

Evaluation of Dental Caries in Children with an Indication for Permanent First Molar Extraction

Daimi Birinci Molar Çekimi Endikasyonu Olan Çocuklarda Diş Çürüklerinin Değerlendirilmesi

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ABSTRACT

Objectives: It is thought that caries seen in primary molars increases the risk of caries formation in permanent first molars. The aim of this study is to evaluate caries rates in the primary and permanent first molars of patients who needed the extraction of a permanent first molar.

Methods: Examination forms containing the codes obtained from the Caries Assessment Spectrum and Treatment (CAST) Index value of the primary and permanent first molars of 236 patients between the ages of 7 and 9 who needed the extraction of any permanent first molar were examined retrospectively. The Spearman's rho correlation coefficient was used to explore the correlations of the CAST codes among the evaluated teeth.

Results: At least one primary molar was lost due to caries in 70.8% of the patients. Permanent first molars, except for those that were indicated for extraction, showed significant rates of morbidity (42.8%) and serious morbidity (37.3%). When CAST codes of permanent first molars and the adjacent primary molars evaluated, positive correlation was found for 16/55, 36/75, 46/85.

Conclusion: The health status of both primary and permanent first molars of children who required the extraction of any permanent first molar tooth was on a very low level.

ÖZ

Amaç: Süt molarlarda görülen çürüklerin daimi birinci molarlarda çürük oluşma riskini arttırdığı düşünülmektedir. Bu çalışmanın amacı, daimi birinci molar çekim endikasyonu konulmuş hastaların süt molarları ve daimi birinci molarlarındaki çürük düzeylerini değerlendirmektir.

Yöntem: 7-9 yaş arasında herhangi bir daimi birinci molar dişine çekim endikasyonu konulan 236 hastanın süt molar ve daimi birinci molar dişlerine ait Caries Assessment Spectrum and Treatment (CAST) indeksinden elde edilen kodları içeren muayene formları geriye dönük olarak incelendi. Değerlendirilen dişler arasında CAST kodlarının korelasyonunu belirlemek için Spearman's rho korelasyon katsayısı kullanıldı.

Bulgular: Hastaların %70.8'inde çürük nedeniyle en az bir süt moların daha önceden kaybedilmiş olduğu belirlendi. Çekim endikasyonu konulan daimi birinci molarlar haricindeki daimi birinci molarların önemli oranda morbidite (%42,8) ve ciddi morbidite (%37,3) gösterdiği belirlendi. Daimi birinci molarlar ile komşu ikinci süt molarların CAST kodları değerlendirildiğinde, 16/55, 36/75, 46/85 için pozitif korelasyon bulundu.

Sonuç: Herhangi bir daimi birinci molar dişine çekim endikasyonu konulan çocukların hem süt hem de diğer daimi birinci molarlarının sağlık durumlarının çok düşük seviyede olduğu belirlendi.

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INTRODUCTION

Dental caries is still a serious health problem in many populations around the world.¹ In children, it is well known that different groups and surfaces of teeth are at risk of caries as dentition develops. In primary and permanent dentition, each newly erupting tooth acts as a new surface that provides an environment for the formation of disease.² In children aged 5.5–7 years, the permanent first molars are the first permanent teeth to erupt. They provide the basis for the development of normal occlusion and balance.³ They also play an important role in masticatory function.⁴ The permanent first molars are also known to be the teeth most frequently affected by caries and susceptible to the requirement of extraction.⁵

There are several reasons for the high caries risk in permanent first molars. First of all, the fact that they erupt at an early age when a child cannot yet practice adequate oral hygiene, the neglect of their care by parents, the presence of enamel tissue that is not yet matured during eruption, and the deep pit and fissure morphology of these teeth suitable for caries.³ During the mixed dentition period, the permanent first molars and primary molars coexist in the oral environment. Considering that caries is an infectious disease,⁶ caries in primary molars is another factor affecting the health of the permanent first molars. Especially in the early eruption period, the permanent first molars, whose enamel maturation is not yet complete, can quickly become carious before they have sufficient time to mature if active decayed primary teeth are present.^{7,8}

To prevent dental caries and caries-related tooth loss in children, community-based protective practices should be developed in accordance with epidemiological data obtained from the community. Caries indices are used to convert the findings related to dental caries into numerical values. Although the Decayed, Missing, and Filled Teeth (DMFT) Index recommended by the World Health Organization has historically been the most commonly used index in caries epidemiology, attempts have been made to develop more detailed indices due to various limitations of the DMFT Index.⁹ In 2011, Frencken et al. introduced the Caries Assessment Spectrum and Treatment (CAST) Index.¹⁰ This index was

developed to examine the early stages of caries and their effects on the pulp and periradicular tissues with a single index.¹¹

