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Evaluation of General Dentists' Knowledge about the Function, Safety, and Infection Control of the Dental Light-Curing Units in Kerman in 2017

Marzieh Karimi Afshar[1], Ali Eskandarizadeh[2], Farzaneh Hasanabadi[3], Molook Torabi[4]*

1- Assistant Professor, Department of Orthodontics, Faculty of Dentistry, Kerman University of Medical Sciences, Kerman, Iran
2- Professor, Department of Restorative Dentistry, Faculty of Dentistry, Kerman University of Medical Sciences, Kerman, Iran
3- Dentist, Department of Oral and Maxillofacial Pathology, Faculty of Dentistry, Kerman University of Medical Sciences, Kerman, Iran
4- Associate Professor, Department of Oral and Maxillofacial Pathology, Faculty of Dentistry, Kerman University of Medical Sciences, Kerman, Iran

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Corresponding Author:
Molook Torabi

Email:
m.torabi@kmu.ac.ir

Address:
Department of Oral and Maxillofacial Pathology, Faculty of Dentistry, Shafa Street, Kerman, Iran

Tel: 03432119025
Fax: 03432118074

Abstract

Background: Light-curing dental restorative materials are currently used extensively. The effective use of these materials increases their properties and prevents damage to the tooth nerve. This study investigated general dentists' knowledge about the function, safety, and infection control of light-curing units (LCUs) in Kerman in 2017.

Methods: This descriptive cross-sectional study was performed on 170 general dentists. The data were collected using a researcher-made questionnaire that assessed the dentists' demographic information and measured their knowledge of LCUs (7 items) and safety and infection control (2 items). The collected data were analyzed using analysis of variance (ANOVA) and t-test (P = 0.05) with SPSS 20 software.

Results: The respondents' mean age and dental service history were 35.77±9.25 and 9.97±8.08 years, respectively. The lifetime of the LCUs in 105 cases (61.8%) was more than 5 years. Moreover, 123 dentists (72.4%) did not have radiometers. It was also shown that 61.8% of the dentists were not aware of the light intensity of their light-curing units, but 68.8% of them were well aware of it. Most of the respondents used protective eyewear during dental services. The most common way to control unit infection was to use cellophane. The respondents' mean knowledge score was 6.00±1.42 out of 7. The knowledge score had a statistically significant relation with having a radiometer, the number of daily composite restorations, and the lifetime of the unit.

Conclusion: Given the technological advancements in dentistry, increasing dentists' knowledge of using LCUs is essential to increase the life and quality of restorations.

Keywords: Light curing unit, Knowledge, Safety, Dentists, Resin composite, Infection control

Background

In many countries, resin-based composites (tooth-colored restorative materials) are currently replacing amalgam restorations in the treatment of dental caries (1-6). With the continuation of research on the properties of adhesives and increasing the aesthetic needs of people, the quality and durability of these composites have improved (7). The use of light-curing materials in addition to restorative dentistry is also increasing in orthodontic treatments (8).

Resin-based composites have light-sensitive primers and their polymerization is done by light-curing units. Some of the factors affecting clean polymerization without scratching the tip of the unit are light irradiation time, light intensity, and distance of the tip of the unit to the restorative material (9).

The recommended wavelength varies from 300 to more than 2000 mV/cm^2 based on the recommendations of the manufacturers and restorative materials. The irradiation time varies from 100 to less than 5 seconds (10, 11). Studies have shown that improper use of light-curing materials increases radiation exposure (12). Blue light such as that emitted by light-curing units can cause eye damage (10, 11). The amount of damage depends on the exposure time, the degree of light reflection, the use of protective eyewear, and the amount of radiation from the lamp (13). Moreover, a significant relation has been shown between the amount of exposure and the pulp temperature (14). The researchers also showed that the clinical success of composite resin restorations depends on the knowledge of materials and LCU-related factors (15).

Kopperud et al. showed that 30% of Norwegian dentists did not have adequate eye protection against the light cure. Furthermore, 78.3% of them were not aware of the amount of radiation in their unit and 14.5% of dentists did not have an annual visit to maintain the unit (16). The knowledge of English general dentists about light-curing units has also been reported to be poor (17).

To protect the patient and to comply with radiation protection principles, dentists should use the ideal method for curing. Excessive exposure can cause damage to the pulp and other tissues exposed to light curing. Knowing how to do the procedure as well as the right amount of curing is essential. Given the relation between technology and dentistry, it is essential to be aware of the necessary and specific methods and safe use of tools and equipment commonly utilized in daily dental work. Thus, the present study aimed to investigate general dentists' knowledge of curing methods, suitable time and protection of blue light, and infection control methods for greater patient and dentist safety and increased durability of composite resin restorations.

