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A microbiological study to evaluate the efficacy of ozone treatment to eliminate bacteria from mobile covers

[1]Gaurav V. Vaishnav, Post Graduate student, Department of Prosthodontics and Crown & Bridge, Narsinhbhai Patel Dental College and Hospital, Visnagar, Gujarat, India.

[2]Sareen Duseja, MDS, Professor, Department of Prosthodontics and Crown & Bridge, Narsinhbhai Patel Dental College and Hospital, Visnagar, Gujarat, India.

[3]Vilas Patel, MDS, Professor and Head, Department of Prosthodontics and Crown & Bridge, Narsinhbhai Patel Dental College and Hospital, Visnagar, Gujarat, India.

[4]Birood Patel, MDS, Reader, Department of Prosthodontics and Crown & Bridge, Narsinhbhai Patel Dental College and Hospital, Visnagar, Gujarat, India.

[5]Zeel V. Somani, Post Graduate student, Department of Prosthodontics and Crown & Bridge, Narsinhbhai Patel Dental College and Hospital, Visnagar, Gujarat, India.

[6]Sejal Gopani, Post Graduate student, Department of Prosthodontics and Crown & Bridge, Narsinhbhai Patel Dental College and Hospital, Visnagar, Gujarat, India.

Corresponding author: Gaurav V. Vaishnav, Post Graduate student, Department of Prosthodontics and Crown & Bridge, Narsinhbhai Patel Dental College and Hospital, Visnagar, Gujarat, India.

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Abstract

Introduction: In 1920s Dr Edwin Parr, a Swiss dentist, started to use O_3 as part of his disinfection system. Ozone is a powerful oxidant and bactericidal agent. By using its properties, it was selected to disinfect mobile covers. **Aim:** In this study, Ozone was used to disinfect the mobile covers of health care workers.

Materials and method: 20 Mobile Covers of post graduate students were selected as sample. Sterile wet swab was rubbed on the cover for pre treatment culture. After that, ozone generator was used to fabricate ozonated water.During this process mobile cover was kept into water. After 15 minutes cover was removed from the ozone water and again with the sterile swab culturing procedure was done. Petri dish was kept into the incubator for 24 hours at 37˚C temperature. Next day, developed colonies were counted and listed into master table. Wilcoxon signed ranks test was done for statistical analysis of the results.

Results: Mean bacterial countreduced from 412.65 ± 118.28 to 48.85 ± 23.25 after treatment. According to Wilcoxon signed ranks test, significant reduction was present in bacterial count before treatment to after treatment with Ozone Therapy. ($P \leq 0.05$)

Conclusion: Ozone can be used as an antimicrobial agent on a regular basis to diminish bacterial colonization and its harmful effect.

Keywords: Ozone, Mobile phones, disinfection, Health care worker.

Introduction

Ozone (O_3) was discovered by Schonbein in 1840, andits employment in industrial environments has a formidable history. The American Indian, for them fishing was central food source, noted a relationship between a successful catch and a robust odor generated by the action of lightning following an electrical storm, same relation also noted by the ancient Greeks who named this odor ‘‘ozein’’. These cultural groups fished following electric storms. This phenomenon is understandable by an elevated generation of O_3 in this biosphere since the upper layer of lake water is enriched with O_2.[1]

Christian Friedrich Schönbein (1840), is regarded as the Father of ozone therapy. In 1857a German physicians, Joachim Hänsler and Hans Wolff, developed the first O_3 generator for medical treatment purpose.Dr. C. Lender (1870) purified the bloodin test tubesby using O_3. In 1881, ozone was used as a disinfectant in the treatment of diphtheria. A Florida physician, Dr. Charles Kenworthypublished the book Ozone in the Florida Medical Association Journal, which details the use of ozone on therapeutic purposes. In 1896 Ozone generating system patent was done by Nikola Tesla. In the early 20th century Food and Drug Act revised its use and effect in the field of medicine. In 1920s,a Swiss dentist, Dr. Edwin Parr started to use O_3 as part of his disinfection system. In 1950, a German dentist, Dr. E.A. Fisch applied ozonated water for dental procedures, in1959; an O_3 machine (Ozonosan)was patented by Dr. Joachim Hansler which build the basis of the expansion in German ozone therapy. The first O_3 research center was founded in Cuba. The International Ozone Institute (IOI) also known as the International Ozone Association.

