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Assessment of efficacy of ultraviolet chamber in disinfecting dental instruments

Rahul G. Naik[1], Arun S. Dodamani[2], Prashanthkumar Vishwakarma[3], Mahesh R. Khairnar[4]* Harish C. Jadhav[5], Manjiri A. Deshmukh[6]

1 Senior Lecturer, Department of Public Health Dentistry,A.C.P.M. Dental College, Dhule, Maharashtra, India.
2 Principal, Professor & Head, Department of Public Health Dentistry,A.C.P.M. Dental College, Dhule, Maharashtra, India.
3 Reader, Department of Public Health Dentistry,A.C.P.M. Dental College, Dhule, Maharashtra, India.
4 Assistant Professor, Department of Public Health Dentistry, Bharati Vidyapeeth Deemed University Dental College and Hospital, Sangli, Maharashtra, India.
5 Senior Lecturer, Department of Public Health Dentistry,A.C.P.M. Dental College, Dhule, Maharashtra, India.
6 Senior Lecturer, Department of Public Health Dentistry,Swargiya Dadasaheb Kalmegh Smruti Dental College & Hospital, Nagpur, Maharashtra, India.

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*Corresponding author:

Email : kmahesh222@gmail.com
Tel.: +91 - 7045653288

ABSTRACT

Cross-contamination has been a major concern for both the practitioner and the patient in recent years. Various sterilization equipment's throw the challenge to choose the best available in the market. Hence the present study was conducted to assess the efficacy of UV disinfection chamber.The present study was an *in vitro* study conducted using contaminated dental instruments. Autoclaved dental Instruments were used to obtain the swab from carious lesion. These specimens were then inoculated on blood agar and incubated at 37^0C for 24 hrs and colony forming units were determined. Thereafter, these instruments were kept in Ultraviolet (UV) Chamber for 5 minutes and again they were inoculated on blood agar to determine colony forming units. Same experiment was performed for keeping the instruments in UV cabinet for different time periods i.e. 10 minutes, 15 minutes, 20 minutes, 25 minutes, 30 minutes, 45 minutes and 60 minutes. and no. of colony forming units (CFUs) were again determined before and after keeping the instruments in UV cabinet . The values were subjected to descriptive statistical analysis. UV Disinfection Chamber is most effective when instruments are kept in UV chamber for a period of 45-60 minutes. Thus UV Disinfection chambers can be used in dental offices as well as dental outreach program as an effective tool for disinfection of instruments.

INTRODUCTION

It is rightly said *"Cleanliness is indeed next to godliness"*. Efficient sterilization technique has been the cornerstone in the prevention of spread of infections and ultimately infectious diseases. Many oral and systemic disease causing organisms can be easily transmitted from the oral cavity through contaminated instruments or materials, if proper infection control protocols are not followed[1].The rising concern about transmission of infectious contagious diseases AIDS, Hepatitis, Tuberculosis, etc. between dentists, patients, dental auxiliaries has shifted the focus back on control of cross-infections.

Dentists are at great risk of getting exposed to such disease causing pathogens as they often come in contact with contaminated sharp instruments, oral surgical sites contaminated with blood, etc. failure to properly clean/ sterilize/ disinfect such contaminated or used instruments from previous patient will pose a threat of infection for subsequent patient[1]. This mode of transfer of pathogens is known as cross-contamination and the resultant infection being cross infection.

Sterilization, by definition, is the destruction of all microorganisms, spores, viruses [2]. It can be achieved by moist heat, dry heat; use of chemicals, chemical vapor, etc [3]. Use of autoclave or hot air oven for sterilization of the instruments has been the universally accepted method. But it has certain limitations like time consuming, heavy, requiring trained personnel to operate, corrosion of metal instruments and cannot

be used with heat labile items [4].

However, a disinfection process is one that is intended to significantly reduce the number of pathogenic microorganisms on instruments by removing and/or killing them. Bacterial spores are not necessarily killed by disinfection, however their numbers may be reduced as a result of the cleaning process [2]. High level disinfection of previously cleaned instruments and equipment can produce items with very low likelihood of any pathogenic microorganisms remaining. A high-level disinfectant can kill all microorganisms except a high level of bacterial spores, while a low level-disinfectant will kill most vegetative bacteria, some fungi, and some viruses [2]. It can be accomplished by use of certain chemicals or wet pasteurization. But treatment with chemicals can corrode or rust the metal instruments.

