Research Article

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Effectiveness of Mouthwashes in Reducing Aerosol Contamination in the Dental Operatory

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ABSTRACT

Background: Aerosol production during ultrasonic scaling is a potent source of infection. This has become more of a concern during the present nCoV-19 pandemic outbreak to prevent cross-infection. Preprocedural mouthrinsing has been found effective in reducing the bacterial load of the generated aerosol. The aim of the present study was to evaluate and compare the efficacy of two different types of mouthwash containing Chlorhexidine & Herbal Extracts used preprocedural in reducing the bacterial load of the aerosol produced during ultrasonic scaling.

Materials and Methodology: 60 subjects reporting to the OPD and requiring ultrasonic scaling were randomly divided into three groups on the basis of agents used - Group I: Distilled Water (Control), Group II: Chlorhexidine (C), Group III: Herbal Extracts (H). Three sterilized blood agar plates were placed at three different positions in the previously fumigated operatory to collect aerosols. The plates were subjected to incubation for 48 hrs, and the Colony Forming Units (CFU) was counted.

Result: The mean CFU were recorded highest for Group I patients followed by Group III and Group II patients at all the positions.

Conclusion: In the present study, 0.2 % chlorhexidine was found to be the most effective preprocedural agent for reducing the bacterial load in the aerosol followed by herbal mouthwash.

Keywords: Aerosol, Ultrasonic Scaling, Chlorhexidine, Herbal Extract Mouthwashes, Preprocedural Mouth Rinsing.

INTRODUCTION

The dental operatory involves the dentists and allied staff to work in close proximity to the patients, and under these circumstances, the control of cross-infection has been considered to be one of the most important concerns. The infectious agents may get transmitted via many vectors which include surfaces, instruments and air [1]. The role of aerosol & splatter in causing cross-infection in patients and dental personals has been established for long [2]. Aerosols generated by dentists in a while working may contain solid particles and chemicals or gasses as well as bacteria and viruses [3].

An aerosol is a suspension of solid or liquid particles containing bacteria or viruses, suspended (for at least a few seconds) in a gaseous phase. The

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smaller particles of an aerosol (0.5-100 µm in diameter) have the potential to penetrate and lodge in the smaller passages of the lungs and are thought to carry the greatest potential for transmitting infections [2]. The WHO interim report on the provision of essential oral health services does not rule out the possibility of transmission of nCoV-19 (Novel Coronavirus 2019) in a dental operatory setting via direct transmission, indirect transmission & Aerosol Generating Procedures." [4]. Though aerosols are produced in many dental procedures, the one produced during ultrasonic scaling has a significant amount of oral microfloral contamination, and hence, it acts as a potential cause of infection [5].

Miller reported that aerosols generated from patient's mouth contained up to a million bacteria per cubic foot of air [6]. Other studies have reported the association of these aerosols with respiratory infections, ophthalmic infections, skin infections, tuberculosis and hepatitis-B [7]. Several methods are used to reduce aerosol contamination in a dental office such as high vacuum suction, patient positioning, use of rubber dam and preprocedural anti-bacterialll mouth rinses[8]. The commonly used mouthwashes for this purpose usually contain chlorhexidine (C) or herbal extracts (H).

Chlorhexidine is the gold standard antimicrobial mouthwash owing to its broad-spectrum antibacterial activity and prolonged substantivity of approximately 12 h; however, some side effects such as taste alteration, stained teeth, dry & sore mucosa has been reported [9]. India is the birthplace of Ayurveda, and medicinal value of plants has been utilized by humans for many centuries. Due to the presence of various naturally occurring bioactive compounds, they exert their medicinal effects. These herbal products are economical, with minimal side effects or dependence [10]. Mouthwashes containing herbal extracts with comparable anti-bacterialll spectrum have therefore emerged as an alternative to chemical mouthwashes.

Therefore, the present study was designed to evaluate and compare the efficacy of mouthwashes containing Chlorhexidine and Herbal Extracts using them as preprocedural rinsing agent in reducing the bacterial load of the aerosol produced during ultrasonic scaling.

