GOCE DELCEV UNIVERSITY, STIP, NORTH MACEDONIA

FACULTY OF ELECTRICAL ENGINEERING

ETIMA 2025

THIRD INTERNATIONAL CONFERENCE

24-25 SEPTEMBER, 2025

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УНИВЕРЗИТЕТ „ГОЦЕ ДЕЛЧЕВ“, ШТИП
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GOCE DELCEV UNIVERSITY, STIP
FACULTY OF ELECTRICAL ENGINEERING

ТРЕТА МЕЃУНАРОДНА КОНФЕРЕНЦИЈА
THIRD INTERNATIONAL CONFERENCE

ЕТИМА / ETIMA 2025

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PREFACE

The Third International Conference “Electrical Engineering, Technology, Informatics, Mechanical Engineering and Automation – Technical Sciences in the Service of the Economy, Education and Industry” (ETIMA’25), organized by the Faculty of Electrical Engineering at the “Goce Delchev” University – Shtip, represents a significant scientific event that enables interdisciplinary exchange of knowledge and experience among researchers, professors, and experts in the field of technical sciences. The conference was held in an online format and brought together 78 authors from five different countries.

The ETIMA conference aims to establish a forum for scientific communication, encouraging multidisciplinary collaboration and promoting technological innovations with direct impact on modern life. Through the presentation of scientific papers, participants shared the results of their research and development activities, contributing to the advancement of knowledge and practice in relevant fields.
The first ETIMA conference was organized four years ago, featuring 40 scientific papers. The second conference took place in 2023 and included over 30 papers. ETIMA’25 continued this scientific tradition, presenting more than 40 papers that reflect the latest achievements in electrical engineering, technology, informatics, mechanical engineering, and automation.

At ETIMA’25, papers were presented that addressed current topics in technical sciences, with particular emphasis on their application in industry, education, and the economy. The conference facilitated fruitful discussions among participants, encouraging new ideas and initiatives for future research and projects.

ETIMA’25 reaffirmed its role as an important platform for scientific exchange and international cooperation. The organizing committee extends sincere gratitude to all participants for their contribution to the successful realization of the conference and its scientific value.

We extend our sincerest gratitude to all colleagues who, through the presentation of their papers, ideas, and active engagement in discussions, contributed to the success and scientific significance of ETIMA’25.

The Organizing Committee of the Conference

ПРЕДГОВОР

Третата меѓународна конференција „Електротехника, Технологија, Информатика, Машинство и Автоматика – технички науки во служба на економијата, образованието и индустријата“ (ЕТИМА’25), организирана од Електротехничкиот факултет при Универзитетот „Гоце Делчев“ – Штип, претставува значаен научен настан кој овозможува интердисциплинарна размена на знаења и искуства меѓу истражувачи, професори и експерти од техничките науки. Конференцијата се одржа во онлајн формат и обедини 78 автори од пет различни земји.

Конференцијата ЕТИМА има за цел да создаде форум за научна комуникација, поттикнувајќи мултидисциплинарна соработка и промовирајќи технолошки иновации со директно влијание врз современото живеење. Преку презентација на научни трудови, учесниците ги споделуваат резултатите од своите истражувања и развојни активности, придонесувајќи кон унапредување на знаењето и практиката во релевантните области.

Првата конференција ЕТИМА беше организирана пред четири години, при што беа презентирани 40 научни трудови. Втората конференција се одржа во 2023 година и вклучи над 30 трудови. ЕТИМА’25 продолжи со истата научна традиција, презентирајќи повеќе од 40 трудови кои ги отсликуваат најновите достигнувања во областа на електротехниката, технологијата, информатиката, машинството и автоматиката.

На ЕТИМА’25 беа презентирани трудови кои обработуваат актуелни теми од техничките науки, со посебен акцент на нивната примена во индустријата, образованието и економијата. Конференцијата овозможи плодна дискусија меѓу учесниците, поттикнувајќи нови идеи и иницијативи за идни истражувања и проекти.

ЕТИМА’25 ја потврди својата улога како значајна платформа за научна размена и интернационална соработка. Организациониот одбор упатува искрена благодарност до сите учесници за нивниот придонес кон успешната реализација на конференцијата и нејзината научна вредност. Конференцијата се одржа онлајн и обедини седумдесет и осум автори од пет различни земји.

Изразуваме голема благодарност до сите колеги кои со презентирање на своите трудови, идеи и активна вклученост во дискусиите придонесоа за успехот на ЕТИМА’25 и нејзината научна вредност.