In the literature, some epidemiological studies have investigated the status of permanent first molars in children and compared it to caries in primary molars.¹²⁻¹⁵ However, there is no study using the CAST Index in children with an indication for the extraction of the permanent first molars. Considering this information, our aim in this study was to evaluate the caries status of primary molars and permanent first molars in pediatric patients with indication for the extraction of a permanent first molar using the CAST Index.

MATERIAL AND METHODS

In our study, the examination forms of pediatric patients aged 7–9 years, who were registered with the Zonguldak Bülent Ecevit University Faculty of Dentistry, Department of Pediatric Dentistry over a period of 3 years, were retrospectively examined. Prior to the study, approval was obtained from the Zonguldak Bülent Ecevit University Clinical Research Ethics Committee (December 18, 2019; protocol number 2019-198-18/12). The examination forms evaluated in the study are routinely completed by dentists for patients who are registered at the clinic accompanied by a family member or a caregiver. These forms record the patient's first and last name, date of birth, date of enrollment, the reason for presentation, and medical history. The CAST Index scores of the existing teeth, the appliances used, if any, and the dental treatment planning performed during the examination are also recorded on these forms. Examinations are performed in the dental unit under halogen reflector lighting with the help of a mirror and a probe. With the CAST Index, a round-tipped periodontal probe is used during the evaluation of caries. The examination forms of the patients evaluated in our study were filled in by three research assistant dentists who were working in the Department of Pediatric Dentistry during the study period. The coding system of the CAST Index, which is used in caries evaluation, is shown in Table 1.¹¹

Table 1: Coding system of the CAST index.

Codes	Characteristic	Description
0	Sound tooth	There is no visible evidence of a carious lesion.
1	Sealed	Pits and/or fissures are at least partially sealed with a sealant material.
2	Restored	A cavity has been restored using an (in) direct restorative material.
3	Enamel	Distinct visual change is only present in the enamel. A clear caries discoloration is visible with or without localized enamel breakdown.
4	Dentine	Internal caries-related discoloration is present in the dentine. The discolored dentin is visible through enamel which may or may not exhibit a visible localized enamel breakdown.
5	Dentine	Distinct cavitation into the dentin is present. The pulp chamber is intact.
6	Pulp	Involvement of the pulp chamber is seen. Distinct cavitation, reaching either the pulp chamber or the root fragments, is present.
7	Abscess/fistula	Pus containing swelling or pus releasing sinus tract related to a tooth with pulpal involvement is present.
8	Lost	The tooth has been removed because of dental caries.
9	Others	Does not correspond to any of the other categories.

Patient Selection

The following criteria were used for inclusion in the study: children in whom all four permanent molars had erupted and an indication of tooth extraction due to advanced stages of caries (CAST codes 5, 6, or 7) on one of these teeth at the time of examination. Children in whom one of the premolars had erupted were excluded because, in these cases, we could not determine whether a primary molar was exfoliated or extracted because of caries. Patients with a history of systemic diseases or regular medication, patients using removable or fixed appliances, and patients with mineralization disorders in their teeth were also excluded from the study, as were patients whose examination forms had missing data.

Data Collection

The following information obtained from the patients' examination forms was entered into the computer using the Microsoft Excel 2010 program:

- Age and sex of the patient,
- The permanent first molar that showed an extraction indication during the examination and the CAST code given to the tooth during the examination,
- CAST codes for the other permanent first molars,
- CAST codes for the primary molars.

In addition to these data, the maximum CAST codes of the primary and permanent molars were calculated and recorded separately for each patient. When calculating the maximum CAST codes of the permanent first molars, the tooth with an indication for extraction was excluded.

The collected data were also classified according to the epidemiological concept proposed by Frencken et al.¹⁰ According to this classification, the codes are: 0, 1, 2 (healthy), 3 (reversible pre-morbidity), 4 and 5 (morbidity), 6 and 7 (serious morbidity), and 8 (mortality). Furthermore, the correlations between the CAST codes of the adjacent (16/55, 26/65, 36/75, 46/85, 55/54, 65/64, 75/74, 85/84), symmetrical (16/26, 36/46, 55/65, 54/64, 74/84, 75/85), and antagonist (16/46, 26/36, 55/85, 65/75, 64/74, 54/84) teeth were evaluated.

