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Multicenter study on caries risk assessment in Japanese adult patients

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ABSTRACT

Objectives: This study was conducted to identify significant risk factors for the onset and the accumulation of new caries in adult patients undergoing regular preventive therapy.
Methods: The data of 732 patients from nine Japanese general dental practices were retrospectively analyzed. Classification and regression tree (CART) analysis was applied to develop a caries prediction model using the following patient parameters: age, number of teeth with caries experience (DMFT), levels of mutans streptococci (SM) and lactobacilli (LB), saliva flow rate and buffer capacity, and compliance with a preventive program. Poisson regression analysis was conducted to identify factors affecting caries accumulation within three years.
Results: CART analysis identified patients at high risk for primary caries with an odds ratio of 3.08 (95%CI, 1.55–5.79; $p = 0.0018$) according to SM levels and compliance; and those for secondary caries with an odds ratio of 3.69 (95%CI, 2.29–5.91; $p < 0.0001$) according to LB and SM levels. Poisson regression analyses showed that accumulation of primary caries was affected by compliance ($p < 0.001$), SM ($p < 0.001$) and LB ($p = 0.013$). Accumulation of secondary caries was affected by DMFT ($p < 0.001$), SM ($p < 0.001$) and LB ($p < 0.001$).
Conclusions: CART is an important tool in identifying the risk of caries development in individual adult patients. Cariogenic bacteria are important factors for both the onset and accumulation of primary and secondary caries.
Clinical significance: Participation in a regular preventive program limits the onset and the accumulation of primary caries in adult patients.

1. Introduction

If preventive dental treatment is to be effective, it must be based on an individual's risk of caries and periodontitis. However, preventive treatment has been generally carried out without a proper caries risk assessment, and little is known about the effectiveness of preventive dental treatment in controlling dental caries in adults [1,2]. Several studies have shown that some people are more vulnerable to caries and often develop new lesions in spite of regular check-ups [3,4]. Identification of people at higher risk could lead to improve intensive preventive care for these individuals, and thus better promote individual and community oral health and a more economic use of health resources.

Numbers of researchers have attempted to establish a system for predicting an individual's risk of caries [5–21]. Although most such studies involved children, some have evaluated adults [15,19,20,22,23]. Collecting appropriate clinical data relevant to an individual adult patient is often problematic. Many adult patients have already received a number of restorations and may be undergoing treatment programs. Assessing such patients' vulnerability to caries can be difficult because the quality of treatment affects the individual's risk.

We had the advantage to have fairly complete 15-year dental treatment records of adult patients whose saliva and cariogenic bacteria had been tested before they started regular preventive therapy [22,23]. Equally important, the patients received initial restorative and periodontal treatment before that testing so as to eliminate possible negative effects of inferior oral conditions. We successfully identified patients with ahigh or low risk of caries using classification and regression tree (CART) analysis [22]. CART analysis, a data mining method, involves the use of a decision tree technique to classify data [24]. It provides a set of rules that can be applied to an unclassified dataset to predict which factors are important. Binary tree-shaped structures for tackling classification and regression problems represent sets of decisions. In our previous study, CART analysis identified patients with a high risk

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of developing primary caries according to a mutans streptococci (SM) level of $>1 \times 10^6$ CFU/ml, as well as those at risk of developing secondary caries according to a number of teeth with caries experience (DMFT) of >17 and lactobacilli (LB) level of $>1 \times 10^4$ CFU/ml [22].

These findings are clinically meaningful. However, their usefulness is limited by being conformed to the single clinic. This research attempts to test their validity by conducting identical analyses using multicenter data. Additionally, in our previous study, we analyzed the time until onset of the first primary and secondary carious lesions, but not the total number of occurrences during the observation period. In so doing, it is possible that the caries risk might have been underestimated, since the study looked at the onset of caries without considering the accumulated number of carious lesions during the observation period. Therefore, the present study focused on both the onset and the accumulated numbers of primary and secondary carious lesions that occurred during the observation period using data from nine Japanese dental practices.

The purpose of this study was to investigate the effectiveness of regular preventive therapy in reducing the incidence of primary and secondary caries in adult patients. We also investigated the significant risk factors correlated with the onset and the accumulation of new carious lesions when patients received long-term preventive therapy.

