Lasers in Orthodontics

**Review Article**

**Lasers – A Leading Edge in Orthodontics - An Update**

Dhanare P, Verma VK, Panda S, Singh K

**ABSTRACT:** Lasers have got wide-ranging relevance in the field of dentistry and the field of orthodontics does not remained untouched. Laser therapy is worthwhile by virtue of providing haemostatic, painless, non-invasive and quicker surgery. Incorporation of lasers in an orthodontic practice necessitates comprehensive learning regarding its various aspects to prevent possible tissue damage while using laser dental systems. This article has been reviewed with the application of lasers in orthodontics such as orthodontic tooth movement, stimulated intraoral laser microwelding of orthodontic appliances, debonding orthodontic brackets, reducing pain, etching enamel for bonding and enamel decalcification reduction.

Key Words: Laser Therapy; Debonding; Tooth Movement; Microwelding; Fluorescence; Radiation.

**Introduction**

Laser or “light amplification by stimulated emission of radiation” is monochromatic, invariant optical device, consisting of single wavelength of light. Laser fluorescence is a unique source of focused electromagnetic energy that is capable of usable work. Laser beam is a composite of the elements in the periodic system such as atoms, gases, organic molecules, diodes, chemicals or electrons. Laser therapy is perceived to be modern, high tech, and better.

**Implication of lasers in orthodontics:**

Lasers have various extensive applications in orthodontics such as orthodontic tooth movement, stimulated intraoral laser microwelding of orthodontic appliances, debonding orthodontic brackets, reducing pain, etching enamel for bonding and enamel decalcification reduction. Soft tissue applications such as frenectomies, gingival contouring and crown lengthening can also be accomplished.

**Reducing pain in orthodontic treatment:**

A major concern for clinicians and patients is pain or discomfort during orthodontic treatment which may discourage patients from pursuing or continuing treatment. The incidence and severity of pain have been reported to be higher than those of extractions. Studies have shown that peak of pain occurred approximately 24 hours after separators or initial wire placement and decrease over the next 6-8 days. The mechanism of action of LLLT in reduction of orthodontic pain is not clearly known. It has been suggested that it affects the release of serotonin and acetylcholine at the central level and in the peripheral level release of histamine and prostaglandine are affected. Some studies have shown that they increase the blood supply and promote the recovery of dental tissues. It was proposed by Harris that LLLT has a benign
stimulatory influence on depressed neuronal and lymphocyte respiration. LLLT is a new method to manage pain in orthodontics. It is non-invasive, easy to administer and has no adverse tissue reactions.

**Debonding ceramic orthodontic bracket:**

The basic concept of debonding is to break the bracket-resin interface and remove the bracket from the tooth surface. The properties of ceramic bracket are different from metallic brackets and thus the conventional method of debonding metallic brackets are not as effective in debonding ceramic bracket. Most common problems encountered during ceramic bracket debonding are enamel fracture and bracket fracture.26,27

Conventional lasers soften the adhesive resin due to its heating property and helps in debonding of the brackets.28,29,30 however different adhesives may require different softening temperature. The temperature of the heated brackets may rise too high and also pulpal damage may occur.31,32 In recent years Nd:YAG laser have been recommended as it has a lower ceramic absorption than that of the carbon-dioxide laser, thus direct application to the resin enhances the effect of thermal ablation and photoablation.33,34

**Effects on tooth movement:**

In recent years a lot of focus has been paid to acceleration of orthodontic tooth movements. Various methods have been advocated in the literature to accelerate tooth movement out of which LLLT has shown a lot of promise. Studies have shown that LLLT accelerate bone remodelling process by stimulating osteoblasts and osteoclasts cell proliferation and function during orthodontic tooth movements.23,35

Saito and Shimizo36 have shown bio-stimulatory effects of bone repair in mid-palatal sutures during rapid maxillary expansion in rats. Takada37 has shown stimulation for bone regeneration at extraction site in rats. However some studies have shown contradictory results that LLLT does not have any effect on the rate of orthodontic tooth movement.38 Researchers advocate that LLLT use laser energies varying from 2 to 54 J for stimulating and accelerating tooth movement.39,40

**Etching of enamel for bonding:**

Studies have shown that laser is capable of removing smear layer from the surface of enamel.41 Once exposed to laser enamel undergoes physical changes such as melting and recrystallization.42 These changes resemble the etching pattern produced by phosphoric acid.43 Review of literature shows that the results have been variable when bond strength of laser etched enamel was compared with the bond strength after conventional etching. Ozer et al44 in their study found that irradiation with a 1.50 w laser produced sufficient etching for orthodontic bonding but irradiation with 0.75 w laser didn’t. Basaran et al45 in their study have found that mean shear bond strength and enamel surface etching obtained with Er,Cr:YSGG laser was comparable to that obtained with acid etching. However some authors have found laser etching to have significantly less bond strength when compared to acid etching.46,47

**Enamel decalcification reduction:**

After bonding enamel is susceptible to plaque accumulation around the orthodontic attachments. This often leads to caries and enamel decalcification.48 Sognnaes and stern49 in their study have shown that enamel exposed to laser irradiation shows resistance to acid attack. Anderson et al50 in their in vivo study have shown that argon irradiation is effective in reducing enamel decalcification during orthodontic treatment. They have also shown that pumicing and etching do not appear to reduce the effect of laser on enamel solubility. Fox, Duncan and Olsaka51 found that in addition to decreasing enamel decalcification laser reduced the threshold of pH at which dissolution occurred by a factor of five. A number of studies have shown that combining laser with fluoride therapy has synergistic effect on acid resistance of enamel.52,53,54

**Conclusion:** The use of Lasers in orthodontics is wide spread. Lasers are
widely used in tooth movement, debonding ceramic orthodontic bracket, reducing pain in orthodontic treatment, etching enamel for bonding, enamel decalcification reduction etc. However laser is not a magic but when used efficaciously with thorough knowledge and training, it gives resounding results and this modern technology may bring revolution in the field of dentistry in near future.

Author affiliation: 1. Dr. Poorvasha Dhanare, Post Graduate, 2. Dr. Vinay Kumar Verma, MDS, Professor& Head, 3. Dr. Sujit Panda, MDS, Professor, 4. Dr. Karuna Singh, MDS, Senior Lecturer, Department of Orthodontics and Dentofacial Orthopaedics, Rama Dental College of science and research center, Kanpur, Uttar Pradesh, India, e-mail: prvsha04@gmail.com

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Corresponding Author:
Dr. Poorvasha Dhanare,
Post Graduate,
Dept. of Orthodontics and Dentofacial Orthopaedics,
Rama Dental College of science and research center, Kanpur, U.P, India.
Contact no: 09839138625
Email id: prvsha04@gmail.com


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