Организационен одбор на конференцијата

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LASERS AND THEIR APPLICATION IN PEDIATRIC DENTISTRY

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Abstract

Pediatric dentistry's mission in delivering care to our young patients is simple: provide optimal preventive, interceptive, and restorative dental care in a stress-free environment. The goal of pediatric dentistry is to provide preventive education to parents and patients as well as interception and therapy of dental diseases in a minimally invasive way using a stress-free approach. Modern dental medicine seeks to use an approach that is minimally invasive.
The most commonly used lasers in dentistry include holmium yttrium aluminum garnet (HO:YAG), neodymium-doped yttrium aluminum garnet (Nd:YAG), carbon dioxide laser (CO2), erbium-doped yttrium aluminum garnet (Er:YAG), neodymium doped yttrium aluminum perovskite (Nd:YAP), gallium arsenide (GaAs) (diode), erbium, chromium doped yttrium scandium gallium garnet (Er-Cr:YSGG) and argon lasers enable for minimally invasive dentistry for hard- and soft-tissue procedures. This paper offers a revision and a discussion of international literature, showing also some clinical procedures related to these scientific studies. An electronic search was carried out in IranMedex, InterScience, Scopus, Science Direct, PubMed, ProQuest, Medline and Google Scholar databases to find relevant published articles. Laser applications on hard tissues include caries prevention and detection and application for sealing of pits and fissures, application for cavity preparation, carious removal and pulp therapy. Soft tissues laser applications in Pediatric Dentistry include application in oral surgery as well as in periodontics and orthodontics. Lasers allow pediatric dentists to provide optimal care without many of the fear factors that result from conventional dental techniques in addition to photo bio stimulation or therapeutic lasers that produce their healing benefits without producing heat. Because many children may experience laser treatment as their first contact with dentistry, there is a possibility that a new generation of patients will grow up with a different attitude toward dentistry. Parents are enthusiastic about being able to offer their children the advantages of laser care. It is essential to have a good knowledge of laser operation and of which type of laser is most appropriate for each lesion. The choice of optimal energy parameters is a requirement for successful laser caries treatment in pediatric dentistry. The benefit of laser dental treatment has been shown to be the greatest in children.

Key words:

laser, pediatric dentistry, laser in dentistry

Lasers and their application in pediatric dentistry

Laser technology has been recently introduced into the dental field with the idea of replacing drilling. Having a less painful first dental experience using modern instruments like laser can be an efficient preventive and therapeutic strategy in pediatric dentistry [1]. The goal of pediatric dentistry is to provide preventive education to parents and patients as well as

interception and therapy of dental diseases in a minimally invasive way using a stress-free approach [2,3,4]. Pedodontists need to learn the new less invasive technologies and adopt them in their routine practice.

This article offers a revision and a discussion of international literature, showing also some clinical procedures related to these scientific studies. An electronic search was carried out in IranMedex, InterScience, Scopus, Science Direct, PubMed, ProQuest, Medline and Google Scholar databases to find relevant published articles. This article offers an understanding of treatment planning in pediatric practice and demonstrates the procedures that dental lasers can perform on younger patients. This study aimed to review the available types of lasers and their applications in pediatric dentistry. Laser applications on hard tissues include caries prevention and detection and application for sealing of pits and fissures, application for cavity preparation, carious removal and pulp therapy. Soft tissues laser applications in pediatric dentistry include application in oral surgery as well as in periodontics and orthodontics.

In 1960, Maiman developed the method of light amplification by the stimulated emission of radiation, now commonly known by its acronym, LASER. Five years later, Goldman et al. investigated the application of the laser beam on dental hard tissues [5,6]. Clinicians were concerned about possible adverse pulpal responses, but subsequent investigations demonstrated that lasers cause little thermal damage, especially if used in conjunction with water spray. Lasers have demonstrated some analgesic effects which could increase patient acceptance of certain procedures. Advancements in laser technology have led to multiple dental applications such as periodontal soft tissue plastic surgery, gingivectomy, soft tissue crown lengthening, gingival retraction for prosthodontics, composite photopolymerization, frenectomy, tooth whitening, treatment of aphthous, ulcers, endodontic procedures, and caries removal with increased precision, improved hemostasis and sterility, with minimal post operative pain and swelling [7].

The first dental lasers cleared by the FDA were used exclusively for soft tissue procedures and included the carbon dioxide (CO2) laser, Neodymium–Yttrium–Aluminum–Garnet (Nd:YAG) laser, argon laser, and the semiconductor diode laser. The CO2 laser was the first dental laser approved by the FDA and has been successfully used in soft tissue surgeries such as gingivectomies, frenectomies, removal of benign and malignant lesions, and excisional and incisional biopsies. The Nd:YAG laser uses a fiberoptic delivery system that penetrates wet tissue more easily than the CO2 laser [5,6,8]. There has been interest in using the Nd:YAG laser on mineralized tissue to possibly enhance the bond strength of composite to dentin, but the Nd:YAG laser is still not approved for hard tissue applications. The argon laser can be used for soft tissue procedures and is approved for photopolymerization of light-activated materials. Semiconductor diode lasers perform the same soft tissue procedures as the CO2 and Nd:YAG lasers and have also been used to enhance the effects of bleaching discolored teeth. Other approved systems include the Erbium–Chromium–Yttrium–Scallium–Gallium–Garnet (Er, Cr:YSGG) laser and the Erbium doped,Yttrium–Aluminum–Garnet (Er:YAG) laser. These systems can be used for soft tissue procedures but most of the interest in Erbium lasers has been focused on hard tissue applications such as caries removal and endodontic cleaning and shaping of the root canal system.

