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Experimental, Analytical, Clinico-Microbial Split Mouth Study to Compare an Ingenious and Conventional Suction Tip in Reducing Aerosol During Ultrasonic Scaling in Biofilm Induced Gingivitis Patients

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Abstract

Introduction: *In a dental practise, the mouth of the patient is the primary disease-producing source. During many common dental treatments, aerosols and splatter are created, and these particles could include infectious substances like blood, saliva, and other organic matter. To overcome this, we have devised a new suction tip that helps in reducing the aerosols created during ultrasonic scaling.*

Materials and Methods: *The study was carried out in 30 sides (left/right) in 15 patients (split mouth) in biofilm-induced gingivitis patients undergoing ultrasonic scaling procedure. Selected patients were divided into 2 groups: Group A (15 sides)- Ultrasonic scaling was done (on the left or right half of the mouth) with an ultrasonic scaler, along with an ingenious suction tip for 10 mins. Group B (15 sides): - Ultrasonic scaling was done (on the left or right half of the mouth) with an ultrasonic scaler with the conventional suction tip for 10 mins. During scaling blood agar plates were attached on to the patient's chest (approximately 1.5 feet distance), and the second agar plate was on the operator's side within a radius of approximately 5 feet. The collected samples in the agar plate were cultured in an incubator at 37o Celsius. Colony forming units (CFU) were counted after 48 hours.*

Result: *Mean colony forming unit count (CFU) showed significant difference between the control group and the test group.*

Conclusion: *The use of an ingenious suction tip significantly reduced colony forming unit count more than a conventional suction tip.*

Keywords: *Ultrasonic scaling, Aerosol, Spatter, Colony forming unit, Ingenious suction tip, Gingivitis.*

Introduction

Healthcare professionals have been concerned about cross-infection for ages. The mouth of the patient is where most disease-causing substances are found in dental offices.[1] Numerous routine dental procedures can produce aerosols and spatter that may contain organic waste and pathogenic pathogens. Due to their enhanced susceptibility to the infectious germs contained in these particles, these aerosols have a concerning effect on both operators and patients.[2] The use of ultrasonic scalers intraorally may result in the release of aerosols containing infectious bacteria, endangering both the health of the operators and the patients. Aerosols have the potential to spread oral microbes from one person to another. Solid or liquid particle suspensions in the air is known as aerosols. It may get expelled, when someone coughs, sneezes, laughs, talks, or performs any other action that sends respiratory air and its accompanying fluid into the atmosphere.[3]

When rotating devices and air and water sprays are utilised during dental operations, contamination levels can be higher than those brought on by regular oral activity. The particles and splatter produced by using the air turbine handpiece and sneezing are equivalent.[4] In locations with equipment used to produce aerosols, there has been a fourfold rise in airborne bacteria. The aerosols created by ultrasonic scalers poses a significant microbiological problem, because viruses and bacteria may spread in this method. [5]

Aerosol-generating dental operations ("aerosol-generating procedures") are regarded as a high-risk method of transferring the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) through the air.[6] Several reports indicate, scaling processes are among the most important generators of aerosols that are primarily infected with microbes. To avoid the transmission, it is crucial to follow safety and infection control practises, one of which is minimising the use of aerosols and droplets.[7]

To overcome this, we have devised a new suction tip that might help in reducing the aerosols generated while ultrasonic scaling. This in-vivo experiment was designed to test the efficacy of an ultrasonic scaler aerosol reduction device in lowering the amount of contaminated aerosols produced during ultrasonic measurements.

Materials and Methods

This study was performed in the Department of Periodontology and Oral Impantology, MGV's KBH Dental College and Hospital, Panchavati, Nashik. Ethical clearance was obtained from KBH dental college-institutional ethics committee (no: MGV/KBHDC/619/2021-22). The study was conducted according to the guidelines of declaration of Helsinki and Good clinical practice. Informed consent was obtained from patients before study.