Statistical Analysis

The data were analyzed using the IBM SPSS v23 software. The Chi-squared test was used to compare the categorical variables by groups. The Spearman's rho correlation coefficient was used to examine the relationships between the non-normally distributed data. The categorical data are presented as frequency (percentage) values. The statistical significance level in the calculations was taken as $p < .05$.

RESULTS

The examination forms of 8251 patients aged 7–9 years, who presented to our clinic between January 2017 and December 2019, were evaluated. Among the evaluated examination forms, those that complied with the inclusion criteria were identified. Thus, the records of a total of 236 patients, 120 girls and 116 boys, were included in the study.

Table 2 shows the distribution of the CAST codes given in the range of 0–8 for each tooth. The frequencies of code 0 and code 2 were very low in all primary molars. Code 1 was not found in any of the primary molars, so a fissure sealant was not detected in any of those molars. In all primary molars, advanced stages of caries, such as distinct cavitation (code 5) or cavitation extending to the pulp (code 6), were detected more frequently than earlier stages of caries, such as discoloration reflected from the dentin (code 4) or enamel caries (code 3). Figure 1 shows the distribution of the CAST codes, classified according to the epidemiological concept proposed by Frencken et al.¹⁰

Table 2: Distribution of the CAST codes given for each tooth.

Teeth	CAST Codes (%)								
	0	1	2	3	4	5	6	7	8
16	7,2	0	5,1	21,3	20,8	25,8	16,9	1,3	1,7
26	3,8	0	4,2	22,5	21,6	27,5	16,5	0,8	3
36	2,1	0	4,2	6,8	14	12,3	39,8	17,8	3
46	0,4	0	7,6	10,2	9,3	20,8	32,6	13,6	5,5
55	2,5	0	3,4	2,1	13,6	31,4	26,7	4,2	16,1
54	1,7	0	1,7	2,5	5,9	24,6	25,8	3,4	34,3
64	0,4	0	1,7	3	8,1	19,1	28,8	2,1	36,9
65	0,8	0	3	2,5	11,9	32,6	28,4	1,3	19,5
75	0,4	0	4,7	3	11,4	25	21,2	8,9	25,4
74	1,7	0	4,2	0,8	7,2	34,3	15,7	4,7	31,4
84	2,1	0	4,7	0,8	6,8	33,1	24,2	3,4	25
85	0,4	0	6,8	3	11	30,5	17,8	5,9	24,6

Figure 2 shows the distributions of the maximum CAST scores for primary molars and permanent first molars per patient 70.8% of the patients had lost at least one primary molar due to caries. No patient had CAST codes 0, 1, or 2 as the highest code for primary molars. Thus, there is no patient in whom all primary molars were healthy. Of the patients, 10.6% had a previous extraction of a permanent first molar, serious morbidity was seen in 37.3% of the patients' other permanent first molars, and morbidity was seen in 42.8% of the patients. The percentages of patients with reversible pre-morbidity and healthy teeth were very low.

