Title page

TITLE

Air microbial contamination in dental clinics: comparison between active and passive methods

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RUNNING TITLE

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Key words: dental clinic, microbial contamination, air, active sampling, passive sampling, correlation

Abstract word count: 205

Total text word count:

Air microbial contamination in dental clinics: comparison between active and passive methods

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Abstract

The aim of this study was to evaluate the correlation between the microbial air contamination values obtained by active sampling (colony-forming units per cubic metre, CFU/m^3) and by passive sampling (Index of microbial air contamination, IMA) and to calculate the corresponding equations. Air sampling was performed in ten dental clinics (DC), before (T0), during (T1) and after (T2) the clinical activity, for five consecutive days, once a month for a period of three months, for a total of 450 air samplings. The correlation was evaluated using the Spearman test, and a *p* value below 0.05 was considered statistically significant. A statistically significant correlation was found considering both the results obtained from the total observations and from the single sampling times, T0, T1 and T2. Different correlation patterns were observed stratifying by DC. The following correlation equations were obtained, where "x"=CFU/m^3 value and "y"=IMA value, T0: y=9.46+0.07x; T1: y=28.64+0.02x; T2: y=15.71+0.02x. Total: y=12.91+0.06x. Both methods were able to evaluate the microbial air quality and highlight critical situations; therefore, both can be used with this aim. However, in particular during the activity, passive sampling resulted more sensitive, and for its simplicity, economy and standardization by IMA, as suggested by several authors, can be suggested for routine monitoring.

Introduction

Dental clinics (DC) are care settings where the risk of airborne infections is particularly relevant (1,2,3). The main factor increasing the criticality of the dental environment for airborne infections is the type of instruments used which produce aerosols containing microorganisms from the oral cavity, upper airways and ~~possibly~~possibly blood. The smaller particles can float in the air over a long period before they settle on surfaces or enter the respiratory tract and penetrate the small passages of the lungs, while larger particles settle easily onto environmental surfaces. From the surfaces, microorganisms can be resuspended in the air or can be transferred to healthcare workers' and patients' hands or any other objects or ~~enviromental~~environmental surfaces. Microbiological air sampling represents a useful tool to identify the presence of risk situations and evaluate the effectiveness of the preventive measures undertaken; in this field Italian Society of Hygiene, Preventive Medicine and Public Health, has given an important contribution (4-6) Active and passive sampling can be used; the active method measures the concentration of viable microorganisms in the air, expressed as colony_forming units per cubic metre (CFU/m^3), while passive method measures the rate at which viable microorganisms settle on surfaces (7-9). Passive method has been standardized by the Index of microbial air contamination, IMA (9).

The aim of this study was to evaluate the correlation between the CFU/m^3 and IMA values from a multicentre study by Pasquarella et al, 2012 (6), and to obtain the equations that correlate the values

of CFU/m^3 and IMA.

Materials and methods

Microbial air samplings were performed in ten dental clinics (DC) before (T0), during (T1) and after (T2) the clinical activity, for five consecutive days, once a month for a period of three months. A total of 450 samplings were collected by active sampling and passive sampling, as previously described (6). The analysis of the results was performed by using SPSS 25.0 (IBM SPSS Inc., Chicago-IL). Correlation between CFU/m^3 and IMA was evaluated using the Spearman test, considering the data both in their totality and subdivided by sampling time (T0, T1 and T2) and by clinic.

Results

A significant correlation between the results of the two methods was found considering both the results obtained from the total observations and from the single sampling times, T0, T1 and T2 (Table 1). By stratifying the results by DC, the correlation was significant at time T0 for three dental clinics (No 4, 6, 8), at time T1 for 4 DC (No 6, 7, 8, 10), and at time T2 for two DC (No 3, 8). One DC (No 8) presented a significant correlation both considering the single sampling times and the total samplings performed, with a rho of Spearman ranging from 0.785 to 0.811, while for three DC (No 1, 2 5) in any of the sampling times a correlation was found. DC 9 showed a statistically significant correlation for total values, but not for the single sampling times.
The following correlation equations were obtained: T0: y =9.46+0.07x; T1: y =28.64+0.02x; T2: y = 15.71+0.02x. Total: y = 12.91+0.06x, where "x" = CFU/m^3 value and "y" = IMA value.

Conclusions

The results obtained showed different correlation patterns. The strongest correlation between CFU/m^3 and IMA values was found at T1 and T2, when highest air microbial contamination values were recorded. This finding is consistent with the results reported by Petti et al. in local study, showing a significant correlation for high air micorbial contamination levels, but no correlation for low contamination levels (10). Comparing the values of the obtained equations with the relationships from the recommended limits defined by the EU Guidelines to Good Manufacturing Practice (11), it could be seen that at Grade D, which was proposed as target value in dental clinics, corresponding to 200 CFU/m^3 and 100 CFU/4h (25 CFU/h), the relationship obtained in our study, considering the total number of samplings, was superimposable, being for 200 CFU/m^3 an IMA value of 24.91. Considering the specific sampling times, the relationship was similar for T0 (23.46 IMA), while for T1 and T2, the IMA values corresponding to 200 CFU/m^3 were 32.64 and 19.71 respectively, showing for T1, during the activity, a higher sensitivity of the passive sampling. This could be explained considering the high fluctuation in contamination in dental clinics due to the frequent aerosol product (3) and the cumulative measurement of contamination provided by the use of settle plates exposed for one hour (12). Both methods, active and passive, were able to evaluate the microbial air quality and highlight critical situations, so that both can be used with this aim. However, in particular during the activity, passive sampling showed to be more sensitive, and for its simplicity, economy and standardization by IMA, as suggested by several authors (3,10,12), can be suggested for routine air microbial monitoring.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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Table 1. Correlation between the cfu/m^3 and IMA values, for sampling time and dental clinic, rho di Spearman (p value)

Dental clinic	Sampling time			
	T0	**T1**	**T2**	**T0, T1, T2**
Dental clinic 1	n.s.	n.s.	n.s.	n.s.
Dental clinic 2	n.s.	n.s.	n.s.	n.s.
Dental clinic 3	n.s.	n.s.	0.719 (0.004)	0.643 (<0.001)
Dental clinic 4	0.676 (0.011)	n.s.	n.s.	0.533 (<0.001)
Dental clinic 5	n.s.	n.s.	n.s.	n.s.
Dental clinic 6	0.598 (0.018)	0.571 (0.026)	n.s.	0.588 (<0.001)
Dental clinic 7	n.s.	0.662 (0.007)	n.s.	0.430 (0.003)
Dental clinic 8	0.555 (<0.032)	0.727 (0.002)	0.811 (<0.001)	0.785 (<0.001)
Dental clinic 9	n.s.	n.s.	n.s.	0.644 (<0.001)
Dental clinic 10	n.s.	0.524 (0.045)	0.530 (0.042)	0.684 (<0.001)
Total	0.497 (<0.001)	0.473 (<0.001)	0.399 (<0.001)	0.606 (<0.001)

T0, T1, T2: before, during, after clinical practice