E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.01.576

Research Article

Exploring the Role of Laser Dentistry in Treating Soft Tissue Lesions: A Clinical Trial

Dr Muhammad Junaid Hashmi[1], Maryam Sial[2], Marwa Yousaf[3], Alian Abid[4], Eera Noor[5]
[1]Assistant Professor, Department of community and preventive dentistry, Shahida Islam Dental College, Lodhran.
[2]3rd year BDS, Shahida Islam Dental College, Lodhran.
[3]3rd year BDS, Shahida Islam Dental College Lodhran.
[4]3rd year BDS, Shahida Islam Dental College, Lodhran.
[5]3rd year BDS, Shahida Islam Dental College, Lodhran.
Email: [1]drjunaidhashmi57@gmail.com, [2]Maryamsial25@gmail.com, [3]ranamrana24@gmail.com, [4]alian.abid7950@gmail.com, [5]eera.Noor@icloud.com
Corresponding Author: Dr Muhammad Junaid Hashmi
Assistant Professor, Department of community and preventive dentistry, Shahida Islam Dental College, Lodhran.
Email: drjunaidhashmi57@gmail.com
Received: 15.01.26, Revised: 10.03.26, Accepted: 15.03.26

ABSTRACT
Background: Laser dentistry has become an increasingly popular minimally invasive approach for the management of oral soft tissue lesions.
Objective: To explore the role of laser dentistry in the treatment of oral soft tissue lesions and compare its clinical outcomes with conventional scalpel surgery.
Methods: This prospective randomized clinical trial was conducted in the Department of community and preventive dentistry, Shahida Islam Dental College, Lodhran from February 2025 to September 2026, and included 210 patients with benign oral soft tissue lesions requiring surgical treatment. Patients were randomly allocated to a laser surgery group (n=105) or a conventional scalpel surgery group (n=105).
Results: The mean age of participants was 38.7 ± 12.4 years, and 56.2% were male. Baseline characteristics were comparable between groups. The laser group demonstrated significantly shorter operative time (14.8 ± 4.6 vs. 22.7 ± 6.1 minutes; $p<0.001$), lower blood loss (4.2 ± 2.1 vs. 18.5 ± 6.4 mL; $p<0.001$), reduced need for suturing (17.1% vs. 81.9%; $p<0.001$), and less intraoperative bleeding (8.6% vs. 39.0%; $p<0.001$). Postoperatively, patients treated with lasers experienced lower pain scores (2.8 ± 1.2 vs. 5.4 ± 1.7; $p<0.001$), reduced edema (11.4% vs. 32.4%; $p<0.001$), faster healing (9.6 ± 2.8 vs. 14.2 ± 3.7 days; $p<0.001$), and higher satisfaction scores (8.9 ± 1.1 vs. 6.8 ± 1.6; $p<0.001$). Favorable clinical outcomes were significantly associated with laser treatment, smaller lesion size, shorter healing time, and absence of postoperative infection.
Conclusion: Laser dentistry provides superior intraoperative and postoperative outcomes compared with conventional scalpel surgery for oral soft tissue lesions.

Keywords: Laser Dentistry, Oral Soft Tissue Lesions, Diode Laser, Oral Surgery, Wound Healing, Patient Satisfaction, Minimally Invasive Dentistry, Clinical Trial.

INTRODUCTION

Laser Dentistry has become an emerging new and minimally invasive alternative method for the treatment of various oral soft tissue lesions. In two decades, laser technology has made remarkable progress allowing a wide range of new applications in oral and maxillofacial surgery, periodontology, implantology and oral medicine [1]. There are a number of clinical benefits to soft tissue lasers: precise tissue ablation, excellent hemostasis, less postoperative pain, minimal tissue trauma, and better wound healing than traditional scalpel procedures [3]. Consequently, the use of laser assisted procedures has become increasingly popular among dental patients and dentists. Oral soft tissue lesions represent a heterogeneous group of lesions including those such as fibromas, pyogenic granulomas, mucoceles, frenal abnormalities, leukoplakia, gingival hyperplasia and other benign mucosal lesions [2]. The usual surgical treatment is by scalpel surgery, electrosurgery or cryotherapy. These are effective techniques that can be linked to increased bleeding intraoperatively, pain, edema, risk of infection, delayed healing and patient discomfort postoperatively [4]. These restrictions have prompted the use of

