REVIEW ARTICLE

Laser: A Newer Tool for Orthodontist

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Abstract

In recent years, laser technology is receiving more and more important role in modern dentistry. Recently, even in fields of orthodontics, laser technology was proposed. The use of the laser related to orthodontic treatment offers several advantages when compared with conventional methods. An increased focus on personal esthetics in orthodontics has taken hold. Laser technology has risen to forefront of adjunct care. Laser technology has created the opportunity for the most esthetic result possible in conjunction with orthodontic treatment. Laser technique now is widely applied in orthodontic treatment and proved to have many benefits. Soft tissue lasers can be used to perform gingivectomy, frenectomy, and surgical exposure of tooth with less bleeding and swelling, improved precision, reduced pain, and less wound contraction. Other laser applications include enamel etching and bonding and bracket debonding. Lower level lasers have the potential effects of pain control and accelerating tooth movement. Clinicians must be aware of the safety issues and risks associated with laser and receive proper training before the laser treatment is started. In this study we compile all the possible data for the sake of convenience and highlighting all the uses of laser technology in the various branches of orthodontics.

Keywords: Bracket bonding, Debonding, Laser, Orthodontics, Tooth movement.

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Introduction

Laser is the acronym for "Light Amplification by Stimulated Emission of Radiation" that dates back to approximately 50 years ago. In 1960, the first functioning laser was built by the American physicist Maiman at the Hughes Research Laboratories by using a synthetic ruby crystal made of aluminum oxide and chromium oxide.[1] In general, lasers are composed of three principal parts: an energy source, an active medium, and a set of two or more mirrors that form a resonator. Properties such as wavelength are determined primarily by the active medium, which can be a gas, crystal, or solid-state conductor.[2,3]

Laser light is produced as a result of the stimulation of the active medium with an external agent such as a flash lamp strobe device, an electrical current, or an electrical coil. A laser beam has several physical characteristics that distinguish it from a typical white light source, including collimation, coherence (phase correlation), and monochromaticity (single wavelength). For dental laser systems, the light is typically delivered to the target tissue through an optical fiber cable, a hollow waveguide, or an articulated arm.[4] The number of orthodontists has increased who use laser technology to facilitate treatment outcomes. Laser is a wavelength of light which travels through a collimated tube and delivers a concentration of energy. This energy is then explicated as light. Many elements in periodic table can be used to produce laser irradiation. Different laser systems are able to emit visible lights or invisible lights. The first laser which emits visible light was introduced by Theodore H Maiman. Visible beams emit laser at 400–780 nm and invisible beams emit at a different spectrum in infrared and ultraviolet ranges.

Classification of Lasers

- **Based on active medium:**[5]
  - Solid
  - Liquid
  - Gas
- **Based on application:**
  - Soft tissue lasers
  - Hard tissue lasers
- **Based on wavelength:**
  - Excimer 195–350 nm
  - Alexandrite 337 nm
  - Argon 455–515 nm
  - He-Ne 637 nm
  - Diode 655–980 nm
  - Nd:YAG 1064 nm
  - Ho:YAG 2100 nm
  - Er,Cr:YSGG 2780 nm
  - Er:YSGG 2790 nm
  - Er:YAG 2940 nm
  - CO2 10600 nm

Laser in Orthodontic Perspective

Laser Etching of Enamel for Orthodontic Bonding

Etching of enamel for bonding purpose is carried out since Buonocore introduced the procedure. Since its introduction, lasers have been used for enamel etching. Lasers used for etching purpose are Argon, Diode, and Nd:YAG laser. Özer et al.[6] found statistically insignificant

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difference in shear bond strength after etching of teeth with laser and conventional phosphoric acid. Von Fraunhofer et al.[7] studied bond strength after laser etching at four different power settings, i.e., 80 mJ, 1 W, 2 W, and 3 W. He found that etching of enamel with laser at lower settings decreases the bond strength and recommended.

