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Aerosols in Dentistry

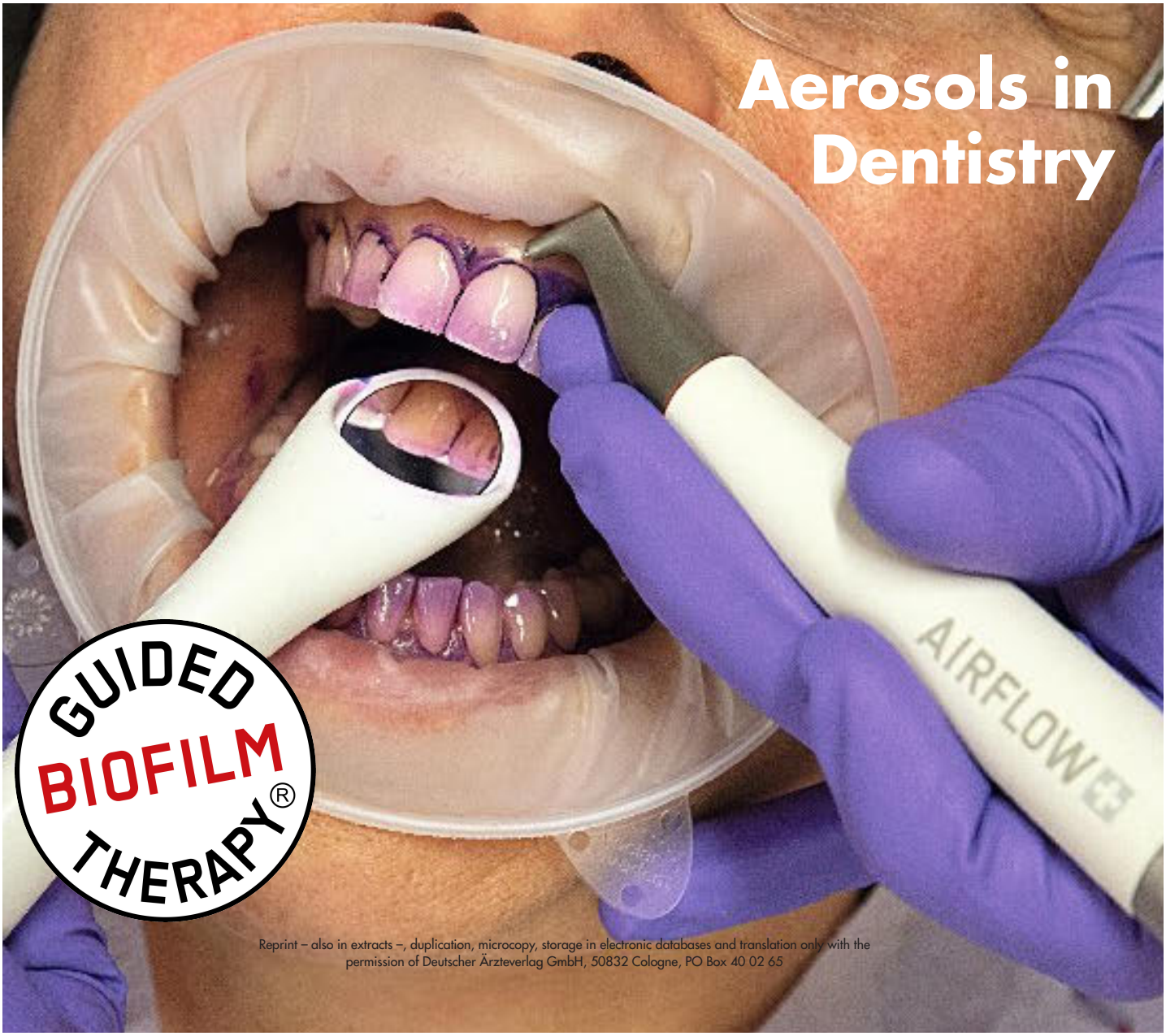

Photo: Holger Hornberg

Fig. 1: Patient of group 3: Two-handed AIRFLOW® treatment with high vacuum suction and Optragate: A cyclone system prefilled with filtered water (PRELECT, Medentex GmbH, Bielefeld, Germany) was placed about 20 cm to the left of the patient's mouth to collect the aerosols.

RISIKO AEROSOLE

The bacterial contamination of the room air during an AIRFLOW® treatment

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Dentists and scientists, supported by EMS, have measured bacterial contamination of room air during an AIRFLOW® treatment in two scenarios (without and with special protective measures). Although the results of this investigation cannot be transferred analogously to a possible viral load (e.g. SARS-CoV-2) in the aerosol, the data show an impressive reduction of the bacterial contamination of the room air if the AIRFLOW® treatment is carried out with appropriate protective measures.

