Evaluation of the knowledge of dental students on light curing

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Received: 04/15/2020. Approved: 08/19/2020.

ABSTRACT

The clinical success of resin materials depends on adequate curing. Several light cured materials are frequently used in dental school clinics. This study aimed to assess the knowledge of students from the 10th period of Dentistry at Maurício de Nassau University Center, Recife/PE, about light curing, using a questionnaire. Data were tabulated and analyzed by descriptive statistics, Pearson chi-square test and Fisher exact test, at a significance level of 5% ($p<0.05$). The results show that 83.8% of students do not have a light curing unit, 72.9% do not know the device power, 56.2% do not know the ideal minimum power and only 8.5% know the name of the device that measures the irradiance/power. Also, 48.5% do not know the ideal wavelength for light curing of composite resin and 69.2% do not know the type of device they use (monowave or polywave). Regarding the light curing time, 60.8% stated they used 20 seconds in conventional composite resins and 38.5% used 40 seconds in bulk-fill composite resins. Although 84.6% stated that they use light curing units frequently, only 26.9% know the ideal distance from the tip to the restoration. Additionally, 51.5% reported performing cleaning and disinfection with 70GL alcohol and 45.4% use a plastic barrier. In this context, it can be concluded that the knowledge of students regarding light curing was unsatisfactory, requiring a more effective approach and evaluation so that the students may be aware of the clinical importance of this procedure and its consequences.

Descriptors: Dental Education, Dental. Light Curing. Composite Resins.

1 INTRODUCTION

The clinical success of procedures using resin materials depends on adequate curing. A well-cured resin material may have good longevity, since this step has direct interference on its physical and mechanical properties. This emphasizes the importance to know the characteristics of the light emitted by the light curing unit and the composition of resin materials used, requiring the manufacturer to inform these characteristics[1].

Halogen light appliances were widely used until the 1990s. however, since they promoted marked heating of composite resins and dental structures, they led to irreversible damage to the dental pulp and greater polymerization shrinkage. Thus, new devices were developed to meet the needs without causing such adverse effects[2]. Currently, highly efficient light-emitting diode (LED) devices are characterized by inducing little heat, both to the restorative material and tooth structure, during the light curing process, being available in several brands, models and with several wavelengths[3-5].

Due to the large number of light cured materials, light curing units are frequently used in laboratories and school clinics of Dentistry, as part of the academic training. In the institution where this study was conducted, the students have contact with light curing units and materials requiring such process since the 4th period and continue to use them until they finish the course (10th period), which involves more than 10 disciplines accounting for more than 100 uses of the device during graduation. However, the light curing process is considered simple and its real importance is underestimated, with evident lack of knowledge of students and professionals on the subject[6]. Thus, the aim of this study was to assess the knowledge of students in the Dentistry course at Maurício de Nassau University Center - Uninassau/PE, about light curing.

2 METHOD

The study was approved by the Institutional Review Board of Hospital das Clínicas, Federal University of Pernambuco, under protocol n. 3.576.584. The participants, students of the 10th period of the Dentistry Course at Maurício de Nassau University Center, Recife, signed an informed consent form and voluntarily responded to the questionnaire, without the need for identification. The sample calculation considered a homogeneous distribution of the population of 181 students, significance level of 95% and an error margin of 5%, yielding a sample of 105 students.

The inclusion criteria were age above 18 years and completing the course in the semester 2019/2. Two students refused to participate in the study.

The questionnaire was based on a previously published study[7] that considered different aspects related to light curing, such as ideal power and wavelength, cleaning and maintenance methods used, frequency of accomplishment of this procedure and most used light curing method, being adapted to the reality of clinical procedures, new methodologies and materials. The students responded to a printed questionnaire, inside the institution, in person.

Data were tabulated using the Epi Info v. 7 software (*Centers for Disease Control and Prevention*, Atlanta, GA, USA). Data were then exported to the IBM SPSS Statistics v. 23 software (IBM, Amronk, NY, USA) to achieve the absolute and percentage frequencies of qualitative information, mean, standard deviation, minimum and maximum in variables

with normal distribution. The analysis of associations employed the Pearson chi-square test and Fisher exact test. A significance level of 5% ($p<0.05$) was adopted for the associations.

3 RESULTS

The study included 130 students, aged 21 to 33 years, among which 83.8% responded that they do not have their own light curing unit. Most students (72.9%) stated they did not have knowledge about the irradiance of devices they use, nor about the adequate irradiance for effective light curing; 56.2% answered not knowing and 34.6% answered the alternatives with irradiance ≥400 mW/cm². Only 8.5% of students knew the name of the device to measure it. When asked about the wavelength, 48.5% answered not knowing and 3.8% chose the alternative that includes the spectrum of blue and violet light (400-600 nm). Concerning the light source used, 20% answered they used second-generation LED devices (monowave), 8.5% responded that they used third-generation LED (polywave) and 69.2% did not know which type of device they used (table 1).

