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Recommended Citation

Frazier, Kevin; Bedran-Russo, Ana K.; Lawson, Nathaniel C.; Park, Jacob; Khajotia, Sharukh; and Urquhart, Olivia, "Dental Light-curing Units: An American Dental Association Clinical Evaluators Panel Survey" (2020). *School of Dentistry Faculty Research and Publications*. 390.

https://epublications.marquette.edu/dentistry_fac/390

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Dentistry Faculty Research and Publications/College of Dentistry

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The Journal of the American Dental Association, Vol. 151, No. 7 (July 2020): 544-545, e2. [DOI](#). This article is © 2020 American Dental Association and permission has been granted for this version to appear in [e-Publications@Marquette](#). American Dental Association does not grant permission for this article to be further copied/distributed or hosted elsewhere without express permission from American Dental Association.

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Abstract

Background

The ability to polymerize light-activated dental materials with dental light-curing units (DLCUs) has revolutionized dentistry. However, proper DLCU use is essential for ensuring the effectiveness and performance of these materials.

Methods

The authors developed an electronic cross-sectional survey in the American Dental Association Qualtrics Research Core platform. The survey included questions about DLCU use, unit type and selection, training, maintenance, technique, and safety measures. The authors deployed the survey to 809 American Dental Association Clinical Evaluators (ACE) panelists on October 9, 2019, and sent reminder links to nonrespondents 1 week later. They conducted exploratory and descriptive analyses using SAS software Version 9.4.

Results

Of the 353 ACE panelists who completed the survey, most used a DLCU in their practices (99%), and light-emitting diode multiwave units were the most common type of DLCU units (55%). Dentists use DLCUs for over one-half of their appointments each day (mean [standard deviation], 59% [22%]). Regarding technique, respondents reported that they modify their curing technique on the basis of material thickness (79%) and material type or light tip-to-target distances (59%). Maintenance practices varied, with two-thirds of respondents reporting that they periodically check their DLCUs' light output.

Conclusions

DLCUs are an integral part of a general dentist's daily practice, but maintenance, ocular safety, and technique varied widely among this sample.

Practical Implications

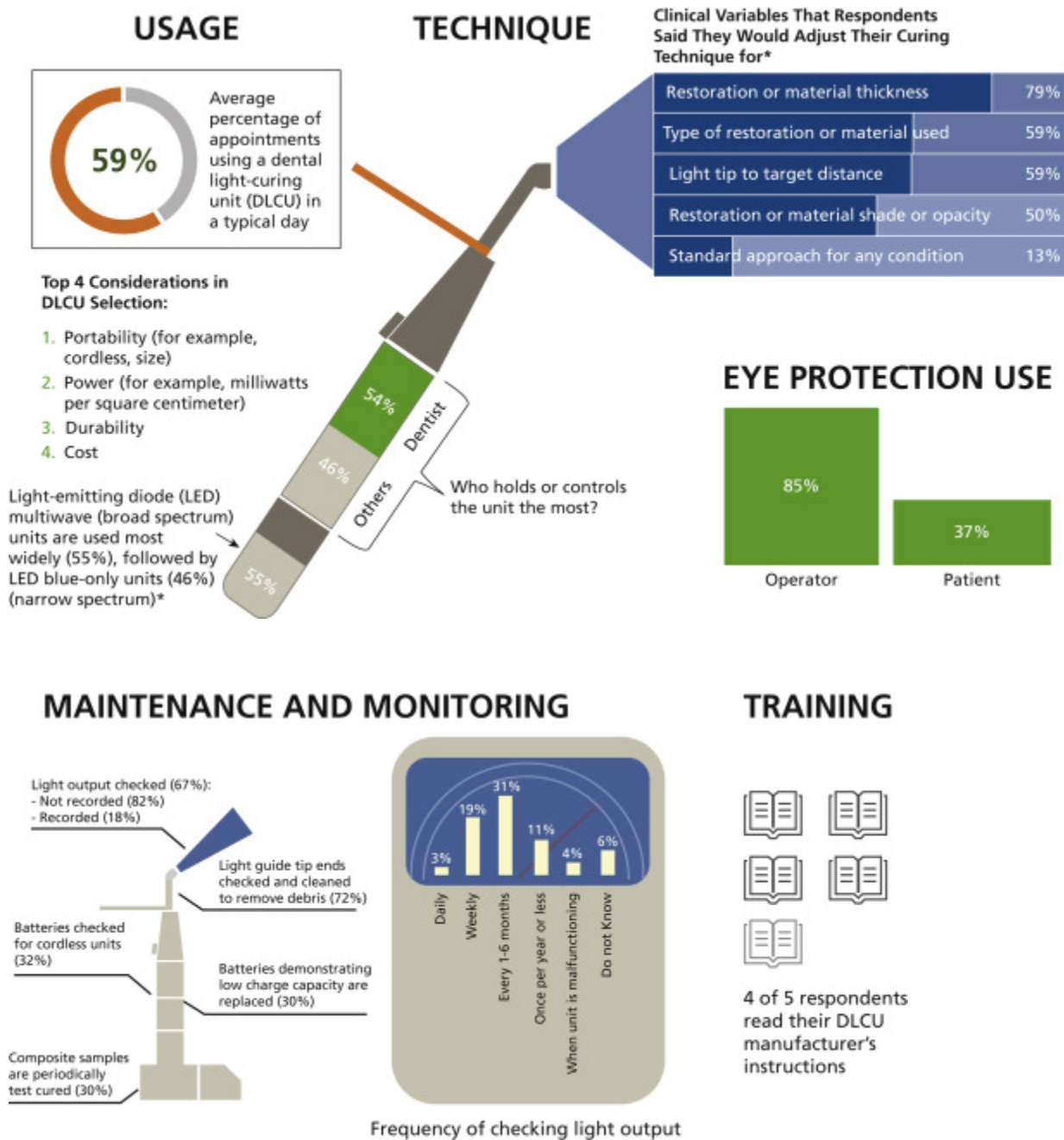
Because clinical effectiveness requires delivery of an adequate amount of light energy at the appropriate wavelength, variation in DLCU maintenance, safety, and techniques suggest that dentists could benefit from additional guidance and training on DLCU operation.

