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Effect of an oral health education program based on the use of quantitative light-induced fluorescence technology in Uzbekistan adolescents

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ABSTRACT

Objectives: The aim of this study was to determine whether an oral health education program using a Qscan device based on quantitative light-induced fluorescence (QLF) technology could improve the oral hygiene status and oral health literacy of adolescents.

Materials and methods: One hundred adolescents aged 14–16 years attending a school in Tashkent city were included in this study. The participants were assigned to the following two groups using permuted block randomization technique: (i) control group (traditional learning) and (ii) experimental group (Qscan device-based learning). The participants included in the experimental group received additional education and training on dental plaque removal using the Qscan device. The accumulated levels of plaque were assessed in all participants, who also completed questionnaires about their oral health status, oral health knowledge, attitude, and behavior during an 8-week period.

Results: There were statistically significant improvements in the experimental group compared to the control group in the plaque index (0.46 vs 0.07, $p < .05$), oral health knowledge (19.4 vs 28.8, $p < .05$), attitude (16.7 vs 20.2, $p < .05$), and behavior (19.9 vs 30.5, $p < .05$).

Conclusions: This study has demonstrated that an oral health education program based on the use of QLF technology could be useful for improving the oral hygiene status and oral health literacy of adolescents in Uzbekistan.

1. Introduction

Dental disease is highly prevalent and a significant burden, especially in developing countries [1,2]. Excessive anxiety caused by the fear of treatment of dental disease in children can affect their learning capabilities as well as behavioral and social development [3,4], and so preventing dental disease is an issue that also has social and economic implications. However, more than 80% of the world's children live in developing countries with extremely limited oral health-care resources [5], and where the desired level of prevention of the dental disease has not yet been achieved. Dental caries affects people in Uzbekistan of all ages, and especially children and adolescents. Dental caries in Uzbekistan is the most common cause of hospital admissions for inpatient treatment among children and adolescents aged 5–15 years [6,7].

Oral health education has been considered a primary method via which dental health services can provide oral health information and improve the health literacy of patients, especially when the available resources are limited. The school setting is known as the most appropriate for applying health education programs in developing countries because it can be used to promote healthy lifestyles and self-care practices at a very low cost [8]. School-based oral health education programs have produced positive outcomes in oral cleanliness, oral health knowledge, and oral behavior among adolescents [9–13]. However, study results have been inconclusive concerning changes in the attitude of adolescents [14,15].

The Extended Parallel Process Model (EPPM) was developed with the aim of understanding how attitude both forms and changes, and it has provided a useful framework for understanding the attitudes of adolescents that are still forming [16]. The EPPM is based on two key variables: risk and efficacy. Improving the perceived risk and perceived efficacy requires a standard mode of delivery of health messages via the personal instruction approach in clinical settings on a one-on-one basis.

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Although this approach has been shown to be effective in improving dental health, it is time-consuming and may not be practical from a community perspective. Substituting such personal instruction with other forms of communication has been investigated, such as self-education using leaflets or videos, and classroom lectures, but these approaches have shown only limited success when compared with personal instruction [17]. It might be possible to improve the attitude and oral health status of adolescents if they could be made more aware of the risks from dental plaque and cariogenic diet which might lead to dental caries and gingival disease.

Various optical detection devices have recently been introduced in the field of dentistry. Quantitative light-induced fluorescence (QLF) technology is commonly used in clinical dentistry as an assessment tool for quantifying the degree of maturity and pathogenicity when attempting to control dental plaque [18,19]. It has also been confirmed that QLF technology can be used in the clinical setting for plaque assessment by detecting mature plaque as red fluorescence. A recently developed Qscan device (AIOBIO, Seoul, Korea) allows nonprofessionals to visualize and detect dental plaque easily, thereby enabling oral hygiene care to be managed in the home.

The aim of this study was to determine the effect of an oral health education program based on the use of QLF technology on the oral hygiene status and oral health literacy among adolescents in Tashkent city, Uzbekistan. We hypothesized that adolescents who receive oral health education using QLF technology are more likely to exhibit improved oral hygiene, oral health knowledge, attitude, and behavior.

