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Original Article

The evaluation of developmental enamel defects and dental treatment conditions in a group of Turkish children with congenital heart disease

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Abstract *Objective:* The aim of this study was to determine developmental enamel defects and dental treatment conditions in children with congenital heart disease by comparing them with a control group of healthy children. *Methods:* Children included in the study were referred to a paediatric dentistry for dental examination and treatment after undergoing routine examination in a paediatric clinic. *Results:* The congenital heart disease group included 72 children and the control group included 56 healthy children. Children in the age group of 3–14 years were included in this study. The mean age of the congenital heart disease group and control group was 6.24 ± 2.85 and 6.73 ± 3.01, respectively. The mean values of the decayed, missing, and filled indices for primary and permanent teeth in the congenital heart disease group were 2.80 ± 3.77 and 0.81 ± 1.63, respectively. In the control group, the values were 1.87 ± 3.31 and 0.72 ± 1.46, respectively. The care score for primary teeth was 3.6% in the congenital heart disease group and 13.3% in the control group. The enamel defect was detected in at least one permanent tooth in seven out of 72 children (9.7%) in the congenital heart disease group and in three out of 56 children (5.3%) in the control group. *Conclusion:* Although there was no significant difference in the development of dental caries or the prevalence of enamel defects between children with congenital heart disease and healthy children, the care score was low in children with congenital heart disease. In addition, children with congenital heart disease had a higher rate of pulled primary teeth and delayed treatment of decayed teeth.

Keywords: Congenital heart diseases; caries experience; enamel hypoplasia

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Dental problems and congenital heart disease are important factors that adversely affect quality of life.[1–4] Approximately eight per 1000 live births are estimated to have congenital heart disease,[5] one-third of which are complex anomalies.

During the first few years of their lives, children with congenital heart disease are generally hospitalised for short or long periods of time for medical and surgical treatment. For this reason, dental problems are expected to be commonly seen in children with this disease. In addition, there are other underlying factors such as nutrition, drug use, and family's socioeconomic status that influence the formation of early dental caries.[6]

Ameloblasts are cells that are sensitive to changes in intracellular environment. Congenital heart disease might adversely affect ameloblast activity.[6] When the development of heart disease coincides with the formation of teeth in children, it results in the reduction of enamel deposition, which then leads to the formation of soft and defective teeth.[7]

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Although heart disease is reported to cause delayed dental maturation, their effect on dentition is not fully understood.[6]

Previous studies have shown that children with congenital heart disease have higher caries prevalence than healthy children.[6–8] The reports from previous studies are presented in Table 1. However, there is no clear study regarding the ratio of untreated and treated teeth in children with congenital heart disease.

In the light of this information, the main objective of this study was to compare the formation of dental caries and developmental enamel defects in healthy children and children with congenital heart disease and to evaluate the treatment conditions in the congenital heart disease group.

Methods

Children included in the study were first routinely examined in the paediatric clinic and then referred to the dental clinic for dental examination and treatment.

The study group included the following:

1. Patients between the ages 3–14 years and diagnosed with congenital heart disease during their first year.
2. Children with congenital heart disease but without any other systemic disease or syndrome.

The control group included healthy children who were referred to the paediatric clinic for heart murmur examination but subsequently were not diagnosed with any heart disease.

A single investigator (H.G.) conducted the dental examination of all children included in the study in conditions with appropriate lighting, compressed air spray, mirror, with a probe, and taking into account the criteria accepted by The World Health Organization.

Each child's age, gender, and race were recorded. In addition, caries and missing and filled primary and permanent teeth were recorded for children from both groups. All the initial (limited to enamel) and specific (advanced dentin) caries lesion volumes were included in the decayed, missing, and filled indices calculation.

Kolmogorov–Smirnov test was used to study the distribution of the parameters. The t-test for independent measurement was used for comparison of the decayed, missing, and filled indices values for primary and permanent teeth, as well as incidence of dental caries, tooth loss, and teeth filling in children in the control group and congenital heart disease group. The χ^2 test was used for comparison of the ratio of dental enamel defects and care score between the control groups and the congenital heart disease group. All statistical analyses were performed using a

Table 1. Results from previous studies showing the amount of dental caries in children with heart disease.