The primary objective of the study was to compare and evaluate colony forming unit (CFU) count in a cultured agar plate, kept at 1.5 feet and 5 feet, using an ingenious suction tip and conventional suction tip during ultrasonic scaling in biofilm-induced gingivitis patients.

This study was carried out on 30 sides (left/right) in 15 patients (split mouth) with biofilm-induced gingivitis, patients were undergoing ultrasonic scaling procedures for 10 mins. Patients who met the inclusion requirements were taken into consideration for the current study. For oral prophylaxis, 15 voluntarily participating individuals with at least 20 permanent teeth were taken into consideration.

Inclusion criteria: -

1. Biofilm-induced gingivitis.
2. Age – 18-60 years.
3. Plaque index score 1 (Silness and Loe 1964)
4. Patients who are voluntarily ready to be a part of a study and give informed consent.
5. Systemically healthy patients.

Exclusion criteria: -

1. Study participants with medical conditions that forbade the use of ultrasonic scalers were not included.
2. Uncooperative patients.
3. Unwillingness to take part in the study.

Selected patients were divided into two groups:

Group A (15 sides)- Ultrasonic scaling was done (on the left or right half of the mouth) with an ultrasonic scaler, along with an ingenious suction tip for 10 mins.

Group B (15 sides) - Ultrasonic scaling was done (on the left or right half of the mouth) with an ultrasonic scaler with the conventional suction tip for 10 mins.

Ingenious suction tip (figure 1):

The materials used to make ingenious suction tip are conventional suction tip and clear acrylic material. In this, the head of the conventional suction tip is cut and it is replaced by round shaped hollow acrylic disc. The hollow acrylic disc is prepared with acrylic material poured into a wax model and dewaxing is done. Later, the disc holes are made on the surface. The purpose of giving a round disc shape is to increase the surface area to facilitate more suction compared to that of a conventional suction tip. For the study purpose, these tips were made as disposable tips using plastic suction tube and self-cure acrylic. The acrylic head was smoothened enough to avoid soft tissue irritation. This sample model was used for study purpose only. For manufacturing purpose, we recommend that industries can make similar disposable tips (with better finishing) or heat cure acrylic head attached to stainless steel suction tips can be manufactured that would serve as autoclavable, reusable tips.

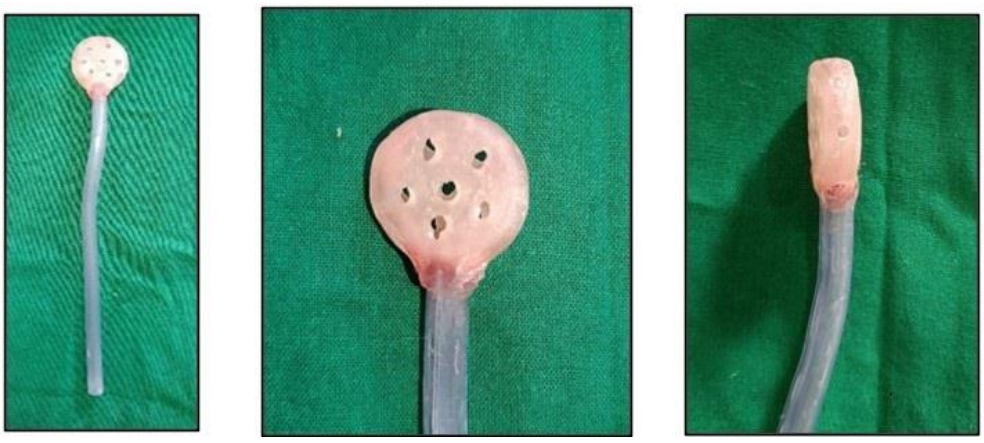


Figure 1: Ingenious suction tip

Procedure

Biofilm-induced gingivitis patients ready for ultrasonic scaling were provided information about the study. Informed verbal and written consent was obtained from each subject. Each study participant acted as his/her control and was subjected to both the study group criteria.

