ($P < 0.001$)			
Lower jaw	47 (42%)	15 (13%)	51 (45%)	113
Difference high score versus low score	28% \pm 5.6 ($P < 0.001$)			

radiographs between 9 and 12 years, 12 of the 130 children had to be omitted from this part of the study. The same material was used to study whether caries appears first on the distal surfaces of the first permanent molars or on the mesial surface of the second molars. An examination of the relation between the appearance of caries on the adjacent surfaces of the premolars and their order of eruption was also performed.

The statistical evaluations were performed with Student's *t* test.

Results

In cohort I radiographs taken at 16 years of age showed that carious lesions occurred on one or both of the adjacent approximal surfaces in 182 of the approximal contacts (35%) between the first and second permanent molars (Table 1). In both jaws the distal surfaces of the

first molars had higher caries scores than the mesial surfaces of the second molars. Of 69 pairs of contacting surfaces in the upper jaw 68% presented a higher caries score on the distal surface of the first molar than on the mesial surface of the second molar, whereas 10% showed a higher score on the mesial surface of the second molar. The difference, 58%, is statistically significant ($P < 0.001$). Corresponding values for 113 approximal sites in the lower jaw with approximal lesions were 42% and 13%, respectively, with a significant difference of 28% ($P < 0.001$).

In cohort II radiographs taken at 13 and 16 years of age showed carious lesions on one or both adjacent approximal surfaces in 145 of the present interstices (34%) (Table 2). In both jaws the distal surfaces of the first molars had higher scores than the mesial surfaces of the second molars. Of 59 pairs of surfaces in the upper

Table 2. Findings on radiographs taken at the ages of 13 and 16 years for 108 individuals in cohort II (born in 1971). The findings were registered, grouped, and compared in accordance with the methods used in Table 1

	Higher	Lower	Equal	Difference higher/lower
Upper jaw	30	6	23	41 \pm 15.4**
Lower jaw	44	16	26	30 \pm 12.3*

Table 3. Number of years between the appearance of caries on the distal surface of the first molar (year C) and full eruption of the second molar (year E). Number of individuals = 118 (cohort I)

No. of surfaces	Year C-year E					Total
	-1	0	1	2	3	
Upper jaw		3	9	26	21	59
Lower jaw	5	2	22	35	30	94
Total	5	5	31	61	51	153

Table 4. The first appearance of caries on either of the contacting approximal surfaces of the first and second permanent molars. Radiographs taken of 118 individuals in dental treatment between 9 and 14 years of age (cohort I)

	Appearance of caries on adjacent approximal molar surfaces			Total
	1st molar first affected	2nd molar first affected	Both surfaces simultaneously affected	
Upper jaw	20 (67%)	8 (27%)	2 (7%)	30
Lower jaw	26 (59%)	6 (14%)	12 (27%)	44
Differences 1st molar versus 2nd molar:				
Upper jaw = 40%	±11.3	(<i>P</i> < 0.01)		
Lower jaw = 46%	±9.0	(<i>P</i> < 0.001)		

jaw 51% had a higher score on the distal surfaces of the first molar than on mesial surfaces of the second molar, whereas 10% showed a higher score on the mesial surface of the second molar. The difference, 41%, is statistically significant (*P* < 0.01). Corresponding values for 86 sites in the lower jaw were 51% and 19%, respectively, with a significant difference of 30% (*P* < 0.05).

Table 3 (cohort I) gives the relation in time between the eruption of the second permanent molars and the appearance of caries on the distal surfaces of the adjacent first molars. Within 3 years after eruption of the second molars, 153 carious lesions on the distal surfaces of the first molars in both jaws were recognized: 3% had appeared the year before eruption, 3% in the same year, and 94% 1–3 years thereafter.

In cohort I the time of the appearance of caries on the distal surface of the first molar was compared with that of caries on the mesial surface of the second molar. The study comprised children up to 14 years of age (Table 4). Thirty-two carious lesions were found on 30 pairs of contacting surfaces in the upper jaw; caries had appeared first on the distal surface of the first molar in 67% of the cases and first on the mesial surface of the second molar in 27%, which gives a significant

difference of 40% (*P* < 0.01). Corresponding figures for 44 pairs of adjacent surfaces in the lower jaw were 59% and 14%, with a significant difference of 46% (*P* < 0.001).

At the examination of the radiographs taken between 9 and 16 years of age in cohort I, 124 cases were identified in which an early carious lesion opposed an intact adjacent surface (Table 5). When this was related to the order of full eruption of the premolars, it was found that 67% of the 70 cases in the upper jaw showed a carious lesion on the first erupted surface, in contrast to 16% on the last erupted. The difference gives a significant value of 51% (*P* < 0.001). Corresponding values for the 54 cases in the lower jaw were 57% and 20%, respectively, giving a significant difference of 37% (*P* < 0.001).

Discussion

The present results (Tables 1 and 2) agree with observations presented previously (1–7); that is, the distal surfaces of the first permanent molars are found to be decayed more often than the adjacent mesial surfaces of the second molars. When this is regarded in connection with the present molar and premolar data (Tables 3–5) and the fact that agreeing results were obtained for both jaws, a general pattern for caries on adjacent approximal surfaces was found; that is, the first surface to erupt is likely the first to become carious at the establishment of the approximal contact. Data from cohorts I and II (Tables 1 and 2) indicate bearing over time irrespective of dental health activities. The conclusion is supported by studies on adjacent approximal tooth surfaces in other parts of the jaws (12–15). More caries has been reported on the distal surfaces of the second primary molars than on the mesial surfaces of the first permanent molars (12) and also more on the distal surfaces of the first primary molars than on the mesial surfaces of the second primary molars (13–15).

The early appearance of caries on the distal surface of the first permanent molars seems to be connected

Table 5. The first appearance of caries on contacting approximal premolar surfaces in relation to order of eruption. Examination of bitewing radiographs taken between 9 and 16 years of age in cohort I (118 individuals). Relation of A to B when the first premolar erupted first = 65:21 and when the second premolar erupted first = 13:1

	A Caries on first erupted surface	B Caries on last erupted surface	Caries on simultaneously erupted surfaces
Upper jaw	47 (67%)	11 (16%)	12 (17%)
Lower jaw	31 (57%)	11 (20%)	12 (22%)
Difference A/B			
Upper jaw = 51%	±7.1	(<i>P</i> < 001)	
Lower jaw = 37%	±8.7	(<i>P</i> < 001)	

with the eruption of the second molar (Table 3). The significance of the eruption of an adjacent tooth is further underlined by the study of premolars (Table 5), in which the order of eruption in most cases determined the order in which caries would appear on the two adjacent surfaces. Therefore, an explanation of the differing caries prevalences of two adjacent approximal tooth surfaces may be as follows. When a tooth erupts, the approximal surface of an already erupted adjacent tooth, which either has not been exposed to the oral environment or has been a self-cleansing surface, becomes a retention area. On this surface, a caries-promoting plaque may become established and then remain in the same area. The surface of the erupting tooth, on the other hand, is not colonized on a fixed location by a caries-promoting plaque until this tooth has come into occlusion. The establishment of caries-inducing plaque may be promoted by temporary high acidity near the gingival margin of an erupting tooth (16).

Newly erupted teeth are regarded as especially prone to caries development, owing to an insufficient post-eruptive maturation of the enamel surface (8, 9). However, the present study indicates that the approximal surfaces of teeth are at high risk for caries during the period they are in contact with an erupting tooth. It therefore seems important to increase the caries resistance of erupted teeth by preventive measures before and during the eruption of adjacent teeth.

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