

Original article: Awareness of Dental Laser Applications Among Final-Year Dental Students: A Cross-Sectional Study



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ABSTRACT



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Introduction: With the advancement of laser technology in dentistry, ensuring that dental professionals possess adequate knowledge and adhere to proper safety practices is essential. This study aimed to assess the awareness of final-year dental students at Guilan University of Medical Sciences regarding the use of lasers in dentistry.

Materials and Methods: This analytical cross-sectional study was conducted in 2024 and included 78 final-year dental students. Data were collected using a structured and validated questionnaire (content validity index = 0.98, content validity ratio = 1.0, Cronbach's alpha = 0.79) comprising three sections: demographic information (age, gender, GPA [Grade Point Average]), general questions (3 items), and clinical awareness (17 items). Each correct response was scored as 1 and incorrect or unanswered items as 0, yielding a total score range of 0–17. Awareness levels were categorized as poor (0–6), moderate (7–12), and good (13–17). Data were statistically analyzed ($\alpha=0.05$).

Results: Of the participants, 46.2% were male and 53.8% female. The mean age was 26.99 ± 2.18 years, and the average GPA was 16.08 ± 0.73 . Most students (73.1%) demonstrated a moderate level of awareness, while 25.5% had poor awareness and only 6.4% showed good awareness of laser applications. No significant association was found between awareness and age ($P > 0.05$); however, a statistically significant relationship was observed between GPA and awareness ($P = 0.011$).

Conclusions: The overall awareness of dental laser applications among final-year students was moderate. Students with higher academic performance exhibited significantly greater awareness levels.

1. Introduction

Over the past two decades, laser technology has attracted significant attention as an innovative and effective tool in dentistry (1). This technology, due to features such as non-contact surgery, significant reduction of bleeding, acceleration of tissue healing, and increased treatment precision, has rapidly been adopted in many developed countries (1-3). More than 17 years have passed since certain types of lasers were approved by the U.S. Food and Drug Administration (FDA) for therapeutic applications including soft tissue oral surgeries and caries removal, and currently, a considerable percentage of dentists in the United States and Europe utilize these devices in their clinics (1).

Furthermore, studies and surveys have shown that over 60% of patients prefer laser treatments due to less pain and anxiety compared to traditional methods, highlighting the importance of education and the expanded use of lasers in dentistry (4).

Despite the numerous advantages of lasers in dentistry, correct and effective use of this technology requires specialized training and practical skills, which unfortunately many dental students in Iran have not sufficiently received (5, 6). This lack of knowledge and practical training has resulted in many dental graduates being unable to fully and optimally benefit from laser advantages in their treatments after entering professional practice. Moreover, insufficient understanding of the benefits and wide range of laser applications is considered a major reason for the limited and suboptimal

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use of this technology nationwide (5, 7).

Given the rapid advancement of laser technology in dentistry and its crucial role in improving treatment quality and increasing patient satisfaction, assessing dental students' awareness regarding the applications of this technology is of great importance (7). Additionally, considering the absence of recent and comprehensive studies on laser education and awareness in Iran over the past decade, this study aimed to evaluate the knowledge of final-year dental students at Guilan University of Medical Sciences about lasers and their applications in dentistry. The findings of this research can be instrumental in identifying educational gaps and planning for the enhancement of both practical and theoretical training on laser use in dentistry, ultimately contributing to the better development and more effective application of this technology in the country.

2. Materials and Methods

This study was a descriptive -analytical cross-sectional research conducted in 2024 at the Faculty of Dentistry, Guilan University of Medical Sciences. The study population included all final-year dental students during the academic year 2023–2024. Census sampling was employed, and based on the official student list obtained from the university's education department, 78 eligible students were invited to participate. Inclusion criteria consisted of giving informed consent and completing the entire questionnaire, while incomplete responses were excluded from the final analysis.

