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Analysis of Microbial Load in Air at Different Time Intervalin Dental Clinic

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Introduction: Patients and healthcare professionals can be exposed to several microorganisms that colonize or invade the oral cavity and respiratory tract, or are transported in the water used during treatment, which increases the risk of infection.
Materials and Methods: To determine the air germ count over four consecutive hours, by exposed plate method using Brain heart infusion agar (BHI) plates in the multi chair treatment room of the Department of Prosthodontics, Department of Periodontics, Department of Pedodontics, Department of Conservative dentistry & Operative Dentistry of Saveetha Dental College.
Results: The CFUs in the multi-chair treatment room were between 47 and 243 CFU m3. . During treatment, it reached up to 243 CFU m3.
Conclusion: During treatment, the bacterial count was greater than the actual time before treatment. While bacterial numbers in dental rooms have been substantially higher, the risk in dental clinics is higher due to the formation of aerosols that contain microorganisms.

Keywords: Air; dental clinic; microbial load; time duration.

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1. INTRODUCTION

Patients and healthcare professionals can be exposed to several microorganisms that colonize or invade the oral cavity and respiratory tract, or are transported in the water used during treatment, which increases the risk of infection [1-3].

Water lines, microbial aerosols, and clinical contact surfaces are three of the most common causes of infection. Microorganisms that multiply on the inner surface of water tubes and form a biofilm may colonize dental unit waterlines [4-6]. The biofilm will then offer some protection to maximize the number of microorganisms in the water used for dental treatments. Microbial aerosols are frequently generated during dental procedures, smaller particles can float in the air and enter small passages of the lungs, whereas larger particles can easily settle on environmental surfaces [7-10].

Some surfaces, particularly so-called clinical contact surfaces that are constantly handled (e.g. dental unit switches, lamp handles, and drawer knobs), can serve as microorganism reservoirs.

Microorganisms can be transmitted to instruments, other environmental objects, or the nose, mouth, or eyes of healthcare workers and patients as these surfaces are touched. While it has been recognized that environmental matrices (water, air, and clinical touch surfaces) can play an important role as a vector for infection, the research on microbial pollution in the dental clinic setting is not comprehensive. Existing trials included only a small number of hospitals and very few measured total microbial environmental degradation. Moreover, while the assessment of water toxicity is based on widely agreed and uniform sampling and processing procedures and well-specified threshold values [11-21].

For this purpose, hospital environmental management protocols may provide useful assistance for the reduction of nosocomial infections [22,23]. This is especially the case in high-risk health services where people are more vulnerable due to their health problems or in operating theatres due to proximity to air tissue [24,25]. In reality, surgeons were the first to work with environmental hygiene conditions during high-risk surgery to eliminate post-operative infections. Since then, several authors have emphasized the value of microbial monitoring of environmental matrices.

Mick et al. [26] first observed aerosol particles produced during dental treatment. The researchers have established their new fields of study in dental aerobiology. Besides, the authors characterized their studies as a science of air particles and the relationship between these particles and the wellbeing of patients and the treatment of staff. They also found that streptococcal aerosols emitted by dental turbines remained detectable in the air after 24 hours. However, improvements in dental chair technology and the use of rubber dams should also be taken into account when considering the possibility of dental aerosols.

While dental therapies have been shown to greatly increase the amount of bacterial air pollution, there is currently no systematic study of the microbiological atmosphere in dental practice and a multi-stage dental clinic compared to public areas. In comparison, the experiments carried out concerned a few assessment points before and during dental procedures. To date, data over longer periods of several hours and days have not been produced.

This study aimed to analyze the airborne microbial load at a normal dental practice and period of four consecutive hours.

2. MATERIALS AND METHODS

To determine the aerosol microorganism by exposed plate method over four consecutive hours, on brain heart infusion agar (BHI) plates in the multi chair treatment room of the Department of Prosthodontics, Department of Periodontics, Department of Pedodontics, Department of Conservative dentistry & Operative Dentistry of Saveetha Dental College. Particles, bacteria, and fungi were deposited on the culture medium located underneath. Windows and doors were kept closed during the day. In the multi-chair dental clinic as well as in the dental practice complex dental treatments such as professional tooth cleaning, restoration, dental fillings, and root canal treatments were performed during the air sampling. During the dental treatment, the windows were closed and the clinics were using air conditioning units.

