REVIEW ARTICLE

LASERS IN PEDIATRIC DENTISTRY

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ABSTRACT:
Pediatric laser dentistry is a promising field in modern minimally invasive dentistry, and it can be “child friendly” approach. Its usage in surgical cases, operative dentistry, oral pathology, pulpal treatments, and prevention is analyzed. The current and the future situation of laser treatment in pediatric dentistry is evaluated with a promising view towards an improvement in our treatments and obtaining standardized protocols. This review article presents the current knowledge of laser therapy in pediatric dentistry.
Keywords: pediatric dentistry, laser dentistry, modern dentistry.

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INTRODUCTION:

Pediatric dentistry is age defined specialty based not on a particular skill, but encompassing all aspects of child development in health and disease. Working with children is different from working with adults, it is essential to familiar with age-appropriate skills and functioning, and development. This century has seen advent of advancements even pediatric dentistry also influenced by all such advancements. Such changing trends help us to raise the standards by incorporating child-friendly approaches into dental care.

The concept of microdentistry was introduced in dentistry many years ago. The old concept extension for prevention” changed to “prevention of extension”. In keeping with this, new preparation designs and new materials have undergone continuous development. The other concept that must be taken into consideration is prevention. For much of the history of dentistry, treatment was the main goal of our profession, but little by little it is being replaced by prevention as our principle objective. Microdentistry and prevention have changed our way of practicing so much that young dentists today would find the dentistry of the 1970s unrecognizable. This psychological and technological evolution includes adhesion techniques, the different uses of fluorides, the concept of tooth preservation, and air abrasion. Laser technology is also an advancement that fits into the two concepts expressed above.[1,2]

Medicine began integrating lasers in the mid 1970’s for soft tissue procedures. Oral and maxillofacial surgeons incorporated the carbon dioxide (CO_2) laser into practice for removal of oral lesions in the 1980s. The first laser specifically for dental use was a neodymium-yttrium-aluminum-garnet (Nd:YAG) laser, developed in 1987 and approved by the Food and Drug Administration in 1990. 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. The energy radiated by the laser is basically a light of one color (monochromatic) and thus a single wavelength.[3-8]

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.

Modern pediatric dentistry must take advantage of all new advances, and once tested and proven useful, apply them to improve the standard of care of children and adolescents. The use of lasers in medicine is so widespread nowadays that it has become the standard treatment in many fields, such as ophthalmology and dermatology, for many routine procedures. In general and pediatric dentistry, this is not yet the case, but I am confident that it will be in the near future. It is important to be open to new technology, not only to offer better quality treatment to our patients but also to make our profession more enjoyable. If we enjoy what we are doing, we are in a better state of mind to help pediatric dentistry progress by being more creative in terms of developing new techniques or modifying and improving the existing ones. In spite of the enthusiasm which this technology inspires among pediatric dentists who use it, further research and more experience is still needed to better understand the advantages and disadvantages that it offers, and finally to establish treatment protocols. [9]

This article offers an understanding of treatment planning in the pediatric practice and demonstrates the procedures that dental lasers can perform on younger patients.

CLASSIFICATION OF LASERS[10,11]

1. Based on active material used
   - Gas lasers
   - Solid lasers
   - Liquid lasers
2. Based on the wavelength
   - Invisible ionizing radiation
   - Visible
   - Invisible thermal radiation
3. Based on their operating mode
   - Continuous
   - Pulsed
4. Based on their power supply
   - Low power lasers
   - Mid power lasers
5. Based on delivery systems
   - Flexible hollow waveguide or tubes
   - Articulated arms
   - Fiber optic
6. Based on clinical use
   - For diagnosis Ex: Laser fluorescence, laser Doppler flowmetry
   - For non-surgical treatment
   - Laser activation of bleaching agent
   - Laser activation of light curing materials
   - For surgical treatment
   - Soft tissue
   - Hard tissue
   - Combined

LASER APPLICATIONS IN PEDIATRIC DENTISTRY [12]

These are broadly divided into hard and soft tissue applications.

Hard tissue applications:

- Caries detection by laser induced fluorescence
- Prevention of enamel and dental caries
- Caries removal
- Cavity preparation

- Pit and fissure sealants
- Curing light activated resins
- Laser pediatric crowns
- Bleaching of vital and non-vital tooth
- Laser fusion of vertical root fracture
- Removal of old restorative materials
- Laser analgesia
- Orthodontic tooth movement
- Dental traumatology.

Soft tissue applications:

- Exposure of teeth to aid in tooth eruption
- Frenectomy
- Ankyloglossia
- Aphthous ulcers
- Herpes labialis lesions
- Dentigerous cyst
- Leukoplakia
- Treatment of mucocele
- Pediatric endodontics
- Gingival remodeling and Gingivectomy.

CARIES PREVENTION

A majority of children feel discomfort when lasing deep parts of the dentin, while only a minority feel it in superficial dentin. Only occasionally can we reach the pulp chamber and the pulp without pain. In our experience, primary teeth with scleroticized carious defects in which the pulp has retreated react less sensitively to laser in terms of pain perception than permanent teeth with carious defects. Using laser equipment for obtaining anesthesia is another challenge of this relatively new technology. Several in vitro and initial in vivo studies have shown that argon laser irradiation provides a certain degree of protection against enamel caries initiation and progression. Studies have shown that it reduces caries susceptibility of sound enamel and white spot lesions.[13]

Various mechanisms which suggest caries prevention by lasers are:

- Increased acid resistance in lased enamel by ultrastructural alterations of enamel, as a result of melting and resolidifying. Enamel micro hardness seems to be related to enamel mineral content, and plays a role in enamel demineralization, as well as in erosion inhibition.[14]
- Organic blocking theory: Partial denaturation of organic matrix may block the diffusion pathway in enamel, resulting in retardation of enamel demineralization.[15]
- Combination of reduced enamel permeability and enamel solubility as suggested by Stern et al. Diminution in the size of the apatite crystal, due to loss of water and CO2, and that the hydroxyapatite crystal could be made more compact after laser irradiation, thus increasing to enamel resistance.[16]
- Laser can alter the chemical composition and morphology of the highly mineralized (96%) dental enamel. Frequencies <450 mJ/cm2, resulted in an increased Ca/P ratio, decreased amount of carbonate and protein and the formation of tri calcium phosphate and tetra calcium phosphate, suggesting the involvement of photo thermal mechanism.[17]

More recent in vitro studies showed reductions in lesion depth in primary tooth surfaces using argon laser irradiation combined with topical acidulated phosphate fluoride treatment (APF). This combination provides a protective surface coating against caries and results in significant decreases in lesion depth.[18,19]

The erbium lasers can remove caries effectively with minimal involvement of surrounding tooth structure because caries-affected tissue has a higher water content than healthy tissue. The noise and vibration of the conventional high speed dental hand piece has been postulated as stimulating discomfort, pain, and anxiety for the pediatric patient during restorative procedures. The non-contact of erbium lasers with hard tissue eliminates the vibratory effects of the conventional high-speed handpiece allowing tooth preparations to be comfortable and less anxiety provoking for children and adolescents. Nd:YAG and erbium lasers have been shown to have an analgesic effect on hard tissues, eliminating injections and the use of local anesthesia during tooth preparations.[20-22]

The CO_2 laser has also been used for caries prevention. Investigators have evaluated the effect of carbon dioxide laser irradiation in the prevention of pit and fissure caries in immature molars with covering opercula. The operculum cut takes less than 2 minutes and there is no bleeding, Laser irradiation imparted acid resistance to the teeth without any discomfort to the children. The patients did not complain about any pain after the procedure, and hence they concluded that a CO_2 laser might be an effective mode of treatment in the prevention of pit and fissure caries. [23]

Ankyloglossia

Ankyloglossia is a relatively common finding in the newborn population and is responsible for a significant proportion of breast-feeding problems. Ankyloglossia can be diagnosed in 3.2% of pediatric patients. The abnormal attachment of the lingual frenum is one of the most misdiagnosed and overlooked congenital abnormalities observed in children. There is no consensus, nor are there many current studies or recommendations on what constitutes abnormal lingual attachments which could lead to the diagnosis and treatment of ankyloglossia. After treatment is completed, children can begin nursing, and nursing mothers report immediate relief of pain, extended nursing intervals, and improved infant sleep duration. Older children and adults are prepared in the usual manner using a local anesthesia. It is important to avoid the glands on the floor of the mouth. A suture can be placed at the junction of the frenum when using an Er:YAG or Er,Cr:YSGG laser. If using a CO_2, Nd:YAG, or diode laser, no additional sutures are necessary.[24] The benefits of laser treatment include reduced bleeding during surgery with consequent reduced operating time and rapid postoperative hemostasis, thus eliminating the need for sutures. The lack of need for anesthetics and sutures, as well as improved postoperative comfort and healing, make this technique particularly useful for very young patients.[25]

LASERS IN PULPOTOMY:

Pulpotomy is a procedure in which the inflamed or infected but vital coronal pulp is removed, leaving the healthy pulp in the root canal. Different techniques are used for this: Buckley's formocresol 1/5 dilution, glutaraldehyde, calcium hydroxide, ferric sulfate, MTA, electrosurgery, and laser. Different authors found interesting results concerning bacterial reduction in dental tissues treated with lasers. Mello et al[26] achieved 100% bactericide at a depth of 300 microns and 95% to 98% at 500. microns. Moritz[27] demonstrated that total sterilization could be obtained in the first 500 microns, and 95% to 97% at 1000 microns of depth. Matsumoto et al [28] and Ebihara et al[29] described the histological characteristics and the reaction of the laser-irradiated pulp. In the positive controls, necrosis of the superficial layer, hyperemia, and inflammatory cells resulting from dentinogenesis were observed. In some specimens, a well-shaped newly formed dentin bridge appeared. The use of the Er:YAG laser allows opening the cavity in a completely sterile way, an advantage which is not provided by any other means of access to the pulp chamber. The Nd:YAG laser is especially well suited to work on soft tissues; its properties include cutting, sterilizing, coagulating, and vaporizing.For the treatment performed in this study, its capacity to sterilize and coagulate were particularly relevant. 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 bridge.[30]

LIMITATIONS OF LASERS IN PEDIATRIC DENTISTRY:

There are some disadvantages of laser use in pediatric dentistry. Laser use requires additional training and education for the various clinical applications and types of lasers. High start up costs are required to purchase the equipment, implement the technology, and invest in the required education and training.3,16 Since different wavelengths are necessary for various soft and hard tissue procedures, the practitioner may need more than one laser.3 Most dental instruments are both side and end-cutting. When using lasers, modifications in clinical technique along with additional preparation with high-speed dental handpieces may be required to finish tooth preparations. Wavelength-specific protective eyewear should be provided and consistently worn at all times by the dental team, patient, and other observers in attendance during laser use.1,3 When using dental lasers, it is imperative that the doctor and auxiliaries adhere to infection control protocol and utilize highspeed suction as the vaporized aerosol may contain infective tissue particles. The practitioner should exercise good clinical judgment when providing soft tissue treatment of viral lesions in immunocompromised patients; as the potential risk of disease transmission from laser-generated aerosol exists. To prevent viral transmission, palliative pharmacological therapies may be more acceptable and appropriate in this group of patients.[6,22,31]

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