Ref: Ro J Stomatol. 2023;69(2)
DOI: 10.37897/RJS.2023.2.5

Statistical study concerning doctor's opinion in using the Diode Laser in Endodontics

Janos Kantor[1], Sorana Maria Bucur[2], Dorin Cocos[3], Alexandru Meroiu[4], Mioara Decuseara[3], Mariana Pacurar[1]

[1]Faculty of Dental Medicine, "G.E. Palade" University of Medicine Pharmacy, Science and Technology, Targu Mures, Romania
[2]Faculty of Medicine, "Dimitrie Cantemir" University, Targu Mures, Romania
[3]Faculty of Medicine and Pharmacy, "Dunarea de Jos" University, Galati, Romania
[4]Clinica ARTA, Bucharest, Romania

ABSTRACT

Our questionnaire-based study with 14 items proposed an investigation of the dental practitioners' opinions and knowledge of lasers, especially on the diode lasers application in Endodontics. The number of respondents was 104, with a higher percentage of 44.2% between 23-30 years old and 61.5% women. 86.5% of the participants worked in the private dental system. 80.8% of the respondents stated that they do not use the diode laser in their daily practice. Only 43.3% considered diode lasers useful in the sterilization of root canals, and 87.5% of respondents considered the sodium hypochlorite the most effective antiseptic.

Among those who do not use laser systems, 76.9% were complaining about the high costs of this equipment. 65.4% of the respondents stated they never used the diode laser during endodontic treatment, and the most frequent use was for sterilizing the infected root canals. 87.5% did not know which wavelength to use in practice. Asked if they would like to learn how to use the laser system, 76.9% (80) of respondents answered affirmatively, and 45.2% of study participants said they wanted to purchase a laser system in the future. There is a great need to educate dentists to use diode lasers and make them aware of their advantages. The only problem at present is the need for more affordable laser equipment.

Keywords: diode laser, endodontics, advantages, costs

INTRODUCTION

During the last decade, many dentists in our country have been using more lasers, which are high-end devices with indications almost for all clinical fields. The lasers are categorized based on the emitted wavelength. Due to the accessibility, portability, and costs, most dentists are becoming familiar with lasers by first using a diode laser.

Endodontic treatment has as its main objective the bacterial decontamination of the root canals which must prevent further septic complications. Mechanical and chemical instruments have been used to prepare root canals, decontaminate them, and get them ready for endodontic obturation [1].

Rotary mechanical instruments, classic hand-handled endodontics, or ultrasonic devices have been commonly used for reaming root canals, shaping them, and for the root obturation [1]. The medication that is used to disinfect the canals in the form of canal dressings is very diverse [2]. Frequent application of endocanalicular medication such as calcium hydroxide, mineral aggregate trioxide (MTA), and endocanalicular washes with antiseptic solutions such as sodium hypochlorite can induce antimicrobial resistance [3].

Reaming and antiseptic treatment can cause unexpected problems such as the spread of infection. Failure of endodontic treatment results in acute or

Corresponding author:
Sorana Maria Bucur
E-mail: bucursoranamaria@gmail.com

Article History:
Received: 20 June 2023
Accepted: 27 June 2023

chronic apical periodontitis. In situations, only two-thirds of these cases that benefit from repeat endodontic treatment have a satisfactory result [4].

Lasers of different types and wavelengths have been introduced into dental practice since the last century and have gradually gained ground in endodontics, where they are used for reaming root canals, disinfection and reduction of inflammation, facilitating and shortening the treatment [5]. Lasers began to be used in periodontology, oral-maxillo-facial surgery, endodontics, and implantology, even in odontology for the preparation of cavities with minimal sacrifice of dental substance.

Erbium:yttrium-aluminum-garnet or Er:YAG lasers, neodymium-doped yttrium aluminum garnet or Nd:Yag lasers, carbon dioxide CO2 lasers, and diode lasers can be used in endodontics [6]. The diode laser when used in treatment has a wavelength of 810-980 nm, being a low-power laser.

