بسم الله الرحمن الرحيم

كلية نبتة
NAPATA COLLEGE

Dentistry Program

Department of Periodontology

Assessment of Knowledge of Laser Technology in Periodontal Disease Management Among Graduate Dentists in Sudan, 2026

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Dedication

We dedicate this thesis to our families, whose unwavering support, patience, and encouragement have been our guiding light throughout this academic journey. Their sacrifices, understanding, and belief in our abilities have provided us with the strength and determination to overcome challenges and complete this work.

We also dedicate this work to our teachers, mentors, and all the academic staff who have shared their knowledge, guidance, and inspiration with us. Their dedication to education and commitment to excellence have shaped our learning and motivated us to strive for the highest standards in our research.

Finally, we dedicate this work to our colleagues, whose collaboration, constructive feedback, and shared experiences have enriched our journey and contributed to the successful completion of this thesis.

Declaration & Acknowledgement

Declaration

I declare that the research (Knowledge of Laser Technology in Gum Disease Among Graduated Dentists) in this graduation project is original and has only been submitted to Napata College to obtain Bachelor's Degree in Dentistry.

Acknowledgement

How does a person say “thank you “when there are so many people to thank? In fact, this research is a thank you to everyone who worked hard to produce it in this way, and certainly to our parents who were waiting for this effort.

The person most responsible for this research becoming reality is our supervisor. We are deeply honored to have had Dr. Esraa Omer as a guiding light and a source of inspiration on this road. Her continued advice and instruction were very helpful, so big thanks to her.

List of Abbreviations

Abbreviation	Full Form
WHO	World Health Organization
GBD	Global Burden of Disease
SRP	Scaling and Root Planing
Nd:YAG	Neodymium-doped Yttrium Aluminum Garnet laser
Er:YAG	Erbium-doped Yttrium Aluminum Garnet laser
Er,Cr:YSGG	Erbium, Chromium-doped Yttrium Scandium Gallium Garnet laser
CO_2	Carbon Dioxide laser
LANAP	Laser-Assisted New Attachment Procedure
P. gingivalis	Porphyromonas gingivalis
P. intermedia	Prevotella intermedia

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Abstract

Background: Periodontal disease is a common chronic inflammatory condition, with scaling and root planing remaining the main treatment despite known limitations in complex cases. Laser technology offers adjunctive benefits, but its clinical use remains inconsistent. This study aimed to assess the knowledge, perceptions, and perceived barriers regarding laser use in periodontics among graduate dental professionals, including their familiarity with different laser systems.

Methods: A cross-sectional study was conducted using an online self-administered questionnaire among 100 graduate dental professionals from Sudanese dental universities. The questionnaire, adapted from validated tools, assessed knowledge, awareness, and perceptions of laser technology in periodontal management. Data were analyzed using SPSS version 22 with descriptive and appropriate inferential statistics. Ethical approval was obtained prior to data collection, and participation was voluntary and anonymous.

Results: The majority of participants demonstrated awareness of dental laser technology (81%), although only 39% had received formal training. Overall knowledge was moderate, with 67% correctly identifying the full form of LASER and 70% recognizing its use in both hard and soft tissues. Attitudes were generally positive, with most respondents supporting laser benefits such as pain reduction (83%), improved precision (79%), and future integration into dental practice (85%). However, uncertainty remained regarding cost justification and clinical experience, with limited hands-on exposure reported.

Conclusion: High awareness and positive attitudes toward laser technology were observed, but formal training and practical knowledge were limited. Key gaps existed in understanding laser types and clinical application. The main barrier to adoption was insufficient training rather than lack of interest. Improved structured education is needed to support effective integration of laser technology into periodontal practice.

المستخلص

خلفية الدراسة: تُعد أمراض اللثة حالة التهابية مزمنة شائعة، ولا يزال التنظيف وإزالة الترسبات الجذرية هما العلاج الرئيسي رغم القيود المعروفة في الحالات المعقدة. توفر تقنية الليزر فوائد تكميلية، لكن استخدامها السريري لا يزال متفاوتًا. تهدف هذه الدراسة إلى تقييم المعرفة والتصورات والعوائق المتصورة فيما يتعلق باستخدام الليزر في طب اللثة بين أخصائيي طب الأسنان الخريجين، بما في ذلك مدى إلمامهم بأنظمة الليزر المختلفة.

المنهجية: أُجريت دراسة مستعرضة باستخدام استبيان ذاتي عبر الإنترنت شمل 100 من خريجي كليات طب الأسنان السودانية. قام الاستبيان، الذي تم تكييفه من أدوات معتمدة، بتقييم المعرفة والوعي والتصورات المتعلقة بتكنولوجيا الليزر في علاج أمراض اللثة. تم تحليل البيانات باستخدام برنامج SPSS الإصدار 22 مع إحصاءات وصفية واستنتاجية مناسبة. تم الحصول على الموافقة الأخلاقية قبل جمع البيانات، وكانت المشاركة طوعية ومجهولة الهوية.

النتائج: أبدى غالبية المشاركين دراية بتكنولوجيا الليزر في طب الأسنان (81٪)، على الرغم من أن 39٪ فقط منهم تلقوا تدريبًا رسميًا. كانت المعرفة العامة متوسطة، حيث حدد 67٪ بشكل صحيح الشكل الكامل لكلمة LASER واعترف 70٪ باستخدامها في كل من الأنسجة الصلبة واللينة. كانت المواقف إيجابية بشكل عام، حيث أيد معظم المستجيبين فوائد الليزر مثل تقليل الألم (83٪)، وتحسين الدقة (79٪)، والتكامل المستقبلي في ممارسة طب الأسنان (85٪). ومع ذلك، بقيت الشكوك قائمة بشأن تبرير التكلفة والخبرة السريرية، مع الإبلاغ عن تعرض عملي محدود.:

الخلاصة: لوحظ وجود وعي عالٍ ومواقف إيجابية تجاه تكنولوجيا الليزر، لكن التدريب الرسمي والمعرفة العملية كانت محدودة. كانت هناك فجوات رئيسية في فهم أنواع الليزر وتطبيقه السريري. كان العائق الرئيسي أمام اعتماده هو عدم كفاية التدريب وليس قلة الاهتمام. هناك حاجة إلى تحسين التعليم المنظم لدعم الدمج الفعال لتكنولوجيا الليزر في ممارسة طب اللثة.

Chapter one

Introduction

1. INTRODUCTION

1.1 Background

Periodontal disease is a widespread chronic inflammatory condition. WHO data suggests severe forms affect roughly 10–15% of adults globally, while Global Burden of Disease tracking shows a notable jump in cases from 52.3 million in 1992 up to 89.6 million in 2021 [1,2]. The process involves the gradual breakdown of tooth support structures driven by biofilm and the host response, often quietly advancing until tooth loss occurs [3,4]. Diagnostically, the field has moved toward greater precision with the 2017 World Workshop staging and grading framework, which acknowledges periodontitis as a product of both microbial challenge and host inflammatory response [3].

