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Recent Advanced Esthetic Laser Procedures In Orthodontics: A Literature Review.

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ABSTRACT

Orthodontists and the specialist in various fields of dentistry utilizes the advantages provided by the lasers during treatment. There are various types of dental lasers that can be competently used for soft and hard tissue applications in the field of orthodontics. The orthodontic procedure such as bonding, de-bonding and the and other procedures like frenotomy, exposure of canine, and gingivectomy can be done with lasers. For the successful treatment results, knowledge about laser features such as wavelength, timing is necessary. Use of the laser in orthodontic treatment is shown to be an important tool to increase specificity, ease, cost-effectiveness and comfort of the dental treatment. In this article we reviewed the different types of lasers, features, and their application in field of orthodontics.

Keywords: Hard tissue, soft tissue, wavelength, specificity, resin residues, frenectomy, gingivectomy.

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INTRODUCTION

LASER an abbreviation that stands for Light Amplification by the Stimulated Emission of Radiation. A laser is a single wavelength of light that travels through a collimated tube and delivers a concentrated energy source. The elements in periodic system like atoms, molecules, gases, diodes, electrons or chemicals can be used as a media to develop a laser beam. [1] The first Laser in dentistry to use visible light for the various applications was developed by physicist Theodore H Maiman in 1960.[2] The application of Laser in orthodontics include tooth movement acceleration, remodeling of bone, etching of enamel before bonding, ceramic brackets de-bonding, gingivectomy, frenotomy, holography, spectroscopy, 3D laser scanning, micro-welding, impacted teeth management, and reduction of pain after applying orthodontic force. [3]

COMPONENTS OF LASER

Three necessary components of lasers are

- Laser medium
- Pump Source
- Optical resonator. (fig:1)

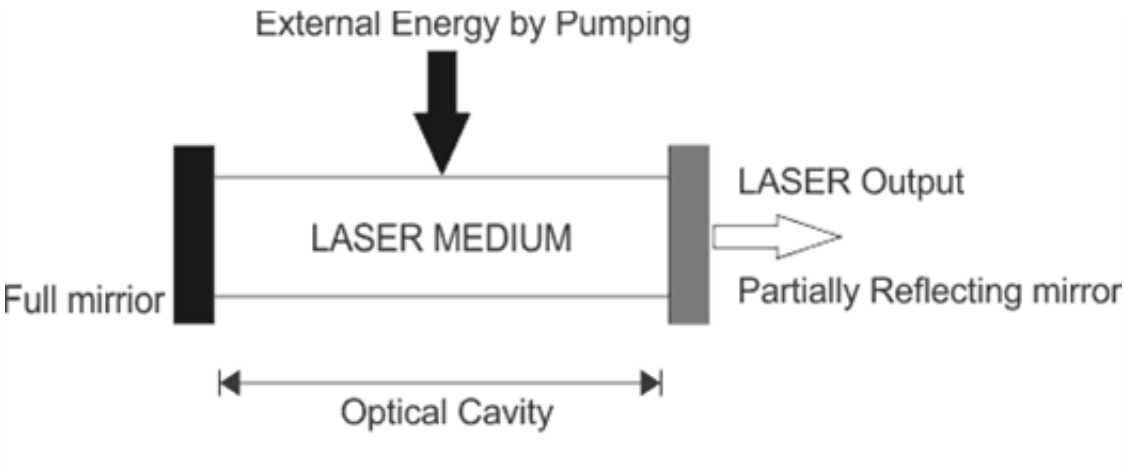

Figure 1: components of laser

Laser Medium

This act as a 'dynamic element'. The different types of laser medium are gas, dye, solid-state element, or semiconductor. The output of wavelength is determined by medium, which effects the usefulness of the laser at target site.

Pump Source

Once light-energy starts to emit, the pump source will arouse the lasing medium. The few types include electrical discharges, flash-lamps, arc-lamps, or chemical reactions. The pump source to be used depend on the variety of laser medium. The principal function of the laser optical resonator is to amplify the light energy. It has a section of mirrors that has laser medium. The mirror reflects the light-energy released from the laser back to it, which is known as feedback. Feedback is amplified by emission prior to the exit of cavity. The laser system operating wavelength is determined by the alignment of the mirror concerning the laser medium. The pump source stimulates the laser media to release the laser beam within the laser machine, passes through the optical cavity and gets amplified. The light energy produced from the laser machine is known as laser beam. The light energy enters the target tissue and is converted into heat energy. This process is known as photo-thermal effect. This results in target tissue cell's vaporization. [4]