The diode laser can act better than other types of lasers against the microorganisms in the dentinal tubules because it can achieve a much greater absorption of water inside the hard tissues [7]. This type of laser has large divergences that give it poor optical performance [8,9].

Lasers are used for the removal of filling materials in endodontic retreatments, pulpotomies, cavities and root canal preparations, root canal obturations, and reducing pain during and after endodontic treatments [10-13].

Through the present study, we aimed to investigate to what extent the diode laser was used in daily clinical practice by dentists and final-year dental students. We wanted to determine the opinion of practitioners regarding the use of this new type of equipment, especially in the field of Endodontics. We evaluated participants' knowledge regarding the method of use, the advantages of using the laser, and the dental procedures in which it is effective. The study meant to investigate the frequency of laser use in endodontics, the phases of endodontic treatment in which it is used, and the working wavelength. The frequency of using different classic or more modern methods of sterilizing infected root canals was investigated.

MATERIAL AND METHODS

Our descriptive study was performed in April-May 2023. A self-designed questionnaire of 14 items was sent to the Faculty of Dentistry at the "George Emil Palade" University of Medicine, Pharmacy, Sciences and Technology of Targu Mures and the College of Dentists of our district and distributed online. Of the total number of registered dentists, 104 answered correctly and completely to our questionnaire regarding the use of the diode laser in endodontic practice. The participants were informed about the purpose of the research, the confidentiality of the data obtained, and the use of the results only for scientific purposes. We provided instructions for completing the questionnaire. The obtained data were recorded in databases using the Excel utility.

Our self-designed questionnaire had the following questions and answer options:

1. What is your age?
   a. 23-30 years old
   b. 31-37 years old
   c. 38-45 years old
   d. Over 45 years old
2. What is your gender?
   a. Feminine
   b. Masculine
3. What is your professional status:
   a. 6th year dental student
   b. Specialist /primary dentist in Endodontics
   c. Specialist/primary dentist in other specialty than Endodontics
   d. General dentist
4. What is the place where you carry out your activity:
   a. In education
   b. In the private system
   c. In a state polyclinic
   d. In a school dental office
5. Do you use the Diode Laser System in your practice?
   a. Yes
   b. No
6. What do you think are the advantages of the laser system?
   a. Faster healing of surgical wounds
   b. Effective sterilization of root canals
   c. Efficiency in periodontal therapy
   d. Adjuvant in the therapy of oral lesions
7. Why don't you use the laser system?
   a. High costs
   b. I find it difficult to use
   c. Time consumer
   d. I think the benefits of its use are exaggerated
8. Do you use the diode laser system during endodontic treatment?
   a. Most of the time
   b. Rarely
   c. Not yet
   d. No
9. At which stage of the endodontic treatment do you use the Laser system?
   a. During access cavity preparation
   b. During root canal preparation
   c. During root canal disinfection

d. During root canal obturation
e. I do not use it

10. What wavelength are you using?
    a. 450 nm
    b. 650 nm-660 nm
    c. 970 nm-980 nm
    d. 2780 nm
    e. I don't know
11. What type of root canal sterilization do you use for endodontic treatments?
    a. Chloramine
    b. Sodium hypochlorite 5.25%
    c. Oxygenated water
    d. Laser diode
12. What do you think are the advantages of this system?
    a. Provides aseptic working conditions
    b. Prevents pain
    c. Prevents the occurrence of infection, ensuring effective sterilization of the root canals
    d. Provides comfort and confidence to the patient
13. Would you like to learn how to use this system?
    a. Yes
    b. No
14. Would you like to purchase a laser system in the future?
    a. Yes
    b. I'm not sure
    c. Definitely not

RESULTS

Our results showed that the higher percentage of 44.2% of our respondents (46) were between 23-30 years, followed by 25% (26 respondents) represented by those between 31 and 37 years of age, 16.3% (17 respondents) were between 38-45 years and the smallest percent of 14.4% (17) were the oldest of the respondents, between 38 and 45 years.

Out of the total number of respondents, 61.5% (65) were women, and 38.5% (40) were men.