Author (year)	n	Age (year)	dmft (mean)	DMFT (mean)
Cantekin et al	165 CHD 165 control	2–14	2.8 CHD 1.4 control	2.0 CHD 1.1 control
Stecksen-Blicks et al	41 CHD 41 control	2–11	dmfs 5.2 CHD 2.1 control	DMFS 0.9 CHD 0.3 control
Franco et al	60 CHD 60 control	2–16	3.7 CHD 3.9 control	2.7 CHD 2.0 control
Pollard and Curzon	100 CHD 100 control	2–16	2–4 years 1.81 study 1.63 control 5–9 years 4.32 study 2.77 control	5–9 years 0.58 study 0.45 control 10–16 years 1.81 study 1.62 control
Berger	57 CHD 57 control	8–10	Cyanotic: a high amount of dental caries	
Hallett et al	39 CHD 33 control	1–15	4.2 CHD 2.3 control	0.9 CHD 0.6 control
Urquhart and Blinkhorn	134 CHD	4–12	4–6 years: 3.34 7–9 years: 3.26	5.03
Hayes and Fasules	209 waiting for heart surgery	1–16	29% with caries 7% with abscess	
da Silva et al	104 IE risk	2–17	2.62	3.97
Balmer and Bu'Lock	38 IE risk	2–16	39% untreated dental caries	

dmft = decay, missing and filling score (primary teeth); DMFT = decay, missing and filling score (permanent teeth); dmfs = decay, missing and filling surface score (primary teeth); DMFS = decay, missing and filling surface score (permanent teeth); CHD = congenital heart disease; IE = infective endocarditis

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computerised statistical software program (SPSS version 17.0, SPSS Inc., Chicago, Illinois, United States of America). Statistical significance was set at 5%.

Results

A total of 87 children were evaluated. In all, 12 children were excluded from the study because of other concomitant systemic diseases and three children were excluded because their heart disease was diagnosed after the age of 1. As a result, the congenital heart disease group included 72 children, while the control group included 56 children without any heart disease or systemic disease.

The age range of the children included in the study was 3–14 years and the mean age ranges of the congenital heart disease group and the control group were 6.24 ± 2.85 and 6.73 ± 3.01, respectively. There was no significant difference between the two groups in terms of age, gender, and race. The results of the primary teeth are shown in Table 2.

The mean values of the decayed, missing, and filled indices (primary teeth) of the congenital heart disease group and the control group were 2.80 ± 3.77 and 1.87 ± 3.31, respectively. The children in the control group had a high percentage of missing teeth, whereas children in the congenital heart disease group had a high percentage of untreated dental caries. However, this difference was not statistically significant ($p = 0.36$).

The results from the permanent teeth are shown in Table 3. The mean scores of the decayed, missing, and filled indices (permanent teeth) of the congenital heart disease and the control group are 0.81 ± 1.63 and 0.72 ± 1.16, respectively. There was no significant difference between the two groups ($p = 0.79$).

The care score values were calculated as percentages of mean filled teeth/mean of the decayed, missing, and filled indices.[9] The care score of the congenital heart disease group and the control group was 3.6% and 13.3%, respectively, and the difference between the two groups was statistically significant ($p < 0.01$). The untreated tooth ratio for the congenital heart disease group and the control group was 31% and 18%, respectively. This difference between the two groups was statistically significant ($p < 0.01$).

In all, seven out of 72 (9.7%) children in the congenital heart disease group and three out of 56 children (5.3%) in the control group had an enamel defect in at least one permanent tooth. The difference between the two groups was not statistically significant ($p = 0.12$).

In all, four of those children from the congenital heart disease group and one child from the control group had more than one affected permanent incisor, and three children from the congenital heart disease group and two children from the control group had only one affected permanent molar tooth.

