EFFECTIVENESS OF ULTRAVIOLET LIGHT ON THE DISINFECTION OF COMPLETE DENTURES.

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ABSTRACT

Aims: To evaluate the disinfection potential of different exposure times of Ultraviolet Light (UV-light) on upper removable complete dentures.

Materials and Methods: A total of 100 patients with upper complete dentures were selected randomly to be involved in this study. All of the tissue sides of the involved dentures were exposed to four shots with 5 minutes to each. Swap sampling of each exposure to the UV-light (5-20) minutes was collected and cultured. Colony forming unit (CFU) for each of isolated species was determined based on grown of bacterial colonies.

Results: A total of 34 strains of bacteria distributed between 12 strains of Gram-negative and 22 strains of Gram-positive were diagnosed. The sensitivity of these bacteria to various shots of UV-light was variable between Gram-negative and Gram-positive. Colony counts of some isolated was noted to decrease along with increase the exposure time of UV-light. Two isolates of Gram-negative and 6 isolates of Gram-positive were shown more sensitive to UV-light as indicated by the absence of growth after first shot of light (5 minutes). Some types of bacteria exhibited resistance to the first two shots of UV-light (10 minutes) and their growth started to decline after the third shot (15 minutes).

Conclusions: This study showed that removable dentures could be disinfected with UV-light.

Keywords: Vitek2, Ultraviolet Light, Complete Denture, Gram-negative, Gram-positive

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INTRODUCTION

One of the most important parts of oral hygiene for denture wearers is the regular cleaning of dentures. Removable dentures can anchor both oral bacterial and fungal microorganisms. Moreover, unclean dentures predispose the wearer to denture stomatitis (Nair et al, 2016; Čanković et al, 2017). Cleaning is the elimination of all strange material like blood, saliva, and debris from an objects. While, the removal of pathogenic microorganisms from an objects are the decontamination (Oussama and Ahmad, 2014; Duyck et al, 2016). Disinfection is the process that eliminates many to all pathogenic microorganisms on nonlivingsubstances except bacterial endospores. While sterilization is the entire removal of all microorganisms including spores (Rutala and Weber, 1999). In general, it was found that the majority of the denture wearers have limited knowledge of denture cleansing and oral hygiene practices (Barreiro et al, 2009; Apratim et al, 2013; Shankar et al, 2017). Many available studies have evaluated the typical methods used to clean dentures by denture wearers. In general, different methods have been found however the most commonly used one is brushing with water and toothpaste (Apratim et al, 2013; Axe et al, 2016). But a progressive impairment to acrylic resin has been shown with continued brushing specially when inappropriate brushes or sever abrasives are used (Oussama and Ahmad, 2014). While, soaking in disinfectant solutions like household bleach was highly antimicrobial but cause corrosion to the metal dental prosthesis components. Isopropyl alcohol and alcohol based mouthwash were antimicrobial but damaged the surface of polymethyl methacrylate (Kiesow et al, 2016). Al-Janabi and Al-Baghadi in (2019) reported that fungal isolates and one of the bacteria (Staphylococcus aureus) were decreased in number after exposure to X-radiography and to CT scan. Ultraviolet light is the electromagnetic irradiation with a wavelength shorter than that of noticeable light, but longer than X-rays, which are in the extent between 400nm and 100nm (Tamuriet al, 2014). Because of the ability of Ultraviolet light to cause chemical reactions and stimulate fluorescence in materials, it has a massive number of beneficial applications in modern medicine, for diagnostic and therapeutic purposes. One of the oldest method humans have been used for decontamination are the UV rays; it is used for inactivating viruses, bacteria and fungi (Panov and Papancheva, 2015). Several studies investigate the effect of different disinfectants on acrylic...
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resin including mechanical, chemical and irradiation in an ultraviolet light. They presented that UV irradiation could be an effective alternative to other methods for disinfection of acrylic resin denture base. Moreover, use of UV-light to disinfect denture was suggested to overcome problems associated with mechanical and chemical methods (Lee et al, 2011; Yildirim-Bicer et al, 2014; Binns, 2018). Ultraviolet radiation used by Metzger et al in (2007) as an immediate disinfection for root canal walls. It was found that only 47% of the cases achieved negative culture with sodium hypochlorite alone while 96% was achieved with sodium hypochlorite followed by ultraviolet light and this result continued after 14 days. In the present study it was decided to use Vitek 2 automated microbiology system for counting and identification of gram negative and gram positive microorganism. Vitek 2 automated microbiology system and its application in the direct rapid identification of microorganisms (Nimer et al, 2016). Moreover, Pincus, in (2014) concluded that Vitek 2 is an automated microbial identification system that provides highly precise and reproducible results. With its colorimetric reagent cards, and associated hardware and software advances, the Vitek2 offers advanced technology platform for phenotypic identification methods. Aim of the study was to investigate the effect of UV-light on the growth of the oral bacteria on the heat cure acrylic denture base in-vivo, for truthfulestimation, using Vitek 2 system.

