

Research Article

Evaluation of Light Curing Units and Dentists' Knowledge About Photo Polymerization Techniques in Sulaimani Governmental Dental Clinics

Mohammed A. Mahmood¹, Bestoon M. Faraj²

Abstract

Objective: To measure the output intensity of light curing units (LCU) in governmental dental clinics of the Sulaimani governorate. To evaluate practitioners' knowledge on light cure application.

Methods: Ninety-four dental units and eighty-eight dentists in the Sulaimani governorate were included in this research. Output intensity and diameter of tips of the dental LCU devices were measured. Two survey questionnaires were filled, one for the LCU and its maintenance, the other for evaluating the knowledge, attitude, and practice of the dentists.

Results: Output power intensity results ranged from 50-2000W, with an average of 993W. The output intensity of 78% of the tested devices was found to be acceptable regarding the manufacturer instruction of the radiometers used (every intensity below the given range that given in the Result section is regarded as unusable or non-acceptable). The range of age in service of the devices was 1-12 years with a mean of 4.7 years. The average restorations performed in a week by a device was 17.8. Dentists had poor knowledge, attitude, and practice towards the maintenance of the LCU devices. 51% of the dentists were quite satisfied with the devices. 48.9% of the dentists reported that they don't have an idea of LCU intensity.

Conclusions: Devices should be checked regularly for output intensity, light bulb efficiency, and composite build up. Dentists express poor knowledge, maintenance, and attitude toward LCUs. Educational programs are advisable and recommended.

Keywords: *Light-cure intensity, Dentists knowledge.*

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1. *Kurdistan Board for Medical Specialties, Iraq.*
2. *Kurdistan Board for Medical Specialties and Department of Conservative Dentistry, College of Dentistry, University of Sulaimani, Sulaimani, Iraq.*

* Corresponding author: mhamadabm@gmail.com.

Introduction

The development of the light-curing device came with the development of light-activated composite materials in the 1970s heralded a period of rapid progress in the field of tooth-colored restorations. There is an increasing demand for aesthetic restorative dentistry, using primarily direct or indirect composites, or composite bonded porcelain veneers⁽¹⁴⁾.

Adequate depth of cure of a light-activated composite depends on the intensity of the light source and the exposure time, as well as on the material and other factors⁽¹⁾. Many factors influence the clinical performance of composites, of which the utmost importance is the functioning of the light curing unit (LCU), Duration of application is relatively easy to control, but the intensity is not so readily monitored^(2, 3). Three essential components are required for adequate polymerization, namely, sufficient radiant intensity, the correct wavelength of the light, and ample curing time^(4,5).

Visible light photo-activating LCU usually emit wavelength spectra from 400 and 515 nm. Some units may have small to moderate amounts of radiation outside this range. Even though the dentist may increase the irradiation time, there is a law of diminishing returns, and the dentist must possess an effective light source⁽⁶⁾.

According to the results of a recent survey by Berry et al., many current light activating units do not produce adequate energy and increased irradiation time may not compensate for this⁽⁷⁾.

Light activation units are the standard items of equipment in dental practice. This necessitates every practitioner to understand various factors relating to the maintenance of an LCU and their effect on clinical performance and longevity of a restoration. For any failure of a restoration, practitioners usually blame the material used rather than technique or method of placement^(4,8).

Several studies have been conducted about the measurement of output intensity and evaluation of dentists' knowledge on the type of light cure, exposure time, maintenance of the device, and mode of polymerization. Measured output intensity differs among various researches, for example, acceptable output intensity (every intensity below the given range that given in the Result section is regarded as unusable

or non-acceptable) was found to be 68% in Malaysia⁽⁹⁾ and %45 in Israel⁽¹⁰⁾, 25% in India⁽⁴⁾. Researches from England⁽¹¹⁾, Saudi Arabia⁽¹²⁾ and Turkey⁽¹³⁾ agree on the necessity of further education, training, and guidance of dentists about using light curing units⁽¹²⁾.

