REVIEW ARTICLE

Lasers in Orthodontics

Praveen Mehrotra*, Raj Kumar Jaiswal**, Sonahita Agarwal**, Rachita Mehrotra***, Faiz Warsi****


Introduction

Lasers have been used in dentistry since 1960s. Researchers and clinicians have explored the possibilities of replacing conventional treatment techniques with lasers in the hope of improving patient care. More recently, the diode laser has been used in orthodontic practice, and published reports demonstrate its usefulness for addressing aesthetic and other soft tissue challenges facing orthodontists1-3.

Laser types in dentistry

Numerous different applications have been developed, depending on the varying parameters of the emitted laser light.

1. The argon ion laser

Argon ion laser used for soft-tissue surgery, photo-polymerization and decay prevention and is suitable for soft tissue surgery due to the high absorption in melanin, haemoglobin and oxyhemoglobin4-5.

2. The Helium–Neon Laser

The Helium-neon laser was not only the first gas laser, but also the first continuous-wavelength laser in the history of laser development6. This laser is commonly used as a tool for adjusting optical and mechanical systems, in holography and interferometry, as well as in applications in biology and medicine.

3. The Neodymium:YAG Laser

The Neodymium: YAG laser was developed in 1964 and is the classical and most widely used solid-state laser. Emitting its strongest fundamental wave length at 1,064 nm, the Neodymium: YAG laser is characterized by a relatively simple set-up and the generation of high output powers, both in pulsed mode at high repetition rates (up to 10 kHz) and in continuous wave mode7,9.

4. The Erbium Family Lasers

Since 1988 Erbium lasers are the mainly used laser systems in dentistry for cavity preparation (Figure 1)10.
5. Laser florescence for caries detection

The laser fluorescence (LF) device is a quantitative method based on emission of light from adioid laser at a wavelength of 655 nm and measurement of the fluorescence emitted mainly from the carious tissues. At this wavelength, clean healthy teeth exhibit little or no fluorescence. In contrast, demineralized teeth exhibit fluorescence proportionate to the degree of remineralization, resulting in elevated scale readings on the display.

High intensity laser therapy in orthodontics

1. Laser curing of light-cured materials

The application of visible light is necessary for initiating the polymerization reaction of many cements used in orthodontics, including photo-polymerized adhesive resins and some glass ionomer products.

There are several options for curing of orthodontic cements:
- Conventional and fast quartz-tungsten-halogen (QTH) lights
- Light emitting diodes (LEDs)
- Plasma arc units
- Argon laser

2. Enamel conditioning for bracket bonding with laser

In orthodontics, as in other fields of dentistry, the most common method of enamel preparation is acid phosphoric etching. Acid etching removes and demineralizes the most superficial and protective layer of enamel and makes the teeth more susceptible to long-term acid attack. Laser etching is painless and does not involve either vibration or heat; also, the easy handling of the apparatus makes this treatment highly attractive for routine clinical use. Laser etching of enamel creates micro cracks that are ideal for resin penetration (Visuri et al. 1996). Because water spraying and air drying are not needed with laser etching, time can be saved (Usümbez et al. 2002). Different types of laser such as CO2, Er:YAG, Nd:YAG, and Er:Cr:YSGG have been used in orthodontics for enamel conditioning to bond brackets.
3. Bonding to porcelain

It has been demonstrated that the application of 9.6% hydrofluoric acid for 2 minutes provides suitable surface alterations for orthodontic bonding\(^1\). Several alternative techniques have been proposed to replace the use of hydrofluoric acid gel in bonding to porcelain surfaces, such as the application of acidulated phosphate fluoride (APF) gels or laser etching (Nd:YAG).

4. Bracket debonding

The low fracture toughness of ceramics may cause partial or complete bracket fracture during removal, removal of bracket fragment on the tooth may require the use of diamond burs, a process that is time consuming and can damage the pulp (Vukovich et al., 1991) and enamel surface\(^1\). Since the early 1990s, lasers have been used experimentally for debonding of ceramic brackets. The use of lasers eliminates problems such as enamel tear outs, bracket failures, and pain that are encountered during conventional ceramic bracket removal techniques.

Laser minor surgery

Laser surgery offers numerous advantages compared with traditional scalpel surgery. Various applications of laser surgeries in orthodontics are:

1. Gingival enlargements, gingival hyperplasia and reshaping gingival shape and contours recontouring. Gingival shape and contour can be readily accomplished in the orthodontist’s office with a diode laser. Laser gingivectomy has advantages such as minimal bleeding and postoperative pain and no swelling\(^1\) (Lioubavina-Hack 2002).

2. Fibrotomy. Fibrotomy (Pericision) is frequently indicated to provide long term stability of teeth with severe rotations before treatment. Fibrotomy should be performed at the end of orthodontic treatment and before appliance removal. (Vanarsdall RL and Secchi AG, 2005) In recent time laser fibrotomy gain popularity. The laser tip was inserted into the gingival sulcus to the level of the alveolar bone crest, and the incision was extended around the tooth circumference with the system configured to the soft tissue cutting mode\(^2\) (continuous wave; 1.2 W).

Frenectomy. Frenectomy is usually indicated to prevent relapse after correction of midline diastema. Olivi et al. (2010) clinically evaluated the efficacy of Er,Cr:YSGG laser at a power setting of 1.5 W or less in 156 frenectomies. They reported very high patient acceptance and no postoperative adverse events. Recently diode laser frenectomy without infiltrated anesthesia was suggested by Kafas et al. (2009). They concluded that this procedure have optimum healing post-surgically\(^2\).

References


