DOI: https://doi.org/10.53350/pjmhs202317243

ORIGINAL ARTICLE

Effect of Different Cross-Infection Control Barriers on Intensity of Curing Light: An In-Vitro Study

SAQIB NAEEM SIDDIQUE[1], PALWASHA BABAR[2], HUMA TANVIR[3], HAFSA ASLAM[4], HAMDA KHURRAM[5], EESHA HASSAN[6]
[1,2]Assistant Professor, Department of Operative and Pediatric Dentistry, University College of Dentistry, The University of Lahore
[3]Senior Registrar, Department of Operative and Pediatric Dentistry, University College of Dentistry, The University of Lahore
[4]Demonstrator, Department of Operative and Pediatric Dentistry, University College of Dentistry, The University of Lahore
[5,6]FCPS Resident, Department of Operative and Pediatric Dentistry, University College of Dentistry, The University of Lahore
Correspondence to Dr. Palwasha Babar Email: palwasha.babar@ucd.uol.edu.pk

ABSTRACT

Aim: To evaluate the effect of different cross infection control barriers on the intensity of the curing light.
Study Design: In-vitro experimental study.
Place and duration: Department of Operative and Pediatric Dentistry, The University of Lahore from January to March 2022.
Methodology: The intensity of the light-curing unit was measured using a radiometer. The intensity of light without using any barrier was taken as control. Four barriers were used; polythene glove, latex glove, cling film wrap and standard barrier tape. Ten measurements for each group were performed after placing each type of protection barrier and the average was taken. The data was analyzed using SPSS v 22.
Results: The mean value for light intensity without using any barrier was found to be 737.6 mW/cm^2. The light intensity was maximum for cling film, polythene glove, barrier tape and latex glove with mean values of 720.6 mW/cm^2, 581.2 mW/cm^2, 541.7 mW/cm^2 and 255.06 mW/cm^2 respectively. A comparison of the output values without barrier and with different barriers showed a statistically significant difference with all barriers except cling film.
Conclusion: It was found that cling film, polythene glove and barrier tape could serve as a barrier to cover the tip of the light curing unit.
Keywords: Dental curing light, cross-infection, composite resin

INTRODUCTION

Cross-infection control is a vital part of patient care in dentistry and measures are taken to control the spread of infection within the dental office. The use of effective and efficient cross-infection control strategies prevent cross-contamination between patients and the work team.

Light-cured resin composite restorations are widely used in restorative dentistry.The tip of this light-curing unit i.e. the light guide, comes directly in contact with the oral cavity and is therefore a crucial instrument for spread of infection in the dental office[1]. This light guide of the light curing unit is categorized as 'semi-critical' by Center for Disease Control (CDC) as it is used within the oral cavity and has high risk for contamination[2].

Many methods have been employed in this regard to minimize the spread of infection. The common methods include wiping the light guide with a disinfectant, using autoclavable or disposable guides and by covering it with a barrier[3,4]. Each of these methods has some implication associated with it. The use of disinfectant causes damage to the light guides which affects its output[5,6]. Light-curing tips which could be autoclaved were introduced, but it resulted in reduction in the transmission of the light thereby losing its efficacy[7]. Single-use plastic light guides are technique sensitive as the light intensity decreases if the sides come in contact with the oral tissues. Another method is to place a mechanical barrier to cover the tip of the curing light unit[8]. This offers an inexpensive, non-invasive and efficient way to ensure cross-infection control. However, this barrier may reduce the intensity of the transmitted light which is delivered to the tooth surface. This could jeopardize the polymerization of the composite as the photoinitiators in the resin composite require appropriate intensity of light for activation[9]. It has been reported that some barriers may reduce the light intensity upto 35% making it sub-optimal to cure the resin completely[10]. If light is insufficient, this partially polymerized composite could compromise the properties of the restoration as the incompletely cured composite has reduced strength and durability.

Another consequence is increased marginal microleakage which results in poor marginal adaptation resulting in recurrent caries. This results in increased risk of failure of the restorations[11].

Received on 14-09-2022
Accepted on 23-01-2023

Different translucent polyvinyl based barrier filmsare used by the dentists for this purpose.

The aim of the current study was to evaluate the effect of different cross infection control barriers covering the tip of light-curing unit on the intensity of the light.

METHODOLOGY

This is in vitro experimental study conducted in the Department of Operative and Pediatric Dentistry, University College of Dentistry, The University of Lahore from January to March 2022.
Sample size calculation method: Sample size of 50 samples was calculated (10 in each group) with 95% confidence interval and 90% power of study and by taking expected mean intensity value for control group and cure sleeve group as 573±6 and 559±11 respectively[12]. Open epi software was used to calculate sample size.
Inclusion and exclusion criteria: Not applicable to the study design.
Data collection procedure: The intensity (mW/cm^2) of the light-curing unit was measured using a manual radiometer (Kerr Corporation, Danbury, CT, USA). Curing light unit was fully charged before taking the measurements. Light guide was cleaned with an alcohol swab to remove any debris and the tip was held in contact with the sensor of the radiometer at 90^o.

