Level of caries activity and an estimate in the increase of permanent teeth caries: a three-year follow up study in preschool senior children

Yoshihide Okazaki, Ying Ji*, Bazar Oyuntsetseg*, Omar M.M. Rodis*, Masahiko Hori, Seishi Matsumura* and Tsutomu Shimono*

Pediatric Dentistry, Okayama University Dental School Hospital
* Department of Behavioral Pediatric Dentistry,
Graduate School of Medicine and Dentistry, Okayama University
2-5-1 Shikata-cho, Okayama 700-8525, JAPAN

Abstract  The aim of this study was to examine relationships between the level of caries activity in preschool senior children and the increase of dental caries 3 years after the permanent teeth erupted. A total of 1133 preschool senior children aged 5–6 years were examined yearly during 3-year duration. A Caries Activity Test (Cariostat Test) was used at the first examination of this study. The results were as follows;
1. The caries prevalence rate of the subjects was 84.1% and the mean dft was 5.89 at the first examination.
2. There was a significant relationship between the CAT score and dft at the first examination ($P<0.001$).
3. The subjects were divided into 3 risk groups by CAT score: low-risk group (20.4%), middle-risk group (43.3%) and high-risk group (36.3%).
4. Increments of DFT from 1 year to 3 years after the permanent tooth erupted for the high-risk group were more than twice for those of the low-risk group ($P<0.001$). The prevalence of the permanent tooth decay for the high-risk group was also higher than that of the low-risk group ($P<0.001$).
The results showed that the usage of the CAT Test for preschool senior children was useful to predict increase in permanent teeth caries over 3-year duration.

Key words  Caries Activity Test, Caries prediction, Caries prevalence, Cariostat Test, Permanent tooth

Introduction  Many attempts have been made recently to identify those children who are more susceptible to caries development so as to implement specific prevention programs. It is well known that there is a significant correlation between dental caries of the permanent tooth and the primary tooth. Demers et al. reported that the caries increase group contained a higher proportion of children with past caries experience, high levels of mutans streptococci and lactobacilli, a poor oral hygiene, and a lower level of parents’ education, but that the best model comprised only 2 factors: caries experience and lactobacilli, using regression analysis. Kobayakawa et al. reported that in a Japanese sample, the percentage of 5-year olds who were caries free fell far short of the WHO global target of 50% by the year 2000. They suggested that there is a continuing need for more effective preventive services for this important age group. As dental caries susceptibility of recently erupted permanent tooth is very high, caries prevention during this period is very important. If dental caries prevention is done from the primary dentition period, it would relate to the life-long retention of healthy teeth.

A caries activity test termed Cariostat Test
Okazaki, Y., Ji, Y., Oyuntsetseg, B. et al.

Fig. 1 Distribution of caries risk groups in preschool children

There are no reported studies regarding the relationship between the CAT Test and increase in permanent teeth caries in children whose permanent teeth have not yet erupted during the data gathering period. If regular examination is done during this period, and the Cariostat Test score (CAT score) has been found to be not good, then an effective permanent teeth caries prevention program may be introduced.

Hence, in this study we investigated the relationship between the CAT Test and increase of the permanent teeth caries during a 3-year follow-up period in preschool senior children.

Materials and methods

The subjects were 1133 preschool senior children aged 5–6 years at the time of the initial examination, who were born between April 1982 and March 1994. All of the subjects’ permanent teeth have not yet erupted. The study sample selected from our database is as follows:

Preschool senior children who underwent oral examination and CAT Test sampling at 5–6 years old, and 1 year thereafter for 3 years, which included oral hygiene instructions, and dental examination at least once for kindergarten field work programs.

The CAT Test was used at the time of the initial examination. Dental plaque was taken by swabbing the bucco-cervical surfaces of the maxillary teeth using a sterile cotton swab. The plaque sample was placed into the ampoule, then incubated at 37°C for up to 48 hours. Scoring was done after a predetermined incubation period using the modified 7-scale grading system from 0 to 3.0 with 0.5 intervals. The subjects were grouped as low-risk group (CAT score 0, 0.5 and 1.0), middle-risk group (CAT score 1.5 and 2.0), and high-risk group (CAT score 2.5 and 3.0).