For years, management has relied heavily on mechanical nonsurgical debridement, mainly scaling and root planing (SRP) [5]. While SRP remains essential first-line care, we know it struggles to reach into deeper pockets or furcation areas effectively [6]. As Sanz and Teughels noted, achieving complete debridement in anatomically complex sites remains a genuine clinical challenge with hand or ultrasonic instruments alone [7]. This limitation is why laser technology has gained traction as an adjunct. In principle, lasers offer a way to address some of SRP's inherent limitations through precision, hemostasis, and direct antimicrobial effects [8]. Aoki and colleagues grounded this discussion in the principle of selective photothermolysis—essentially, what the laser does to the tissue depends entirely on wavelength and the tissue's chromophore content [9].

Different wavelengths behave quite differently in the mouth: diode lasers (810–1064 nm) are absorbed well by pigment and are useful for soft tissue cleanup and reducing bacterial load, with studies by Moritz et al. and Kreisler et al. demonstrating significant reductions in periodontal pathogens [10-12]. The erbium family (Er:YAG and Er,Cr:YSGG), by contrast, interacts with both hard and soft tissue due to their affinity for water and hydroxyapatite, enabling ablation with minimal thermal collateral damage [13,14]. When added to SRP, we have observed improvements in pocket depth reduction and bleeding scores in the literature [15,16]. Systematic reviews by Karlsson et al. and Slot et al. have reinforced that specific laser systems provide statistically significant additive benefits over SRP alone, particularly in initially deeper pockets [15,16].

Patient-reported outcomes also tend to favor laser-assisted approaches, with studies noting reduced discomfort, less bleeding, and diminished swelling postoperatively [17,18].

Yet, applying this technology safely demands a specific understanding of physics and tissue heating thresholds to avoid unintended iatrogenic thermal injury [8,19]. Despite the growing body of evidence supporting adjunctive laser use, routine clinical adoption remains inconsistent. Practitioner-level data from Wagh et al. and Bhasin et al. reveal a familiar pattern: high awareness of laser technology but low clinical experience, with barriers including equipment cost, perception that lasers are for specialists, and a clear lack of confidence coupled with strong demand for hands-on training [20,21]. Cobb et al. argued that adoption is hindered not by a lack of evidence, but by the need for specialized training, capital investment, and the absence of universal guidelines [22]. This translational gap—between what the science supports and what clinicians actually do—forms the central concern of the present investigation.

1.2. Problem statement:

Periodontitis remains a highly prevalent chronic inflammatory disease, with its global burden continuing to rise as reported by the World Health Organization and the Global Burden of Disease Study [1,2]. Although scaling and root planing (SRP) is the cornerstone of nonsurgical periodontal therapy, its limitations in accessing deep pockets and complex anatomical areas are well established [6,7].

Adjunctive laser therapy has been proposed to overcome these challenges, with evidence demonstrating improvements in clinical and microbiological outcomes, as well as favorable patient-reported experiences [15–18]. These effects are supported by the principle of Selective photothermolysis, which underpins wavelength-specific tissue interactions [9]. However, despite this growing body of evidence, the adoption of laser technology in routine periodontal practice remains inconsistent.

Studies indicate that while awareness of lasers among dental practitioners is high, actual clinical use is limited, largely due to barriers such as cost, insufficient training, and lack of confidence [20–22]. This highlights a translational gap between research evidence and clinical implementation.

This gap is particularly important among graduate dental trainees, who will shape future clinical practice. Yet, there is limited data on their understanding of laser-tissue interactions, familiarity with different laser systems, and perceptions of their clinical value and limitations. Without this insight, educational programs may struggle to address existing deficiencies effectively.

Therefore, this study aims to evaluate the knowledge, perceptions, and perceived barriers related to laser use in periodontics among graduate dental professionals, in order to inform targeted educational strategies and support evidence-based adoption in clinical practice.

1.3.Justification:

Graduate dental students were selected for this study because their foundational knowledge and early clinical exposure play a critical role in shaping future practice patterns. At this stage, learners begin forming clinical preferences and attitudes toward emerging technologies, making it important to understand how they perceive adjunctive tools such as lasers in periodontal therapy. The objective is not simply to assess knowledge, but to identify areas where understanding may be limited or where confidence in clinical application has yet to develop.

Since the adoption of dental laser technology is strongly influenced by education and hands-on experience, evaluating these factors at the graduate level provides an opportunity to identify gaps early in training. Insights from this study can help educators refine undergraduate curricula by emphasizing key concepts such as laser-tissue interactions, appropriate clinical indications, and safety considerations.

By addressing these gaps during foundational training, educational programs can better prepare future clinicians to make informed, evidence-based decisions regarding the use of laser technology. In the long term, this may support more consistent integration of adjunctive therapies into periodontal care and contribute to improved patient outcomes, including enhanced healing and overall treatment experience.

1.4.Research Questions

1. What is the level of knowledge regarding laser principles and periodontal applications among graduate dentists, and how confident are they in differentiating between diode and erbium laser indications?
2. What are their perceptions regarding the benefits and risks associated with laser use in periodontal practice?
3. What are the primary perceived barriers to routine clinical adoption, and do knowledge or perceptions vary by specialty track or years of graduate training?

1.5. Research Objective:

1.5.1 General objective:

To study what graduate dental professionals know about laser use in periodontics, their clinical familiarity with laser systems, their perceptions of benefits and barriers, and the influence of demographic factors on these perceptions.

1.5.2. Specific objectives:

1. To evaluate the current understanding of laser-tissue biology and the evidence backing up laser-assisted therapy among these trainees.
2. To determine their practical familiarity with different laser types (diode, Nd:YAG, Er:YAG) and when each is indicated for soft tissue versus pocket therapy.
3. To identify which clinical benefits of lasers (like bacterial reduction or healing time) graduate dentists find most convincing or worth pursuing.
4. To explore the perceived drawbacks and logistical headaches—be it cost, training, or safety—that limit adoption.
5. To identify the common sources of knowledge regarding laser use in periodontal management among participants.
6. To examine how demographic factors like gender, specialty choice, or prior hands-on experience shape their knowledge base and perceptions.

