Original Article
Journal of Pierre Fauchard Academy (India Section), *Vol 34(1), DOI: 10.18311/jpfa/2020/24453, March 2020, p. 1-8*
ISSN (Print) : 0970-2199
ISSN (Online) : 2405-772X

Evaluation and Comparison of Efficacy of 5.25% Sodium Hypochlorite and UV Rays for Disinfecting Polyvinyl Siloxane and Polyether Monophase Impression Material: An in vivo Study

Neha Prakash[1]*, Rajeev Srivastava[2], Apurva Pathak[3], Umesh Palekar[4], Vivek Choukse[5] and Ankita Parmar[6]

[1]Post Graduate, Department of Prosthodontics, Crown and Bridge and Implantology, Modern Dental College and Research Center, Indore – 453112, Madhya Pradesh, India; nehaprakash91@gmail.com
[2]Head and Professor, Department of Prosthodontics, Crown and Bridge and Implantology, Modern Dental College and Research Center, Indore – 453112, Madhya Pradesh, India
[3]Professor, Department of General Pathology and Microbiology, Modern Dental College and Research Centre, Indore – 453112, Madhya Pradesh, India
[4]Professor, Department of Prosthodontics, Crown & Bridge and Implantology, Rural Dental College, Loni - 413736, Maharastra, India
[5]Professor, Department of Prosthodontics, Crown and Bridge and Implantology, Modern Dental College and Research Centre, Indore – 453112, Madhya Pradesh, India
[6]Lecturer, Department of Prosthodontics, Crown and Bridge and Implantology, Vaidik Dental College and Research Centre, Daman, Gujurat, India

Abstract

Aim: To evaluate the efficacy of 5.25% Sodium hypochlorite, UV rays for disinfecting Polyether Monophase and Polyvinyl monophase impression material. **Materials and Methods:** Ten healthy dentulous subjects irrespective of gender were selected. For each dentulous subject four impressions of maxillary arch were made with Polyvinyl siloxane and Polyether monophase impression material. First impression was kept as control. Second impression was disinfected with 5.25% sodium hypochlorite for 10 minutes. Third impression was disinfected by exposing it to UV light (A and B) for 3 minutes and fourth impression was disinfected by exposing it to UV light (A and B) for 10 minutes. The colony was observed based on standard method and technique under binocular microscope and the growth in broth were observed based on their turbidity with the help of colorimeter. **Result:** The intergroup comparison was done by using ANOVA test while the comparison between two groups was done by using paired t test. **Conclusion:** In this study sodium hypochlorite was found to be more effective in killing microorganisms than UV rays as it kills only surfaces microbes.

Keywords: Impression Material, Polyvinyl Siloxane, Polyether, Sodium Hypochlorite, UV rays

1. Introduction

Impression materials are used to make accurate replicas of the oral tissues which can involve a single tooth, the entire dentition or an edentulous mouth. As the impression gives a negative reproduction of the mouth, the accuracy of the subsequent stone cast is only good as the impression.

A variety of dental impression materials are available such as alginate, agar and elastomers. Four basic types of elastomeric impression materials are currently in use: Polysulphide, Polyether, Condensation silicones and Addition silicones[1].

Several factors influence the quality of impression including impression material, impression technique,

*Author for correspondence

and viscosity of material. Impression techniques can be categorized as monophase (using a single step medium viscosity material) or dual phase (using either a one step or two step putty or heavy body and a light body wash material).

Disinfection is generally a less lethal process as compared to sterilization[2]. Decontamination of impression performed by rinsing under tap water has been reported an insufficient procedure and hence various methodologies were introduced for its disinfection, off course without affecting its integrity[3].

2. Materials and Methods

2.1 Materials used for Impression

1. Polyvinyl Siloxane Monophase impression material (Aquasil ultra monophase, Densply Caulk, medium body consistency, ISO 4823).
2. Polyether Monophase impression material (3M ESPE impregnum^{Tm} soft).
3. Plastic dentulous autoclavable maxillary stock trays (ABS).

2.2 Materials used for Disinfection

1. 5.25% Sodium hypochlorite solution (Prime Dental).
2. Ultraviolet chamber (UV-A and B) PRIM Electronic ballast, lamp 1X40 W, Un-240V, In- 50:30 Hz, C- 75 C max.