Key Words

Light curing, dental materials, surveys

Survey Results

Data reflect the responses of 353 American Dental Association Clinical Evaluators (ACE) Panel member dentists in the United States.



Demographics (n = 353)

Age, y, mean (standard deviation)	56 (13)
Female/Male, %*	22.4/77.1
Region, %	
Northeast	18.6
Midwest	26.8
West	25.6

South	29.0
Race, %*	
White	76.9
Asian	11.9
Other	11.3
Practice Type, %*	
General practice	90.3
Specialties	9.6
Occupation, %*,†	
Full-time practice (≥ 30 h/wk)	76.0
Part-time practice (< 30 h/wk)	6.8
Dental school faculty	6.8
Part-time faculty or practice	3.2
Other	6.8

*Percentages do not add up to 100% owing to rounding.

†One respondent was unemployed at the time of the survey.

Clinical Insights

Dental light-curing units (DLCUs) are used to cure photopolymerizable resin-based composites (RBCs) through the activation of molecules called photoinitiators.¹ To achieve optimal clinical effectiveness, the material must receive an adequate amount of light energy delivered to the material at the appropriate wavelength.

Each RBC requires a certain amount of energy to achieve an optimum degree of polymer conversion. To deliver this energy, each RBC manufacturer's instructions will provide a minimum curing time for a DLCU with a specific power, which may vary on the basis of shade. Maintaining energy via increasing power and decreasing time may not release sufficient photoinitiators to adequately cure the RBC.² Other variables affecting the quality of the cure include light tip-to-target distance,^{3,4} tip diameter,^{4,5,6} beam homogeneity,⁷ and angle at which the light tip is positioned in relation to the curing surface.⁸ In addition, the wavelength of the light must match the peak absorption range of the photoinitiator in the chosen RBC material. Of the many types of DLCUs on the market, light-emitting diode multiwave DLCUs are the most versatile as they emit light at multiple wavelengths.^{3,9}

Monitoring and recording the output of DLCUs on a regular basis with a radiometer can help practitioners determine if their DLCU is working properly. There is some variability between radiometers, but they tend to be individually consistent with each use and therefore helpful in detecting changes in the output of a DLCU.^{10,11} Test curing an RBC sample can help determine if a DLCU is functioning properly. Recommendations for cleaning and disinfecting a DLCU can be found in the manufacturer's instructions, and guidelines are available for infection control.^{12,13}

Protecting dentists' and patients' eyes while a DLCU is being operated can be achieved through the use of blue light-filtering eyewear, DLCU-mounted shields, or handheld shields. For maximum protection, the chosen eye protection method will filter light at the same wavelength as the DLCU's output.

