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Review Article

A literature review on use of lasers in the field of orthodontics

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ABSTRACT

Lasers has been used from the past more than forty years in the different field of dentistry. The use of lasers becomes more common in the field of dentistry because of there various applications like they help in reducing the pain perception while doing the procedure, they helps in making the operative field blood less, while doing the operative procedure in dentistry, makes it more approachable for the clinical practice in dentistry. In the field of orthodontics lasers helps in accepting the treatment by the patient as with the help of the lasers application efficiency of the treatment can be improved, lasers helps in improving the esthetics of the patient smile, by reducing the pain discomfort.

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1. Introduction

In the field of orthodontics, lasers can be used in different ways, like lasers are very much helpful in reduction of the pain, lasers are used in the process of bonding the metal or ceramic brackets on the tooth surface for the orthodontic tooth movement purpose, lasers can be used as an alternative technique for the process of etching and bonding, lasers are very much helpful in increasing the rate of tooth movement, lasers helps in reducing the rate of demineralization, lasers helps in reducing the time for any soft tissue surgery procedure for example relieving the high attachment of the frenum from over the ridge i.e. frenectomy procedure, helps in removing excessive gingival growth i.e. gingivectomy procedure, lasers also helps in the exposing the impacted tooth. The term LASERS stand for, light

activation by stimulated emission of radiation. It is a source of electromagnetic radiation that is focused properly.^{1,2}

The main source of the laser is found to be a medium that could be in the form of solid element, gaseous or liquid element that is scattered in to a matrix of a glass or in to some semi conductor i.e. diode, that ultimately helps in determining the wave length of the output. That ultimately helps in stimulating the medium till the emission of the light energy, and with the help of the optical cavity that helps in amplifying the light energy before the emission of the stimulated light that exits from the cavity.³

Lasers were first introduced by Gordon Gould In the year of 1957, that are totally based on the theory given by Albert Einstein's of propagation of light and also on the stimulated emission concept. Maiman first time used laser in hughes company of air craft, he generated high energy intensity light with the help of medium consisting of ruby. In the field of dentistry the first time use of laser was done

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to vaporising process of enamel as well as dentine in the year of 1964 by Ralph Stern, Reidar and Sognaes. This is followed by introduction of carbon dioxide laser in the field of dentistry by Patel in the year of 1964. The clinical use of laser on enamel as well as dentine was first of all clinically demonstrated by Leon Goldman. Later in the year of 1985 Erbium doped solid state i.e. Er:YAG was used clinically by Paghidiwala, on enamel as well as dentine, later in the year 1997 he demonstrated the use of the same laser on hard as well as soft tissues.^{4,5}

1.1. Different components of lasers

Lasers comprises of: - medium of laser, source of pump.

Medium comprises of crystals that are mixed with ions of are earth metals that are yttrium, erbium, neodymium, along with it transition metal ions can also be used such as titanium and chromium. Lasers also comprises of glasses such as phosphate or silicate that are mixed or doped with active ions of lasers. Mixture of helium and neon gases, argon, nitrogen, carbon monoxide, carbon dioxide are also use as medium of laser. Gallium arsenide, indium gallium arsenide, Gallium Nitride are used as semi conductors in the medium of lasers. To fire the laser the medium of laser must reach the energy non thermal for distribution, which is known as population inversion. The pump source helps in achieving this, that ultimately provides the external source energy for the medium to ultimately reach the population medium. The main source of the pump might be comprised of electrical discharge, flash lamp, or arc lamp or may comprised of chemical reaction. The medium source helps in determining the choice of pump, i.e. which source of pump is need to be selected.⁴⁻⁷

1.2. Different types of lasers

1. Emission type of lasers, that constitute of whether it is spontaneous type of emission or stimulated type of emission.
2. Power output i.e. whether the laser is high powered, medium powered or light powered.
3. Medium i.e. the laser is constitute of which type of active medium with in it i.e. solid active medium, liquid active medium or gaseous active medium.
4. Tissue target i.e. whether the laser is hard tissue target laser or it is soft tissue target laser.
5. Source of the laser i.e. whether the laser is continuous laser type, that includes carbon dioxide laser or diode laser or whether the laser is of pulsating type.
6. Contact mode of the laser, that includes whether the tip of the laser is in contact with the soft or the hard tissue or whether the tip of the laser is near the target tissue bt not in direct contact of the tissue.