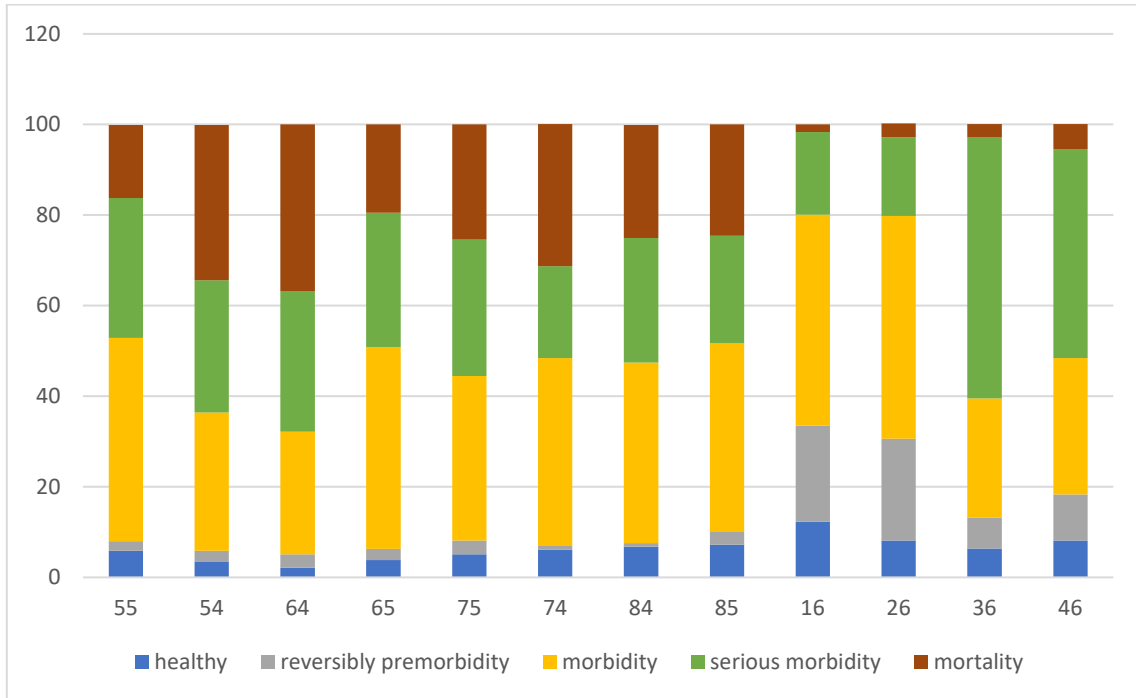


Figure 1: Evaluation of the primary and permanent molars based on the epidemiological concept of Frencken et al. (10)

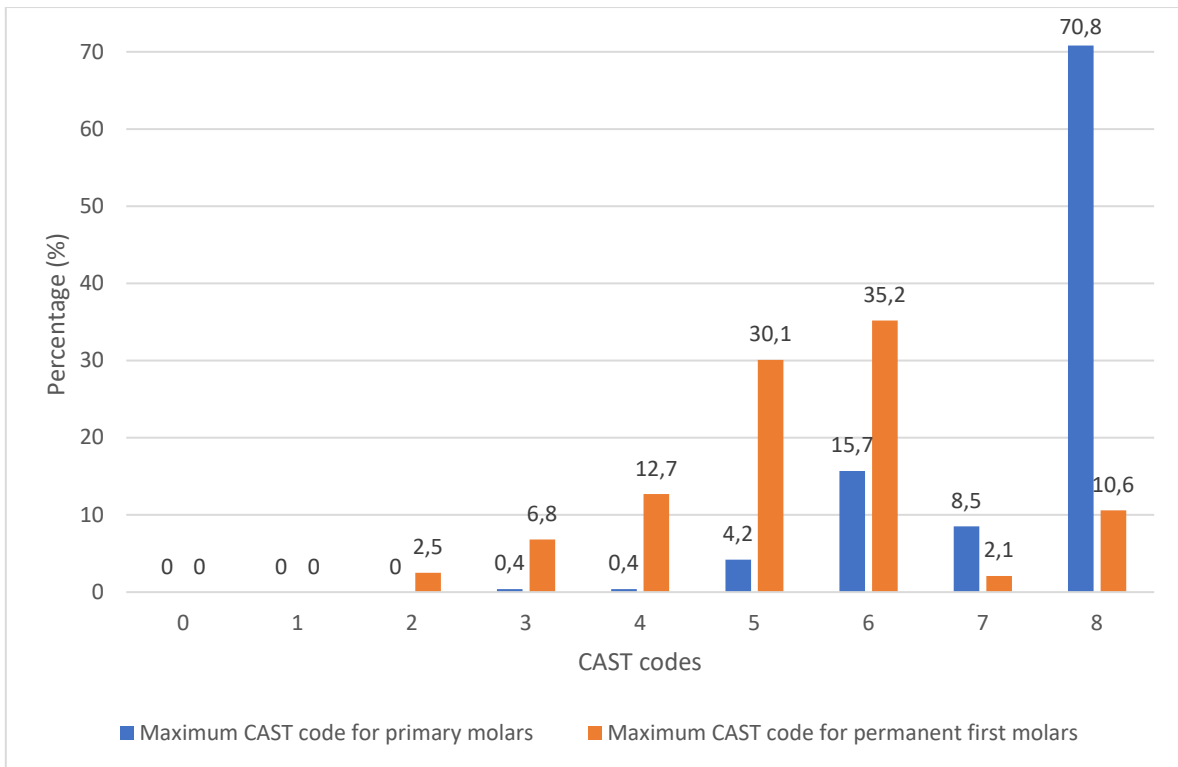


Figure 2: The percentage of children according to the maximum CAST code in primary and permanent molars.

