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ORIGINAL ARTICLE

Evaluation of laser-activated irrigation on evidence-based endodontology: a bibliometric and scientometric analysis of recent articles

ABSTRACT

Aim: *To identify the research articles on laser use in endodontic irrigation in the last 5 years and conduct a bibliographic analysis.*
Materials & Methods: *A literature search was conducted through an online database, Web of Science, by using the Clarivate search engine. The search strategy was as follows in all fields including the database: the main keyword was "Endodontics" and the secondary were "Laser" and "irrigation". The time frame was limited to the last 5 years until May 2022. The search was restricted to mainly focusing on endodontics concerning laser-activated irrigation, therefore all papers were manually screened for inclusion. Title, first author, institute/country, number of authors, journal name, impact factor, year, citation, keywords, and abstracts were recorded. VOSviewer version 1.6.10 software was used to map the bibliometric network.*
Results: *A total of 30 articles published by indexed journals (Web of Science Index) between 2017-2022 years were included in the study. 17 countries contributed to the research and publications in the field, with/without collaborations. The most prolific country in the field is Türkiye with the highest contribution rates (33,3%). The highest number of publications was published by 'Photomedicine and Laser Surgery' with 6 articles.*
Conclusions: *The bibliometric analysis overviewed the current trends, leading journals, and countries in terms of the research focused on laser use in endodontic irrigation. The most-cited research articles related to laser use in endodontic irrigation have covered topics such as bactericidal effect, smear layer removal, pushout bond strength, growth factor release, and apical extrusion of irrigant.*

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KEYWORDS *bibliometric analysis, citations, endodontics, irrigation, laser*

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Introduction

Root canal treatment includes various steps such as preparation with various types of instruments, disinfection using chemical solutions, and filling the root canal space hermetically. Although it is possible to remove pulpal residues and microorganisms from the root canals by chemo-mechanical debridement (1-3), complete shaping and cleaning of the root canals are impossible due to the complex anatomy (4, 5). Areas that cannot be reached via instrumentation, such as the lateral canal and isthmus, may harbor tissue debris, microorganisms, and their by-products, preventing full adaptation of the obturation material and may cause persistent periradicular infections (6, 7). Therefore, it is crucial to ensure direct contact with the solution with the whole canal structure during irrigation, especially at the apical part of the root canals (8, 9).

Studies on new systems or techniques to ensure effective intracanal disinfection are still ongoing due to the inadequacy of using irrigation solutions without additional activation. Cavity preparation, pulp capping, canal disinfection, and activation of irrigation solutions are among the use of lasers in endodontics (10). Laser activation of irrigation solutions was found to be statistically significantly more effective in removing the smear layer compared to conventional techniques (11).

Bibliometrics uses quantitative measures to assess academic productivity. Citation analysis is a common method in the bibliography of the science and evaluates the impact of research papers by observing the number of citation data received by other scholarly works (12-14). Citation analysis highlights the trendy areas of research and hints at prospective areas of interest (15). This method has been applied to various aspects of endodontics and identified the contributing institutions, authors, and journals in relevant and novel fields including micro-CT use in endodontics and regenerative endodontics (16, 17). However, no bibliometric analysis of papers focusing on laser use in endodontic irrigation has been published. Therefore, this study aimed to analyze the papers focused on laser use in endodontic irrigation in the last 5 years.

Materials and Methods

A comprehensive systematic literature search was conducted to identify the related research in the field through an online database, Thomson Reuters Web of Science, by using the Clarivate search engine. The search strategy was as follows in all fields including the database: the main keyword was “Endodontics” and the secondary were “Laser” and “irrigation”. Keywords selection was conducted with the purpose of search optimization to locate every related publication. To reach current studies, the time frame was limited to the last 5 years until May 2022. The search was restricted to mainly focusing on endodontics concerning laser-activated irrigation, therefore all papers were manually screened for inclusion. Proceeding papers, editorial materials or letters, corrections, notes, and early access papers were excluded from the study. Each article was further reviewed, and basic information was collected, including the study design. The data with the full record and cited references were exported using the ‘tab-delimited file’ tool. Title, first author, institute/country, number of authors, journal name, impact factor, year, citation, keywords, and abstracts were recorded. VOSviewer version 1.6.10 software (Centre for Science and Technology Studies, Leiden University, Netherlands) was used to map the bibliometric network of the exported data that has an automatic term identification algorithm (downloadable at www.vosviewer.com).

Questions to be answered in line with the purpose of this study

1. What is the distribution of articles by year?
3. What is the distribution of the most contributing countries?
3. Which are the journals with the highest number of published articles in the field?
4. Who are the most cited authors and

which are the most cited publications?
5. Which type of laser is most commonly used for laser activation of irrigants in endodontics?