3. RESULTS

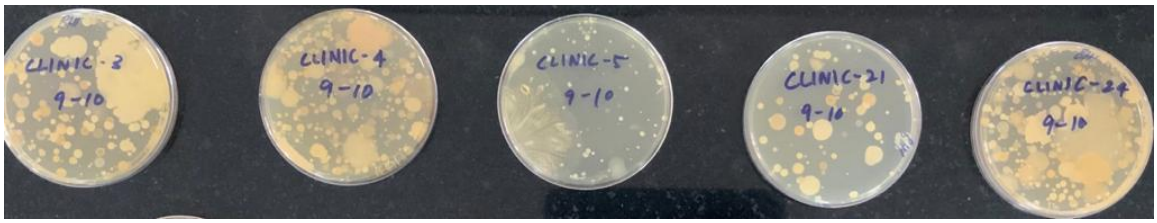

Fig. 1. Culture plates collected and incubated (24-48hrs) between 9 am-10 am from different clinics

Fig. 2. Culture plates collected and incubated (24-48hrs) between 10 am-11 am from different clinics

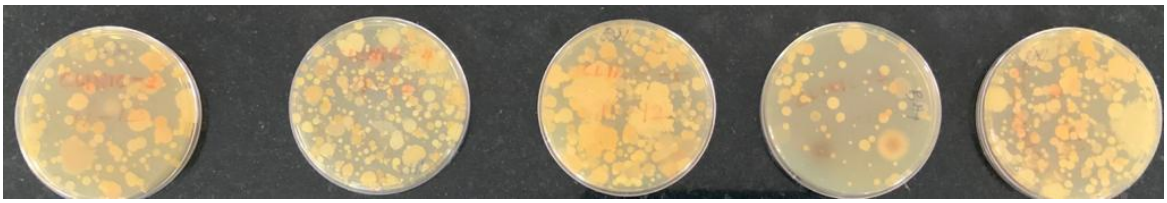

Fig. 3. Culture plates collected and incubated (24-48hrs) between 11 am-12 pm from different clinics

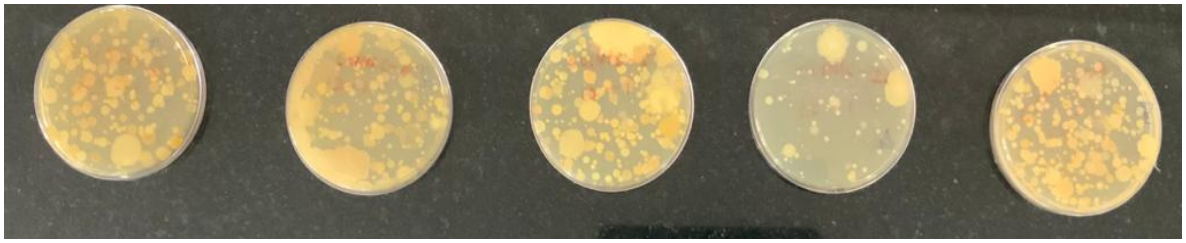

Fig. 4. Culture plates collected and incubated (24-48hrs) between 12 pm-1 pm from different Clinics

Table 1. The table depicts the Colony forming units (CFUs) between consecutive time intervals in different clinics

CLINIC	9AM-10AM	10AM-11AM	11AM-12 PM	12PM-1PM
CLINIC-1	167	115	124	107
CLINIC-2	243	135	235	144
CLINIC-3	151	146	199	155
CLINIC-4	96	138	47	117
CLINIC-5	216	116	183	190

