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Applications of Lasers in Pediatric Dentistry and Their Types

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ABSTRACT
Drilling has recently been replaced with laser technology in the realm of dentistry. Using cutting-edge tools like lasers to create a less painful first dental experience can be a successful preventive and therapeutic approach in paediatric dentistry. The new, less intrusive technology must be learned by pedodontists and incorporated into everyday practise. This study aims to review the various laser types that are now available and their uses in paediatric dentistry. To locate pertinent publications published between 2000 and 2014, an electronic search was conducted in the databases of IranMedex, InterScience, Scopus, Science Direct, PubMed, ProQuest, Medline, and Google Scholar. Additionally, pertinent textbooks were reviewed. Many common diagnostic and therapeutic dental treatments can be effectively replaced using laser technology. It works particularly well for pulp therapy, caries detection and removal, minimising the risk of infection, inflammation, and swelling, and bleeding. On the other hand, youngsters tolerate laser treatment well because it causes less intrusion. Parental, dental, and child satisfaction all increase as a result of better patient compliance.

Keywords: Laser; Pediatric dentistry; Laser in dentistry.

1. INTRODUCTION

In order to more quickly and effectively meet patients' diagnostic and therapeutic needs, laser technology has lately been brought to the area of medicine. [1] The first functional laser was created by Maiman as a result of the stimulated emission theory that Einstein2 proposed in 1916 [3]. The term "laser" refers to light amplification by radiation stimulation [4]. Due to its special qualities, researchers tried to employ it for dental reasons soon after it was invented [5].

As minimally invasive techniques are the foundation of modern dentistry, laser can be a good substitute for drilling because it causes less discomfort, sound, and vibration. A better outcome is obtained by maintaining a dry environment, which improves the clinician's vision of the working space. Additionally, using lasers instead of sharp dental tools draws more patients to dental offices [6]. However, there are several drawbacks to laser therapy as well, including its high cost, limited accessibility, risk if safety precautions are not taken,

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inapplicability un all areas of dentistry, inability to remove metal restorations, and thermal injury to soft tissues [7].

The first soft tissue incisions made using a laser. However, the newest generation of lasers can also be used to remove dental hard tissue due to their unique ability to affect water Molecules. Recent developments in laser applications have made it possible to effectively treat, diagnose, and prevent caries in most dental professions [8].

By utilising cutting-edge, minimally invasive technologies to support the kid in developing healthy oral habits, pedodontists aim to make the child's first dental appointment a positive experience [9]. An effective preventive and therapeutic approach would be to use current technology, such as lasers, to make your child's first dentist visit less uncomfortable. Lasers can be used to treat hard and soft tissues, diagnose oral and dental diseases, and prevent children's oral and dental conditions from rapidly progressing [10]. This study aims to review several types of lasers and their uses in paediatric dentistry in light of the significance of oral and dental health in children's physical health status.

History of Laser

Theodore Maiman3 used a synthetic ruby crystal to create the first laser on May 16, 1960. The initial use of laser technology was for the detection and treatment of skin problems. It was then applied to ophthalmology and endoscopic surgery [11]. Oral soft tissue surgery was the first dental procedure to use a laser [12]. The energy of the laser light was used to cut or ablate the tissue, acting as a scalpel. It works by stimulating a synthetic material inside a light chamber, which produces amplified light. Without making direct touch with the target organ, the energy is released equally and continuously in that direction [6].

The active medium that produces photons is frequently the source of a laser's name. Dental lasers can operate in pulsed, running pulsed, or continuous wave modes and have a range of wavelengths. In dentistry and medical, wavelengths between 193 and 10600 nm are useful. The wavelength of a laser determines the type of laser device and its clinical application [12].

Types of Lasers and Their Applications in Dentistry

Holmium yttrium aluminium garnet (HO:YAG), neodymium-doped yttrium aluminium garnet (Nd:YAG), argon lasers, gallium arsenide (GaAs) (diode), erbium, chromium doped yttrium scandium gallium garnet (Er-Cr:YSGG), and carbon dioxide lasers are the most often utilised lasers in dentistry. For example, soft and hard tissue surgery, root planning (the removal of calculus from the root surfaces), cavity preparation in the enamel and dentin, dental caries detection, cleaning the root canal system, etching, caries prevention by altering the crystalline structure of enamel, tooth whitening, periodontal therapy, and peri-implantitis treatment are clinical uses of lasers in dentistry [8].

Application of Laser in Pediatric Dentistry

In order to avoid oral and dental diseases, it's crucial to encourage kids to visit the dentist. Therefore, pedodontists must grasp the new technologies in addition to dental concepts [13] Children's oral and dental soft and hard tissue disorders can now be diagnosed and treated more effectively thanks to laser technology. Because laser therapy is so minimally invasive, parents and kids both accept it [7].