Regarding the professional status of the participants, 54.8% (57) were general dentists, 28.8% (30) were specialists or primary dentists in a specialty other than Endodontics, 8.7% (9) were specialists or primary in Endodontics and 7.7% (8) were students in their final year of Dentistry.

When asked about where they work, 86.5% (90) of the participants stated that they work in the private system, 16.3% (17) worked in a state polyclinic, 5.8% (6) worked in education, and 2.9% (3) stated that they work in a school dental office.

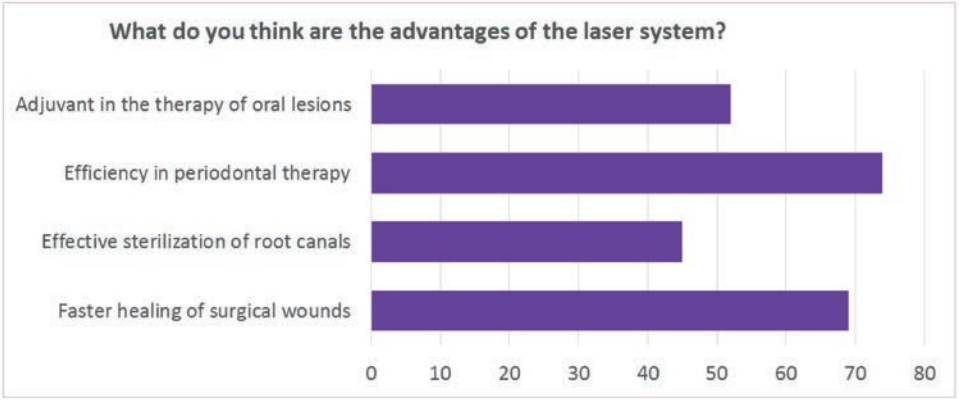

FIGURE 1. The advantages of the laser

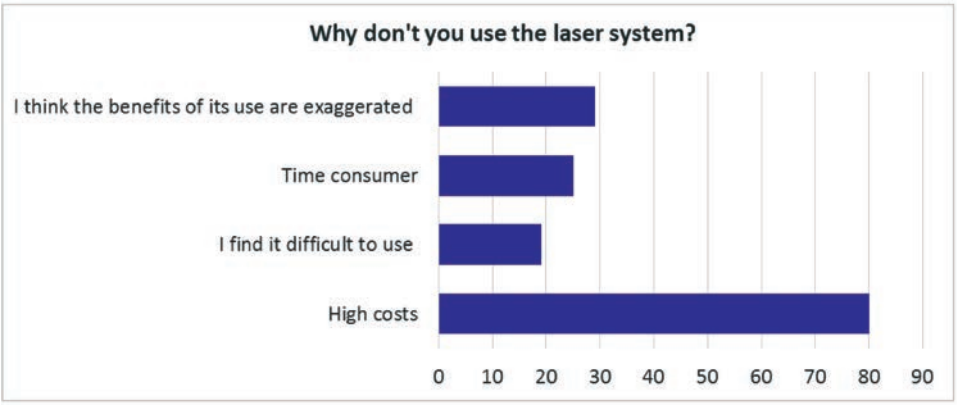

FIGURE 2. Reasons for avoiding using lasers

80.8% (84) of the respondents stated that they do not use the diode laser in their daily practice, and 19.2% (20) said that they do.

What do you think are the advantages of the laser system? Among the study participants, 71.2% (74) found the laser to be effective in periodontal therapy, 66.3% (69) believed that the use of the diode laser helps to heal surgical wounds faster, 50% (52) described the effectiveness of laser as an adjuvant in the therapy of oral lesions, 43.3% (45) said that it is useful in the effective sterilization of root canals.

Among those who do not use the laser systems, 76.9% (80) do not do so because of the high costs of the equipment, 18.3% (19) do not use lasers because they find them difficult to use, 24% (25) believe that they are time-consuming and 27.9% (29) believe that the benefits of its use are exaggerated.