American Dental Association Clinical Evaluators Panel Methodology

History of the American Dental Association Clinical Evaluators Panel

The American Dental Association Clinical Evaluators (ACE) Panel¹⁴ was first convened in 2006 as a volunteer group of American Dental Association (ADA) members who provided clinical feedback on professional product evaluations for a professional product evaluation newsletter known as the *ADA Professional Product Review*.

In 2013, the ADA Division of Science received software to conduct its own surveys, and the first professional product review survey was deployed in September 2013 to the ACE Panel and a separate random sample of 3,000 dentists. Since then, the ADA Science and Research Institute (SRI) staff has worked with the ACE Panel Oversight Subcommittee of the Council on Scientific Affairs to generate ACE Panel survey results reports.

As of January 2020, the ACE Panel is used to take the pulse of ADA member perceptions and feedback regarding professional products, materials, and clinical technique. The ACE Panel comprises nearly 824 ADA members who have the opportunity to participate in quarterly surveys.

Purpose of the American Dental Association Clinical Evaluators Panel

The ACE Panel is a network of practicing ADA members who want to learn from one another by sharing clinical insights and experiences that can help build science content focused on dental materials and clinical-based research. The ACE Panel is a valuable resource in that it enables ADA members to expand their clinical knowledge about dental products, materials, devices, and drugs. In addition, the ACE Panel provides a platform for dentists to expand their professional network of dental experts and clinical scientists. ACE Panel members also have the opportunity to identify knowledge gaps and areas of future research for the ADA SRI.

Panel Recruitment and Composition

The ADA SRI actively recruits new ACE Panel members through the ADA Meeting, targeted e-mail campaigns, ADA News stories, the ADA Morning Huddle, and science-related ADA continuing education courses for clinicians. Any ADA member can join the ACE Panel by visiting the ACE Panel home page.

Survey Development

A subcommittee of the ADA Council on Scientific Affairs selects topics for each survey on the basis of suggestions from the ACE Panel and ADA SRI priorities. After topic selection, the subcommittee and the ADA staff methodologist (O.U.) develop the survey content in the Qualtrics Research Core platform.¹⁵ When a topic is outside the expertise of the subcommittee, ADA SRI staff members and subcommittee members consult subject matter experts. Before deployment to the ACE Panel, ADA SRI staff and the subcommittee conduct an iterative process of pretesting the questions with another group of ADA SRI staff and the subcommittee to ensure the comprehensiveness of answer choices, brevity (that is, surveys should take ≤ 5 minutes complete), clarity in question wording, logic, and response options and response scales (for example, Likert scales and numerical rating scales), among other survey methodology best practices. ADA SRI staff and the subcommittee deploy the surveys to the ACE Panel electronically via e-mail, including a link to access the questionnaire. All

links are set to expire 2 weeks after deployment. One week after deployment, ADA SRI staff and the subcommittee send e-mail reminders to nonrespondents.

Data Analysis and Reporting

After respondents take the survey, they immediately have access to an interim report containing aggregate data from all respondents to that particular point in time. Two weeks after deployment, ADA SRI staff members export the final data set from Qualtrics Research Core platform to a .csv file and import the file into SAS Version 9.4 for data cleaning, relabeling of variables, and conducting exploratory and descriptive analysis (for example, participant demographics [including sex, age, geographic location, race, specialty, and occupation] and means for continuous variables and proportions for discrete variables). These analyses provide insights as to which data will be prioritized for reporting and in which format. Next, in consultation with a graphic designer, ADA SRI staff members develop infographics to illustrate the most relevant results and elaborate clinical insights to facilitate the use and contextualization of the information from the survey. The collection of final reports for ACE Panel surveys are published in *The Journal of the American Dental Association* and are available electronically in the ACE Panel report library.¹⁶

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