Patients, dental staff and dentists are exposed to bacteria and viruses, which can lead to infectious diseases, especially of the oral cavity and the respiratory tract. Anyone who has chosen a profession in dentistry was aware that dental treatment always involves the risk of infection. In dentistry, the short distance to the patient's oral cavity means a basic exposure to the patient's saliva, blood, aerosols and sulcus fluid [Peng et al., 2020]. The main transmission pathway of bacteria and viruses is saliva droplets [Yang et al., 2020; Szymanska et al., 2005]. For these reasons, very strict hygiene rules have always been applied in dentistry. In recent decades, dentists have dominated the risk of influenza, tuberculosis, hepatitis and AIDS. Today, the risk of SARS-CoV-2 must also be successfully managed.

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Photo: EMS

Nearly all dental instruments used in common dental treatments generate aerosols: low and/or high-speed handpieces, turbines, sonic and ultrasonic devices, air-water spraying and powder-water jet devices [Graetz et al., 2014]. Aerosols differ from droplets and spray mist. Due to their smaller particle size (< 50 µm), aerosols can be carried several meters away and can be detected for longer periods of time in the ambient air [Drisko et al., 2000].

In dentistry, aerosols can occur as solid particles, powder dust (non-contaminated), splashes that settle quickly (contaminated), device aerosol (non-contaminated) and treatment aerosol (contaminated). The risk of contamination depends on the type of treatment, the degree of patient infection and preventive hygiene measures to minimize the transmission of contaminated aerosols. To date, there is a lack of scientific evidence that shows the risk of aerosols and the danger they pose to clinicians and patients [RKI, 2020]. One reason for this is the difficulty in effectively measuring the level of contamination with bacteria and viruses transported in aerosols.

According to our research, there is no scientific literature on the viral and bacterial contamination of aerosols during professional tooth cleaning with AIRFLOW®. Therefore, we carried out an observational study in practice to better understand the risk of aerosol contamination by using the AIRFLOW® technology.

OBJECTIVE

The aim of this observational study was to measure the bacterial load of the room air during an AIRFLOW® treatment in order to obtain information for the assessment of the risk of aerosol contamination for practitioners, practice team and patients during the use of the AIRFLOW® technology in different situations.

MATERIALS AND METHODS

The AIRFLOW® treatments were performed in the prophylaxis rooms of the company EMS (Nyon, Switzerland) by a dentist (Dr. Neha Dixit, EMS). The measuring procedure and the general conditions for the execution of the prophylaxis had previously been designed by the authors.

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Photo: private

A total of 20 adult patients aged between 30 and 45 years were treated. The plaque index Quigley-Hein modified according to Turesky [Turesky et al., 1970] was 0.80. The prophylaxis sessions took place on four consecutive days with five patients each. Between treatments, the rooms were thoroughly ventilated to remove remaining aerosols and to restore a neutral situation for the next session.

The aerosol was measured for exactly ten minutes at each AIRFLOW® treatment. A cyclone system (PRELECT, Medentex GmbH, Bielefeld, Germany) pre-filled with filtered water and placed 20 cm from the patient's mouth was used to collect the aerosols (Figure 1). With a Cattani high performance vacuum suction system 900 l/min (Cattani Micro Smart, Parma, Italy) 9 m^3 of the air-aerosol mixture was suctioned during the ten-minute treatment. Immediately after the treatment, bacterial contamination of the aerosol was measured using an adenosine triphosphate (ATP) system. This method allows to determine the amount of all living bacteria [Watanabe et al., 2019].

Three measurement groups were defined for the study:

- Group 1 (control): Room air measurement without treatment, measurement of the bacterial load of 9 m^3 air in the treatment room before each patient treatment (20 measurements)
- Group 2: Room air measurement during an AIRFLOW® treatment with saliva ejector, without mouth rinse, without high vacuum suction (10 patients)
- Group 3: Room air measurement during an AIRFLOW® treatment with saliva ejector, with mouth rinse, with high vacuum suction (10 patients)

According to the protocol for "Guided Biofilm Therapy" (GBT), patients were asked to rinse with chlorhexidine (BacterX, EMS, Nyon, Switzerland) for 60 seconds before starting treatment (group 3 only). After taking the patient's medical history and collecting the necessary diagnostic data, all patients were treated with eye protection, saliva ejector (Kaladent, St. Gallen, Switzerland), Optragate (Ivoclar Vivadent, Schaan, Liechtenstein), additionally in group 3 with Purevac® high-vacuum suction (Dentsply Sirona, York, Pennsylvania, U.S.A.). The biofilm was stained (Biofilm Discloser, EMS) and made visible. It was removed with the AIRFLOW® PROPHYLAXIS MASTER (AFPM) and the AIRFLOW® handpiece with erythritol-based PLUS powder (14 µm). The AFPM unit was used with the recommended power (level 3) and maximum water setting for biofilm removal.

