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Research Article

Efficacy of Light Curing Units of Kerman Private Dental Offices in 2016-2017

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ABSTRACT

Background and Aim: Regarding extent of dental composite usage, the importance of proper polymerization is clear. The aim of this study was to assess the efficiency of curing units, in private dental offices in Kerman.
Materials and Methods: In this descriptive cross-sectional study, light intensity of light curing units in 199 private dental offices were evaluated using radiometer. Other informations such as type and age of the unit curing time used history of maintenance, replacement of components, etc recorded in questionnaire. Data were analyzed using pearson and t.test, with p<0/05 as the level of significance.
Results: The mean light intensity of curing units was 399/5mw/cm^2. 49/7% of the units had intensities more than 400mw/cm^2 and 18/7% of units had intensities lower than 200mw/cm^2.
Conclusion: The results indicated that the light intensities of about 50/3% of surveyed light curing units were inadequate, addressing the importance of regular quality control of these devices.

Keywords: light curing unit Intensity,Radiometer,composite resin.

INTRODUCTION:

Visible light has a wide range usein curing dental resin materials, such as dental cements, temporary restorative materials, periodontal patches, molding materials, and especially composites, glass ionomers and bonding agents (1).The success of composite restorations depends on the degree of polymerization and the output intensity of the light cureunit (2)

The depth ofcure of composite depends on material factor (resin chemistry, filler fraction, etc.), optical properties (shade and translucensy, etc.), and the intensity and duration of exposure to the light source and the correct wavelength of light (2,3)As the device age increases, It's efficiency diminishes due to component degradation. In addition, various factors affect the output intensity of the unit, such as changes in the voltage of the workplace, the filter deterioration, contamination of device tip, the blurring and dimming of the lamp, the failure of the electrical components, (4 and 5). Different methods of sterilization also reduce the intensity of light output to different degrees (6).In a study after autoclaving three times, the severity of light was reduced by 50% (7). The disinfectants which contain glutaraldehyde also creates fractures in the glass surface of fiber that reduces the intensity of light (8).

In order to achieve maximum polymerization, the radiation intensity of the Light Cure device

should be sufficient (2). Some researchers described that the intensity of 300$\frac{mw}{cm^2}$ is proper for a 2 mm thick increment of composite (9). However, it should be noted that suitable curing with this light intensity is only achievable in optimum conditions, since close contact between the tip of the device and the parallel holding of the composite surface during radiation can not be achieved under clinical conditions (6), Rueggeberget all recommended the minimum of 400$\frac{mw}{cm^2}$ light intensityfor adequate cure (10).

As the light cure unit ages, the output decreased which is not detectable by visual examination inspection.

Inadequate polymerization of resin composite, increased water sorption and solubility, reducing hardness, weak color stability and stain. Also, the lack of proper polymerization can affect the bond strength of the composite,mechanical properties and dimensional stability and cause secondary decay (2, 11).

Inadequate polymerization of resin composite can produce a number of clinical problems such as increased water s&s, composite bulk softening, weak color stability and increased stainability of restoration. (11)

Dentist should monitor the efficacy of their light cure units periodically. (12)

Unfortunately neither visual inspection nor probing the set composite surface will give an accurate inclination of efficiency of light unit.(13) Test such as hardness and infrared spectroscopy which determine the degree of conversion of composite have been found to be more accurate in measuring light output, but these tests are expensive and inaccessible for dentists.(14) Numerous authors have demonstrated the usefulness of the radiometer as a tool for measuring light output from curing units.(13)

Several studies have been done which indicate that dentists are not aware of the need for their devices to be regularly monitored. Also, the results of all these studies indicated that the intensity of light was inadequate in most devices (15, 16 and 17)

Due to the fact that, based on preliminary estimates, the majority of dental offices use Light cure devices, a study was conducted on the need for regular monitoring of the device's exposure and its proper functioning.

METHODS AND MATERIALS:

Private dental offices of Kerman were visited for investigating intensity of curing units. In this way, first refer was to the treatment department of Kerman University of Medical Sciences and Health Services to receive theaddress of the private offices in Kerman (199 units).An information form and a radiometer was sent to each office in 1394.

After reaching agreement to participation, the curing unit was examined and information collected for the survey included the name of the unit, the manufacturer, the model of the unit and the offices intensity in accordance with$\frac{mw}{cm^2}$. (The questionnaire is included in the attachment appendix)

The used radiometerwas Optilux (kerr, usa) (dedicated to QTH and LED). If light curing units were contaminated with composite, after recording the output intensityof unit, the contamination was cleanedand the output intensity was measured again. The radiometer used in this study utilised a sensor window and a display screen.The light guide tipwas placed on the sensor's part of the radiometer and wasturned on then the intensity of the light shined on the screen was appeared. After the unit was turned on and worked one minute three readings were taken with radiometer and if the difference of read numbers was more than 25 $\frac{mw}{cm^2}$, the measurement was repeated again.