Table 2. The age, oral health, and dmft (primary dentition) values for children with CHD and healthy children.

	CHD group (n = 63)	Control group (n = 46)	p-value
Age range (years)	3–11	3–11	
Mean age ± SD	5.88 ± 2.64	5.94 ± 2.83	ns
Mean dt ± SD	2.02 ± 3,11	1.28 ± 2.85	ns
Mean mt ± SD	0.69 ± 2.63	0.34 ± 1.23	ns
Mean ft ± SD	0.09 ± 0.32	0.25 ± 0.83	ns
Mean dmft ± SD	2.80 ± 3.77	1.87 ± 3.31	ns

CHD = congenital heart disease; dt = decay score (primary teeth); mt = missing score (primary teeth); ft = filling score (primary teeth); dmft = decay, missing and filling score (primary teeth); ns = non-significant

Table 3. The age, oral health, and DMFT (permanent dentition) values for children with CHD and healthy children.

	CHD group (n = 42)	Control group (n = 38)	p-value
Age range (years)	5–14	5–14	
Mean age ± SD	9.56 ± 2.75	9.83 ± 2.81	ns
Mean DT ± SD	0.35 ± 0.77	0.32 ± 0.98	ns
Mean MT ± SD	0.29 ± 1.01	0.12 ± 0.56	ns
Mean FT ± SD	0.17 ± 0.75	0.28 ± 0.28	ns
Mean DMFT ± SD	0.81 ± 1.63	0.72 ± 1.46	ns

CHD = congenital heart disease; DT = decay score (permanent teeth); MT = missing score (permanent teeth); FT = Filling score (permanent teeth); DMFT = decay, missing and filling score (permanent teeth); ns = non-significant

Discussion

The oral health of children staying in the hospital with heart disease has been neglected for a long time,[6,8,10–13] and this neglect may also affect their general health over time. Owing to the long-term consequences, oral health care of children with heart disease should not be neglected. There are many studies published on children with heart disease, and most related to children with congenital heart disease.[7,9–12,14–20] In our study, an experienced paediatric dentist performed oral and dental examination at the dental school, and thus our study could provide the most reliable diagnosis of dental caries and oral hygiene evaluation. The caries assessment was based on clinical examination and intraoral radiographs. In contrast to previous studies, children with systemic diseases concomitant to the congenital heart disease were excluded from the study, and thus the effects that might have been caused by other medical conditions were eliminated. In addition, the use of other diagnostic arguments led to more accurate diagnosis of caries.

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In this study, we did not find a significant difference between the congenital heart disease group and the control group in terms of the presence of dental caries. Both Franco et al[8] and Tasioula et al[9] reported that there was no significant difference between healthy children and children with congenital heart disease in terms of the amount of tooth decay in permanent and primary teeth. Our dental caries findings are different from the study by Cantekin et al,[6] where they evaluated the oral health and dental age assessment in 165 children with congenital heart disease and in 103 children with acquired heart disease. Children with congenital heart disease who were referred to the dental clinic for routine dental examination were found to have higher prevalence of tooth decay than healthy children. Urquhart and Blinkhorn[19] reported that the amount of caries in primary dentition was higher in children with congenital heart disease than in healthy children. They suggested that this difference was due to children's differential social sub-structures and the time spent in hospital: children with heart disease from the low socio-economic structure often spend more time in the hospital outpatient clinic than their healthy counterparts. Stecksén-Blicks et al[10] found that children with congenital heart disease had a higher percentage of caries in the permanent dentition than age-and sex-matched healthy children. They suggested that this difference might be due to frequent ingestion of digoxin, a sucrose-containing syrup. Berger[18] reported that the amount of dental caries in children with cyanotic heart disease was higher than those with acyanotic heart disease – the amount of dental caries is higher than in healthy children. Berger suggested that the cause of the high amount of caries in children with heart disease is due to low-level dental care and treatment, less frequent teeth brushing, and higher consumption of cariogenic foods compared with healthy children. Balmer et al[7] suggested that higher amount of dental caries in children with congenital heart disease is due to dentists' mistakes. Dentists do not allocate sufficient time to these patients and the treatment cost is higher. In addition, dentists stated that they felt themselves unconfident while treating children with congenital heart disease. Pollard and Curzon[12] showed that the amount of tooth decay is higher in children 5–9 years of age with congenital heart disease than in the control group of healthy children and argued that this difference can be explained by insufficient dental care at an early age.