This study has two aims: 1. to measure the output intensity of light curing units in governmental dental clinics of the Sulaimani governorate. 2. To evaluate practitioners' knowledge on light cure application.

Patients and methods

Ethical approval was taken from the Kurdistan Board of Medical Specialties in Erbil. All of the governmental dental clinics of Sulaimani Governorate were selected. Two survey questionnaires were prepared and validated by using the literature review and previous researches with slight modification. One of the surveys targeted light cure evaluation and covered the following items: type of curing unit, measurement of output intensity, manufacturer brand or company name, age of curing unit, number of restorations per week, maintenance of curing unit for intensity, frequency of changing the bulb, diameter of the light tip guides and presence or absence of composite build-ups on the curing tips. The second survey covered different aspects of light cure application aiming evaluation of the dentists' knowledge, such as knowledge of the light cure type, used the mode of curing, type of restoration material, application time, and regular maintenance of the device and level of satisfaction.

The output intensity of the light cure devices was measured by two manual radiometers (COXO) (Serial No: P07237, CO04026) from China (Figure.1). Each LCU was tested twice by two different radiometers for the measurement of output intensity. The diameter of the LCU tips was measured by a metal gauge and checked for the presence or absence of composite build up.

The first questionnaire was filled out by the author. The second questionnaire was filled by the participants (dentists) themselves in a one-to-one meeting. Participants had the chance of asking about any part of the survey that not understood enough. Participants were the users of the LCUs measured in this research.

Results

Light-cure units

Ninety-four dental units were included in the research. The majority of LCUs were Light Emission Diode (LED) (91.5%), while the rest were Quartz Tungsten Halogen (QTH) (8.5%). Regarding the output intensity, the results ranged from 50-2000W with an average of 993W. According to the manufacturer of the used radiometer, two independent criteria were used: 500-800 mW/cm² (recommended) and 300-500 mW/cm² (the composite should be tested to be sure).

Percentages of the unusable LCUs were 28.7% and 11.7% respectively. The majority (71.27%) of the tested LCUs were above 500 mW/cm². (every intensity below the given range that given in the previous sentence is regarded as unusable or non-acceptable).

Most of the units enrolled were of Satelec[®] device made by action company from France (45.7%, n=43) 29.8% of the devices were of the unknown made since they were without labels. The rest of the light-cures were mostly Chinese (OSAKA, KASO, Woodpecker, DTE, YDL-Hangzhou, Quayle, LY-CZ40 China). The range of age in service of the devices was 1-12 years with a mean of 4.7 years (Figure 2). Besides, the tiredness of the devices was measured by the number of restorations per week, with an average of 17.8 restorations per week per each LCU (Figure 3). All of the dental LCU lacked light intensity maintenance, and none of them had given the chance of bulb changing.

Table 1: Dentists' knowledge on photopolymerization techniques.

Variables	No.	%
Type of your light cure:		
1. QTH.	3	3.4
2. LED.	74	84.1
3. Other	2	2.3
4. Not sure.	9	10.2
Mode of curing:		
1. Soft Start	21	23.9
2. Continuous	62	70.5
3. Ramping	3	3.4
4. Not sure	2	2.3
For which restorations do you use the light cure?		
1. Composite.	42	47.7
2. Glass Ionomer.	2	2.3
3. Composite + Calcium Hydroxide.	30	34.1
4. All.	14	15.9
Difference between the types regarding the efficiency of curing:		
1. Yes	55	62.5
2. No	9	10.2
3. Not sure	24	27.3
How many seconds do you perform curing for composite restoration?		
1. 10-15 sec.	9	10.2
2. 20-30 sec.	61	69.3
3. 30-60 sec.	18	20.5
Did you have any idea about light cure intensity previously?		
1. Yes	45	51.1
2. No	43	48.9
Do you check your light cure regularly for maintenance?		
Yes	25	28.4
No	63	71.6
Level of satisfaction with your light cure.		
1. Very satisfied.	27	30.7
2. Quite satisfied.	45	51.1
3. Neither.	8	9.1
4. Quite dissatisfied.	2	2.3
5. Very dissatisfied.	6	6.8



Figure 1: Front and back side of the used radiometers.

