Usage and Preferences of Dental Light Curing Units Among Orthodontic Practitioners: A Questionnaire Study

[1]Benazeer Hussain, [2]Harshal Munot, [3]Chinmayee Chaulwar, [4]Piyush Khandelwal, [5]Javed Sodawala

[1-3]Postgraduate Student, [4]Professor, [5]Professor & Head of Department
[1]Department of Orthodontics and Dentofacial Orthopedics,
[1]Chhattisgarh Dental College & Research Institute, Rajnandgaon, C.G., India
[1]drbenazeerhussain@gmail.com, [2]hj9049@gmail.com, [3]dr.chinmayeechaulwar@gmail.com,
[4]dr.piyush.cdcri@gmail.com, [5]drjavedazher@gmail.com

***Abstract*—**

Introduction: The purpose of the study was to evaluate the usage patterns, selection preferences, training modalities, and safety practices associated with Dental Light Curing Units (DLCUs) among orthodontic practitioners, with the broader goal of informing evidence-based improvements in clinical protocols**.**
Materials and method: A cross-sectional questionnaire-based survey was conducted among 200 orthodontic practitioners fulfilling inclusion criteria of ≥1-year clinical experience and daily DLCU usage. A validated 25-item questionnaire was distributed online. Data were analyzed using descriptive statistics**.**
Results:104 practitioners responded, Single-wave LED curing units were predominantly utilized (58.7%), with ergonomic design and portability cited as primary determinants of selection (51.9%). Continuous curing was the most frequently employed technique (68.3%), although only 47.1% of respondents expressed confidence in achieving optimal polymerization. Training was largely informal (33.7%) or self-directed (31.7%), and maintenance was reactive, with units commonly replaced upon malfunction (67.3%). Safety practices were inconsistent, with limited use of protective eyewear (15.4%) despite moderate adoption of UV filters (59.6%).
Conclusions: The study demonstrated significant variability in DLCU usage among orthodontic practitioners, with widespread reliance on single-wave LED units and continuous curing techniques. However, the predominance of informal training, reactive maintenance practices, and inconsistent safety measures highlights critical gaps in current practice. Addressing these deficiencies through structured educational programs, preventive maintenance protocols, and adherence to standardized safety guidelines is essential to ensure effective polymerization, enhance device longevity, and improve overall treatment outcomes in orthodontic practice**.**

Index Terms*—Dental Light Curing Units (DLCUs); Orthodontic Practice; Clinical Training; Safety Protocols; Device Maintenance; Practitioner Preferences*

I. Introduction

Orthodontic procedures present distinct challenges regarding the use of Dental Light Curing Units (DLCUs).[1] Unlike general dentistry, orthodontists frequently employ curing lights for bracket bonding, necessitating precise curing to ensure adhesive durability and minimize treatment failures.[2] Despite their importance, there is a significant lack of research addressing the usage patterns, selection criteria, and maintenance of DLCUs among orthodontic professionals.[3] This knowledge gap hinders the establishment of standardized practices and effective training programs.

This study aimed to assess and evaluate the current practices associated with dental light curing units among orthodontic professionals and to bridge this gap by examining the current practices related to DLCUs among orthodontists. It focused on the types of curing lights used, the factors influencing their selection, and the extent of training received by practitioners. Additionally, it investigated the maintenance practices and safety measures to identify potential areas for standardization and improvement.

Insights from this research are expected to inform the development of comprehensive training programs and standardized protocols, thereby enhancing the clinical effectiveness of DLCUs. By addressing inconsistencies in training and maintenance, this study aims to improve the long-term success of orthodontic treatments and patient outcomes, ultimately contributing to the advancement of orthodontic practice.

II. Materials and Methods

This cross-sectional survey-based study was conducted in the Department of Orthodontics and Dentofacial Orthopaedic at Chhattisgarh Dental College and Research Institute, Rajnandgaon, Chhattisgarh. The ethical clearance was approved from the Institutional Ethical Committee **(Reference No. CDCRI/DEAN/ETHICSCOMMITTEE/ORTHO/PG-02/2025)** The study involved orthodontic professionals who demonstrated a willingness to complete a structured questionnaire. Participants were selected based on specific inclusion criteria: active use of curing light units in clinical practice, a minimum of one year of professional experience, daily use of DLCUs, and willingness to complete the questionnaire thoroughly. Exclusion criteria included retired or non-practicing dental professionals, incomplete questionnaire responses, and individuals affiliated with companies manufacturing or distributing curing light units. The required sample size was determined based on a 95% confidence level, 59% expected prevalence, and 10% precision. The initial calculation yielded 93, which was adjusted to 104 considering a 10% attrition rate. This ensures an estimated prevalence range of 49%-69%.

