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ORIGINAL RESEARCH

A Study to evaluate and compare the Efficacy of Preprocedural Mouthrinsing and High Volume Evacuator Attachment Alone and in Combination in Reducing the Amount of Viable Aerosols Produced during Ultrasonic Scaling Procedure

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ABSTRACT

Background and objectives: In recent years, ultrasonics has gained prime importance and is considered a valuable tool in the dentist's armamentarium. Studies have confirmed that an aerosolized bacterial contamination is produced during the use of ultrasonic scalers.

Aim: To evaluate and compare the efficacy of preprocedural mouthrinsing using a bis-biguanide (chlorhexidine gluconate 0.2%) and high volume evacuator attachment alone and in combination in reducing the amount of viable aerosols produced during ultrasonic scaling procedure.

Materials and methods: A total 90 subjects were assigned to group I (who rinsed with 0.2% chlorhexidine gluconate prior to scaling), group II (high volume evacuator attachment was used during ultrasonic scaling) and group III (who rinsed with 0.2% chlorhexidine gluconate prior to scaling and in whom high volume evacuator attachment was used during ultrasonic scaling). Control group consisted of subject's whose mouth was scaled using a piezoelectric ultrasonic scaler without preprocedural rinsing or high volume suction.

Aerosol samples were collected using blood agar plates. The blood agar plates containing the aerosol sample were taken to the microbiology department as soon as the sampling was over and were subjected to aerobic culturing.

Results: The values obtained showed that all the three groups were effective in reducing the mean colony forming units (CFUs).

Conclusion: The results of this study showed that pre-procedural rinse and high volume suction were effective when used alone as well as together in reducing the microbial load of the aerosols produced during ultrasonic scaling. There was a significant reduction in the number of CFUs in aerosol samples obtained.

Keywords: Preprocedural rinse, Chlorhexidine, High volume suction, Blood agar, Aerosol, Ultrasonic scaler, Infection control, Plaque index, Gingival index, CFUs.

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INTRODUCTION

Cross-infection during health care delivery has concerned health care providers for centuries.[1] The major source of disease producing agents in the dental office is the patients mouth. In recent years, ultrasonics has gained prime importance and is considered a valuable tool.[2]

Antimicrobial chemotherapeutic substances have touched every health care discipline.[2-6] Another application that has recently gained considerable attention is the use of high volume evacuation (suction) which has shown to lower the aerosol contamination during ultrasonic scaling.[7-9]

An attempt has been made to evaluate the efficacy of a preprocedural rinse (chlorhexidine gluconate 0.2%) and high volume evacuation used alone as well as used together in reducing the microbial content of the aerosol.

AIMS AND OBJECTIVES

To evaluate and compare the efficacy of preprocedural mouthrinsing using a bis-biguanide (chlorhexidine gluconate 0.2%) alone, high volume evacuator attachment

alone and both preprocedural mouthrinsing (chlorhexidine 0.2%) and high volume evacuator attachment used together to reduce the amount of viable aerosols produced during ultrasonic scaling procedure.

MATERIALS AND METHODS

The selected patients were initially screened for their plaque index (Silness and Loe)[10] 35 and gingival index (Loe and Silness)[10] 35 and 90 subjects from both sexes within the age group of 18 and 45 years were chosen.

Inclusion Criteria

- Minimum of 20 healthy permanent teeth
- Absenced any dental treatment for the past 1 year
- Patients with plaque index score and gingival index score between 1 and 2.

Exclusion Criteria

- History of any systemic disease, cardiac pacemakers or respiratory complication
- Pregnant women
- Patient with conditions requiring prophylactic antibiotics, prior to dental procedures and those currently on any medicines.

CRITERIA FOR GROUP DIVISION

- *Group 1:* Thirty patients who rinsed with 0.2% chlorhexidine gluconate prior to scaling.
- *Group 2:* Thirty patients in whom high volume evacuator attachment was used during ultrasonic scaling.
- *Group 3:* Thirty patients who rinsed with 0.2% chlorhexidine gluconate prior to scaling and in whom high volume evacuator attachment was used during ultrasonic scaling.
- *Controls:* A split-mouth design was used in the study. One side (maxillary and mandibular) of the subject's mouth was scaled by using a piezoelectric ultrasonic scaler without preprocedural rinsing or high volume suction following which the other side was scaled using the same ultrasonic scaler with preprocedural rinsing and high volume suction used alone or together.

