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Research Paper: Relationship between Dental Caries of the First Permanent Molar and Other Teeth in 18–20-Year-Old Young Adults

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ABSTRACT

Introduction: The first permanent molar, with its large occlusal surface and early eruption, plays a pivotal role in oral health. This study assessed the association between caries in the first permanent molar and caries in the second molar, second premolar, and overall dentition.

Materials and Methods: In this cross-sectional study, 632 volunteers aged 18–20 years in Qazvin, Iran in 2023 were examined using clinical and radiographic assessments based on a standardized checklist. Pearson's correlation test was applied, with statistical significance set at P = 0.05.

Results: A significant association was observed between the condition of the first permanent molar and both the second premolar and the second permanent molar. Individuals with caries in the first permanent molar were more likely to have decay in the second premolar (r = 0.650, P = 0.021) and the second molar (r = 0.616, P = 0.024). In addition, a positive correlation was found between the DMF6 index (specific to the first permanent molars) and the overall DMF index, indicating that higher DMF6 values were associated with higher total DMF scores (P < 0.05).

Conclusions: The status of the first permanent molar was found to reflect overall oral health and the total DMFT score, and it may serve as a predictive indicator for the condition of other teeth. Early monitoring of first molar status could help guide preventive interventions, underscoring its relevance for public health and preventive dentistry.

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1. Introduction

The first molars are the earliest permanent teeth to erupt, typically around the age of six. Owing to their large occlusal surface and early emergence, they play a critical role in the masticatory system. However, their anatomical structure, characterized by deep pits and fissures, makes them particularly susceptible to dental caries (1). The loss of permanent first molars can result in impaired chewing, altered occlusion, and reduced vertical facial height. Additionally, these teeth play a central role in the decayed, missing, and filled (DMF) index, one of the most widely used dental indices, as they are particularly susceptible to decay due to their early eruption (2).

Understanding the patterns and contributing factors of dental caries in adolescents is crucial for several reasons. By around 18 years of age, individuals are in the early years of having their permanent dentition, making timely health interventions and identification of risk factors for decay particularly important for preserving oral health in the years to come (3). Moreover, this issue holds significant importance in terms of health economics, as promoting oral health during adolescence can substantially reduce both individual and societal healthcare costs. Poor oral health at an early age increases the likelihood of tooth loss later in life, which can

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diminish quality of life and, in some cases, contribute to the development of other health conditions (4). According to similar studies, the condition of the first molar can be a predictive variable for the future dental condition such as deviations leading to orthodontic treatment, dental plaque, and the individual's masticatory condition (5, 6).

Despite certain limitations, the DMF index is widely considered a reliable measure of oral health. Previous studies have demonstrated a positive correlation between the DMF score of the first permanent molar (DMF6) and the overall DMF index, highlighting its predictive value. Monitoring the status of this early-erupting tooth can, therefore, offer insight into an individual's future oral health, providing a solid foundation for this study. Although several studies have explored DMF and tooth 6 in children, evidence in late adolescence (18–20 years) is scarce, leaving unclear whether the first molar remains a predictor of general caries status in young adults (7).

Examining the relationships between dental caries can serve as a model to predict an individual's future oral health status (8). This study aimed to determine whether caries in the first permanent molar is associated with caries in the second premolar and second molar and whether DMF6 correlates with overall DMF. The null hypothesis was that no significant associations would be found between caries in the first permanent molar and caries in other teeth or overall DMF.

2. Materials and Methods

This cross-sectional study was conducted in 2023 among 18- to 20-year-old adolescents attending dental centers in Qazvin, Iran. Ethical approval was obtained from the Qazvin University of Medical Sciences Ethics Committee (IR.QUMS.REC.1401.223).

The sample size of this study was calculated using the Krejcie and Morgan table, which required at least 384 samples for a population of 500,000 in Qazvin, and ultimately 632 people were included in the study.