Of the total participants in our study, 65.4% (68) answered that they never use the diode laser during endodontic treatment, 25% (26) said that they do not use it for now but do not exclude the possibility of using it in the future, 7% (7) declared that they use it in most cases, and 2.9% (3) said that they use it rarely.

Study participants were then asked at which stage of endodontic treatment they were using the Laser system. 80.8% (84) answered that they do not use the laser at all, 17.3% (18) used the laser to sterilize the root canals, 0.9% (one person) answered that they use it to prepare the access cavity, 0.9 % (one person) used it in root canal preparation. No respondent uses it for the obturation of the root canal.

The study participants declared in a percentage of 87.5% (91 people) that they do not know which wavelength they use in practice. 6.7% (7 people) stated that they use the laser at a wavelength of 970-980 nm, 3.8 (4 people) used it at a wavelength of 650-660 nm, and 2.9% (3 people) used it at a wavelength of 450 nm. None of the respondents were using the laser at the wavelength of 2780 nm.

When asked about the method of sterilizing root canals in endodontic treatments, 87.5% (91) of respondents said they use sodium hypochlorite 5.25%, 32.7% (34) used hydrogen peroxide, 8.7% (9) chloramine and only 5.8% (6) diode laser.

When asked which were the advantages of using the laser in endodontics, 51.9% (54) of participants