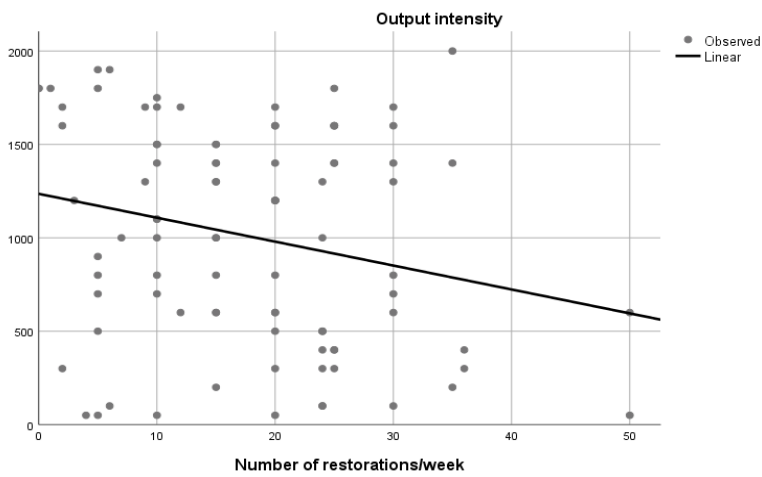


Figure 2: Linear correlation between output intensity and age of the device.

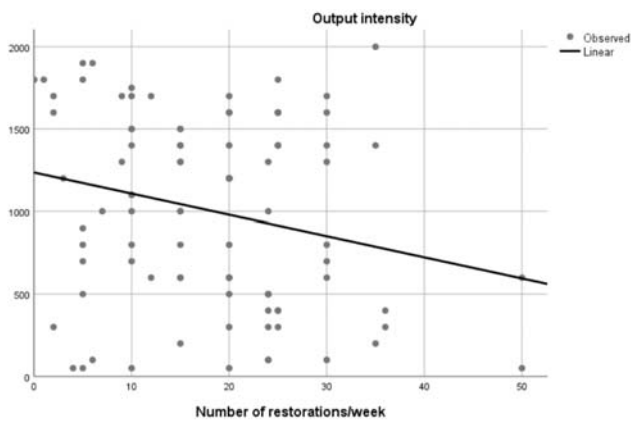


Figure 3: linear correlation between output intensity and number of restorations/weeks.

The diameter of the tip of the device, 52 of them (55%) were 8 mm, followed by 7.5 mm in 36% of the devices. As for the presence of the composite build up on the device, most of them had composite buildups on their tip of the light guide (75%). Sixty-seven percent of 67% of the devices were wired, while 33% were portable. Summary of the results is shown in Table 1.

Dentists' knowledge and the attitude most of the participants correctly predicted the type of LCU (90%). Regarding the common type of curing mode preferred by the dentists, the majority (70%) used continuous mode, followed by 23.9% for the soft start mode. Composite was the main filling material for which light-cure was used for; as 47.7% of the respondents used light only for the composite, while 34% used in combination with resin-modified glass ionomer cement. 16% used light curing for all types of materials. 62.5% of the participants believed that the type of polymerization technique affects the efficiency of the curing and the subsequent quality of the filling. However, 10% said that there is no link between the two, and, 27% were not sure. Most of the participating dentists (69%) preferred 20-30 seconds for the curing, while 10% selected 10-15 seconds and 20% selected 30-60 seconds. Nearly half of the respondents (48.9%) reported that they don't have an idea of light-cure intensity. Besides, 71.6% they don't check the device for regular maintenance. Finally, the dentists asked about the level of satisfaction with the light-cure they used and, only 51% were quite satisfied.