2.3 Instruments and Reagents used for Microbial Procedure

1. Petri dishes.
2. Graduated conical flask (RANKEM 250 ml and 100 ml).
3. L-spreader.
4. Dispensing micro pipette (50µml) (Axiva Sichem Pvt. Lmt.)
5. BOD incubator (REMI).
6. Phosphate buffer saline solution (MERCK Life Science Pvt. Ltd.) east Mumbai, India.
7. Culture media (TGYEA solid media) HIMEDIA Laboratories Pvt. Ltd., India.
8. Culture broth (TGYE broth) HIMEDIA Laboratories Pvt. Ltd., India.
9. Centrifugal machine (R8C Laboratory centrifuge, REMI Centrifuge, REMI motors, Mumbai, India).
10. Digital photo colorimeter (Electronics India).
11. Inoculating nichrome wire loop.
12. Test tubes (BOROSIL ®).
13. Ethyl Alcohol (Pharmco AAPR UN1170).
14. Binocular microscope (100 X) Lawrence and Mayo.
15. Micro slides (PLAZA scientific industrial corporation, Delhi, India).

3. Inclusion Criteria

- Dentulous subjects.

4. Exclusion Criteria

- Any infectious disease since 3 months.
- Systemic disease and psychological disorders.
- Missing teeth.
- Subject on antibiotic.

5. Methodology

5.1 Subject Selection

Ten healthy dentulous subjects irrespective of gender were selected from the OPD of Department of Prosthodontics, Crowns and Bridge and Implantology, Modern Dental College and Research Centre, Indore for making impressions of maxillary arch.

5.2 Impression Making

5.2.1 Polyvinyl Siloxane Impression

For each dentulous subject four impressions of maxillary arch were made with Polyvinyl siloxane. Total 40 impressions were made with polyvinyl siloxane impression material.

The adequate size tray (Figure 1) was selected and loaded with Polyvinyl Siloxane impression material (Figure 2) without lifting the tip of cartridge and placed into the patients' mouth (Figure 3) and impression was made (Figure 4).

5.2.2 Polyether Impression

For each dentulous subject four impressions of maxillary arch were made with Polyether material.

The impression was made using autoclaved maxillary plastic dentulous stock trays. Total 40 impressions were made with Polyether impression material (Figure 5).



Figure 1. Dentulous maxillary stock trays.





Figure 2. Polyvinyl siloxane monophase impression material.



Figure 3. Impression of maxillary arch.

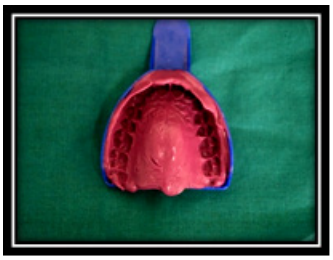


Figure 4. Polyvinyl impression.





Figure 5. Polyether monophase impression material.



Figure 6. Base and catalyst on mixing pad.

The adequate size tray was selected. Equal lengths of base and catalyst were dispensed onto the mixing pad (Figure 6) and mixed with a broad stiff blade spatula to get a non-streaked homogenous mix. The material was loaded on impression tray and placed into patients mouth (Figure 7) and the impression was made (Figure 8).

Thus a total of 80 impressions were made from both the materials.



Figure 7. Impression of maxillary arch.

5.2.3 Disinfection Control

1. For each Subject
2. For Polyvinyl Siloxane Impression
3. First impression was kept as control.

Second impression was disinfected with 5.25% sodium hypochlorite for 10 minutes (Figure 9).

Third impression was disinfected by exposing it to UV light (A and B) for 3 minutes and fourth impression was disinfected by exposing it to UV light (A and B) for 10 minutes (Figure 10).



Figure 8. Polyether impression.



Figure 9. Sodium hypochlorite



Figure 10. Ultraviolet chamber.

5.3 For Polyether Impression

First impression was kept as control. Second impression was disinfected with 5.25% sodium hypochlorite for 10 minutes. Third impression was disinfected by exposing it to UV light (A and B) for 3 minutes and fourth impression was disinfected by exposing it to UV light (A and B) for 10 minutes.

5.4 Microbiological Procedures

After disinfection of each sample, it was washed with 10 ml of phosphate buffer saline solution (Figure 11). The wash was collected aseptically. The wash was further subjected to centrifugation for 20 minutes at 2000 rpm (Figure 12). Leaving the sediment behind rest of the solution was decanted. Then after sediments were mixed with PBS solution to raise it to 1ml. 50 µl of this solution was picked up with micropipette (Figure 13) to inoculate on solid TGYEA media (Figure 14) using L-spreader (Figure 15) and rest of the solution were mixed with 9ml of TGYE broth (Figure 16).

