

Bacterial Exposure and Microbial Activity in Dental Clinics during Cleaning Procedures

Authors : Atin Adhikari, Sushma Kurella, Pratik Banerjee, Nabanita Mukherjee, Yamini M. Chandana Gollapudi, Bushra Shah

Abstract : Different sharp instruments, drilling machines, and high speed rotary instruments are routinely used in dental clinics during dental cleaning. Therefore, these cleaning procedures release a lot of oral microorganisms including bacteria in clinic air and may cause significant occupational bioaerosol exposure risks for dentists, dental hygienists, patients, and dental clinic employees. Two major goals of this study were to quantify volumetric airborne concentrations of bacteria and to assess overall microbial activity in this type of occupational environment. The study was conducted in several dental clinics of southern Georgia and 15 dental cleaning procedures were targeted for sampling of airborne bacteria and testing of overall microbial activity in settled dusts over clinic floors. For air sampling, a Biostage viable cascade impactor was utilized, which comprises an inlet cone, precision-drilled 400-hole impactor stage, and a base that holds an agar plate (Tryptic soy agar). A high-flow Quick-Take-30 pump connected to this impactor pulls microorganisms in air at 28.3 L/min flow rate through the holes (jets) where they are collected on the agar surface for approx. five minutes. After sampling, agar plates containing the samples were placed in an ice chest with blue ice and plates were incubated at $30\pm 2^\circ\text{C}$ for 24 to 72 h. Colonies were counted and converted to airborne concentrations (CFU/m³) followed by positive hole corrections. Most abundant bacterial colonies (selected by visual screening) were identified by PCR amplicon sequencing of 16S rRNA genes. For understanding overall microbial activity in clinic floors and estimating a general cleanliness of the clinic surfaces during or after dental cleaning procedures, ATP levels were determined in swabbed dust samples collected from 10 cm² floor surfaces. Concentration of ATP may indicate both the cell viability and the metabolic status of settled microorganisms in this situation. An ATP measuring kit was used, which utilized standard luciferin-luciferase fluorescence reaction and a luminometer, which quantified ATP levels as relative light units (RLU). Three air and dust samples were collected during each cleaning procedure (at the beginning, during cleaning, and immediately after the procedure was completed (n = 45). Concentrations at the beginning, during, and after dental cleaning procedures were 671 ± 525 , 917 ± 1203 , and 899 ± 823 CFU/m³, respectively for airborne bacteria and 91 ± 101 , 243 ± 129 , and 139 ± 77 RLU/sample, respectively for ATP levels. The concentrations of bacteria were significantly higher than typical indoor residential environments. Although an increasing trend for airborne bacteria was observed during cleaning, the data collected at three different time points were not significantly different (ANOVA: p = 0.38) probably due to high standard deviations of data. The ATP levels, however, demonstrated a significant difference (ANOVA: p < 0.05) in this scenario indicating significant change in microbial activity on floor surfaces during dental cleaning. The most common bacterial genera identified were: Neisseria sp., Streptococcus sp., Chryseobacterium sp., Paenisporosarcina sp., and Vibrio sp. in terms of frequencies of occurrences, respectively. The study concluded that bacterial exposure in dental clinics could be a notable occupational biohazard, and appropriate respiratory protections for the employees are urgently needed.

Keywords : bioaerosols, hospital hygiene, indoor air quality, occupational biohazards

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