Chapter Two
Literature Review

2. LITERATURE REVIEW

2.1 Global Burden and Pathogenesis of Periodontal Disease

Periodontal disease remains one of the most widespread chronic inflammatory conditions globally. Current WHO estimates indicate that severe periodontitis, the form most likely to lead to tooth loss, affects roughly 10–15% of adults worldwide [1]. Recent Global Burden of Disease data paint an even starker picture: incident cases climbed from 52.3 million in 1992 to 89.6 million in 2021, and projections through 2050 don't suggest a reversal any time soon [2]. The implications extend well beyond the oral cavity; as Tonetti and colleagues have argued, the burden of periodontal disease carries measurable consequences for nutrition, systemic health, and overall quality of life [4].

Diagnostically, the field has moved toward greater precision. The 2017 World Workshop introduced a multidimensional staging and grading framework that integrates severity (attachment loss, bone loss), complexity, and risk of progression [3]. This shift, detailed by Papapanou et al., reflects a more nuanced understanding of the disease—one that acknowledges periodontitis as a product of both microbial challenge and host inflammatory response [3].

2.2 Conventional Nonsurgical Periodontal Therapy: Scaling and Root Planing

Mechanical debridement—scaling and root planing (SRP)—has long been the cornerstone of initial therapy. The objective is straightforward: disrupt and remove subgingival biofilm and calculus to reduce bacterial load and arrest inflammation [5]. The evidence supporting SRP's efficacy in reducing probing depth and improving attachment levels is robust and well-rehearsed [5,6].

That said, the procedure has its limits, and it's worth being honest about them. As Sanz and Teughels noted in a European Workshop consensus, achieving complete debridement in anatomically complex sites—deep pockets, furcations, root concavities—remains a genuine clinical challenge with hand or ultrasonic instruments alone [7]. Add to that the issues of patient discomfort and postoperative hypersensitivity, as reviewed by Greenstein [23], and the rationale for exploring adjunctive modalities becomes fairly clear.

2.3 Fundamentals of Laser Technology in Dentistry

This is where lasers enter the conversation. In principle, lasers offer a way to address some of SRP's inherent limitations through precision, hemostasis, and direct antimicrobial effects [8]. But—and this is a recurring theme in the literature—safe and effective use demands a working knowledge of laser physics, wavelength-specific tissue interactions, and rigorous safety protocols. Without that foundation, the risks of iatrogenic thermal injury are real [8].

Aoki and colleagues provided an early, comprehensive overview of lasers in nonsurgical therapy, grounding the discussion in the principle of selective photothermolysis [9]. Essentially, what the laser does to the tissue depends entirely on wavelength and the tissue's chromophore content—water, hemoglobin, melanin. Later, Ishikawa and colleagues posed a more pointed question: innovation or myth? Their conclusion was measured—lasers offer clear advantages in specific scenarios, but only when the underlying science is respected [24].

2.4 Types of Lasers Employed in Periodontal Therapy

The term "dental laser" is imprecise. Different wavelengths mean different clinical jobs, and we noticed in the literature that this distinction is often where confusion begins for clinicians.
Diode Lasers (810–1064 nm): These are absorbed well by pigment (hemoglobin, melanin) but poorly by water. This makes them effective soft-tissue surgical tools with excellent hemostasis [12]. Romanos and Nentwig documented this extensively in oral surgical applications [12]. In nonsurgical pockets, the rationale centers on bacterial reduction—the energy is absorbed by pigmented periodontopathogens. Moritz et al. demonstrated significant reductions in P. gingivalis and P. intermedia with diode application [10], findings later corroborated by Kreisler et al. [11].
· Nd:YAG Lasers (1064 nm): Similar affinity for pigmented tissue but with deeper penetration. It's been used for laser curettage (removing inflamed sulcular epithelium) and bacterial reduction.

Ben Hatit and colleagues reported significant subgingival bacterial load reductions in vivo, though they cautioned that parameter selection is everything [25].
· Erbium Family (Er:YAG 2940 nm; Er,Cr:YSGG 2780 nm): This is where the physics shifts. These wavelengths are heavily absorbed by water and hydroxyapatite, enabling ablation of both soft and hard tissue with minimal thermal collateral damage [13,14]. We explored the early work by Aoki et al., which showed Er:YAG could remove calculus without melting or charring the root surface—a significant finding [13]. Schwarz and colleagues later translated this clinically, reporting outcomes comparable or superior to SRP with less patient discomfort [26]. Ting et al. confirmed similar safety and efficacy profiles for Er,Cr:YSGG [14].
· CO_2 Lasers (10,600 nm): Highly absorbed by water. Primarily a soft-tissue surgical laser. Pick and colleagues described its use in gingivectomy for phenytoin-induced hyperplasia decades ago, noting the advantages in hemostasis [19]. Its role in subgingival debridement, however, is limited by delivery challenges.

2.5 Clinical and Microbiological Outcomes of Laser-Assisted Therapy

Antimicrobial Effects: Beyond the studies already mentioned [10,11], Arcuri and colleagues combined in vivo and in vitro work to show that laser irradiation reduces pocket bacterial loads and exerts a biostimulatory effect on surrounding tissues [27].
Systematic Reviews: Karlsson et al. conducted an early systematic review and concluded that specific laser systems provide statistically significant additive benefits over SRP alone [15]. This was reinforced by the meta-analysis from Slot et al., which focused specifically on the thermal diode laser [16]. Their pooled data showed significant weighted mean differences favoring the laser group for probing depth reduction and attachment gain—particularly in initially deeper pockets [16].
Regeneration and Healing: The LANAP protocol, utilizing a specific pulsed Nd:YAG approach, has shown promising regenerative potential. Nevins et al. reported improvements in probing depth, attachment gain, and radiographic bone fill at nine months [28]. More recently, a scoping review by Bosisio et al. synthesized evidence suggesting laser irradiation positively influences cellular proliferation, growth factor release, and angiogenesis—all components of a favorable healing

environment [29]. Aoki and colleagues later provided a detailed mechanistic review of how specific parameters can modulate the inflammatory cascade and accelerate wound healing [30].

Patient Comfort: It was observed during data collection for several studies that patient-reported outcomes tend to favor laser-assisted approaches. Qadri et al. noted reduced discomfort alongside clinical improvements [17], and Raffetto's clinical review emphasized that proper laser use consistently translates to less bleeding and swelling postoperatively [18].

2.6 Knowledge, Attitudes, and Barriers to Laser Adoption

Despite this body of evidence, routine clinical adoption remains inconsistent. Understanding why requires looking at the practitioner-level data.

Wagh and colleagues surveyed periodontal practitioners in Pune and found a familiar pattern: 77% awareness, but 74% with no clinical experience using lasers [20]. The cited barriers were predictable—equipment cost (45%) and a perception that lasers are for specialists (85%). Critically, 80% wanted laser education integrated into curricula [20]. Bhasin et al. reported similar findings among interns and postgraduates: a clear lack of confidence coupled with a strong demand for hands-on training [21].