Oral examination was performed using a probe and a mouth mirror with sufficient illumination. All of the subjects were examined by the same dentist. Teeth with fissure sealant were recorded as healthy.

The relationship between CAT score and caries prevalence was analyzed using \( \chi^2 \) test. The differences in dft/DFT between the each risk groups were analyzed by ANOVA-test.

All of the statistical analyses were done using the SPSS 11.0J software (SPSS JAPAN Inc.).

Informed consents were obtained from the parents regarding the CAT Test and oral examination and its purpose for this study.

Results

The caries prevalence of the subjects was 84.1% and the mean dft was 5.89 at the initial examination. Distribution of CAT scores was 20.4% in the low-risk group, 43.3% in the middle-risk group and 36.3% in the high-risk group (Fig. 1).

The CAT score at the time of initial examination was significantly correlated with dft \( (r=0.439: P<0.001) \).

The mean dft and standard deviation of the primary teeth caries was \( 3.87 \pm 4.66 \) (SD) in the low-risk group, \( 6.08 \pm 3.96 \) (SD) in the middle-risk group and \( 9.22 \pm 4.53 \) (SD) in the high-risk group. It can therefore be presumed that the dft will increase with every increase of the risk group.

There were significant differences among the 3 risk groups (ANOVA \( P<0.001 \), Fig. 2).

The prevalence of caries of the permanent teeth was 19.4% and the mean DFT was 0.36 after 1 year. It became 52.4% and 0.87 after 2 years, and 61.1% and 1.53 respectively, after 3 years.

The CAT score at the time of initial examination was highly correlated with the increment of the permanent DFT 1 year later, 2 years later, and 3 years later \( (r=0.169: P<0.001, r=0.232: P<0.001, r=0.263: P<0.001, \) respectively).

Figure 3 shows the correlation between CAT
score and the increase of permanent teeth caries after 1, 2 and 3 years. The mean DFT and standard deviation of the permanent teeth caries after 1 year, was 0.19±0.58 in the low-risk group, 0.32±0.81 in the middle-risk group, and 0.49±0.95 in the high-risk group.

After 2 years, the mean DFT were 0.56±1.01 (SD), 0.78±1.19 (SD) and 1.17±1.34 (SD) (low-risk group, middle-risk group and high-risk group, respectively). After 3 years, the mean DFT were 1.03±1.32 (SD), 1.38±1.49 (SD) and 2.00±1.66 (SD) (low-risk group, middle-risk group and high-risk group, respectively).

In each year, it was observed that as the risk group increased, the mean DFT scores also increased. The increase was 1.9–2.6 times higher when the high-risk group is compared with the low-risk group.

There were significant differences among the 3 risk groups each at 1, 2 and 3 years (ANOVA $P<0.001$, Fig. 3).

Table 1 shows the correlation between CAT score and the caries prevalence of the permanent teeth after 1, 2 and 3 years. The caries prevalence after 1 year was 12.1%, 16.9% and 26.5% (low-risk group, middle-risk group and high-risk group) respectively.

After 2 years, it was 30.3%, 37.5% and 55.0%, and after 3 years, it was 47.2%, 56.0% and 74.9% (low-risk group, middle-risk group and high-risk group) respectively.

There was a significant difference among the each groups at 1, 2 and 3 years ($\chi^2$ test $P<0.001$, Table 1).

**Discussion**

In our previous investigations, caries-free children 3 years of age, had a mean DFT score of 3.09 when they reached 12 years of age. Likewise, 3-year old children who had 9 or more carious teeth had a mean DFT score of 6.05 when they become 12 years old, which is approximately twice than that of their peers with a caries-free primary dentition. As there is a strong relationship between primary teeth
caries and the permanent ones, treatment of primary teeth caries alone is not enough to have a healthy permanent teeth.

Therefore, it is rather important to do the caries prevention earlier in childhood.

Even if children have primary teeth caries, the recall program after treatment could be important for a healthy permanent dentition. In order to prevent secondary caries or new caries initiation, it is effective to do the caries prevention at the dental clinic.

Presently, caries activity tests are among utilizable methods to predict dental caries in the clinical application. In Matsumura’s study\(^2\), CAT Test is an assessment method that mainly measures the acid production capability of mutans streptococci and lactobacilli.