Results

A total of 30 articles published by indexed journals (Web of Science Index, SCI-E) between 2017-2022 years were included in the study. The distribution of publications by year was presented in Figure 1. Analysis of the country of origin using VOSviewer showed that 17 countries contributed to the research and publications in the field, with/without collaborations. The country contributions and the bibliographic coupling were presented in Figure 2. The highest contribution is from Türkiye with 9 articles. Figure 3 presented the paper count distribution published in the field and total citations. The highest number of publications is in the category of 'Engineering' and 'Medicine' with 6 articles published by 'Photomedicine and Laser Surgery', following 'The Journal of Endodontics' with 4 articles (Figure 3). A total of 150 authors were involved in publishing articles related to laser-activated irrigation and the most cited author is Chiniforush with a total of 77 citations by 3 documents, followed by Afkhami and Akbari with 49 citations in the field of subject.
Research focuses on included papers according to the keywords presented in Figure 4. The articles with research information and conclusions were presented in Table 1. According to the scientometric evaluation, the most focused laser type was Er: YAG, followed by diode-laser. The distribution of laser-type metrics was presented in Figure 5.

Table 1
List of the publications about laser use in endodontic irrigation (2017-2022)

Authors	Research Article	Journal	Institution (Corresponding author)	Times Cited, WoS Core	Times Cited, All Databases	Year	Laser	Conclusion
Afkhami, F; Akbari, S; Chiniforush, N	Enterococcus faecalis Elimination in Root Canals Using Silver Nanoparticles, Photodynamic Therapy, Diode Laser, or Laser-activated Nanoparticles: An In Vitro Study	Journal of endodontics	Tehran University of Medical Sciences	49	52	2017	Diode laser	PDT with indocyanine green photosensitizer, an 810-nm diode laser, and AgNPs have the potential to be used as an adjunct for disinfection of the root canal system.
Ghorbanzadeh, R; Assadian, H; Chiniforush, N; Parker, S; Pourakbari, B; Ehsani, B; Alikhani, MY; Bahador, A	Modulation of virulence in Enterococcus faecalis cells surviving antimicrobial photodynamic inactivation with reduced graphene oxide-curcumin: An ex vivo biofilm model	Photodiagnosis and photodynamic therapy	Tehran University of Medical Sciences	21	22	2020	Light-emitting diode	Reduced Graphene oxide-Curcumin-Photodynamic inactivation inhibited the biofilm formation ability and virulence activity of E. faecalis
Lukac, N; Jezersek, M	Amplification of pressure waves in laser-assisted endodontics with synchronized delivery of Er: YAG laser pulses	Lasers in medical science	University of Ljubljana	19	19	2018	Er: YAG	Amplification of cavitation bubbles was more apparent in canals with a smaller diameter.

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Kirmali, O; Ustun, O; Kapdan, A; Kustarci, A	Evaluation of Various Pretreatments to Fiber Post on the Push-out Bond Strength of Root Canal Dentin	Journal of endodontics	Akdeniz University	18	20	2017	Nd: YAG	Nd: YAG laser-assisted irrigation with EDTA improved smear layer and debris removal.
Gokturk, H; Ozkocak, I; Buyukgebiz, F; Demir, O	Effectiveness of various irrigation protocols for the removal of calcium hydroxide from artificial standardized grooves	Journal of applied oral science	Gaziosmanpasa University	17	18	2017	Er: YAG	Laser-activated irrigation and Passive ultrasonic irrigation methods removed more calcium hydroxide than XP-endo Finisher, CanalBrush, Vibringe, and conventional syringe irrigation.
Golob, BS; Olivi, G; Vrabec, M; El Feghali, R; Parker, S; Benedicenti, S	Efficacy of Photon-induced Photoacoustic Streaming in the Reduction of Enterococcus faecalis within the Root Canal: Different Settings and Different Sodium Hypochlorite Concentrations	Journal of endodontics	University of Genoa	14	17	2017	Er: YAG	Er: YAG laser-activated irrigation with 5% NaOCl using PIPS technique led to effective removal of the bacterial biofilm and removal of the smear layer.
Passalidou, S; Calberson, F; De Bruyne, M; De Moor, R; Meire, MA	Debris Removal from the Mesial Root Canal System of Mandibular Molars with Laser-activated Irrigation	Journal of endodontics	University of Ghent	11	12	2018	Er: YAG	Er: YAG laser-assisted irrigation removed significantly more debris in the canals and the isthmus compared to needle irrigation.
Beltes, C; Economides, N; Sakkas, H; Papadopoulou, C; Lambrianidis, T	Evaluation of Antimicrobial Photodynamic Therapy Using Indocyanine Green and Near-Infrared Diode Laser Against Enterococcus faecalis in Infected Human Root Canals	Photomedicine and laser surgery	Aristotle University of Thessaloniki	11	14	2017	Diode laser	Photodynamic therapy with indocyanine green activated by a diode laser emitting NIR light (810 nm) is bactericidal to E. faecalis but is inferior to 2.5% NaOCl.
Cheng, XG; Tian, TT; Tian, Y; Xiang, DD; Qiu, J; Liu, XH; Yu, Q	Erbium: Yttrium Aluminum Garnet Laser-Activated Sodium Hypochlorite Irrigation: A Promising Procedure for Minimally Invasive Endodontics	Photomedicine and laser surgery	Air Force Military Medical University	9	12	2017	Er: YAG	Er: YAG activation of NaOCl with PIPS tip showed a similar disinfection effect to NaOCl alone at smaller apical terminal working widths.
Eymirli, A; Nagas, E; Uyanik, MO; Cehreli, ZC	Effect of Laser-Activated Irrigation with Ethylene Diaminetetraacetic Acid and Phytic Acid on the Removal of Calcium Hydroxide and Triple Antibiotic Paste from Root Dentin	Photomedicine and laser surgery	Hacettepe University	9	9	2017	Er, Cr: YSGG	Er, Cr: YSGG activation of EDTA and phytic acid completely removed triple antibiotic paste and effectively removed calcium hydroxide on root dentin