We explored this translational gap further in the work of Cobb et al., who argued that adoption is hindered not by a lack of evidence for specific applications, but by the need for specialized training, capital investment, and the absence of universal guidelines [22]. The literature paints a picture of a profession that is aware of the technology, interested in it, but fundamentally underprepared to use it.

2.7 Summary and Rationale for the Present Study

Periodontal disease is prevalent, and SRP, while foundational, has limitations [1,2,5,6]. Lasers offer a scientifically sound way to augment care—better debridement in difficult anatomy, antimicrobial effects, improved hemostasis, and greater patient comfort [9,10,16, 24,29]. But the evidence has not fully translated into education or widespread practice.

The existing knowledge and attitude research has largely focused on general practitioners or specific regional samples [20, 21]. What's less examined—and arguably more critical—is the post-graduate cohort. These are the clinicians currently shaping protocols and who will soon be teaching the next generation. Their baseline knowledge, their confidence, and their perceived barriers will disproportionately influence the trajectory of laser adoption in the coming decade.

This study was designed to address that specific gap: a focused assessment of knowledge, attitudes, and perceived barriers regarding lasers in periodontal therapy among graduate dentists. The goal is to generate findings that can inform curriculum development, continuing education strategies, and ultimately, the safer translation of laser science into improved periodontal care.

Chapter three

Methods and Materials

3. METHODS AND MATERIALS

3.1. Study Design

This study adopted a cross-sectional design using an online self-administered questionnaire to assess the level of knowledge, clinical awareness, and perceptions regarding laser technology in periodontal management among graduate dental professionals in Sudanese dental universities.

3.2. Study Area

The study was conducted among graduate dental professionals from selected Sudanese dental universities. These institutions represent a diverse academic and clinical training background, providing an appropriate setting to evaluate knowledge and perceptions of laser technology in periodontics

3.3 Study Population

The study population included Sudanese graduate dentists from both genders who had completed their Bachelor of Dental Surgery (BDS) from recognized dental universities in Sudan.

3.4 Eligibility Criteria

3.4.1 Inclusion Criteria:

- Sudanese graduate dentists of both genders.
- Graduates from recognized dental universities in Sudan.

3.4.2 Exclusion Criteria:

- Dentists holding postgraduate qualifications (specialist or master's degree holders).
- Individuals who did not consent to participate in the study.

3.5 Study Variables

3.5.1 Demographic Variables

- Age
- Gender
- University

3.5.2 Dependent Variables

- Level of knowledge regarding laser technology in dentistry
- Awareness of laser types and their applications
- Perceptions of laser use in periodontal (gum) disease management
- Common sources of knowledge regarding laser use in dentist

3.6 Sample Technique and Sample Size

A total of 100 graduate dental professionals were included in the study. A convenience sampling technique was used to recruit participants based on availability and willingness to participate during the data collection period.

3.7 Data Collection Techniques and Tools

Data were collected using an online self-administered questionnaire distributed to graduate dental professionals across Sudanese dental universities.

The questionnaire was adapted and modified from previously validated instruments to ensure relevance to the study objectives. It was designed to assess participants' knowledge of laser-tissue interactions, familiarity with different laser systems, perceptions of clinical benefits and limitations, and demographic characteristics.

Participants completed the questionnaire independently and anonymously to ensure confidentiality.

3.8 Data Management and Statistical Analysis

Data collected from the structured questionnaire were coded, entered, and analyzed using Statistical Package for the Social Sciences (SPSS) version 22. Data cleaning was performed to check for completeness, consistency, and accuracy before analysis.

Descriptive statistics were used to summarize the data. Frequencies and percentages were calculated for categorical variables, including demographic characteristics, training exposure, knowledge of laser technology, and attitude and perception-related responses. Results were presented using tables and figures for clear interpretation.

Knowledge, awareness, and perception items were analyzed individually using frequency distribution.

3.9 Ethical Considerations

Ethical approval was obtained from the Research Center of Napata College prior to data collection. The purpose of the study was clearly explained to all participants, and informed consent was obtained electronically before participation. Participation was voluntary, and confidentiality was strictly maintained. All data were anonymized and securely stored, accessible only to the research team.

Chapter Four
Result

Introduction

This part embodies data analysis of the gathered data and the results of the research. The data obtained from quantitative research is presented and analyzed, and interpreted in a systematic approach. The documentation and data analysis process intended to interpret data related to knowledge of laser technology.

Data Analysis

The data analyzes the responses obtained from the research field. The data findings were analyzed with the help of charts and frequency tables, which are used to represent the survey findings.

General Information

Figure (1) Based on the data for respondents who answered "Yes" (39%),and (61%) "answered "No

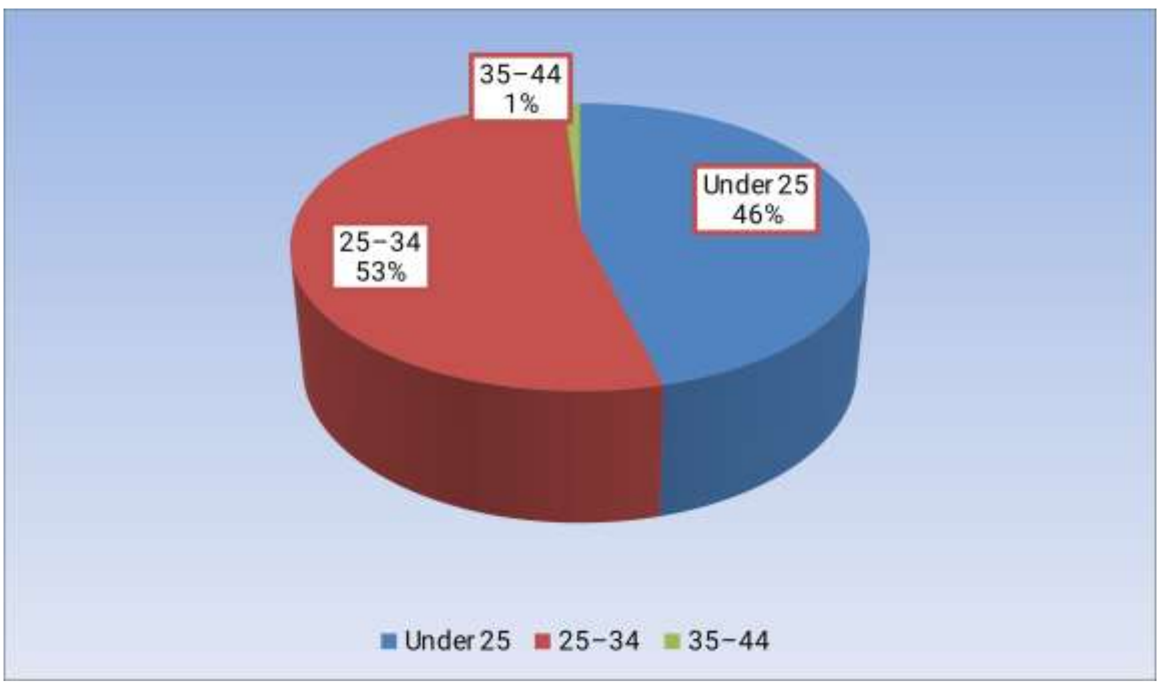

Figure No. (1) Age

Figure (2) The majority of participants were aged 25–34 (53%)