different treatment options with the aim of achieving better clinical results with fewer complications. The dental lasers work by transmitting the light energy to the biological tissue in a concentrated manner, which then interacts with the tissue in three different ways: photothermal, photochemical, and photomechanical effects [5]. Different laser systems are currently available, such as diode, Nd:YAG, CO_2, Er:YAG and Er,Cr:YSGG lasers, with different interactions and clinical applications with tissue [7]. These include diode and CO_2 lasers which are extensively used in soft tissue surgery due to their excellent cutting and coagulation properties, and ease of use [6]. Immediate sealing of small blood vessels during the incision of tissues is one of the major advantages of laser surgery, as this has been achieved with better hemostasis [8]. This helps to create a more clear operative field, shorten surgical duration and can remove the need of suturing. Furthermore, the sealing of the lymphatic vessels and the sensory nerve endings with laser energy can help to reduce swelling and pain after surgery [10]. These benefits are particularly important when surgical trauma is minimized, such as in anxious patients, medically compromised, and in pediatrics [9]. Clinical benefit after laser treatment of oral soft tissue lesions such as decreased blood, postoperative pain score, quicker healing times, and high levels of patient satisfaction have been reported in several studies [11]. In addition, laser surgery has antimicrobial properties, which can minimize the amount of bacteria at the site of surgery and thus lower the risk of postoperative infection [13]. However, because these benefits have been reported, differences have been observed between studies in terms of outcome assessment, laser wavelength, operator experience, and the type of lesions, with regard to the size of the clinical benefit. Laser dentistry has become more popular, and well-designed clinical studies, testing its effectiveness and safety in routine practice, have become more required [14]. The literature confirms the efficacy of lasers in soft tissues, but clinical trials in the local setting are still scarce, focusing mainly on laser safety and efficacy, and to a lesser extent on patient-centered outcomes including pain, healing and satisfaction [15]. It is important to have an understanding of these outcomes in order to make evidence-based clinical decisions and to optimise treatment protocols.

Objective

To explore the role of laser dentistry in the treatment of oral soft tissue lesions and compare its clinical outcomes with conventional scalpel surgery.

METHODOLOGY

This prospective randomized clinical trial was conducted in the Department of community and preventive dentistry, Shahida Islam Dental College, Lodhran from February 2025 to September 2026, that involved 210 patients with oral soft tissue lesions. Any patient aged 18 and older with a benign oral soft tissue lesion, such as fibromas, pyogenic granulomas, mucoceles, frenal abnormalities, gingival hyperplasia, papillomas or other clinically diagnosed soft tissue lesions that required surgical intervention were included. Eligible patients were those who were willing and provided informed consent. They were excluded if they had malignant lesions, severe systemic diseases that would not be suitable for surgery, coagulation disorders, active oral infections that needed urgent medical intervention, pregnancy, a previous history of treatment of the same lesion, immunocompromised status, or were unable to attend follow-up visits.

Data Collection

Following the ethical approval, qualified patients were randomly divided into two groups: laser surgery group (n=105) and conventional scalpel surgery group (n=105). Detailed demographic data such as age, gender, type of lesions, lesion size, lesion site, medical history and smoking status was recorded. In the laser group, the lesions were removed with the appropriate soft tissue dental laser and the control group had their lesions removed with the scalpel following standard surgical protocols. Intraoperative factors such as operative time, blood loss, suturing requirements and complications were recorded. The postoperative outcomes that were evaluated were pain (Visual Analog Scale (VAS)), bleeding, edema, wound healing, infection, recurrence, patient satisfaction and time to complete healing. Repeat evaluation was done at one week, two weeks, 1 month and 3 months after surgery.

Statistical Analysis

SPSS version 26.0 was used for data analysis. Numerical data was presented as mean ± sd and categorical data was presented as frequencies and percentages. Independent t-

tests and chi-square tests were used to determine differences between the laser and conventional surgery groups for continuous and categorical variables, respectively. Multiple measures. Factors associated with favorable clinical outcomes were determined by using multivariate logistic regression analysis. A p-value of ≤0.05 was deemed to be statistically significant.

RESULTS

The mean age of patients was 38.7 ± 12.4 years, with males slightly more common (118, 56.2%) than females (92, 43.8%). Mean lesion size was 1.9 ± 0.8 cm. Fibroma was the most common lesion (58, 27.6%), followed by pyogenic granuloma (43, 20.5%) and mucocele (39, 18.6%). Buccal mucosa was the most frequent site (67, 31.9%), followed by gingiva (59, 28.1%).