Overall, in this study the number of dental caries was lower in both groups and in both dentitions compared with the scan data from Istanbul.[21] This situation might have been caused by the socio-economic differences in the two study groups. Both the study and the control groups in that study were socio-economically richer when compared with the Townsend material deprivation index based on Istanbul's population. In our study, there was no difference between the congenital heart disease group and the control group in terms of socio-economic status.

The care score is an indication of the restorative therapy of teeth with caries.[9] In this study, the care score is 13.3% in the control group and 3.6% in the congenital heart disease group, which revealed that the percentage of dental care is lower in children with congenital heart disease than in healthy children. There are at least three reasons for the lower percentage of restorative treatment of primary dentition in children with congenital heart disease. First, parents of children with congenital heart disease are not sufficiently informed about the importance of oral hygiene and adverse effects of dental disease on quality of life. Second, the practitioner (general) dentists are reluctant to treat children with congenital heart disease. Third, paediatric cardiac disease specialists do not provide adequate information to families of children with congenital heart disease about the importance of oral care.[6] Owing to the fact that there is a higher risk of developing infective endocarditis in children with congenital heart disease, both paediatric dentists and paediatric cardiologists have great responsibilities regarding the general health status of patients with heart disease, and they should be in close communication during evaluation of these patients.

Previous studies indicated that the prevalence of enamel defect in the general population was between 4% and 25%.[9,22] In agreement with these studies, our study showed that seven children in the congenital heart disease group (9.7%) and three children in the control group (5.3%) had diffused or limited enamel defects in at least one permanent tooth. There was no significant difference between the two groups in terms of the presence of enamel defect ($p > 0.05$). However, different results were reported by a study where they evaluated enamel hypoplasia in conjunction with congenital heart disease. Similar to our study, Tasioula et al[9] and Franco et al[8] did not find a significant difference in terms of the presence of enamel defects. On the other hand, Hallett et al[11] showed that at least one primary tooth is affected in children with congenital heart disease compared with healthy children, and that there is a significant difference between the two groups. They also elaborated that in children with congenital heart disease, enamel hypoplasia might be associated with systemic conditions such as surgical complications due to heart failure and heart disease. Early intervention and successful treatment during the early stages of tooth formation has been proposed to reduce the duration and severity of systemic disorders such as cyanosis in

patients with congenital heart disease. With advanced examination, diagnosis, and surgical and anesthetic methods, it is expected that the prevalence of enamel defect will decrease in children with congenital heart disease.

Study limitations

Although our study population was wide and diverse, complex heart disease and surgical patients represent only a small fraction of the population of heart disease. The determination of risks of specific sub-groups is one of the limitations of our study. The history of surgical intervention is seen as one of the possible factors that have an effect on oral hygiene. For this reason, more specific studies are needed to investigate the effects of sub-groups.

Conclusion

1. There is no significant difference between children with congenital heart disease and healthy children in terms of prevalence of dental caries or enamel defect.
2. Dental care, which reflects the primary teeth that underwent restorative treatment, was lower in the congenital heart disease group.
3. A high rate of tooth loss in primary dentition was observed in children with congenital heart disease. Late intervention in the treatment of dental caries drew attention.
4. In children with congenital heart disease, primary teeth with pulpal infection should be pulled instead of restored. For this reason, the child's heart health must be evaluated in a comprehensive manner. Then, it needs to be determined whether there is a need for any kind of special care and a definitive treatment plan needs to be prepared.

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Conflicts of Interest

None.

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