

DIODE LASER APPLICATIONS IN PAEDIATRIC DENTISTRY

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Abstract

Paediatric laser dentistry is a promising field in modern minimally invasive dentistry, and it can be “child friendly” approach. The current and the future situation of laser treatment in Paediatric dentistry is evaluated with a promising view towards an improvement in our treatments and obtaining standardized protocols. Diode laser has one of the most versatile ranges of wavelengths available due to the number of different therapies that can be performed in several tissues. This review article presents the current knowledge of laser therapy in Paediatric dentistry.

Key words: – Laser Dentistry, Modern Dentistry, Paediatric Dentistry.

Introduction

Medicine began integrating lasers in the mid 1970's for soft tissue procedures.¹ Oral and maxillofacial surgeons incorporated the carbon dioxide (CO₂) laser into practice for removal of oral lesions in the 1980s. The first laser specifically for dental use was a neodymium yttrium-aluminium-garnet (Nd:YAG) laser, developed in 1987 and approved by the Food and Drug Administration in 1990.² The term laser is an acronym for light amplification by stimulated emission of radiation. Within a laser, an active medium is stimulated to produce photons of energy that are delivered in a beam with an exact wavelength unique to that medium. Lasers typically are classified by the active medium that is used to create the energy.³ The energy radiated by the laser is basically a light of one colour (monochromatic) and thus a single wavelength. Paediatric 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.⁴

Discussion

The Diode laser was introduced in the mid-90s.¹ The diode laser contains a solid active medium and is composed of semiconductor crystals of aluminium or iridium, gallium, and arsenic.⁵ Wavelengths of diode laser ranging from 810 nm to 1064 nm, as its wavelength is poorly absorbed by hard dental tissue, diode laser is safe and well indicated for soft oral tissue surgeries in regions near the dental structures for cutting, vaporization, curettage, blood coagulation and haemostasis in the oral region. The chromophore of diode lasers is pigmented (or coloured) tissues, specifically melanin, haemoglobin and oxyhemoglobin.⁶ The diode is efficient for treating the patients soft tissues because the gingival tissues have a concentration of these chromophores; as a result, a diode photon has a high affinity for gingival tissues. Its use in contact mode provides tactile feedback during surgical procedure. The main advantages of the laser therapy over scalpel surgical procedures on oral tissues are greater precision, bloodless surgical procedures, sterilization of the surgical area, minimal swelling and scarring, no suturing, and less or no postsurgical pain.⁷

The various clinical procedures in which diode laser is used in Paediatric dentistry are as follows:

1. **Caries Detection and Diagnosis:** Hibst and Paulus discovered that bacterial metabolites within caries produce fluorescence that can be enhanced by a laser light.⁸ Based on this, DIAGNOdent (Kavo, Biberach, Germany, a portable laser diode based device was developed. DIAGNOdent's accuracy has been studied both in vitro and in vivo for occlusal caries in primary and permanent teeth.⁹
2. **Pulpotomy:** Laser use in pulpotomies was first reported by Shoji in 1985, who used CO₂ laser. The main advantages of laser-assisted pulpotomies were: less chair side time and painless procedure thus increasing paediatric patient's co-operation. The Diode laser is the most frequently used due to its reliability, versatility and convenience, together with its handiness and simple set-up. Laser sterilization reinforces the overall sterilizing procedure, and laser coagulation produces a thin necrotic layer over the vital remaining pulp. The vital pulp responds in some cases with the formation of a dentin bridge¹⁰.
3. **Apexogenesis:** The management of pulpally exposed immature teeth often proves to be challenging to the clinician. In young patients with immature teeth, it is desirable to maintain pulp vitality so as to ensure continued root development.¹¹ This can be achieved by either pulp capping or pulpotomy depending upon the size of exposure. A diode laser (940 nm, Ezlase, Biolase Technology Inc. USA) in a young permanent tooth with traumatically exposed pulp has proved to be an effective technique for Pulpotomy in an immature tooth. Therefore, the use of soft-tissue diode lasers can influence the treatment outcome and should be seen as a predictable tool for vital pulp therapy.¹²
4. **Frenectomy:** A frenectomy carried out with diode laser at a wavelength of 800 nm and power of 2 W in non-contact mode proved that the laser can be considered as a simple and safe alternative for children while reducing the amount of local anaesthetics, the bleeding and the chances of infection, swelling and discomfort.¹³ Also, lingual frenectomy using a Diode laser (830nm) proved to be a successful method for management of ankyloglossia or tongue tie. Laser technique is an excellent alternative to traditional surgery. It is simple and rapid to perform, well accepted and tolerated by patients,

requires a minimal anaesthesia, with an asymptomatic postoperative period, without relapse.¹⁴

Advantages and Disadvantages

Advantages of laser treatment are greater hemostasis, bactericidal effect, and minimal wound contraction.^{4,15} Compared with the use of a conventional scalpel, lasers can cut, ablate and reshape the oral soft tissue more easily, with no or minimal bleeding and little pain as well as no or only a few sutures. The use of lasers also has disadvantages that require precautions to be taken during clinical application. Laser irradiation can interact with tissues even in the noncontact mode, which means that laser beams may reach the patients eyes and other tissues surrounding the target in the oral cavity.¹⁶ Clinicians should be careful to prevent inadvertent irradiation to these tissues, especially to the eyes. Protective eyewear specific for the wavelength of the laser in use must be worn by the patient, operator, and assistant. Laser beams can be reflected by shiny surfaces of metal dental instruments, causing irradiation to other tissues, which should be avoided by using wet gauze packs over the area surrounding the target.¹⁵ However, previous laser systems have strong thermal side effects, leading to melting, cracking, and carbonization of hard tissues.⁷

Precautions before and during Irradiation^{10,17}

1. Use glasses for eye protection (patient, operator, and assistants).
2. Prevent inadvertent irradiation (action in noncontact mode).
3. Protect the patient's eyes, throat, and oral tissues outside the target site.
4. Use wet gauze packs to avoid reflection from shiny metal surfaces.
5. Ensure adequate high speed evacuation to capture the laser plume.

Potential risks¹⁸

1. Excessive tissue destruction by direct ablation and thermal side effects.
2. Thermal injury to the root surface, gingival tissue, pulp, and bone tissue.

Conclusion

A diode laser can be used in Paediatric dentistry as a tool needed to reach a therapeutic result and a helping device to complete conventional therapy. With advantages of easy and faster application, better coagulation, no need for suturing, less swelling and pain and better de-epithelialization, diode lasers can be used as an effective aid in paediatric dental treatments.

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