The survey was administered online using Google Forms, consisting of 25 questions divided into sections: demographic data and occupation, unit types and selection, training and maintenance, technique, and safety measures. The questionnaire was pre-tested to assess its clarity, reliability, and validity. The pre-test involved 10 orthodontic professionals and the final questionnaire demonstrated good internal reliability, with a Cronbach's alpha of 0.82.

The questionnaire was distributed via email and professional dental WhatsApp groups. Data collected from the survey were analyzed using SPSS v23.0. Descriptive statistics, including frequency and percentage, were used to present the results.

III. RESULTS

Out of 200 a total of 104 practitioners responded in the survey, with no exclusions at baseline. Table I presents the demographic characteristics of the participants. The majority were aged between 25–34 years (53.8%) and predominantly female (58.7%). Most were full-time practitioners (46.2%) working in private practice (48.1%) within urban settings (63.5%). No statistically significant differences were observed in demographic distribution across subgroups.

Preferences regarding dental light curing units (DLCUs) are detailed in Table II. Single-wave LED lights were the most commonly used (58.7%). Portability and ergonomics were the leading selection criteria (51.9%), followed by light intensity and wavelength compatibility (45.2%). Lightweight design (71.2%) and ease of maintenance (60.6%) were prioritized features. Table III shows that continuous curing was the predominant technique (68.3%), with a curing distance of 2–3 mm maintained by 55.8% of respondents. Despite this, only 47.1% expressed confidence in achieving optimal polymerization.

Table IV outlines DLCU replacement and training practices. Units were typically replaced only upon malfunction (67.3%), and training was largely informal (33.7%) or self-directed (31.7%). Maintenance responsibilities were primarily delegated to dental assistants (52.9%), with cleaning the curing tip/lens being the most frequently performed task (34.6%).

Safety practices are summarized in Table V. UV filters were widely adopted (59.6%), although consistent use of protective eyewear was limited (15.4%). While 51% of respondents reported no safety-related issues, 19.2% experienced improper curing or material failure, and 12.5% noted overheating concerns. Table VI shows that intergroup comparisons of safety practices revealed no statistically significant differences.

Table I Demographic details of the participants

Category	Frequency	Percentage(%)
Age Group		
25-34	56	53.8
35-44	42	40.4
45-above	6	5.8
Gender		
Female	61	58.7
Male	43	41.3

Table II Professional Background of the participants

Category	Frequency	Percentage(%)
Professional role		
Dental school faculty	14	13.5
Dental school faculty and part time practice	4	3.9
Full time practice	48	46.2
Part-time faculty or practice	27	26
Part-time practice	11	10.6
Practice Setting		
Academic institution	33	31.7
Group practice	4	3.8
Hospital	17	16.3
Private practice	50	48.1
Practice located		
Rural area	14	13.5
Sub urban	24	23.1
Urban area	66	63.5

Table III Dental Light Curing Units Types and Selection (DLCUs)

Category	Frequency	Percentage(%)
Curing light Type		
Halogen	4	3.8
LED (Multi-wave)	39	37.5
LED (Single Wave)	61	58.7
Selection criteria		

Cost	36	34.6
Brand or manufacturer recommendation	33	31.7
Portability and ergonomics	54	51.9
Light intensity and wavelength compatibility	47	45.2
All of the above	46	44.2
Most Prioritized Features in DLCUs		
Power output	29	27.9
Durability	41	39.4
Ease of maintenance	63	60.6
Lightweight design	74	71.2
Battery life	39	37.5

Table IV Curing Techniques and Practices

Category	Frequency	Percentage(%)
Most Frequently Used Curing Technique		
Continuous Curing	71	68.3
Pulse Curing	11	10.6
Soft-Start Curing	16	15.4
Step Curing	6	5.8
Average Distance Maintained Between Curing Light Tip and Material Surface		
<1 mm	4	3.8
1-2 mm	19	18.3
2-3 mm	58	55.8
3-5 mm	22	21.2