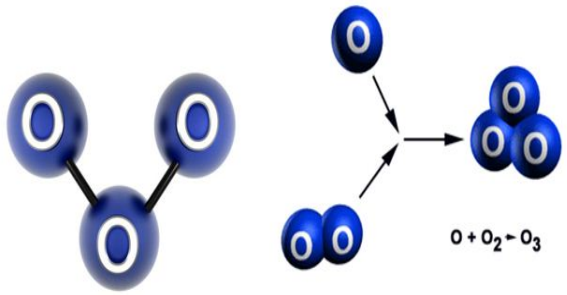


Figure 1: Ozone structure

Ozone (O_3) is a triatomic molecule (Figure 1), it contains three oxygen atoms. Its molecular weight is 4798 g/mol.[2]It is produced when UV light strikes the oxygen rising from plants, plankton, and algae in our forests and seas. It then falls back through the atmosphere, as it is heavy in comparison to air, it combines with pollutants and water, and it cleans the air and forms peroxides that benefit plants.[1] Ultraviolet light breaks down pollutants and nitrous oxides.Itcan produce ozone at the ground level, which is the eye and lung irritant in smog. Ozone is an unstable gas and it quickly release nascent oxygen molecule and converted into oxygen gas. The release of nascent oxygen is believed to have beneficial effects on every part and organ.[1]

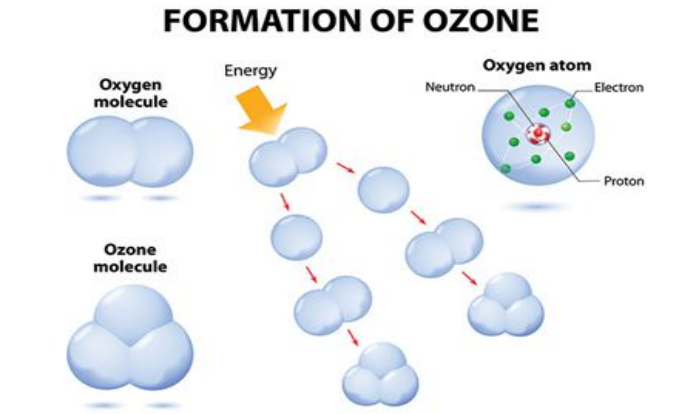


Figure 2: Ozone formation

It's been used in the medical field for the past so many years because of its extremely strong oxidizing property that oxidizes nearby all surfaces to the very best oxidation stage. It's utilized in circulatory enhancement and stimulation of oxygen metabolism, disruption of tumor metabolism and to kill pathogens.[3]

Ozone (O_3) is present in small amounts in atmospheric air. The earth's natural way of self-cleansing is completed by ozone molecules as it reserved within the upper layer of the atmosphere in abundance. [4-6]

Ozone therapy became an inherent element of the treatment of infection in many fields like surgery, dermatology, cosmetics, and dentistry.[7] Controlled ozone application has been found to be extremely safe, free from side effects.[8] Bactericidal, virucidal, and fungicidal activity of ozone is commonly known and has been exploited for years in industry and medicine.[9]

The goals of oxygen/ozone therapy are to eliminate the pathogens, restoration of proper oxygen metabolism, and induction of a friendly ecologic environment, to energizing circulation, immune activation, and stimulation of the humoral anti-oxidant system.[10]

Raghavendra Rao Morubagal *et al.* [11]in 2017 reveal that there is definite colonization of bacteria on mobile phones of the health care workers. It is not only capable to transfer messages but also disease-producing microbes. So as to cut back incidence of nosocomial infections, there should be implementation of hand washing practices and regulations around the use of mobile telephones in hospital settings.