MATERIALS & METHODOLOGY

A total of 60 participants (34 males & 26 females) requiring oral prophylaxis were selected from the patient pool reporting to the outpatient clinic of Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknow.

Patients scheduled for ultrasonic scaling with a minimum of 24 permanent teeth and a mean plaque score of 2.0–3.0 on the plaque index (PI) were included in the study [11]. Participants exhibiting good overall general health, nonsmokers, no history of periodontal treatment for the past six months, no history of antimicrobial therapy for the past six months, and no history of hypersensitivity to any drugs were included in the study. Exclusion criteria included pregnant and lactating females, patients with a history of trauma in the past six months, patients on phenytoin, calcium channel blockers, and cyclosporine medication, immunocompromised patients, or patients suffering from chronic systemic disease. An informed and written consent was obtained from each patient willing to participate in the study.

Patients selected by the above-mentioned criteria were randomly divided into three groups having twenty patients each:

• Group I (control) – The patients were asked to rinse with sterile water for 60 seconds 10 minutes before ultrasonic scaling

• Group II (C) – The patients were asked to rinse with 10 ml of 0.2% chlorhexidine mouthwash (Hexidine®, ICPA Health Products Limited, Mumbai, Maharashtra, India) for 60 seconds 10 minutes before ultrasonic scaling

• Group III (H) – The patients were asked to rinse with 15 ml of mouthwash containing herbal extracts (HiOra®, Himalaya Herbal Healthcare, Bengaluru, Karnataka, India) for 60 seconds 10 minutes before ultrasonic scaling

The demographic data (age & sex) and clinical characteristics (number of teeth present, PI, and probing depth) of all the three groups (control, C and H) have been summarized in Table 1. Ultrasonic scaling was carried out in all the patients after preprocedural rinsing by a single qualified dental professional in the previously disinfected operatory.

Table 1: Demographic and clinical characteristics (mean ± SD) of the groups

Characteristics	Group - I (control) n = 20	Group - II (C) n = 20	Group - III (H) n = 20
Age	36.60±5.45	37.30±3.78	36.80±4.16
Sex			
Male	12 (60%)	9 (45%)	7 (35%)
Female	8 (40%)	11 (55%)	13 (65%)
Teeth Present	28.60±2.80	27.70±1.70	29.30±3.37
PI	2.36±0.20	2.40±0.29	2.43±0.34
PD (mm)	3.94±0.62	3.86±0.54	3.74±0.62
PI- Plaque Index, PD – Probing depth, C- 0.2 % Chlorhexidine mouthwash, H- Herbal mouthwash			

Table 2 - Colony-Forming Units (mean±standard deviation) of three groups at three different locations after 48 hrs

Location of Blood Agar Plate	Group - I (control) n = 20	Group - II (C) n = 20	Group - III (H) n = 20	p
OC	236.70±23.68	110.70±19.47	182.60±32.17	<0.001
PC	245.90±37.46	123.40±21.54	196.30±19.86	<0.001
FF	74.40±21.02	28.60±7.11	37.60±10.18	<0.001
OC: Operator chest, PC: Patient chest, FF: At 4' distance at 4'O clock position, C: 0.2% Chlorhexidine mouthwash, H: Herbal mouthwash				

Table 3 - For each location, comparison of mean colony-forming units between the groups by Tukey test after 48 hrs

Comparisons	OC	PC	FF
control v/s C	<0.001	<0.001	<0.001
control v/s H	0.047	0.043	<0.001
C v/s H	<0.001	<0.001	0.037
OC: Operator chest, PC: Patient chest, FF: At 4' distance at 4'O clock position, C: 0.2% Chlorhexidine mouthwash, H: Herbal mouthwash			

While the patients were undergoing treatment, the aerosols were collected on three previously prepared and sterilized blood agar plates by fixing the plates on operator's chest (OC), patient's chest (PC), and at a distance of 4 feet at 4 "O" clock position (FF) as shown in Figure 1.

The blood agar plates were incubated for 48 hours, and the numbers of bacterial colony-forming units (CFUs) [Figure 2] were counted by a single investigator. In the present study, the type of bacterial growth on blood agar plate was not accessed. The recorded data were statistically analyzed.