  For scoring, the indices used were the plaque index by Loe and Sillness (1964) and the gingival index by Loe and Sillness (1964).

  All the selected cases were subjected to ultrasonic scaling. Blood agar plates were selected as a medium to collect the aerosol for assessing the total CFUs (CFUs).

PLATE POSITION

Reference point: Mouth of the patient.

- At 6 inches (half feet) from reference point (operator's nose level).
- At 6 inches (half feet) from reference point (assistant's nose level).
- At 12 inches (1 feet) from reference point (patient's chest level).
- At 36 inches (3 feets) from reference point on patient's right (Fig. 1).

The patient was made to sit in a reclined position with his mouth at a standardized height of 3 feets from the floor of the operatory and all guidelines for infection control were maintained. The operator and the assistant used all preventive measures. Strict asepsis was followed inside the operatory.

Scaling was performed using sterile ultrasonic inserts [Varios 550 (NSK, Japan)]. Distilled water was used for all the ultrasonic scaling procedures. Coolant water flow was adjusted. The vacuum of high volume evacuator was standardized at 140 mm Hg.

Blood agar[11] plates used to sample the air was prepared by adding sterile blood to sterile nutrient agar that has been melted and cooled to 50°C. Blood agar was chosen because it is a general purpose, nonselective and enriched medium that promotes the growth of microorganisms, such as those sampled from the air.[7-9,12-14]

Group 1

Oral prophylaxis was done on one quadrant (control side) for 10 minutes following which blood agar plates were taken off. After 10 minutes the subject was assigned 10 ml of 0.2% chlorhexidine mouthrinse and instructed to rinse for 2 minutes. Oral prophylaxis was again done on the other

Fig. 1: Plate position

side (test side) for a period of 10 minutes. Following the 10 minutes sampling period, blood agar plates were taken off.

Group 2

Oral prophylaxis was done on a randomly selected side (control side) for a period of 10 minutes. After a gap of 30 minutes high volume suction tip was tied to the ultrasonic scaler. Oral prophylaxis was done on the other side (test side) of the same arch with the high volume suction for a period of 10 minutes. Following the 10-minute sampling period, blood agar plates were taken off.

Group 3

Oral prophylaxis was done on a randomly selected side (control side) for 10 minutes. Following the 10-minute sampling period, the blood agar plates were taken off. After a gap of 30 minutes the subject was assigned 0.2% chlorhexidine mouthrinse and instructed to rinse for 2 minutes. High volume suction tip was tied to the ultrasonic scaler handpiece. Oral prophylaxis was done on the other side (test side). Following the 10-minute sampling period, blood agar plates were taken off.

MICROBIOLOGICAL EXAMINATION

The blood agar plates containing the aerosol sample were taken to the microbiology department and subjected to aerobic culturing (Figs 2 and 3).

The blood agar plates were incubated at 37ºC for 24 hours after which the plates were observed for microbial growth. Using a colony counter, the resulting CFUs were counted.

OBSERVATIONS AND RESULTS

The results of the study were subjected to statistical analysis using mean, standard deviation (SD) and Student's paired 't-test'.

Fig. 2: Incubator

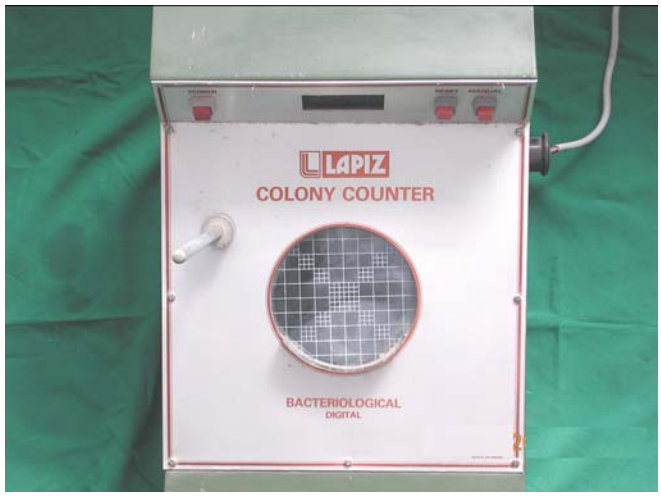


Fig. 3: Colony counter

Location I: Operator's Nose (Fig. 4)

