ATP BIOLUMINESCENCE STUDY OF MICROBIAL LOAD AND SURFACE CONTAMINATION OF PPE SUITS IN A PRIVATE DENTAL COLLEGE SETUP

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Abstract

Introduction: Dental clinics pose multiple ways of cross contamination. Personal protective equipment (PPE) is one of the effective ways to control the spread of infections among dentists, providers of oral care, health care professionals, and medical professionals. The aim of this study is to check the microbial load on reusable PPE suits before and after clinic duty in a dental college using ATP bioluminometer.

Materials and Methods: The PPE sleeves of the dominant hand of 40 dental professionals were assessed at rest in two different time intervals in a given day. The first samples were collected before clinic duty began and the second sample was collected after clinic duty was completed. The samples collected and assessed using ATP bioluminescence test.

Results: Among the 40 samples taken, all showed an increase in the microbial load after clinic duty. The increase is not constant among all subjects. The samples were collected only from the dominant hand sleeve before and after. The paired t test was done with the results obtained from this study. The value of P=0.000045; P is < .00001. The result is significant at P< .05. There was a significant difference in the microbial load on the PPE suits before and after clinic duty.

Conclusion:The results of the study stresses the importance of wearing good and effective PPE suits while performing clinical procedures in order to reduce incidence of nosocomial infections.

Keywords: ATP bioluminesence, nosochomial infections, PPE suits, cross infection, surface contamination

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1. Introduction

Dental clinics pose for multiple ways of cross contamination. The surfaces of the different equipment, doors, tables and chairs are either touched unintentionally or they are exposed to blood and saliva of the patients due to splatter or spread of aerosols. All this allows the harboring of various bacteria resulting in cross contamination. This is seemingly the major cause of cross contamination in a dental setting world wide(1). The various dental operating procedures result in the transmission of pollutants and infectious particles. This results in the daily increased risk of cross infection for the dental staff and patients(2). The primary cause for the contamination of dental clinics is the oral microbial flora(3). This scaffolds as a source for direct dental infection and cross contamination. At the same time it also is an indirect source of risk for the working dentists. The multiple routes of cross contamination in a dental setup happens between patient to clinicians and staff, from one patient to another , from clinician to staff, from the clinic to the public. The control and limitation of cross contamination in a clinic setting is of utmost importance. This is because the bacteria causing this contamination are antibiotic resistant strains. Infections caused by such strains are difficult to treat. Thus controlling this will drastically improve public health(4).

Personal protective equipment (PPE) is one of the effective ways to control the spread of infections among dentists, providers of oral care, health care professionals, and medical professionals. In dental practice there is transmission of viral and bacterial organisms via bio-aerosols(5,6). These microorganisms like influenza cause respiratory diseases which can affect the operator who is protected with a mask and spectacles(7). This evidence from multiple sources is enough to justify the occupational risk associated with dentistry. The saliva is considered as a major source for viruses(8). The bio-aerosols are produced from the oral cavity as a result of drilling of the tooth or during the use of ultrasonic instruments like scalers to remove debris or calculus. Direct contact with unsterilised instruments can also act as a mode of transmission of various microorganisms(9). Our team has extensive knowledge and research experience that has translate into high quality publications (10–19))

For a dental professional, the minimum personal protective requirements for infection control include gloves, masks and protective eyewear. This protective equipment is essential during oral examination and while performing any dental procedures. According to a study, the dental professionals who didn't use any one of the above mentioned basic PPE, were more susceptible to getting bacterial and viral infections compared to those who followed personal protective measures(20). The aim of this study is to check the microbial load on reusable PPE suits before and after clinic duty in a dental college using ATP bioluminometer.

