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A CROSS SECTIONAL ANALYSIS OF THE INTENSITY OF DIFFERENT CURING UNITS USED IN PRIVATE DENTAL CLINICS OF KASHMIR

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ABSTRACT

The success of light-cured restorative materials highly depends on the efficacy of light-curing units. The most commonly used dental curing lights are LED lights. An appropriate intensity of light is the main factor in the polymerization composite restorations. Therefore it becomes pertinent to measure their intensity regularly to determine when the device needs to repaired or replaced. So we have taken this cross sectional study to measure the intensity of different curing devices used by clinicians of Kashmir. Eighty light curing units in different dental clinics in Kashmir division were examined for their output intensity by a radiometer. Among the total of 80 light curing units were examined, 60 (80%) were cordless LEDs and 20 (20%) were cabled corded devices. it has been demonstrated that cordless LED demonstrates better performance than cabled. Age of light cure units and contamination of tip affect the performance of units than the frequency of their usage. So a periodic maintenance of light cure units is advocated to achieve optimal performance.

Keywords: LED lights, cordless LEDs

Introduction

Composites are most popular restorations among practicing dentists. Now a day's dentistry cannot be performed without use of these resin-based restorative materials. The strength of these restorations depends on the degree of polymerization of resins. Incomplete polymerization produces adverse biological effects, increasing water absorption, composite solubility, and reducing hardness.[1]The success of light-cured restorative materials highly depends on the efficacy of light-curing units. Adequate polymerization of these materials depends on the light source intensity (irradiance or power density), wavelength, and exposure duration. An appropriate intensity of light is the main factor in the polymerization composite restorations. If the light output intensity decreases, it will adversely influence the clinical and cosmetic performance.[2]Various types of light-curing units available to dental professionals include: high-output quartz tungsten halogen (QTH), light-emitting diode (LED), plasma arc, and Argon ion laser light units. The most commonly used dental curing lights are LED lights.[3,4]The light intensity of curing devices is defined by the International Organization for Standardization as the ISO 4049 standard, which recommends an intensity of 300 mW/cm^2 with a wavelength bandwidth of 400-515 nm on the tip of the light curing device. At this standard wavelength, the minimum depth of cure is assumed to be 1.5 mm, which is 50% of the length of the composite specimen.[5] Most LED units produce light within a narrow spectral range. The diodes use gallium nitride as a semiconductor and produce light with wavelengths between 450 and 490 nm with a peak at 460 nm.[5,6] There are several factors that affect the output of LCU, mainly due to the damage of internal

components of curing units; for instance, line voltage, bulb and filter failure, contamination of light tip end, and breakage of conductive fibers.[7] Spectral purity in LED devices allows better polymerization of composites with camphorquinone and these devices do not emit too much of heat which may be damaging to pulp.[8] However in these curing devices, the intensity of light is affected by inappropriate performance of the lamp and filter, breakage and pollution of the device tip, the failure of electrical components, and defect in optical fibers.[9,10] The output light of the LED device decreases as the device ages and under regular clinical use, leading to inadequate polymerization of light-cured restorative materials can lead to increasing clinical problems such as secondary decay, discoloration, de-bonding ,marginal breakdown, hardness deterioration, poor flexural and compressive strengths and post-op sensitivity.[11] ,[12,13] Therefore it becomes pertinent to measure their intensity regularly to determine when the device needs to repaired or replaced. [9] So we have taken this cross sectional study to measure the intensity of different curing devices used by clinicians of Kashmir to determine and educate them about the life of their light cure device.

Materials and Methodology

Eighty light curing units in different dental clinics in Kashmir division were examined for their output intensity. Collection of related information and measurement of the intensity was performed by two operators. Consent of the dentist was obtained in order to examine the light curing unit in the operatory. History was elicited from operator about the life and maintenance and usage of each unit included in the study. Only LEDs were included in the study and other curing devices like QTH were excluded. Both cabled and cordless devices were included in study. This study was conducted in moisture-free and contamination-free environment, under maintained temperature to overcome the failures. Light intensity output of LEDs was measured by LED Radiometer (Kerr Manufacturing Products). This LED Radiometer has calibrations for intensity measurement from 0 to2000 mW/cm2. To calculate the irradiation intensity, exposure time was standardized as 20 seconds for each of the light cure unit tested. To accommodate different styles of removable fibrotic light guides of different curing units, a customised nozzle was attached to radiometer for unhindered light delivery. Disinfection barrier like plastic sleeves was placed on the curing devices of only those operators who gave a history of using them routinely to mimic the clinical conditions. The output intensity (mW/cm^2) of all the examined lights was categorized into three groups:

1. <200 mW/cm^2
2. 200-400 mW/cm^2
3. >400 mW/cm^2

The six different parameters noted during examination of LED devices were tabulated and intensity of each device was recorded into corresponding group.

