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KNOWLEDGE AND ATTITUDES OF DENTAL CLINICIANS REGARDING LIGHT-CURING UNITS IN NORTHERN TURKEY

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ABSTRACT

Background and Aim: Different types of light-curing units have been used for the polymerization of resin-based materials, however, dental clinicians' knowledge and attitudes regarding light-curing units and materials science have been the focus of limited studies so far. This study aimed to evaluate the knowledge and attitudes regarding light-curing units and materials science among dental clinicians in Northern Turkey.

Materials and Methods: A survey questionnaire was sent by email to 448 dental clinicians, who were asked to provide demographic information and respond to questions on their knowledge and attitudes regarding current LCUs and materials science. Chi-square tests were used to identify the differences in responses for different variables.

Results: A total of 184 questionnaires were responded, which corresponds to a rate of 41%. All of the respondents were the ones who had already used resin-based composite materials. 41% (n=75) of the respondents preferred LED units. Although 102 (55%) of the respondents had access to LCUs that offered various options for irradiation, 82 (53%) of them used the conventional mode. Neither of the variables examined (specialization, years of professional experience) were found to have a statistically significant effect on the number of correct responses regarding LCUs and materials science ($p > 0.05$).

Conclusion: The results of this study demonstrated that the knowledge of dentists on materials science and LCUs was poor. Therefore, materials science and LCUs educational programs for dentists are needed.

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CLINICAL DENTISTRY AND RESEARCH 2016; 40(1): 26-34 Orjinal Araştırma

TÜRKİYE'NİN KUZEYİNDE YER ALAN DİŞ HEKİMLERİNİN IŞIK CİHAZLARI HAKKINDAKİ BİLGİ VE TUTUMLARI

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ÖZ

Amaç: Rezin esaslı materyallerin polimerizasyonunda farklı ışık cihazları kullanılmaktadır. Günümüze kadar diş hekimlerinin materyal bilimi ve ışık cihazları hakkındaki bilgi ve tutumlarını değerlendiren sınırlı sayıda çalışma mevcuttur. Bu çalışmanın amacı, Türkiye'nin kuzeyinde yer alan diş hekimlerin materyal bilimi ve ışık cihazları hakkındaki bilgi ve tutumlarını değerlendirmektir.

Materyal ve Metot: Katılımcıların demografik bilgilerini, materyal bilimi ve ışık cihazları hakkındaki bilgi ve tutumlarını içeren sorulara yanıt verilmesi istenen anket formu e-mail aracılığı ile 448 diş hekimine gönderildi. Faklı değişkenlere verilen yanıtlar arasındaki farklılığın belirlenmesinde Ki-kare testleri kullanıldı.

Bulgular: % 41 yanıtlanma oranı ile toplam 184 ankete cevap verildi. Katılımcıların tümü rezin esaslı kompozit materyallerini kullanmaktadır. Katılımcıların %41'i (n=75) LED ışık cihazlarını tercih etmektedir. Katılımcıların 102'sinin (%55) kullandığı ışık cihazlarının çeşitli ışınlama seçeneklerine sahip olmasına rağmen, 82'si (%53) geleneksel modu kullanmaktadır. Uzmanlık, mesleki deneyim yılı gibi değişkenlerin, materyal bilimi ve ışık cihazları hakkında verilen doğru yanıt sayısı üzerinde istatistiksel olarak anlamlı bir etkisinin olmadığı bulundu ($p > 0.05$).

Sonuç: Sonuç olarak; diş hekimlerin materyal bilimi ve ışık cihazları hakkındaki yetersiz bilgiye sahip olduğu gösterilmiştir. Bu nedenle, diş hekimlerine materyal bilimi ve ışık cihazları hakkında eğitimlerin verilmesi gereklidir.

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INTRODUCTION

Resin-based materials are being increasingly used in modern preventive and conservative dentistry.[1] These materials are preferred mainly for their improved esthetics, physical properties and operator control over working time.[2,3] The most important factors for a successful restoration are good bonding to the structure and adequate polymerization of the resin-based materials.[4]

Different types of light-curing units have been proposed for the polymerization of resin-based materials,[5] including quartz tungsten halogen (QTH), plasma arc, argon laser and light-emitting diode (LED).[6] These units usually consist of hand-held devices with a light source and light guide of fused optical fibers.[7] All these devices emit blue light in the spectrum of absorption of camphorquinone, the photoinitiator found in most resinous material.[5] QTH and LED are the most commonly employed light-curing units in clinical practice.[8] While QTH lights can achieve satisfactory results, they present certain inherent limitations related to lamp durability and heat production.[9,10] In order to overcome these limitations, LED curing units were introduced to dental markets and have since been recognized as a successful technology for polymerization of resin-based materials.[11,12]

Given that clinical failure of resin-based materials is due largely to changes taking place during polymerization, LCUs have taken on a key role in dental practice.[13] Both the quantity and quality of polymerization can be improved with the proper selection of light-curing unit and clinical curing technique.[14] It goes without saying that when working with resin-based materials, dental clinicians should fully understand the chemistry of the composite resins being used, the nature of the polymerization process and the operating characteristics of the curing unit.[15,16] The aim of this study was to evaluate the knowledge and attitudes regarding light-curing units and materials science among dental clinicians in northern Turkey.