In this study, new method to disinfect the mobile cover was proposed. Maximum bacteria were present on mobile cover and on the screen, as ozone is understood to be a robust oxidative agent, it had been planned to disinfect mobile cover with it.

Methodology

Twenty smart phone covers of post graduate students, which were consistently in use since 3 monthswere taken as sample (Figure 3). All instruments used for microbial test were autoclaved. Autoclaved swab was dipped into sterilized water and was rubbed on the outer surface of the cover for culturing (Figure 4). Directly same swab was streaked into the nutrient agar media and then cover was transferred to the ozone chamber containing autoclaved water. In this study, ozone water was fabricated by the ozone generator (500mg per hour capacity) (Figure 5).Ozone treatment was given for 15 minutes. After completion of cycle, the cover was removed and with the fresh autoclaved swab culturing was done. The culture media was kept into the incubator at 37˚C temperature for 24 hours. All the microbiological procedures were performed in controlled atmosphere (Laminar air flow). One agar plate was kept opened while performing above procedures for environmental monitoring (Figure 6). Developed colonies (Figure 7) were examined and counted to make quantitative outcome of the study. The recorded data was listed for statistical analysis.

Figure 3 : Samples for study

Figure 4: Sample collection

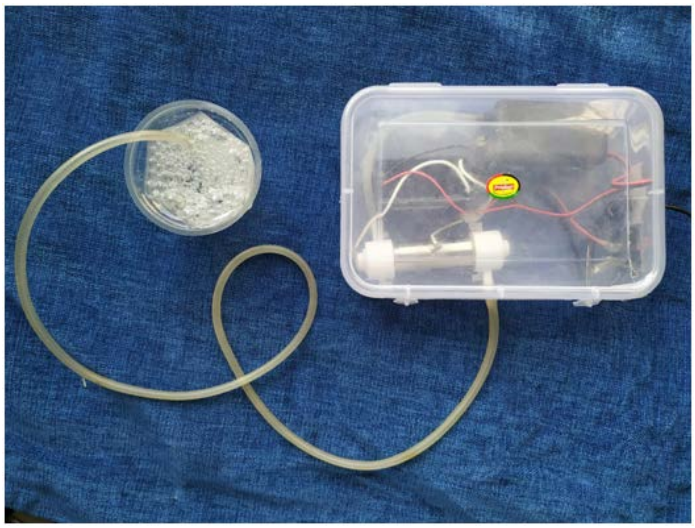


Figure 5: Ozone generator

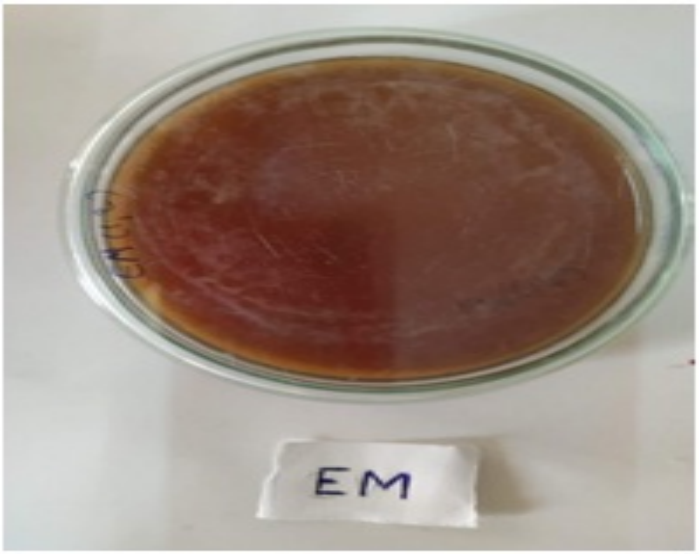


Figure 6: Environmental monitoring plate

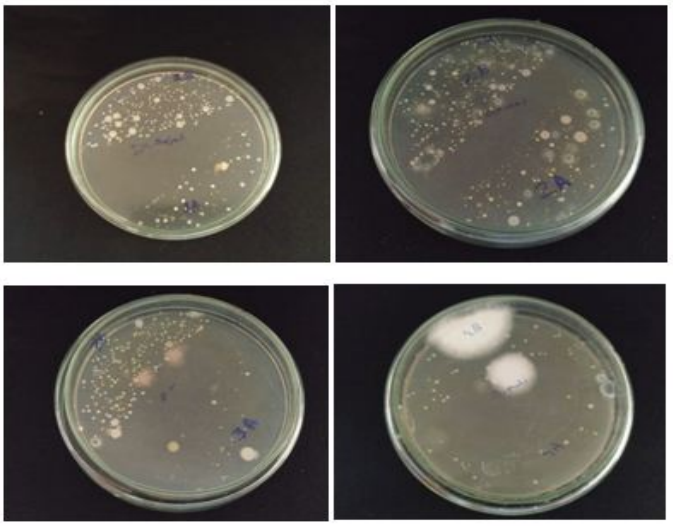


Figure 7: Sample shows bacterial colonies

Results

Table 1: Bacterial count pre and post treatment of ozone

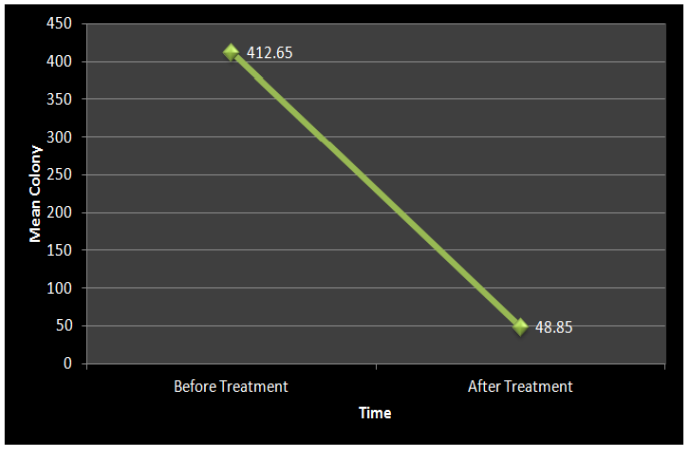
Sr No.	Bacterial colonies before treatment	Bacterial colonies after treatment
1	290	100
2	334	95
3	420	44
4	328	65