Hence, there is a need to search for an effective alternative for achieving proper cleansing of the instruments using a simple, effective, affordable method which could be implemented in dental offices as well as dental outreach programs. Hence, the proposed alternative for asepsis is Ultraviolet light chamber/cabinet. It is a feasible, easy-to-use and hassle-free option for serving the underprivileged population in the most aseptic way possible. There is dearth of literature regarding its efficacy on dental instruments. Hence, the present study was designed with an aim to check the efficacy of UV disinfection chamber at different intervals of time period.

MATERIAL AND METHODS

The present study was an in-vitro study. Ethical Clearance for the present study was obtained from the Institutional Review board. Ultraviolet storage cabinet (Denfort International, Ambala Cantt), installed in the department of Public Health Dentistry was used for the study.

Dental Instruments were autoclaved and the working ends of the instruments were used to take the swab from the carious lesion of patients reporting in the department.Five swabs using five different instruments were obtained from the same tooth. These instruments were properly packed in sterile self-sealing flat plastic pouches immediately and were transported to Microbiology Laboratory. The specimens were inoculated on blood agar plates. These plates were incubated at 37°C for 24 hrs and no. of colony forming units were determined using digital colony counter (Lab Hosp Digital Colony Counter LHC 06). After initial inoculation, the instruments were kept in UV chamber for 5 minutes and the instruments were taken out of UV chamber and again inoculated on blood agar plate and no. of colony forming units (CFU) were again determined. Same experiment was performed for keeping the instruments in UV cabinet for different time periods i.e. 10 minutes, 15 minutes, 20 minutes, 25 minutes, 30 minutes, 45 minutes and 60 minutes. and CFUs were again determined before and after keeping the instruments in UV cabinet . The values were subjected to descriptive statistical analysis.

RESULTS

Results show that there was gradual reduction in microbial colony forming units (CFU's) as the time period for keeping the instruments in UV chamber increased (Table 1). Maximum reduction (99.62%) in microbial colony forming units was seen when contaminated instruments were kept in UV chamber for about 60 minutes followed by 45 minutes of the keeping time where almost similar reduction was seen (99.56%). Least amount of reduction (69.55%) was seen when instruments were kept in UV chamber for about 5 minutes.

DISCUSSION

Dentist and their assistant are at high risk of developing diseases when treating patients with infectious diseases. Hence, effective infection control is necessary during dental treatment procedures to reduce the possibility of cross-contamination and ultimately to reduce disease transmission. A variety of disinfectant materials are available in the commercial market. But each of these disinfectants carries their own benefits as well as limitations which have been proved in previous studies. For example, some researchers claim glutaraldehyde to be effective for disinfection, but others have shown it to be toxic which makes it unsuitable for daily clinical use [5].

Ultraviolet (UV) radiation is defined as a portion of the electromagnetic spectrum between x-rays and visible light. The UV spectrum is commonly subdivided into three sections: UVA (wavelengths of 400 nm to 315 nm), UVB (315 nm to 280 nm), and UVC (280 nm to 200 nm). The sun is a primary natural source

Table 1. : % Reduction in colony forming units (CFU) at different time intervals

Time	Pre Score	Post Score	% Reduction
5 min	220.3±1.52	67.33±0.57	69.55
10 min	212.33±1.51	38.66±0.57	81.80
15 min	366±3.16	57.33±1.1.5	84.34
20 min	156.66±1.52	23.33±1.15	85.45
25 min	611.66±0.57	82.66±1.52	86.49
30 min	111.66±1.52	13.33±0.58	88.06
45 min	533.66±1.52	2.33±0.58	99.56
60 min	617.66±0.58	2.33±0.58	99.62