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Korkut, E; Torlak, E; Gezgin, O; Ozer, H; Sener, Y	Antibacterial and Smear Layer Removal Efficacy of Er: YAG Laser Irradiation by Photon-Induced Photoacoustic Streaming in Primary Molar Root Canals: A Preliminary Study	Photomedicine and laser surgery	Necmettin Erbakan University	8	10	2018	Nd: YAG Diode laser Er: YAG laser	Irrigant activation by Nd: YAG, diode laser, and Er: YAG laser with PIPS resulted in a significantly higher reduction in the number of E. faecalis compared to the NaOCl group.
Pourhajibagher, M; Chiniforush, N; Bahador, A	Antimicrobial action of photoactivated C-phycocyanin against Enterococcus faecalis biofilms: Attenuation of a quorum-sensing system	Photodiagnosis and photodynamic therapy	Tehran University of Medical Sciences	7	7	2019	Diode laser	C-phycocyanin is an effective photosensitizer against biofilm of E. faecalis inside the root canal system
Nagas, E; Kucukkaya, S; Eymirli, A; Uyanik, MO; Cehreli, ZC	Effect of Laser-Activated Irrigation on the Push-Out Bond Strength of ProRoot Mineral Trioxide Aggregate and Biodentine in Furcal Perforations	Photomedicine and laser surgery	Hacettepe University	7	8	2017	Er, Cr: YSGG	Er, Cr: YSGG laser activation of irrigation has no detrimental effect on the push-out dentin bond strength of Biodentine and ProRoot MTA used in furcal perforation repair.
Ozbay, Y; Erdemir, A	Effect of several laser systems on the removal of smear layer with a variety of irrigation solutions	Microscopy research and technique	Kirikkale University	6	7	2018	Er, Cr: YSGG Nd: YAG Er: YAG	Er, Cr: YSGG, Nd: YAG, and Er: YAG laser with PIPS tip have almost similar efficiency in smear layer removal when used for activation of NaOCl and EDTA.
Turkel, E; Onay, EO; Ungor, M	Comparison of Three Final Irrigation Activation Techniques: Effects on Canal Cleanness, Smear Layer Removal, and Dentinal Tubule Penetration of Two Root Canal Sealers	Photomedicine and laser surgery	Baskent University	6	8	2017	Er: YAG	EndoVac system, laser activation with PIPS, and conventional syringe irrigation are similarly effective in debridement efficacy, smear layer removal, and dentinal tubule penetration.
Vidas, J; Snjaric, D; Braut, A; Carija, Z; Bukmir, RP; De Moor, RJG; Prso, IB	Comparison of apical irrigant solution extrusion among conventional and laser-activated endodontic irrigation	Lasers in medical science	University of Rijeka	5	7	2020	Er: YAG	Er: YAG laser-activated irrigation with PIPS fiber tip resulted in reduced endodontic irrigant extrusion compared with needle-syringe irrigation.
Betancourt, P; Merlos, A; Sierra, JM; Arnabat-Dominguez, J; Vinas, M	Er, Cr: YSGG Laser-Activated Irrigation and Passive Ultrasonic Irrigation: Comparison of Two Strategies for Root Canal Disinfection	Photo-biomodulation photomedicine and laser surgery	University of Barcelona	4	5	2020	Er, Cr: YSGG	Laser-assisted irrigation with Er, Cr: YSGG is more effective at improving the antimicrobial activity of 0.5% NaOCl than passive ultrasonic irrigation against intracanal biofilm.
Afhkami, F; Ahmadi, P; Chiniforush, N; Sooratgar, A	Effect of different activations of silver nanoparticle irrigants on the elimination of Enterococcus faecalis	Clinical oral investigations	Tehran University of Medical Sciences	3	3	2021	Er: YAG Diode laser	Activation with passive ultrasonic irrigation and Er: YAG laser activation with PIPS enhanced the efficacy of AgNP in the elimination of E. faecalis.