5	645	35
6	264	75
7	298	25
8	396	20

9	470	66
10	536	32
11	524	54
12	436	43
13	288	41
14	355	32
15	298	23
16	610	70
17	474	54
18	265	23
19	528	37
20	494	43
	8253	977

Table 2: Distribution based on Bacterial Colonies (Wilcoxon Signed Ranks Test)

Time	Number	Bacterial Colony		P Value
		Mean	SD	
Before Treatment	50	412.65	118.28	0.000 S
After Treatment	50	48.85	23.25	

Mean bacterial count was reduced from 412.65 ± 118.28to 48.85 ± 23.25 after ozone treatment. Statistically, significant reduction was present in bacterial count before treatment to after treatment with Ozone Therapy. ($P \leq 0.05$)



Graph 1: shows decreased mean colony count after ozone treatment

Discussion

The mobile phones have become multi-purpose non-medical devices used in the healthcare line and in the community. It has become an important means of communication in the community and in the healthcare facility for taking photographs, collecting epidemiological data and monitoring chronic diseases. There is no restriction of mobile phone usage in healthcare facilities, including specific, susceptible areas like the operation room and ICUs, regardless of their unknown microbial load.[10]

The constant handling of mobile phones by different users exposes to an array of micro-organisms and thus makes a good carrier for microbes. Due to the moisture and optimum temperature of human skin of our palms along with heat generated by mobile phones favors the colonization and multiplication of micro-organisms, so these devices can harbour various potential pathogens and serves as an exogenous source of nosocomial infection among hospitalized patients.[11]

Raghavendra Rao evaluated 92.80% of HCWs mobile phones and 57.50% of non-HCWs mobile phones have microbial growth.[11] Similar Studies performed-by Marwa *et al.*[12], Jaya Lakshmi *et al.*[13], Neha Sharma *et al.*[14]and Ulger *etal.*[15]have found same results.