Table 3 presents the correlation results of the CAST codes in the evaluated primary and permanent molars. Positive correlations on moderate or weak levels were

found between the caries stages of the adjacent primary molars. In the examination of the CAST codes of the permanent first molars and the adjacent primary second

molars, a statistically significant positive correlation was found for 16/55, 36/75, and 46/85. However, this correlation was found to be very weak. A moderate, positive and statistically significant correlation was found for all the symmetrical primary molars.

Table 3: Correlation between the CAST codes of the adjacent, symmetrical, and antagonist teeth.

	r	p
Neighbouring teeth		
16/55	0,166	0,011
26/65	0,107	0,100
36/75	0,175	0,007
46/85	0,129	0,048
55/54	0,491	<0,001
65/64	0,559	<0,001
75/74	0,454	<0,001
85/84	0,297	<0,001
Symmetrical teeth		
16/26	0,283	<0,001
36/46	0,041	0,536
55/65	0,479	<0,001
54/64	0,415	<0,001
74/84	0,454	<0,001
75/85	0,516	<0,001
Antagonist teeth		
16/46	0,007	0,918
26/36	-0,138	0,034
55/85	0,296	<0,001
65/75	0,274	<0,001
64/74	0,185	0,004
54/84	0,264	<0,001

r: Spearman's rho correlation coefficient

DISCUSSION

Although their importance is well-known, the protection of permanent first molars is usually overlooked, so, these teeth are the most frequently affected teeth by caries, and they are susceptible to the requirement of extraction.⁵ Many epidemiological studies have been conducted in Turkey and worldwide to determine the health status of the permanent first molars.¹⁶⁻¹⁹ In epidemiological studies, the use of an index that covers all stages of caries allows more data to be collected and various advanced analyses to be performed. Unlike other indices, the CAST Index allows all stages of caries progression to be reported in a simple hierarchy.¹⁴

Despite the common knowledge that the early extraction of permanent first molars can have significant negative effects on the growth and development of the jaw and the face,²¹ there is no study investigating caries in a specific group of patients for whom an extraction indication has been observed for one of the permanent first molars. In our study, we focused on this group of patients, and the evaluation of the caries levels in the primary molars and permanent first molars of these patients was performed using the CAST Index.

In the evaluation of the patients according to the highest CAST codes they received for their primary molars, it was particularly noteworthy that there were no patients who received the codes 0, 1, and 2. Accordingly, here were no patients in whom all primary molars were healthy. This rate was found to be 34.1% in the study by Khokhar et al.¹⁵ and 22.5% in the study by Baginska et al.¹³ In the primary molars of the patients examined in our study, the highest CAST code per patient showed a tooth mortality rate of 70.8%. In the vast majority of the patients, at least one primary molar tooth was lost due to caries. This rate was reported to be 17.6% in the study by Baginska et al.¹³ and 7.63% in the study by Khokhar et al.¹⁵ In our study, it was determined that 24.2% of the patients showed serious morbidity and, 4.7% were found to have morbidity. In primary molars, Baginska et al.¹³ reported a morbidity rate of 23.1%, and Khokhar et al.¹⁵ reported a morbidity rate of 27.3%. In comparison to the data reported in previous studies, in our study, healthy tooth surfaces and early stages of caries were found at lower frequencies in primary molars, while advanced stages of caries and tooth loss due to caries were seen more frequently in these teeth. While previous studies included all patients in the appropriate age group for routine dental examinations or screening at schools,¹²⁻¹⁵ our study was conducted with patients with permanent first molar extraction indications. It is thought that the difference between our findings and the findings reported in previous studies¹²⁻¹⁵ was due to this issue.

It is well-known that the presence of caries in primary molars provides important data for predicting caries in the permanent dentition stage. In the results of the study by Leroy et al.⁷, due to the presence of caries in the primary molars and poor oral hygiene, a peak in caries susceptibility was reported 1–2 years after the appearance of the permanent first molars. However, it was observed that the risk of caries decreased over time when good oral hygiene was maintained.⁷ Risk factors that cause caries, such as diet and oral hygiene habits, are common for deciduous and permanent teeth. Children with decayed primary teeth are at a high risk for caries in permanent teeth. Moreover, carious deciduous second molars were shown to cause caries formation in permanent first molars, even after related common risk factors are controlled.⁷ Carious tooth surfaces are more suitable for plaque accumulation than sound surfaces, and they cannot benefit from mechanical cleaning and the

buffering effect of saliva. It was demonstrated that the acidogenic potential of microbial dental plaque was higher in areas adjacent to caries in comparison to sound surfaces.²² This provides an ecological environment that directly increases the caries risk for solid surfaces adjacent to caries.²²