The inclusion criteria were: age 18–20 years, consent to participate, availability of a relevant orthopantomogram (OPG) taken within the past 30 days, and absence of systemic disease. Exclusion criteria included non-eruption or developmental defects of teeth, history of jaw trauma, withdrawal from the study, or incomplete checklist data. Additionally, patients in emergency conditions who could not cooperate due to abscess or pain were not included.

Two clinics with a high number of patients in one of the districts in the city of Qazvin were randomly selected, and within these clinics, participants were recruited using a convenience sampling method. Consent was obtained from the clinic manager prior to conducting the study.

A researcher-designed checklist was used to record detailed information for each participant, including the status of their first permanent molars, referred to as the DMF6 index, which ranges from 0 to 4. The checklist also included demographic information and overall dental status. It was developed in collaboration with seven researchers, including university academic staff in dentistry. Content validity was established through expert review, and the instrument demonstrated good reliability, with a Cronbach's alpha coefficient of 0.85.

In order to definitively diagnose dental decay, the World Health Organization (WHO) standards were used, including clinically visible lesion, deep penetration of probe tip into the softened material, and the presence of discoloration or a loss of normal enamel translucency.

The examination was conducted by a senior dental student who had received training according to the Iranian dental curriculum, under the supervision of an experienced faculty member. All examinations were carried out at the dental unit using a probe and mirror. A separate chart was created to record the status of each participant's first molar teeth individually.

The researcher first reviewed each participant's OPG and then carefully examined the teeth using a probe and mirror. The status of all teeth was recorded as the DMF index, while teeth numbers 5, 6, and 7 were documented separately. Interdental caries was identified using the OPG. Tooth 6 status was recorded as DMF6, and the status of all teeth as the overall DMF. In cases where a tooth had a crown or implant, it was documented separately under "crown" or "implant." If a tooth under a crown functioned as a pontic, it was recorded as an extracted tooth.

Finally, the statistical relationships between the DMF components of the first molar and those of the second premolar and second molar were assessed, along with the association between the DMF6 index and the individual's overall DMF index.

Since the data were normally distributed, Pearson's correlation coefficient was used to assess the associations between dental caries, and all analyses were performed using SPSS version 26 ($\alpha = 0.05$).

3. Results

A total of 632 participants (311 women and 321 men), aged 18–20 years, were included in the study. The mean overall DMF score was 5.57, while the mean DMF6 score was 2.28 out of a maximum of 4 (Table 1).

In the first permanent molars, dental caries was the most common status, followed by sound and filled teeth, whereas in the second premolars and second molars, the sound condition was most frequent, followed by caries. The least frequent condition overall was dental implants, observed only in 9 out of 2528 teeth (Table 2).

The most common condition observed in the second premolar and second molar teeth was sound, followed by decayed. The least frequent condition was the presence of implants, which occurred in only one case for the second premolar and none for the second molar (Table 3).

Table 1. Demographic information of participants in the study

Variable	Subgroup	N	Mean ± SD DMF	Mean ± SD DMF6	General Mean ± SD DMF	General Mean ± SD DMF6
Gender	Female	311	5.51 ± 1.62	2.27 ± 0.81	5.57 ± 1.67	2.28 ± 0.81
	Male	321	5.63 ± 1.68	2.29 ± 0.82		
Age (year)	18	201	5.41 ± 1.58	2.27 ± 0.81		
	19	253	5.53 ± 1.63	2.28 ± 0.81		
	20	178	5.79 ± 1.68	2.92 ± 0.90		

n: *Number of teeth/participants*, SD: Standard deviation, DMF: Decayed, Missing, and Filled teeth index, DMF6: DMF index specific to the first permanent molars

Table 2. Distribution of first permanent molar among participants in the study

Variable	Upper right first molar n (%)	Upper left first molar n (%)	Lower left first molar n (%)	Lower right first molar n (%)
Sound	181 (28.6)	169 (26.7)	138 (21.8)	136 (21.5)
Missing	79 (12.5)	83 (13.1)	99 (15.7)	95 (15.0)
Implant	1 (0.2)	1 (0.2)	3 (0.5)	4 (0.6)
Crown	29 (4.6)	34 (5.4)	40 (6.3)	33 (5.2)
Decay	242 (38.3)	240 (38.0)	278 (44.0)	284 (44.9)
Filled	100 (15.8)	105 (16.6)	74 (11.7)	80 (12.7)

