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PRELIMINARY TEST ON THE REDUCTION OF AEROSOLS IN THE DENTAL CABINET WITH THE USE OF AERODAM™

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INTRODUCTION

A dental turbine is a dental milling instrument comprising a working head provided with a bur that rotates at a speed of 100,000 to 500,000 revolutions per minute for milling hard tissues of the teeth, such as enamel, dentin or prosthetic material.

Conventional turbines incorporate an air and water irrigation system designed to cool the heat produced by the friction of the bur on the teeth. This cooling fluid is necessary to prevent the tooth pulp from overheating, and also contributes to freeing the milled material or material resulting from the ablation, to have greater visibility over the work area. However, the effect of the jet of air and cooling water on the tissues of the teeth produces suspensions of tiny particles of solids and liquids (aerosols) that carry bacteria, viruses and multiple blood by-products, a source of disease transmission for the patient and for the operator (1).

It is known that the fluid and aerosol deflections generated during daily dental work pose a risk to the health of both the operator and the patients, since they are a source of transmission of diseases and pathogens to which professionals are continuously exposed. In particular, it must be taken into account that aerosols can remain suspended in the box environment for a period of time greater than three hours (2), which significantly increases the risk of contagion of diseases.

The SARS-CoV2 pandemic situation was the trigger to develop a product that stops the aerosol in proximity to its source of origin.

As its efficacy must be confirmed with an objective test under standardized conditions, a preliminary trial was designed. The objective of this trial is to demonstrate the reduction of aerosols in the environment with the use of Aerodam.

1. Peng X, Xu X, Li Y, Cheng L, Zhou X, Ren B Transmission routes of 2019-nCoV and controls in dental practice. Int J Oral Sci. 2020 Mar 3; 12 (1): 9
2. van Doremalen N., Bushmaker T., Morris D.H., Holbrook M.G., Gamble A., Williamson B.N., Tamin A., Harcourt J.L., Thornburg N.J., Gerber S.I., et al. Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1. N. Engl. J. Med. 2020; 382: 1564–1567.

MATERIAL AND METHODS

In this descriptive study, a typical working position with a turbine is emulated on the second lower left premolar, in a first stage without using the Aerodam device, and in a second stage, using it.

With the intention of capturing the aerosol particles produced by the turbine, a Whatman disc of cotton cellulose qualitative filter of 15 cm. in diameter and 0.18 mm. thick, mounted on a circular methacrylate frame is available. This frame fits into an infundibulum connected to a suction system that sucks the air through the filter at a rate of 216 l / min. All air flow measurements have been performed with an air column float flowmeter "ASA P13-2800".

With the intention of objectifying the aerosol particles, sodium fluorescein ($C_{20}H_{10}Na_2O_5$) is used, an odorless orange powder that turns green when mixed with water, in our case at a rate of 1g per liter.

An "Orbitec 008453" type "A" UV lamp is used to detect fluorescein in the aerosols captured by the filter.

To emulate a clinical work situation, a "Bader" phantom is attached to an AG3 permanent denture typodont on the headrest of a "DKL L2 ECO" dental unit. The phantom is separated 20 cm. of the Whatman cellulose disc. A distilled water tank "A.E.B." is connected to this equipment. pressurized to 3 Atm. as a turbine coolant, with two liters of the fluorescein solution. A quadruple spray turbine "B.A. INTERNATIONAL OPTIMA BA525K "with a blunt bur is placed over the mesial fossa of the second lower left premolar of the typodont. Said turbine operates at a regime of 300,000 r.p.m, 2.2 kgf / cm^2 of pressure in pipes and a water flow of 25 ml / min considered as intermediate.