The averages of readings were taken and they were divided into 3 classes.

1-400 $\frac{mw}{cm^2}$And above it (sufficient intensity)

2- 201-399 $\frac{mw}{cm^2}$(Marginal intensity in which extra curingwas needed)

3-200 $\frac{mw}{cm^2}$and less (insufficient intensity that cannot be compensated even by lengthening the light time).

Since a study reported that a precise measure of theunit intensity is possible only if the unit head size is equal or larger than the radiometer window, then curing units with a head size

smaller than the radiometer window were excluded

(1).Method of calculating and analyzing data:

In order to analyze the data, central and dispersion index for quantitative variables and frequency and percentile for qualitative data were used. To compare the output intensity of light cure units with binary variables, considering the normal distribution of radiation, t- Test and Pearson's correlation were used to determine the relationship between mean severity and clinical age.

RESULTS:

A total of 199 dentistswere studied, 72.4% of them were general dentists and 27.6% were specialized dentists.

89 units of the all were made in the United Statesand the manufacturercountry of 7 pcs were not identified.Most of the units in this study were not made in Iran and the difference of intensity in Iranian and non Iranianunits was significant(p=0.0001). Non Iranian units had significantly higher intensity than the Iranian ones. Curing units had two type of LEDs and QTHs, and 53/88% 0f them were QTH(107 pcs). The intensity of LED units were more than QTH, and the difference of intensity was significant between them (p = 0.001).In the case of infection control, 187 dentists (94%) used cover and disinfectants and 11% used cover only. In 146 units which were 73.4% of all, any part like lamp was not replaced and in the others the lamp was replaced.The maximum number of lamp changing was 20 times.

The results showed that there was no significant relationship between radiation intensity and number of lamp changing. (p = 0.44)

195 units equal to 98% had complete satisfaction with the units and only 4 dentists were dissatisfaction.

There was no significant difference between the intensity of light cure units between general and specialist dentists. (P = 0.44). The findings showed that the average of light intensity was $1{,}340 \pm 1/399 \frac{mw}{cm^2}$.The maximum intensity was $1000 \frac{mw}{cm^2}$ and the least was $100 \frac{mw}{cm^2}$.The light intensity of the units was divided into 3 groups.

A) Light intensity higher than $400 \frac{mw}{cm^2}$. (49/7% of the units)

B) The light intensity between 201-399 $\frac{mw}{cm^2}$. (31/6% of the units)

C) The light intensity less than $200 \frac{mw}{cm^2}$. (18/7% of the units)

None of the curingunits had intensity fewer than $100 \frac{mw}{cm^2}$, and only 3% of them had light intensity more than $600 \frac{mw}{cm^2}$.The average age of the units was 6.1years.Therelationship between light intensity and clinical age was investigated with Pearson's correlation and the results indicated that the light intensity decreases as the unit ages. This relationship was statistically significant (r = -0.25 / p = 0.0001).

The results showed that light intensity decreased with increasing curing time. The Pearson's correlation(r = -0.2, p = 0.11)

Table 1: Relationship between the light intensity of unit and clinical age.

Year			Average radiation intensity			Total
			0-200	201-399	400 and up	
Year	0-4/9	Number	14	21	62	97
		Percent	14/4	21/6	63/9	100
	5-9/9	Number	6	17	43	66
		Percent	9/1	25/8	65/2	100
	10-14/9	Number	5	6	9	20
		Percent	25	30	45	100
	15-19/9	Number	3	3	4	10
		Percent	30	30	40	100
	20-24/9	Number	1	2	1	4
		Percent	25	50	25	100
	25 and up	Number	0	0	2	2

		Percent	0	0	100	100
Total		Number	29	49	121	199
		Percent	14/6	24/6	60/8	100

DISCUSSION:

The polymerization quality of composites affects almost all of their properties. Incomplete polymerization has adverse effects like biologic effects, increasing water absorption and solubility of composites and reducing hardness, as well as inadequate light intensity can affect the bond strength of restorations (18).

Several studies have so far been conducted on the light intensity of curing units, most of which have not been satisfactory, and dentist's lack of knowledge about their light cure units 's intensity was worse. (1,4,9,11,12,15,16,19,20).

Ferracane and Dewald found that optical and scratch tests are useful for checking the quality of the cure, but are less efficient because their cure depth is over estimated. Hardness tests and FITR tests are more accurate, but these methods are expensive and not readily available to dentists. Therefore, radiometers are a useful and effective method for assessing the intensity of light cure units (1). Several studies have shown the efficacy of radiometers for measuring the light intensity of units. (1,21,22,23).