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Hard Tissue Applications of Laser

Caries Detection: Accurate caries identification enables physicians to rebuild the tooth more quickly and affordably. Studies have shown that laser fluorescence (LF) can improve the clinical identification of caries in terms of speed and accuracy.

Caries Prevention: Caries prevention depends in large part on the tooth surface's resistance to cariogenic substance penetration. The resistance of a recently erupted permanent tooth in children and adolescents to acid erosion can be improved with the use of erbium and CO2 lasers. Studies have shown that the use of CO2 lasers with wavelengths of 9600, 9300, and 10600 nm, erbium lasers with wavelengths of 2780 and 2940 nm, and argon lasers can provide enamel surfaces with resistance to caries.

Restoration, Pit and Fissure Sealants: Prior to applying pit and fissure sealants, the tooth surface can also be prepared with a laser. Pits and fissures can also be treated with laser for conditioning, cleansing, and disinfecting. For instance, the erbium laser can be used for fissurotomy and the removal of cavities after confirming the presence of caries in pits and fissures based on the obtained LF values (between 11-20 and 21-30). Sound tooth is indicated by LF values between 0 and 10; in this circumstance, only macro-roughening is accomplished by erbium laser at lower wavelengths [14].

Endodontics: As an alternative to formocresol, which is used for pulpotomy of primary teeth and has mutagenic and carcinogenic qualities, laser technology can be employed for pulpotomy, pulpectomy, and pulp coagulation. Researchers have shown that pulpal inflammation decreased following laser therapy and had a reverse association with the amount of energy received, and that CO2 laser pulpotomy of primary teeth produced improved clinical results compared to formocresol.

Soft Tissue Applications of Laser

Children with periodontal disease can now receive safe laser treatment without running the risk of adverse reaction or bacterial resistance [11]. Gingivectomy, gingivoplasty, and operculectomy are all possible with lasers of all wavelengths without the requirement for local anaesthesia or bleeding. Other uses for lasers include enhancing tooth eruption, removing abnormal gingival lesions brought on by incorrect tooth movements, treating drug-induced gingival hyperplasia, resecting fibromas, aphthous lesions, herpes labialis, mucocele, and pyogenic granulomas, as well as performing aesthetic procedures [14].

Traumatology and Vitality Testing: Trauma to the teeth may compromise pulp vitality and have unfavourable short- and long-term effects. The pulp blood flow (PBF) is indicated by laser doppler flowmetry (LDF), which can be used to evaluate the vitality of the pulp. Children accept this technique well as it is accurate, non-invasive, repeatable, reliable, and painless. LDF seems to be beneficial for monitoring revascularization and mobile teeth.

Preservation of Pulp Vitality: Pulp viability can be preserved by laser irradiation. For this, a variety of wavelengths with 0.5–1 W power, non–concentrated beams, low frequencies, and pulse modes for durations less than 10 seconds (to avoid coagulation) and at intervals of 30 seconds (to avoid overheating the pulp) can be useful. [15]

Disinfection and Decontamination: Laser technology also has positive antibacterial properties. A diode laser application using the photo-activated bacterial disinfection (PAD) approach during root canal therapy and caries removal was shown to eliminate 99% of the bacteria in collagen matrix in an in vitro investigation [16]. However, because of the intricate anatomy of the apex, cleaning and disinfecting the major root canal system calls for the highest level of accuracy. The laser's infrared-like depth of penetration is something that needs special consideration [17].

Analgesic Effects, Alleviation of Pain and Discomfort: Patients who receive laser treatment have higher pain thresholds and require less local anaesthesia. 8,45 According to studies, anaesthesia can be produced by employing a non-concentrated laser in the near infrared range (803–880 nm). By hyperpolarizing the membrane of the nerve fibres, this effect can be produced on the pulp and last for 15 minutes. Using a 660 nm probe, this method successfully prepared class II cavities on primary molar teeth with a success rate of 50% to 75% [11].

Exposure of Unerupted Teeth for Orthodontic Purposes: Lasers such the Er,Cr:YSGG, Er,YAG, diode, and Nd:YAG are used to remove soft tissue and expose teeth that haven't fully erupted for orthodontic purposes [18]. Both soft and hard tissue can be effectively ablated with erbium laser technology. Enamel damage at the surgery site is always a possibility, though. Diode or Nd:YAG lasers, on the other hand, can be utilised without any harm thanks to their particular wavelengths [19].

2. CONCLUSION

Given everything said above, laser can be a good replacement for many common procedures in paediatric dentistry. Applications of laser in paediatric dentistry include the detection and treatment of caries, pulp therapy, lowering the risk of infection, edoema, and inflammation, minimising bleeding, increasing the repair of soft tissues, pain relief, and lowering gag reflex. Due to the low invasiveness of laser dentistry, kids are frequently more agreeable. Children and their parents are more satisfied, and the level of service is improved as a result. Further research is needed on the effectiveness of laser application for dental operations, particularly in paediatric dentistry, due to the complexity of this topic.

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