BRIEF COMMUNICATION

A Two-year Longitudinal Study of Dental Caries in Permanent First Molars of Korean Elementary Schoolchildren

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Abstract

Objective: *This longitudinal study investigated dental caries increment in permanent first molars of Korean elementary schoolchildren.* ***Methods:*** *A convenience sample of 722 children aged 7–9 years attending one urban elementary school was examined at baseline, with follow-up examinations at one and two years. Coronal surfaces of permanent first molars were scored with regard to caries experience and sealant status.* ***Results:*** *Among sound occlusal surfaces at baseline, 21 percent of upper and 25 percent of lower surfaces developed caries during the two-year interval. In teeth that erupted between baseline and the first follow-up exam, over 10 percent of occlusal surfaces developed caries. Pit and fissure caries accounted for 93 percent of all new carious surfaces, while sealants had been placed on 16 percent of occlusal surfaces during the study.* ***Conclusions:*** *Recognizing the limitations of this convenience sample, dental sealants should be used more widely in this Korean population, and should be applied soon after tooth eruption. [J Public Health Dent 2001;61(2):120-22]*

Key Words: caries, pit and fissure sealants, Korea, children, longitudinal study, molar.

Dental caries in most industrialized countries has declined remarkably in recent years. Not only has its prevalence decreased, but its pattern of development also has changed, with occlusal caries becoming more predominant relative to smooth surface caries (1). Because preventive methods exert varying levels of effectiveness across different tooth surfaces, information about caries increment patterns by tooth and surface can help guide preventive strategies (2-3).

Coronal caries incidence generally has been greatest for occlusal surfaces (4). Blinkhorn and Davies (1) reported that in American children aged 5–17 years, pit and fissure caries accounted for 90 percent of total caries in the permanent dentition. Most of the caries experience in the permanent dentition of children under age 10 years is attributed to permanent first molars. Because much of the caries in these teeth occurs during and within a few years after eruption (5), elementary schoolchildren are a good population for studies of caries incidence in permanent first molars.

In contrast to the caries decline noted in other industrialized countries, caries in Korean children has increased, with a mean DMFT of 3.1 and 76 percent of children aged 12 years having DMFT >0 in 1995 (6). Because appropriate caries-preventive strategies depend on valid assessments of caries experience, the objective of this study was to investigate the pattern of caries development in permanent first molars of Korean elementary schoolchildren.

Methods

Guachon City is located at the border of Seoul, the capital of Korea. Residents of Guachon City mostly are middle class, like much of the Korean population. Guachon City has three elementary schools, one of which was selected as the source for the present convenience sample.

At baseline in 1995, 722 children aged 7–9 years (grades 1–3) underwent clinical examination of their permanent first molars. Examinations were repeated one and two years later by the same three dentists, who had been calibrated before each annual examination to establish kappa values of 0.9 or higher. At each examination, decayed, missing, and filled surfaces (DMFS) and dental sealant status were recorded for each coronal surface of every permanent first molar. The examiners used criteria from the National Institute of Dental Research (7) and dental mirrors and explorers under natural light. Frequency distributions were analyzed using SAS Version 6.04 (SAS Institute Inc., Cary, NC).

Results

Of the 722 subjects examined at baseline, 497 attended the two-year follow-up examination. Baseline caries experience did not differ significantly between subjects who were or were not present at the two-year exam ($P>.05$). For the 497 subjects present at the two-year exam, 817 upper and 861 lower permanent first molars had been present at baseline, at which time caries had been experienced on almost 20 percent of lower occlusal surfaces, 11 percent of upper occlusal surfaces, 8 percent of lower buccal surfaces, and 5 percent of upper lingual surfaces. Only 3 percent of upper occlusal surfaces and 3 percent of lower occlusal surfaces were sealed, and no buccal or lingual surfaces were sealed (data not shown).

Table 1 presents data on caries development during the study, with the

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top half representing erupted surfaces at baseline that were neither carious nor sealed, and the bottom half representing surfaces erupting between baseline and the one-year follow-up examination. Lower occlusal and buccal surfaces, along with upper occlusal and lingual surfaces, accounted for most of the newly carious surfaces during the two years. Among permanent first molars erupting between baseline and the one-year examination, almost 16 percent of upper occlusal surfaces and 18 percent of lower occlusal surfaces became carious by the two-year exam.

No teeth were extracted due to caries during the study, and by the two-year examination, the filled component accounted for 77 percent of the caries experience (Table 2). Of the surfaces that were sound at baseline, after two years sealants had been placed on 16 percent of upper occlusal surfaces, 4 percent of upper lingual surfaces, 16 percent of lower occlusal surfaces, and 2 percent of lower buccal surfaces (data not shown).

TABLE 1
Caries Development on Sound Surfaces of Permanent First Molars

Surface	No. of Sound Surfaces Erupted at Baseline	No. of DMF Surfaces (%) at Examination	
		At 1st Follow-up	At 2nd Follow-up
Upper arch			
Occlusal	706	133 (18.8)	147 (20.8)
Lingual	776	97 (12.5)	108 (14.0)
Others	2,440	13 (0.5)	18 (0.7)
Total	3,922	243 (6.2)	273 (7.0)
Lower arch			
Occlusal	664	155 (23.3)	166 (25.0)
Buccal	793	103 (13.0)	114 (14.4)
Others	2,573	14 (0.5)	19 (0.7)
Total	4,030	272 (6.7)	299 (7.4)
	No. of Sound Surfaces Erupting between Baseline and 1st Follow-up Exam		
Upper arch			
Occlusal	152	15 (9.9)	24 (15.8)
Lingual	152	3 (2.0)	9 (5.9)
Others	456	2 (0.4)	2 (0.4)
Total	760	20 (2.8)	35 (4.6)
Lower arch			
Occlusal	118	14 (11.9)	21 (17.8)
Buccal	118	6 (5.1)	14 (11.9)
Others	354	—	1 (0.2)
Total	590	20 (3.4)	36 (6.1)

