Laser restorative dentistry in children and adolescents

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Abstract

BACKGROUND: The idea of substituting a drill with a laser light, has led to its introduction in dentistry. Besides being less adverse to patients, in paediatric dentistry the laser has demonstrated safety compared with rotating instruments. **REVIEW:** A review of the past 20 years of the dental literature concerning laser use in dentistry, including paediatric dentistry was completed. The findings of that review are presented. **TECHNIQUES:** The various types of lasers and their uses for caries detection, tooth sealing and carious removal are described. RESULTS: Laser caries detection demonstrated a good reproducibility, reliability and predictability to monitor the caries process over time. Erbium lasers have been found to be efficient for carious removal, tooth cleaning and decontamination. **CONCLUSION:** The laser erbium technology represents a safe device to effectively and selectively remove carious tissues from decayed teeth. For children, all the recognized advantages of this technique play a decisive role in the successful day-to-day treatment of dental caries.

Background

The idea of substituting a drill with a laser light which has less adverse effects on patients, without vibration, noise and pain, has led its introduction in dentistry. Lasers are extremely safe compared with rotating instruments, especially in paediatric dentistry, when used in the treatment of very young children, due to the lowered risk of accidental damage to soft tissues and pulp tissue. Lasers bring new possibilities for safe and minimal removal of carious tissue with better acceptance compared with traditional techniques [Wigdor, 1997; Keller et al.,1998; Parkins, 2000; Matsumoto et al., 2002; Takamori et al., 2003; Boj et al., 2005; Liu et al., 2006; Genovese and Olivi, 2008]. It is important to observe the rules of safety, such as the use of specific protective glasses according to the wavelength used, as well as choosing the appropriate size glasses for the face of the child.

Nowadays, as reported by Martens [2003, 2011] and emphasised by Gutknecht et al. [2005], 'children are the first in line to receive dental laser treatment' and based on micro dentistry's comment 'filling without drilling'. Thus, the philosophy of laser-supported dental diagnosis and treatment is becoming a gold-standard to treat children successfully, according to the latest extensive publications in paediatric dentistry [Olivi et al., 2010; Martens 2011].

Laser usage. Lasers are commonly used on hard tissues in paediatric dentistry in the following fields:

- Diagnosis,
- Preventive dentistry,
- Restorative dentistry,
- Endodontics.

For the purpose of this paper, the authors consider only the procedures limited to restorative dentistry, and also include some mention of caries diagnosis by laser and laser-assisted techniques in caries prevention.

Lasers in dentistry

Basic physics in the use of lasers. Laser-tissue interaction depends on the effects of different wavelengths on the different hard tissue treated. The interaction is primarily determined by the wavelength's affinity for specific chromophores of different tissues [Parker et al., 2007]. The main chromophores of dental tissues are the hydroxyapatite and the water content within the hydroxyapatite crystals of enamel and dentine that highly absorb medium infrared wavelengths (2,780nm and 2,940nm), (Fig.1). For the purpose of restorative paediatric dentistry, the application of laser energy on dental tissues takes into account only the water content of healthy, demineralised and carious dental tissues (enamel and dentine), as the interaction with hydroxyapatite has only a minor and negligible role. Consequently it is important to consider the different water content of healthy enamel and dentine, the different composition of primary and permanent teeth, both in youth and adult, when choosing the parameters of laser use. Moreover carious tissues are demineralised and richer in water in comparison with healthy and/or not vital teeth. This concept is important to understand because more energy will be needed for enamel and less energy for carious tissue, depending on different absorption of different water content in the tooth (different ablation thresholds of dental tissues) (Fig.2).

It is also important to emphasize the ablation of the organic component of dentine (collagen) that affects the adhesion of bonding filling materials. The physical properties involved in the ablation of hard tissues by the erbium family of lasers is based on the transfer of laser energy to the tissues that causes different phenomena that rapidly occur, which are thermal and thermo-mechanical phenomena. The first mechanism of action of the erbium family lasers on hard tissues is a thermal effect on the water molecules within the tissues. Once the energy is absorbed by the water, it is converted into heat, causing superheating, and vaporization. The increased