Both the inoculants were incubated at 37 °C for 24-48 hours in a BOD incubator (Figure 17) to observe any kind of growth.

The colony was observed based on standard method and technique under binocular microscope (Figures 18, 19) and the growth in broth were observed based on their turbidity with the help of colorimeter (Figure 20).

The colonies grown on the petridishes were identified based on their staining characterstics.

The reading observed was subjected to statistical analysis.



Figure 11. Phosphate Buffered Saline solution.



Figure 12. Centrifugal machine



Figure 13. Micropipette



Figure 14. TGYEA solid media.



Figure 15. L-SPREADER.



Figure 16. TGYE- broth.



Figure 17. BOD incubator.



Figure 18. Binocular microscope.

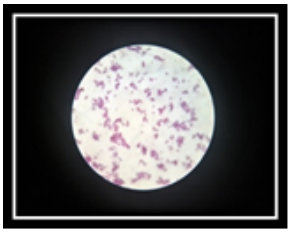


Figure 19. Microbial colonies observed under microscope



Figure 20. Digital photo colorimeter.

6. Results

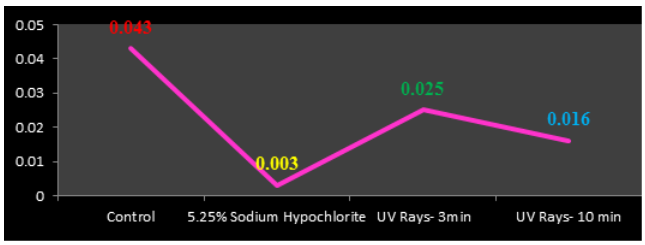
Table 1 shows optical density of innoculant obtained from Polyvinyl Siloxane monophase impression material of control group with the mean of 0.043, 0.003 in sodium hypochlorite, 0.025 in UV rays for 3 minutes and 0.016 in UV rays for 10 minutes.

Thus it indicates that 5.25% sodium hypochlorite has more efficiency for disinfecting Polyvinyl Siloxane followed by UV rays for 10 minutes and UV rays for 3 minutes.

Table 2 shows optical density of inoculants obtained from Polyether monophase impression material of control group with the mean of 0.031, 0.003 in sodium hypochlorite, 0.02 in UV rays for 3 minutes and 0.016 in UV rays for 10 minutes.

Table 1. Mean colonization of microorganisms in control, 5.25% sodium hypochlorite, UV rays for 3 minutes and UV rays for 10 minutes in Polyvinyl Siloxane monophase impression material

Group	Mean	S.D	F value	Sig.
Control	0.043	0.012	28.94	0.01 (S)
5.25% Sodium Hypochlorite	0.003	0.004		
UV Rays-3min	0.025	0.013		
UV Rays- 10 min	0.016	0.005		

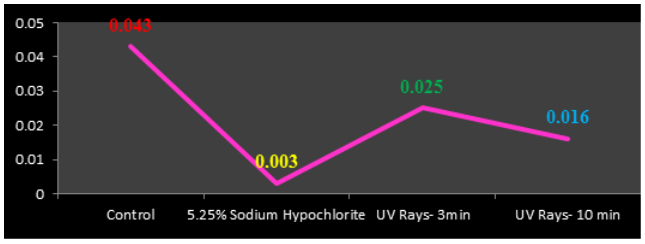


Graph 1. Comparison of colonization of microorganisms on Polyvinyl Siloxane monophase impression material.

Table 2. Mean colonization of microorganisms in control, 5.25% sodium hypochlorite, UV rays for 3 minutes and UV rays for 10 minutes in Polyether monophase impression material

Groups	Mean	S.D	F value	Sig.
Control	0.031	0.008	26.61	0.01 (S)
5.25% Sodium Hypochlorite	0.003	0.004		
UV Rays- 3min	0.02	0.013		
UV Rays- 10 min	0.015	0.004		

*Significant at the level of 0.01.



Graph 2. Comparison of colonization of microorganisms on Polyether monophase impression material.

