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ORIGINAL ARTICLE

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Development of an auxiliary resource for diagnosis of dental caries in epidemiological surveys

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da Silva RP, Pereira AC, de Castro Meneghim M, Mialhe FL. Development of an auxiliary resource for diagnosis of dental caries in epidemiological surveys.

Abstract: *Objective:* Early dental caries diagnosis within the changing global pattern of dental caries development requires the use of auxiliary resources and adjuncts to diagnosis. The aim of this study was to introduce an alternative resource for drying teeth to enable early diagnosis of dental caries in epidemiological surveys. *Methods:* Polyurethane tips and three-in-one syringes were fitted to nebulizers and non-professional portable compressors for dental surface drying. The output air pressure of these sets was compared with the output pressure from the three-in-one syringe in a dental office. *Results:* Although the output pressure from the alternative resources was lower than the output pressure from the dental office equipment, the dental surfaces were dried satisfactorily, allowing the early diagnosis of the dental caries. *Conclusion:* When a dental setting is not available, these alternative resources for drying teeth can be used satisfactorily.

Key words: auxiliary resource of caries diagnosis; caries diagnosis; dental compressor

Introduction

From the 1970s onwards, there has been decreasing prevalence of cavitated caries lesions in industrialized and emerging countries (1–4). This change in the pattern of development of the disease can negatively affect its diagnosis, especially on occlusal surfaces of posterior teeth, where a large number of non-cavitated enamel carious lesions remain undetected by clinical examination (5, 6).

In spite of the new diagnostic criteria and other caries diagnostic systems that are being developed, dental caries diagnosis in an epidemiological setting is mostly carried out by clinical visual examination in accordance with the WHO diagnostic criteria (7). However, improvements in the visual examination can be achieved by supervised toothbrushing, drying the dental surfaces to be examined, and using an artificial source of lighting (8), even when the examination is performed in an epidemiological setting (9).

The actual development and distribution patterns of dental caries have confirmed non-cavitated initial carious lesions (white spot lesions) on enamel as the most prevalent type of carious lesions worldwide (2, 3). To remove the water inside the interstitial pores of the dental tissues makes the task of detecting these types of carious lesions easier in a clinical and/or epidemiological setting (8).

Therefore, the aim of this study was to introduce alternative devices to dry dental surfaces for visual exams performed in dental caries epidemiological surveys.

Methods

This study was approved by the Research Ethics Committee of the Piracicaba Dental School/UNICAMP (State University of Campinas), Protocol No. 147/2003, and conducted in accordance with resolutions 196/96 of the National Health Council of the Brazilian Ministry of Health and 179/93 of the Dental Professional Code of Ethics of the Brazilian Dental Council.

The study was composed of a laboratorial stage, in which the output air pressure of the alternative dental drying devices was measured, and a field stage, in which the dental examinations, using these devices as adjunct tools, were performed to collect data for the studies of Cortellazzi *et al.* (10) and Pereira *et al.* (11). In the first study, the objective was to evaluate the influence of socioeconomic, clinical and demographic variables in caries experience, measured by the dfmt/dfms index, in 728 5-year-old preschool children. In the second, the authors aimed to develop regression models to describe the epidemiological profile of dental caries in 1763 12-year-old schoolchildren in an area of low caries prevalence in Piracicaba, São Paulo, Brazil. In both studies, the children were examined by visual examination (flat dental mirror and ballpoint probe to remove debris only) in an outdoor setting, under natural light and World Health Organization (WHO) (7) recommendations. The air-drying of children's teeth provided by the alternative dental drying devices helped the examiners to detect initial and cavitated caries lesions in epidemiological settings.

Nebulizers

An Inalatec Plus (Nevoni®; NSR Odonto Medical Hospital Equipments LTD, Barueri, SP, Brazil) nebulizer, labelled nebulizer 'A', and an Inalar Compact Standard (Inalar®; NS Industries of Medical Devices, São Paulo, SP, Brazil) nebulizer, labelled nebulizer 'B' (Fig. 1), were used to dry dental surfaces, in a laboratory setting. The aim was to evaluate the output air pressure with or without fitting a tip or a three-in-one syringe to the nebulizer (Fig. 2).

The tip was a piece of a polyurethane hose 5 cm long with an internal diameter of 2 mm (external diameter = 4 mm) (Fig. 3).