Group A (15 sides): - Ultrasonic scaling was done (on the left or right half of the mouth) with an ultrasonic scaler, along with an ingenious suction tip for 10 mins. The patient was shifted to another

operatory for remaining ultrasonic scaling of the other half of the mouth. Group B (15 sides): - Ultrasonic scaling was done (on the left or right half of the mouth) with an ultrasonic scaler with the conventional suction tip for 10 mins.

The procedure was done in closed room area. During the procedure blood agar plates were placed at the patient chest area (approximately 1.5 feet area), and a second agar plate on the operator side within a radius of approximately 5 feet. Agar plates were brought to the Department of Microbiology for additional examination after the samples had been collected. The collected samples in the agar plate were cultured in an incubator at 37o Celsius. Colony forming units (CFU) were counted after 48 hours. The location of the agar plates and the exposure time were concealed from a microbiologist, while counting the colony-forming units. For tabulation, the collected data was transferred to data tables created in a Microsoft Excel spreadsheet. All the discrete data was collected data and tabulated in an MS-XL spreadsheet. It was analyzed using paired t-test, the data were analysed using SPSS (Statistical Package for the Social Sciences) for Windows (version 8.0), and significance was defined at the P <0.05 level.

Result

The result shows Mean colony forming units/agar plate (CFU/plate) were measured under both the ingenious suction tip and the conventional suction tip (figure 2) while using an ultrasonic scaler in various treatments and locations. The maximum count of the colony was obtained in the agar plate kept at patient's chest area (1.5 feet) and second agar plate on operator side within a radius of approximately 5 feet by using the conventional suction tip. And the minimum colony count was obtained from the agar plate kept at the patient's chest area (1.5 feet) and the second agar plate on the operator side within a radius of approximately 5 feet by using an ingenious suction tip. (Figure 3)

The mean value of CFU/agar plate on the patient's chest 1.5 feet area by using a conventional suction tip is 619.46 and by using an ingenious suction tip is 465.466 (P value=0.0211), suggestive of statistically significant. The mean value of the CFU/agar plate on the operator side within a radius of approximately 5 feet by using a conventional suction tip is 224.33 and by using an ingenious suction tip is 129.86 (P value=0.0478), suggestive of statistically significant. In intergroup comparison, at 1.5 feet, and at 5 feet area there was a significant reduction in CFU count by using an ingenious suction tip than a conventional suction tip. (Graph no. 1) In intragroup comparison, there was a significant difference in CFU count in the control group at 1.5 feet area (619.46) and 5 feet area (224.33) and in

the test group also there is a significant difference in CFU count at 1.5 feet area (465.46) and at 5 feet area (129.86). (Table 1). A significantly higher count of the colony was seen during ultrasonic scaling under conventional suction tips compared to ingenious suction tip during ultrasonic scaling. (Figure 4)

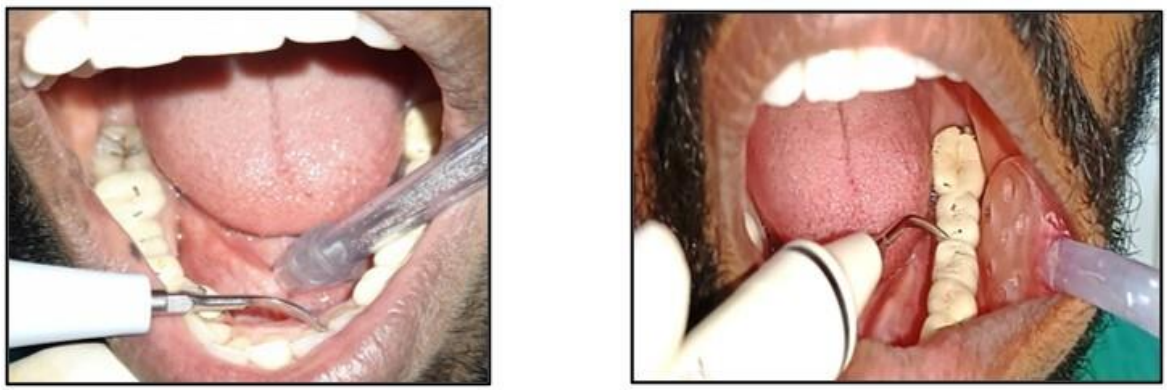


Figure 2: Showing conventional and ingenious suction tip

Figure 3: Agar plate placed at a distance of 1.5 feet and 5 feet from the operating site

