

## **Manuscript Title: Comparative Assessment of the Microbial Load Before and After Dental Procedures on Scrubs Worn by Dental Students**

**Type of the study:** Original study

**Running title:** Comparative assessment of the microbial load before and after dental procedures on scrubs worn by dental students

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**Abstract:**

**Background:** Cross contamination is the spread of microorganisms from one surface to another and this is commonly observed in a hospital setting where both the patients and the healthcare workers are at risk. Dental procedures have shown a high amount of production of droplets and aerosols that contain bacteria and blood that are likely to cause respiratory infections. These aerosols are often seen in the air and on the attire worn by the dental care professionals. Aim of the study is to assess the load of microorganisms on the scrubs before and after various dental procedures. **Materials and method:** A total of 6 types of procedures were carried out by the operators- Extraction, Single visit pulpectomy, Root canal treatment, Scaling, Pit and fissure sealants, Preparation and cementation of Stainless-steel crowns. A total of 120 samples were obtained from the PPE of the dental operators from the chest and arm region, before and after each procedure after treating 30 patients. These samples were transferred to a nutrient agar media and incubated for 24 hours. **Results:** The total mean CFU analyzed after the dental procedure in the arm region was highest in Ultrasonic Scaling (212 CFU) and lowest in sealant (46.4 CFU). A paired sample T test was done on the microbial count before and after the procedure in both chest and arms, which showed that the number of CFUs were high for all the samples taken after the procedure, which was highly statistically significant ( $p$ -value  $< 0.01$ ) **Conclusion:** There is a significant increase in the microbial colonies after every procedure. Proper protocols should be followed to prevent nosocomial infections.

**Keywords:** Microbial load, Nosocomial infections, Colony Forming Units, hospital acquired infections,

**Introduction:**

Due to the recent pandemic, there are concerns about the spread of pathogens through cross contamination. Cross contamination is the spread of microorganisms from one surface to another. This is very common in a hospital setting where both the patients and the healthcare workers are at risk. Hence sanitation plays a major role in preventing cross contamination.

Scrubs and white coats are the most common clothing worn by health care professionals as a method of maintaining sanitation as these are often spattered with saliva, blood and aerosols (1,2). This type of clothing is easy to clean and should only be worn in the workplace since they are a mode of infection and cross contamination.

Dental procedures have shown a high amount of production of droplets and aerosols that contain bacteria and blood that are likely to cause respiratory infections (3)The aerosols and droplets generated during dental procedures which when coming into contact with the saliva of the patients can comprise of a significant number of pathogenic organisms. These include various bacteria, like *Mycobacterium tuberculosis* or pathogenic viruses like influenza, measles or the recent deadly SARS-CoV-2 which is the causative agent for the recent pandemic(4). The splatters that are generated travel in an upward direction in the form of a vertical expanding funnel pattern contaminating the operator's chest, shoulders, face and arms (5,6). These infective microorganisms are present on the clothing of the personnel for several days.

The most common sources of infectious agents causing healthcare associated infections, described in a scientific review of multiple investigations are the individual patient, medical equipment or devices, the hospital environment, the healthcare personnel, contaminated drugs, contaminated food, and contaminated patient care equipment. Although the person-to-person transmission route is the most likely, the role of the environment should not be ignored and dental chairs as well as the operatories may contribute to the spread of nosocomial infections

Numerous factors constitute the risk of nosocomial infections. These include the ability of pathogens to remain viable on a surface for a long duration of time, the number of instances where the contaminated surfaces are touched by patients and healthcare workers, the context in which the patient is exposed, and the levels of contamination that result in transmission to patients (7).

Recent studies have observed that contaminated environmental surfaces play an important role in transmission of pathogens in a healthcare setup(8). The apparel of the healthcare personnel including white coats and scrubs appear to be

contaminated even in the first several hours of use. Other personnel equipment that come under frequent hand contact like stationery, stethoscopes, and mobile phones may have even higher levels of contamination (9).

There have been studies that have shown that white coats and scrubs (10) act as transmitting agents for microbes but there is currently no literature which studies the microbial load for various dental procedures. The aim of the study was to assess the load of microorganisms before and after various dental procedures on scrubs worn by dental students.