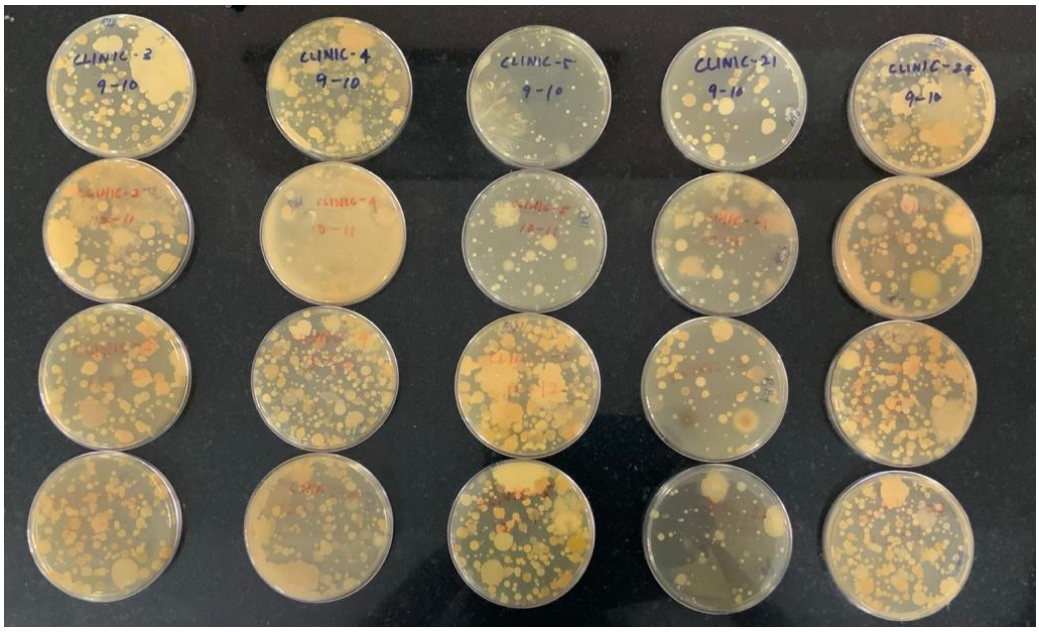

Fig. 5. Culture plates collected and incubated (24-48hrs) from different clinics between 9am-10am, 10am-11am, 11am-12pm and 12pm-1pm

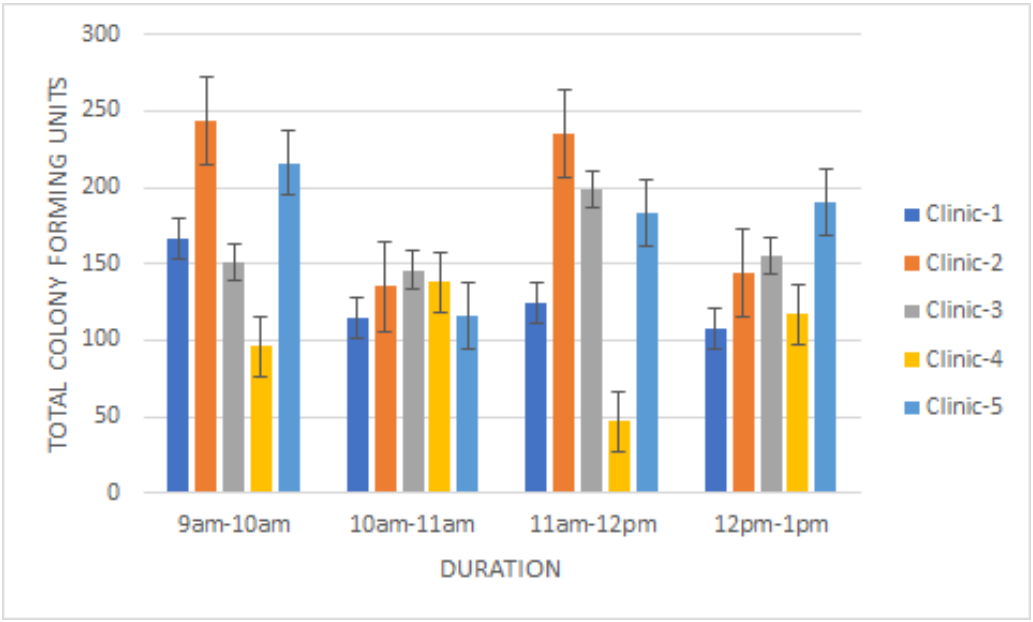

Fig. 6. The graph represents the no. of colony-forming units (CFUs) formed in the clinics between the duration of 9 am-10 am, 10 am-11 am, 11 am-12 pm, and 12 pm-1 pm. The X-axis represents duration and the Y-axis represents the total number of colony-forming units

4. DISCUSSION

4.1 Total airborne Microorganisms

Fig. 1. shows the culture plates collected and incubated (24-48hrs) between 9 am-10 am from different clinics. The total colony-forming units (CFUs) in the clinics during this hour, Clinic-1, Clinic-2, Clinic-3, Clinic-4, and Clinic-5 with 167 CFUs, 243 CFUs, 151 CFUs, 96 CFUs, and 216 CFUs respectively. A maximum of 243 CFUs was identified in Clinic-2 and a minimum of 96 CFUs was identified in Clinic-4. Fig. 2. shows the culture plates collected and incubated (24-48hrs) between 10 am-11 am from different clinics. The