TABLE 2
Contribution of Decayed and Filled Components to Caries Increment in Permanent First Molars Erupted at Baseline

Arch	Surface	No. of DMF Surfaces (%) at Examination			
		At 1st Follow-up		At 2nd Follow-up	
		Decayed	Filled	Decayed	Filled
Upper	Occlusal	74 (56)	59 (44)	34 (23)	113 (77)
	Lingual	40 (41)	57 (59)	24 (22)	84 (78)
	Others	3 (23)	10 (77)	5 (28)	13 (72)
	Total	117 (48)	126 (52)	63 (23)	210 (77)
Lower	Occlusal	89 (57)	66 (43)	52 (31)	114 (69)
	Buccal	37 (36)	66 (64)	11 (10)	103 (90)
	Others	3 (21)	11 (79)	5 (26)	14 (74)
	Total	129 (47)	143 (53)	68 (23)	231 (77)

Discussion

Caries prevalence and increment in both upper and lower teeth was primarily due to carious lesions occurring on occlusal surfaces (Table 1). Many upper lingual and lower buccal surfaces also had caries experience, and pit and fissure caries accounted for 93 percent of the total caries occurring on previously sound surfaces.

Dental sealants are the most effective method for preventing pit and fissure caries, but despite their safety and effectiveness, their use has been low in many countries (8). In the present study, sealants were seen infrequently, especially in light of the high caries incidence for lingual and buccal pits and fissures.

Although generalization to the Korean population cannot be made from this convenience sample, the relatively infrequent use of dental sealants may be due to the manner in which the Korean national health insurance system pays for dental procedures. Most dental treatments, including amalgam restorations and extractions, are covered by this plan. In the present study, the 75 percent filled component of the DMFS (Table 2) indicated that dental utilization was high. However, preventive services are not covered under this system and the full cost of dental sealants must be paid by consumers; this likely is responsible for the low prevalence of sealants. If the findings from this convenience sample are similar to those that would be found on a national level, most of the caries experience incurred by children is pit and fissure caries, so many children could benefit if the Korean national health insurance system paid for fis-

sure sealants.

About 10 percent of newly erupted occlusal surfaces became carious less than one year after eruption (Table 1), consistent with the results of Abernathy et al. (9), who reported that caries incidence was greatest within the first year after eruption and decreased gradually thereafter. Among sound surfaces at baseline, caries development between the one-year and two-year examinations was relatively rare compared to that occurring prior to the one-year examination. This finding may be because (a) occlusal surfaces of permanent molars are primarily susceptible to caries during and soon after eruption (5), so the most susceptible surfaces likely would have already experienced caries prior to the one-year examination; (b) dentists may have restored incipient carious lesions (scored as sound according to NIDR criteria) prior to the one-year examination; and (c) the Guachon City community water supply was first fluoridated in 1994 (10), although fewer than one-half of the city's residents drink tap water.

In conclusion, caries increment in buccal and lingual pits and fissures, as well as in occlusal pits and fissures, was relatively high in this convenience sample of middle-class Korean elementary schoolchildren. If this sample is similar to the Korean population, dental sealants, along with oral hygiene and fluoride, should be utilized more widely. Sealants should be applied as soon as possible after sufficient eruption of the permanent first molars, and placed on buccal and lingual pits and fissures, as well as those on occlusal surfaces.

References

1. Blinkhorn AS, Davies RM. Caries prevention. A continued need worldwide. Int Dent J 1996;46:119-25.
2. McDonald SP, Sheiham A. The distribution of caries on different tooth surfaces at varying levels of caries—a complication of data from 18 previous studies. Community Dent Health 1992;9:39-48.
3. Slade GD, Spencer AJ, Davies MJ, Burrow D. Intraoral distribution and impact of caries experience among South Australian schoolchildren. Aust Dent J 1996; 41:343-50.
4. Li SH, Kingman A, Forthofer R, Swango P. Comparison of tooth surface-specific dental caries attack patterns in US schoolchildren from two national surveys. J Dent Res 1993;72:1398-405.
5. Carvalho JC, Thylstrup A, Ekstrand KR. Results after 3 years of non-operative occlusal caries treatment of erupting permanent first molars. Community Dent Oral Epidemiol 1992;20:187-92.
6. Kim JB, Paik DI, Mun HS. The oral health status of Koreans (1995). Seoul: Institute of National Oral Health, 1997:96.
7. Carlos JP, Brunelle JA. Oral health surveys of the National Institute of Dental Research—diagnostic criteria and procedures. Bethesda, MD: US Department of Health and Human Services, Public Health Service, National Institutes of Health, National Institute of Dental Research, Epidemiology and Oral Disease Prevention Program, 1991; NIH pub no 91-2870.
8. Manton DJ, Messer LB. Pit and fissure sealants: another major cornerstone in preventive dentistry. Aust Dent J 1995; 40:22-9.
9. Abernathy JR, Graves RC, Greenberg BG, Bohannan HM, Disney JA. Application of life table methodology in determining dental caries rate. Community Dent Oral Epidemiol 1986;14:261-4.
10. The report of basic data for caries control in Korea. Seoul: Yonsei University, 1997: 44.