At operator's nose in group I after 0.2% chlorhexidine preprocedural rinse, 59.18% reduction of mean CFUs was seen ($p < 0.01$) (Graph 1). In group II, after high volume suction, 83.19% reduction of mean CFU was seen ($p < 0.01$) (Graph 2). In group III, after using 0.2% chlorhexidine preprocedural rinse and high volume suction, 88.1% reduction of mean CFU was seen ($p < 0.01$) (Graph 3). The values obtained showed that all the groups showed highly statistically significant data and were effective in reducing the mean CFU.

The mean CFU difference at operators mask between groups I and II is 25.33 ($p < 0.01$) (Graph 4). Results indicated that group II was more effective than group I. The mean CFU difference between groups I and III is 30.68 ($p < 0.01$) (Graph 5). Results indicated that group III was more effective than group I. The mean CFU difference between groups II and III is 8.21 ($p < 0.01$) (Graph 6). Results indicated that group III was more effective than group II.

Location II: Assistant's Nose (Fig. 2)

At assistant's nose in group I, after 0.2% chlorhexidine preprocedural rinse 60.72% reduction of mean CFU was seen ($p < 0.01$) (Graph 1). In group II, after high volume suction, 81.59% reduction of mean CFU was seen ($p < 0.01$) (Graph 2). In group III, after using 0.2% chlorhexidine preprocedural rinse and high volume suction, 87.69% reduction of mean CFU was seen ($p < 0.01$) (Graph 3). All results were statistically significant.

The mean CFU difference at assistant's nose between groups I and II was 18.45 ($p < 0.01$) (Graph 4). Results indicated that group II was more effective than group I. The mean CFU difference between groups I and III was 21.81 ($p < 0.01$) (Graph 5). Results indicated that group III was more effective than group I. The mean CFU difference