Data were collected using a structured questionnaire previously developed and validated by Bagheri et al. (8). The questionnaire consisted of three parts: demographic information (age, gender, and overall GPA), three general questions, and 17 questions specifically designed to assess knowledge about the application of lasers in dentistry. The knowledge questions were multiple-choice, and scoring was binary: one point was awarded for each correct answer, and zero points for incorrect or unanswered items. The total knowledge score ranged from 0 to 17, and based on the total score, awareness was categorized into three levels: poor (0–6), moderate (7–12), and good (13–17).

Before conducting the main study, the content validity of the questionnaire was evaluated using expert opinion from 10 faculty members and dental specialists at Guilan University. The Content Validity Index (CVI) was calculated at 0.98, and the Content Validity Ratio (CVR) at 1.0, both indicating excellent validity. To assess the reliability of the instrument, a pilot test was conducted with 20 students not included in the final sample, and the Cronbach's alpha coefficient was calculated to be 0.79, confirming acceptable internal consistency.

After obtaining informed consent, the questionnaires were distributed to the students in person, completed, and collected anonymously. All responses were kept

confidential and used solely for research purposes. This study was approved by the Ethics Committee of Guilan University of Medical Sciences under the code IR.GUMS.REC.1403.089. All participants voluntarily took part in the study after being informed of its nature and aims. They were assured that their responses would remain confidential, and no financial incentives were provided for participation.

Data were analyzed using SPSS version 26. Descriptive statistics (mean and standard deviation for quantitative variables; frequency and percentage for qualitative variables) were used. In inferential statistics, independent t-test and ANOVA were applied for normally distributed data, while Mann-Whitney and Kruskal-Wallis tests were used for non-normal distributions. Chi-square or Fisher's exact tests were used to assess associations between demographic variables and awareness levels. A significance level of $P < 0.05$ was considered in all statistical tests.

3. Results

A total of 78 final-year dental students from Guilan University of Medical Sciences participated in the study. The majority of the students were female (53.8%), and the most common age group was 26–30 years (52.6%). Most students had a GPA between 16 and 17 (43.6%). The mean age of the participants was 26.99 ± 2.18 years, and the mean Grade Point Average (GPA) was 16.08 ± 0.73 .

Regarding knowledge, the questionnaire included 17 items related to the use of lasers in dentistry. Over half of the students answered incorrectly to 8 of these questions. The highest rates of incorrect answers were observed for the following questions: "What is the best laser for bleaching?" (87.2% incorrect), "Which laser is used for caries detection?" (71.8% incorrect), "Which laser is best for root canal sterilization?" (59% incorrect), and "Which laser is best for hemostasis?" (66.7% incorrect). For the item "Does using a dental laser require completing a specific training course?", responses were equally divided between correct and incorrect answers (Table 1).

According to the overall knowledge scores, 73.1% of students had a moderate level of knowledge, 25.5% had poor knowledge, and only 6.4% demonstrated good knowledge of lasers and their clinical applications in dentistry (Table 2).

Inferential statistics are presented in Table 3. A statistically significant difference was found between gender and knowledge scores: male students had a higher mean knowledge score (9.25 ± 2.68) compared to female students (7.88 ± 2.25 ; $P = 0.017$). Although students aged 31–35 had the highest mean knowledge score (11.50 ± 3.53), the difference among age groups was not statistically significant ($P = 0.172$). A statistically significant difference was observed between GPA and knowledge scores ($P = 0.011$). Students with a GPA above 17 had the highest knowledge scores ($10.00 \pm$

3.93), while those with a GPA between 14 and 15 had the lowest (7.00 ± 1.78).