Table 1

List of the publications about laser use in endodontic irrigation (2017-2022)

Authors	Research Article	Journal	Institution (Corresponding author)	Times Cited, WoS Core	Times Cited, All Databases	Year	Laser	Conclusion
Mancini, M; Cerroni, L; Palopoli, P; Olivi, G; Olivi, M; Buoni, C; Cianconi, L	FESEM evaluation of smear layer removal from conservatively shaped canals: laser-activated irrigation (PIPS and SWEEPS) compared to sonic and passive ultrasonic activation-an ex vivo study	Bmc oral health	University of Rome Tor Vergata	3	3	2021	Er: YAG	Er: YAG laser-assisted activation with PIPS and SWEEPS techniques are superior to sonic activation in smear layer removal.
Su, Z; Li, ZB; Shen, Y; Bai, YH; Zheng, Y; Pan, C; Hou, BX	Characteristics of the Irrigant Flow in a Simulated Lateral Canal Under Two Typical Laser-Activated Irrigation Regimens	Lasers in surgery and medicine	Beihang University	2	2	2021	Er: YAG	Laser activation with PIPS, and SWEEPS techniques are better than ultrasonic-activated irrigation at delivering the irrigation solution into lateral canals.
Ayranci, F; Ayranci, LB; Ozdogan, A; Ozkan, S; Peker, MO; Aras, MH	Resistance to vertical root fracture of apicoected teeth using different devices during two root canal irrigation procedures	Lasers in medical science	Ordu University	2	2	2018	Er: YAG Diode laser	Diode laser activation of EDTA reduced the fracture resistance of the teeth.
Wen, C; Kong, YY; Zhao, J; Li, Y; Shen, Y; Yang, XC; Jiang, QZ	Effectiveness of photon-initiated photoacoustic streaming in root canal models with different diameters or tapers	Bmc oral health	Guangzhou Medical University	1	1	2021	Er: YAG	Er: YAG laser activation of 2% and 5.25% NaOCl with PIPS has better antibacterial and bacteriostatic effects than conventional needle irrigation.
Hancerliogullari, D; Erdemir, A; Kisa, U	The effect of different irrigation solutions and activation techniques on the expression of growth factors from dentine of extracted premolar teeth	International endodontic journal	Kırıkkale University	1	1	2021	Er: YAG	Er: YAG laser activation of EDTA or Citric acid with PIPS tip resulted in higher growth factor release than conventional syringe irrigation, and passive ultrasonic irrigation.
Wu, LX; Jiang, S; Ge, H; Cai, ZY; Huang, XJ; Zhang, CF	Effect of Optimized Irrigation With Photon-Induced Photoacoustic Streaming on Smear Layer Removal, Dentin Microhardness, Attachment Morphology, and Survival of the Stem Cells of Apical Papilla	Lasers in surgery and medicine	Fujian Medical University	1	1	2021	Er: YAG	Er: YAG laser with PIPS activation of EDTA for 40 seconds was able to remove the smear layer without reducing dentin microhardness and was beneficial for the attachment and survival of stem cells of the apical papilla.
Saricam, E; Kucuk, M; Akyol, M	Evaluation of EDTA, QMix, and Irritrol solutions activated with Er, Cr: YSGG and diode lasers on the push-out bond strength of filling material	Microscopy research and technique	Yıldırım Beyazıt University	1	1	2021	Er,Cr: YSGG Diode laser	Er, Cr: YSGG laser activation of QMix irrigation increased the bond strength of filling material.

