Effect of UV disinfection on dimensional stability and infection control of elastomeric impression materials

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Abstract:
In many areas of dental practice which involves exposure to blood and other body fluids, there is growing concern regarding improvements in cross-infection control. There is a need for disinfection methods to be effective while also being cheap, rapid, non-toxic, broad spectrum and easy to practice. Impression materials used in prosthodontics cannot be heat sterilized and are often damaged by chemical disinfection. In recent advances, ultraviolet disinfection method has begun to prove its effectiveness to control contamination of impression materials by killing microbes while preserving the quality of material. This scientific paper to be presented is on a study conducted to evaluate the effect of ultraviolet disinfection on the dimensional stability and infection control of elastomeric impression materials.

Keywords: Disinfection, Dimensional stability, Elastomeric impression materials

Introduction
Elastomers are a group of flexible chemical polymers, which are either chemically or physically cross linked. Generally they can be easily stretched and rapidly recover their original dimensions when applied stresses are released (GPT-8). Their ADA specification no.is 19.¹

Composition (Fig no 1)
Base Paste:
1. Polymethyl hydrogen silioxane
2. Silicone prepolymer
3. Fillers

Catalyst Paste:
1. Divinylpolydimethylsiloxane
2. Silicone prepolymer
3. Fillers
4. Platinum salt catalyst
5. Palladium or hydrogen absorber
6. Platinum, retarder

Setting reaction
Silicone prepolymers with vinyl and hydrogen side groups polymerize by addition polymerization.

Properties
- Pseudoplastic material
- Excellent elastic recovery: 99-99.99%
- Least volumetric shrinkage: 0.10-0.14
- Tear strength- 1.5-3.5
- Least permanent deformation
- Hydrophobic
- Biocompatible
- Working time: 2-4 min
- Setting time: 4-6.5 min
- Hydrogen gas evolution

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Aims And Objectives

To study and assess the:
1. Efficacy of UV light in reducing the Candida albicans count.
2. Most appropriate exposure time to UV light to reduce Candida albicans count.

Materials And Method

The type of elastomer used was Addition silicone-AQUASIL (Dentsply). A light body putty consistency was used. The impression was made using a Two-step putty wash technique (Fig. no.2) with spacer. Microbiological materials used were Saborauds Dextrose Agar (selective media for Candida albicans). Antibiotics used for the study were Gentamycin inj. Solution (GENSTER 2ml) and Chloramphenicol tablets (PARAXIN 250mg). A UV disinfection chamber with wavelength was used.

Sample size
40 healthy volunteers (40 impressions).

Procedure

1. Elastomeric impressions were made using sterilized dentulous stock trays of each volunteer.
2. Impressions were rinsed in distilled water for 15 seconds.
3. Placed in UV disinfection chamber for varying exposure time- 6, 12 and 18 min. (Fig. No 3. A & B)
4. Wiped with sterile cotton swabs.
5. Inoculated in petri dishes containing SDA media at 37 deg C for 48 hrs. (Fig. No 3. C)
6. Colony count done under microscope for Candida albicans.

Results

After microbiological analysis, results revealed that samples which were exposed to UV light, exhibited proportionate decrease in the number of colonies with each greater time of exposure. Group D (UV-18 min) showed greatest decrease in colony count followed by groups C (UV-12 min) and B (UV-6 min). (Table No. 1)

Discussion

Disinfection in Prosthodontics

Disinfection is a process, which reduces the number of viable micro-organisms to an acceptable level, but may not inactivate some viruses and bacterial spores.

Impression procedures form the starting point in prosthodontic treatment. The risk of infections transmitted from patient to dental personnel by impressions contaminated by saliva, blood and plaque is a potential occupational hazard. The use of disinfection procedures by dental professionals is necessary to prevent such cross-contamination.
Among the oral flora of normal population, candida constitutes about 40-60%. Immersion method with various disinfectant solutions and spray disinfection has been effective for this purpose but it is found to be time consuming and the potential distortion of surface details of impression material is a major concern and hence new alternatives such as ultraviolet disinfection have been introduced and its efficacy is still being studied.10,11

Evaluation of Ultraviolet Disinfection Unit
A study was conducted by Robert J. Boylan, Gary R. Goldstein and Allan Schulman. This study evaluated the disinfectant properties of BDU (Buffalo Ultraviolet Disinfection Unit), an instrument that emits UV radiation (2*60 sec exposure) in an enclosed area, on some dental materials that might be adversely affected by exposure to chemical disinfectants.12

They found that UV light kills micro-organisms that are not shadowed in seconds. The disadvantage was that shadowing effect allows survival of unexposed microorganisms. Also, there is loss of output from the bulbs with time, which is impossible to detect without use of sophisticated measuring devices, and so frequent change of bulb would be imperative.

Objectives of Cross Infection Control
1. To protect patient and members of dental staff team from contracting infections during dental procedures.
2. To reduce the numbers of pathogenic micro-organisms in the dental environment to the lowest possible level.
3. To implement a high standard of cross infection control when treating every patient to prevent transmission of infection. (UNIVERSAL PRECAUTIONS)
4. To simplify cross infection control allowing dental team to complete dental procedures with minimal inconvenience.

Ultraviolet Light Chambers
Action- UV light is absorbed by proteins and nucleic acids and kills microorganisms by the chemical reaction.
Use - purification of air in operating rooms
   -To reduce bacteria in air, water
   -storage of sterilized agents
Dose- all forms of bacteria and viruses are vulnerable below 3000 atm. Pressure.
Disadvantage - low penetrating capacity
   -irritation (burns)

Radiation
Ultraviolet light (non-ionizing radiation): Wavelength is longer than 1 nanometer. (Fig No.4). Damages DNA by producing thymine dimers, which cause mutations. Used to disinfect operating rooms, nurseries, cafeterias.14
Disadvantages: - Damages skin, eyes
   - Doesn’t penetrate paper, glass and cloth

- When microorganisms are subjected to UV light, cellular DNA absorbs energy and adjacent thymine molecules link together.
- Linked thymine molecules are unable to position adenine on RNA molecules during the process protein synthesis thereby replication of chromosome will be impaired.
- The damaged organism can no longer produce critical proteins or reproduce.
- UV light is used to limit airborne or surface contamination in a hospital room, pharmacy food service operation.
- UV light doesn’t penetrate liquids or solids and it may cause damage to the human skin.

The effectiveness of UV light disinfection depends on a no. of factors like time of exposure, intensity, humidity and direct access of UV light to the microorganisms. As per studies, it is found that 5min exposure of UV light causes formation of thymine centaminary photo products in the DNA of cells which causes their death thereby acting as a powerful bactericidal agent. But due to its shadowing effect in certain areas, it allows for the survival of unexposed micro-organisms.

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The most suitable wattage for the maximum efficacy of UV light to reduce the colonies of Candida albicans is suggested to be 24 watts (3750 µm/cm²) with an appropriate time of 90 sec.15

UV light (250 µm/cm²) killed most candida organisms (103 cells/ml) within 5 min. UV light (8000 µm/cm²) killed most Candida albicans (107 cells/ml) within 2 min of exposure.

The effect of UV light on dimensional change and surface roughness of addition silicone was tested and the results showed that neither dimensional change nor surface roughness was affected.

1. Exposure of impressions to UV light effectively decreased the no. of Candida albicans colonies.
2. As the exposure time was increased, the colony count reduced.
3. The killing efficiency with UV light was observed to be maximum with an exposure time of 18 min.

References

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