Table 3. Inter group comparison of colonization of microorganisms on Polyvinyl Siloxane impression

Comparison	Groups	Mean	S.D	t value	Sig.
Comparison 1	Control	0.043	0.012	9.42	0.01(S)
	5.25% Sodium Hypochlorite	0.003	0.004		
Comparison 2	Control	0.043	0.012	3.08	0.02 (S)
	UV Rays- 3min	0.025	0.013		
Comparison 3	Control	0.043	0.012	6.30	0.01(S)
	UV Rays- 10 min	0.016	0.005		
Comparison 4	UV Rays- 3min	0.025	0.013	4.83	0.01(S)
	5.25% Sodium Hypochlorite	0.003	0.004		
Comparison 5	UV Rays- 10 min	0.016	0.005	1.83	0.02(S)
	5.25% Sodium Hypochlorite	0.003	0.004		
Comparison 6	UV Rays- 10 min	0.016	0.005	5.81	0.01(S)
	UV Rays- 3min	0.025	0.013		

*Significant at the level of 0.01

Table 4. Inter group comparison of colonization of microorganisms on Polyether monophase impression material

Comparison	Groups	Mean	S.D	t value	Sig.
Comparison 1	Control	0.031	0.008	8.39	0.01(S)
	5.25% Sodium Hypochlorite	0.003	0.004		
Comparison 2	Control	0.031	0.008	1.17	0.25
	UV Rays- 3min	0.025	0.013		
Comparison 3	Control	0.031	0.008	8.39	0.01(S)
	UV Rays- 10 min	0.015	0.004		
Comparison 4	UV Rays- 3min	0.02	0.013	4.83	0.01(S)
	5.25% Sodium Hypochlorite	0.003	0.004		
Comparison 5	UV Rays- 10 min	0.015	0.004	0.44	0.66
	5.25% Sodium Hypochlorite	0.003	0.004		
Comparison 6	UV Rays- 10 min	0.015	0.004	4.58	0.01(S)
	UV Rays- 3min	0.02	0.013		

*Significant at the level of 0.01.

Thus it indicates that 5.25% sodium hypochlorite has more efficiency for disinfecting Polyvinyl Siloxane followed by UV rays for 10 minutes and UV rays for 3 minutes.

7. Discussion

Dentists and other dental care givers are at risk from cross-contamination from the mouth of patients and other infected working environment in the dental office[4,5].

According to the guidelines published by the British Dental Association, "the only safe approach to routine treatment is to assume that every patient may be a carrier of an infectious disease"[6].

Dental workplaces are potential sites for the spread of various communicable and incurable diseases to, from and among patients and the dental staffs hence, cleaning and disinfection of dental impressions should be carried out before sending to the dental laboratory since a contaminated dental impression can spread infection in the dental laboratory[7].

Accuracy and dimensional stability of the dental impression material is of utmost importance. In recent trends, elastomeric impression materials have revolutionized restorative procedures, as compared to inelastic impression materials. The monophase materials have been formulated with sufficient shear thinning to be used both as low viscosity and high viscosity materials. In this monophase or single viscosity technique, impression material is used with either automix or cartridge mix system and the material can be mixed more homogenously without incorporating any voids[8].

Herrera SP(1986)[9] concluded that after disinfection of dental impressions by short term immersion in sodium hypochlorite, glutaraldehydes or halogenated phenol showed the rubber base impression materials remained stable.

Soganci G (2018)[10] compared the dimensional changes of polyether and polyvinyl siloxane under immersion with 5.25% sodium hypochlorite and 2% gluteraldehyde for 10 minutes and found that the dimensional accuracy of both the material were excellent and similar.

Yilmaz H et al. (2007)[11] described the effect of disinfectants (spray, 2% glutaraldehyde and 0.525% sodium hypochlorite for 10 minutes) on polyether and concluded that there were no significant dimensional changes when the impression was immersed in disinfectants for 10 minutes.

Long-term dimensional stability of monophase addition silicone and polyether after disinfection was earlier studied by Walker MP et al. (2007)[12] for up to 2 weeks of storage of impressions.

Similar studies done by Look JO et al. (1990)[13] found that the efficacy of sodium hypochlorite was similar to glutaraldehyde and sodium hypochlorite exhibited comparable microbial activity which were in concordance with the disinfectant used in the present study.

The study done by Mohammad TAL (2013)[2] found that UV rays exposure to silicon materials showed positive result for 10 minutes exposure and significant reduction in growth of microorganism for 20 minutes.

Anand V (2013)[14] in his study stated that the effectiveness of ultraviolet rays depends on a number of factors i.e., time, humidity and direct access to the organism. Therefore, UV light must be reflected from many directions and frequent orientation of item between exposures in the unit can increase the chances of killing microorganism that may be shadowed.

Godbole SR (2014)[15] in his study concluded that ultraviolet disinfection can be safely used to disinfect impressions in clinical prosthodontic procedures as UV light disinfectant showed no dimensional changes on impressions made by Polyvinyl Siloxane.