Table 1: Baseline Demographic and Clinical Characteristics of Patients with Oral Soft Tissue Lesions (N = 210)

Variable	n (%) / Mean ± SD
Age (years)	38.7 ± 12.4
Male	118 (56.2)
Female	92 (43.8)
Lesion size (cm)	1.9 ± 0.8
Fibroma	58 (27.6)
Pyogenic granuloma	43 (20.5)
Mucocele	39 (18.6)
Gingival hyperplasia	31 (14.8)
Papilloma	21 (10.0)
Other lesions	18 (8.6)
Buccal mucosa involvement	67 (31.9)
Gingiva involvement	59 (28.1)
Lip involvement	42 (20.0)
Tongue involvement	25 (11.9)
Other sites	17 (8.1)

Baseline characteristics were comparable between both groups. Mean age was similar in the laser and conventional groups (38.2 ± 12.1 vs. 39.1 ± 12.8 years; p=0.61), as was male gender distribution (61, 58.1% vs. 57, 54.3%; p=0.58). Mean lesion size was also comparable (1.8 ± 0.7 vs. 2.0 ± 0.8 cm; p=0.09), with no significant differences in lesion type or site.

Table 2: Comparison of Baseline Characteristics between Laser and Conventional Surgery Groups

Variable	Laser Group (n=105)	Conventional Group (n=105)	p-value
Age (years), Mean ± SD	38.2 ± 12.1	39.1 ± 12.8	0.61
Male gender, n (%)	61 (58.1)	57 (54.3)	0.58
Lesion size (cm), Mean ± SD	1.8 ± 0.7	2.0 ± 0.8	0.09
Fibroma, n (%)	30 (28.6)	28 (26.7)	0.76
Pyogenic granuloma, n (%)	22 (21.0)	21 (20.0)	0.86
Buccal mucosa lesions, n (%)	35 (33.3)	32 (30.5)	0.66

Operative time was shorter in the laser group (14.8 ± 4.6 vs. 22.7 ± 6.1 minutes; p<0.001), and blood loss was markedly lower (4.2 ± 2.1 vs. 18.5 ± 6.4 mL; p<0.001). Need for suturing was also much lower with laser treatment (18, 17.1% vs. 86, 81.9%; p<0.001), along with reduced intraoperative bleeding (9, 8.6% vs. 41, 39.0%; p<0.001).

Table 3: Intraoperative Outcomes Following Treatment

Variable	Laser Group (n=105)	Conventional Group (n=105)	p-value
Operative time (minutes), Mean ± SD	14.8 ± 4.6	22.7 ± 6.1	<0.001
Blood loss (mL), Mean ± SD	4.2 ± 2.1	18.5 ± 6.4	<0.001

Need for suturing, n (%)	18 (17.1)	86 (81.9)	<0.001
Intraoperative bleeding, n (%)	9 (8.6)	41 (39.0)	<0.001
Procedure-related complications, n (%)	3 (2.9)	8 (7.6)	0.12

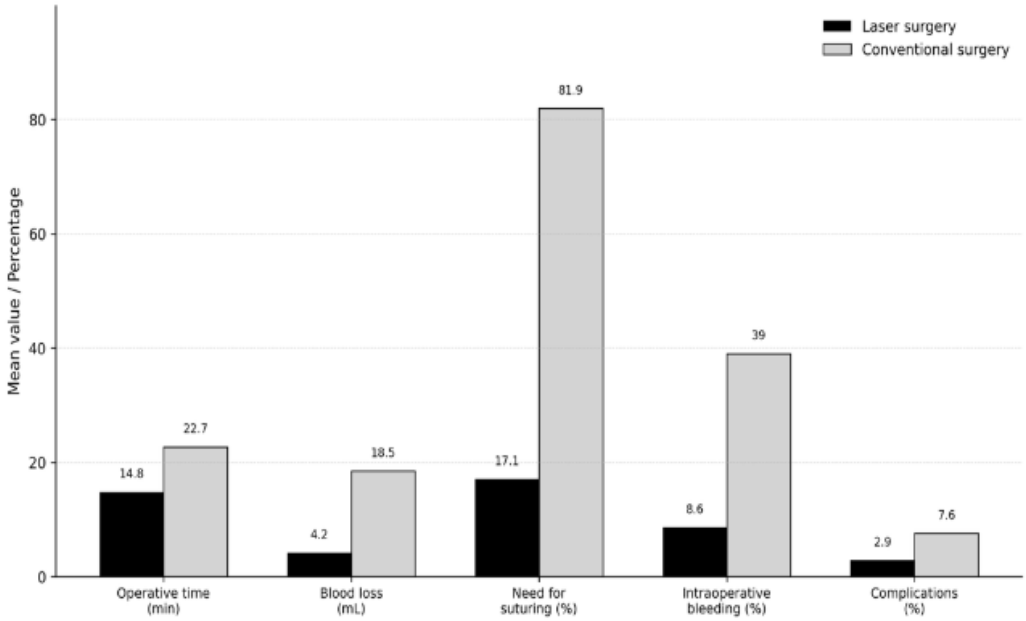

Figure 1. Comparison of Intraoperative Outcomes between Laser-Assisted and Conventional Surgery for Oral Soft Tissue Lesions