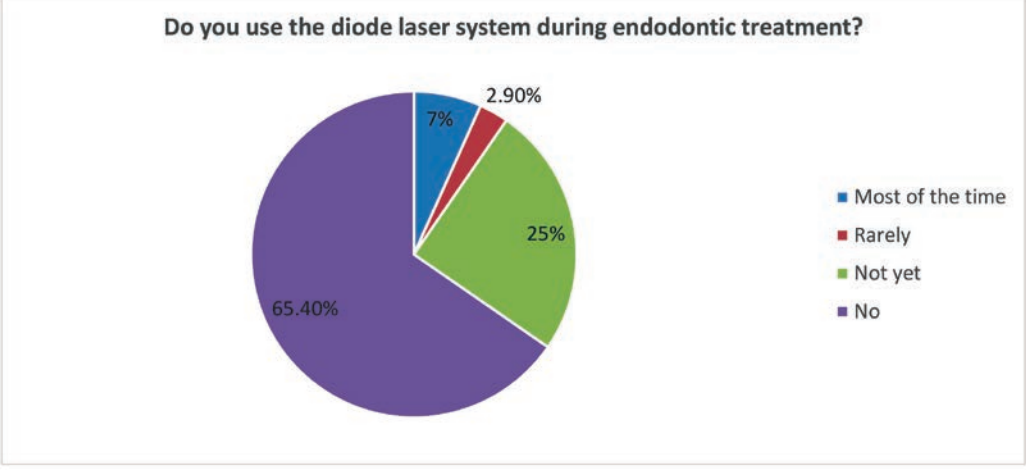

FIGURE 3. Frequency of using diode laser in endodontic treatments

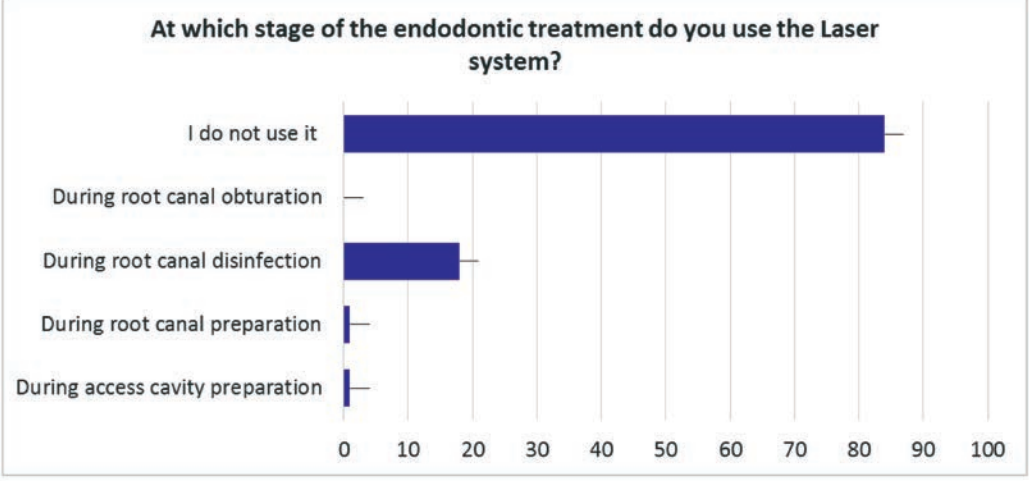

FIGURE 4. The use of the laser in different endodontic treatment phases

said that it prevents infection, ensuring effective sterilization of the root canals. 46.2% (48) participants found that its use provides comfort and confidence to the patient, 46.2% (48) considered that it ensures aseptic working conditions and 28.8% (30) said that using the diode laser prevented the onset of pain.

Asked if they would like to learn how to use the laser system, 76.9% (80) of respondents answered yes, and 23.1% (24) answered no.

45.2% (47) of study participants said they wanted to purchase a laser system in the future, 43.3% (45) said they were not sure whether or not they would make this purchase, and 11.5% (12) clearly said no.

DISCUSSIONS

In another study similar to ours that investigates the attitude of dentists regarding the use of lasers through the questionnaire method, 55% of the respondents knew its use and application fields in dentistry. The attitude of dentists regarding the use of the laser was not commensurate with the advantages it offers in clinical practice. The practice of modern laser dentistry was poorly represented, with only 10% of dentists practicing laser dentistry [13].

In terms of age-related interest in laser use, contrary to our study where 23-30-year-olds were more receptive (46%), another study reports the greatest interest from dentists aged 32-55 years (52%) [13]. Regarding this study, dentists over the age of 55 are the least interested in using the laser (15%), and 33% of the study participants were under 35 years old.

In our study, 61.5% of participants were women, and 38.5% were men. The much higher number of female dentists compared to male dentists can be explained by the fact that in our country many more women than men embrace this profession.

The biggest part of the study participants (86.5%) worked in the private system, 16.3% of them worked in a state polyclinic, 5.8% were persons involved in education, and 2.9% worked in a school dental office. This is explained by the fact that most dentists in our country work in the private sector, and the state medical system is not encouraged by the current health policies. Dispensing of children through school doctors is very low; only a few big schools in cities benefit from this prevention system which could be particularly useful in educating the population about oral health [14]. To enter a university as a teacher you have to get a Ph.D. in Dentistry that a small percentage of dentists were willing to have.

A high percent (80.8%) of the study participants stated that they do not use the diode laser in their daily practice, and only a few (19.2%) said that they do. Among those who do not use the laser system, 76.9% complained about the high costs of the lasers, 18.3% found them difficult to use, 24% believed they prolonged the treatment, and 27.9% were not confident in the advantages of this new system.

An extensive review of diode laser treatment for root canals concluded that there is no substantial evidence of the effectiveness of this therapy compared to other treatments of infected root canals [15]. However, diode laser can be effective in disinfecting the root canals and less pain after the endodontic treatment session [8]. It has to remove the smear layer that clogs the dentinal tubules and contains bacteria that will affect the treatment result after reaming. Laser irradiation can shape the root canals and remove the smear layer. The laser waves can penetrate the dental hard tissues and open the dentinal tubules by removing the smear layer [9].

Root canal antisepsis is an important factor for infection control and the success of endodontic treatments. Ultrasound, sonic activation and lasers have been used over time to optimize this procedure. Laser-activated root canal irrigation uses fine tips to produce cavitation bubbles in the irrigation solutions. The content attached to the channel walls is thus removed [10].

When retreatment is needed, complete removal of filling materials is important. The remaining residues maintain the bacterial flora and plug the apical zone, but hard-filling materials are often difficult to remove. Ultrasonic irrigation and different types of lasers can be used successfully in their removal [10,11].

Even partial vitality of the dental pulp is important, especially when we have young permanent teeth with the forming apex; this is done by pulpotomy or pulp capping.

