Policy on the Use of Lasers for Pediatric Dental Patients

Latest Revision

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Purpose

The American Academy of Pediatric Dentistry (**AAPD**) recognizes the judicious use of lasers as a beneficial instrument in providing dental restorative and soft tissue procedures for infants, children, and adolescents, including those with special health care needs. This policy is intended to inform and educate dental professionals on the fundamentals, types, diagnostic and clinical applications, benefits, and limitations of laser use in pediatric dentistry.

Methods

This policy was developed by the Council on Clinical Affairs and adopted in 2013. It is based on a review of current dental and medical literature related to the use of lasers. This document included database searches using the terms: laser dentistry, dental lasers, laser pediatric dentistry, laser soft tissue treatments, and laser restorative dentistry. Articles were evaluated by title and/or abstract and relevance to pediatric dental care. Expert and/or consensus opinion by experienced researchers and clinicians also was considered.

Background

Medicine began integrating lasers in the mid 1970s 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.[1,2] The first laser specifically for dental use was a neodymium-yttrium-aluminum-garnet (**Nd:YAG**) laser, developed in 1987 and approved by the U.S. Food and Drug Administration in 1990.[3] Since then, laser technology has advanced significantly. The use of lasers is contributing to many areas of dentistry including periodontics, pediatrics, endodontics, oral surgery, restorative dentistry and dental hygiene, cosmetic dental whitening, and management of temporomandibular joint pain to name a few.

Laser basics

While a detailed description of how lasers work is beyond the scope of this document, it is important to understand the basics of laser physics prior to selecting a laser for dental treatment. The term laser is an acronym for light amplification by stimulated emission of radiation. Lasers are classified by the active medium that is used to create the laser energy. Within a laser, an active medium is stimulated to produce photons of energy that are delivered in a beam of unique wavelength that is measured in nanometers.[4] The wavelength of a dental laser is the determining factor of the level to which the laser energy is absorbed by the intended tissue. Target tissues differ in their affinity for specific wavelengths of laser energy depending on the presence of the chromophore or the laser-absorbing elements of the tissue.[4-6] Oral hard and soft tissues have a distinct affinity for absorbing laser energy of a specific wavelength. For this reason, selecting a specific laser unit depends on the target tissue the practitioner wishes to treat.

The primary effect of a laser within target tissues is photothermal.[7] When the temperature of the target tissue containing water is raised above 100 degrees Celsius, vaporization of the water occurs, resulting in soft tissue ablation.[1] Since soft tissue is made up of a high percentage of water, excision of soft tissue initiates at this temperature. Hard tissue composed of hydroxyapatite crystals and minerals are not ablated at this temperature, but the water component is vaporized and the resulting steam expands and then disperses the encompassing material into small particles.[6] Laser operating parameters such as power, frequency, emission mode, thermal relaxation time, and air and water coolant used affect the clinical abilities of a laser. Additionally, the delivery system of laser unit as well as the tissue concentration of the chromophore greatly influence the laser tissue interactions.

Various types of lasers have been used in dentistry. Clinical applications of the lasers commonly used in pediatric dentistry are listed in the Table.

Laser safety

Laser plume, a mixture of gases as well as debris, is generated during the use of lasers. When using dental lasers, it is imperative that the doctor and auxiliaries adhere to infection control protocol and utilize high-speed suction as the vaporized aerosol may contain infective tissue particles.[2,8] The practitioner should exercise good clinical judgment when providing soft tissue treatment of viral lesions in immunocompromised

ABBREVIATIONS

AAPD: American Academy Pediatric Dentistry. **Nd:YAG:** Neodymium-yttrium-aluminum-garnet.

patients, as the potential risk of disease transmission from laser-generated aerosol exists.[9,10] To prevent viral transmission, palliative pharmacological therapies may be more acceptable and appropriate in this group of patients. Reflected or scattered laser beams may be hazardous to unprotected skin or eyes. 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.[2] Many states have well defined laser safety regulations and practitioners should contact their specific state boards to obtain this information.