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Authors	Research Article	Journal	Institution (Corresponding author)	Times Cited, WoS Core	Times Cited, All Databases	Year	Laser	Conclusion
Magni, E; Jaggi, M; Eggmann, F; Weiger, R; Connert, T	Apical pressures generated by several canal irrigation methods: A laboratory study in a maxillary central incisor with an open apex	International endodontic journal	University of Basel	1	1	2021	Er: YAG	Irrigation with EndoVac, Er: YAG laser activation, ultrasonically activated irrigation, the Self-adjusting file, and the XP-endo Finisher generated safer apical pressure levels than EDDY and RinsEndo in a simulated maxillary central incisor with an open apex.
Henninger, E; Berto, LA; Eick, S; Lussi, A; Neuhaus, KW	In Vitro Effect of Er:YAG Laser on Different Single and Mixed Microorganisms Being Associated with Endodontic Infections	Photo-biomodulation photomedicine and laser surgery	University of Basel	0	0	2019	Er: YAG	Laser activation of NaOCl has better antimicrobial efficiency when used with 600 micrometers conical PIPS tip than 300 micrometers tapered tip.
Wen, C; Yan, L; Kong, YY; Zhao, J; Li, Y; Jiang, QZ	The antibacterial efficacy of photon-initiated photoacoustic streaming in root canals with different diameters or tapers	Bmc oral health	Guangzhou Medical University	0	0	2021	Er: YAG	Er: YAG activation of 2% NaOCl with PIPS tip had a greater bactericidal effect in root canals with a smaller taper and width.
Todea, DCM; Luca, RE; Balabuc, CA; Miron, MI; Locovei, C; Mocuta, DE	Scanning electron microscopy evaluation of the root canal morphology after Er: YAG laser irradiation	Romanian journal of morphology and embryology	Victor Babes University of Medicine & Pharmacy	0	1	2018	Er: YAG	Er: YAG laser activation of 2.5% NaOCl with PIPS tips is effective at smear layer removal.
Onac, A; Florescu, A; Tudose, AD; Manea, S; Pangica, AM; Ionescu, TP; Biclesanu, C	Comparative SEM Study on the Effect of Irrigating the Radicular Dentine with NaOCl and EDTA Through Conventional Techniques and Diode Laser	Revista de chimie	Titu Maiorescu University of Bucharest	0	0	2017	Diode laser	Irrigation with 2% NaOCl and 17% EDTA activated diode laser is superior to conventional irrigation with the same irrigants in smear removal.

Discussion

Our study aimed to evaluate the impact of research regarding laser use in endodontic irrigation as a current concept in endodontics in the last 5 years by citation analysis. It was claimed that bibliometric analysis is supposed to be performed by including articles concerning classic topics and the scientific impact of the studies could be determined after many years of publications. However, it was shown that 73 of the 100 top-cited articles published in endodontic journals were published in the last 10 years, therefore it may be concluded that former studies are not necessarily to be with the highest impact (15, 18). Moreover, the fact that laser use in endodontic irrigation is a relatively novel phenomenon, the authors of this study believe that limiting the study to articles published in the last 5 years is not a drawback but rather a rational approach to include studies with the most cutting-edge equipment and therefore relevant study design.

Web of Science (WoS) is a popular database that has been used as a tool for citation analysis due to its broad database includes publications from way back to 1945 (19). WoS is not the only platform used for ac-

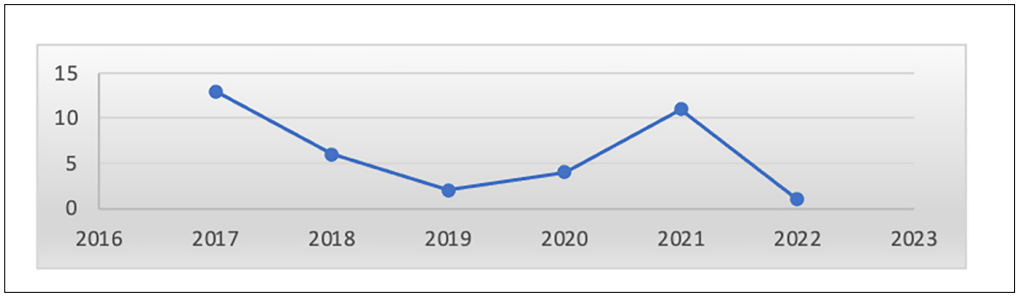

Figure 1
Distribution of publications by year.

ademic search. Google Scholar, includes citations from dissertations, conference reports, preprints, and books (18). Therefore, WoS was used to include and evaluate the articles, and Google Scholar was used to verify the number of citations concerning laser use in endodontic irrigation.

Photobiomodulation, Photomedicine, and Laser Surgery (formerly Photomedicine and Laser Surgery) was the journal in which the highest number of related articles were published. Topic-specific scope of the journal and indexing in Science Citation Index Expanded might be the attracting factors for researchers. Journal of Endodontics, which is considered one of the leading journals in endodontics, was the journal that published articles in the field with the second-highest number.

Based on the number of institutions of the corresponding author, it is observed that almost one-third of the articles were from Türkiye. This result is consistent with some previous studies concerning the fact that Türkiye is amongst the most contributing countries to endodontic literature (20, 21). This might be attributed to the increasing number of researchers interested in endodontics and study groups.