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Properties Of Laser

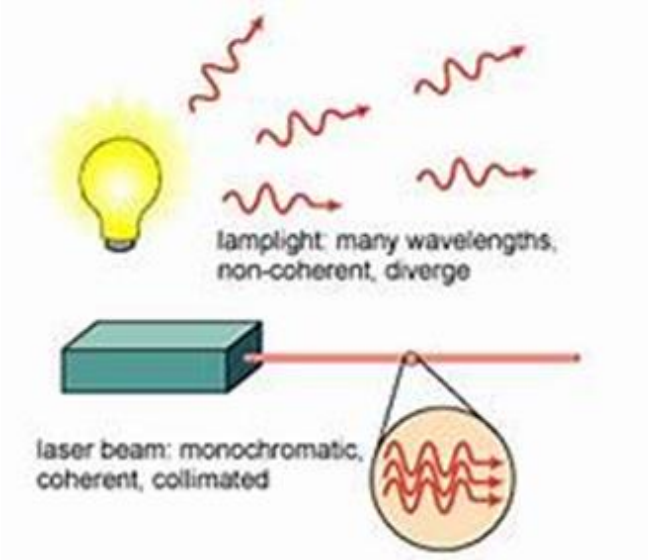

Figure 2: Properties of Laser

- Monochromatic
- Directional
- Coherent

Monochromatic

The laser emits the light which is homochromatic or has a wavelength from ultraviolet to infra-red. This feature is significant for the high spectra power density of the laser beams. [5]

Directional

The laser beam that exits from the laser device has low divergence or no divergence and travel parallel. The beam emitted has a constant size and shape. Laser light maintains brightness as it does not diverge over distances. This features is significant for sound conduction through the delivery system. [4,5]

Coherent

Laser light waves formed are substantially identical. The two forms of laser light coherence are longitudinal and transverse. The collimation of a laser beam proceeds over large distances in-return an excellent focusing can be achieved. [5] (fig: 2)

Types Of Lasers

The different types of lasers are

Argon laser
CO2 laser
Erbium laser
Diode laser
Nd:YAG laser
Ho:YAG laser.

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Argon Laser

The active medium is argon gas. The two wavelengths are 488nm (blue) and 514nm (blue-green). It is commonly used in gingival surgeries and caries detection as it illuminates the tooth. [6, 7] (fig:3)

Figure 3: Argon laser

CO2 Laser

This is the type of gas active medium laser. It works with the wavelength which is invisible. The fiber optic system contains He-Ne laser with the wavelength of 632nm. It is used as an aiming beam. The disadvantage is that it does not contact the tissue. No tactile response is produced at time of surgery. [7] (fig: 4)

Figure 4: CO2 Laser

Erbium Laser

The wavelength of erbium laser is 2790nm to 2940nm and also has the advantage of cutting soft tissues. The main disadvantage is that it cannot control bleeding. [8]

Diode Laser

The wavelength of diode laser is 812nm to 980 nm. This wavelength is equal to rate of absorption coefficient of melanin. It acts as an excellent hemostatic agent as the energy of laser is engrossed by coloration of the tissues. It is used in contact mode as it provide tactile feedback during the surgical procedure. It has an advantage that anterior soft tissue surgery can be done without anesthesia, without bleeding and no discomfort. [6,8] (fig:5)

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Figure 5: Diode Laser

Nd: YAG Laser

The crystal of yttrium-aluminum-garnet is doped with neodymium. It is initial laser completely intended for dentistry. The wavelength is 1064nm. There are mostly used in periodontal procedures like debridement of sulcus, carious lesion vaporization. [6]

Ho: YAG Laser

The crystals of yttrium-aluminum-garnet doped with holmium act as the active medium, where the wavelength is about 2120nm. Rate of absorption by water is greater than Nd: YAG. Arthroscopic surgery of the temporomandibular joint can be done using this laser. [6,7, 9]

Low-Level Laser Therapy

Low-level lasers can stimulate epithelialization, vascularization, and collagen synthesis due to their photochemical and photo-biological effects. Low-level lasers show effective pain reduction action and enhance the orthodontic tooth movement rate as they increase bone remodeling rate without imposing any adverse effect. [10] The effects of LLLT depends on factors such as total dose, intensity, and frequency of the irradiation. If LLLT is used in maxillary mid palatal suture expansion, there will be reduced tendency of relapse, and retention period. [10,11]

Indications For Aesthetic Laser Treatment

The main motive of the orthodontist is to provide the best esthetic treatment result. The most serious application of lasers in orthodontics is cosmetic gingival contouring and providing the best esthetic results. [12]