In this study, kerr radiometer units (QTH and LED) were used to measure the light intensity. The reason for this choice was the higher accuracy of these units than radiometers manufactured by other companies. Due to the camphorquinone absorption spectrum (515-400 nm), light-curing units should produce an optical spectrum in this range. According to kerr's claim, its radiometer can evaluate the light automatically. Therefore, it was an important criterion for choosing kerr radiometer for this study. In this study, two types of radiometers were used but there are differences between the two radiometers. Although both of them operate with the help of a detector and filter to measure a particular light spectrum but they are different in grading and the results are slightly different. The numbers from the LED radiometer are slightly less than the QTH radiometer (18).

In this study, the average intensity of curing units in Kerman private clinics was estimated to be 3993 mw / cm2. Indeed, 18.7 % of the units had a light intensity of less than 200 mw / cm2, which was 18 % in the study of Dunne, 30 %in the Barghi study, 4-12% in the Elmowafy study, and 31.6 % of the units had light intensity between 399-201. And 49.7% had light intensity above 400.Ranges between 399-201 are marginal ranges, in which additional curing time may compensate low light intensity (1).

Martin in his study has divided the light intensity into three groups.1- Group with enough light intensity and more than 400

2. Group with marginal light intensity, in which additional curing times are recommended (201-399)3. A group with insufficient light intensity (intensity less than 200) (1).Which is cited in this study.

Caughman in his study, checked various units from different manufacturers by using four radiometers and reported that the intensity of these units, while still are in use, was between 350-800 and had sufficient light intensity for composite polymerization of 2 mm thick. (24).

In this study, 30.8% of dentists used 20 seconds or less for each composite layer polimerization. The proposed curing times for the composite thickness of 2 mm are variable. 60 seconds is reported by some researchers and others recommend 40 seconds.The manufacturer's recommendation varies from 20 to 40 seconds. Longer time is recommended for darker colors. Matsumoto also reported that manufacturer's recommended times are not generally sufficient for complete polymerization (1).In this study, the average age light cure units was 6/1 years. This average in Scoie study (1380) was 3.78 years, in the Barghi study (1994)was 4.5 years, in the Martin study (1998) was 2.5 years, and In the review of Zanjani (1997) it was 4.7 years.

In this study, there was a significant correlation between aging and unit and its light intensity, which was coordinated with the results of Barghi (1994), Burke (1997), Martin (1998) and Zanjani (1376). Many dentists mistakenly think that halogen bulbs have a good and continuous effect until the bulb burns. Friedman's studies showed that the lamp was gradually degraded over time, so that light-curing units should be monitored regularly for sufficient intensity.

In our study, the intensity of non Iranian units was significantly higher than Iranian ones, which was due to technology and manufacturing methodology, how to control the quality of the manufacturer or unit damaging from the factory to the place of use, which were possible along with other factors such as age, mode of maintenance and input voltage variations (18 and 25).

Another issue was further intensity of LED units than QTH units.

There is a contradiction in the superiority of these two types of units on each other in different articles, in some of them QTHs are superior, while others have certified the superiority of LED units (18). High intensity QTH units have recently entered to the market, but overall, the intensity of LEDs used in offices was more than them. In this study, half of units had light intensity less than 400 mw / cm, while only 2% of dentists were not satisfied with their units.

The intensity of light on the composite is influenced by the distance between the unit's tip and curing surface, and the dentists think that the intensity of output light decreases with a square of the distance between the unit's tip and tooth surface. Accordingly, the failure in locating the unit's tip near the restoration surface can disrupt the polymerization process, but at least two studies have shown that unit's light does not follow this law.

If the distance of unit's tip does not exceed 1cm from the surface, light intensity will not decrease significantly. In fact, if the tip of the unit is about 6 mm above the surface, during 60 seconds, the composite polymerization does not significantly decrease with a thickness of 2 mm. which is important for the interproximal layers polymerization of CL II cavities especially in the deep gingival regions.

The possibility of contacting the light tip and composite surface should be reduced while curing process because it can contaminate the tip (24). In this study, by increasing the curing time for each 2 mm composite layer, the intensity of the light cure unit decreased. The reason for this is likely to be the heavy use of unit and the lack of periodic monitoring.

CONCLUSION AND RECOMMENDATIONS:

According to the results of this study, about half of the Light Cure units in Kerman had lower light intensity than optimum, which specifies the need for Further informing dentists about the importance of periodic control of light cure units.It is suggested that this problem be specifically addressed in dental training courses.