When asked about the time required for light curing of conventional composite resin (2-mm increment), 60.8% responded approximately 20 seconds and only 16.2% responded that this time depends on the resin brand. Regarding the time required for light curing of bulk-fill composite resin (4 to 5 mm-increment), 38.5% stated that the time required was 40 seconds and only 11.5% responded that it depends on the manufacturer. Concerning the distance between the light curing unit tip and the material to be cured, there was great divergence of responses, with 26.9% responding up to 2 mm, 26.9% greater than 2 mm, 25.4% did not know the maximum distance and 20.8% did not respond. Regarding the consequences of suboptimal light curing, 24.6% answered insufficient curing of the resin composite, with all results converging to restoration failure; 3.10% responded that the consequences are not the result of insufficient curing, such as curing shrinkage stress, and 42.3% did not know the consequences (table 2).

Regarding the frequency of use of light curing units in the clinic, 84.6% said they used it frequently and 15.4% rarely used it. Concerning the type of device hygiene, 51.5% said they use a 70GL alcohol solution and 45.4% protect the active tip using plastic film barriers. Regarding the frequency of cleaning, 68.4% answered that they perform cleaning before each attendance, 30.8% stated they only perform it at onset or completion of the procedure, and 0.8% did not respond (table 3).

Table 4 shows the relationship between the variables "owning a light curing unit" and "knowing the irradiance it uses", as well as the variables "knowing which irradiance it uses" and "knowing the effective irradiance", without significant association for both ($p=0.05$ and $p=1.31$, respectively). However, there was higher frequency of students who do not have their own device and are unaware of the irradiance used (n=88), as well as students unaware of the irradiance they use and the adequate irradiance for correct cuing (n=70).

Table 5 presents the variables, frequency of use and wavelengths (blue and violet light) required for light curing. There was higher frequency among students who always use the light curing unit in their clinical activities, yet do not know which wavelengths are required to activate the photoinitiators present in composite resins (n=52), yet without significant association ($p=0.972$).

Table 1. Relative and absolute frequencies of questions related to having or not aa light curing unit and knowing the characteristics of the devices employed

VARIABLES	**n (%)**
1. Do you already have a light curing unit?	
Yes	21 (16.2%)
No	109 (83.8%)
2. Do you have knowledge about the irradiance of the light curing unit you use?	
Yes	28 (21.5%)
No	100 (76.9%)
Did not respond	2 (1.5%)
3. What is the irradiance for a light curing unit to be effective?	
Between 100mw/cm² and 200mw/cm²	4 (3.1%)
Between 200mw/cm² and 299mw/cm²	7 (5.4%)
Between 300mw/cm² and 600mw/cm²	29 (22.3%)
Above de 600mw/cm²	16 (12.3%)
Does not know	73 (56.2%)
Did not respond	1 (0.8%)
4. Do you know how to measure the power of your light curing unit? If yes. please cite.	
Spectrophotometer	12 (9.2%)
Photometer	5 (3.8%)
Radiometer	11 (8.5%)
Microvoltmeter	5 (3.8%)
Does not know	91 (70%)
Did not respond	6 (4.6%)
5. What are the wavelengths to light cure a composite resin?	
Between 100nm and 200nm	0
Between 200nm and 400nm	18 (13.8%)
Between 400nm and 600nm	31 (23.8%)
Above 600nm	16 (12.3%)
Does not know	63 (48.5%)
Did not respond	2 (1.5%)
6. Which source light do you use more often?	
Polywave	11 (8.5%)
Monowave	26 (20%)
Does not know	90 (69.2%)
Did not respond	3 (2.3%)

Table 2. Relative and absolute frequencies of questions related to the requirements for light curing of composite resins