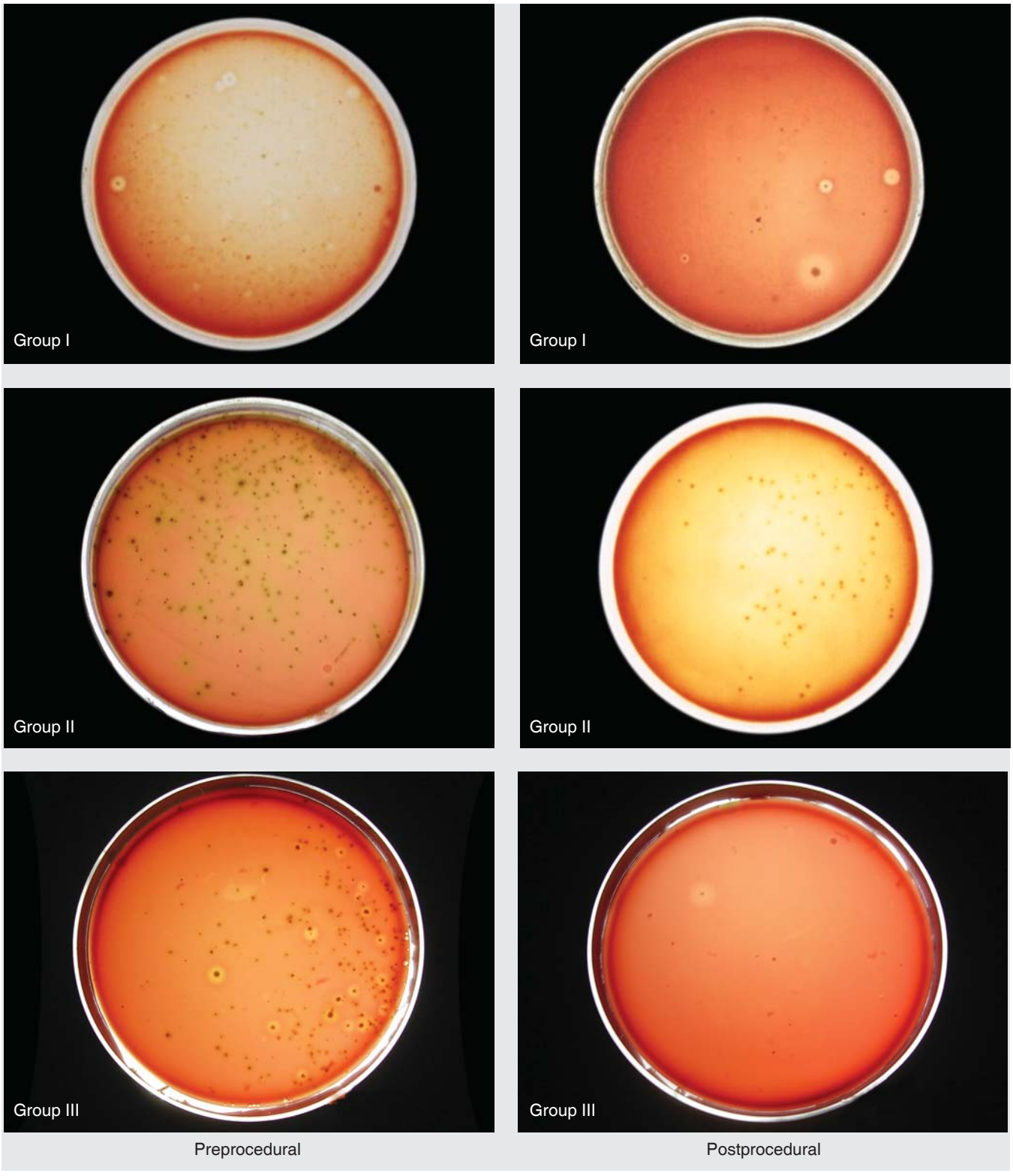


Fig. 4: CFUs in various groups at operator's nose level

between groups II and III was 9.19 ($p < 0.01$) (Graph 6). Results indicated that group III was more effective than group II.

Location III: Patient's Chest (Fig. 5)

At patients chest in group I, after 0.2% chlorhexidine preprocedural rinse, 55.92% reduction of mean CFUs was seen ($p < 0.01$) (Graph 1). In group II, after using high volume suction, 83.07% reduction of mean CFU was seen ($p < 0.01$) (Graph 2). In group III after using 0.2% chlorhexidine preprocedural rinse and high volume suction, 87.91% reduction of mean CFU was seen ($p < 0.01$) (Graph 3). All results were statistically significant.

The mean CFU difference at patient's chest between groups I and II is 30.69 ($p < 0.01$) (Graph 4). Results