### **Materials and Methods:**

This study was conducted in a university setting involving ten students pursuing dental graduation, who were attending the outpatient department in a private dental college. The study period was between January 2021 to February 2021. The study was approved by the Institutional Ethical review board. An autoclaved sterile scrub was provided to the dental students before each dental procedure. A total of 6 types of procedures were carried out by the operators- Extraction, Single visit pulpectomy, Root canal treatment, Scaling, Pit and fissure sealants, Preparation and cementation of Stainless-steel crowns. The patients involved in the study were in the age group of 6-17 years with no medical comorbidities and randomly assigned to the dental students and subjected to one of the treatments mentioned above. Standard ergonomic operator-chair positions were followed for the above-mentioned dental procedures. Cotton swab samples were collected from two regions; arms and chests; before and after the dental procedure. These samples were then transferred within half an hour onto a 2% nutrient agar and incubated for 24 hours. The colonies were then counted by a single investigator who was blinded to the type of procedure performed. The mean colony forming units (CFU) that was derived was then transferred to a data sheet which was then subjected to statistical analysis.

#### **Statistical analysis**

The collected data were analyzed using SPSS software version 22.0 (SPSS Inc., ChicagoIII., USA). Test for normality was conducted after which the samples were subjected to a paired sample T test to assess the statistical difference in the colony count before and after the dental procedures.

### **Results:**

30 patients (5 patients under each treatment group) were involved in the study. A total of 120 samples were collected from the arm and chest regions of the dental operators before and after the treatment procedures.

The total mean CFU analyzed after the dental procedure was highest in Ultrasonic Scaling (349.4 CFU) and lowest in sealants and extraction (88 CFU and 88.6 CFU respectively). The total mean CFU analyzed after the dental procedure in the chest region was highest in Ultrasonic Scaling (137.4 CFU) and lowest in extraction (26.4 CFU). The total mean CFU analyzed after the dental procedure in the arm region was highest in Ultrasonic Scaling (212 CFU) and lowest in sealant (46.4 CFU). (Figure 1-6) A paired sample T test was done on the microbial count before and after the procedure in both chest and arms, which showed that the number of CFUs were high for all the samples taken after the procedure, which was highly statistically significant. (p-value < 0.01) (Table 1)

### **Discussion:**

The study was done to determine the level and type of microbial contamination present in scrubs during different treatment procedures in a private Dental institution. The results showed that root canal treatment, scaling and pulpectomy procedures are more likely to increase the microbial load on the scrubs of the operators. The reason for this is due to the presence of aerosols. The predetermined sites selected for examination were the sleeves and the chest areas, the reason being because during examination and treatment of the patient the sleeve of the scrub most frequently comes into contact with the patient. There have been studies that show that sleeves have a significantly higher contamination than the rest of the body (11,12).

Previous studies that were conducted have shown that the attire worn by healthcare professionals carry pathogenic microbes which are causative agents for nosocomial infections.

During standard treatment, a rapidly rotating bur would create heat, using a coolant that prevents damage to the hard dental tissues that leads to pathological changes in the dental pulp. The usage of a water coolant generates aerosols, which when combined with the fluids present in the oral cavity, such as blood and saliva generates bioaerosols. Microorganisms like bacteria, virus and fungi are most commonly found contaminating the bioaerosols. These aerosols have the ability to stay in the air for an extended duration of time, leading to its aspiration by dentists or other patients (13). A study conducted by (14) in 2017 described that nearly 38 types of microorganisms can be found in the setting of a dental clinic which includes *Legionella pneumonia*, the primary cause of severe pneumonia (14). Instances where nosocomial infections have resulted in the patients being affected with pneumonia after visiting a dental clinic have been observed in certain studies (15). Similarly, an outbreak of tuberculosis occurred and was acquired among dental patients after visiting their local dentist (16). Due to the outbreak of coronavirus, more precautions must be carried out. In a recent study conducted, saliva samples of the oral cavity of affected individuals were taken (17). These samples showed a large number of microorganisms, which suggests the possibility of the transmission of infections through oral droplets.