Lasers in pediatric dentistry

One of the benefits of laser use in pediatric dentistry is the selective and precise interaction with diseased tissues.[2] Less thermal necrosis of adjacent tissues is produced with lasers than with electrosurgical instruments.[11] During soft tissue procedures, hemostasis can be obtained without the need for sutures in most cases.[2,12] With the benefit of hemostasis during soft tissue treatments, wound healing can occur more rapidly with less post-operative discomfort and a reduced need for analgesics.[6,11-13] Little to no local anesthesia is required for most soft-tissue treatments.[6,12-14] Reduced operator chair time has been observed when soft tissue procedures have been completed using lasers.[12,13] Lasers demonstrate decontaminating and bacteriocidal properties on tissues, requiring less prescribing of antibiotics post-operatively.[6,12,13] Lasers can provide relief from the pain and inflammation associated with aphthous ulcers and herpetic lesions without pharmacological intervention.[5,12,13]

Lasers can remove caries effectively with minimal involvement of surrounding tooth structure because caries-affected tissue has a higher water content than healthy tissue.[11] The noise and vibration of the conventional high-speed dental handpiece has been postulated as stimulating discomfort, pain, and anxiety for the pediatric patient during restorative procedures.[6,15-17] The non-contact of erbium lasers with hard tissue eliminates the vibratory effects of the conventional

Table. LASER BASICS IN PEDIATRIC DENTISTRY

Laser type	Wavelength	Applications
Diode	450 - 655 nm‡	1. Laser fluorescence – diagnostic applications, detection of occlusal caries, detecting calculus in periodontal pockets, detection of dysplastic cells during oral cancer screening
Diode	810 - 980 nm	1. Soft tissue ablation – gingival contouring for esthetic purposes, frenectomy, gingivectomy, operculectomy 2. Photobiomodulation – proliferation of fibroblasts and enhancing the healing of oral lesions (mucositis) or surgical wounds 3. Periodontal procedures – laser bacterial reduction, elimination of necrotic epithelial tissue during regenerative periodontal surgeries 4. Whitening
Er, Cr:YSGG*	2,780 nm	1. Hard tissue procedures – enamel etching, caries removal and cavity preparation in enamel and dentin 2. Osseous tissue procedures – bone ablation 3. Soft tissue ablation – gingival contouring for esthetic purposes, frenectomy, givectomy, operculectomy 4. Endodontic therapy – pulp cap, pulpotomy, pulpectomy, root canal preparation 5. Periodontal procedures – laser bacterial reduction, elimination of necrotic epithelial tissue during regenerative periodontal surgeries 6. Treatment of oral ulcerative lesions
Er:YAG**	2,940 nm	1. Hard tissue procedures – caries removal and cavity preparation in enamel and dentin 2. Endodontic therapy – root canal preparation
CO_2†	9,300 nm	1. Hard tissue procedures – caries removal and cavity preparation in enamel and dentin 2. Osseous tissue procedures – bone ablation 3. Soft tissue procedures – incision, excision, vaporization, coagulation and hemostasis
CO_2	10,600 nm	1. Soft tissue ablation – gingival contouring for esthetic purposes, frenectomy, gingivectomy 2. Treatment of oral ulcerative lesions 3. Periodontal procedures – elimination of necrotic epithelial tissue during regenerative periodontal surgeries

* Er, Cr:YSGG – erbium, chromium, yttrium, scandium, gallium, garnet.
** Er:YAG – erbium, yttrium, aluminium, garnet.
† CO_2: Carbon dioxide.
‡ nm – nanometer.

high-speed handpiece allowing tooth preparations to be comfortable and less anxiety provoking for children and adolescents.[6,15,17] 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.[6,15,18-20]

Limitations of lasers in pediatric dentistry

There are some disadvantages of laser use in pediatric dentistry. Since different wavelengths are necessary for various soft and hard tissue procedures, the practitioner may need more than one laser.[2] Laser use requires additional training and education for the various clinical applications and types of lasers.[2,13,15,18] High start up costs are required to purchase the equipment, implement the technology, and invest in the required education and training.[2,13] 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.[2,15] There are a variety of resources, such as the Academy of Laser Dentistry, available to assist dentists in the training and education for safe and effective use of lasers.

Policy statement

The AAPD:

- recognizes the use of lasers as an alternative and complementary method of providing soft and hard tissue dental procedures for infants, children, adolescents, and persons with special health care needs.
- advocates the dental professional receive additional didactic and experiential education and training on the use of lasers before applying this technology on pediatric dental patients.
- encourages dental professionals to research, implement, and utilize the appropriate laser specific and optimal for the indicated procedure.
- endorses use of protective eyewear specific for laser wavelengths during treatment for the dental team, patient, and observers.

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