Day-1 pain score was lower after laser treatment (2.8 ± 1.2 vs. 5.4 ± 1.7; p<0.001), and edema was less frequent (12, 11.4% vs. 34, 32.4%; p<0.001). Healing time was shorter in the laser group (9.6 ± 2.8 vs. 14.2 ± 3.7 days; p<0.001), while patient satisfaction was higher (8.9 ± 1.1 vs. 6.8 ± 1.6; p<0.001).

Table 4: Postoperative Outcomes and Patient Satisfaction

Variable	Laser Group (n=105)	Conventional Group (n=105)	p-value
Pain score at Day 1 (VAS), Mean ± SD	2.8 ± 1.2	5.4 ± 1.7	<0.001
Edema present, n (%)	12 (11.4)	34 (32.4)	<0.001
Infection, n (%)	2 (1.9)	7 (6.7)	0.09
Healing time (days), Mean ± SD	9.6 ± 2.8	14.2 ± 3.7	<0.001
Patient satisfaction score, Mean ± SD	8.9 ± 1.1	6.8 ± 1.6	<0.001

Favorable clinical outcome was associated with younger age (37.5 ± 11.8 vs. 44.2 ± 13.6 years; p=0.003), laser treatment (95, 55.2% vs. 10, 26.3%; p=0.001), and smaller lesion size (1.7 ± 0.7 vs. 2.8 ± 0.9 cm; p<0.001). Unfavorable outcomes were linked with higher postoperative infection (6, 15.8% vs. 3, 1.7%; p<0.001), longer healing time (16.3 ± 4.2 vs. 9.8 ± 2.9 days; p<0.001), and lower satisfaction scores.

Table 5: Factors Associated with Favorable Clinical Outcome

Variable	Favorable Outcome (n=172)	Unfavorable Outcome (n=38)	p-value
Age (years), Mean ± SD	37.5 ± 11.8	44.2 ± 13.6	0.003
Laser treatment, n (%)	95 (55.2)	10 (26.3)	0.001

Lesion size (cm), Mean ± SD	1.7 ± 0.7	2.8 ± 0.9	<0.001
Postoperative infection, n (%)	3 (1.7)	6 (15.8)	<0.001
Healing time (days), Mean ± SD	9.8 ± 2.9	16.3 ± 4.2	<0.001
Patient satisfaction score, Mean ± SD	8.5 ± 1.3	5.9 ± 1.7	<0.001

DISCUSSION

The effectiveness of laser dentistry in managing oral soft tissue lesions was compared with scalpel surgery in this randomized clinical trial, which showed great benefits of the laser treatment over the traditional scalpel surgery. The patients that were treated using laser surgery had better outcomes in the surgery and the recovery process, including the following: Less surgery time, Less blood loss, Less pain, Quicker recovery, and Higher satisfaction. The results confirm the importance of laser technology as a useful minimally invasive treatment method in contemporary dentistry. The mean age of participants was 38.7 ± 12.4 years and there was slightly more males than females (56.2%). Fibroma was found in 27.6% of the cases, pyogenic granuloma and mucocele in 22.3% and 14.5%, respectively. This is similar to previous studies that have reported fibromas, mucoceles, and pyogenic granulomas as some of the most common oral soft tissue lesions that need surgical intervention. As seen in this study, the majority of the lesions were seen in the buccal mucosa and the gingiva, which is also in line with other studies that assessed soft tissue lesions in dental outpatient clinics [17]. The two groups were similar in terms of the baseline characteristics, including age, gender distribution, size of the lesions, type of lesions, and location of the lesions. This suggests that these were postoperative differences and not due to patient characteristics at baseline. Similar study groups were also found to be important in previous studies when assessing clinical outcomes related to laser surgery [18]. One of the most important results of the present study is that the laser group had a significantly shorter operating time than the conventional group: 14.8 ± 4.6 minutes vs. 22.7 ± 6.1 minutes, respectively. By utilizing laser-assisted surgery, tissue division and coagulation can both occur simultaneously, minimizing need to pause surgery for hemostasis and suturing. Previous studies have also confirmed that surgery is more efficient and the operating field is easier to see with laser surgery, which leads to a shorter operating time. The blood loss was significantly less for those patients receiving laser therapy (4.2 ± 2.1 mL) than for those receiving conventional surgery (18.5 ± 6.4 mL). Only 8.6% of the laser-treated patients experienced intra-operative bleeding compared to 39% of the conventional surgery patients. These results are representative of the excellent hemostasis properties that laser energy exhibits in incision of tissues. Numerous studies have shown that there is a significant decrease in surgical bleeding and better surgical visibility during laser-assisted oral soft tissue surgery [19].