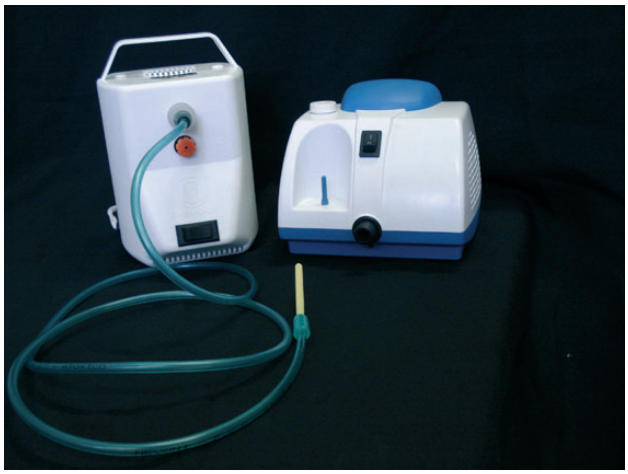

Fig. 1. Nebulizers 'A' and 'B'.

Non-professional portable compressor

A non-professional portable compressor, without air reservoir, was modified to receive a paddle pedal and canvas hose. A 1/4' polyurethane hose was fitted to the free extremity of this canvas hose. The tips and the three-in-one syringe were fixed onto the polyurethane hose. The compressor was placed in a 24-l polystyrene thermal insulation box (internal dimensions: 385 × 190 × 345 mm; external dimensions: 445 × 250 × 400 mm) (Fig. 4).

At the laboratorial stage, for comparative purposes, the air pressure from a three-in-one syringe in a dental office was measured. The input air pressure in the dental office was 80 psi, while the output air pressure from a three-in-one syringe was 40 psi. A manometer was used to check the pressures.

A manometer was put directly into the output hose of the devices to measure their output air pressure, without the tip or three-in-one syringe in place. For the output air pressure with tip or three-in-one syringe, the manometer was put into their output nozzles.

At the field stage, the non-professional portable compressor was used in the dental examination of preschool (5-year-old) and schoolchildren (12-year-old) in addition to the flat dental mirror and CPI probe (ball point) in the studies of Cortellazzi

Fig. 2. Fitting the 'tips' and three-in-one syringe to nebulizers/portable compressor.

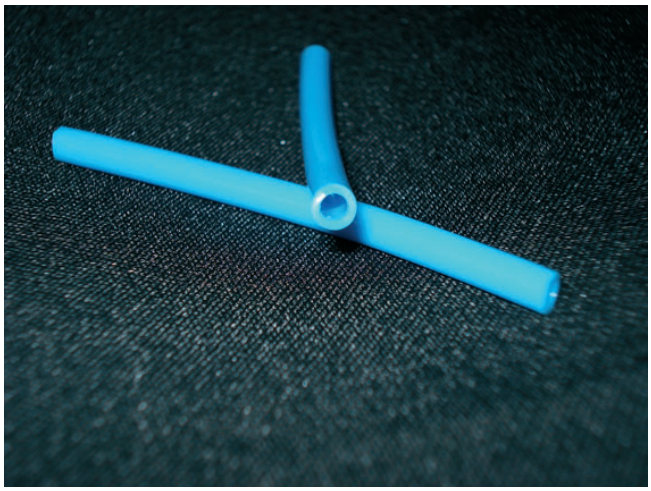

Fig. 3. Polyurethane 'tips'.

et al. (10) and Pereira *et al.* (11), respectively. Dental caries was evaluated by the DMFT, dmft/dmfs and indexes and by detecting initial carious lesions.

Biosafety was guaranteed because the polyurethane tips could be autoclaved and they were changed after each individual examined, minimizing the risk of cross infection. As in a traditional dental office, the three-in-one syringe could be disinfected and wrapped in PVC film, which was changed after each individual examined.

Results

The output air pressure values of the alternative dental drying devices are shown in Table 1.

As seen in Table 1, Nebulizer 'A' and the portable compressor presented the highest output air pressure without a tip or three-in-one syringe. However, only the portable compressor fitted with a tip or three-in-one syringe met the output pressure value of a three-in-one syringe in a dental office. There were air leaks in all of alternative devices tested. Nebulizer 'A' had the most evident air leak (Table 1).