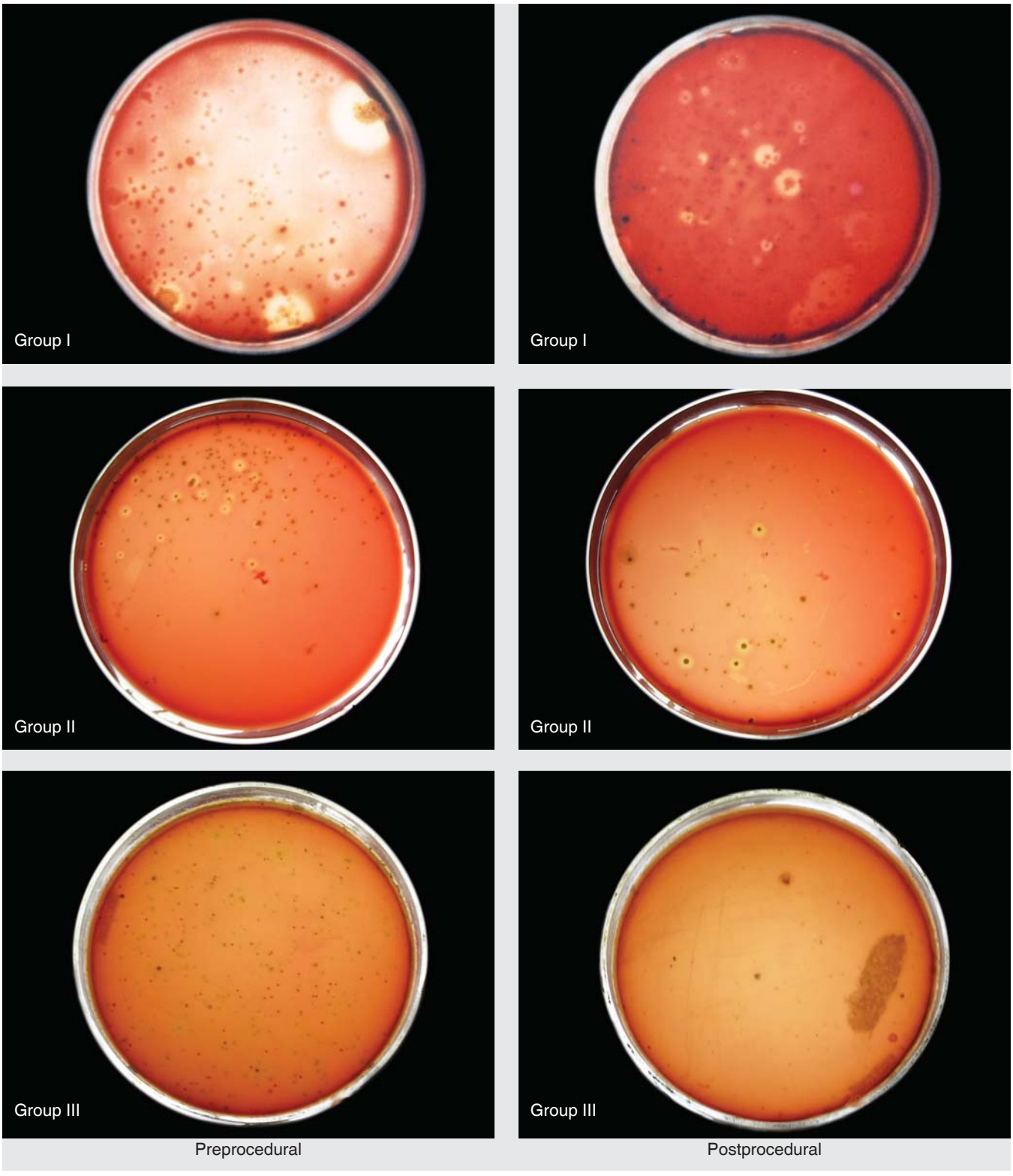
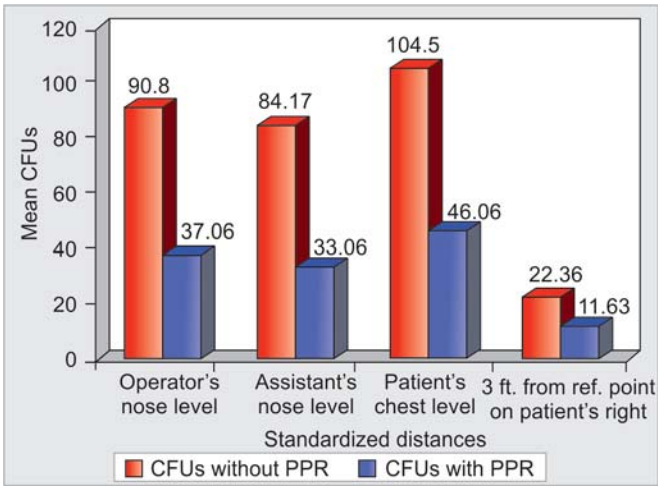