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REFERENCES:

1. Martin. F. E. “A survey of the efficiency of visible light curing units. Journal of Dentistry: 1998; 26 (3): 239-243
2. MirzaeiM ,Moradimajd N. Evaluation of curing units efficiency used in private dental offices in Kerman in 2005z. J Dent Tehran: 2007;2:71-82 (Persian)
3. Rajinder B, Balject S, Amandeep K, Manu B. “Aclinical survey of the output intensity of light curing units” Indian J 2//0; 2/:2294-2239 4.Barghi N, Berry T,Hatton C.”E valuation intensity of curing lights in private dental offices” J Am Dent 1994;125(7):992-6
4. Rueggeberg FA, CaughmanWF,Cutis JW. “Factors affecting cure at depth within light-activated resin composites” J Am Dent 1993; 6(2):91-5
5. Savadioskoee S, Poor Abbas R, Hafezequran A.Evaluation of light curing units effectiveness used in clinics and private dental offices of Tabriz, 2001.J Dent Sch 2004 22(1): 82-95(PERSIAN)
6. Frederick A,RueggebergFA,RobertW,et al: The effect of auto cleaving on energy transmission through light curing tips. J Am Dent Assoc 1996;127:1183-1187
7. Nelson SK, Caushman WF, Rueggeberg FA, Lockwood PE: Efeect of glutaraldehyde cold streilants on light transmission of curing tips. Quintessence Int 1997;28:725-730
8. Dunne SM, Davies BR, Millar BJ. A survey of the effectiveness of dental light-curing on units and a comparison of light testing devices. Br Dent J 1996;180(11):411-6

9. RueggebergFA,Coughman WF, Curtis JW. Effect of light intensity and exposure duration on cure of resin composite. Oper Dent 1994;19(1):26-32
10. Pilo o, El-Badrawy W, Lewis DW, Shokati B, Kermalli J, Soliman O, et al. “Intensity of quartz-tungstenhalogen light-curing units used in private practice in Toronto. J Am Dent Assoc 2005; 136(6): 766-73
11. Miyazaki M, Hattori T, Ichiishi Y, Kondo M, Onose H, Moore BK. Evaluation of curing units used in private dental offices” Oper Dent 1998; 23(2): 50-4.
12. R.Pilo,D.Oelgiesser,H.S. Cardash. A survey of out put intensity and potential for depth of cure among light curing units in clinical use. J Dent 1999; 27(3):235-41
13. Omar El-Mowafy, Wafa El-Badrawy, Donald W. Lewis,BabakShokati, Osama Soliman, JafferKermalli. Efficacy of Halogen Photopolymerization Units in Private Dental Offices in TorontoJ Can Dent Assoc 2004; 70(5):323–8.
14. Fathi K. Evaluation of light curing units in privte dental offices in Mashhad. [Doctorate Thesis]. Iran. Dental School of Mashhad University of Medical Sciences;1999. (Persian)
15. Mesbahkiaee M. Evaluation of light curing units in privte dental offices in Rasht. [Doctorate Thesis]. Iran. Dental School of Gilan University of Medical Sciences;2003. (Persian)
16. Feiz A, ArbabzadehZavareh F, Dabagh M, Badrian H. Assessment of the correlation between light intensity and curing depth by light-curing units of the Department of Operative Dentistry of Isfahan Faculty of Dentistry. J **Isfahan** Med Sch 2012; 7(5): 662-670.
17. SolomanCS,OsmanYI:Evaluating of the efficacy of curing lights. SADJ 1999; 54:357-362
18. AkhavanZanjani V.A.D, Ghasemi A, Nasohi N. Evaluation of light curing units for their light intensity output in private dental offices , tehran 1998. J Dent Sch 2001;19(1):17-24.
19. AR.Daneshkazemi, AR.Davari, M Mousavinasab, AR.Shahbaghi.Effect of Voltage Stabilizer on the Light Intensity Output of Curing Units. J shiraz Med Sch 2008; 9(2): 170-179(Persian).
20. Burke T,EarpD,Cheung SW: Effectiveness of light curing units in vocational training practices. Prim Dent Care 1997; 4:91-94
21. Fowler CS, Swartz ML, Moore BK .”Efficiency testing of visible light curing units” Oper Dent 1994; 19: 47-52
22. Rueggberg F.A. Precision of hand-hedd dental radiometers. Quintessence International 1993;24:391-396
23. Manga R.K,Charlton D.G, Wakefield C.W. Invitro evaluation ofacuringradiometeraz a predictor of polymerization depth. General Dentistry 1995; 43: 241-243
24. Caughman WF, Rueggeberg A, James W, Curtis JR. “Clinical guidelines for photocuring restorative resins” American Dental Association 1995; 126:1280-1286.