Table V Training and Maintenance of DLCUs

Category	Frequency	Percentage(%)
Frequency of Upgrading or Replacing DLCUs		
Every 2-3 years	10	9.6
Every 4-5 years	24	23.1
Only when it malfunctions	70	67.3
Training Received on DLCUs		
No training	14	13.5
No, but I plan to seek training	10	9.6
Yes, formal hands-on training	12	11.5
Yes, informal training (e.g., peer-guided or online videos)	35	33.7
Yes, self-taught	33	31.7
Responsibility for Maintaining DLCUs		
Dentist	6	5.8
Dental Assistant	55	52.9
Equipment Technician	16	15.4
Shared responsibility	46	44.2
No one is specifically assigned	14	13.5
Frequency of Checking DLCUs for Maintenance Issue		
Annually	18	17.3
Quarterly	10	9.6
Monthly	7	6.7
Only when there is a problem	69	66.3
Common Maintenance Tasks Performed		
Battery replacement or charging	16	15.4

Checking light output intensity	24	23.1
Cleaning the curing tip/lens	36	34.6
All of the above	28	26.9

Table VI Safety Practices

Category	Frequency	Percentage(%)
Safety Measures Implemented While Using Curing Lights		
Eye protection for patients	2	1.9
Eye protection for staff	6	5.8
Heat shields for curing tips	7	6.7
Use of UV filters	62	59.6
All of the above	27	26
Issues Experienced Related to Curing Light Safety		
No issues experienced	53	51
Yes, eye strain or irritation	12	11.5
Yes, improper curing or material failure	20	19.2
Yes, overheating of material or tissue	13	12.5
Other	6	5.8

IV. DISCUSSION

The findings of this study provide valuable insights into the usage, preferences, and safety practices associated with dental light curing units (DLCUs) among orthodontic professionals. The preference for single-wave LED curing lights (58.7%) highlights the perceived effectiveness and ease of use of these devices. Additionally, factors such as portability and ergonomics (51.9%) were the most influential in the selection of DLCUs, which aligns with the growing demand for efficient and user-friendly equipment in clinical practice.

A significant concern identified in this study is the reliance on informal training and self-teaching methods for DLCU usage. The results show that only 11.5% of respondents received formal hands-on training, while 33.7% relied on informal peer-guided or online training, and 31.7% were entirely self-taught. These findings mirror those of Kopperud et al.[4] who reported that a substantial proportion of dentists lacked knowledge about the technical specifications and irradiance values of their curing lights. In their study, 78.3% of dentists were unaware of the irradiance levels of their devices, making it difficult to determine optimal curing times, which could compromise the polymerization of dental materials. Similarly, Wright[5] highlighted that more than 75% of dentists did not know the irradiance values of their curing lights, and 17% failed to perform regular maintenance, further underscoring the widespread knowledge gap in DLCU usage. Suliman et al.[6] also found that individualized training significantly improved curing efficiency, with trained practitioners delivering 60% more energy to restorations and reducing improper curing cases from 37.5% to 2.5%, reinforcing the need for structured training programs.

Maintenance practices among orthodontists in this study were predominantly reactive, with 67.3% of respondents replacing their DLCUs only upon malfunction. Routine maintenance tasks such as checking light output intensity (23.1%) and cleaning the curing tip/lens (34.6%) were not widely practiced. This pattern of maintenance negligence is also evident in Kopperud et al.[4] where more dentists who lacked knowledge of their curing light's irradiance values failed to conduct regular maintenance checks compared to those who were informed. The lack of preventive maintenance could contribute to inconsistent curing performance, thereby affecting the longevity and effectiveness of dental restorations. The American Dental Association (ADA) Clinical Evaluators Panel survey[1] similarly reported that while 55% of dentists used multiwave LED curing lights, only two-thirds regularly checked their DLCUs' light output, highlighting the necessity for proactive maintenance practices.

Curing techniques also varied among practitioners. Continuous curing was the predominant technique (68.3%), with most orthodontists maintaining a 2–3 mm distance between the curing light tip and the material surface (55.8%). However, only 47.1% of respondents expressed confidence in achieving proper polymerization, suggesting a need for improved training on curing protocols. Kopperud et al.[4] emphasized that inappropriate curing practices, including insufficient curing times and excessive distance from the restoration site, could lead to inadequate polymerization and material failures. Price[7] further reinforced this, noting that manufacturers' guidelines often provide general instructions but lack detailed guidance on optimizing polymerization, contributing to suboptimal curing outcomes.

