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Lighting the Way to Better Composites: A Study on Dentists' Awareness and Use of Light Curing Units in Pune

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ABSTRACT:
Aim and Objectives:
This study is aimed to investigate general dentists' understanding and clinical practices concerning the effective use of light curing units in resin composite restorations.
This study aims to comprehensively assess the awareness of general dental practitioners regarding the technical specifications and clinical utilization of light-curing units in resin composite restorations.
It further seeks to evaluate their knowledge of critical factors influencing the efficacy of light-curing such as exposure time, tip to surface distance, angulation, and light intensity.
Additionally, the study intends to investigate whether practitioners routinely evaluate and monitor the output and functional performance of their light-curing devices in clinical settings.
Materials and methods:
An online questionnaire-based survey was conducted. The study included Dentists selected through convenience sampling. The questionnaire consists of 18 questions sectioned into 3 categories: 1. Demographic details,2. Light curing unit in current use, 3. Technical aspects of application for composite restorations.
Conclusion:
While Pune's dental practitioners demonstrate strong clinical technique, their widespread neglect of light-curing unit maintenance threatens the durability of composite restorations. Addressing this technical knowledge gap through targeted training on equipment monitoring is essential to bridge the divide between procedural skill and long-term restorative success.
KEYWORDS: Light-curing unit (LCU), Resin composite restorations, Radiometer, Dental survey, Clinical awareness.

I. INTRODUCTION

In contemporary Indian dentistry, the demand for composite resin restorations has surged, primarily driven by patient desire for aesthetics and tooth-coloured alternatives to traditional amalgam restorations.[1] The long-term clinical success of these restorations depends fundamentally on adequate polymerization, which dictates physical strength, wear resistance, and colour stability. Conversely, suboptimal polymerization can precipitate restoration failure, secondary caries, and post-operative sensitivity.[2]

While light-curing units (LCUs) are the most widely accepted method for polymerization, the technology has evolved from early quartz-tungsten halogen (QTH) units to high-intensity, newer-generation light-emitting diode (LED) devices.[3] Despite these advancements, the effective intensity of an LCU can diminish over its clinical lifespan, necessitating regular monitoring via modern radiometers to ensure a minimum light intensity of 400 mW/cm² for a standard 2 mm composite increment.[4-6] While full intensity curing causes rapid stress and higher pain risks, soft start and pulse-delay techniques slow polymerisation to let material adapt and reduce sensitivity.[7]Clinical factors such as the distance between the curing tip and the resin, the duration of exposure, and the angulation of the light beam are critical variables that influence the quality of the final restoration.[8-9]

Given the vital role of proper protocol in restorative longevity, this cross-sectional survey was conducted to evaluate the knowledge, awareness, and routine maintenance practices of general dental practitioners (GDPs) in Maharashtra regarding evidence-based light-curing standards. The study aims to bridge the gap between recommended guidelines and current clinical practice to identify areas for professional development.

II. MATERIALS AND METHODS

Study design and population:

A cross-sectional descriptive study was performed to assess the awareness and LCU usage patterns among dental practitioners in Maharashtra, India. The study population included registered dental practitioners (BDS and MDS) actively practicing in the region at the time of the survey.

Selection criteria:

Participants were included if they were registered with the Dental Council of India (DCI), practiced within Maharashtra, and utilized light-curing units in their clinical work. Exclusion criteria included practitioners with less than one year of experience, those not currently in clinical practice, or those practicing outside the study region.

Data Collection Tool:

Data were collected using a structured, pre-validated, closed-ended questionnaire. The tool was divided into three primary domains:

Demographics: Professional qualification and years of clinical experience.

Knowledge and Awareness:

Technical specifications of LCUs, including intensity and wavelength.

Clinical Practices**:** Usage patterns, maintenance protocols (radiometer use), and safety measures.

The questionnaire was validated by a panel of restorative dentistry experts and pilot-tested with 20 dentists to ensure clarity and reliability prior to full dissemination.

Survey Methodology and Analysis:

The survey was distributed digitally via Google Forms over a three-month period. Out of 130 invited participants, 91 completed responses were received, representing a 70% response rate. Descriptive statistics were used to summarize results, and Chi-square tests were employed for statistical analysis of equipment usage and clinical techniques, with a significance level set at $p < 0.01$.

III. RESULTS:

A total of 91 completed questionnaires were analysed, representing a 70% response rate from the 130 distributed surveys.

Demographics and Professional Background

The study population was primarily composed of early-career professionals, with 63.7% of respondents having less than 5 years of clinical experience. The majority of participants (61.5%) held a Bachelor of Dental Surgery (BDS) degree, while 38.5% were postgraduates (MDS).

Light Curing Unit (LCU) Profiles and Maintenance

The use of LED curing lights was nearly universal, reported by 94.5% of practitioners ($p < 0.01$). Despite this high adoption of modern technology, maintenance practices were notably poor:

Duration of Use: 46.2% of respondents have been using their current LCU for more than 6 years.

Intensity Monitoring: A significant majority (58.2%) reported that they **never** check the intensity of their LCU with a radiometer.

Power Output Awareness: 42.9% of participants were unaware of the specific power output (mW/cm^2) of their device.

Clinical Application Techniques

While equipment maintenance was low, reported adherence to clinical protocols was relatively high:

Curing Technique: The "Full intensity" method was the most common (47.3%), followed by pulse cure (28.6%) and soft start (24.2%).