VARIABLES	n (%)
7. For how long you would light cure a 2-mm increment of composite resin?	
Nearly 10s	3 (2.3%)
Nearly 20s	79 (60.8%)
Nearly 40s	20 (15.4%)
Nearly 45s	3 (2.3%)
Nearly 50s	0
Nearly 60s	3 (2.3%)
Depends on the brand	21 (16.2%)
Does not know	0
Did not respond	1 (0.8%)
8. For how long you would light cure a 4-mm increment of bulk-fill composite resin?	
Nearly 10s	1 (0.8%)
Nearly 20s	42 (32.3%)
Nearly 40s	50 (38.5%)
Nearly 45s	7 (5.4%)
Nearly 50s	1 (0.8%)
Nearly 60s	7 (5.4%)
Depends on the brand	15 (11.5%)
Does not know	6 (4.6%)
Did not respond	1 (0.8%)
9. What is the maximum distance from the light curing tip to achieve adequate curing?	
Up to 2 mm	35 (26.9%)
Greater than 2 mm	35 (26.9%)
Does not know	33 (25.4%)
Did not respond	27 (20.8%)
10. Do you now the consequences of insufficient light curing of restorations? If yes, which?	
Correct responses	32 (24.6%)
Incorrect responses	4 (3.1%)
Does not know	55 (42.3%)
Did not respond	39 (30%)

Table 3. Relative and absolute frequencies of questions related to the frequency of use and hygiene of the light curing unit

VARIABLES	**n (%)**
11. How often do you use the light curing unit in the clinic?	
Always	110 (84.6%)
Rarely	20 (15.4%)
Does not know	0
12. What is the type of hygiene performed in the light curing unit?	
Autoclave	1 (0.8%)
Active point protected by plastic film barrier	59 (45.4%)
70% alcohol solution	67 (51.5%)
None	1 (0.8%)
Did not respond	2 (1.5%)
13. What is the frequency of the hygiene procedure?	
At onset and completion of work	40 (30.8%)
Before each attendance	89 (68.5%)
None	0
Did not respond	1 (0.8%)

Table 4. Associations between having their "own light curing unit" and "knowing which irradiance it uses" and between "knowing which irradiance it uses" and "knowing the effective irradiance" (chi-square and Fisher exact tests)

	Owns light curing			
	Yes (n=21)	No (n= 107)	Did not respond (n=0)	p value
Knows the irradiance it uses				
Yes	9 (32.1%)	19 67.9%)		
No	12 (12.0%)	88 (88.0%)		p=0.05
Did not respond	0	2 (100%)		
	Knows the irradiance it uses			
	Yes (n=28)	No (n=100)	Did not respond (n=2)	
Knows the effective irradiance				
100 - 200W/cm²	2 (50.0%)	2 (50.0%)	0	
200 - 299W/cm²	3 (42.9%)	4 (57.1%)	0	
300 - 600mW/cm²	10 (34.5%)	18 (62.1%)	1 (3.4%)	p=1.31
> 600mW/m²	2 (12.5%)	14 (87.5%)	0	
Does not know	11 (15.1%)	61 (83.6%)	1 (1.4%)	
Did not respond	0	1 (100%)	0	

Table 5. Association between "frequency of use of the light curing unit" and "knowledge on the wavelength for light curing" (chi-square and Fisher exact tests)

	Frequency of use		
	Always (n=110)	Rarely (n= 20)	p value
Wavelength for light curing			
200 - 400nm	15 (83.3%)	3 (16.7%)	
400 - 600nm	27 (87.1%)	4 (12.9%)	p=0.972
> 600nm	14 (87.5%)	2 (12.5%)	
Does not know	52 (82.5%)	11 (17.5%)	
Did not respond	2	0	

4 DISCUSSION

A significant percentage of students did not know which irradiance they use, neither the ideal minimum, nor the name of the machine used to measure it, as well as the maximum distance between the light curing unit tip and the restoration. These results corroborate a study[7] in which the interviewed students stated they had no knowledge about the same aspects.

The device power may be expressed by the number of photons emitted by the light curing unit. However, more important than power is the device irradiance (mW/cm²), defined by the ratio between the number of photons emitted and the tip area. This should be measured frequently using a radiometer[8].

The literature does not advocate a standardized minimum irradiance. Some studies report that the minimum should be 500 mW/cm² and others 400 mW/cm², thus it is recommended that devices should have a high irradiance that covers the entire length of material[2,9,10]. However, factors as the battery level and characteristics of the light curing unit tip (type, size and distance of the restoration) can reduce this measurement[2,6,11].

Regarding the time required for light curing of conventional composite resin, the responses varied between 10s and 60s, with majority of 20s. The same variation was observed for light curing of bulk-fill composite resins, yet with the majority choosing 40s. For both resins, less than 1/5 of the students indicated light curing for the time recommended by the manufacturer. These results corroborate a study[12] that applied questionnaires answered by dental professionals, noting that the light curing time ranged between 5 and 60s, with higher frequencies in 20s and 40s, yet the frequency of participants who consider the time recommended by the manufacturer was not reported.