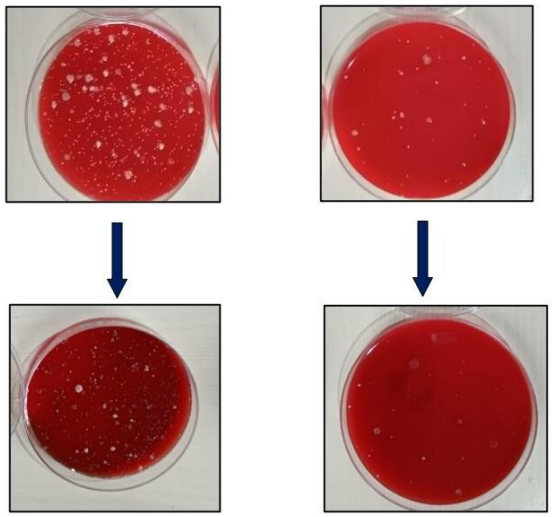
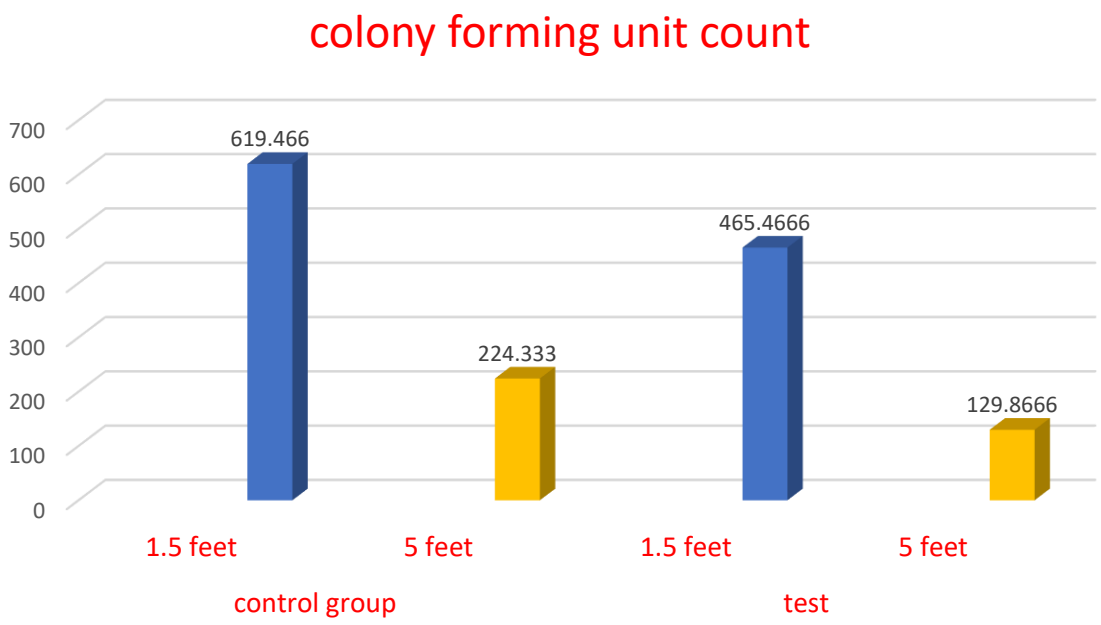


Figure 4: Showing colony forming agar plates

Study group / Sample site for agar plate	Agar plate under conventional suction tip (mean value± std. dev)	Agar plate under ingenious suction tip (mean value± std. dev)	P value
On patient's chest (1.5 feet from operating area)	619.46 ± 23.57	465.466± 45.05	0.0211
On operator side (within a radius of 5 feet area)	224.33± 27.71	129.866± 15.97	0.0478

Table 1: shows the Mean colony forming units/agar plate (CFU/plate) count according to treatment and locations during the use of an ultrasonic scaler under an ingenious suction tip and conventional suction tip.