of UV radiation. Artificial sources include curing lamps, tanning booths, germicidal lamps, black lights, halogen lights, mercury vapor lamps, high-intensity discharge lamps, fluorescent and incandescent sources, and some types of lasers (nitrogen lasers, excimer lasers, third harmonic Nd:YAG lasers) [6].The UV light of 200-280 nm (UVC) wavelengths is lethal to bacteria, bacterial spores, viruses, mold, mold spores, yeast, and algae. UVC radiation denatures the DNA of microorganisms, which have a high absorbance of the UV spectrum at 254 nm. Denaturing is caused by the formation of pyrimidine dimers, resulting in the inactivation of the bacterium by blocking DNA replication. While using dental UV chamber the wavelength used is 254 nm which is quite effective for disinfecting [4].

The current study was conducted to evaluate the efficacy of UV Rays using Clinical UV cabinet to disinfect contaminated dental instruments at different time intervals. In the present study, it was seen that efficacy of UV cabinet in disinfection of instruments increased as the time period increased. Largest amount of reduction in bacterial colony forming units (99.56% 99.62% reduction) took place when instruments were kept in UV cabinet for a period of almost 45 to 60 minutes. Least amount of reduction in colony forming units took place when instruments were kept in UV cabinet for a period of 5 minutes.

Since there is dearth of literature on efficacy of UV rays on contaminated dental instruments, present study cannot be compared with any other previous study. However, there are various studies conducted to check the efficacy of UV rays on other contaminated dental impressions, to disinfect root canal walls, for sterilizing tools used for surgically implanting transmitters into fish, etc [6]. A study conducted by Anand V to compare the efficacy of ultra-violet light (U-V light) and direct current glow discharge in disinfecting Candida Albicans coated elastomeric impression material exhibited proportionate decrease in the number of colonies with each greater time of exposure [7]. Another study evaluated the use of clinical UV cabinet to disinfect various impression materials at different time intervals and its comparison with 2% glutaraldehyde using standard immersion technique. It was seen that UV rays were effective in disinfecting the impression materials [8].A study conducted to assess Efficacy of Different Disinfectant Systems on Alginate and Addition Silicone Impression Materials of Indian and International Origin showed UV disinfection system to be most effective among all the disinfection systems used [9].

Another study concluded that UV radiation was effective at disinfecting forceps (tools used for surgically implanting transmitters into fish) exposed to three different bacteria and for all UV radiation durations [4]. A study conducted to test the application of ultraviolet light to root canal walls, as a means of complementary immediate disinfection after the use of sodium hypochlorite found negative bacterial cultures in 96% of the cases with sodium hypochlorite followed by ultraviolet light as compared to cases with sodium hypochlorite alone (47%) [10]. Studies have also demonstrated that UV sanitizers effectively kill bacteria, germs and microorganisms up to 99% in toothbrushes [11,12].

Blood agar was used for as culture media in the present study as it is easily available, economical and enriched media [13]. Present study employed commercially available UV cabinet which is used to store the sterilized instruments until they are used. But UV cabinet has shown efficacy even on contaminated dental instruments as seen in present study. It removes the possibility of corrosion or surface deterioration of metal instruments as in case of chemical disinfectants [2,14]. Thus, the present study clearly revealed the efficacy of ultraviolet light in disinfecting the surface of dental instruments by decreasing the bacterial colony counts of coated over the surface of instruments when kept for 45-60 minutes.Hence it is recommended that instruments can be kept in UV chamber for at-least 45 minutes (since 45 minutes and 60 minutes storage time had almost similar effect on reduction of bacterial colony counts) after initial cleaning procedure. Also, it can be effectively used in dental outreach programs to disinfect the instruments since it is easy to operate and doesn't involve constraints like requiring trained operators as in case of autoclave.

Since this is the first study which conducted the efficacy of UV disinfection chamber on contaminated dental instruments; it can lay foundation for further research to take place on larger scale. Also we didn't compare UV chamber's efficacy with any other means of disinfection. Hence it is recommended to compare the efficacy of UV disinfection chambers with other disinfection systems available in commercial market.

CONCLUSION

Thus UV Disinfection chambers can be used in dental offices as well as dental outreach program as an effective tool for disinfection of instruments.

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