Fig. 5: CFUs in various groups at patient's chest level

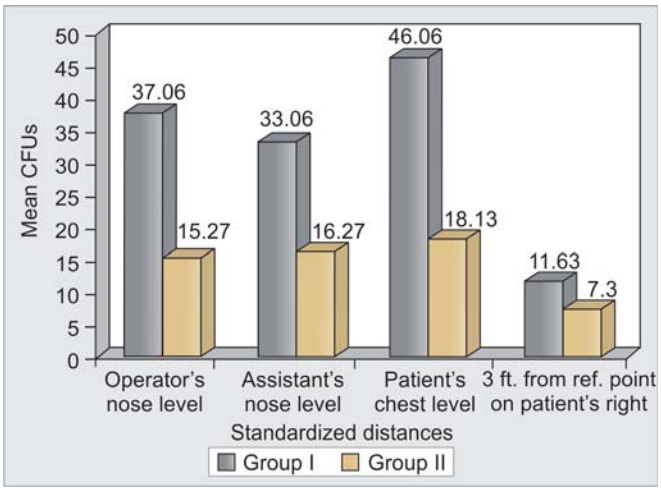
indicated that group II was more effective than group I. The mean CFU difference between groups I and III was 38.74 ($p < 0.01$) (Graph 5). Results indicated that group III was more effective than group I. The mean CFU difference between groups II and III was 6.84 ($p < 0.01$) (Graph 6). Results indicated that group III was more effective than group II.

Location IV: Three Feets from Reference Point on Patient's Right (Fig. 5)

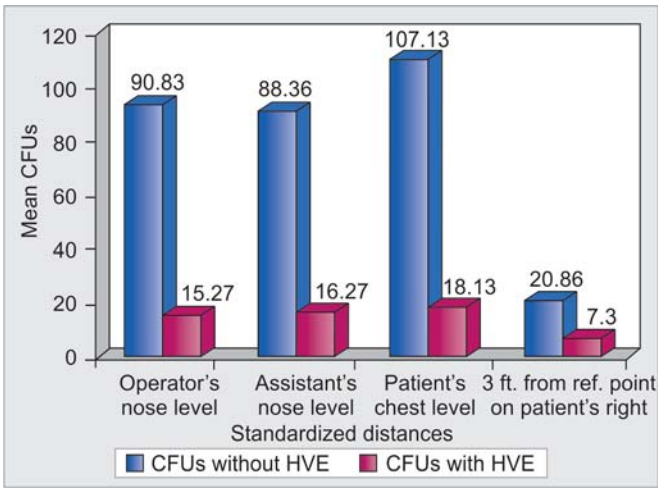
At location IV in group I, after 0.2% chlorhexidine preprocedural rinse, 47.99% reduction of mean CFUs was seen ($p < 0.01$) (Graph 1). In group II, after using high volume suction, 65.0% reduction of mean CFU was seen ($p < 0.01$) (Graph 2). In group III, after using 0.2% chlorhexidine



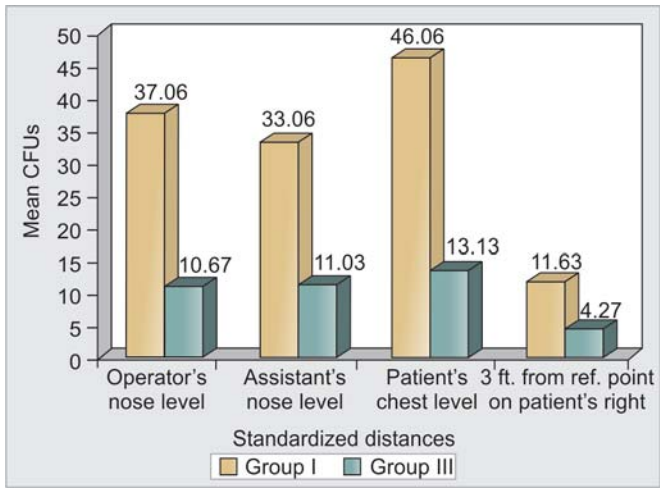
Graph 1: Pre- and postprocedural CFUs in group I



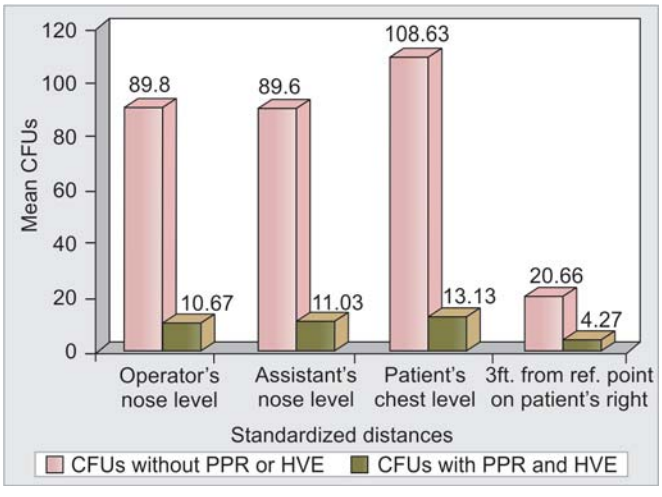
Graph 4: Comparison of CFUs at standardized distances in groups I and II