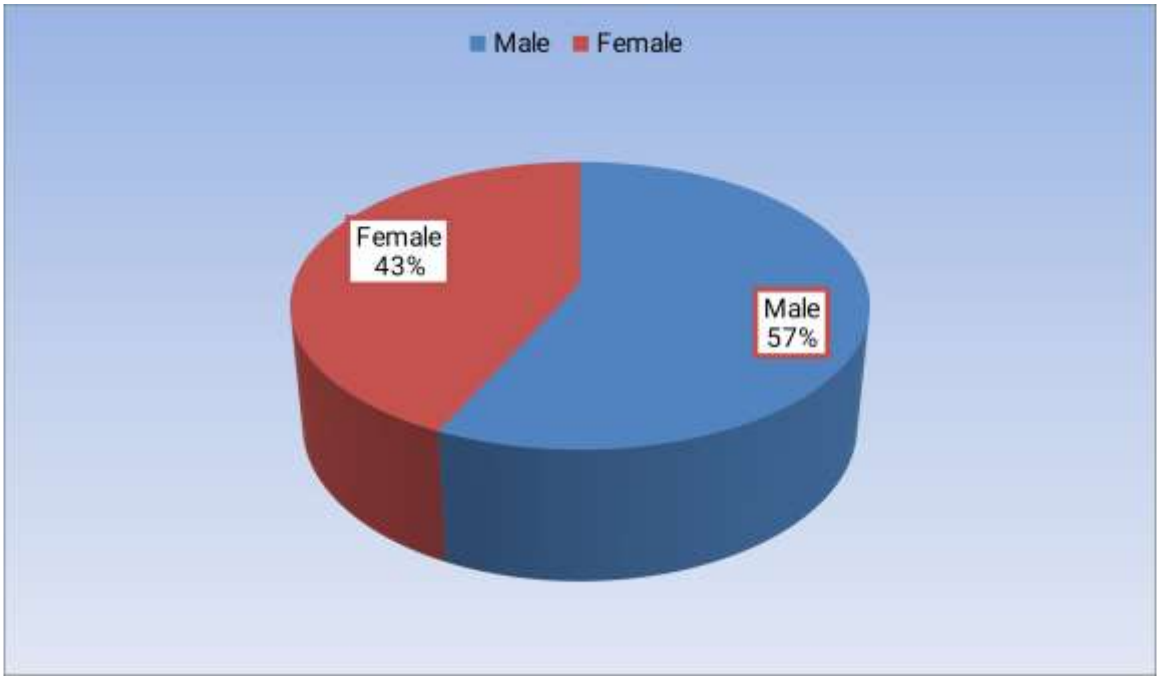

Figure No. (2) Gender

Figure (3) Higher representation of males (57%)

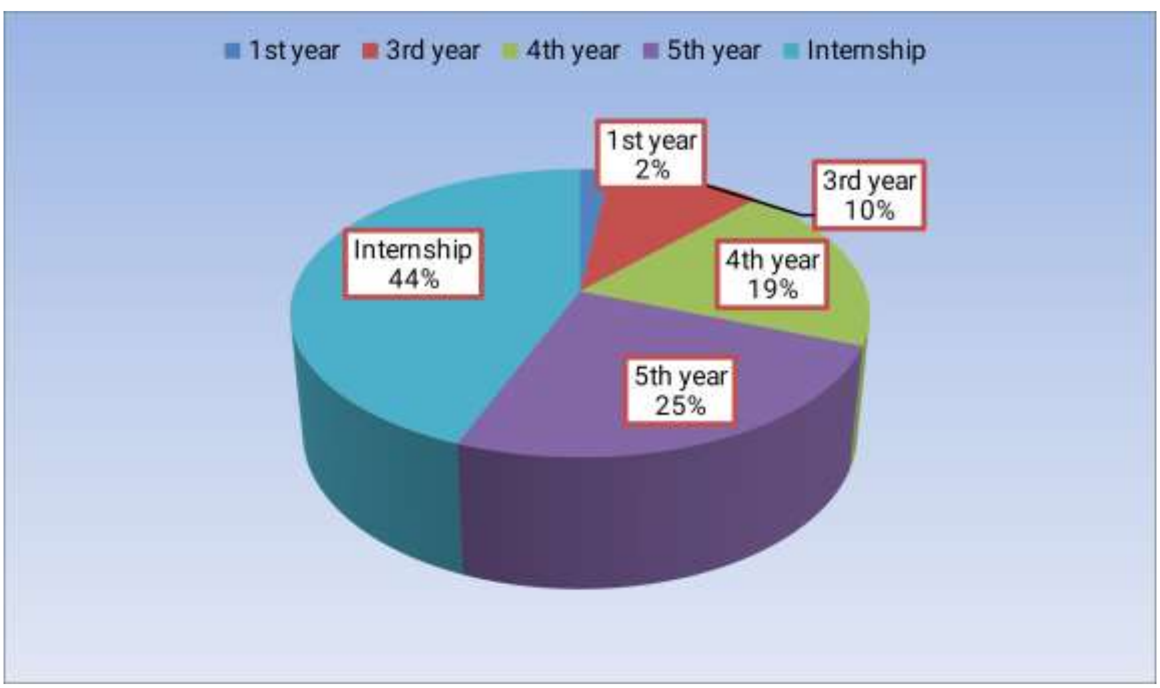

Figure No. (3) Academic Level (for students)

Figure (4) The largest group is Internship (44%), followed by 5th year (25%). The smallest group is 2nd year (2%)