2. Materials and methods

2.1. Participants

The study period was from September 2015 to November 2015, and it included 100 adolescents aged 14–16 years attending school #123 in the M. Ulugbek district of Tashkent city. Written informed consent was obtained from the parents or caregivers of all participants before the trial. The study was performed according to the protocols and procedures approved by the Institutional Review Board at Tashkent State Dental Institute (2017-0001). The sample size was calculated for α error fixed at 5% and β error fixed at 20%, expected mean difference of plaque index (primary outcome) 0.38 and standard deviation 0.41 based on the formulations required in each group. Considering the dropout rate (10%), a minimum of 50 participants would be required. The participants were assigned to two groups using a permuted block randomization technique: (i) the Qscan device-based learning group and (ii) the traditional learning group (Fig. 1). Initially there were more than 100 adolescents, but we selected 100 adolescents according to the selection criteria given in Fig. 1. During the evaluation periods, some of the students were sick and some were absent for unknown reasons, and for others we could not evaluate certain characteristics such as their level of education or oral hygiene status. These various reasons meant that we had to exclude them from the analysis, and so of the initial 135 subjects at baseline, 100 of them were randomly selected and divided into 2 groups. Fifty subjects were assigned to the control group, which received a traditional learning program about oral hygiene, while the other 50 subjects were assigned to the experimental group, which received an oral health education program based on the use of the Qscan device. The final numbers of subjects were 42 in the experimental group and 44 in the control group (Fig. 1).

2.2. Educational intervention

Lessons on oral hygiene were provided to the control group of adolescents in a traditional lecture format lasting 10 min and involving demonstrational models. The key educational messages were the importance of oral health, the role of microbial plaque, the appropriate frequency and methods of toothbrushing and flossing, the importance of regular dental attendances, what constitutes a healthy diet, and the appropriate use of fluoride.

Lessons were provided to the experimental group with a traditional method combined with a demonstration of how to measure the individual plaque level using the Qscan device. This device is usually used by consumers to check their own plaque in the home setting (Fig. 2), and it can also be used effectively in the school oral health care setting because it reduces the inconvenience and time required to measure dental plaque compared to traditional disclosing methods [20,21]. The educator used the Qscan device to help students to see plaque in their mouth in a red color, and explained the concept of dental plaque and the importance of its daily removal (Fig. 3).

On the first day of education, fluoride-containing toothpaste and toothbrushes (Dentafill Plyus, Uzbekistan) were distributed to all participants. Leaflets containing the same oral health information were also distributed during the first lesson. The education was provided three times: at baseline and during the second and fourth weeks of the intervention period.

2.3. Clinical examination and questionnaire-based measurement

The oral health status of all participants was examined in the classroom during school hours while they were seated in comfortable chairs. Three blinded and calibrated dentists examined all participants using headlamps, dental mirrors, and World Health Organization (WHO) probes. At baseline, the dental caries status was recorded using the decayed, missing, and filled teeth (DMFT) index according to the WHO diagnostic criteria [21]. The Silness-Löe plaque index was used to evaluate oral hygiene, with the scores recorded for six index teeth: #16, #12, #24, #36, #32, and #44 [22]. Six dental plaque measurements were made at baseline, weekly during the intervention period of 4 weeks, and at a final examination after a follow-up period of 4 weeks (Fig. 4). A gold-standard examiner (one of the authors: B.K.) trained the three dentists who participated in this study (D.K., J.A., and K.T.). During the survey we conducted duplicate examinations on 5% of the participants each day. The interexaminer and intraexaminer reliabilities were maintained during all periods of the trial, as indicated by Cohen's kappa values of ≥ 0.70.

All of the participants completed a questionnaire survey at baseline about oral health knowledge, attitude, behavior, and demographic information. The oral health knowledge, behavior, and attitude were assessed using a modified version of the questionnaire developed by Angelopoulou et al. [23]. The researchers administered the questionnaire with assistance from class teachers. The respondents were asked questions on their basic knowledge of oral heath, attitude, and dental health practices. The questions on oral health knowledge comprised the causes of gingivitis and gum bleeding, reasons for using dental floss, the importance of a healthy diet, what fluoride is, the fluoride content of toothpaste, the use of fluoride, the effects of fluoride on dentition, and the importance of teeth. Questions were included on brushing habit, aids used for brushing, brushing frequency, and rinsing habit in order to assess the practices related to oral health. The respondents also completed questionnaires on background characteristics including sex and age.

The 23-item structured questionnaire was originally constructed in English, and it was translated into the Uzbek language for local use. The lessons were provided once over a 2-week period, and oral health knowledge, oral health behavior, and attitude were evaluated with the aid of the questionnaire. The total study duration was 8 weeks (Fig. 3).

2.4. Statistical analysis

All statistical procedures were performed using SPSS (version 23.0, IBM Corporation, Armonk, NY, USA). Descriptive statistics were reported using frequency (%) or mean ± SD values, as appropriate. The chi-square test and independent-samples *t*-test were conducted to