Statistical analysis

Data were summarized as mean ± standard deviation. Groups were compared by one-way analysis of variance (ANOVA), and the significance of the mean difference between the groups was done by Tukey's post hoc test. Categorical (discrete) groups were compared by Chi-square test. A two-tailed $p < 0.05$ was considered statistically significant.

Figure -1: Ultrasonic scaling being done with blood agar plates fixed at predetermined positions.

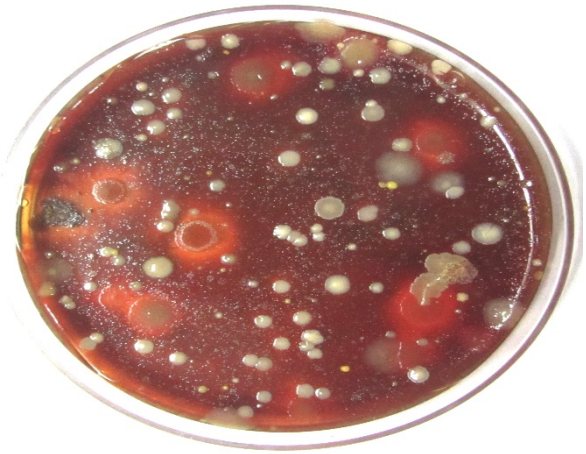

Figure - 2: Blood agar plates with microbial colonies after 48 hrs of incubation

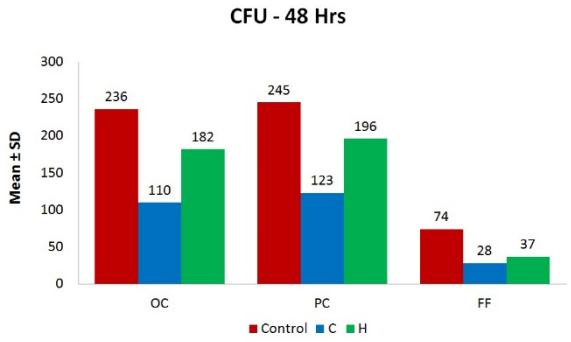

Figure -3: Mean Colony Forming Units (CFU's) after 48 hrs of incubation

RESULTS

The mean CFU of the groups (I, II & III) at three locations (OC, PC, and FF) were counted and analyzed after 48 h and has been summarized in Table 2 and also shown in Figure 3. At all locations, the mean CFU was highest in Group I followed by Group III and Group II. For each location, comparing the mean CFU between the groups, ANOVA revealed a statistically significant difference ($p < 0.001$) in CFU amongst the groups [Table 2].

Further, Tukey test showed that the mean CFU at both OC & PC lowered significantly in Group II ($p < 0.001$) and Group III ($p < 0.05$) as compared to Group I [Table 3]. The mean CFU in both Group-II and Group-III at FF lowered significantly ($p < 0.001$) as compared to Group-I. Also, at all the locations, a significantly lower CFU count was observed for Group-II compared to Group-III ($p < 0.001$ or $p<0.05$).

DISCUSSION

Dental procedures often involve usage of high-speed handpieces which causes thermal damage to the underlying pulp, and therefore water is used as a coolant. This result in the creation of spatter and aerosols contaminated with a patient's oral fluids. The dental literature have ample evidence reporting aerosol as a potent media for cross infections, causing measles, tuberculosis, pneumonia and severe acute respiratory syndrome (SARS) [12]. Researchers from the Netherlands reported the presence of 38 different microorganisms in the air of dental clinic [13].

In the current state of COVID pandemic, a group of researchers from china reported high expression of ACE2 (Angiotensin Converting Enzyme II) receptors, the cell receptors for nCoV-19 (Novel Coronavirus 2019) on oral mucosa suggesting oral cavity being high-risk transmitter of nCoV-19 [14]. Therefore, apart from practising "standard precautions", certain special guidelines have been issued for a dental practice which often includes – Triage, Social Distancing, Hand Hygiene including Sanitizers, PPE including FFP2/FFP3 masks and face shields, pre-procedural mouth rinsing, rubber dam isolation, high volume evacuator (HVE), high-efficiency particulate arrestor (HEPA) filters, surface disinfection etc.

