Prevalence of early caries lesions in erupting permanent molars in Hue city

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Abstract

Background: The difficult access to molars and the presence of gingival tissue on the occlusal surface during eruption can lead to dental caries. This study aims to determine the prevalence of early caries lesions in erupting permanent molars among schoolchildren aged 6 - 10 years in Hue city, Vietnam. **Materials and methods**: A cross-sectional study was conducted in 2023 to assess the status of early caries lesions in erupting permanent molars of 818 schoolchildren at primary schools in Hue city, using the International Caries Detection and Assessment System (ICDAS). **Results**: The rate of caries in permanent molars was 76.9% (53.6% of cases occurred in first molars), of which early caries accounted for 67.1% (36.0% of cases occurred in first molars). The prevalence of early caries lesions was higher in the mandibular molars than in the maxillary molars and significantly higher overall when considering the total caries rate. The left permanent mandibular first molar had the highest prevalence of early caries lesions (39.7%). In addition, among the erupting molars with early caries lesions, the first molar predominantly had ICDAS 2 (32.9%). **Conclusion**: The prevalence of early caries lesions in erupting permanent molars is high, with the permanent mandibular first molars being the most susceptible to influence.

Keywords: *ICDAS, early caries lesions, children.*

1. INTRODUCTION

In developed countries, dental caries has become less common in recent decades. However, it is still one of the most common infectious diseases in the world, affecting 60% to 90% of schoolchildren and most adults [1]. In a systematic review and meta-analysis of the prevalence of dental caries in children worldwide from 1995 to 2019, the authors found that 53.8% of children worldwide have permanent tooth decay, with molar teeth having the highest rates and significant regional and national variations [2]. The prevalence rose from 20.4% (2013) to 29.0% (2017) in China, and it was 30.5% in Saudi Arabia [3, 4]. In Vietnam, a previous study conducted on a primary school showed that 51.3% of children aged 7 to 9 were found to have first permanent molar caries [5].

Regarding the permanent molars, the occlusal surface is the most vulnerable site for dental caries from when the tooth erupts due to pits and fissures that allow bacteria and food plaque to accumulate [1]. The increased susceptibility to caries usually occurs 2 - 4 years after the tooth erupts [6]. The permanent molars are responsible for mastication, supporting vertical and buccal dimensions, and ensuring the dental arch and occlusion remain continuous. The posterior support function alleviates the load on the temporomandibular joint, and its loss frequently results in occlusal disorders [7]. Given their importance, numerous studies have examined the prevalence of caries in fully erupted permanent molars [2]. However, fewer studies have focused on the prevalence of early caries lesions in erupting permanent molars [2]. The difficult access to molars, the presence of gingival tissue on the occlusal surface, and the absence of full occlusion contribute to biofilm accumulation and, consequently, caries activity.

Early detection of caries in erupting permanent molars is critical, as untreated caries can spread into the dentin and cause significant damage. This issue affects not only masticatory function but also children's overall health and academic performance. As a result, this study aimed to determine the prevalence of early caries in erupting permanent molars among children aged 6 to 10 in Hue city, which helps to provide information on the prevalence of early caries in erupting permanent molars and propose timely preventive and intervention measures, thereby contributing to improving children's oral health.

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2. MATERIALS AND METHODS

2.1. Study Design: Cross-sectional study.

2.2. Sample Size

The sample size was calculated using the formula for estimating a proportion, with p = 0.513 based on a study by Vo Truong Nhu Ngoc and Nguyen Kieu Ngan, which was conducted on 154 schoolchildren aged 7 - 9 years in Ha Noi to assess the prevalence of caries in the first permanent molars [5]. The statistical significance level was 5%, and the absolute error was 5%. The calculated sample size was n = 384. An additional 10% was added to account for potential sample loss, resulting in a final sample size of n = 423. This represents the minimum required sample size for the study. In our study, 818 schoolchildren were surveyed from Quang Trung primary school and Phu Hoa primary school, which are located in Hue City. The data collection was conducted from April to May 2023.

2.3. Methods

- Research tools:

+ Examining kit: dental probe, forceps, air syringe, tray, explorer, and mirror.

+ Light source, gloves, cotton gauze, and antiseptic solution.

+ Preparation of the Investigators: As certified dental professionals, the investigators underwent extensive training in the study protocol.

The study was conducted in a well-lit setting with artificial lighting and natural light to ensure that the proper examination procedures were followed.

- Erupting molars were identified using the following criteria [8]:

(0) unerupted;

(1) the occlusal surface partially erupted;

(2) the occlusal surface fully erupted, but more than half of the facial surface was covered with gingival tissue;

(3) the occlusal surface was erupted, and less than half of the facial surface was covered with gingival tissue;

(4) full occlusion.