Table 1. Frequency distribution of correct and incorrect responses to questionnaire items

Question No.	Question	Correct Response	Frequency	Percentage (%)
1	Is the use of laser requiring special safety measures?	Yes	61	78.2
2	For whom should laser safety be observed?	Yes	45	57.7
3	Which organ is most likely to be damaged if safety is not observed?	Yes	32	41.0
4	Can ignoring laser safety cause a fire?	Yes	61	78.2
5	Can all dental procedures be done with the laser device?	No	11	14.1
6	What is the most commonly used type of laser in dentistry?	Specified	30	38.5
7	Is the laser used for hard and soft tissue different?	Yes	47	60.3
8	Is it easy to use the laser device after purchase?	No	67	85.9
9	Does working with the laser require special training?	Yes	39	50.0
10	Does laser use affect patient acceptance in the clinic?	Yes	44	56.4
11	What is the best laser for hard tissue?	Specified	36	46.2
12	What is the best laser for soft tissue?	Specified	41	52.6
13	What is the best laser for bleaching?	Specified	10	12.8
14	Which laser is used for caries detection?	Specified	22	28.2
15	What is the best laser for canal sterilization?	Specified	32	41.0
16	What is the best laser for hemostasis?	Specified	26	33.3
17	How many years has laser been used in dentistry?	Specified	41	52.6



Table 2. The overall awareness level of students regarding laser in dentistry

Awareness Level	Frequency	Percentage (%)
Poor	16	25.5
Moderate	57	73.1
Good	5	6.4



Table 3. Relationship between demographic variables and awareness level

Variable	Group	N	Mean Awareness Score	Standard Deviation	p-value
Gender	Male	36	9.25	2.68	0.017
	Female	42	7.88	2.25	
Age (years)	20-25	35	8.17	2.29	0.172
	26-30	41	8.66	2.66	
	31-35	2	11.50	3.53	
	14-15	11	7.00	1.78	
Overall GPA	15-16	28	8.50	2.00	0.011
	16-17	34	8.79	2.28	
	Above 17	5	10.00	3.93	



4. Discussion

The introduction of laser technology into dentistry has significantly enhanced both the quality and efficiency of routine and specialized dental treatments. However, strict adherence to safety protocols is critically important for both the dentist and the patient. The choice of laser type, the method of application, the site of irradiation, and the specific treatment being performed all play a crucial role in the therapeutic outcomes (1). Consequently, it is essential for dental practitioners, particularly dental students, to possess comprehensive knowledge of the applications, advantages, limitations, and safety precautions associated with lasers (1). The present study primarily focuses on evaluating the knowledge of final-

year dental students at Guilan Dental School regarding laser applications in dentistry.

The findings revealed that approximately 73% of the students had a moderate level of knowledge, while 25.5% exhibited poor knowledge on this important topic. These findings are consistent with previous assessments of dental students and practitioners, which have reported similar levels of understanding regarding laser applications in dentistry. Sachelarie et al. (1) identified a lack of clinical experience and inadequate knowledge as significant barriers to the widespread adoption of laser therapy, a conclusion that aligns closely with the results of our study. In a study conducted in Saudi Arabia, it was found that 76% of fourth-year dental students lacked sufficient knowledge

regarding laser applications (5). Interestingly, another investigation revealed that most final-year dental students in Iran expressed a preference for incorporating laser education into their curriculum (5). Additionally, dental clinicians have also shown insufficient knowledge concerning laser applications in their practices (9, 10). Gupta et al. (11) reported that many general dentists had a moderate to low awareness level regarding the use of lasers in dental procedures. Similarly, Mendiratta et al. (12) found that 99% of final-year dental students in India were familiar with the concept of lasers, and 93.4% recognized their applications in pediatric dentistry. However, while many students correctly identified the use of lasers for soft-tissue procedures such as frenectomies (89.6%) and gingivectomies (84%), their understanding of other applications, such as lingual frenectomy for ankyloglossia, was notably weaker. The authors concluded that knowledge regarding both soft and hard tissue procedures, as well as the use of lasers in cavity and crown preparations, was below satisfactory levels. They also reported inadequate awareness of safety protocols and potential hazards associated with laser use. Further studies in India have suggested that dental interns possessed satisfactory knowledge regarding the various types and benefits of lasers. However, these interns also exhibited below-satisfactory understanding of the precise applications of lasers across different fields of dentistry (13).