Gingival Recontouring

It plays a major role in the aesthetic outcome of the case after finishing the treatment. Excessive gingiva display, uneven gingival contour, disproportionate crown height, and width that are less than the ideal value will affect the aesthetic outcome. Aesthetic gingival recontouring is done usually for upper arch from canine to canine. The upper incisors gingival margins are placed at the inferior border of lower lips on the time of complete smile ideally. [13,14] The excess display displaying a gingival margin of more than 2 mm is undesirable. The recommended laser settings are diode laser of 1.0-1.5W, erbium-solid state laser of 1.5-2.5W. During gingivectomy, topical anesthetics are applied, and a probe is used to mark height guides. Leave 1mm of sulcus after preserving biologic width. The gingival contour is marked by using the laser points. The laser power of 1.2 watts is established. The laser is positioned perpendicular to the tissue of gingival margin. By smooth and constant motion, completely eliminate the excess tissue and the surrounding area is cleaned with a micro-brush or cotton roll with 3% hydrogen peroxide once the ideal contours are achieved. [6, 13, 14] (fig: 6)

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Figure 6: A, Pre-op Gingival contour B, post-op gingival contour after treating with Laser

Frenectomy

A low frenum attachment will cause large diastema, which further causes spacing. The treatment for this case includes closing the space and performing a frenectomy. [14,15] Throughout the surgical excision of labial or lingual frenum, the patient's lip or tongue is griped by 2 X 2 gauze and lifted. The frenum is pulled back and opened in shape of rhombus. The procedure is finished very quickly. Soft tissue laser is more often recommended for frenectomy as no sutures and dressing is needed, bleeding can be controlled. [15] (fig: 7)

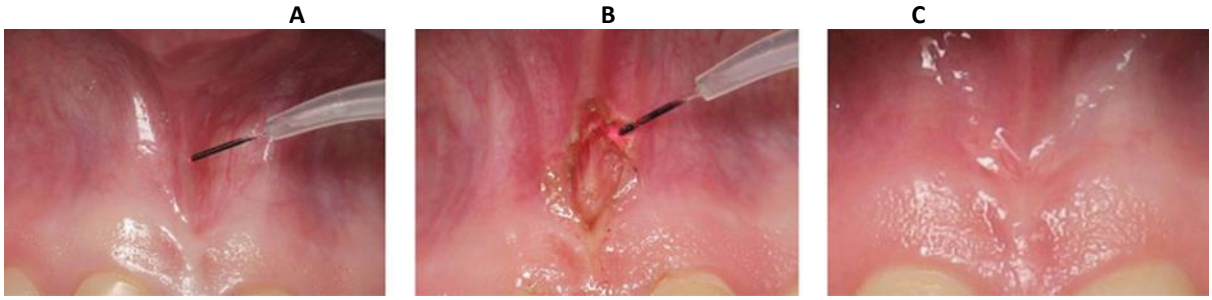

Figure 7: A- Pre-op frenal attachment B- Frenectomy by Laser C- Post-op Frenectomy

Papilla Flattening

It is the procedure performed for thinning, reshaping, removal of loose or bulbous papilla mainly in the upper anterior. It is always performed with the gingivectomy or gingivoplasty. [6, 13, 14] Ideal gingival contour is knife-edged interdental papilla. If the patient presents with bulbous papilla after the space closure procedure, it is because of poor oral hygiene, thick fibrotic tissue. This procedure is completed by functioning the laser at low wattage and moving it from side to side position to peel the attached tissue layers. The recommended laser setting for this procedure includes diode laser: 1.0–1.5 W, erbium-doped solid-state Laser: 1.5–2.5 W. [16] (fig:8)

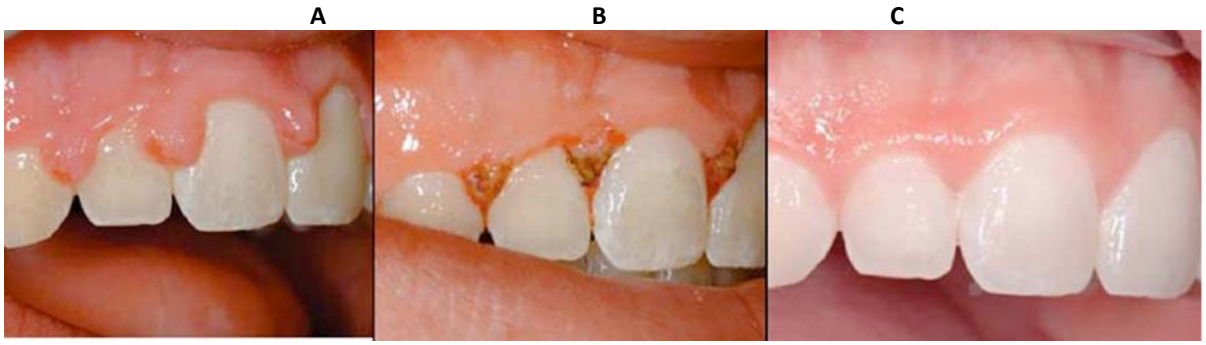

Figure 8: A- patient with enlarged interdental papillae and fibrotic gingival margins. B- Instant result after treating with laser. C- post-op After four weeks the tissues readily heals, and gingival contours gets enhanced. [14]