Methods

This descriptive-analytical cross-sectional study was performed on general dentists in Kerman. First, a list of general dentists in Kerman was prepared. Then, taking into account prevalence = 0.5, error = 0.08, and Z = 1.96, the sample size was estimated as 150 persons using the sample size formula. However, a total of 170 questionnaires were distributed to compensate for the respondents' dropout.

The respondents were selected using convenience sampling. First, after obtaining the necessary permits, a senior dental student who was familiar with the questionnaire items and how to conduct the study, visited dentists' offices, explained the objectives of the study, obtained oral consent from the respondents, distributed the questionnaires, and asked them to fill them on the same day.

The questionnaires were anonymous and the respondents were assured that participation in the research project was completely voluntary. This research project was approved with the code IR.KMU.REC.1396.1445 by the Research Ethics Committee of Kerman University of Medical Sciences.

The data were collected using a researcher-made questionnaire consisting of three parts. The first part measured the respondents' demographic characteristics (gender, year of graduation, age, workplace). The second part of the questionnaire contained items about the number of resin restorations used per day, protection against light rays, having a radiometer, light-curing service, the type, number, and lifetime of the life-curing units. Finally, the third part of the questionnaire consisted of 7 items that measured the respondent's awareness of radiation intensity, exposure time, the effect of intensity and reduction of exposure, and infection control. Each correct answer was

scored 1 and each incorrect answer was scored 0, with a total score of 0 to 7. The questionnaire was developed by the researchers based on previous studies in the literature. The content validity of the questionnaire was assessed by one epidemiologist, two restorative dentists, one pediatric dentist, and one orthodontist and was confirmed with a validity coefficient of 0.88. The reliability of the questionnaire was confirmed by administering the questionnaire to 10 dentists with an interval of two weeks, with a Cronbach's alpha coefficient of 0.90.

After collecting the completed questionnaires from the respondents, the data were coded and entered into SPSS software (version 20). The data were analyzed using t-test and ANOVA at a significance level of 0.05.

Results

The respondents in the study were 170 general dentists in Kerman, including 62 female dentists (36.5%) and 108 male dentists (63.5%). The respondents' mean age was 35.77±9.25 and they were offering dental services for an average of 9.97±8.08 years. The lifetime of the LCUs in more than 105 cases (61.8%) was more than 5 years. Moreover, 123 dentists (72.4%) did not have radiometers and 27 dentists (15.9%) were unaware of the existence of radiometers in their dental offices. In addition, 61.8% of the respondents did not know the intensity of the LCUs at their offices and 66.5% of the respondents reported the irradiation time for each 2 mm composite layer as 20-29 seconds (Table 1).

Table 1. The respondents' distribution in terms of the demographic variables and LCUs

Variables	Categories	Frequency	Percentage
Gender	Male	108	63.5%
	Female	62	36.5%
Workplace	Dental office	86	50.6%
	Medical center	33	18.6%
	Dental office/medical center	51	30.0%
Number of dentists at the workplace	1	79	46.5%
	2	19	11.2%
	3	41	8.3%
	> 3	58	34.1%
Number of composite restorations	3-5	31	18.2%
	5-7	39	22.9%
	7-10	99	58.2%
	> 10	1	0.6%
Number of LCUs	1	41	24.1%
	2	77	45.3%
	> 2	52	20.6%
LCU lifetime (year)	1-5	38	22.4%
	5-10	105	61.8%
	NS*	27	15.9%
The existence of any LCU at the workplace	Yes	20	11.8%
	No	123	72.4%
	NS	27	15.9%
Irradiation time (second)	20-29	113	66.5%
	30-39	52	30.6%
	40-60	5	2.9%

*: Not specified

The mean score of the dentists' knowledge was 6.00±1.42 out of 7. The dentists' knowledge was divided into three good, average, and poor levels, and 68.8% of the respondents had good knowledge of LCUs. It was found that the year of graduation, gender, and the number of dentists in the workplace had no significant relation with the dentists' average knowledge. Table 2 shows the average score of the respondents' knowledge in terms of various demographic variables. As can be seen, the dentists who worked in dental offices had higher knowledge scores, but they were not significantly different from those working in other places. The dentist who reported a shorter LCU lifetime (P=0.027), the dentists who had more daily composite restorations (P=0.026), and who had radiometers (P=0.011) had a significantly higher knowledge of LCUs.