In contrast to above study, Nehasharma *et al.*[14] have reported 80% of contamination of mobile phones among non-HCWs. Arora *et al.*[16] however reported (41%), lower bacterial contamination of mobile phones. The difference in the contamination rate may be due to the variation of the study participants in adherence to infection prevention, the pattern of mobile phone use, mobile phone keeping habits and personal behavior.

Several studies also revealed that HCWs do not consider mobile phones to be contaminated items and rarely disinfect their phones.[17] Hand washing is the most

effective method for the prevention of bacterial transmission. Even though there is strict rule on hand hygiene in hospitals, it is not possible to provide de-contamination, disinfection or sterilization of each device used personally. Even though the presence of some items can be restricted in the hospital setting, it is not possible to limit the use of mobile phones by HCWs due to their indispensable benefits. The Centers for Disease Control and Prevention (CDC)'s guidelines for environmental infection control in healthcare facilities recommend periodic disinfection after cleaning instruments and surfaces that often come into contact with the hands, such as computer keyboards and mouse, as defined by the infection control committee.[18]

Different factors were associated with contamination of mobile phones. Male health professional's mobile phones were more contaminated. This is similar to a study conducted in India [19] and Iran [20]. However, this was in contrast to the findings of Pal *et al*.[21] and Shooriabi *et al*. [22] who reported no such sex association. The difference might be due to a female's habit of keeping their mobile phones in a handbag and using phones less frequently in the hospital setup. This is also evident in the present study where most females (66.7%) did not use their mobile in a hospital environment.

Higher bacterial contaminations seen in health professionals who did not clean their mobile phone in compare to those who regularly clean their mobile phone. This was supported by other studies [23, 24, 25, 26]; a past study reported a significant decline of mobile phone contamination after treating it with 70% isopropyl alcohol.[27] One of the study concluded that professionals who aware of phone contamination did not clean their mobile phones as they were afraid that contact with water or liquid disinfectant might damage the mobile phones.[28]

This study was conducted to remove bacteria from mobile cover as most of bacteria are present on mobile cover. Cover of mobile can be removed and disinfected separately, so there are no chances of damage to mobile phone.

Ozone was applied on mobile cover and checked for diminished bacterial count on mobile cover (Table 1). On basis of Pre and post treatment bacterial count, the result was evaluated with Wilcoxon Ranks Test for statistical analysis (Table 2). The mean bacterial count difference pre and post treatment is presented in graph (Graph 1).

Mean bacterial count was reduced from 412.65 ± 118.28 to 48.85 ± 23.25 after ozone treatment. Statistically, significant reduction was present in bacterial count before treatment to after treatment with Ozone Therapy ($P \leq 0.05$).

Summary

In this fast-growing generation, treatments are being searched for the ease and effectiveness of treatments. In this study, ozone was used as an antimicrobial agent to cleanse the mobile covers. When ozone water was applied as an antimicrobial agent the effect of ozone was seen with microbiological tests, the results of which show a drastic reduction of bacterial colonies after the ozone water treatment on a mobile cover. Ozone does not show side effects on mobile covers material.

In this study, we have used ozone generator for ozone treatment of mobile cover. For the microbiological study, sterile wet swabs were used for culture. Both pre and post treatment culture was performed and it was kept in incubator for 24 hours at 37ºC. Once the bacterial growth occurred counting of the total colonies was done and listed (Table 1). Wilcoxon signed ranks test used for statistical analysis. Result of this study showed clear reduction of bacterial colonies after ozone treatment on mobile covers. Here we have performed quantitative microbiological test

to evaluate the total reduction of colonies. For the qualitative microbiological test, further study is required. On basis of this study we can say that ozone can be used as effective & efficient anti microbiological agent for disinfecting the mobile covers.

Conclusion

Within the limitations of this study, It can be concluded that Ozone can be used as an antimicrobial agent on a regular basis to diminish bacterial colonization on mobile covers and its harmful effect.

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