MATERIALS AND METHODS

Patients
A total of one hundred patients with upper complete denture including fifty males and fifty females at age 40-60 years were selected randomly to be involved in this study. Excluded patients included patient with denture stomatitis. This study was carried out in private clinical office of dentist in Kerbala from 1 June 2018 to 1 July 2019. All upper complete dentures were rinsed thoroughly under clean running water in order to remove all visible contamination, food, saliva, etc. The tissue sides of the involved upper complete dentures were under exposure to ultraviolet light (ASTRALUX-Super 2000/ Austria) of 220 volts and 520W. Exposure was represented by four shots, each shot take 5 minutes of exposure. For collecting of samples, a disposable transport cotton swab was attached to the left side of the tissue side of upper denture base before treatment. Then the tissue side of the upper denture was exposed to the UV-light for 5 minutes and then a disposable transport cotton swab was attached to the right side of the tissue side of upper complete denture and then repeat the denture to the apparatus for further 5 minutes and take another swab. This procedure was repeated for another three times with 5 minutes for each shot. All the upper dentures included in the study were exposed to UV-light from 5-20 minutes. Then all the swabs immediately grouped and transferred to the laboratory for bacteriological study.

Colony counting of bacteria
Collected swab samples before treatment and for the four shots of UV-light were cultured on two different types of culture media, including blood agar and MacConkey agar (HiMedia, India). Inoculated cultures were incubated at 37 °C for 24 hours. Colony counting of all isolated species of bacteria for each shot of UV-light was determined for all isolated species as colony forming unit (CFU). Grown bacteria were diagnosed by Vitek2 system (bioMérieux, France) using of Gram-positive and Gram negative cards.

RESULTS
Diagnosis of isolated bacteria showed the presence of 34 strains of bacteria distributed between 12 strains of Gram-negative and 22 strains of Gram-positive. The sensitivity of these bacteria to various shots of UV-light was variable between Gram-negative and Gram-positive. Colony counts of some isolated was noted to decrease along with increase the exposure time of UV-light as with 4 isolates of Gram-negative, including Acinetobacter haemolyticus, Aeromonas salmonicida, Pseudomonas fluorescens, and Ralstonia insidiosa and 6 isolates of Gram-positive, including Kocuria rosea, Leuconostoc mesenteroidesssspremoris, Leuconostoc pseudomesenteroides, Rothia dentocariosa, Staphylococcus aureus, and Staphylococcus lentus (Fig. 1, 2 and 3).
Colonies NO. (CFU)

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<th>Type of bacteria</th>
<th>shot 0</th>
<th>shot 1</th>
<th>shot 2</th>
<th>shot 3</th>
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</tr>
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<td>A. ...</td>
<td></td>
<td></td>
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<td></td>
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</tr>
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**Fig. 1: Effect of ultraviolet light on the growth of the oral Gram-negative bacterial**

Two isolates of Gram-negative (*Burkholderia cepacia*, and *Enterobacter cloacae complex*) and 6 isolates of Gram-positive (*Kocuria varians*, *Klycococcus sedentarius*, *Streptococcus iniae*, *Staphylococcus warneri*, and *Gemella morbillorum*) were shown more sensitive to UV-light as indicated by the absence of growth after first shot of light (5 minutes). Meanwhile, resistance to all of UV-light exposure shots was shown by 4 isolates of Gram-negative bacteria (*E. coli*, *Klebsiella pneumoniae* ssp. *Pneumonia*, *Pseudomonas aeruginosa*, and *Sphingomonas paucimobilis*) and 7 isolates of Gram-positive bacteria (*Dermacoccus nishinomiyaensis*, *Lactococcus garvieae*, *Granulicatella adiacens*, *Granulicatella elegans*, *Gemella sanguinis*, *Staphylococcus pseudintermedius* and *Staphylococcus sciuri*) (Fig. 1, 2, and 3).

**Fig. 2: Effect of light-cure on the growth of the oral Gram-positive bacterial**

Some types of bacteria exhibited resistance to the first 2 shots of UV-light (10 minutes) and their growth started to decline after the third shot (15 minutes) as with two strains of Gram-negative bacteria (*Acinetobacter lwoffii* and *Pseudomonas stutzeri*) and 3 isolates of Gram-positive bacteria (*Helcococcus kunzii*, *Streptococcus mits*, and *Staphylococcus haemolyticus*) (Fig. 1, 2, and 3).
DISCUSSION:

The predisposing factors for the high number of microorganisms in the oral cavity are wearing dentures and poor denture hygiene (Nair et al., 2016). The contaminated prosthesis could harmfully affect the oral health, accordingly the high number of bacterial colonization will become more pathogenic and act as a potential source of infection (Lyon et al., 2006; Kumar et al., 2015). Nearly 24-60% of denture wearers get affected by inflammatory disorder which causes inflammation of the oral mucosa in contact with the denture (Pattanaik et al., 2010; Yildirim-Bicer et al., 2014). The inner surface of the dentures is rough and pitted because it cannot be mechanically polished and thus act as niduses for biofilm formation and colonization of microorganisms. The oral mucosa in close contact with this rough surface may show mucosal changes as a result from a mechanical irritation by the denture, an accumulation of microbial plaque, and fungal infection (Pattanaik et al., 2010; Uma et al., 2016). The stagnation, accumulation of saliva, and the absence of contact with the tongue are the causes of higher plaque level on the inner surfaces of the dentures (Keng and Lim, 1996). For this reason, the present study dealt with the evaluation of the effect of different times of exposure to UV-light on the inner surface of removable dentures. It has been found that there may be over 600 different species of predominant bacterial taxa has been involved in the oral cavity, with different subsets predominating at different habitats, including the teeth, gingival sulcus, tongue, cheeks, hard and soft palates, and tonsils, which are colonized by bacteria (Dewhirst et al., 2010). For along time, it has been known that UV irradiation is an active disinfection method for killing microbes (Chang et al., 1985). Many Studies have shown that disinfection can be used effectively to control bacterial and viral contaminants (Best et al., 1999; Ganavadiya et al., 2014). Kumar et al., in (2015) reported that the action of the UV light in killing microorganisms is by the chemical reaction that occur when the UV-light absorbed by proteins and nucleic acids. Arita et al., in (2005) reported that exposure of contaminated heat-cured acrylic denture plate to flowing ozonated water for 1 min or immersion in ozonated water with ultrasonication showed a reduction in the number of Candida albicans on denture plate. Other studies reported that microwave radiation produced sterilization of complete dentures contaminated with bacteria and Candida albicans (Silva et al., 2006; Altieri et al., 2012). In comparison with other existing disinfection methods UV irradiation has several advantages such as no need to any chemicals or heat and provide rapid, cheap and nontoxic method so it can be used effectively for surface sterilization (Devine et al., 2001). The findings of this study showed that the use of UV-light was an effective method for elimination bacterial growth on the fitting surface of upper complete removable denture; however the sensitivity of these bacteria to the UV-light was variable between Gram-negative and Gram-positive bacteria. These findings in agreement with Berger et al., (2008) they remarked that using two different UV sanitizers (VIOLight and HIGHDENT) for Gram-negative and Gram-positive bacteria and the two devices decreased the amount of bacteria in 83% and 100%, respectively. Also the findings of the present study agree with Robert, (1987), they used the UV-light as a mode of sterilization of complete dentures, partial dentures and a rubber base impression contaminated with known species of microorganisms with killing of 100% of microorganisms within 2 minutes.
In the present study two isolates of Gram-negative (Burkholderia cepacia, and Enterobacter cloacae complex) and 6 isolates of Gram-positive (Kocuria varians, Kytococcus sedentarius, Streptococcus iniae, Staphylococcus warneri, and Gemella morbillorum) were shown more sensitive to ultraviolet light as indicated by the absence of growth after the first shot of light (5min.). This findings of the present study coincides with the findings of Devine et.al. (2001). They obtained rapid killing effect of the UV-light in irradiation for 15 second and 45 seconds which reduced viable bacterial count in saliva by 68% and 99% respectively, they concluded that kinetics of killing varied, reflecting the fact that fatal mechanisms are complex, and perhaps depend on interaction between UV-light and heat. Regarding the exposure time, the results of the present study showed that some types of bacteria exhibited resistance to the first 2 shots (10min) of UV-light and their growth started to decline after the third shot (15min.) as with two strains of Gram-negative bacteria (Acinetobacter lwoffii and Pseudomonas stutzeri) and 3 isolates of Gram-positive bacteria (Helcococcus kunzii, Streptococcus mitis, and Staphylococcus haemolyticus). The results were confirmed by AL-Khafagy et al., (2013), they showed that 10 min the exposure to UV or blue light were in effective in disinfection of the alginate or silicon impression while 20 min exposure was enough to give negative culture results just for the silicon impression with UV-light. Also the results of the present study were supported by Kumar et al., (2015), they concluded that as the exposure time was increased, the colony count reduced, so different surface conditions and exposure time are important in UV-light sterilization of microorganisms.

CONCLUSIONS:

The present study showed that removable dentures could be sterilized with UV-light. The sensitivity of Gram positive and Gram negative bacteria to various shots of UV-light was variable. Colony counts of some isolated bacteria was noted to decrease along with increase the exposure time of UV-light from (5 to 20) minutes. Two isolates of Gram-negative and 6 isolates of Gram-positive were shown more sensitive to UV-light as indicated by the absence of growth after first shot of light (5minutes). Resistance to all of UV-light exposure shots was shown by 4 isolates of Gram-negative bacteria and 7 isolates of Gram-positive bacteria. Some types of bacteria exhibited resistance to the first 2 shots of UV-light (10minutes) and their growth started to decline after the third shot (15minutes).

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