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ORIGINAL ARTICLE / ARAŞTIRMA MAKALESİ

A Pilot Study for the Aerosol Capture, One Center Test Results

Aerosol Salınım Kontrolü: Tek Merkezli Pilot Çalışma

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ABSTRACT

Objective: In the present study, showing the efficacy of aerosol capture systems used in dentistry was aimed. For this purpose, Aerosol Control System (ACS) (Nederman, Sweden) was used in capturing the aerosols during the dental treatments.

Methods: Aerosol capture studies were conducted by Aerosol Control System (Nederman, Sweden). The measurements were divided to three groups. The first group is the reference group in which the Reference Value Readings were recorded. The RVR data were recorded in the treatment area where the dental staff and the patient were in the clinic, but no treatment protocol. The second group consist of the Aerosol Concentration Readings during the treatment, mentioned before, but the ACS was off. The third group had the Aerosol Concentration Readings during treatment when the ACS was on.

Results: 16 records in 2986 samples were measured. For the reference group, particle concentration average was 47 (ng/m3), whereas for the second and for the third groups, they were 119(ng/m3) and 53,6 (ng/m3), respectively.

Conclusion: It was observed that the aerosol concentration is increased dramatically during the operations when the system is off but came close to the reference records when the aerosol control system was turned on. When the system is off, the aerosols that accumulated on the glasses, masks and protective equipment of the dentists were examined. These also showed the effect of the spread of the aerosols during the treatment.

Keywords: Aerosol capture, SARS-CoV-2, COVID-19

ÖZ

Amaç: Bu çalışmada Diş Hekimliğinde kullanılan aerosol yakalama sistemlerinin etkinliğini göstermek amaçlanmıştır. Bu amaçla diş tedavileri sırasında aerosollerin yakalanmasında Aerosol Kontrol Sistemini (ACS) (Nederman, İsveç) kullanılmıştır.

Materyal ve Metot: Aerosol yakalama çalışmaları Aerosol Kontrol Sistemi (Nederman, İsveç) ile yapıldı. Ölçümler üç gruba ayrıldı. Birinci grup, Referans Değer Okumalarının kaydedildiği referans grubudur. RVR verileri, diş hekimi personelinin ve hastanın klinikte bulunduğu tedavi alanında kaydedildi, ancak herhangi bir tedavi protokolü uygulanmadı. İkinci grup, daha önce bahsedilen tedavi sırasındaki ACS kapalıyken Aerosol Konsantrasyon Okumalarından oluşturuldu. Üçüncü grup ise, tedavi sırasında ACS açıkken Aerosol Konsantrasyon Okumalarından oluşturuldu.

Bulgular: 2986 örnekte 16 kayıt ölçülmüştür. Referans grubu için partikül konsantrasyonu ortalaması 47 (ng/m3) iken, ikinci ve üçüncü gruplar için sırasıyla 119(ng/m3) ve 53,6 (ng/m3) idi.

Sonuç: Sistem kapalıyken yapılan işlemler sırasında aerosol konsantrasyonunun önemli ölçüde arttığı ancak aerosol kontrol sistemi açıldığında referans kayıtlara yaklaştığı gözlemlendi. Sistem kapalıyken diş hekimlerinin gözlük, maske ve koruyucu ekipmanlarında biriken aerosolleri incelendi. Bu inceleme, tedavi sırasında aerosollerin yayılmasının etkisini göstermiştir.

Anahtar Kelimeler: Aerosol yakalama, SARS-CoV-2, COVID-19

Introduction

The oral cavity is inhabited by more than 700 microbial species, including fungi and viruses which may arise from the respiratory tract (1). The oral microflora, which is the sum of all microorganisms in oral structures, has been linked to various infections, not only to SARS-CoV-2 infection, which is the causative factor of Covid-19 since the end of 2019 (2).

During dental treatments, aerosols, which are formed during the use of low-or high-speed handpieces, lasers, electrosurgery units, ultrasonic scalers, air polishers, prophy angles, hand instruments, air/water syringes and other aerosol-forming instruments, may contain oral microbiota-based microorganisms which may cause cross-infection and

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infection through the dentist and dental staff (3). Inhalation of these formed aerosols or airborne particles produced during dental procedures may cause adverse respiratory health problems and bidirectional disease transmission. To avoid these, protective disposable gloves, medical masks, face shields and eyeglasses with solid side shields are widespread use by the staff to avoid any infection (4,5).