The light curing time is directly related to the energy dose that the composite resin must receive for correct curing. According to Price (2015)[13], the minimum energy to cure a 2-mm increment of material is 16J. Thus, if a light curing device has a light intensity of 400mW/cm², it will take 40s to reach the minimum light curing dose. However, it is understood that this energy value is not absolute and may vary according to the color, translucency and type of photoinitiators present in the composite, thus the light curing time recommended by the manufacturer should be used[8,14].

Regarding the ideal wavelength, the results showed that students do not have such knowledge. This characteristic is related to the photoinitiators present in resins and/or the light spectrum emitted by the device. This is related

to the type of devices currently used, second-generation (monowave) and third-generation (polywave) LEDs, whose difference is the light wavelength emitted[15]. The monowave LED device emits light in the blue spectrum wavelength (430nm to 470nm), basically activating camphorquinone as photoinitiator[16]. The polywave LED device, besides covering the blue light spectrum, also emits violet light (395nm to 480nm), thus activating camphorquinone and alternative photoinitiators[17,18].

Concerning the type of device they use, the results obtained in this study showed that the students interviewed have no knowledge, corroborating a study[1] that revealed that most students considered their knowledge about LED units insufficient, yet they knew the consequences of insufficient curing, with answers converging for restoration failure. This result diverged from the present study, in which it was observed that most respondents did not know the consequences of insufficient curing.

The inadequate light curing causes problems as increased discoloration, marginal defects, decreased hardness, decreased flexural and fracture resistance, lower wear resistance, lower bond strength and lower biocompatibility of the restorative material. These characteristics can be clinically noticed as changes in color, gaps at the interface, microleakage, postoperative sensitivity, cracks and tendency to tooth crown fracture[5,14].

Concerning the method of hygiene of light curing units, the results corroborate those found in the literature[19], which indicate that most students perform hygiene of devices using alcohol 70 GL and plastic film barrier. Analyzing the frequency of hygiene, it was observed that most stated to perform it before each attendance, which is important to prevent cross contamination.

Overall, the results found in the present study do not differ from those found by other authors who assessed the knowledge of students and professionals about light curing of composite resins, reinforcing the need for and importance of greater knowledge on the use, maintenance and factors that influence the light curing units, since they are frequently used in the clinical practice.

5 CONCLUSION

According to the present results, the knowledge of students about light curing was unsatisfactory. The results showed the need to re-evaluate the current theoretical-practical focus of the subject during graduation. It is fundamental to establish an educational protocol on the types, characteristics, correct use, conservation, disinfection and regular maintenance of light curing units, as well as on the undesirable effects of inadequate light curing.

RESUMO

Avaliação do nível de conhecimento de acadêmicos de Odontologia sobre fotopolimerização

O sucesso clínico de materiais resinosos é dependente de uma adequada polimerização. Diversos materiais fotoativados são utilizados frequentemente nas clínicas-escola de Odontologia. O objetivo desse estudo foi avaliar o nível de conhecimento dos acadêmicos do 10º período de Odontologia do Centro Universitário Maurício de Nassau, Recife/PE, sobre fotopolimerização, por meio de questionário. Os dados foram tabulados e analisados por meio de estatísticas descritivas, teste Qui-quadrado de Pearson e teste Exato de Fischer, com nível de significância de 5% ($p<0,05$). Os resultados demonstram que 83,8% dos estudantes não possuem fotopolimerizador, 72,9% não conhecem a potência do aparelho, 56,2% não

sabem qual é a potência mínima ideal e apenas 8,5% sabem o nome do aparelho aferidor da irradiância / potência. Além disso, 48,5% não sabem o comprimento de onda ideal para fotoativação de resina composta e 69,2% desconhecem o tipo de aparelho que utilizam (*monowave* ou *poliwave*). Em relação ao tempo de fotopolimerização, 60,8% afirmaram utilizar 20 segundos em resinas compostas convencionais e 38,5% utilizam por 40 segundos em resinas compostas *Bulk-fill*. Embora 84,6% afirmem usar aparelhos fotopolimerizadores frequentemente, apenas 26,9% sabem a distância ideal da ponteira à restauração. Além disso, 51,5% relataram que fazem a limpeza e desinfecção com álcool 70GL e 45,4% usam barreira plástica. Nesse contexto, pode-se concluir que o nível do conhecimento dos acadêmicos em relação à fotopolimerização foi insatisfatório, exigindo uma abordagem e avaliação mais efetivas para que os discentes tenham consciência da importância clínica deste procedimento e suas consequências.

Descritores: Educação em Odontologia. Polimerização. Resinas Compostas.

ACKNOWLEDGMENT

To all academics who collaborated as volunteers in this study.

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