Graph 1: Bar chart showing a significant reduction in colony forming unit count in the test group than a control group

Discussion

Nearly all dental procedures involve the use of aerosol-producing equipment, such as air rotor handpieces, ultrasonic/sonic scalers, air polishing tools, and air abrasion units. Because they can harm the health of patients with impaired immune systems as well as dental personnel, aerosols and droplets are a concern in dentistry. Numerous common dental treatments result in the creation of aerosol and spatter that contain different ratios organic particles and organic fluids like blood and saliva.**[**8**]**

Inhaling aerosols produced by the oral cavity during dental treatments may increase the spread of infectious illnesses to the dental practitioner. These aerosols are most likely to be contaminated with bacteria when they are used within two feet of the patient, which is typically where the dental professional is positioned.**[**9,10**]** A study of dental hygienists who use ultrasonic sealers found that they were more likely to experience aerosol-related symptoms than nurses and hospital personnel. These symptoms included nose irritation, a recurrent cough, eyesores, itching, and itchy skin.**[**11**]** The aetiology of lung infections, liver disease, pneumonia, conjunctivitis, herpes simplex and other skin illnesses has been linked to microorganisms isolated from dental aerosols.**[**12**]**

The effectiveness of an aerosols control tool for ultrasonic scaling was discussed, and it was proposed that it might lower the number of bacteria produced during ultrasonic scaling, hence lowering the danger of disease transmission..**[**3**]** According to research on the efficiency of various intra-oral suction tools to minimise aerosols during ultrasonic scaling and high speeds handpiece use, dynamic high-volume suction tools that move in tandem with the path of the aerosol-generating device are more effective at doing so than static devices, which allow periodic aerosol particle escape, in preventing aerosol from leaving the oral cavity. Although there are many potential routes for spreading SARS-CoV-2 in dentistry clinics, these data suggest that using the appropriate suction device could further reduce the risk from aerosol-generating operations.**[**13**]** Extraoral suction units were shown to be successful in lowering the bioaerosols and splatter generated during ultrasonic scaling, according to the study on the effectiveness of extraoral suction devices in minimising aerosol and splatter during ultrasonic scaling.**[**14**]** A comparable study was conducted. The use of high-volume evacuators and extraoral vacuum aspirators considerably reduced aerosols and droplets compared with employing saliva ejector only, the effectiveness of extraoral vacuum aspirators and high-volume evacuators in lowering aerosol and droplet in ultrasonic scaling processes during the COVID-19 pandemic was studied.**[**7**]**

In this study, we devised an ingenious suction tip for reducing an aerosol produced during ultrasonic scaling. Here two different operatory fields were used for 2 sides of the same patients to avoid previous aerosol contamination which can be affected colony forming unit count and the result might be biased. Following the procedure, for thirty minutes, there was an aerosol cloud in the operatory. According to a study, scaling processes cause the peak of aerosol concentration dissipates within 10–30 minutes.**[**15**]** Operatory field should not have been used for a long time, so all study participants were the first patient to be appointed. The maximum colony forming count was obtained at the patient's chest area (1.5 feet) from the operating area and the second agar plate was kept on the operator's side at a distance of 5 feet by using a conventional suction tip. And least colony count was obtained by using an ingenious suction tip. By utilising a conventional suction tip, the mean CFU/agar plate on the operator's side within a radius of about 5 feet is 224.33, and by using an ingenious suction tip, it is 129.86 (P value=0.0478), suggesting statistical significance. (Table 1)

Conclusion

In conclusion, this study showed, the ingenious suction tip significantly reduced contaminated aerosol during ultrasonic scaling than the conventional suction tip. Ingenious suction tip helps in the reduction of contaminated aerosol during a dental procedure, and it will be helpful for both operator and patients from aerosol contamination. The clinician can use it for a dental procedure in regular practice.

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