Laser for Orthodontic Tooth Movement

Sometimes long duration of orthodontic treatment is the one reason for patient to deny the treatment. Many of the orthodontist attempt to increase the orthodontic tooth movement thereby decreasing the treatment duration. Yassaei et al.[8] used low level laser therapy to increase the rate of tooth movement during orthodontic treatment successfully. According to them, this may be due to increased levels of receptor activator of NF KappaB ligand (RANKL) in periodontal ligament (PDL) which leads to increased osteoclastogenesis. Increased macrophage colony stimulating factor (M-CSF) level may be the reason for increased tooth movement during orthodontic treatment. Doshi-Mehta and Bhad-Patil[9] applied laser to reduce treatment duration and pain. They observed an average increase of 30% in the rate of tooth movement with the low-intensity laser therapy. Pain scores were significantly lower so they conclude that low-intensity laser therapy is a good option to reduce treatment duration and pain.

Laser for Stability of Orthodontic Mini-implant

Nowadays temporary anchorage devices (TADS) are commonly used for the purpose of providing orthodontic anchorage. Stability of TADS is a major concern when they are utilized as anchor sources. Osman et al.[10] found that, low level laser therapy (LLLT) has been shown to improve stability of orthodontic mini-screws as evidenced by reduced mobility values measured with Periotest. LLLT reduces gingival inflammation around mini-screws. Some studies are also conducted on animals. Omasa et al.[11] did a study with rat model and used LLLT of gallium-aluminum-arsenide laser (830 nm) and they found Periotest values were significantly lower and the volume of newly formed bone was significantly higher with LLLT. Low level laser treatment also stimulates significant *BMP-2* gene expression in peri-implant bone. So, they conclude that LLLT enhanced the stability of mini-implants placed in rat tibiae and accelerated peri-implant bone formation by increasing the gene expression of BMP-2 in surrounding cells. Pinto et al.[12] also did the animal study with tibia of rabbits with similar conclusions.

Laser Irradiation on the Debonding of Metal and Ceramic Brackets and Enamel Damage

Debonding of brackets is a major concern after completion of fixed orthodontic treatment. Orthodontist aims to debond the brackets along with complete removal of composites from enamel surface without enamel trauma. Dostalova et al.[13] used Er:YAG laser (FJFI CVUT) 280 mJ, 250 µs long before debonding of brackets and they found that laser irradiation with Er:YAG laser before debonding of ceramic brackets significantly decreases the bonding failure and amount of remaining adhesive and does not cause any enamel fracture. Han et al.[14] applied Nd:YAG laser before debonding of ceramic brackets and concluded that Nd:YAG laser could facilitate the debonding of ceramic brackets and diminish the amount of remnant adhesive without damaging enamel structure.

Laser for Prevention of White Spot Lesion

White spot lesion is a common consequence of orthodontic treatment which causes esthetic problems. Khoroushi and Kachuie[15] observed that, application of argon laser beams (488 nm) significantly decreases the mean lesion depth by decreasing the amount of demineralization up to 30–50%, they lowered the dissolution threshold pH value also. Thus, argon laser beams might prevent the development of white spot lesion (WSLs) during treatment.

Laser as Adjunctive for Soft Tissue

Diode lasers can be used in oral soft tissue surgery like frenectomy, gingivectomy, gingivoplasty, genioplasty, and especially small prominent lesions because of easy application, better coagulation, sterilizes the target area, no need for suturing, less swelling and pain, as well as for its capability for treatment of physiologic gingival pigmentation from an esthetic point of view. It can be considered as a first choice despite surgery due to faster action, better deepithelialization, no bleeding, and better repair.[16-19]

Disadvantages of Laser

- Laser beam could harm the patient or operator by direct beam or reflected light, causing retinal burns.
- Need qualified personal.
- Application of laser is limited due to the high cost of laser devices.
- Some clinicians also prefer scalpel because of its tactile sense.
- Lack of operating knowledge may cause excessive thermal damage to the tissue and cause bone exposure.[6]

Laser Hazard Control Measures

- The small flexible fiber optic, hand pieces, or tip must be steam sterilized in sterilizing pouches.
- Practice of protective wear.
- Use of screen and curtains should be promoted.
- Use of proper clothing.
- Use of anti-fire explosive.
- Proper training and courses.
- Use of laser filtration masks prevents air borne contamination.
- Foot pedal control switch with protective hood prevents accidental depression by surgical staff.[6]

Conclusion

Lasers are a "new and different scalpel." Although lasers cannot replace all the conventional procedures in dentistry, its use enables some procedures to be performed differently than the conventional procedure and its development in the field of orthodontics continues to expand further, enabling greater patient care.