Discussion

Light curing unit

Over a period, the intensity of LCUs will reduce due to many factors, like composite resin build-up on the curing tip, condition of the bulb in units, orientation position of the curing tip to the radiometer, voltage regulation, and handling of the LCU^(4,14).

The output of dental light-curing units is usually evaluated indirectly by subjective tactile examination of the upper surface of restorations. However, it has been shown that it is not possible to completely differentiate between adequately cured and under-cured composite and because even an inferior curing unit can polymerize the surface as well as an effective unit⁽¹⁵⁾.

The recently marketed hand-held radiometers should serve as a means to objectively measure the performance of these units, instead of depending on unreliable subjective parameters. These are simplified,

less accurate, chair-side versions of sophisticated laboratory equipment used to measure the output intensity of curing lights⁽¹⁰⁾.

According to the manufacturer of the radiometer used in this research, two independent criteria were conducted: 500-800 mWcm² (recommended) and 300-500 mWcm² (the composite should be tested to be sure) below 300mW considered as unusable. Percentages of the unusable lighting cures (less than 300mW) were 28.7% and 11.7% respectively (according to the two independent criteria mentioned respectively in the previous sentence) with the average of (20.2%). This finding is by Yogesh *et al.*⁽¹⁶⁾ in which unusable LCUs were estimated to be 22%.

As the age advances, the output intensity of these LCU gradually diminishes⁽²⁾. The present survey also showed a significant reduction in light intensity with older units. As the measured devices relatively old with an average of 4.7 years. This agrees with the result of similar researches⁽⁴⁾.

Resin-based composite build-up on the light curing tip was evident on 76% of 100 LCUs. This build-up may have a significant negative effect on intensity because the resin-based composite material partially blocks the light output^(8,17) since it is likely that intensity from the LCU can be improved by removing any resin contamination on the tip⁽¹⁷⁾. The influence of the number of composite build-ups on the intensity of curing light was not measured in the present survey; hence, the effect of the cleaning of curing tips on the outcome of this study is unknown.

About the monitoring of output intensity of curing units, the majority of the participants reported that they never checked the output intensity of their curing lights. Findings from the neighbor country, Saudi Arabia reflect the same problem⁽¹²⁾. (the problem is lack of maintenance).

A number of the restorations conducted with a device in a given period could give a clue on the tiredness of the device⁽¹⁷⁾. In this study, the average number of restorations per week per each light-cure unit is 17.8. This result agrees with the findings of an Indian article in which 49% of the tested LCU devices were performing <10 restorations in a week⁽⁴⁾.

Dentists' knowledge

Adequate polymerization is a crucial factor in obtaining optimal physical properties and satisfactory

clinical performance of composite materials. Inadequate polymerization reduces the strength, hardness, water sorption, and color stability of composites^(18,19). Several factors affect resin polymerization, including a selection of the appropriate LCU; light intensity, wavelength and exposure time; and size, location, and orientation of the LCU tip^(20,21). In addition to the type of LCU used, the clinician's knowledge and skill regarding the use of LCUs plays an important role in the outcome of polymerization and thus the outcome of resin-based restorations⁽¹³⁾. The findings of this study indicated that dental clinicians had low levels of knowledge regarding LCUs and materials science.

Knowledge and understanding of the LCU output intensity are important to ensure sufficient curing of the resin and to prevent any damage or harm⁽¹²⁾. Most of the respondents did not know the output intensity of the LCU they were using, which increases their chances of having insufficient curing and polymerization by the LCU. This agrees with the results of Alsuliman *et al.*⁽¹²⁾ (In which 88.7% of the participants were unaware of the intensity value of their LCUs).

Conclusions

Based on the study results, it's concluded that about 78% of the tested LCUs were found to be acceptable (more than 300mW). Dentists express poor knowledge, maintenance, and attitude toward LCUs. Educational programs are advisable and recommended.

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