There was a significant decrease in the laser group, with just 17.1% of patients requiring stitches, as opposed to 81.9% in the conventional group. This decrease may be due to the very sharp cutting that lasers provide and their ability to coagulate tissues at the same time. The same is reported in previous studies where less suturing was needed after laser surgery, which leads to more comfort for the patient and easier postoperative care. Patients in the laser group had significantly less pain after surgery (2.8 ± 1.2) than those in the conventional surgery group (5.4 ± 1.7). This is due to less pain, which may be associated with the sealing of sensory nerve endings and less inflammatory response after laser application. Some previous studies have consistently found that laser surgery for oral soft tissue lesions is associated with fewer postoperative pain scores and fewer required analgesics, and better patient satisfaction [20]. There was also significantly less edema in the laser group (11.4%) than in the conventional group (32.4%). During tissue ablation with the laser, the structure of the lymphatic vessels is sealed, which reduces the appearance of fluid on the body and inflammation after surgery. The same has been proven in previous studies about laser-aided oral surgery, where the rate of swelling and tissue oedema was found to be lower. The laser group had a healing time of 9.6 ± 2.8 days, which was significantly shorter than the conventional surgery group (14.2 ± 3.7 days). Minimal tissue trauma, reduced inflammation, and a sterile surgical field which is sterile may lead to faster healing. Other studies have also demonstrated improved

wound healing and earlier tissue epithelialisation after laser treatment of oral soft tissue lesions. These findings are in accordance with previous studies and further support the potential of laser technology as a safe, efficient, and patient-friendly method for the treatment of oral soft tissue lesions.

LIMITATIONS

This study has several limitations. Although designed as a randomized clinical trial, it was conducted at a single center, which may limit the generalizability of the findings to broader populations. The study focused on benign oral soft tissue lesions, and therefore the results may not be applicable to malignant or more complex oral pathologies. Variations in lesion type, lesion location, and individual healing capacity may have influenced postoperative outcomes despite randomization. The follow-up period was relatively short and may not fully capture long-term recurrence rates or delayed complications. In addition, operator experience with laser equipment may have affected procedural efficiency and outcomes. Future multicenter studies with longer follow-up periods and evaluation of different laser systems are recommended to further validate the clinical benefits of laser dentistry.

CONCLUSION

Laser dentistry demonstrated significant advantages over conventional scalpel surgery in the treatment of oral soft tissue lesions. Laser-assisted procedures were associated with shorter operative time, reduced blood loss, less intraoperative bleeding, decreased postoperative pain and edema, faster wound healing, and higher patient satisfaction. Favorable clinical outcomes were more frequently observed among patients treated with lasers, particularly in those with smaller lesions and uncomplicated postoperative recovery. These findings support the use of laser technology as a safe, effective, and minimally invasive treatment option for managing oral soft tissue lesions and highlight its potential to improve patient-centered outcomes in contemporary dental practice.