Molars scored from 1 to 3 were classified as erupting molars in this study.

- Diagnostic criteria: based on the International Caries Detection and Assessment System (ICDAS) [9]. Early caries lesions were defined as scores 1 and 2 according to the ICDAS criteria:

+ First visual change in enamel: Opacity or discoloration (white or brown) is visible at the entrance to the pit or fissure seen after prolonged air drying.

+ Distinct visual change in enamel visible when wet, lesion must be visible when dry.

2.4. Statistical analysis

The statistical program SPSS version 26 (IBM Corporation, Chicago, Illinois, United States) was used to analyze the data in this study. The variables were analyzed using descriptive statistics, such as frequency and percentage.

3. RESULTS

3.1. Characteristics of the study population

Table 1. General characteristics of the study population

		n	%
Gender	Male	454	55.5
	Female	364	44.5
Age	6	249	30.4
	7	135	16.5
	8	138	16.9
	9	147	18.0
	10	149	18.2

A total of 818 schoolchildren participated in the study, with a higher proportion of males (55.5%) than females (44.5%). All participants were between 6 and 10 years old, with the largest group being 6-year-olds (30.4%) and the smallest group being 7-year-olds (16.5%) (Table 1).

3.2. Caries Prevalence

Table 2. Dental caries prevalence among permanent molars by gender and age

		Sound		Decayed		p*
		n	%	n	%	
Gender	Male	106	56.1	348	55.3	0.854
	Female	83	43.9	281	44.7	

Age	6	97	51.3	152	24.2	< 0.001
	7	25	13.2	110	17.5	
	8	18	9.5	120	19.1	
	9	20	10.6	127	20.2	
	10	29	15.3	120	19.1	
Total		189	100	629	100	

*Chi-square test

In the study, 76.9% of the participating schoolchildren had dental caries. No statistically significant difference between male and female schoolchildren was found (p = 0.854), but the prevalence of caries was higher in male schoolchildren (55.32%) than in female schoolchildren (44.7%). Six-year-old schoolchildren had the highest caries prevalence (24.2%), while seven-year-olds had the lowest (17.5%). Caries prevalence varies statistically significantly (p < 0.001) among age groups (Table 2).

Table 3. Early caries prevalence among permanent molars by gender and age

		Sound		Early caries		p*
		n	%	n	%	
Gender	Male	152	56.5	302	55.0	0.686
	Female	117	43.5	247	45.0	
Age	6	114	42.4	135	24.6	< 0.001
	7	33	12.3	102	18.6	
	8	32	11.9	106	19.3	
	9	50	18.6	97	17.7	
	10	40	14.9	109	19.9	
Total		269	100	549	100	

*Chi-square test

In Table 3, 67.1% of schoolchildren had an early caries diagnosis. Male had a greater prevalence of early caries (55.0%) than females (45.0%), but there was no statistically significant difference between the genders (p = 0.686). Schoolchildren aged 6 had the highest prevalence of early caries (24.6%), while those aged 9 had the lowest prevalence (17.7%). The findings show a statistically significant variation in early caries prevalence among age groups (p < 0.001).

Table 4. Distribution of dental caries by type of permanent molar

Tooth	Unerupted		Sound		Decayed	
	n	%	n	%	n	%
16	65	7.9	396	48.4	357	43.6
26	66	8.1	380	46.5	372	45.5
36	28	3.4	299	36.6	491	60.0
46	33	4.0	284	34.7	501	61.2
17	793	96.9	21	2.6	4	0.5
27	789	96.5	24	2.9	5	0.6
37	747	91.3	47	5.7	24	2.9
47	743	90.8	49	6.0	26	3.2

The right mandibular first molar had the highest caries prevalence, making up 61.2% of the study population, while #17 had the lowest prevalence, at 0.5%. Compared to the second molar, the first molar had a substantially higher caries prevalence (52.6% vs. 1.8%). Furthermore, the upper molars had a lower prevalence of caries than the lower molars (22.6% vs. 31.8%) (Table 4).

Table 5. Distribution of early caries by type of permanent molar

	n	%	n	%	n	%
16	65	7.9	481	58.8	272	33.3
26	66	8.1	481	58.8	271	33.1
36	28	3.4	465	56.8	325	39.7
46	33	4.0	474	57.9	311	38.0
17	793	96.9	21	2.6	4	0.5
27	789	96.5	25	3.1	4	0.5
37	747	91.3	48	5.9	23	2.8
47	743	90.8	54	6.6	21	2.6

The left mandibular first molar had the highest prevalence of early caries (39.7%), whereas #17 and #27 had the lowest prevalences, both at 0.5%. Compared to the second molar, the first molar had a much higher prevalence of early caries (36.0% vs. 1.6%). Furthermore, the upper molars had a lower prevalence of early caries (16.8% vs. 20.8%) than the lower molars (Table 5).