Many different lasers are useful in pediatric dentistry. There are lasers for diagnosing dental disease such as the Diagnodent (Kavo, Lake Zurich, Illinois). This laser analyzes the emitted fluorescence on the tooth's occlusal surface, which correlates with the degree of demineralization in the tooth, and, when quantified, indicates the relative amount of caries present. Argon lasers are available for curing composite restorations and soft-tissue surgical procedures [9]. The first dental laser for use in cutting human teeth in vivo was cleared by the Food and Drug Administration for marketing in the United States. The authors explored, in

summary form, the data provided to the FDA for the clinical use of the erbium: yttrium-aluminum-garnet, or Er:YAG, laser. The authors concluded that using the Er:YAG laser to treat dental hard tissue is both safe and effective for caries removal, cavity preparation and enamel etching [10, 11]. The Er:YAG laser, originally developed by Zharikov et al. in 1975, was approved by the FDA in 1997 for caries removal, forming cavity preparations, and modifying dentin and enamel prior to etching. The Er:YAG laser has compared favorably with the high-speed rotary dental handpiece in some scanning electron microscopic (SEM) and histological studies. The Er:YAG laser has also been shown to be more comfortable for patients than conventional preparation with a high-speed rotary handpiece. In endodontic studies the Er:YAG laser has demonstrated effective cleansing and antimicrobial properties. Use of the Er:YAG laser has been suggested for nonsurgical periodontal therapy, soft tissue surgery, and possibly subgingival scaling. Tooth preparation using the Er:YAG laser has not demonstrated any significant thermal elevation compared with a rotary dental handpiece. Takamori demonstrated that tooth preparation with the Er:YAG laser may lead to pulpal repair faster than with rotary preparation. The Er:YAG laser produces minimal thermal effect on the tooth during preparation in comparison to other dental lasers. The Er:YAG laser, originally developed by Zharikov et al. in 1975, was approved by the FDA in 1997 for caries removal, forming cavity preparations, and modifying dentin and enamel prior to etching. The Er:YAG laser has compared favorably with the high-speed rotary dental handpiece in some scanning electron microscopic (SEM) and histological studies [12,13]. The Er:YAG laser has also been shown to be more comfortable for patients than conventional preparation with a high-speed rotary handpiece. In endodontic studies the Er:YAG laser has demonstrated effective cleansing and antimicrobial properties. Use of the Er:YAG laser has been suggested for nonsurgical periodontal therapy, soft tissue surgery, and possibly subgingival scaling. Tooth preparation using the Er:YAG laser has not demonstrated any significant thermal elevation compared with a rotary dental handpiece. The Er:YAG laser produces minimal thermal effect on the tooth during preparation in comparison to other dental lasers. Laser caries detection demonstrated good reproducibility, reliability and predictability to monitor the caries process over time. Erbium lasers have been found to be efficient for caries removal, tooth cleaning and decontamination [14,15].

There are many conditions in pediatric dentistry that can be treated with the help of lasers as they are ankyloglossia, Diagnosis and treatment of the maxillary frenum in infants and in the mixed dentition, exposure of teeth for orthodontic care, gingival recontouring and gingivectomies in orthodontic patients, removal of lesions and biopsies, treatment of pericoronal problems in erupting teeth, treatment of aphthous ulcers and herpetic lesions, pulp therapy in primary teeth, hard-tissue interaction, removal of amalgam and other direct restorations, sealant placement, caries removal and tooth preparation, combining soft- and hard-tissue treatments.

Lasers allow pediatric dentists to provide optimal care without many of the fear factors that result from conventional dental techniques in addition to photo bio stimulation or therapeutic lasers that produce their healing benefits without producing heat. Because many children may experience laser treatment as their first contact with dentistry, there is a possibility that a new generation of patients will grow up with a different attitude toward dentistry. Parents are enthusiastic about being able to offer their children the advantages of laser care.

Conclusion

The pediatric dentist's mission is simple: provide optimal preventive, interceptive, and restorative dental care in a stress-free environment. Lasers such as the argon, diode, Nd: YAG, CO2, and erbium have enabled dentists to reduce patient stress and fear during dental treatment. Lasers enable the dentist to provide children with minimally invasive dentistry for hard- and soft-tissue procedures with minimal discomfort, no pain during and after treatment, no injections and etc. The choice of optimal energy parameters is a requirement for successful laser caries treatment in pediatric dentistry. The benefit of laser dental treatment has been shown to be the greatest in children.

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