Table 2. The relation between the dentists' knowledge and demographic variables

Variables	Categories	Mean	Std. Deviation	Sig.
Gender	Male	5.93	1.48	0.434
	Female	6.11	1.31	
Workplace	Dental office	6.18	1.40	0.077
	Medical centers	5.25	1.58	
	Dental clinics	5.30	1.31	
	More than one center	5.94	1.39	
Number of dentists	1	6.10	1.46	0.613
	2	6.15	1.57	
	3	5.66	1.55	
	4	5.89	1.32	
Number of composite restorations	3-5	5.41	1.23	0.026
	5-7	5.94	1.37	
	7-10	6.20	1.45	
Number of LCUs	1	6.02	1.59	0.840
	2	6.05	1.37	
	3	5.9	1.37	
LCU lifetime (year)	1-5	6.23	1.19	0.027
	5-10	6.00	1.47	
	NS*	5.91	1.37	
The existence of any LCU at the workplace	Yes	6.15	0.94	0.011
	No	6.05	1.43	
	NS	5.25	1.48	

*: Not specified

Concerning the disinfection light-curing tips, 75.9% of respondents used cellophane and 14.1% of the respondents used disinfectant solutions and cellophane to cover the tip. The results concerning eye protection from radiation indicated that 53.5% of the respondents used head protection and 18.9% of them wore glasses and head protection together (Figure 1):

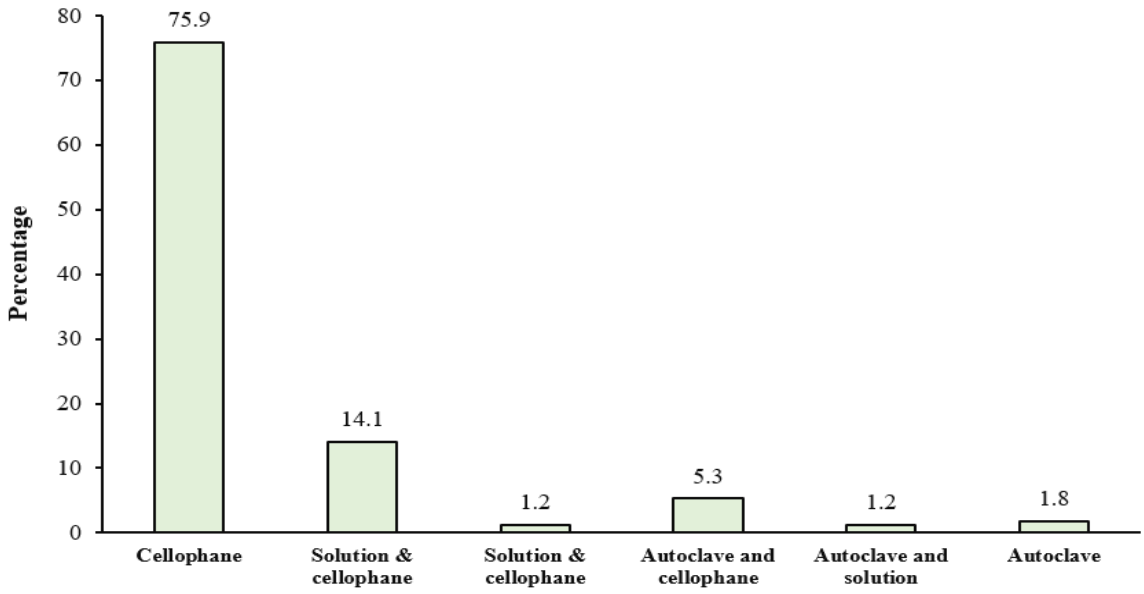

Figure 1. Disinfecting the LCU tips

Discussion

The clinical success of composite resin restorations depends on the dentist's knowledge of materials and LCU-related factors (15). The data in this study indicated that 68.8% of general dentists had good knowledge of the function, safety, and infection control of dental light-curing units. Santini and Turner (15) found that general dentists in the UK had poor knowledge of light-curing technology. These differences can

be attributed to the instruments used for data collection in the two studies.

Moreover, 11.8% of the dentists in this study reported that they had a radiometer in their workplace. However, Santini and Turner (15) reported that 30% of UK general dentists had access to radiometers, which was higher than the rate reported in the current study. The presence of a radiometer is necessary to control the light output of LCUs, and measuring the light intensity is necessary for the adequacy of the LCUs. Thus, it seems that dentists should have the necessary knowledge and information about radiometers. In the present study, 61.8% of the dentists did not know the intensity of the light output of their LCUs at work. Kopperud et al. (16) showed that 78.3% of Norwegian dentists were unaware of the amount of radiation in their unit, which was almost consistent with the findings of the current study. In this study, the most common method of infection control in LCUs was cellophane. Different methods of controlling infection at the tip of the LCUs have been shown to reduce the intensity of light output to varying degrees. Hodson et al. reported the use of disposable infection control barriers could reduce the light intensity compared to the time when they were not used (17).