The diode laser, used in these situations, stimulates collagen in the remaining pulp tissue, accelerates the healing of the remaining pulp, and activates the growth factors that help regenerate the dentin [12].

Treatment with low-level laser therapy brings benefits in reducing pain during endodontic therapy, which can be caused by mechanical reaming, bacterial load or application of some chemical substances, and post-endodontic intervention in patients with apical periodontitis [13].

During the last decades, dental laser applications have become more and more popular. Lasers of many types and wavelengths have been used, but diode lasers were the most affordable and common ones [16]. Diode lasers for dentistry work with wavelengths from the infrared and visible region to the electromagnetic one. The lasers are used in intervention on soft tissue, microbial reduction, teeth whitening, and biostimulation. Laser wavelengths are related to the absorption of tissue components. The lasers more recently manufactured have 400-450 nm wavelength. One of the latest wavelengths is the “blue wavelength,” which can be 445 or 450 nm and has the highest absorption in hemoglobin, mel-

anin and the lowest in water among all the diode lasers used in dentistry. This is a wavelength for surgical procedures. Thermal effects occur faster than using a 970 nm wavelength [17]. It has been demonstrated that a 445 nm wavelength has a destructive effect on Enterococcus faecalis during endodontic treatments [16,17]. In our study, 87.5% of participants did not know which wavelength is better to use. Only a very small percentage of 2.9% were using the wavelength of 450 nm. A few of them used the laser at a wavelength of 970-980 nm or a wavelength of 650-660 nm.

Our study demonstrated that in Endodontics, diode lasers were mainly used to sterilize the root canals, very rare to prepare the access cavity or in root canal preparation. No respondent used it for the obturation of the root canal.

The lasers have been used in periodontal therapies, faster healing of surgical wounds, oral lesions cure, and endodontic treatments [16]. In our study, 71.2% of participants found diode laser effective in periodontal therapy, 66.3% considered it helps to heal surgical wounds faster, 50% described it effective as an adjuvant in the therapy of oral lesions, and 43.3% said that it was useful in the sterilization of root canals.

CONCLUSIONS

Dental practitioners are theoretically aware of the advantages of using diode lasers for the sterilization of the root canals during endodontic treatments, in periodontal therapy, in healing surgical wounds, or in oral lesions. However, there is a deficiency in the use of lasers in Endodontics.

In Endodontics, diode lasers were mainly used to sterilize the root canals and were very rare to prepare the access cavity or in root canal preparation. Most of the participants did not know which wavelength was better to use.

Classic antiseptics were used much more frequently than diode lasers for sterilizing the infected root canals. The advantages of using the laser in daily practice outweigh the disadvantages as material handling and equipment costs.

There is a great need to educate dentists to use lasers and make them aware of the advantages of using this device in their field of work. The only problem at present is the need for more affordable laser equipment.

Conflict of interest: none declared
Financial support: none declared

Acknowledgments: all authors contributed equally to the manuscript.