Based on the historical review of laser use, since the development of the ruby laser by Maiman (1960) and the application of the laser in endodontics by Weichman (1971), a variety of documents on potential applications for lasers in endodontology have been published (22). One of these applications is the laser doppler flowmeter used for diagnostic purposes. This laser technique measures the number and velocity

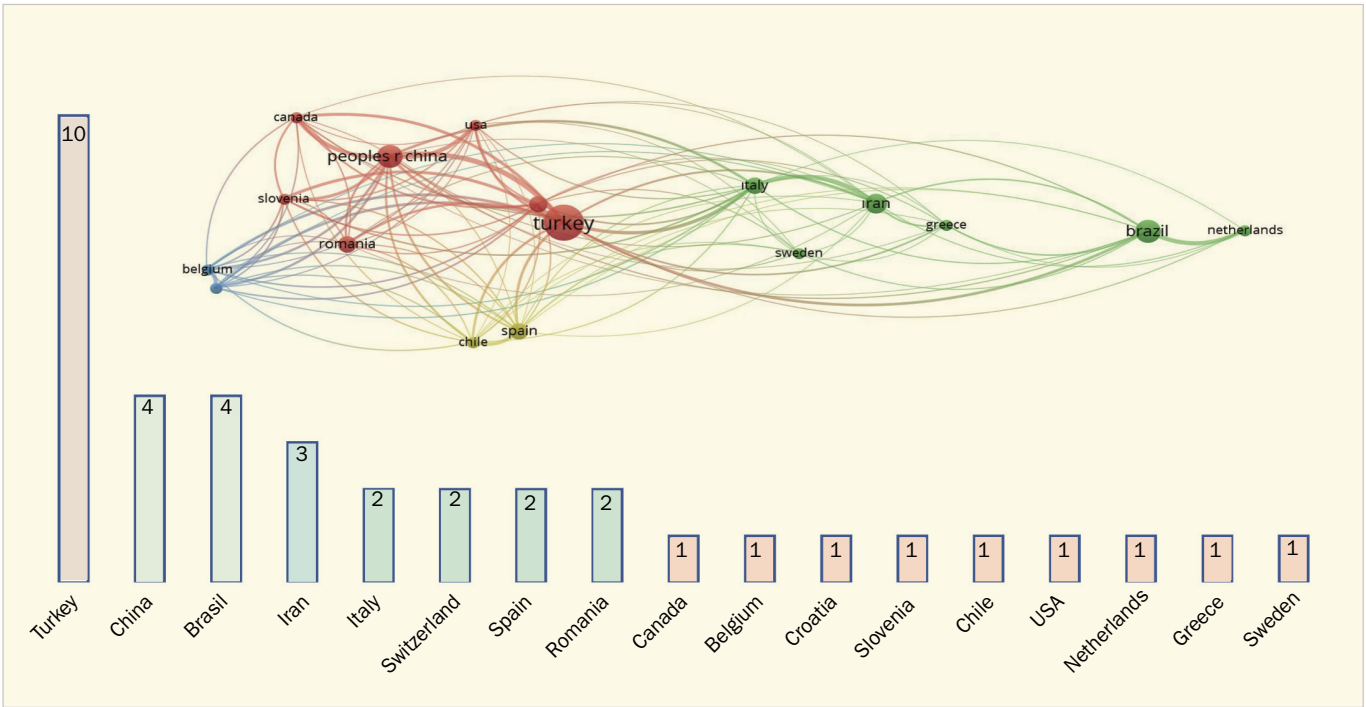

Figure 2
Contribution to the literature based on countries and bibliographic coupling.