Shimono et al.\(^1\) reported that CAT Test is simple, effective and inexpensive for the application of the clinical or healthy examination of the primary teeth, and is designed to evaluate the acidogeneity of dental plaque. Many researchers also reported the relationship between caries activity in the primary dentition and increase in dental caries\(^1,2,6,11–14\). However, there are few studies regarding the predictive capacity of the CAT Test concerning permanent teeth caries in preschool children. In our previous research\(^13\), we investigated the relationship between caries activity in the primary dentition and increase in permanent teeth caries. In comparison with the low-risk 3-year-old group, the high-risk had 0.33 more carious teeth at 6 years old, and 1.5 more carious teeth at 12 years old.

However, it is very difficult to predict primary teeth caries by caries activity tests for 3-year old children. Some limitations may be due to changes in lifestyle and dietary habits after 3 years of age and also caries activity becomes high.

Therefore, it is very important to use the CAT Test at every recall and not only one time.

The 1st permanent molar erupts during the early elementary period and is a basis for the center of occlusion; therefore caries prevention before this period is especially important in considering the total health promotion of the children.

In this study, before the permanent first molar erupts, we used the CAT Test to investigate the relationship between caries activity at the time of the preschool senior children and the increase of the permanent teeth caries. The level of caries activity at that time correlated with the caries prevalence of the primary tooth; the mean dft in the high-risk group increased 5.35 than that of the low-risk group.

In addition, caries activity also correlated with the increase of the caries in the permanent dentition. As for the relationship with the permanent caries after 1 year, the mean DFT of low-risk group was 0.19, and that of high-risk group was 0.49. The DFT of the high-risk group was approximately 2.5 times more than that of the low-risk group. As for the high-risk group, the DFT was approximately twice than that of the low-risk group 2 and 3 years later.

This tendency was recognized through the caries prevalence of the permanent tooth from 1 year to 3 years. The CAT score at the time of preschool senior children and the increase of the permanent tooth caries were strongly correlated.

Therefore, it was suggested that it is necessary to make a management system of caries prevention on the basis of the CAT score at the time of preschool senior children. For instance, when the CAT score is high, the dentist should use fissure sealant, fluoride application, and make the interval of his/her recall short in the clinic.

Furthermore, it is necessary to lower the CAT score. The CAT Test is an assessment method that measures the acid production capability of mutans streptococci and lactobacilli\(^2,15\). As the result of our investigation in a kindergarten\(^12\), the number of lactobacilli was very high in CAT score 2.5 or more. Most of the high-risk group had carious teeth, while, in children without tooth decay and/or in children who finished caries treatment, lactobacilli decreased dramatically. Lactobacilli generally exists inside the oral cavity. After restorative treatments, the counts of lactobacilli decreased.

In fact, after the treatment of the caries tooth, 88% of the children with CAT scores 2.5 or more decreased their CAT score\(^16\).

It is very important to lower the CAT score through caries treatment. However, caries treatment alone cannot completely eliminate mutans streptococci. Continued presence of this microorganism can still initiate new caries. It is difficult to remove them completely when they have already adhered to the teeth of children. It is known, however, that mutans streptococci decrease by using Dental Drug Delivery system (3 DS) and Professional Mechanical Tooth Cleaning (PMTC) methods\(^17,18\). There are studies relating the appearance of the mutans streptococci in children to irregularity in taking snacks, frequency of snacking at 3 times or more, excessive intake of sweetened beverages, guardians with many caries,
and inability to brush after meals. Thus, it is important to pay attention to the daily habits of children to decrease their CAT score.

Thus, if preschool children were examined using the CAT Test, the dentist/health educators would be able to know their caries activity level and then guide/educate children in high-risk group intensively.

The study was done not only to investigate the relationship between CAT score and increase of permanent teeth caries in preschool senior children. In the future, studies regarding effective control materials of the recall system for the clinic using the CAT Test are expected. In our clinic, the CAT Test is used to manage caries assessment and caries prevention during the recall system and the first dental examination.

Finally, another important aspect in making this study was to have a control data for future studies regarding permanent teeth caries in children under the recall program using the CAT Test.

References