2. Materials and methods

2.1. Patients

The entire database of 9537 patients registered in nine Japanese general practices from May 1993 to February 2013 was screened. In total, 1800 patients were randomly selected for analysis. We have checked all the samples of 200 patients from the nine clinics and confirmed that there was no bias in terms of the age, sex and DMFT from the full register of patients at the clinics. Patients aged 20–64 years whose cariogenic bacteria levels and flow rate and buffer capacity of saliva had been tested when completing their initial restorative and periodontal treatments were considered eligible. Patients who met any of the following conditions were excluded: those who failed to complete the initially planned treatments, those who could not control their plaque because of physical problems, and those who received restorative treatments in other clinics. The study protocol was approved by the ethics committee of Osaka University.

2.2. Caries examination

The oral conditions of all patients were examined by dental hygienists who had been trained and whose work was calibrated and then double-checked by a dentist. All teeth were examined by visual inspection and radiographic examination. Any carious lesion that penetrated to one-third of the dentin was considered to be severe enough to require restorative treatment.

2.3. Caries risk assessment

Before the caries risk assessment, each patient had completed initial restorative and periodontal treatments to eliminate possible negative effects of inferior oral conditions. The stimulated saliva flow rate was measured after the patients had chewed on paraffin pellets for 5 min. The saliva buffering capacity and SM and LB levels were assessed with Dentobuff Strip, Dentocult SM Strip, and Dentocult LB kits (Orion Diagnostica, Espoo, Finland), respectively. The trained dental hygienists collected the biological samples. The dental hygienists underwent annual evaluations throughout the testing period to ensure that there was 85% agreement in evaluating the cariogenic bacteria.

2.4. Preventive program

All patients who completed the initial restorative and periodontal treatments were advised to undergo preventive treatments against caries and periodontitis at 3–6 month intervals. The preventive treatments included education on plaque control, scaling and polishing, and fluoride application with 9000 ppm NaF

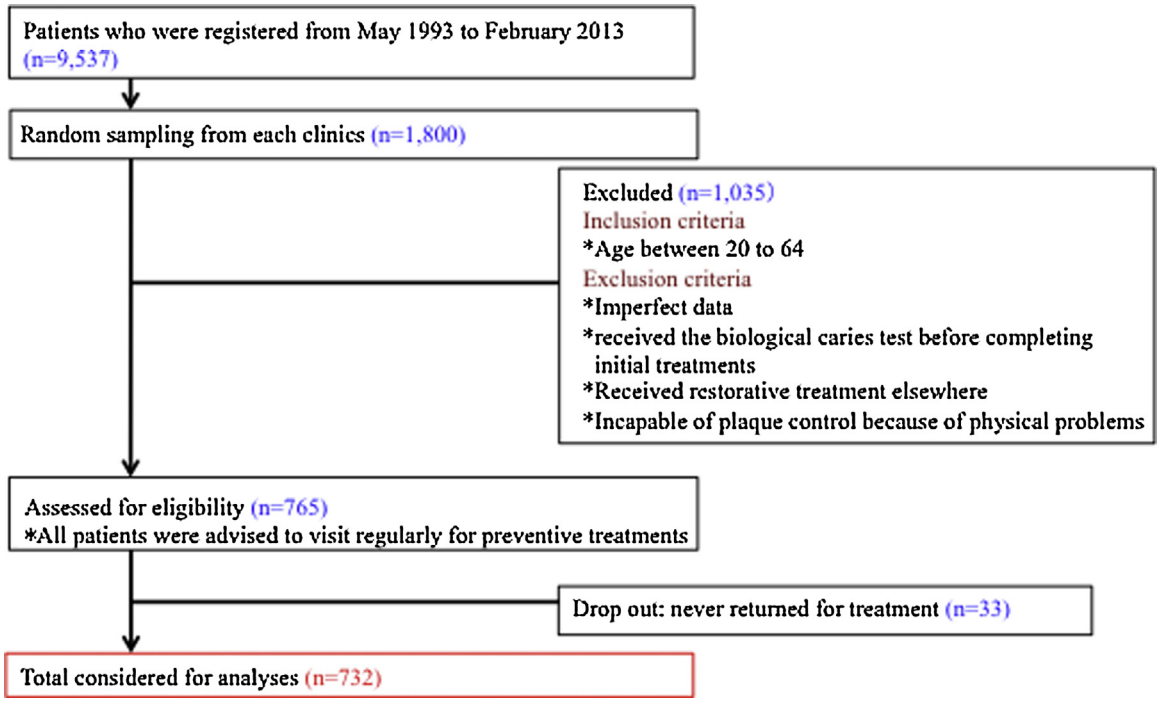

Fig. 1. Patient selection.

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