Preprocedural mouth rinsing is one of the most effective methods of reducing the bacterial load of microorganisms in oral aerosols [15, 16]. A meta-analysis established that the use of preprocedural mouth rinse, including chlorhexidine, essential oils and cetylpyridinium chloride resulted in a mean reduction of 68.4% CFUs in dental aerosol [17]. However, the effect of preprocedural mouth rinse against n-CoV19 is still to be documented.

The present study was carried out to compare the efficacy of two mouthwashes in reducing the bacterial count in the aerosol produced during ultrasonic scaling. Chlorhexidine 0.2% is highly effective in inhibiting subgingival plaque formation and prevents the development of gingivitis [18, 19]. It has a broad spectrum of antimicrobial activity ranging from gram-positive organisms, gram-negative organisms, yeasts, dermatophytes to some viruses. Apart from the above benefits, it also possesses excellent substantivity property and hence is considered as standard gold mouthwash [8]. Hi-Ora™ mouthwash is a nonalcoholic herbal preparation made from natural herbs with their beneficial anti-cariogenic, antiplaque, antibiotic and anti-inflammatory properties [20].

The results demonstrate that the patient, operator, and people present in the operatory are exposed to a high number of bacteria during the procedure of ultrasonic scaling. The microbial load of aerosol reduced significantly in Group - II & Group - III after preprocedural mouthwash usage in comparison to the control group. The analysis of CFUs after 48 hrs revealed that 0.2% Chlorhexidine was most effective in reducing the bacterial counts in the aerosol followed herbal mouthwash.

Fine et al. (1992) reported the use of various plaque control agents as a preprocedural mouthwash to be effective in reducing bacterial count in aerosol when compared with distilled water or saline [21]. Thus, the result of this study was in accordance with the present study. In agreement to our study, another study carried out to compare 0.12 % chlorhexidine gluconate with essential oils mouthwash and distilled water, demonstrated a higher reduction in the bacterial counts with chlorhexidine [22].

A study undertaken to compare the effects of 0.12% chlorhexidine versus herbal mouthwash on gingival health reported chlorhexidine to be more effective in reducing the bacterial population and thereby greater reduction in gingival inflammation [23]. The results of the present study also suggest the superiority of chlorhexidine over herbal mouthwash in bacterial population reduction in the aerosol produced during ultrasonic scaling. Yadav et al. (2018) compared the antimicrobial effectiveness of 0.2% chlorhexidine, herbal mouthwash & essential oils mouthwash used pre procedurally in reducing the bacterial load of aerosols generated during ultrasonic scaling and reported herbal mouthwashes to be less effective than 0.2% chlorhexidine and essential oils mouthwashes which is in accordance to the present study[24].

In another study comparing the efficacy of aerosol reduction devices versus 0.12% chlorhexidine solution as a preprocedural rinse, it was reported that aerosol reduction suction device was more effective than 0.12% chlorhexidine in reducing the bacterial aerosol production. Also, the combination of aerosol reduction device and 0.12% chlorhexidine did not improve the results further [25].

The limitation of the present study is that only colonies formed by aerobic microbes capable of growth on blood agar culture plates were counted. The study did not include anaerobic culture technique, thereby excluding the oral anaerobic microbes. Also, the aerosol borne transmission of viruses was not accessed.

CONCLUSION

The oral cavity is a reservoir of a large number of microbes including bacteria and viruses. Routine dental practice includes the use of high-speed handpieces causing aerosol production, thereby increasing the risk of cross-infection to the patients and dental health care workers. The present study clearly demonstrated that the microbial load of the aerosol is greatly reduced by preprocedural mouth rinsing.

This study reinforces the significance of preprocedural mouth rinsing by the patients prior to any dental treatment apart from standard precautions being followed for infection prevention and control in dental settings as recommended by the CDC. In the present study, 0.2% chlorhexidine was found to be more effective preprocedural mouthwash agent than herbal mouthwash agents in reducing the bacterial load of aerosol produced during ultrasonic scaling.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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