1.3. Different uses of lasers in the field of orthodontics

Etching: - lasers can be used for the purpose of etching the surface of the enamel or the dentine superficial surface for the purpose of the bonding of the brackets. A study revealed that laser Er,Cr:YSGG which is used for etching of enamel when compared with the etching of ortho phosphoric acid with the concentration of 37 percent, produces same results, when compared with the 37 percent phosphoric acid. Etching results by the action of lasers i.e. it splits the bond between the organic and inorganic component of the tooth, that ultimately results in the evaporation of the content of the water, finally results in micro cracks over the tooth surface and results in etching of the surface of the tooth.²

Bonding: lasers can also be used in the process of bonding of metal or ceramic brackets to the superficial surface of the tooth.

Demineralization resistance: lasers helps in increasing the demineralization resistance of the tooth. A study revealed that, the tooth structure that is treated with lasers shows more resistance to the acid. It also helps in reducing caries susceptibility over the tooth surface that is treated with laser. Irradiation around the brackets is the new method of reducing the demineralization process along with the process of the fluoride therapy.

Debonding: lasers are quite helpful in the process of debonding of ceramic brackets. literature revealed that debonding of ceramic brackets is done by three mechanism, i.e. first is by the process of thermal softening, which includes softening of the bonding agent and results in slippage of the bracket. The second mechanism is by ablation thermal, which includes rapid heating process which ultimately increases the resin temperature upto vaporization that ultimately results in slippage of the ceramic bracket, the third mechanism is photoablation, which includes high laser energy light interacts with the resin material and lysis the bond of the adhesive material which results in break down of the atoms of the adhesive resin and ultimately results in slippage of the ceramic bracket and the process of debonding is done.

Relief from pain: lasers also helps in relieving the pain after the placement of the separators are done. Literature revealed that the use of lasers helps in reducing the pain sensation by increasing the blood circulation which finally results in removal of pain mediators and finally increases the activity if the cells.

Orthodontic tooth movement: literature revealed that low laser therapy increases the orthodontic tooth movement this is attributed to increased revascularization, bone remodeling along with synthesis of the collagen.

Removing soft tissue: literature revealed that soft tissue ablation, due to high absorption in soft tissue as compared to hard tissue results in removal of soft tissue around the impacted tooth in controlled manner. It can also be used for the procedure of crown lengthening. Literature revealed that

lasers used in the study was Diode laser with the wave length of 810 – 980nm and Er:YAG laser with the wave length of 2780- 2940 nm.

Designing of bracket: lasers are used in designing of the meshwork of the brackets. Computer aided lasers are used in designing the retentive tags of the lasers. They utilized laser cutting which ultimately results micro or macro tags in the brackets which act as undercuts and provides passive retention to the brackets.¹⁻⁸

1.4. Different effects produced by the lasers

Photo thermal effect: - when the light energy enters the target tissue, it is transformed in to heat and results in vaporisation of the cells of the target tissues. This effect is generated when the laser energy is absorbed by chromophores it results in release of heat subsequently.

Flourescence: This phenomenon of the lasers can be used as a diagnostic purpose, when a wave length of 655nm is used as a diagnostic purpose.

Photodisruptive Effect: This produces a thermo-mechanical acoustic shock that is capable of disrupting enamel and bony matrices efficiently. This shock wave creates distinct popping sound heard during Erbium LASER use. Thermal damage is very unlikely with no residual heat.

Photochemical: chemical reaction with in the tissue.

Biostimulation: helps in increasing the speed of healing, helps in increasing the circulation and also helps in reducing the pain.

1.4.1. Advantages

1. Portable
2. Compact, handy
3. Most of the lasers are wire less.
4. Quite easy to use
5. Very simple to operate
6. Helps in reduction of pain sensation
7. Helps in providing blood less field.

1.4.2. Disadvantages

1. High cost
2. Less tactile sensation is felt with the lasers
3. Training is required for the proper use of lasers.

2. Conclusion

In the present time, lasers plays an important role in reducing the time of the treatment, helps in reducing the post operative pain, helps in minor oral surgical procedure like frenectomy, gingivectomy and exposure of impacted tooth. So a proper and thorough knowledge of lasers is required to work properly with it. The use of lasers very much helpful

in providing better results.

3. Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

4. Source of Funding

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