Table 3. Distribution of dental status in first molar, second premolar and second molar in the participants in the study

Variable	Sound n (%)	Decay n (%)	Missing n (%)	Filled n (%)	Implant n (%)	Crown n (%)
First molar	624 (24.6)	1054 (41.7)	356 (14.1)	349 (13.8)	9 (0.3)	136 (5.4)
Second premolar	1497 (59.2)	622 (24.6)	181 (7.2)	203 (8.0)	1 (0.04)	24 (0.9)
Second molar	1525 (60.3)	638 (25.2)	153 (6.0)	189 (7.5)	0 (0)	23 (0.9)

Pearson's correlation coefficient revealed a significant association between caries in the first permanent molar and decay in the second premolar (r = 0.65, P = 0.021) and second molar (r = 0.616, P = 0.024). Individuals with caries in the first permanent molar were more likely to exhibit decay in the adjacent second premolar and second molar teeth (Table 4).

The overall DMF comprised 2.84 decayed (D), 1.52 filled (F), and 1.21 missing (M) teeth, while the DMF6 comprised 1.27 decayed, 0.48 filled, and 0.53 missing teeth. Strong positive correlations were observed for all components: decay (r = 0.81, P < 0.001), filling (r = 0.76, P < 0.001), and missing teeth (r = 0.64, P < 0.001) (Table 5).

Table 4. Association between decay in the first permanent molar, second premolar, and second molar.

Mean number of carious first molars	Mean number of carious second premolars	Mean number of carious second molars	Correlation between second premolar and first molar decay		Correlation between first molar and second molar decay	
0.41	0.24	0.025	r[a] (95% CI) 0.650	P-value[b] 0.021	r (95% CI) 0.616	P-value 0.024

a: Pearson product-moment correlation coefficient, b: P-value for Pearson correlation testing, r: Pearson correlation coefficient

Table 5. Association between mean DMF and mean DMF6 in participants

Mean ± SD DMF	Variable component	Mean	Mean ± SD DMF6	Variable component	Mean ± SD	r[a] (95% CI)	P[b]
5.57 ± 1.67	D	2.84 ± 0.88	2.28 ± 0.81	D	1.27 ± 0.37	0.81*	< 0.001
	F	1.52 ± 0.41		F	0.48 ± 0.18	0.76*	< 0.001
	M	1.21 ± 0.36		M	0.53 ± 0.16	0.64*	< 0.001

a: Pearson product-moment correlation coefficient, b: P-value for Pearson correlation testing, *Correlations were statistically significant at p < 0.001, DMF: Decayed, Missing, and Filled teeth index, DMF6: DMF index specific to the first permanent molars, D: Decayed, M: Missing, F: Filled, SD: Standard deviation, r: Pearson correlation coefficient, CI: Confidence interval

4. Discussion

The present study was designed to evaluate DMF6 and overall DMF scores among 18–20-year-old individuals and to examine the association between the first permanent molar and its adjacent teeth. The results showed that the mean overall DMF score was 5.57 and the mean DMF6 score was 2.28. Furthermore, the status of the first permanent molar was positively associated with the general DMF status.

One of the most important factors affecting oral health is an individual's sociocultural status, which has a significant impact on their risk of dental decay. Moreover, behavioral changes occur gradually and are influenced by multiple internal and external factors. Therefore, individuals with an existing decayed tooth are more likely to develop further decay compared to those with higher health literacy and better access to care (9, 10).

The higher decay rate observed in the first permanent molar in this study is likely due to its earlier eruption and anatomical structure, a finding that has been supported by previous research (2).

Additionally, the presence of a restoration in the first permanent molar was associated with a higher likelihood of restorations in other teeth, which may reflect the individual's socioeconomic status (11).