8. Conclusion

In the present study, efficacy of 5, 25% sodium hypochlorite, UV rays for 3 minutes and UV rays for 10 minutes were compared for disinfecting Polyvinyl Siloxane monophase and Polyether monophase impression material was evaluated.

In this study sodium hypochlorite was found to be more effective in killing microorganisms than UV rays as it kills only surfaces microbes.

UV rays have some short coming that it cannot penetrate into the deeper surfaces and hence other methods like gamma rays, electron beam, ozone water etc. should be evaluated for this method.

9. References

1. Pandey A, Mehtra A. Comparative study of dimensional stability and accuracy of various elastomeric materials. *IOSR Journal of Dental and Medical Sciences*. 2014; 13(3):40–45. https://doi.org/10.9790/0853-13354045
2. Mohammad TAL, Yasiri IKA, Hamed SJ. Disinfection of alginate and silicon impressions by using UV and blue light. (In Vivo Study). *Journal of Kufa for Nursing Science*. 2013; 3(2):1–8.
3. Taylor RL, Wright PS, Maryan C. Disinfection procedures: Their effect on the dimensional accuracy and surface quality of irreversible hydrocolloid impression materials and gypsum casts. *Dental Material*. 2002; 18: 103–110. https://doi.org/10.1016/S0109-5641(01)00027-6
4. Palenik CJ, Burke FJ, Miller CH. Strategies for dental clinic infection control. *Dent Update*. 2000; 27(1): 7–10. https://doi.org/10.12968/denu.2000.27.1.7. PMid:11218267
5. Silva SM, Salvador MC. Effects of the disinfection technique on the linear dimensional stability of dental

impression materials. *J Appl Oral Sci*. 2004; 12(3):244–249. https://doi.org/10.1590/S1678-77572004000300016. PMid: 21049261

6. Watkinson AC. Disinfection of impressions in UK Dental Schools. *Br Dent J*. 1988; 164(1):22–23. https://doi.org/10.1038/sj.bdj.4806325. PMid:3276345
7. Leung RL, Schonfeld SE. Gypsum casts as a potential source of microbial cross-contamination. *J Prosthet Dent*. 1983; 49(2):210-211. https://doi.org/10.1016/0022-3913(83)90503-6
8. Duseja S, Shah RJ, Shah DS, Duseja S. Dimensional measurement accuracy of recent polyether and addition silicone monophase impression materials after immersion in various disinfectants: An in vitro study. *International J. Healthcare and Biomedical Research*.2014; 2(4): 87–97.
9. Herrera SP, Merchant VA. Dimensional stability of dental impressions after immersion disinfection. *J Am Dent Assoc*. 1986 ;113(3):419–422. https://doi.org/10.14219/jada.archive.1986.0214. PMid:3093552
10. Soganci G, Cinar D, Cagler A. Yagiz A. 3D evaluation of the effect of disinfectant on dimensional accuracy and stability of two elastomeric impression materials. *Dental Materials Journal*. 2018; 37(4):675–684. https://doi.org/10.4012/dmj.2017-097. PMid:29848853
11. Yilmaz H, Aydin C, Dogruman F, Gul B, Yilmaz C, Semiz M. Effect of disinfection on the dimensional stability of polyether impression material. *J. Prosthodont*. 2007; 16(6):473–479. https://doi.org/10.1111/j.1532-849X.2007.00235.x. PMid:17760866
12. Walker MP, Rondeau M, Petrie C, Tasca A, Williams K. Surface quality and long term dimensional stability of current elastomeric impression materials after disinfection. *J Prosthodont*. 2007; 16(5):343–351. https://doi.org/10.1111/j.1532-849X.2007.00206.x. PMid:17559536
13. Look JO, Clay DJ, Gong K, Harold HM. Preliminary results from disinfection of irreversible hydrocolloid impressions. *J. Prosthet. Dent.* 1990; 63(6):701–707. https://doi.org/10.1016/0022-3913(90)90329-B
14. Anand V. A comparative evaluation of disinfection effect of exposures to ultra-violet light and direct current glow discharge on Candida Albicans colonies coated over elastomeric impression material: An in vitro study. *Dental Science*. 2013; 5(5):80–84. https://doi.org/10.4103/0975-7406.113302 PMid:23946583 PMCid:PMC3722712
15. Godbole SR, Dahane TM, Patidar NA, Nimonkar SU. Evaluation of the effect of ultraviolet disinfection on dimensional stability of the polyvinyl siloxane impressions- an in vitro study. *J Clin Diagn Res*. 2014; 8(9):73–76.