Table 1. **Output air pressure (psi) from the alternative devices for drying teeth**

	Nebulizer 'A'	Nebulizer 'B'	Portable compressor
Without tip	50	30	40–50
With tip	25	25–30	40
Three-in-one syringe	25	25–30	40
Three-in-one syringe in a dental office		40	

The good results from the portable compressor were supported by the field observations noted during the studies conducted by Cortellazzi *et al.* (10) and Pereira *et al.* (11). The cavitated and non-cavitated (initial/white spot lesions) carious lesions were detected adequately in these studies. Problems using the non-professional portable compressor such as air leaks at the connections between the tips or three-in-one syringes and the drying devices were found in both laboratorial and field stages.

During the field stage, the compressor needed to work constantly, because of the lack of an air reservoir of the type found in the professional dental compressor. In addition, the portable compressor became heated when used for long periods, because the heat did not dissipate through the polystyrene. The loud noise produced by the compressor was related as a problem by the examiners at this stage. The nebulizers produced less noise than the portable compressor.

Discussion

With the decreasing prevalence and polarization of dental caries (1–3), many studies have been conducted as regards the use of auxiliary resources and adjuncts to diagnosis to supplement the traditional dental visual examination for the task of detecting initial carious lesions (9, 12).

Fig. 4. Portable compressor in a polystyrene thermal insulation box.

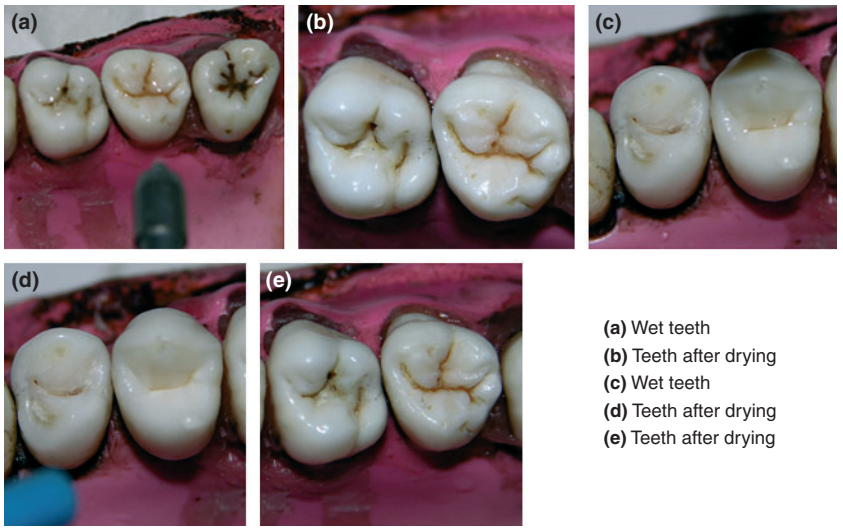

Fig. 5. Tooth drying by three-in-one syringe in a dental office (a and b) and by alternative devices (c, d and e).

Dental surface drying is one of the most promising auxiliary resources for detecting, estimating the depth and determining the activity of initial carious lesions on enamel surfaces, also called white spot lesions (8, 9). As the refractive index of air (stated as 1.00) differs from that of water (1.33), enamel (1.62) and hydroxyapatite (1.66), when an initial carious lesion is dried, the air gradually fills the inner part of tissue pores, previously filled with water. Thus, it is possible to visualize the white spot lesion (8).

Although the output air pressure from nebulizers was lower than the pressure of a three-in-one syringe in a dental office (stated as 40 psi), dental drying using the alternative devices was satisfactory (Fig. 5). Evidence was found that a minimal pressure of at least 25 psi is sufficient to perform a dental drying. The portable compressor was successfully used in the data field studies of Cortellazzi *et al.* (10) and Pereira *et al.* (11). The initial carious lesions and carious lesions at frank cavitation stage were adequately detected at both studies.

The main advantage of the use of these devices is their relatively low cost to the health system, in addition to their portability. The average cost of a nebulizer is around US$ 114.00. In many public health units, the nebulizer is already part of the health equipment arsenal. The average cost of the portable compressor used in this study is around US$ 268.00. The average cost of these alternative devices is lower than the price of a professional dental compressor, which varies from US$ 715.00 to US$ 3572.00, depending on the model.

From a technical–financial point of view, the balance between advantages and disadvantages of these devices makes it feasible to use them in epidemiological surveys of dental caries.

It was concluded that drying the dental surfaces with adapted nebulizers and non-professional compressors can be performed with some success, supplementing the visual examination when the use of a dental office is unfeasible.

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