Positioning: 65.9% of practitioners hold the LCU perpendicular to the composite surface, and 54.9% maintain a distance of 0–2 mm.

Class II Protocols: 72.5% of respondents implement three-sided curing for Class II restorations.

Safety: 67.0% of clinicians use eye protection, and 69.2% consider the risk of pulpal damage due to heat generation.

Master table:

Domain	Question / Variable	Category	Count (n)	Percentage (%
Demographics	**Qualification**	BDS	56	61.5%
		MDS	35	38.5%

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Domain	Question / Variable	Category	Count (n)	Percentage (%
	Years of Experience	< 5 years	58	63.7%
		5–10 years	21	23.1%
		> 10 years	12	13.2%
LCU Profile	**Type of Unit Used**	LED	86	94.5%
		QTH	2	2.2%
		Unsure	3	3.3%
	Duration of Current LCU Use	1 year	15	16.5%
		1–3 years	12	13.2%
		3–6 years	22	24.2%
		> 6 years	42	46.2%
Maintenance	**Radiometer Check Frequency**	6 months	21	23.1%
		1 year	13	14.3%
		2 years	4	4.4%
		Never	**53**	**58.2%**

Domain	Question / Variable	Category	Count (n)	Percentage (%
	Awareness of Power Output	300–500 mW/cm²	16	17.6%
		500–800 mW/cm²	26	28.6%
		> 800 mW/cm²	10	11.0%
		Don't know	**39**	**42.9%**
Clinical Practice	**Follows Recommendations**	Yes	78	85.7%
		No	13	14.3%
	LCU Holding Direction	Perpendicular	60	65.9%
		Angulated	31	34.1%
	Curing Distance	0–2 mm	50	54.9%
		2–5 mm	30	33.0%
		In contact	8	8.8%
		> 5 mm	3	3.3%
	Curing Duration	Follow Manufacturer	59	64.8%
		10–30 s	18	19.8%

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Domain	Question / Variable	Category	Count (n)	Percentage (%
		> 30 s	8	8.8%
		< 10 s	6	6.6%
	Factors Considered	All Factors	62	68.1%
		Depth only	9	9.9%
		Distance/Manufacturer	12	13.2%
	Safety & Technique	Eye Protection (Yes)	61	67.0%
		Consider Heat (Yes)	63	69.2%
		3-Sided Cure (Yes)	66	72.5%
	Curing Mode	Full Intensity	43	47.3%
		Pulse Cure	26	28.6%
		Soft Start	22	24.2%

IV. Discussion:

The primary objective of this study was to identify and quantify the disparity between established, evidence-based light-curing guidelines and the self-reported clinical practices of dental professionals in Pune. The study achieved a 70.0% response rate (91/130), a methodological strength that minimizes non-response bias and ensures the data accurately reflects regional practices. Although the sample size is smaller than the 156 respondents reported by Haridy et al. [10], the high engagement level reinforces the validity of the findings.[10]

This oversight is a major risk factor for under-cured restorations, especially considering that nearly half of the participants (46.2%) have used their current unit for over six years.[11] While theoretical awareness appeared high—with 85.7% claiming adherence to manufacturer instructions and 68.1% recognizing the multivariate factors affecting curing—practical application showed significant variability.[12]Furthermore, the lapse in safety protocols, with 33% of practitioners failing to use eye protection, highlights an urgent occupational

health concern regarding retinal damage from blue light.[13]

The most critical finding revealed that 58.2% of respondents never check their LCU intensity with a radiometer.[14-18]For instance, while 65.9% correctly utilize a perpendicular angulation, the remaining 34.1% utilize an angulated approach which significantly reduces irradiance and risks incomplete polymerization in deep cavities.[15]

This demographic alignment likely explains the nearly universal adoption (94.5%) of LED curing units, confirming the clinical obsolescence of legacy technologies like QTH or Plasma Arc systems.[20,22]Despite the use of modern technology, a profound "maintenance gap" was identifiedCompounding this, 42.9% were unaware of their unit's power output (mW/cm²), operating without knowledge of a parameter that dictates curing efficacy. Such gaps pose a direct threat to the physical strength, wear resistance, and colour stability of composite restorations.[21]

Similarly, while 54.9% maintain the optimal 0–2 mm distance, over one-third of practitioners hold the unit further away, drastically reducing delivered energy due to the inverse square law.[19,24]The preference for "Full Intensity" curing (47.3%) over "Soft Start" (24.2%) suggests a clinical priority on speed, which may inadvertently increase polymerization shrinkage stress and post-operative sensitivity.[23]

Ultimately, these findings move beyond theoretical concerns to provide empirical evidence of specific professional development gaps. The data serves as a foundation for targeted interventions by regulatory bodies and CPD programs to emphasize equipment calibration and technical precision. Addressing these deficiencies is essential to ensuring the efficacy and longevity of composite restorations across general dental practice.

V. CONCLUSION

This study underscores a "mixed landscape" in dental practice in Pune. While there is high adoption of LED technology and good awareness of clinical techniques like incremental curing and proper angulation, there is a profound lack of equipment maintenance and technical awareness.

Because adequate energy delivery is the single most important factor in the longevity of composite restorations, this oversight represents a major threat to clinical success. Future professional development programs should shift focus from just "how to cure" to include "how to monitor and maintain" the curing unit to ensure reliable, long-term restorative outcomes.

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