Ajaj et al. also reported a significant decrease in light intensity of the LCUs when using infection control barriers (18). Infection control measures should be carefully considered before use to prevent adverse effects on the light-curing capacity and to ensure that the degree of polymerization within the composite resins and the curing efficiency are not affected (19).

Research has shown that some light cure protectors can reduce radiation by more than 40%, and it is important that the coating used does not cover the light-curing tips (LCTs), as it may reduce light output (20-22). If cold sterilization methods are used, standard solutions should be used and the lens or filter inside the unit should be thoroughly checked for cleanliness (23). In the present study, all the dentists stated that they protected their eyes from radiation. However, Kopperud et al. reported that 1.7% of Norwegian dentists did not protect their eyes at all (16). The data in the present study indicated 53.5% of the dentists used LCU- mounted barriers and 7.5% wore glasses. Kopperud et al. showed that 7.5% of dentists wore glasses and 19.7% used mounted barriers (16). In a study of dental students in the United States, only 84% of students reported that they protected their eyes while working with LCUs (24).

McCusker et al. showed that the risk of LCU radiation is low, especially when protective measures are taken, but the long-term effects of blue light emitted from LCUs are not clear. Blue light, such as that emitted by LCUs, can cause eye damage (8). However, if blue light filter glasses are used, light transmission with a wavelength below 500 nm can be reduced to less than 1% (23, 25).

In the current study, 97.1% of the dentists chose the radiation intensity to cure the composite resins based on the manufacturer's order. Kopperud et al. (16) found that 60.9% of dentists used the manufacturer's instructions for the resin composite. A 2013 review study found that dentists, dental students, and dental assistants did not have sufficient training to use LCUs (26). Manufacturers should provide more information about the light output of light-curing units and the absorption spectrum of resin composites (25). In the present study, 23.5% of the dentists reported periodic maintenance of their LCUs. Kopperud et al. (16) found that 14.5% of Norwegian dentists did not have LCU periodic maintenance. Clinicians should periodically evaluate their LCUs for light output, fracture, and dirt on light-curing tips for restorative materials on LCTs (27). Maghaireh et al. showed that contamination on LCTs had a significant effect on radiation output. Besides, the light intensity of the LCUs decreased over time (28).

In the present study, 66.5% of the dentists reported the curing time of 20-29 seconds for the 2 mm deep resin composites. The curing time depends on factors such as the light intensity and the type of materials. Thus, dentists are recommended to carefully study and apply the manufacturer's instructions (29).

The data in the present study indicated that most of the dentists were aware that the time for polymerization of the composite depth could be increased if the intensity of the output light was reduced. In the deep parts of the sidewalls, a resin composite restoration with a light cure of 600 mV/cm^2 can increase the

curing time to 40 to 60 seconds to ensure proper polymerization (27).

The present study showed no statistically significant difference between the knowledge scores of the male and female dentists. However, the females scored slightly higher. Perhaps the reason for the lack of difference between the males and female dentists is the similarity of dental education for both sexes at university.

The findings of the present study also indicated there was no statistically significant difference between the dentists' workplace and the knowledge score. However, those dentists who only worked in dental offices had a higher knowledge score. Perhaps the reason for this difference was that the dentists working in dental offices have more attention to and mastery of the devices and materials used. Moreover, the dentists who had more composite restorations per day were significantly more knowledgeable. Thus, it can be argued that multiple restorations increased the dentists' work experience and consequently their knowledge. There was also a statistically significant relation between LCU lifespan and the dentist's knowledge. People whose units had a lifespan of fewer than 5 years were more aware. Similarly, Kopperud et al. (16) showed that dentists having LCUs with a lifespan of 5 years or less were more knowledgeable. Meanwhile, increasing the life of the unit reduces the light output (23).

This study was conducted with some limitations. Since the questionnaire in this study was completed as a self-report tool by the dentists, some of the responses provided by them may have been unrealistic, which was beyond the researchers' control. Moreover, because the current research was conducted on general dentists in Kerman, its findings cannot be generalized to all general dentists in Iran.

Conclusion

The results of this study showed dentists had good knowledge of the function, safety, and infection control of dental light-curing units (LCUs). Nevertheless, the number of dental centers equipped with radiometers was not enough to evaluate the performance of LCUs. The dentists were well aware of the use of factory instructions for the amount of time required for curing. Accordingly, holding refresher courses on the function of LCUs and their periodic maintenance is essential to prevent the failure of resin composite restorations and unwanted exposure.

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Conflict of interest

The authors reported no conflict of interest.

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