REFERENCES

1. Del Fabbro M, Corbella S, Sequeira-Byron P, Tsesis I, Rosen E, Lolato A, Taschieri S. Endodontic procedures for retreatment of periapical lesions. *Cochrane Database Syst Rev.* 2016 Oct 19;10(10):CD005511. doi: 10.1002/14651858.CD005511.pub3
2. Alsubait S, Alsaad N, Alahmari S, Alfaraj F, Alfawaz H, Alqedairi A. The effect of intracanal medicaments used in Endodontics on the dislocation resistance of two calcium silicate-based filling materials. *BMC Oral Health.* 2020 Feb 18;20(1):57. doi: 10.1186/s12903-020-1044-6
3. Saydjari Y, Kuypers T, Gutknecht N. Laser Application in Dentistry: Irradiation Effects of Nd:YAG 1064 nm and Diode 810 nm and 980 nm in Infected Root Canals-A Literature Overview. *Biomed Res Int.* 2016;2016:8421656. doi: 10.1155/2016/8421656
4. Siqueira JF Jr. Aetiology of root canal treatment failure: why well-treated teeth can fail. *Int Endod J.* 2001 Jan;34(1):1-10. doi: 10.1046/j.1365-2591.2001.00396.x
5. Anagnostaki E, Mylona V, Parker S, Lynch E, Grootveld M. Systematic Review on the Role of Lasers in Endodontic Therapy: Valuable Adjunct Treatment? *Dent J (Basel).* 2020 Jul 1;8(3):63. doi: 10.3390/dj8030063
6. Huang Q, Li Z, Lyu P, Zhou X, Fan Y. Current Applications and Future Directions of Lasers in Endodontics: A Narrative Review. *Bioengineering.* 2023; 10(3):296. https://doi.org/10.3390/bioengineering10030296
7. Mathew T, Bm S, Gv P, Jose J. Comparative Evaluation of the Antibacterial Efficacy of Chlorhexidine and 810 nm Diode Laser in the Disinfection of Root Canals Contaminated With Enterococcus faecalis: An In Vitro Study. *Cureus.* 2022 Aug 30;14(8):e28596. doi: 10.7759/cureus.28596
8. Genc Sen O, Kaya M. Effect of Root Canal Disinfection with a Diode Laser on Postoperative Pain After Endodontic Retreatment. *Photobiomodul Photomed Laser Surg.* 2019 Feb;37(2):85-90. doi: 10.1089/photob.2018.4539
9. Violich DR, Chandler NP. The smear layer in endodontics - a review. *Int Endod J.* 2010 Jan;43(1):2-15. doi: 10.1111/j.1365-2591.2009.01627.x. PMID: 20002799.
10. Swimberghe RCD, Tzourmanas R, De Moor RJG, Braeckmans K, Coenye T, Meire MA. Explaining the working mechanism of laser-activated irrigation and its action on microbial biofilms: A high-speed imaging study. *Int Endod J.* 2022 Dec;55(12):1372-84. doi: 10.1111/iej.13824
11. Yang R, Han Y, Liu Z, Xu Z, Liu H, Wei X. Comparison of the efficacy of laser-activated and ultrasonic-activated techniques for the removal of tricalcium silicate-based sealers and gutta-percha in root canal retreatment: a microtomography and scanning electron microscopy study. *BMC Oral Health.* 2021 May 22;21(1):275. doi: 10.1186/s12903-021-01638-5
12. Arany PR, Cho A, Hunt TD, Sidhu G, Shin K, Hahm E et al. Photoactivation of endogenous latent transforming growth factor-β1 directs dental stem cell differentiation for regeneration. *Sci Transl Med.* 2014 May 28;6(238):238ra69. doi: 10.1126/scitranslmed.3008234
13. Dhayanidhi A, Mudiarasu N, Mathivanan A, Gopalkrishnan JR, Nagarajan SKK, Bharathan K. "Laser Dentistry" - The Need of the Hour: A Cross-sectional Study. *J Pharm Bioallied Sci.* 2020 Aug;12(Suppl 1):S295-S298. doi: 10.4103/jpbs.JPBS_89_20
14. Hostiuc S, Isaila OM, Curcă GC. Perceptions of Dental Medicine Students on Equity within Healthcare Systems in Romania: A Pilot Study. *Healthcare (Basel).* 2022 May 6;10(5):857. doi: 10.3390/healthcare10050857
15. Dawasaz AA. *In Vivo* Efficacy of Diode Laser as a Monotherapy in Root Canal Disinfection: A Systematic Review and Meta-Analysis. *Photobiomodul Photomed Laser Surg.* 2022 Jan;40(1):59-70. doi: 10.1089/photob.2021.0073
16. Strakas D, Franzen R. The blue wavelengths in laser dentistry: a review of current literature. *Laser Dent Sci.* 2023;7:97-9. https://doi.org/10.1007/s41547-023-00182-5
17. Dai S, Xiao G, Dong N, Liu F, He S, Guo Q. Bactericidal effect of a diode laser on *Enterococcus faecalis* in human primary teeth-an in vitro study. *BMC Oral Health.* 2018 Aug 31;18(1):154. doi: 10.1186/s12903-018-0611-6