Safety measures were another area of concern. Although 59.6% of respondents used UV filters, only a small proportion always used protective eyewear (15.4%). Notably, 51% of respondents reported no safety issues, yet 19.2% experienced improper curing or material failure, and 12.5% reported overheating of material or tissue. This aligns with the findings of Kopperud et al.[4] and Wright[5] ,who both identified inadequate use of eye protection as a significant issue. In their study, nearly one-third of dentists used inadequate eye protection against blue light exposure, which poses risks of retinal damage. Shortall et al. [8] emphasized the necessity of selecting high-quality curing units and performing routine maintenance to ensure their safety and effectiveness. Soares et al.[9] evaluated various eye protection filters, finding that while most blocked at least 97% of irradiance, their effectiveness varied, highlighting the importance of selecting proper protective equipment tailored to the curing light in use.

The collective findings of this study, in conjunction with the referenced literature, underscore the urgent need for standardized training programs, routine maintenance protocols, and strict adherence to safety guidelines. Establishing comprehensive educational initiatives and institutional guidelines could significantly enhance the efficacy and safety of DLCU usage in orthodontic practice. By addressing these critical gaps, the orthodontic community can improve treatment outcomes, minimize clinical failures, and enhance patient safety.

V. Conclusions

This study comprehensively evaluated the current practices related to Dental Light Curing Units (DLCUs) among orthodontic professionals. The findings revealed that single-wave LED curing lights are the most commonly used, with lightweight design, ergonomics and portability as the main determinants of selection. Curing techniques varied, with continuous curing being predominant, and an average distance of 2–3 mm maintained between the curing light tip and the material surface. However, maintenance practices were largely reactive, with most practitioners replacing units only upon malfunction rather than following preventive protocols and majority of maintenance responsibilities were delegated to dental assistants, further indicating limited professional engagement in device upkeep. Such practices may shorten device lifespan, reduce curing efficiency, and increase the risk of treatment failure. Safety measures were inconsistently applied, with limited use of protective eyewear despite moderate adoption of UV filters, highlighting areas for urgent improvement. This study highlights several critical areas for enhancement in the utilization of Dental Light Curing Units (DLCUs) among orthodontic professionals.

These findings indicate a significant need for structured and standardized training programs to ensure that practitioners are well-versed in the optimal use and maintenance of DLCUs. A proactive approach to maintenance, with standardized protocols, is essential to uphold the efficacy and durability of these units. By addressing these gaps through targeted interventions and standardized practices, the orthodontic community can enhance clinical efficiency, minimize treatment failures, and improve patient outcomes. These improvements will ultimately contribute to the advancement of orthodontic practice and patient care.

References

[1] Frazier K, Bedran-Russo AK, Lawson NC, Park J, Khajotia S, Urquhart O; Council on Scientific Affairs. Dental light-curing units: An American Dental Association Clinical Evaluators Panel survey. J Am Dent Assoc. 2020;151(7):544-5

[2] Fleming PS, Eliades T, Katsaros C, Pandis N. Curing lights for orthodontic bonding: a systematic review and meta-analysis. Am J Orthod Dentofacial Orthop. 2013;143

[3] Ferracane JL, Watts DC, Ernst CP, Barghi N, Rueggeberg FA, Shortall A et al. Effective Use of Dental Curing Lights: A Guide for the Dental Practitioner. ADA Professional Product Review. 2013;8(2):2-12.

[4] Kopperud SE, Rukke HV, Kopperud HM, Bruzell EM. Light curing procedures: performance, knowledge level and safety awareness among dentists. J Dent. 2017;59:19-24.

[5] Wright WG. Knowledge Gaps Exist Among Dentists Regarding Curing Lights and Personal Protection. J Evid Based Dent Pract. 2017;17(3):296-7.

[6] Suliman AA, Abdo AA, Elmasmari HA. Training and experience effect on light-curing efficiency by dental practitioners. J Dent Educ. 2020;84(6):652-9.

[7] Price RBT. Light Curing in Dentistry. Dent Clin North Am. 2017;61(4):751-78.

[8] Shortall AC, Price RB, MacKenzie L, Burke FJ. Guidelines for the selection, use, and maintenance of LED light-curing units - Part 1. Br Dent J. 2016;221(8):453-60.

[9] Soares CJ, Rodrigues MP, Vilela AB, Rizo ER, Ferreira LB, Giannini M et al. Evaluation of Eye Protection Filters Used with Broad-Spectrum and Conventional LED Curing Lights. Braz Dent J. 2017;28(1):9-15.