2. Materials and Methods

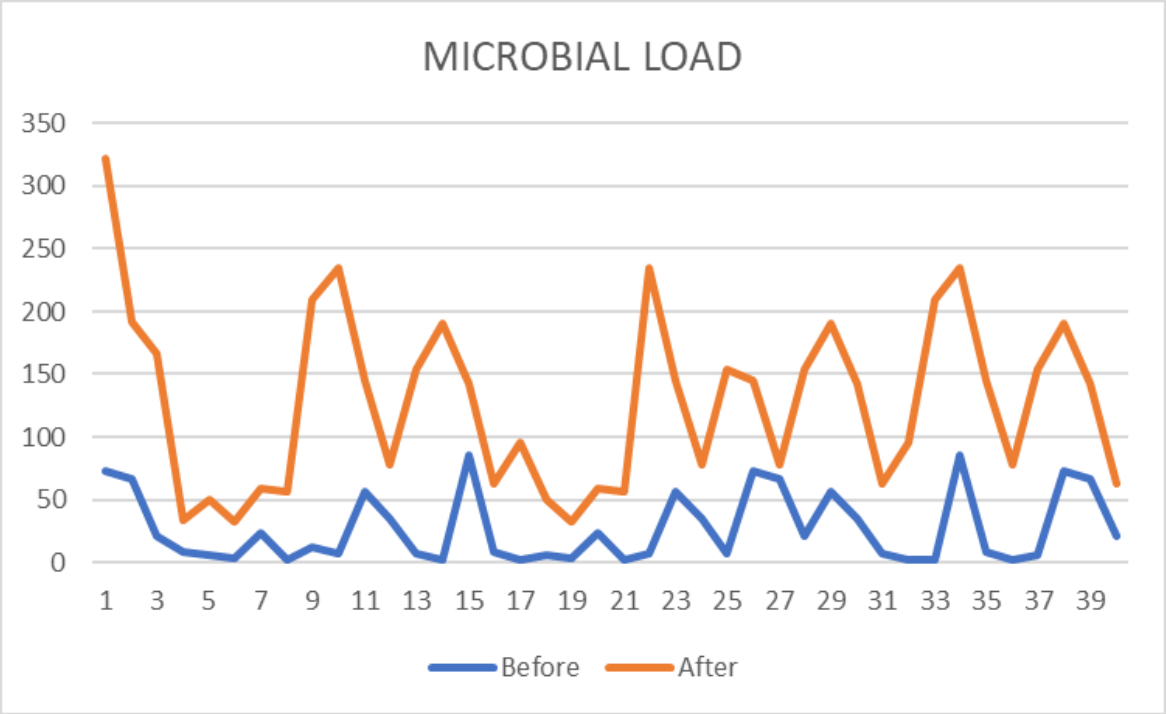
Setting and sampling

The sampling was conducted in the clinics of Saveetha Dental College, Chennai. All the clinics in the college have similar structural characteristics and similar cleaning protocols. The samples were collected at two timestamps - once before starting clinic duty and the second one after completion of clinic duty. Sample size was 40 PPE kits. The sampling was taken when there were no patients inside the clinic. The samples were collected after at least 30 minutes of the patients leaving the clinic. This is done to avoid any possible interaction with any disinfectants or detergents. The samples were swabbed from the surface of the PPE from the sleeve of the dominant hand of the operator. The same criterion was adopted for all the samples taken before and after clinic duty. The amount of contamination of the PPE was assessed using ATP bioluminescence assay.

ATP bioluminescence assay

UltraSnap was used for assessing the microbial load. UltraSnap is a single use test device which consists of an impregnated swab for collecting the sample from the surfaces. The swab was rubbed on the sleeve of the operator's dominant hand in two opposite directions. On an average all the samples collected in the before and after groups covered a 10cm x 10cm area. After each individual swab was taken, it was immediately placed into a bioluminometer. The bioluminometer measures the amount of light that is generated by a specific chemical reaction. The values displayed in the luminometer are represented in Relative Light Units (RLU). The greater the intensity of light, the greater is the reading on the luminometer which is directly proportional to the amount of ATP present which eventually indicates the amount of bacterial contamination.

3. Results



Graph 1: Graph representing the microbial load present on the protective equipment before and after clinic duty using ATP bioluminescence method. The blue line indicates the microbial load on the PPE before beginning clinic duty. The orange line indicates the microbial load on the respective PPE after clinic duty.