Table 6. Distribution of early caries in permanent molars by status

Tooth	ICDAS 1		ICDAS 2	
	n	%	n	%
16	111	20.2	161	29.3
26	114	20.8	157	28.6
36	121	22.0	204	37.2
46	111	20.2	201	36.6
17	2	0.4	2	0.4
27	3	0.5	1	0.2
37	16	2.9	7	1.3
47	19	3.5	2	0.4

The left mandibular first molar, which accounted for 37.2% of the study population, had the highest prevalence of early caries among the 549 schoolchildren with early caries at ICDAS 2. In contrast, #27 had the lowest prevalence, making up 0.2%. Compared to ICDAS 1 (20.8%), early caries in the first molar were more frequently seen at ICDAS 2 (32.9%). Early caries was more common at ICDAS 1 (1.8%) for the second molar than at ICDAS 2 (0.5%). Early caries was more common in lower molars at ICDAS 2 (18.9%) than at ICDAS 1 (12.2%), and it was more common in upper molars at ICDAS 2 (14.6%) than at ICDAS 1 (10.5%) (Table 6).

4. DISCUSSION

4.1. Characteristics of the study population

The study was conducted on 818 schoolchildren aged 6 - 10 years from two primary schools in Hue city. The gender distribution of the study population was 55.5% male and 44.5% female. In a study conducted by Vo Truong Nhu Ngoc et al. (2012), schoolchildren aged 7 - 9 were found to be 47.4% female and 52.6% male [5]. These findings are consistent with international studies, such as the study by Zhu Fudong et al. (2021) on children aged 6 - 8 years, with a male-to-female ratio of 53.2% and 46.8%, respectively [4]; the study by Urvasizoglu et al. (2022) on children aged 7 - 10 years, with a male-to-female ratio of 50.2% and 49.8% [10]; and the study by Giuseppe Pizzo et al. (2023) on children aged 6 - 7 years, with a male-to-female ratio of 52.6% and 47.4% [11].

4.2. Prevalence of early caries

The first permanent molars had a 76.9% prevalence of dental caries, of which 67.1% were early caries. For the first molar, the prevalence rates were 36.0% for early caries and 53.6% for overall caries. Although these results are considerably higher than those found in the studies by Zhu Fudong (29%) [4] and Urvasizoglu (15.9%) [10], they are in line with those published by Vo Truong Nhu Ngoc (51.3%) [5] and Giuseppe Pizzo (74.6%) [11]. The similarity

between the diagnostic criteria and study design could explain the consistent findings. However, the variation in results between these studies may be explained by the differences between the WHO and ICDAS diagnostic criteria.

Considering the overall caries prevalence, the lower molars had a noticeably higher prevalence of early caries than the upper molars. This result aligns with the previous study [4, 5, 10, 11] and can be accounted for because the upper and lower jaws' molar eruption times differ. The lower molars are more vulnerable to damage because they erupt earlier and are exposed to the oral environment sooner.

In the study sample, the highest prevalence of early caries in the lower molars was observed in the first left lower molar, accounting for 39.7%. Additionally, among the erupting molars with early caries, the first molar with ICDAS 2 was the most prevalent, with a rate of 32.9%. Overall, no significant difference was found in caries prevalence between the left and right sides of the mandible. Since the mandible erupts earlier, they are exposed to the oral environment sooner, which increases the likelihood of damage. Based on these results, a hypothesis could be proposed regarding the relationship between hand dominance and oral hygiene capability. The observed differences may be attributed to various factors, such as regional and geographical diversity, study design differences, and inconsistent diagnostic criteria in studies on dental caries prevalence.

Based on the results of this study, we propose several recommendations to improve children's oral health: further studies should be performed in different geographical areas to understand better the prevalence of early caries and associated influencing factors. This will contribute to more thorough and representative children's oral health data. Furthermore, educational and counseling programs should be improved on oral health for parents and children to support primary healthcare initiatives. These programs might cover topics like developing healthy brushing habits, selecting foods and beverages that support dental health, and putting preventative measures in place to lessen dental cavities. School dental programs should be improved to enhance the early detection, prevention, care, and timely treatment of oral health issues. Regular dental examinations and offering schoolchildren primary dental care are two possible activities. These suggestions seek to enhance children's oral health and lower the incidence of early caries.

5. CONCLUSION

There is a high incidence of early caries in the permanent first molars in Hue city, especially during the eruption. Based on our results, school-based dental programs and preventive efforts for primary oral care should be improved. In addition, further studies in other areas should be performed to determine the prevalence of early caries lesions and risk factors, guiding the creation of suitable preventative strategies.

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