A dental clinic can be a source of infections, but not many dentists are aware of the risk they undergo while treating patients. They are likely to cause cross infection as well as transmit infections. Hospital acquired infections and cross contamination can be prevented by following proper protocol but are not followed due to negligence or lack of awareness. A survey conducted (18) among general practitioners found that only 60% of dentists were aware of the proper sterilization protocols that are to be followed. Not many practitioners utilize personal protective equipment in their general practice despite recommendations (19). The practice of changing face masks and wearing eye glasses was less than 50% in another survey conducted (20). The usage of protective wear like face shields and eyeglasses should be practiced by dentists to protect themselves during the procedures they perform, as they decrease the spread of aerosols.

This is one of the few studies that have assessed the microbial contamination over the scrubs used by dental students before and after various procedures in a university setting. Regarding the limitations of the study, the sample size was small. Assessment of the count of microbial colonies was seen in six procedures. Further studies should be done to assess the type of microorganisms transmitted and with a larger sample size.

### **Conclusion:**

Within the limitations of the present study, there was a significant increase in the microbial contamination post treatment for all the dental procedures. Ultrasonic scaling showed highest contamination followed by root canal therapy and pulpectomy, while the least contamination was noticed in placement of sealants and extraction. Dentists are most susceptible to infections while performing various treatments, so to prevent the transmission of infections and reduce the risk of cross infections, proper protocols like wearing personal protective equipment and a ventilated environment should be maintained to prevent the spread of nosocomial infections.

### **Conflict of Interest:**

The authors state no conflict of interest.

### **Funding:**

Nil

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Tables

Procedure	Region of samples	Mean difference in the CFU count before and after the procedure	Std Deviation	Sig
Scaling	Chest	-136.2	12.3	.000
	Arm	-210.2	16.5	.000
Sealants	Chest	-40.4	7.7	.000
	Arm	-44.6	7.09	.000

Pulpectomy	Chest	-82.0	4.06	.000
	Arm	-110.2	7.4	.000
Root Canal Therapy	Chest	-78.2	8.8	.000
	Arm	-100.6	8.5	.000
Extraction	Chest	-24.6	6.1	.001
	Arm	-60.4	4.7	.000
Crown	Chest	-112.8	9.88	.000
	Arm	-110.8	20.6	.000

Table 1: The paired sample T test showed a significance between the two pairs- microbial colonies present on the chest before and after the procedure and present on the arm before and after of all 6 procedures. There is a significant increase in the number of microbial colonies present in all the dental procedures performed (p-value < 0.001).

Figure legends:

Fig1: Simple bar graph shows the mean of microbial counts on the chest and arm before and after the procedure on the x axis and the count of microbial colonies on the y axis. Microbial contamination was high after the ultrasonic scaling procedure with maximum CFU noticed in the arm region (212 CFU).

Fig 2: Simple bar graph shows the mean of microbial counts on the chest and arm before and after the placement of sealants on the x axis and the count of microbial colonies on the y axis. Microbial contamination was moderate after the placement of sealants with maximum CFU noticed in the arm region (46.40 CFU).

Fig3: Simple bar graph shows the mean of microbial counts on the chest and arm before and after pulpectomy on the x axis and the count of microbial colonies on the y axis. Microbial contamination was high after pulpectomy procedure with maximum CFU noticed in the arm region (112 CFU).

Fig 4: Simple bar graph shows the mean of microbial counts on the chest and arm before and after pulpectomy on the x axis and the count of microbial colonies on the y axis. Microbial contamination was high after root canal procedure with maximum CFU noticed in the arm region (101.40 CFU).

Fig 5: Simple bar graph shows the mean of microbial counts on the chest and arm before and after extraction on the x axis and the count of microbial colonies on the y axis. Microbial contamination was moderate after extraction procedure with maximum CFU noticed in the arm region (62,20 CFU).

Fig 6: Simple bar graph shows the mean of microbial counts on the chest and arm before and after crown preparation on the x axis and the count of microbial colonies on the y axis. Microbial contamination was high after the preparation and cementation of crown with maximum CFU noticed in the chest region (114.80 CFU).