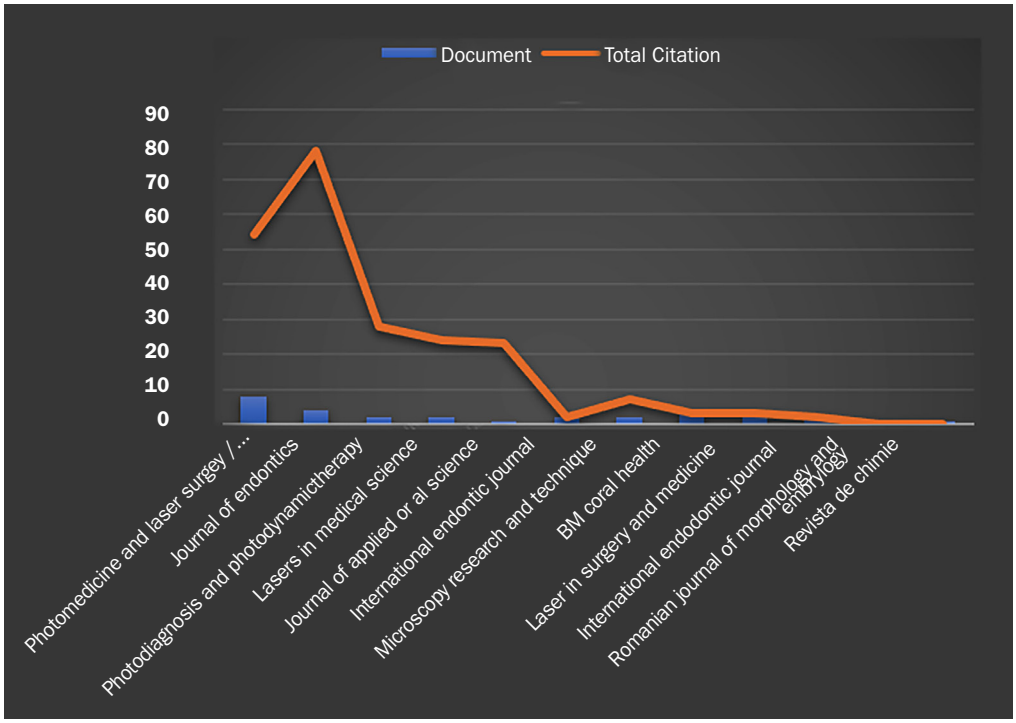

Figure 3
Distribution by the journal which published the maximum count of the article.

of particles transported in the fluid stream with 632.8 nm wavelength helium-neon laser or semiconductor diode laser at wavelengths of 780 and 780-820 nm (22, 23). Melcer et al. (1987), proposed a CO_2 laser to provide hemostasis in exposed canine teeth. Besides, Moritz et al. (1998) reported that the CO2 laser used in the application of direct pulp capping of human teeth gives useful results (24, 25). Since then, the Er: YAG laser has gained increasing popularity among clinicians for direct pulp capping application, and it was shown that dentin bridge formation is detected and

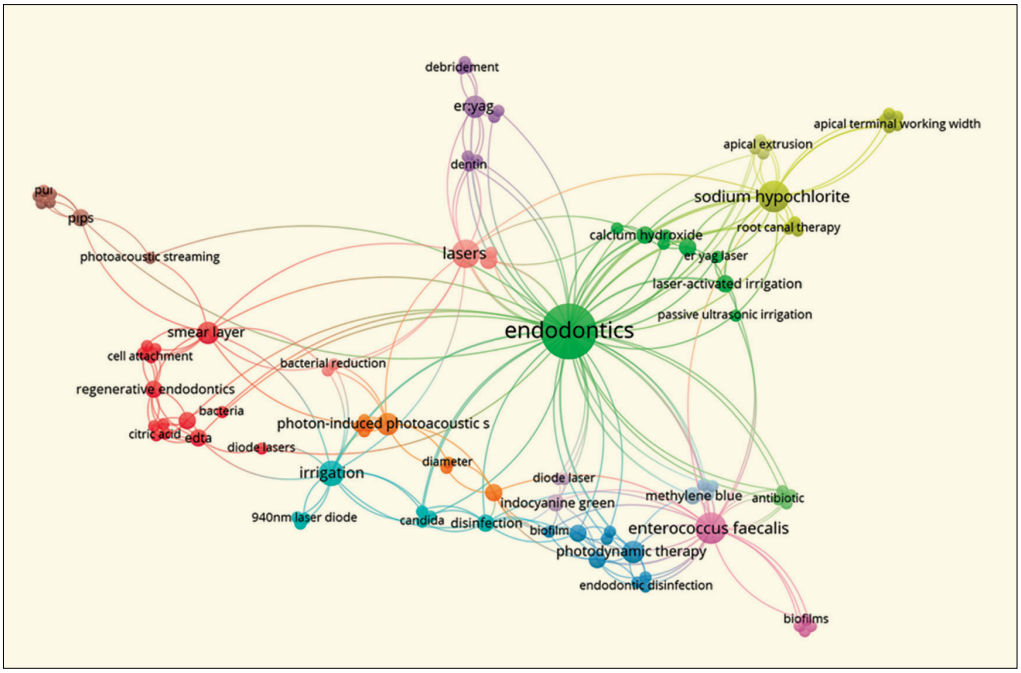

Figure 4
Research focuses according to the keywords.

