Paediatric laser dentistry. Part 1: General introduction

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ABSTRACT

Knowledge of the physical characteristics of different laser lights and optical and thermal properties of oral tissues is very important to understand the interaction of dental lasers with biological tissues. Choosing the correct dental laser is crucial to match specific wavelengths with target chromophores of different tissues; this affinity makes laser irradiation selective and therefore minimally invasive. Various types of lasers are used in dentistry, offering a viable alternative to low and high-speed handpieces and surgical blades, and also minimising fear and discomfort of the patient. Lasers can provide innovative and minimally invasive therapies in different branches of dentistry including preventive and restorative dentistry, traumatic injury treatments and surgical procedures. Laser has also biostimulating and anti-inflammatory effects, as well as analgesic effect.

Keywords *Children; Laser tissue interaction; Paediatric laser dentistry.*

Introduction

The American Academy of Pediatric Dentistry (AAPD) recognises the use of laser as beneficial in restorative dentistry and soft tissues treatments for infants and children, including patients whith special health care needs [AAPD, 2013].

The term laser is an acronym that stands for Light Amplification by Stimulated Emission of Radiation. Laser technology was introduced in dentistry in the mid 1970's, and its classification in dentistry is based on the active medium used to supply electrons for the emission of laser photons. Laser photons are delivered as waves, which are typically collimated, coherent and monochromatic, i.e. of a single wavelength [Convissar, 2000; Coluzzi, 2005-2007; Moritz, 2006; Fasbinder, 2008; Olivi and Olivi, 2015]. Another classification considers the clinical use as follows: for soft tissues exclusively, for soft and hard tissues, for low level applications, for photopolymerisation, for tooth whitening and for caries detection (Table 1).

The choice of a laser depends on the optical affinity and absorption coefficient in different target chromophores for different wavelengths. Lasers in the visible and near-infrared electromagnetic spectrum are specifically absorbed by haemoglobin and melanin, and are used to treat soft tissues pathologies. The erbium family lasers (mid-infrared spectrum) are absorbed by water in the gingiva and mucosa, and within the hydroxyapatite and are therefore used on both hard and soft tissuess [Kotlow, 2004; Olivi, 2009; Caprioglio, 2010-2017; Boy, 2011]. CO_2 lasers (far-infrared spectrum) are absorbed by water in the mucosa and gingiva and are mainly used for surgery (incision and vaporisation of tissues); in addition, CO_2 wavelenghts are absorbed by hydroxyhapatite, and some studies reported also their ability to increase the acid-resistance of tooth enamel for preventive dentistry [Featherstone et al., 1997; Rechmann et al., 2013].

Soft tissue lasers	Argon 514 nm
	KTP 532 nm
	Diode 445, 803, 810, 940, 970-980, 1064 nm
	Nd:YAG 1064 nm
	Nd:YAP 1340 nm
	CO_2 10600 nm
Hard and soft tissue lasers	Er,Cr:YSGG 2780 nm
	Er:YAG 2940 nm
	CO_2 9300 nm
Low-Level lasers	Helium neon: 635 nm
	Diode 635-660 nm; 810 to 1064 nm
Photopolymerisation lasers	Argon: 488 nm
Tooth-whitening lasers	KTP 532 nm
	Diode 803, 810, 940, 970-980, 2940 nm
Caries detection lasers	Diode 405 and 655 nm

TABLE 1 Laser classification.
Legend KTP-potassium titanyl phosphate; Nd:YAG-neodymium-doped yttrium aluminum garnet; Nd:YAP- neodymium-doped yttrium aluminum per ovskite; CO_2-carbon dioxide; Er,Cr:YSGG-erbium chromium –doped yttrium scandium gallium garnet; Er:YAG-erbium-doped yttrium aluminum garnet.