The intensity of light without using any barrier was taken as control. Four barriers were used in the study; polythene glove, latex glove, cling wrap (food wrap) and standard barrier tape. It was ensured that no seam or fold was present at the tip before taking the reading. Ten measurements for each group were performed after placing each type of protection barrier and the average of the ten values was taken as the representative value for that barrier.
Statistical analysis: The data was analyzed using SPSS v22. Descriptive statistics were calculated as mean and standard deviation. The normality of data was analyzed using Kolmogorov–Smirnov test. Distribution was found to be normal. One-way ANOVA was performed to compare the means of curing light intensities. The values were compared using paired sample-t test. P-value less than 0.05 was considered as statistically significant.

RESULTS

The mean value for light intensity without using any barrier was found to be 737.6mW/cm^2. All the barriers used in the study markedly affect the light output except cling film. The mean value of intensity for different media is given in Table 1. In decreasing order, the light intensity was maximum for cling film, polythene glove, barrier tape and latex glove as shown in Figure 1. ANOVA test for comparisonwas statistically significant with p-value of <0.001. A comparison of the output values without barrier and with different barriers showed a statistically significant difference with all barriers i.e. polythene glove, barrier tape and latex glove except cling film. The comparison is given in Table 2.

Table 1: Mean values for light intensity with and without using barrier.

	Mean	Std. Deviation	Std. Error	Min.	Max.
Without barrier	737.60	36.26	11.47	686	799
Cling film	720.60	41.96	13.27	653	779
Polythene glove	581.20	78.54	24.84	476	716
Barrier tape	541.70	34.25	10.83	495	595
Latex glove	255.06	10.55	3.34	230	265

Figure 1: Graphical representation of light intensity with and without using barrier.

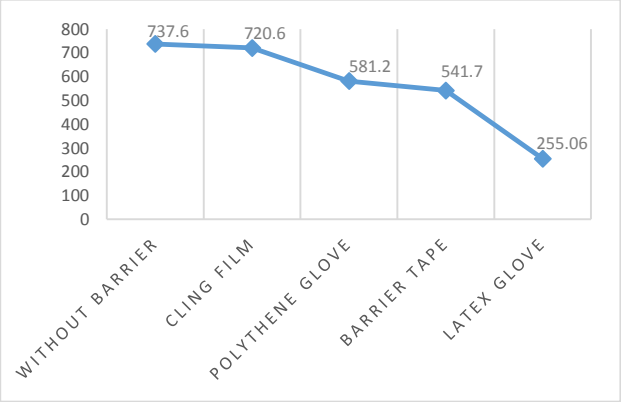

Table 2: A comparison of light output without using any barrier and with different barriers.

Barrier	Mean Difference	Comparison
Cling film	17.0	0.92
Polythene glove	156.4	<0.001
Barrier tape	195.9	<0.001
Latex glove	482.5	<0.001

DISCUSSION

Light curing unit is an essential equipment in clinical dentistry. As the tip of these light curing units comes directly in contact with the oral cavity, it is important to sterilize it in order to prevent the spread of infection. Different methods are used for cross infection control and one of the most commonly employed method is the use of a barrier[12]. The use of this barrier reduces the light intensity thereby resulting in incomplete polymerization of the composite. The optimal level of light intensity for curing composites is 400mW/cm^2[2,13]. However, the recommended level of light intensity is different for different brands of composite. Complete curing of composite is imperative to attain the physical and mechanical properties. Incompletely cured composite resin causes pulpal irritation, sensitivity and recurrent caries[14]. This reduces the longevity of the restoration.

In our study, cling film barrier least affected the light output from the light curing unit while latex gloves reduced it the most. The results are consistent with an in-vitro study by Khode et al which assessed the same barriers in their research[15]. However, none of the barrier in their study reduced the output below the optimal level of 300mW/cm^2.

In our study, latex gloves reduced the output to 255mW/cm^2 which is not optimal for polymerization of the composite. Therefore, latex gloves cannot be used as a barrier on light curing tips. Similar results were reported by McAndrew and colleagues who reported that latex dental gloves affected the power output of light curing units[14].

There are numerous factors which affect the light output through the barrier including its transparency, thickness, presence of folds and entrapment of air between the light glide and the barrier[16,17]. In our study, it was observed that the transparent barriers did not affect the light output compared to the opaque one i.e. latex gloves. In our study, cling film barrier least affected the light intensityoutput which corroborates with the results of the other studies[15,18]. This is attributed to its transparency and minimal thickness. However, this same property also has a disadvantage in the practical use because being very thin, the cling film gets wrinkled thereby causing distortion of light.[19]Moreover, as it has the tendency to tear so multiple folds of the cling film are usedto prevent it from tearing intra-orally in order to prevent contamination. This also negatively affects the output of light and reduces the polymerization of composite as proven by Chang et al in their study.[16] In a study by N Fawad, it was found that covering the light tip with upto four layers of cling-wrap sheet did not sufficiently reduce the light output but when eight layers were used, the light intensity was found to be sub-optimal[20].