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References

1. Fornaini C, Merigo E, Vescovi P, et al. Use of laser in orthodontics: applications and perspectives. Laser Ther 2013;22(2):115–124. DOI: 10.3136/islsm.22.115
2. Kulkarni RB, Misal A, Mishra R. Soft tissue diode laser in orthodontics. Int J Appl Dent Sci 2017;3(2):91–94.
3. Kang Y, Rabie AB, Wong RW. A review of laser applications in orthodontics. Int J Orthod Milwaukee 2014;25(1):47–56.
4. Nalcaci R, Cokakoglu S. Lasers in orthodontics. Eur J Dent 2013;7(Suppl 1):S119. DOI: 10.4103/1305-7456.119089

5. Pendyala C, Tiwari RV, Dixit H, et al. A contemporary apprise on lasers and its applications in dentistry. 2017;4(2)47-51.
6. Özer T, Başaran G, Berk N. Laser etching of enamel for orthodontic bonding. Am J Orthod Dentofacial Orthop 2008;134(2):193–197. DOI: 10.1016/j.ajodo.2006.04.055
7. Von Fraunhofer JA, Allen DJ, Orbell GM. Laser etching of enamel for direct bonding. Angle Orthod 1993;63(1):73–76. DOI: 10.1043/0003-3219(1993)063<0073:LEOEFD>2.0.CO;2
8. Yassaei S, Fekrazad R, Shahraki N. Effect of low level laser therapy on orthodontic tooth movement: a review article. J Dent (Tehran) 2013;10(3):264.
9. Doshi-Mehta G, Bhad-Patil WA. Efficacy of low-intensity laser therapy in reducing treatment time and orthodontic pain: a clinical investigation. Am J Orthod Dentofacial Orthop 2012;141(3):289–297. DOI: 10.1016/j.ajodo.2011.09.009
10. Osman A, Moneim AA, El Harouni N, et al. Long-term evaluation of the effect of low-level laser therapy on orthodontic miniscrew stability and peri-implant gingival condition: a randomized clinical trial. J World Feder Orthod 2017;6(3):109–114. DOI: 10.1016/j.ejwf.2017.08.005
11. Omasa S, Motoyoshi M, Arai Y, et al. Low-level laser therapy enhances the stability of orthodontic mini-implants via bone formation related to BMP-2 expression in a rat model. Photomed Laser Surg 2012;30(5):255–261. DOI: 10.1089/pho.2011.3157
12. Pinto MR, dos Santos RL, Pithon MM, et al. Influence of low-intensity laser therapy on the stability of orthodontic mini-implants: a study in rabbits. Oral Surg Oral Med Oral Pathol Oral Radiol 2013;115(2): e26–e30. DOI: 10.1016/j.oooo.2011.09.036
13. Dostalova T, Jelinkova H, Remes M, et al. The use of the Er: YAG laser for bracket debonding and its effect on enamel damage. Photomed Laser Surg 2016;34(9):394–399. DOI: 10.1089/pho.2016.4115
14. Han X, Liu X, Bai D, et al. Nd: YAG laser-aided ceramic brackets debonding: effects on shear bond strength and enamel surface. Appl Surf Sci 2008;255(2):613–615. DOI: 10.1016/j.apsusc.2008.06.082
15. Khoroushi M, Kachuie M. Prevention and treatment of white spot lesions in orthodontic patients. Contemp Clin Dent 2017;8(1):11. DOI: 10.4103/ccd.ccd_216_17
16. Seifi M, Matini NS. Laser surgery of soft tissue in orthodontics: review of the clinical trials. J Lasers Med Sci 2017;8(Suppl 1):S1–S6. DOI: 10.15171/jlms.2017.s1
17. Azma E, Safavi N. Diode laser application in soft tissue oral surgery. J Lasers Med Sci 2013;4(4):206
18. Borzabadi-Farahani A. The adjunctive soft–tissue diode laser in orthodontics. Compend Contin Educ Dent 2017;38(eBook 5): e18–e31.
19. Kravitz ND, Kusnoto B. Soft-tissue lasers in orthodontics: an overview. Am J Orthod Dentofacial Orthop 2008;133(4):S110–S114. DOI: 10.1016/j.ajodo.2007.01.026