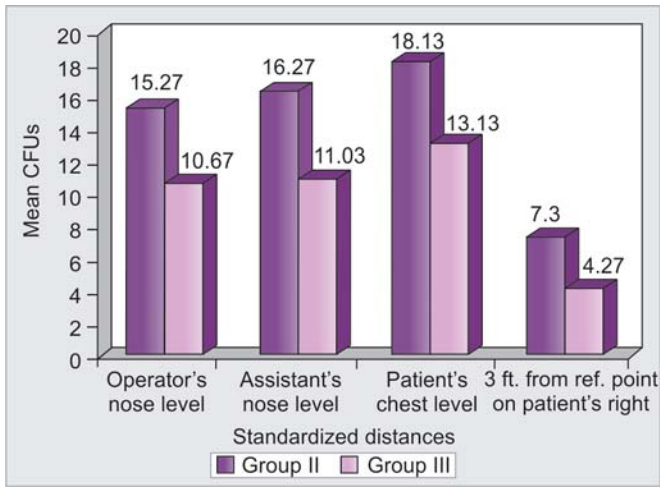
Graph 2: Pre- and postprocedural CFUs in group II



Graph 5: Comparison of CFUs at standardized distances in groups I and III



Graph 3: Pre- and postprocedural CFUs in group III



Graph 6: Comparison of CFUs at standardized distances in groups II and III

preprocedural rinse and high volume suction, 79.33% reduction of mean CFU was seen ($p < 0.01$) (Graph 3). All results were highly significant.

The mean CFU difference at 3 feets from reference point from patient's right between groups I and II was 9.84 ($p < 0.01$) (Graph 4). Results indicated that group II was more effective than group I. The mean CFU difference between groups I and III was 17.95 ($p < 0.01$) (Graph 5). Results indicated that group III was more effective than group I. The mean CFU difference between groups II and

III was 6.18 ($p < 0.01$) (Graph 6). Results indicated that group III was more effective than group II.

DISCUSSION

The oral cavity is a unique environment which provides an ideal medium for bacterial growth. Previous researchers have demonstrated that the aerosol spray produced during ultrasonic scaling contains high concentrations of microorganisms and that the particles released during its use are less than 5µ in diameter.

The American Dental Association[15] has recommended that all potentially contaminated aerosol and splatter produced during dental treatment should be controlled.

This study was undertaken to evaluate the efficacy of chlorhexidine 0.2% as a preprocedural rinse and high volume suction used separately as well as together in reducing viable bacterial count in the aerosols generated during ultrasonic scaling procedure.

The role of microbial plaque as the principal etiological agent in the development of gingivitis has been established beyond doubt. To date, the most dependable mode of plaque control is mechanical means utilizing a toothbrush and other oral hygiene aids. Chemical plaque control agents are considered adjuncts to mechanical methods and should be prescribed according to the needs of the patients.

Ultrasonic scaling devices are power driven units that convert electric energy to mechanical energy to remove deposits of calculus and stains from the teeth. Mechanical energy produced through an electric transducer or air pressure creates rapid vibration of the instrument tip causing it to dislodge plaque and calculus when placed against them.[14]

Thus, the effective removal of plaque and calculus by ultrasonic instruments is accomplished by:

- Vibration of the tip of the instrument which aids in removing the deposits.[14]
- Spraying and cavitation of the fluid which aids in the cleansing process.[8,16-18]

Ultrasonic scaling also produces considerable amount of aerosol spray which can act as a vector for micro-organisms and aid in spread of infection.[2-4,8,9] These scalers when used, produced a mixture of compressed air and water which spurts from the handpiece further mixing with patients saliva and blood forming a fine spray which ejects from the patient's mouth. This fine spray is called 'aerosol'.