RESULTS AND DISCUSSION

With the presented method we were able to measure reproducibly the bacterial contamination of aerosols generated during an AIRFLOW® treatment (Figure 2). The room air measurement during AIRFLOW® treatments with saliva ejector, mouth rinse and high vacuum extraction (group 3) showed the same level of bacterial contamination as was found for the control group ($p > 0.05$). With the use of mouthwash and high vacuum aspiration, the AIRFLOW® treatment did

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Photo: Fotografie Schielberg

Bacterial load in the air (CFU/L_{air})

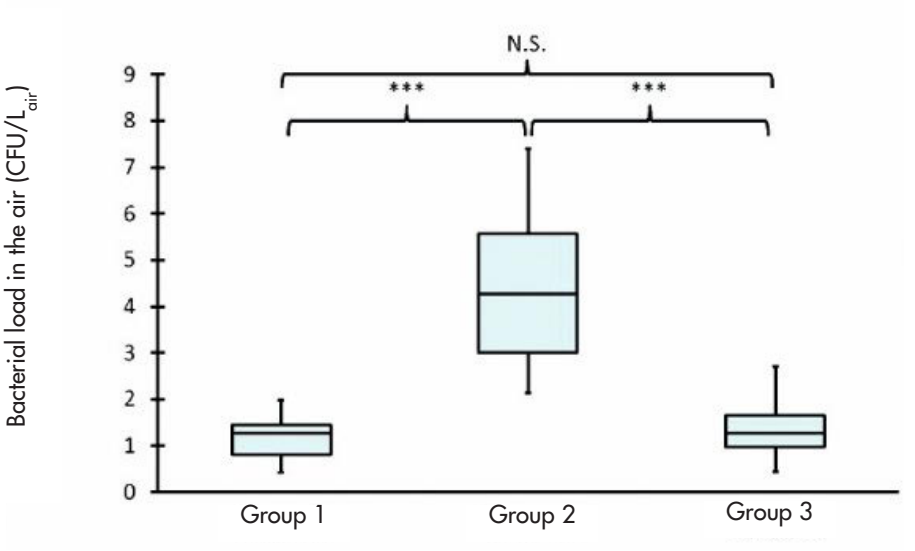

Fig. 2: Box plot of the contaminated aerosol during the ten-minute treatment period.
Group 1: no treatment (control);
Group 2: AIRFLOW® treatment with saliva ejector, without mouth rinse, without high vacuum suction;
Group 3: AIRFLOW® treatment with saliva ejector, with mouth rinse, with high vacuum suction.
N.S.: no significant difference (P > 0.05);
***: significant difference (P < 0.001).
Source: Klaus-Dieter Bastendorf

not lead to a higher level of bacterial aerosol contamination in the room air.

The contribution of the mouthwash or high vacuum suction to this result was not determined.

It was not the aim of the investigation to collect and measure larger droplets. These remain in the treatment environment and are not part of the aerosol. The risk of infection with these droplets is the smear and not the aerosol infection. The smear infection has been known for a long time and is controlled by the dental team through their protective measures [Watanabe et al., 2019].

It is imperative to strictly follow the RKI guidelines and recommendations for personal protective equipment, for surface disinfection as well as for the correct technology and proper use of the equipment.

CONCLUSION

The AIRFLOW® treatment with the use of Optragate, a suitable mouth rinse and high vacuum suction does not lead to an increased risk of bacterial contamination for the practice team and patients. In addition, it could be shown that aerosols can be effectively controlled with the "two-hand suction technique" using a high vacuum suction in the immediate vicinity of the treatment area ■

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Note from the authors:
Furthermore unpublished investigations of the group of authors, which were carried out under the same protocol with the piezoceramic scaler PIEZON® PS, show that this technology does not pose an increased risk of bacterial contamination for dental personnel and patients when using protective measures. Likewise rinsing with BacterX was carried out prior to treatment and use of the high vacuum suction and the two-hand technique. The final report will be published as soon as the tests are completed.