MATERIALS AND METHODS

The study was approved by the University Ondokuz Mayıs Human Research and Ethics Committee (Approval No. 2013-354).

Email addresses of the members of the Samsun Dental Association were obtained from the association's database, and a total of 448 dental clinicians belonging to the Association were sent an introductory email followed by the survey questionnaire in March 2012. Reminders were sent to non-respondents one and three weeks later, and residents were ensured that their responses would remain anonymous, that no personal information would be collected and that the results would be reported as group data only.

Questionnaire preparation

A modified version of Santini and Turner's[17] questionnaire was used. The questionnaire was divided into 3 sections: descriptive data, questions about LCUs and materials science, and questions about the level of satisfaction with their LCU and materials science. Each question had one or more correct answers (Table 1).

Data Analysis

Data collected from the questionnaires was coded, and statistical analysis performed using the software SPSS version 13.0 for Windows (SPSS Inc., Chicago, IL, USA). Chi-square tests were used to identify differences in responses for different variables, with the level of significance set at P=0.05.

RESULTS

A total of 184 questionnaires were responded, corresponding to a rate of 41%. Demographic and professional characteristics of the respondents are given in Table 2. More than half of the respondents (60%, n=110) were female, and the majority (85%) were under 40 years of age. While 54 (29.5%) of the respondents had 0-5 years of professional experience, 66 (36%) had 6-10 years and 63 (34%) had more than 10 years of professional experience. Nearly half of the respondents (44%, n=81) were specialists.

Table 3 shows the responses of dental clinicians to questions on knowledge and attitudes about LCUs and materials science. All of the respondents used RBCs. Most of the respondents (75, 41%) preferred LED units. Although 102 (55%) of the respondents had LCUs that offer different options for irradiation, most of them used the conventional mode for irradiation. The majority also correctly answered the questions about adhesive curing time (120, 65%) and composites (73, 40%). However, only 56 (30%) of respondents knew the minimum light intensity required to polymerize RBCs of 2 mm in thickness for 40 seconds. Dental clinicians also had poor knowledge about the consequences of inadequate polymerization. Nearly half of the respondents (88, 48%) performed maintenance on their LCUs.

Table 1. Questionnaire form

Descriptive data
1. Gender **2. How old are you?** **3. Years in the profession?** **4. Do you have professional background?** ( ) yes ( ) no **5. Current employment;** ( ) private care ( ) hospital ( ) both
Questions about light curing units and materials science;
6. Do you use light curing materials and light curing units? ( ) yes ( ) no **7. If yes, what is the type of your light cuing unit?** ( ) QTH ( ) LED ( ) plasma Arc ( ) laser ( ) unsure **8. Does your LCU offer you different options for irradiation?** ( ) yes ( ) no **9. If yes, which mode do you use for curing?** ( ) soft start ( ) fast cure ( ) conventional mode ( ) unsure **10. Select your curing time for adhesives and composites according to your LCU.** Adhesive (.....) Composite (.....) **11. What must be the light intensity of light curing units for sufficient polymerization of 2-mm thick resin-based composites in 40 seconds?** ( ) 100-300 mv/cm^2 ( ) 300-500 mv/cm^2 ( ) 500<... mv/cm^2 ( ) unsure **12. What can be the result of inadequate polymerization (you can choose one or more)?** ( ) toxic reactions ( ) allergic reactions ( ) secondary caries ( ) marginal leakage ( ) edge discoloration ( ) tooth sensitivity ( ) Physical and mechanical properties of the material weakens ( ) others (....) **13. Do you control your light curing unit's maintenance?** ( ) yes ( ) no **14. If yes, how often do you control your device?** ( ) 1-3 months ( ) 3-6 months ( ) 6-12 months ( ) ...>12 months
Questions about the level of satisfaction with their LCU and materials science;
15. Are you satisfied with your LCU? ( ) satisfied ( ) moderately satisfied ( ) dissatisfied **16. Are you satisfied with your information level about LCUs?** ( ) satisfied ( ) moderately satisfied ( ) dissatisfied **17. How did you choose your LCU?** ( ) colleague's advice ( ) dental magazines ( ) catalogs ( ) congress and scientific meetings ( ) others

In terms of their degree of satisfaction with their LCUs, 98 (53%) of dental clinicians reported that they were satisfied, 58 (32%) reported being moderately satisfied, and 28 (15%) reported being dissatisfied. Only 38 (21%) reported being satisfied with their general knowledge about LCUs, whereas 27(15%) said they were dissatisfied.

The number of correct responses related to knowledge about LCUs and materials science did not differ significantly by specialization or by years of professional experience ($p > 0.05$).