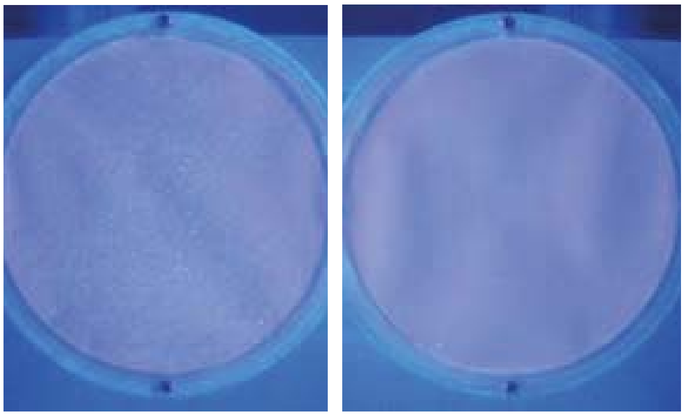
This equipment has a "DÜRR 600" dental aspiration that develops an aspiration of 260 l / min in the 16 mm hose terminal, which places it at the lower limit of a high volume evacuation (> 250 l / min) .

A disposable suction cannula is connected to the phantom to evacuate excess fluid and emulate the flow of air entering the oral cavity.

With aspiration through the filter actuated, the turbine bur is placed perpendicular to the occlusal plane on the mesial fossa of the lower left first premolar and the turbine is operated for two minutes in each of the two experimental groups.

Photographs of the fluorescence on the filters are taken under ultraviolet light with a "Nikon D3000" digital camera.

The two experimental groups are: Group I, turbine and saliva ejector aspirating to the maximum (at a rate of 83 l / min). Group II, turbine with Aerodam connected to the 16 mm suction hose terminal and saliva ejector aspirating to a minimum.



RESULTS

In Group I, all of the 154 cm^2 were contaminated by more than nine thousand aerosol droplets, while in Group II only six droplets appeared.

DISCUSSION

This trial sought to imitate real working conditions: many professionals who work without an assistant do so with the saliva ejector as the only means of aspiration due to the added difficulty of holding the high volume aspiration cannula (HVE) (3).

In Group I, a disposable saliva ejector was placed in the posterior part of the oral cavity of the phantom with a maximum flow of 83 l / min. This creates an air current that opposes the exit of the aerosol droplets to the outside as far as possible. Although, due to the interaction of the ejector nozzle with the soft tissues, it is difficult to maintain an aspiration rate such as the aforementioned in the oral cavity of a patient, it was considered that ideal suction conditions would contribute to the clarity of the results. During the test and against the backlight, the recovery of part of the aerosol was evidenced due to the establishment of said current, but it was insufficient to avoid contamination of the Whatman filter.

On the contrary, in Group II, the ejector flow was reduced to the minimum necessary to evacuate the liquid formed in the most sloping part of the oral cavity of the phantom while Aerodam connected to the aspiration system with 16 mm terminal effectively blocked the exit of aerosols.

Our first intention was to analyze the square centimeters of area contaminated by aerosol in each case, considering one cm^2 contaminated with the least stain, taking as a reference the study by Abdelkarim-Elafifi H et al. (4). However, due to the forcefulness of the result, it was made unnecessary: in Group II, only six dimly lit spots were seen (the upper right corner intense spot was a textile fiber) . No renewal of air was done between groups.

Since the effectiveness of the reduction of aerosols in high volume evacuation systems with the presence of an auxiliary is over 90% according to the literature (5, 6), Aerodam can place us in a new position in that without the help of an auxiliary and in circumstances similar to those in this preliminary study, we are eliminating virtually all of the aerosol. This has its translation, then, both in terms of effectiveness and in terms of efficiency, since it is an inexpensive, sterilizable device that does not require the presence of the auxiliary or expensive equipment (7, 8).

CONCLUSIONS

Under the conditions in which it has been carried out, this experimental trial shows a reduction of aerosols of virtually 100%, so the use of Aerodam can be considered as an alternative for the reduction of aerosols in daily clinical practice and the prevention of airborne diseases during the current pandemic.

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