Statistical analysis

Once the data had been collected the results were tabulated in table 1 and statistically analysed by mean and standard deviation to determine the mean light intensity of the light curing units. Comparison was done by the chi-squared test. Statistical analysis was done using SPSS 24 (IBM Corporation, USA, 2016).

Table 1: Types, specifications, and properties of light-curing units (n=80)

Property	Specification	Number	Intensity(Mean-SD)	P value
Type	Cabled	20	254	0.003
	Cordless	60	692	
Age(No of months used)	<1year	17	704	0.00
	>1 year	63	206	
Maintenance	Repaired	9	557	0.08

	New	71	682	
Contamination of Fibre Optic	Composite/BA	35	208	0.004
	Clean/ Clear	45	686	
Usage	Regularly	27	680	0.082
	Occasionally	53	610	
Barrier used	Sleeves	14	670	0.054
	None	66	678	

Results

Among the total of 80 light curing units were examined, 60 (80%) were cordless LEDs and 20 (20%) were cabled corded devices. Results of our study show that the mean intensity is higher in cordless newer and clean LEDs. Cordless devices show statistically significant increased intensity than cabled devices. Newer devices also show significantly increased intensity than devices used over a period of years. Contamination of device tip significantly decreases the intensity of LEDs. Results show no statistically significant difference between newer and repaired devices or between devices which are used regularly or occasionally. Sleeves for disinfection of LEDs do not decrease intensity significantly.

Discussion

Different types of light-curing units are used in restorative dentistry. Half of all dental income relies on the successful use of light-cured dental materials.[14] A proper intensity with required irradiation time must reach all areas of a photo activated restorations to ensure polymerization reaction.[15] A survey of curing lights in different dental clinics found 30% delivered less than half of the energy dose required by restoration, 43% dentists used extended curing times (to ensure an adequate cure), unknowingly risking heat damage. These dentists needed to modify their light-curing protocols while some may need a new curing light unit for curing.[16] Studies suggests that LEDs, specifically gallium nitride blue LEDs, are very effective in polymerizing composite restorative materials.[17,18]This study also found that most of the devices were LED-type and QTH light curing devices are used very infrequently. Types of curing units are not the only factor which contributes to the performance of curing units. It is also affected by their age and status of the curing device. It was found that none of the devices checked show intensity less than 200 mW/cm^2 ,these results are in concordance to results achieved by Omidi et al but opposite to those of Javaheri and Ashreghiet al who found that the light intensity of 27.4% of the devices in their study was less than desirable.[19,20] The performance of LEDs in our study can be considered as suboptimal as most of them have intensities below the marginal intensity, which is more than 400 mW/cm^2. Most of the curing tips examined in our study showed composite build-ups or other restorations adhered on them. A survey conducted mentioned that resin build up on the light-curing tip may affect curing by the partial light exposure as shown by the results of our study.[21]The same conclusion was not drawn by some other studies like Lee YR et al which may be due to the fact that the performance of light cure units (LCUs) was evaluated by assessing their ability to polymerize composite resin and not by radiometry .[22] It is conceivable that most, if not all, of the inadequate intensities could be corrected or improved by thoroughly cleaning the fibre optic tip and using sleeve barriers. The results also revealed that the intensity is lower in LCUs that are newer unrepaired and more frequently used although difference is not statistically significant. Furthermore, LCUs which have been used for over years also show lower intensity as compared to those that are recently purchased and the difference is significant. These results are same as shown by the studies of Lee et al. and Hegde et al. [22,23] LED light curing unit has a lifetime of over 10,000 h with relatively little degradation.[24] As the curing light gets older, there can be a decrease in the light output due to degradation

of the light source, autoclaving the fibre-optic light probe, breakage and fracture of the light tip, and/or the presence of cured composite resin or debris on the exposed light tip. Thus the clinician should record the light output from their curing light when new and then routinely monitor its light output using the same conditions (light guide, barrier, setting) and the same dental radiometer.[25,26] In addition to intensity and time, polymerization in composite restorations depends on total energy released (energy density). Higher is the energy density; higher is the degree of polymerization and mechanical properties of restorations. Further studies are warranted to take into consideration all these factors.

Conclusion

Under the conditions presented in this study, it has been demonstrated that cordless LED demonstrates better performance than cabled. Age of light cure units and contamination of tip affect the performance of units than the frequency of their usage. So a periodic maintenance of light cure units is advocated to achieve optimal performance. Some needed at least one new curing light.