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Bonding

The most common light-curing adhesives are argon laser. The procedure of light curing is similar to the conventional method of light curing. Here the surface of enamel is etched for 15 seconds with 37% phosphoric acid and the surface is treated with Mega bond. The adhesive precoated brackets are positioned on the enamel surface. Then the tip of the laser is held 0.5mm away from the bracket, and the light-curing is placed touching the bracket. When the Argon laser are at the energy levels of 1.6 to 6 watts, they cause no damage to the enamel. The ten seconds of curing by the argon laser will produce the high bond strength than the other conventional curing light. [18] (fig: 9)

Figure 9: Bonding of brackets to the tooth surface using Laser

Debonding Of Ceramic Bracket Procedures

Ceramic bracket is well known for their aesthetic property compared to other metal brackets. A significant disadvantage of this bracket is its brittleness, as it is difficult to remove. Different laser devices such as carbon dioxide, Nd-YAG, and the Er-YAG laser can worsen the adhesive resin that grips the bracket, thus causing the debonding process. [18] The laser-aided bracket has the advantage of producing the heat to the localized area. This method is applicable for various bracket designs. Exposure of CO2 Laser on brackets for two seconds provide an efficient debonding process. Diode laser will reduce the force that is necessary for monocrystalline ceramic brackets. Er-YAG laser will reduce the force needed to eliminate polycrystalline ceramic brackets [19] (fig: 10)

Figure 10: Debonding of ceramic brackets using lasers

Management Of Aphthous Ulcer:

The low-level lasers play an important role in treating aphthous ulcer. It stimulates the reepithelization of wounds. It is an easy, fast, and pain-free procedure. It has the advantage that it can be performed without causing any side effects and no risk of overdose medication. [6] The techniques involve the Laser with a shallow wattage setting and it should not contact the ulcer. The laser is activated for 30 seconds and the pain is eliminated. Later the wound will heal and vanish one day after the laser treatment. [6, 16] (fig:11)

Figure 11: Management of Aphthous ulcer using Laser

Exposure Of The Tooth And Placement Of Brackets

The orthodontic treatment is maximumly progressed late because of the incomplete or late eruption of the teeth. It leads to difficulty in placing the brackets to the tooth as it causes difficulty for the access of labial surface of the tooth. Using a laser, we can remove the excess tissue and can place the brackets in the same visit. [6,8] (fig: 12)

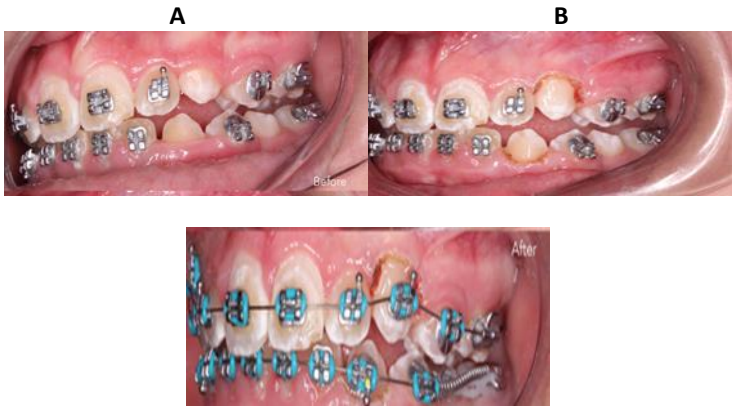

Figure 12: A- Pre-op Before the exposure of canine B- Exposure of canine by using laser C- Post-op Exposure of canine and placement of Brackets.

Removal Of Operculum

The other problem faced during the orthodontic treatment is the presence of operculum. It will affect the placement of the band in the second molar at certain conditions. The soft tissue laser can remove the operculum, and it allows banding at earlier times. [15] (fig:13)

Figure 13: Removal of Operculum by Laser

CONCLUSION

The above aesthetic procedures using the Laser will remain the effective treatment of choice in orthodontics. Since laser introduction in the dental profession, it provides significant treatment results for both hard tissue and soft tissue procedure. In future, with the decrease in cost, proper laser exposure protocol, the Laser will play an essential role in orthodontic treatment.

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