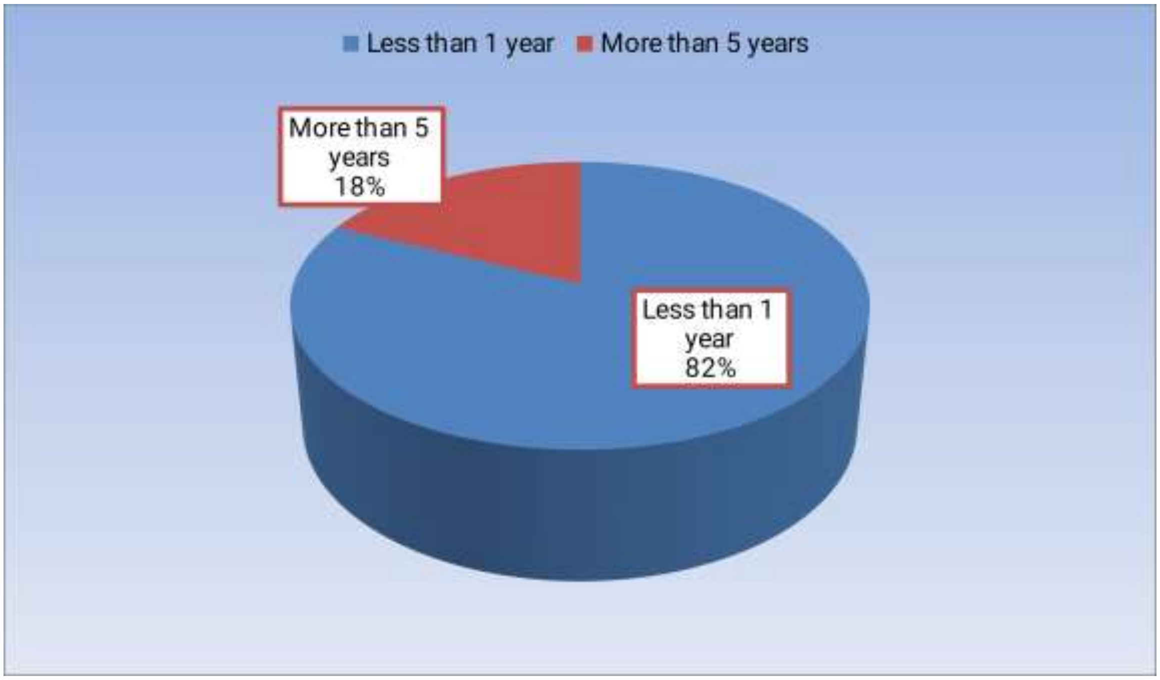

Figure No. (4) Years of Clinical Experience:

Table No. (1) Have you received any formal training in dental laser use?

Variable	Frequency	Percent
Yes	39	39
No	61	61
Total	100	100

Based on the data for respondents who answered "Yes" (39%),and (61%) answered "No".

Table No. (2) If "yes", what was the source of your training?

Variable	Frequency	Percent
University course	12	30.8
Workshop	9	23.1
Online	8	20.5
Other	10	25.6
Total	39	100

The most common training source was University course (30.8%) followed closely by Other (25.6%) and Workshop (23.1%). Online training was the least cited (20.5%).

Table No. (3) I feel confident about using lasers after adequate training.

Variable	Frequency	Percent
Yes	81	81
No	19	19
Total	100	100

Based on the data, 81% of respondents feel confident about using lasers after adequate training, while 19% do not.

Section 2: Knowledge about Dental Laser Technology

Table No. (4) Have you ever heard about dental laser technology?

Variable	Frequency	Percent
Yes	81	81
No	19	19
Total	100	100

81% of respondents have heard about dental laser technology, while 19% have not.

Table No. (5) Which types of lasers have you heard about in dentistry?

Variable	Frequency	Percent
Diode	28	28
Nd:yag	18	18
Co_2	20	20
Not sure	34	34
Total	100	100

The largest proportion (34%) are not sure which types they've heard of, followed by Diode (28%), CO_2 (20%), and Nd:YAG (18%).

Table No. (6) Do you know that lasers can be used for both hard and soft tissues

Variable	Frequency	Percent
Yes	70	70
No	30	30
Total	100	100

A majority (70%) know that dental lasers have dual hard/soft tissue capability, while 30% do not.

Table No. (7) Laser stands for

Variable	Frequency	Percent
Light amplification by stimulated emission of radiation	67	67
Other	12	12
Don't know	21	21
Total	100	100

The correct full form of LASER is Light Amplification by Stimulated Emission of Radiation. In the given data, 67% of respondents answered correctly.

Table No. (8) Lasers can be used for:

Variable	Frequency	Percent
Cavity preparation	6	6
Gingival surgery	16	16
Tooth whitening	5	5
All of the above	73	73
Total	100	100

73% of respondents selected "All of the above," meaning lasers can be used for cavity preparation, gingival surgery, and tooth whitening.

Table No. (9) Do lasers require specific safety measures (e.g., protective glasses, signage)?

Variable	Frequency	Percent
Agree	81	81
Mutually	14	14
Dis agree	5	5
Total	100	100

81% of respondents agreed that lasers require specific safety measures (such as protective glasses and signage). Only 5% disagreed, while 14% selected "Mutually".

Table No. (10) Do you think laser reduces pain compared to conventional methods

Variable	Frequency	Percent
Agree	83	83
Mutually	10	10
Dis agree	7	7
Total	100	100

83% of respondents agree that laser reduces pain compared to conventional methods. Only 7% disagree, and 10% are neutral ("mutually").

Table No. (11) Lasers provide better precision and comfort for patients.

Variable	Frequency	Percent
Agree	79	79
Mutually	10	10
Dis agree	11	11
Total	100	100

79% of respondents agree that lasers provide better precision and comfort for patients, while 11% disagree and 10% are neutral.

Section 3: Attitude and Perception

Table No. (12) Laser technology should be integrated into undergraduate dental curricula

Variable	Frequency	Percent
Agree	67	67
Mutually	20	20
Dis agree	13	13
Total	100	100

the majority of respondents (67%) agree that laser technology should be integrated into undergraduate dental curricula. Another 20% are neutral

Table No. (13) The cost of laser devices is justified by the benefits they provide.

Variable	Frequency	Percent
Agree	1	1
Mutually	92	92
Dis agree	7	7
Total	100	100

The majority of respondents neutral that the cost of laser devices is justified by the benefits they provide, while a smaller proportion were agreed or disagreed.

Table No. (14) Using lasers increases patient satisfaction.

Variable	Frequency	Percent
Agree	70	70
Mutually	17	17
Dis agree	13	13
Total	100	100

Table No. (15) Traditional dental procedures can be replaced by lasers in most cases.

Variable	Frequency	Percent
Agree	57	57
Mutually	28	28
Dis agree	15	15
Total	100	100

shows that the majority of respondents (57%) agree that traditional dental procedures can be replaced by lasers in most cases, indicating a generally positive attitude toward laser technology in dentistry. Meanwhile, 28% of participants remained neutral, which may suggest uncertainty or lack of sufficient knowledge about laser applications. On the other hand, 15% disagreed, possibly due to concerns about cost, availability, or limitations of laser use in certain procedures.

Table No. (16) believe that using lasers enhances the reputation of a dental clinic.