References

1. Omidi BR, Gosili A, Jaber-Ansari M, Mahdkhah A. Intensity output and effectiveness of light curing units in dental offices. J Clin Exp Dent. 2018;10(6):e555-60.
2. Willems G, Lambrechts P, Braem M, Celis JP, Vanherle G. A classification of dental composites according to their morphological and mechanical characteristics. Dent Mater. 1992;8:310-9.
3. Stahl F, Ashworth SH, Jandt KD & Mills RW (2000) Light-emitting diode (LED) polymerization of dental composites: Flexural properties and polymerization potential Biomaterials 21(13) 1379-1385.
4. Powers JM & Sakaguchi RL (2006) Craig's Restorative Dental Materials Mosby Elsevier Int, St Louis, Mo.
5. Fan PL, Schumacher RM, Azzolin K, Geary R, Eichmiller FC. Curing- light intensity and depth of cure of resin-based composites tested according to international standards. Journal of the American Dental Association (1939). 2002;133:429-34; quiz 91-3.
6. Daniel l. Leonard, David g. Charlton, Howard w. Roberts, Mark e. Cohen. Polymerization efficiency of led curing lights. J Esthet Restor Dent 14:286-295,2002)
7. Takamizu M, Moore BK, Setcos JC, Phillips RW. Efficacy of visible-light generators with changes in voltage. Oper Dent 1988;13:173-80.
8. Althoff O, Hartung M. Advances in light curing. American journal of dentistry. 2000;13(Spec No):77d-81d.
1. 9.Barghi N, Berry T, Hatton C. Evaluating intensity output of curing lights in private dental offices. Journal of the American Dental Association (1939). 1994;125:992-6.
9. Goyal A, Jyothikiran H, Shivalinga BM. Use of Light Curing Units in Orthodontics: A Review. Annals of Dental Research. 2011;1:54-61.
10. Michaud PL, Price RB, Labrie D, Rueggeberg FA, Sullivan B. Localised irradiance distribution found in dental light curing units. J Dent 2014;42:129-39.
11. American Dental Association. (2013). Professional Product Review: Effective Use of Curing Lights — A Guide for the Dental Practitioner. 8(2).
12. Canadian Dental Association: CDA Essentials. (2014). Light Curing Guidelines for Practitioners. 1(6), 22–23.
13. American Dental Association. (2007). 2005-06 Survey of Dental Services Rendered. 1–181. ADA (2013). Survey of fees. Retrieved from: http://www.toothnature.com/2013/07/survey-average-fee-charged-by-dentists.html) Dental Revenue in the US. (2013).
14. Fan PL, Schumacher RM, Azzolin K, Geary R & Eichmiller FC (2002) Curing-light intensity and depth of cure of resin-based composites tested according to international standards Journal of the

American Dental Association 133(4) 429-434.
15. International Association for Dental Research. (2015). Curing Light Outputs, Protocols and Composite Requirements at 422 Dental Offices. #3400.
16. Fujibayashi K, Ishimaru K, Takhashi N, Kohno A. Newly developed curing unit using blue light-emitting diodes. Dent Jpn 1998; 34:49-53.
17. Jandt KD, Mills RW, Blackwell GB, Ashworth SH. Depth of cure and compressive strength of dental composites cured with blue light emitting diodes (LEDs). Dent Mater 2000; 16:41-47.
18. Omidi BR, Gosili A, Jaber-Ansari M, Mahdkhah A. Intensity output and effectiveness of light curing units in dental offices. J Clin Exp Dent. 2018;10(6):e555-60.
19. Javaheri M, Ashreghi M. Evaluation of curing light intensity in private dental offices (2005). The Journal of Qazvin University of Medical Sciences. 2009;12:50-5.
20. Madhusudhana K, Swathi TV, Suneelkumar C, Lavanya A. A clinical survey of the output intensity of light curing units in dental offices across Nellore Urban area. SRM J Res Dent Sci 2016;7:64.
21. Lee YR, Nik Abdul Ghani NR, Karobari MI, Noorani TY, Halim MS. Evaluation of light-curing units used in dental clinics at a University in Malaysia. J Int Oral Health 2018;10:206-9.
22. Hegde V ,Jadav S , Gayatri B Aher A clinical survey of the output intensity of 200 light curing units in dental offices across Maharashtra. J Conserv Dent ; 2009: 12 (3).106-108
23. Verma P. Curing efficiency of three light emitting diode units at different curing profiles. Indian J Dent Res 2016;27:168-73.
24. Rueggeberg FA, Caughman WF, Comer RW. The effect of autoclaving on energy transmission through lightcuring tips. J Am Dent Assoc. 1996;127(8):1183-7. https://doi.org/10.14219/jada.archive.1996.0409
25. Poulos JG, Styner DL. Curing lights: changes in intensity output with use over time. Gen Dent. 1997;45(1):70-3.