REFERENCES

1. Sachelarie L, Cristea R, Burlui E, Hurjui LL. Laser Technology in Dentistry: From Clinical Applications to Future Innovations. Dent J (Basel). 2024 Dec 23;12(12):420. doi: 10.3390/dj12120420. PMID: 39727477; PMCID: PMC11674728.
2. Saran R, Kanneeram K, Unnikrishnan VK, Daniel George S, Ghurye AA, Raghu Chandrashekar H, Perampalli NU, Ginjupalli K. Effect of nanosecond laser assisted surface modification on physical and mechanical properties of denture base materials. Sci Rep. 2025 Mar 29;15(1):10879. doi: 10.1038/s41598-025-94757-w. PMID: 40158027; PMCID: PMC11954924.
3. Bhosale S, Gangurde A, Chauhan M, Jaiswal N, Harimkar RL, Shaikh S. Impact of Laser Surface Modification on Zirconia Implants: A Systematic Review of In Vitro Evidence. Cureus. 2025 Dec 8;17(12):e98697. doi: 10.7759/cureus.98697. PMID: 41510486; PMCID: PMC12777445.
4. Romanos G.E., Nentwig G.H. Diode laser (980 nm) in oral and maxillofacial surgical procedures: Clinical observations based on clinical applications. J. Clin. Laser Med. Surg. 1999;17:193–197. doi: 10.1089/clm.1999.17.193.
5. Goharkhay K., Moritz A., Wilder-Smith P., Schoop U., Kluger W., Jakolitsch S., Sperr W. Effects on oral soft tissue produced by a diode laser in vitro. Lasers Surg. Med. 1999;25:401–406. doi: 10.1002/(SICI)1096-9101(1999)25:5<401::AID-LSM6>3.0.CO;2-U.
6. Hegazy RA, et al. Effect of low-level diode laser on dentin topography and symptomatic noncarious cervical lesions prior to composite restorations: a split-mouth randomized controlled trial. J Evid Based Dent Pract. 2024.
7. Ahmed AA, et al. Clinical and radiographic assessment of diode laser 940 nm assisted direct pulp capping on dentin bridge formation versus the conventional method. Laser Dent Sci. 2024;8:6.
8. Hatipoğlu Ö, et al. Factors affecting the decision-making of direct pulp capping procedures among dental practitioners: a multinational survey from 16 countries with meta-analysis. J Endod. 2023;49(6):675-685.
9. Drouri S, El Merini H, Sy A, Jabri M. Evaluation of direct and indirect pulp capping with Biodentine in vital permanent teeth with deep caries lesions. Cureus. 2023;15(5):e39374.
10. Karkehabadi H, et al. Effect of low-level laser therapy on differentiation and proliferation of human dental pulp stem

cells: a systematic review. J Lasers Med Sci. 2023;14:e47.

11. Walsh L.J. The current status of laser applications in dentistry. Aust. Dent. J. 2003;48:146–155. doi: 10.1111/j.1834-7819.2003.tb00025.x.
12. Abu-Ta'a M., Karameh R. Laser and its application in periodontology: A review of literature. Open J. Stomatol. 2022;12:305–320. doi: 10.4236/ojst.2022.1210027
13. Tzanakakis E.G.C., Skoulas E., Pepelassi E., Koidis P., Tzoutzas I.G. The use of lasers in dental materials: A review. Materials. 2021;14:3370. doi: 10.3390/ma14123370.
14. Lazăr A.-P., Dinulescu T., Dako T., Mârţu M.-A., Suciu M., Lazăr L. Laser in periodontology: A review of the fields of applicability and therapeutic effects. Rom. J. Oral Rehabil. 2022;14:108.
15. Ting M., Alluri L.S.C., Sulewski J.G., Suzuki J.B., da Silva A.P.B. Laser treatment of peri-implantitis: A systematic review of radiographic outcomes. Dent. J. 2022;10:20. doi: 10.3390/dj10020020.
16. Shukla P., Dahiya A., Sharma N. Future directions for lasers in general dental practice: Cost reduction and accessibility. J. Dent. Pract. 2024;12:201–216
17. Panova N.K., Nikolova K.T., Dikova T.D. Application of lasers and laser processing technologies in modern dentistry: A review. J. Chem. Technol. Metall. 2023;58:1116–1127. doi: 10.59957/jctm.v58i6.151.
18. Alghamdi M.A.M., Halawani M., Alarawi H.A., Alzaidi A.M., Alhogail L.H., Alsobhi S.W.O., Alamrai A.H.M., Alrashedi J.A.M., AlRashidi A.N.B., Al-Ghamdi T.A.A. The Use of Laser Technology in Dentistry: A Comprehensive Review. Migr. Lett. 2022;19:577–586.
19. Everett J.D., Rossmann J.A., Kerns D.G., Al-Hashimi I. Laser-Assisted Non-Surgical Periodontal Therapy: A Double-Blind, Randomized Clinical Trial. Open Dent. J. 2017;11:79–90. doi: 10.2174/1874210601711010079
20. Slot D.E., Jorritsma K.H., Cobb C.M., van der Weijden G.A. The Effect of a Laser-Assisted Periodontal Therapy (LANAP) on Periodontal Parameters: A Systematic Review and Meta-Analysis. J. Clin. Periodontol. 2022;49:907–920.