In the present study, more than half of the students answered incorrectly on specialized questions pertaining to safety and limitations associated with working with laser devices. The integration of lasers into dental practices introduces potential hazards, including ocular damage, tissue injury, and fire risks. Therefore, comprehensive laser safety measures are vital to mitigate these risks and ensure the well-being of both patients and dental staff (14). It is worth noting that in other studies, the awareness of safety protocols among dental students was frequently found to be inadequate. Many students lacked knowledge about essential aspects such as proper laser handling, the use of protective eyewear, and environmental safety measures (15).

Despite their limitations in knowledge, a significant number of dental students have expressed a strong interest in gaining further education on laser applications and safety protocols (16). For instance, Kadam et al. (16) reported that while only 6.7% of participants had practical experience with dental lasers, a substantial majority (84%) recognized the necessity for both theoretical and practical education on the subject. Furthermore, Damodar et al. (13) indicated that 79% of their participants felt they had not received adequate

knowledge during their Bachelor of Dental Surgery curriculum. Both Paes Batista da et al. (17) and Nassani et al. (18) emphasized the urgent need for enhanced education and specialized training courses on various subjects, including laser applications in dentistry, prior to entering professional practice. Al-Jobair et al. (19) highlighted similar concerns regarding insufficient training in dental laser applications within educational curricula. These findings collectively underscore the necessity for comprehensive laser education within dental curricula. It is essential that dental programs include both theoretical instruction and practical training in laser applications and safety procedures. Moreover, employing interactive programs dedicated to learning about laser applications in dentistry may significantly enhance the understanding of this critical area among dental practitioners. A recent study by Khorasanchi et al. (7) introduced an educational program titled Essential Skills and Knowledge in Learning Laser (ESKILLD) to teach laser applications in dentistry through gamification methods. The feedback from final-year students at Mashhad Dental School indicated a high level of satisfaction with this training approach. In addition to theoretical coursework, practical experience with lasers is essential for developing competence in the field. Dental schools should actively cultivate opportunities for students to practice laser procedures under supervision (11). Moreover, even after graduation, dental professionals must commit to continuous education and staying updated with advancements in laser technology and its applications (11).

Students with higher GPAs exhibited a greater level of knowledge. This finding aligns with expectations, as students who achieve better grades often have improved access to resources and training opportunities. Additionally, they tend to practice more, which enhances their knowledge and confidence in using laser technology (16).

This study has several limitations that should be acknowledged. First, the sample was limited to a single dental school in Iran, which may restrict the generalizability of the findings to other institutions with different curricular structures or access to laser technologies. Second, the use of a self-reported questionnaire may have introduced response bias, particularly social desirability bias, as students might have overestimated their knowledge. Third, the cross-sectional design prevents any assessment of causality or changes in awareness over time. Additionally, the study did not evaluate students' practical competencies or hands-on experience with lasers, which are crucial for safe and effective clinical application. Finally, the questionnaire, while validated, focused primarily on

factual knowledge and did not assess attitudinal or motivational factors that could influence students' willingness to pursue further training in laser dentistry. Future educational interventions should involve a larger group of participants, and their effectiveness should be assessed using pre-test and post-test evaluations.

5. Conclusions

Despite the limitations of this study, it can be concluded that most final-year students at Guilan Dental School possess a moderate level of knowledge. Many students demonstrated inadequate understanding of laser applications in hard and soft tissues, as well as safety measures. This highlights the urgent need to revise educational programs and implement comprehensive theoretical and hands-on training courses on laser applications for final-year dental students.

Ethical Considerations

This study was approved by the Ethics Committee of Guilan University of Medical Sciences under the code IR.GUMS.REC.1403.089. All participants voluntarily took part in the study after being informed of its aim and informed consent was obtained.

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Authors' Contributions

Maryam Zohari: Conceptualization, Methodology, Writing – Original Draft, Writing – Review & Editing, Supervision **Nazanin Rahmani:** Conceptualization, Methodology, Investigation, Data Curation **Sanaz Asadi:** Conceptualization, Methodology, Investigation, Resources.

Conflict of Interests

The authors declared no conflict of interest.

Availability of data and material

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

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