The visible aerosols produced by an ultrasonic scaler or an air polisher are not the only aerosols produced by these instruments. These highly visible aerosols are made up of coolant water and in the case of an air polisher, some form of abrasive.[18]

Besides respiratory infection, the next most common area of infection are the 'Eyes'. Aerosol may carry microorganisms, small calcarious deposits and even minute pieces of filling and tooth resulting in acute conjunctivitis or even a scratch type lesion in the cornea and or sclera that could get infected.[19]

Many routine dental procedures produce aerosol and splatter composed of various combinations of water, organic particles, such as tissue and tooth dust and organic fluids such as blood and saliva.[14]

Ninety subjects having a plaque index (Silness and Loe)[10] score between 1 and 2 and gingival index (Loe and Silness)[10] score between 1 and 2 were selected for the study. The 90 subjects were divided into three groups, each group consisting of 30 subjects.

Group I

Logothesis (1995) proposed that when 0.2% chlorhexidine was used as a preprocedural rinse, fewer CFUs were developed.[20]

Bentley et al (1994)[13] observed that the larger salivary droplets generated during dental procedures settle rapidly from the air with heavy contamination on patient's chest and showed highest bacterial counts, next highest on plates positioned at the level of operator's nose followed by those at the level of assistant's nose.[7]

Muir et al (1978)[21] reported that a preprocedural rinse with chlorhexidine gluconate was effective than no rinsing, in reducing aerosols generated by ultrasonic scalers.

The enhanced efficacy of 0.2% chlorhexidine gluconate in reducing the CFUs could be because of the reason that chlorhexidine starts its antimicrobial action at the point of generation of aerosol and also at the time of onset of formation of aerosol.

Group II

Results showed that high volume suction is effective in reducing the number of microorganisms generated during ultrasonic scaling. This is in accordance with the data reported by King et al (1997).[9]

Harrel et al (1996)[8] demonstrated that the combination of a high volume evacuator device attached directly to the ultrasonic scaler handle will greatly reduce the amount of detectable aerosol contamination.

Comparison within groups showed that group II had significantly greater reduction in the level of aerosols as compared to group I ($p < 0.01$). The possible explanation for this difference may be direct capturing of the coolant water by the high volume suction.

Group III

Results of rinsing with 0.2% chlorhexidine gluconate showed that group III had statistically significant reduction in the level of aerosols compared to the control side ($p < 0.01$).

Comparison within groups showed that group III was significantly more effective than groups I and II in reducing the level of aerosols ($p < 0.01$).

This could be attributed to the combined effect of 0.2% chlorhexidine gluconate preprocedural rinse and high volume suction, i.e. antimicrobial action plus substantivity of chlorhexidine and direct capturing of aerosols by high volume suction.

SUMMARY AND CONCLUSION

The purpose of this study was to measure the efficacy of preprocedural rinsing and high volume suction used alone and together in reducing the level of viable bacteria generated in the aerosol during ultrasonic scaling.

Ninety subjects with plaque index[10] and gingival index[10] score ranging between 1 and 2 were selected and were divided into three equal groups. The first group used 0.2% chlorhexidine gluconate preprocedural rinse for 2 minutes, the second group consisted of patients in whom high volume suction was used during scaling and in the third group, both preprocedural rinse and high volume suction were used.

The results of this study showed that preprocedural rinse and high volume suction were effective when used alone as well as together in reducing the microbial load of the aerosols produced during ultrasonic scaling.

It can be concluded that: Preprocedural mouthrinsing using a bis-biguanide (chlorhexidine gluconate 0.2%) and high volume evacuator attachment is effective in reducing the amount of viable aerosols produced during ultrasonic scaling. But, high volume evacuator attachment is more effective than preprocedural mouthrinsing (chlorhexidine gluconate 0.2%) in reducing the amount of viable aerosols.

CLINICAL SIGNIFICANCE

The results of the study present a strong case for mouthrinsing before dental procedures and high volume suctioning during dental procedures. The dental professionals must realize their protective benefits in reducing the spread of microorganisms from the patient's mouth and, hence, the implementation of these protective methods in their day-to-day practices.

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