In our study, when calculating the maximum CAST code for permanent teeth per patient, the permanent first molar with an indication for extraction was excluded to investigate the status of the other permanent first molars. In the examination of the patient data for this parameter, the maximum CAST codes of the permanent teeth were 0, 1, or 2 in only 2.5% of the patients, meaning that these patients did not require treatment on the other three permanent first molars of theirs. In contrast, in the studies by Baginska et al.¹³ and Khokhar et al.,¹⁵ the percentages of patients with maximum CAST codes for permanent molars of 0, 1, or 2 were 67% and 47%, respectively. In similar studies, the rates of morbidity and serious morbidity in the permanent first molars were found to be very low, and mortality was never reported.^{13,15} In our study, the maximum CAST codes of the permanent teeth indicated morbidity in 42.8% of the patients and serious morbidity in 37.3%. Moreover, 10.6% of the patients had lost at least one permanent first molar before their participation in our study. According to the data examined in our study, other permanent first molars were also in poor health in the pediatric patient group where extraction indications were determined for any permanent first molar. It is well-known that permanent first molars lost in the early period of dentition can cause various orthodontic problems. Nevertheless, if diagnosed with a long-term poor prognosis, the extraction of a permanent first molar at the right age and stage of tooth development can alleviate or prevent problems. It is recommended that other permanent first molars with a prediction of poor long-term prognosis be evaluated in terms of compensating and balancing extractions.²¹

In the analysis of the relationships between the caries levels of the teeth, a statistically significant positive correlation was observed between the caries levels of all adjacent first and second primary molars examined in our study. The relationship between the adjacent primary molars was positive and moderate except for 84/85. The relationship between the caries scores of all symmetrical primary molars was also found to be statistically significant, positive, and moderate. Similar to our study, the symmetrical distribution of the CAST codes for the primary molars were also reported in the study by Baginska et al.¹³ The morphological structure of the symmetrical teeth is the reason for the similarity in caries formation and the rate of progression to the pulp. Other studies using different methods have also reported on the symmetrical distribution of caries in jaws with deciduous teeth and permanent teeth.^{23,24} These data show that when caries occurs on one tooth surface, symmetrical teeth are also at risk. In our study, the relationships between the

antagonist primary molars were statistically significant and positive, but they were weak or very weak. Thus, the correlation of caries scores in primary molars was stronger between the adjacent teeth and symmetrical teeth than the antagonist teeth. This situation was also found in a similar study conducted with the CAST Index.¹⁴ It may be suggested that the low correlation between caries levels was since antagonist teeth had different morphological structures and different anatomical adjacencies.

The results of our study supported the findings that the level of caries in primary second molars may be correlated with the level of caries in permanent first molars. All relationships between the caries levels of the permanent first molars and adjacent primary molars were found to be positive and statistically significant, except for 26/65. However, the correlations were very weak for 16/55, 36/75, and 46/85. In the study by Doneria et al.,¹⁴ like our results, the relationship between the CAST codes was found to be statistically insignificant for 26/65. Furthermore, weak relationships, although statistically significant, were found for 16/55, 36/75, and 46/85.¹⁴ Similar results have been reported in other studies using the CAST Index.^{13,15} Moreover, in the study by Honkala et al.²⁵ which investigated the relationship between primary second molars and adjacent permanent first molars on a surface basis using the ICDAS Index, no strong correlation was found between the carious depths of the relevant teeth.

It is known well that the presence of caries in primary molars is an important indication for predicting caries in permanent first molars.⁷ However, cross-sectional or retrospective studies using the CAST and ICDAS indices usually have not found a strong relationship between the caries levels in these teeth.^{13-15,25} In this regard, our study's findings were similar to the findings reported in the majority of studies in the relevant literature.

CONCLUSION

We determined that the health status of both the primary and permanent first molars of children who required the extraction of any permanent first molar tooth was on a very low level. Despite the predictable caries risk for permanent first molars due to the high caries experience in primary molars, it was shown that patients lost their permanent first molars at very early ages due to a lack of preventive measures. To protect permanent first molars from caries, both children and their families should be educated about oral care from an early age. Community-based protective practices need to be developed specifically for high-risk children.

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