For the second premolar and second molar, a higher proportion of teeth were observed in a sound state, which can be attributed to their later eruption (1).

However, the second most common condition observed in these teeth was dental caries, suggesting that the progression of decay among the study participants occurs gradually. While previous studies indicate that genetics and heredity contribute to dental caries, their influence is generally uniform across all teeth. Therefore, an individual with a genetic predisposition would be equally likely to experience decay in any tooth. In the present study, consistent with previous research, socioeconomic factors appear to play a more prominent role than genetic factors in determining caries risk (12).

An individual's nutritional status plays a crucial role in oral health and is a key contributor to dental caries. Eating habits tend to remain consistent over time, making them difficult to change without intervention. Numerous studies have shown that economic, nutritional, and cultural factors are largely stable and not easily modified. Therefore, in the absence of significant changes in diet or targeted healthcare interventions, the progression of dental decay is likely to continue gradually and predictably (13).

The study results also suggest that the condition of an individual's first permanent molar can reflect the caries status of the second premolar, second molar, and other teeth, indicating that the pattern of dental health can be predicted to some extent from the first permanent molar. These findings are consistent with those reported by Stoica (14). Thus, the presence of caries in tooth 6 may predict the likelihood of decay in teeth 5 and 7 (15). Therefore, implementing preventive interventions, such as fissure sealing of the first molar, could help lower the risk of future dental caries.

Previous studies have demonstrated that caries in deciduous teeth can predict the occurrence of decay in permanent teeth. As a result, the pattern of dental decay is partially predictable, enabling targeted preventive interventions. Measures such as fissure sealing of the first molar may help reduce the risk of future caries (16, 17). The present findings indicate that the first permanent molar can serve as a sentinel tooth for predicting overall caries experience. Preventive interventions, such as fissure sealing of the first molar, may therefore help reduce future caries risk. Beyond individual treatment, incorporating first molar status into public oral health programs could provide a practical tool for early risk assessment and targeted preventive strategies. Using the condition of tooth 6 as a screening indicator in adolescents may enable dental practitioners and policymakers to identify high-risk groups and allocate resources more efficiently.

The strengths of this study include its relatively large sample size, the use of standardized clinical examination methods, and the incorporation of OPG, which enhanced the detection of interproximal caries and reduced under-diagnosis compared to clinical examination alone. In addition, restricting the study population to a narrow age range (18–20 years) minimized variability related to age, thereby improving comparability within the sample.

This study had several limitations. Its geographic scope was restricted to Qazvin, which limits the generalizability of the findings. Moreover, the cross-sectional design does not allow causal inferences about the relationship between first molar status and overall caries experience. Another limitation was the sampling approach: participants were recruited using a convenience sampling method, which may introduce selection bias and restrict external validity. In addition, although examinations were performed by a trained dental student under faculty supervision, inter- and intra-examiner reliability (e.g., kappa statistics) were not formally assessed, which could affect the consistency of the recorded outcomes. Future studies with random sampling, multi-center recruitment, examiner calibration, and longitudinal designs are recommended to strengthen the evidence.

5. Conclusions

This study demonstrated that the condition of the first permanent molar in young adults is strongly associated with caries in adjacent teeth and with overall DMF values. These results underscore the importance of considering the first molar as a sentinel tooth when assessing individual and population-level caries risk. Identifying this relationship provides evidence to support more accurate risk stratification in adolescents and young adults. Further longitudinal studies are required to confirm these associations and to explore how first molar status can be integrated into broader caries prediction models.

Ethical Considerations

This study was approved by the Ethics Committee of Qazvin University of Medical Sciences (IR.QUMS.REC.1401.223).

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Authors' Contributions

Reza Emrani: Supervision, Conceptualization **Mohammadreza Mokarram:** Writing – Original Draft, Investigation **Baharan Ranjbar Omidi**: Supervision, Project Administration **Alireza Foudazi:** Investigation, Resources, Data Curation **Saba Zamani:** Methodology, Writing – Review & Editing.

Conflict of Interests

The authors declare no conflict of interest.

Availability of Data and Material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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