Table 2. Personal and professional characteristics of dental clinicians

Demographics/ characteristics	n	%
Sex		
Male	74	40
Female	110	70
Age		
20-29	81	44
30-39	76	41
40 or above	27	15
Years in profession		
0-5	54	29.5
6-10	66	36
10 above	63	34
Missing	1	0.05
Professional background		
Yes	81	44
No	103	56
Current employment		
Special care	59	32
Hospital	114	62
Both	11	6

DISCUSSION

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] A number of factors affect resin polymerization, including 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 a decisive role in the outcome of polymerization and thus the final outcome of resin-based restorations. The findings of this study indicated that dental clinicians had low levels of knowledge regarding LCUs and materials science. This finding is in accordance with that of an earlier study by Santini and Turner.[17]

Quartz-tungsten halogen (QTH) and light emitting-diode (LED) are the LCUs most commonly employed in clinical practice.[8] LED curing units were first introduced into the dental market with the aim of overcoming the limitations associated with halogen lamps.[22] They continue to be an effective alternative to QTH and high-intensity QTH units and are now a mainstay of many general practices.[17,23] Most of the participants in the present study (75; 41%) also stated their preference for LED units.

Light intensity modulation has recently been introduced as an irradiation mode with the expectation that it may reduce

Table 3. Knowledge and attitudes related to LCUs and materials science

Knowledge/attitude	n	%
LCU type		
LED	75	41
OTH	42	23
Unsure	67	36
Different options for irradiation		
Yes	102	55
No	79	43
unsure	3	2
Mode for curing		
Soft start	21	20
Fast cure	14	14
Conventional mode	54	53
Unsure	13	13
Curing time for		
Adhesives		
10<... sc	55	30
10-20 sc	120	65
20<... sc	9	5
Composites		
10<... sc	4	2
10-20 sc	107	58
20-40 sc	73	40
Intensity of LCUs		
100-300 mv/cm^2	7	4
300-500 mv/cm^2	56	30
500<.... mv/cm^2	48	27
Unsure	73	39
Results of inadequate polymerization		
Toxic reactions	29	
Allergic reactions	15	
Secondary caries	98	

Marginal leakage	119	
Edge discoloration	105	
Tooth sensitivity	104	
Poor physical and mechanical properties	99	
Others	8	4
Both	46	25
LCUs maintenance		
Yes	88	49
No	96	52
Frequency of controlling (months)		
1-3	12	14
3-6	31	35
6-12	25	28
...>12	20	23

polymerization shrinkage. Unlike conventional irradiation (continuous and constant curing), this method may employ a soft-start protocol such as step curing or ramp curing, or a pulse-delay curing procedure. However, it has been reported that in many cases, no differences in outcomes have been found between light intensity modulation and conventional polymerization methods.[24] In the present study, although more than half (102, 55%) of the respondents had LCUs that offer different irradiation options, most of them (54, 53%) used the conventional mode.

In line with earlier studies, no positive relationship was found between years in practice and knowledge of materials science. Santini[17] assessed the knowledge of polymerization of resin-based composite materials among a group of 184 dentists in England and found no relationship between years in practice and materials science. Ueda[25] and McFadzean[26] similarly found no relationship between years of professional experience and materials science.

Light intensity and light-curing time are two important factors that impact the number of photons delivered to a specimen during polymerization.[24] In general, light applied at an intensity of 400 mw/cm^2 for 40 seconds can sufficiently polymerize composite of 2 mm in thickness.[27] However, only a minority of respondents in the present study supplied correct answers regarding minimum required light intensity of LCUs and results of inadequate polymerization. This low level of understanding of materials science related to RBC light-curing is in accordance with the earlier studies.[28,29]

Regardless of the type of curing unit used, periodic control and maintenance is required to ensure maximum effectiveness. This is especially true of halogen units, which require greater maintenance than other technologies. Satisfactory curing is dependent upon the good condition of all system components.[30] In the present study, nearly half of all respondents (88, 49%) reported that they performed LCU maintenance, which is higher than two other studies, both of which reported that less than 30% of respondents checked their LCUs for efficiency.[17,31]

Regarding the methodology of the present study, data was collected from a self-reporting survey conducted via email and had a response rate of 41%, which is considered to be in line with mail-based surveys in general.[32-34] One reason for the non-response in the present study may be that some dentists felt less confident or knowledgeable about the subject of the study and so decided against responding.

CONCLUSION

Photopolymerization conditions have a major impact on

the final mechanical, physical and biological properties of resin composite materials. Hence, the role of the dentist in choosing appropriate curing procedures is important in determining the outcome of the final restoration. Within the limitations of the present study it was found that dental clinicians have poor knowledge of LCU properties. This is an indication of a gap in the system of continuing dental education regarding this aspect of primary dental care. Based on the study results, it can be stated that continuing dental education programs are required to improve clinicians' knowledge and practice related to new technologies, since it is important for clinicians to use all materials judiciously and for the clinical application to which they are best suited.

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SO, EST, NT and SB conceived the study, and carried out all experiments. SC performed all statistical analysis. SO and EST drafted the paper. All authors revised and agreed on the final draft. All authors read and approved the final manuscript.

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