The barrier tape used in the study also reduced the light intensity of the light curing unit. However, it is reported that although the light intensity is reduced in these manufacturer based barrier tapes, the spectrum distribution is not altered thereby the polymerization of composite is not affected[14].

A limitation of this study is that it measures light intensity using a radiometer and does not measure the emission spectrum which actually effects the curing of composite resin. This could have been achieved if a spectrophotometer was used or the effect of the light output was measured objectively on the depth of cure of composite.

CONCLUSION

Within the limitation of the study it was found that cling film, polythene glove and commercially available barrier tape could serve as a barrier to cover the light guide of the light curing unit. However, the use of latex gloves reduces the light intensity below the recommended optimal level thereby affecting the clinical outcome of the composite restoration.

Recommendation: Therefore it is important that the dentists should be aware about the effect of the barrier they are using in their clinical practice on the output of the light curing unit as well as the recommended intensity of light for the composite being used.

Conflicts of interest: Nothing to declare

Funding: None

Ethical Approval: Granted permission from Institutional Ethical Review Board

REFERENCES

1. Price RB, Ferracane JL, Hickel R, Sullivan B. The light-curing unit: An essential piece of dental equipment. IntJ Dent 2020 Dec 1;70(6):407-17.
2. Chinn RY, Sehulster L. Guidelines for environmental infection control in health-care facilities: recommendations of CDC and Healthcare Infection Control Practices Advisory Committee (HICPAC). 2003.
3. Laneve E, Raddato B, Dioguardi M, Di Gioia G, Troiano G, Lo Muzio L. Sterilisation in dentistry: a review of the literature. Int J Dent 2019 Jan 15;6507286.
4. Scott BA, Felix CA, Price RB. Effect of disposable infection control barriers on light output from dental curing lights. J Can Dent Assoc 2004;70:105-10.
5. Dugan WT, Hartleb JH. Influence of a glutaraldehyde disinfecting solution on curing light effectiveness. Gen Dent 1989;37:40-3.
6. Rueggeberg FA, Caughman WF, Comer RW. The effect of autoclaving on energy transmission through light-curing tips. J Am Dent Assoc 1996;127:1183-7.

7. Rueggeberg FA, Caughman WF. Factors affecting light transmission of single-use, plastic light-curing tips. Oper Dent 1998;23:179–84.
8. Kohn WG, Collins AS, Cleveland JL, Harte JA, Eklund KJ, Malvitz DM, et al. Guidelines for infection control in dental health-care settings. Recomm Rep 2003;52:1–61.
9. Koupis NS, Vercruysse CW, Marks LA, Martens LC, Verbeeck RM. Curing depth of (polyacid-modified) composite resins determined by scraping and a penetrometer. Dent Mater 2004;20:908–14.
10. Warren DP, Rice HC, Powers JM. Intensity of curing lights affected by barriers. J Dent Hyg 2000; **74**: 20–23.
11. Soares CJ, Braga SS, Ribeiro MT, Price RB. Effect of infection control barriers on the light output from a multi-peak light curing unit. J Dent 220 Dec 1;103:103503.
12. Boeira PO, Alves JG, Meereis CT, Michelon D, Cuevas-Suárez CE, Piva E, da Silveira Lima G. Protective Barriers and Radiant Exposure elivered from Light-curing Units. Oper Dent 2022 Sep;47(5):E222-32.
13. smussen E, Peutzfeldt A. Light-emitting diode curing: Influence on selected properties of resin composites. Quintessence Int 2003;34:71-5.
14. McAndrew R, Lynch CD, Pavli M, Bannon A, Milward P. The effect of disposable infection control barriers and physical damage on the pwer output of light curing units and light curing tips. Br Dent J 2011 Apr 23;210(8):E12.
15. Khode RT, Shenoi PR, Kubde RR, Makade CS, Wadekar KD, Khode PT. Evaluation of effect of different disposable infection control barriers o light intensity of light-curing unit and microhardness of composite-An in vitro study. J Conserv Dent 2017 May;20(3):180.
16. Chang HS, Lee SR, Hong SO, Ryu HW, Song CK, Min KS. Effect of infection control barrier thickness on light curing units. J Korean Acad Cns Dent 2010;35:368–73.
17. l-Marzok MI. The effect of wrapping of light-cure tips on the cure of composite resin. Eur J Gen Dent 2012;1:183–6.
18. Sword RJ, Do UN, Chang JH, Rueggeberg FA. Effect of curing light barriers and light types on radiant exposure and composite conversion. J Sthet Restor Dent. 2016 Jan;28(1):29-42.
19. de Moraes Porto IC, Ramos de Brito AC, Parolia A. Effect of cross infection control barriers used on the light-curing device tips on the cure dpth of a resin composite. J Conserv Dent. 2013;16:224–8.
20. Fawad N. Effect of covering curing tip with multi protective layers on Vicker's hardness of different composites. J Pak Dent Assoc. 2015 Apr;24(02):81.