total colony-forming units (CFUs) in the clinics during this hour, Clinic-1, Clinic-2, Clinic-3, Clinic-4, and Clinic-5 with 115 CFUs, 135 CFUs, 146 CFUs, 138 CFUs, and 116 CFUs respectively. A maximum of 146 CFUs was identified in Clinic-3 and a minimum of 115 CFUs was identified in Clinic-1. Fig. 3. shows the culture plates collected and incubated (24-48hrs) between 11 am-12 pm from different clinics. The total colony-forming units (CFUs) in the clinics during this hour, Clinic-1, Clinic-2, Clinic-3, Clinic-4, and Clinic-5 with 124 CFUs, 235 CFUs, 199 CFUs, 47 CFUs, and 183 CFUs respectively. A maximum of 235 CFUs was identified in Clinic-2 and a minimum of 47 CFUs was identified in Clinic-4. Fig. 4. shows the culture plates collected and incubated (24-48hrs) between 12 pm - 1 pm from different clinics. The total colony-forming units (CFUs) in the clinics during this hour, Clinic-1, Clinic-2, Clinic-3, Clinic-4, and Clinic-5 with 107 CFUs, 144 CFUs, 155 CFUs, 117 CFUs, and 190 CFUs respectively. A maximum of 190 CFUs was identified in Clinic-5 and a minimum of 107 CFUs was identified in Clinic-1.

Microbial aerosols in the dental clinic may have various causes, e.g. from dental procedures, dental staff, or patients, but also outside sources, i.e. air, soil, and dust. Such aerosols can transmit microorganisms to dental staff or patients. Due to varying potential causes of microbial air pollution, quantitative and qualitative studies of airborne microbes in dental clinics compared to the public sector may be useful in estimating the risk of infection due to microbial aerosols throughout dental surgery. This has not been available in literature so far. To date, there is no comparison of microbiological evidence from aerosols obtained using the same methodology and derived from dental and communal settings. Different air sampling would yield different results, making it much more impossible to compare different dental procedures. This makes it impossible to estimate the effect of microbial aerosols on dental work.

The estimation of the overall germ count at various time points in the day facilitates a detailed analysis of the shifts in the microbial load. The variations in the experimental architectures and the technological designs of the air sampling systems have often had to be taken into account when comparing the studies carried out so far. Also, the time intervals observed were often inconsistent between these earlier studies. The values detected by Castiglia [15] were 107 CFU m3 on average (baseline) and there was no quantitative discrepancy between the empty room values and those detected during the presence of patients and the treatment team. As a result, the investigators found that the presence of humans did not result in a substantial rise in air germ values. This is consistent with the findings given by Castiglia [15]. The sampling position chosen in the room should not be too close to the patient. Particles with a diameter between 50 mm and 100 mm display ballistic activity if the forces of inertia are stronger than the forces of friction. Based on their composition, a contorted direction of motion similar to that of a projectile is taken and, after a brief time in the air, the particles adsorb onto the neighboring surface [27]. Particles less than 50 mm are undetectable to the human eye but can stay in the air as aerosols for a long period. In this study, the assessment of pure airborne microbes in aerosol particles is not affected by direct spraying because the measurement was not carried out too close to the treatment chair. Compared to this report, Bennett et al. [14] observed comparable CFU-values for the most part in general dental practice, with average values of approximately 500 CFU m3. However, these values have consistently been surpassed by considerably higher peaks of up to 6000 CFU m3. Szymanska and Dutkiewicz [28] received maximum values of up to 40,080 CFU m3. The risk of external pollution must be considered for such high values. The act of suction of between 100 and 600 of air has demonstrated its robustness, given its capacity to be assessed and the knowledge value obtained. Smaller concentrations of the air are too inaccurate and poor in microbial counts because too few microbes have been captured. Excessively long period measurements are less than suitable for the representation of shifts because the points in time with higher loads are marginally leveled and obliterated by the use of a single average value, but which cover periods overlapping various dental procedures or events. However, the measurements were taken by Grenier [29] over a time of 30 minutes. The airflow was just 20 l/min. Very few experiments have been conducted to date with such depth that various forms of microbes are found in dental aerosols relative to airborne microbes from other non-dental public areas using limited agar or biochemical norm measures. Al Maghlouth et al. [12] recorded a CONS proportion of 37.7 percent and a micrococci proportion of 32.6 percent. This is consistent with the findings of the present analysis. The pseudomonas bacteria accounted

for 0.6 percent and the fungi accounted for 0.9 percent of the microbes measured. Pagniano [30] examined 166 microbes randomly collected using normal methods and observed comparable amounts. It really should be emphasized that the reduced capacity of the API1 test and related systems present a challenge specifically in the classification of non-pathogenic environmental microbes. These devices have been designed for the rapid detection of some clinically important bacteria and are thus the only species that can be identified. This study analyzed the microbial load in the air at different intervals in the dental clinic.

Our team has extensive knowledge and research experience that has translated into high-quality publications [31-50].

5. CONCLUSION

During treatment, the bacterial count was greater than the actual time before treatment. While bacterial numbers in dental rooms have been substantially higher, the risk from dental clinics is higher in the microorganisms, host susceptibility, and exposure period.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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