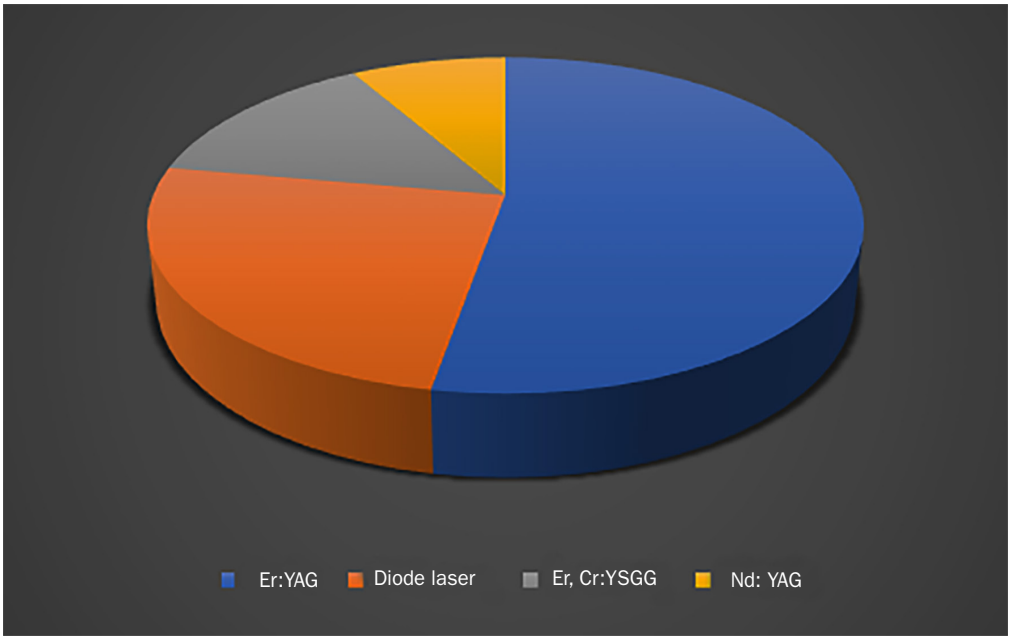

Figure 5
Distribution of laser types used in studies.

doesn't cause any side effects on the pulp (26, 27). In addition, the use of lasers has been introduced to provide a plug in the apical region to prevent leakage. For this reason, various types of lasers were used, especially firstly CO_2 laser in 1971 by Weichman and Johnson (28). In terms of smear layer removal, Er: YAG laser was found to be the most superior among other types of lasers such as Nd: YAG, Argon, and CO_2 (29, 30). CO_2 laser (10.600 nm), Nd: YAG laser (1064 nm), Er: YAG laser (2940 nm), and diode laser (810 nm or 980 nm) Er, Cr: YSGG laser, Ho: YAG laser (2100 nm, 2W,5Hz) have been used for disinfection of root canal system (31-34). However, recent studies have focused on irrigation solution activation, rather than just the use of lasers for disinfection of the root canal system.

66,6% of the articles in the last 5 years included Er: YAG laser in their study design. Er: YAG laser was used in 8 out of 9 total articles published in 2021. Er: YAG laser has a wavelength of 2940 nm, which can be well absorbed in the hydroxyl groups of hydroxyapatites, and water is best absorbed. This provides good interaction with biological tissues, including enamel and dentin, and allows the use of Er: YAG laser in endodontics for different purposes (35). In addition, enabling the use of techniques that can be used for irrigation such as PIPS and SWEEPS may have caused the Er: YAG laser to become widespread in laser studies. It might be speculated that Er: YAG laser use with novel goal-directed techniques is prospective to be the new popular area of interest.

Randomized clinical trials are superior to the other study types in terms of scientific evidence and have a crucial part in evidence-based dentistry. None of the included studies was a randomized clinical trial which indicates the need for further studies for clinical decision-making. The lack of randomized clinical trials might be attributed to the recent introduction of dental lasers to endodontics and the lack of cohort studies and case-controlled studies in the literature (36-38).

The number of articles included in our study might be considered a limitation. The high cost of laser devices, therefore a limited number of research centers and study groups participated in laser research, and the exclusion of case reports and reviews might be the possible reasons. Our study took endodontic laser-activation-related publications into account to highlight the bibliometric characteristics of a highly specific application. Further research might focus on laser application in endodontics in a broader context.

Conclusions

This bibliometric analysis presents an overview of current trends in publications about laser use focused on endodontic irrigation and the determination of prominent journals and countries. The most-cited research articles related to laser use in endodontic irrigation in the last 5 years covered various topics such as bactericidal effect, smear layer removal, pushout bond strength, growth factor release, and apical extrusion of irrigant. 2017 was the year with the highest number of publications, and Türkiye was the highest number of publications on the topic. The highest number of publications were published in Photomedicine and Laser Surgery. Er: YAG laser was the most studied laser in endodontics in the last 5 years.

Clinical Relevance

Laser use in the clinical practice of endodontics has received broad acceptance amongst clinicians. This study provides an overview of current trends in publications about laser use focused on endodontic irrigation and the determination of prominent journals and countries.

Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

Acknowledgments

None.

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