Variable	Frequency	Percent
Agree	80	80
Mutually	13	13
Dis agree	7	7
Total	100	100

80% of respondents agree that using lasers enhances the reputation of a dental clinic. 13% are neutral ("mutually"), and 7% disagree.

Table No. (17) Would you be interested in attending a certified course on dental lasers?

Variable	Frequency	Percent
Agree	77	77
Mutually	12	12
Dis agree	11	11
Total	100	100

77% of respondents agree that they would be interested in attending a certified course on dental lasers. 12% are neutral ("mutually"), and 11% disagree.

Table No. (18) Do you believe laser dentistry will become a standard part of dental care in the next decade?

Variable	Frequency	Percent
Agree	85	85
Dis agree	15	15
Total	100	100

85% agree that laser dentistry will become a standard part of dental care in the next decade, while 15% disagree.

Table No. (19) Laser dentistry represents the future of modern dental treatment

Variable	Frequency	Percent
Agree	82	82
Mutually	8	8
Dis agree	10	10
Total	100	100

a strong majority (82%) agree that laser dentistry represents the future of modern dental treatment. Only 10% disagree, while 8% are in the "mutually" category—likely meaning neutral or undecided.

Chapter Five: Discussion, Conclusion & Recommendations

5.1. DISCUSSION

This study set out to assess what graduate dentists actually know about laser applications in periodontal therapy and perhaps more importantly, what they think they know and what's stopping them from using the technology. Given that this cohort will soon define clinical standards, understanding their baseline is essential.

Our sample leaned young: 53% were between 25 and 34 years old, with a slight male predominance (57%). Academically, interns made up the largest subgroup (44%), followed by fifth-year students (25%). We're essentially looking at clinicians at the very beginning of their specialization trajectory a stage where openness to adopting new technologies tends to be highest.

On a surface level, the news is good. We noticed that general awareness of dental lasers is widespread. A full 81% of respondents reported prior familiarity with the term. This aligns reasonably well with regional data, Wagh and colleagues, for instance, documented a 77% awareness rate among periodontal practitioners in Pune [20]. The slight edge we observed might simply reflect the growing visibility of laser-assisted protocols in continuing education and social professional networks over the last few years.

However, it was observed during data collection that this awareness rarely translates into functional competence. The numbers here are sobering: 61% reported having received no formal training whatsoever in the use of dental lasers. We're not talking about advanced proficiency, we're talking about the absolute basics of operation and safety. This mirrors what Bhasin et al. described as a "persistent confidence gap," where interns and postgraduates consistently report feeling underprepared to use lasers clinically despite a clear interest in doing so [21].

Looking more closely at the 39% who had accessed some form of training, the routes were fragmented. University courses were the most cited source (30.8%), but a substantial portion relied on "other sources" (25.6%), with workshops and online platforms accounting for the remainder. The fact that dedicated, hands-on workshops represent less than a quarter of the training exposure is telling. It supports the argument advanced by Cobb and colleagues that the absence of standardized, accessible training pathways remains a principal bottleneck in laser adoption [22]. Our data suggest that current graduate curricula are simply not bridging the gap between theoretical awareness and clinical application.

We explored this knowledge gap further by asking participants to name specific laser types relevant to dentistry. Here, the picture shifts from "limited training" to "fundamental knowledge deficit." A striking 34% answered "Not sure". Among those who did venture a response, the diode laser was most frequently named (28%), followed by CO_2 (20%) and Nd:YAG (18%). While it's encouraging that diode recognition is relatively higher, likely due to its common use in soft tissue procedures, the fact remains that one-third of a graduate sample cannot differentiate between wavelengths with vastly different tissue interactions.

This is not merely an academic concern. As Aoki and colleagues have extensively reviewed, the clinical indication, safety profile, and biological effect are entirely wavelength-dependent [9]. An Nd:YAG laser does not behave like an Er:YAG laser in the periodontal pocket. Romanos and Nentwig have demonstrated the specific utility of the diode for soft tissue decontamination [12], while Schwarz and colleagues established Er:YAG as a viable alternative to mechanical instrumentation for root surface debridement [26]. If a clinician cannot confidently distinguish these systems, the risk of off-label or inappropriate application becomes a legitimate concern. To be fair, conceptual understanding on broader points was intact—70% correctly understood that lasers can target both hard and soft tissues, and 67% correctly identified the LASER acronym So there's a scaffold of knowledge present, but it's missing the detail required for safe clinical translation.

Despite the training deficits, the attitudinal landscape is notably favorable toward the technology itself. We noticed a strong consensus around patient-centered benefits. 83% agreed that laser-assisted therapy reduces pain relative to conventional instrumentation, and 79% associated it with improved precision and overall patient comfort. These perceptions are not baseless; they align with a robust body of clinical evidence. Slot et al.'s meta-analysis confirmed that adjunctive diode laser use with SRP yields statistically significant improvements in probing depth reduction and clinical attachment gain [16]. Raffetto, in a clinical review, emphasized that proper laser use demonstrably reduces intraoperative bleeding and postoperative morbidity [18]. The convergence of practitioner perception and published evidence is reassuring; it indicates that even without personal hands-on experience, the clinical narrative surrounding lasers is reaching this new generation accurately.

Additionally, 70% felt that laser availability enhances patient satisfaction, and 80% saw it as a reputational asset for the clinic. From a practice management standpoint, the technology is clearly perceived as a value-add.

Perhaps the most actionable finding of this study is the unequivocal demand for structured education. Two-thirds of respondents (67%) explicitly endorsed the integration of laser technology into undergraduate curricula. This echoes the sentiment captured by Wagh et al., where 80% of surveyed practitioners advocated for similar curricular reform [20].

Further reinforcing this point, we explored interest in continuing education and found that 77% expressed a clear desire to enroll in a certified laser training course. This readiness metric is critical. It suggests that the barrier is not attitudinal resistance or generational skepticism; it is structural. The opportunity simply isn't there. This aligns with the conclusions of Bhasin et al., who identified a significant disconnect between the demand for laser competence and the availability of practical training during residency or internship years [21].

Reassuringly, when asked about future use conditional on training, we noticed that 81% reported they would feel confident operating a laser after adequate instruction. This conditional confidence is important because it isolates the problem. It tells us we are not dealing with a cohort that is inherently technophobic. The same proportion (81%) also recognized the need for specific safety protocols like protective eyewear and signage, indicating a baseline understanding of the responsibility that accompanies laser use [8].

Looking forward, the optimism is almost unanimous. 85% anticipate that laser dentistry will become a standard component of care within the next decade, and 82% view it as representative of modern dentistry's trajectory. Ishikawa and colleagues have argued that lasers, when applied with a sound understanding of the underlying science, represent genuine therapeutic innovation in periodontics [24]. The graduates in our sample appear to agree totally.