The role and challenges of hygiene in dentistry have changed radically over the past decades, not only in the equipment used for dental staff, but also in the equipment that are used in the workplace of dental office. Poorly ventilated spaces, in which the air exchange with filtration cannot be successfully applied, or spaces decreasing the indoor bioaerosol concentration are some of the points which may create hygiene problems (6,7) To overcome these problems, the high-efficiency particulate air (HEPA) systems are recommended. While no single system can fully mitigate risk, the use of well-designed engineering controls, as a part of a multi-tiered safety strategy and independent working interactions, can significantly reduce worker exposure to hazardous aerosols. Most of these systems work similarly, with small modifications. They direct air through a series of prefilters, which help to continuously catch airborne microorganisms and retain particles as small as 0.3 µm in diameter (8,9).

In the present study, we aimed to show the efficacy of aerosol capture systems used in dentistry. For this purpose, we used the Aerosol Control System (ACS) (Nederman, Sweden) in capturing the aerosols during the dental treatments.

Methods

Samples:

Temporary filling removal, onlay preparation, crown preparation and scaling treatments were applied to different patients in regular treatments. All the treatment protocols were carried out in the routine clinics of the faculty.

Aerosol Capture and Analysis:

Aerosol capture studies were conducted by Aerosol Control System (Nederman, Sweden). This system had 2 flexible arms (FX2 arm model), had a N16 fan model with a flexible ducting part. Aerosol Concentration Measuring Device was used to analyze the captured particles. This device can capture particles with the size of 0.1 to10 µm, with a reading resolution of 0.001 mg/m3.

The measurements were divided to three groups. The first group is the reference group in which the Reference Value Readings were recorded. The RVR data were recorded in the treatment area where the dental staff and the patient were in the clinic, but no treatment protocol. The second group consist of the Aerosol Concentration Readings during the treatment, mentioned before, but the ACS was off. The third group had the Aerosol Concentration Readings during treatment when the ACS was on.

Results

16 records in 2986 samples were measured. For the reference group, particle concentration average was 47 (ng/m3), whereas for the second and for the third groups, they were 119 (ng/m3) and 53,6 (ng/m3), respectively. Table 1 and Figure 1 lists the results.

Table 1: The measurement values of the particles

Operation Type	Reading Averages (ng/m3)		
	Group 1	Group 2	Group 3
Temporary Filling Removal	49	75	49
Onlay Preparation	48	205	45
Crown Preparation	50	131	63
		178	56
		93	58
Scaling	46	54	45

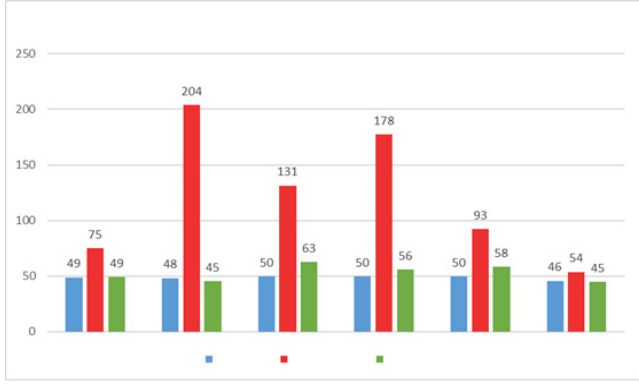

Figure 1: Comparison of the particles during the treatment (blue column reference, red second group, green third group).

Discussion

In the present study, showing the efficacy of the ACS in capturing the aerosols before reaching the breathing zones of the staff, and to avoid the aerosols from spreading to the treatment area was aimed. It was observed that the aerosol

concentration is increased dramatically during the operations when the system is off but came close to the reference records when the aerosol control system was turned on. When the system is off, aerosols that accumulated on the glasses, masks, and protective equipment of the dentists was examined. These also showed the effect of the spread of the aerosols during the treatment.

Conclusion

This report showed the effect of the ACS for avoiding the contact of infectious agents during treatment process. Here, the dramatically reduce in the particles showed promising results, which is very important in determining the human health.

The major limitation for the study is the number of the cases. 16 records in 2986 samples were detected, and the average results was used, despite the increase in number of the cases no statistically significant change was assumed. Another limitation is not determining the identity of microorganism and the nature of the aerosols captured. Further studies must be performed considering those limitations.

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