From graph 1 it is suggested that there is an obvious increase in the microbial load in the PPE after clinic duty is completed. Among the 40 samples taken, all showed an increase in the microbial load after clinic duty. The increase is not constant among all subjects. The samples were collected only from the dominant hand sleeve before and after. The paired t test was done with the results obtained from this study. The value of P=0.000045; P is < .00001. The result is significant at P< .05.

4. Discussion

All healthcare professionals require a minimum amount of personal protective equipment to protect themselves from the various microorganisms which are present in their immediate surroundings. Wearing specific clinical gowns can help prevent cross contamination for the provider and clinic staff after clinic hours are over. For the longest time, nosocomial infections or hospital acquired infections have posed an occupational risk for healthcare providers and their support staff. The lack of good protective equipment can lead to a multitude of problems. The most important being cross contamination and acquiring nosocomial infections.

The dental profession is notoriously dangerous for hospital acquired infections due to the nature of treatment that is done. Dentistry involves the use of high speed burs and aeroters and ultrasonic scalers. These instruments are known to produce micro-aerosols into the immediate environment after interaction with the patient's saliva. The most problematic situation posed by nosocomial infections is the presence of highly antibiotic resistant species of bacteria. Tackling this issue is the biggest hurdle for overcoming hospital acquired infections. It is hence of utmost importance that the dental professionals use adequate and appropriate personal protective equipment to ensure decreased chances of gaining nosocomial infections and also prevent cross contamination.

In this study, the dental professionals used reusable protective clinical gown apart from the standard gloves, headcap and eyewear. The highlight in this study is focussed upon the amount of increase in the microbial load before and after clinic duty. The samples were all collected from the same area before and after duty. The area chosen was the dominant hand sleeve of the protective gown for

the respective dental operator. The results from the study are plotted in graph 1. There has been a significant increase in the microbial load on the PPE after clinic duty was complete. Among the 40 subjects, all of them showed an increase in microbial load; but the degree of increase in the microbial load wasn't constant among subjects. On evaluating the results statistically, using a paired T test, it can be concluded that there is a significant increase in the microbial load on the PPE before and after clinic duty lasting 8 hours. A recent study also concluded similar findings where they suggested a significant increase in the microbial load in the operators chest, arm and face area after ultrasonic scaling was done(21). A similar study performed in 2018 in a hospital setting checked the surface contamination of the surfaces present near the area of operation. The results of their study also supported the findings in our study. The authors concluded that there is an increase in the microbial load after medical procedures were done(22). Huang et al in 2015 conducted a study comparing the different methods to assess surface contamination. The three different methods used in their study include visual inspection, colony counting and ATP bioluminescence assay. The results of their study suggested that the ATP bioluminescence assay is a rapid and sensitive tool to assess contamination of various surfaces(23). In 2017, Nante N et al published a review to conclude the effectiveness of the ATP bioluminescence assay in hospital settings. The authors, at the end of their review concluded that this method is not completely standardized yet. Each tool from different manufacturers have different benchmark values making it non standardized. The authors feel that ATP bioluminescence can be used to check surface cleanliness, but it isn't the best for assessing sterility of surfaces(24).The main drawbacks of the study is the small sample size. The PPE used is a reusable PPE. There was no standardisation of the initial contamination already present in the PPE. There is no evidence suggesting that ATP bioluminesence assay is precise while taking samples from fabrics.

5. Conclusion

The study performed by us assesses the microbial load on the PPE sleeves of the dominant hand of a dental operator before and after clinic duty. ATP bioluminescence assay is used to evaluate the increase in microbial load. The results of the study suggest that there is a significant increase in the microbial load on the PPE after clinic hours. The results of the study is important because it is suggestive of the amount of microbial contamination that occurs while performing dental procedures. It also highlights the importance of wearing appropriate PPE while in the clinic. Thus, within the limitations of the study, it can be concluded that there is a significant increase in microbial contamination after clinical duty on the PPE suits or gowns. This highlights the importance and necessity of wearing effective PPE suits to ensure reduction of acquiring nosocomial infections and also reducing the rate of cross contamination within and outside the dental clinic.

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CONFLICT OF INTEREST
The authors would like to declare no conflict of interest.

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