One data point warrants particular attention. When asked whether the financial investment in laser equipment is justified by the clinical benefits, we noticed a near-universal neutrality: 92% neither agreed nor disagreed. Only 1% agreed, and 7% disagreed. At first glance, this might appear to be a non-finding. However, we explored this response in the context of the other data and interpreted it differently. This is not indifference; it is an expression of profound uncertainty rooted in inexperience. Without direct exposure to the technology's effect on procedural efficiency, patient flow, or treatment outcomes, a new practitioner is in no position to conduct a meaningful cost-benefit analysis. This neutrality is likely the intellectually honest position of someone who has read about lasers but never held a handpiece. It reflects the same underlying economic barrier identified by Wagh et al., where high equipment cost was cited as a primary obstacle by 45% of respondents [20]. Our data suggest that the cost concern manifests as hesitation and suspended judgment rather than outright rejection.

5.2. Conclusion

This study highlights a complex and somewhat contradictory picture. We observed high baseline awareness of laser technology coupled with a pervasive lack of formal training and specific, actionable knowledge. The attitudes toward the technology are overwhelmingly positive, particularly regarding patient comfort and clinical precision, yet the majority of respondents remain unable to differentiate between laser types or justify the economic investment. The data strongly indicate that the primary barrier is not a lack of interest or a fear of the technology, but rather a systemic deficit in educational opportunity during the formative post-graduate years. The high level of conditional confidence, the belief that competence would follow training, points toward a clear and urgent path forward.

5.4. Recommendations

Based on these findings, we propose the following:

1. Curricular Integration: Dental schools and post-graduate programs must move beyond superficial mentions of lasers and incorporate structured, competency-based modules covering laser physics, tissue interaction, wavelength-specific indications, and safety protocols.
2. Accessible Certification Pathways: Professional organizations and academic institutions should collaborate to develop and subsidize accessible, hands-on certification courses specifically targeting early-career dentists and graduates. Online theory paired with mandatory in-person practical sessions could address the fragmentation we observed.
3. Reinforced Safety Training: Given the universal awareness of safety requirements, educational initiatives should build on this foundation by emphasizing clinical case scenarios and emergency protocols rather than solely focusing on protective equipment.
4. Transparent Cost-Benefit Data: To address the pervasive neutrality regarding cost, future studies and industry communications should provide transparent, real-world data on return on investment, including patient acquisition, procedure time savings, and reimbursement considerations.

5. Future Research Directions: Longitudinal studies tracking the same cohort post-training would be valuable to assess whether structured education effectively converts the documented conditional confidence into sustained clinical adoption and improved patient outcomes.

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Appendices:

1: Questionnaire:

Knowledge of Laser Technology in Periodontal Disease among Graduate Dental Professionals

This questionnaire aims to assess the knowledge, awareness, and perceptions of graduate dental professionals regarding the use of laser technology in the diagnosis and treatment of periodontal (gum) diseases. Please answer all questions honestly. Your responses will remain confidential and will be used for research purposes only.

Section 1: Demographic and Clinical Information

1. Age: ___________
2. Gender:
- Male
- Female
3. University / Institution: _______________________
4. Academic Level (for graduates):
- Intern
- Graduate dentist
5. Years of Clinical Experience:
- Less than 1 year
- 1–5 years
- More than 5 years
6. Have you received any formal training in dental laser use?
- Yes
- No
7. If yes, what was the source of your training?
- University course
- Workshop
- Online course
- Other
8. Do you feel confident about using lasers after adequate training?
- Yes
- No
- Not sure

Section 2: Knowledge of Dental Laser Technology

9. Have you ever heard about dental laser technology?
- Yes
- No
10. Which types of lasers have you heard about in dentistry?
- Diode
- Nd:YAG
- CO_2

- Not sure

11. Do you know that lasers can be used for both hard and soft tissues?
- Agree
- Disagree
- Not sure

12. LASER stands for:
- Light Amplification by Stimulated Emission of Radiation
- Other
- Don't know

13. Lasers can be used for:
- Cavity preparation
- Gingival surgery
- Tooth whitening
- All of the above

14. Do lasers require specific safety measures (e.g., protective glasses, signage)?
- Agree
- Disagree
- Not sure

Section 3: Attitudes and Perceptions

15. Do you think laser reduces pain compared to conventional methods?
- Agree
- Disagree
- Not sure

16. Lasers provide better precision and comfort for patients.
- Agree
- Disagree
- Not sure

17. Laser technology should be integrated into undergraduate dental curricula.
- Agree
- Disagree
- Not sure

18. The cost of laser devices is justified by their benefits.
- Agree
- Disagree
- Not sure

19. Using lasers increases patient satisfaction.
- Agree
- Disagree
- Not sure

20. Traditional dental procedures can be replaced by lasers in most cases.
- Agree
- Disagree
- Not sure

21. I believe that using lasers enhances the reputation of a dental clinic.
- Agree
- Disagree
- Not sure

22. Would you be interested in attending a certified course on dental lasers?
- Agree
- Disagree
- Not sure

23. Do you believe laser dentistry will become a standard part of dental care in the next decade?
- Agree
- Disagree
- Not sure

24. Laser dentistry represents the future of modern dental treatment.
- Agree
- Disagree
- Not sure

25. Any suggestions for improving laser education and training in dentistry?

Section 4: Knowledge and Practice in Periodontal Laser Use

26. What is the main biological effect of laser on periodontal tissue?
- Bactericidal effect
- Promotes healing
- Removes calculus
- All of the above

27. Which periodontal procedures can lasers assist with?
- Pocket decontamination
- Frenectomy
- Curettage
- All of the above

28. Do you know the approximate wavelength range of diode lasers used in gum therapy?
- 300–600 nm
- 800–1000 nm
- 2000–3000 nm
- I don’t know

29. Can laser therapy completely replace scaling and root planing (SRP)?
- Agree
- Disagree
- Not sure

30. Which advantage of laser do you think is most important in periodontal therapy?
- Reduced bleeding
- Less pain
- Better sterilization
- Faster healing

31. In your opinion, which periodontal condition benefits most from laser use?

- Chronic periodontitis
- Gingivitis
- Peri-implant mucositis
- All of the above

32. What is the main disadvantage or risk of using lasers?

- Tissue burn
- High cost
- Need for operator training
- All of the above

33. During laser pocket therapy, what is the proper sequence?

- Scaling → laser → irrigation
- Laser → irrigation
- Laser only
- I don't know

34. Laser energy acts mainly on:

- Pigmented bacteria
- Cementum
- Bone
- All tissues equally

35. Laser therapy can promote regeneration of periodontal tissues.

- True
- False
- Not sure

36. Do you think laser use can reduce post-operative inflammation and discomfort?

- Agree
- Disagree
- Not sure