

LATEST ADVANCEMENTS AND APPLICATIONS OF LASERS IN THE FIELD OF PROSTHODONTICS: A REVIEW

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DOI: 10.47750/pnr.2022.13.S06.536

Abstract

Laser is no more new entity in the field of dentistry. Mostly lasers therapies are related to the improvement of facial esthetics however, intraoral uses are also imperative. Laser therapies are also advised for minor oral surgical procedures with minimum bleeding. Lasers in prosthodontics may also be used in fixed or removable prosthesis, implantology and in case of maxillofacial rehabilitation. In fixed Prosthodontics, lasers are mostly used for crown lengthening and associated soft tissue management. In oral implantology, lasers are primarily advised for implant site making, associated gingival modifications and other nearby soft tissues management. In removable Prosthodontics, lasers are highly recommended in certain pre-prosthetic surgeries before planning actual prosthesis. Pre prosthetic surgeries performed by lasers usually exhibit clear operatory field and optimal access due to less bleeding and trauma. Therefore considering all these imperative points in mind, this article was planned to discuss the latest advancements and applications of lasers in the field of prosthodontics.

Keywords: Gingiva, Implant, Lasers, Prosthodontic, Surgery.

Introduction

Laser is a short form which stands for Light Amplification by Stimulated Emission of Radiation. Laser has been used in many fields of day to day life including life sciences. The early 20th century evidenced this remarkable discovery in science & technology. In fact the LASERS had become a gift to health sciences and medicine.^{1,2} Many of the researchers have experimented this concept but Albert Einstein is typically appreciated for the early development of the laser technology. Albert Einstein had also become the first researchers to think up the term “Stimulated Emission” in his manuscript. The applications of Lasers in the field of medicine have actually opened newer avenues for several newer therapies.^{3,4} In the field of dentistry, it has actually opened newer standard of care. Mostly, applications of Lasers are for cosmetic and esthetic treatment. Many of the pioneer workers have

demonstrated that the application and use of Lasers in prosthodontics in fixed dental Prosthodontics enhances the overall efficiency of treatment with excellent prognosis. Both dentist and patients are benefited with such modalities. Laser application also shows better responses with wound healing and post surgical recoveries.^{5,6} Literature has well evidenced that methodical knowledge of Lasers are very imperative specially about their wavelength and intended tissue so as to enable clinician for perfect planning and execution of the planned treatment. Laser is actually created by low convergence of beam of radiation with different wavelengths. They are in red color of infrared spectrum of visible light. Most commonly used Lasers in prosthodontics are CO₂, neodymium-doped yttrium aluminum garnet (Nd:YAG).^{7,8} Therefore, this article was planned to discuss the latest advancements and applications of lasers in the field of prosthodontics.

Historical Background

History of clinical laser is not very old and it was extensively worked during 1990s itself. Many clinicians postulated the clinical usage of laser in early 1990s when they presented several clinical papers and concepts about its medicinal use. Earlier, Thomas Mailman exposed extracted sound permanent tooth to prototype Ruby. He exposed at wavelength of 694. He primarily focused upon the quantification of laser energy related to laser beam. Goldman along with Jako developed Nd:YAG, CO₂ lasers from normal regions of oral mucosa during minor oral surgical procedures. Later on few other researchers had clinically proved the efficiencies of pulsed Er:YAG lasers tested at wavelength 2780.^{2,6,8,14}

Classification of Lasers

Lasers can be classified on several basis. According to the wavelength (nanometers) it can be UV (ultraviolet) range – 140 to 400 nm, VS (visible spectrum) – 400 to 700 nm, IR (infrared) range – more than 700 nm. Infrared region or range is the most favorable wavelength band of most of the clinical usage. Alternatively lasers can also be classified as per intended works like Hard laser (for surgical work), CO₂ lasers (CO₂ gas), Nd:YAG lasers (Yttrium-aluminium-garnet crystals dotted with neodymium), Argon laser (Argon ions). Soft laser (for biostimulation and analgesia) are also available and they are He-Ne laser, Diode lasers. As per the mode of delivery of laser, laser can be classified as articulated arm (mirror type), Hollow waveguide, and Fiber optic cable. According to the type of active medium used; lasers are Gas lasers, solid lasers, semi-conductor or dye lasers. As per the type of lasing medium; lasers can be classified as Erbium:Yttrium, Aluminum Garnet. According to pumping scheme lasers may be optically pumped laser and electrically pumped laser.^{10,11,12}

Usage in Prosthodontics

As we all are aware that the final success of any prosthesis is mostly depended on the acceptance and reactions of the surrounding soft and hard tissues. In complete denture prosthesis, prototyping and computer aided designing or computer-aided manufacturing technology is basically utilized with laser technology. Rapid prototyping is actually a method to robotically prepare physical replicas of information and details received from computer aided designing. Therefore, rapid prototyping is actually working as a three dimensional copier which enables clinicians to fabricate clinically accepted precise prosthesis.^{13,14} Basically, metallic denture base is fabricated by using computer aided designing or computer-aided manufacturing technology with laser technology. Few of the supporting logistics are laser scanners, standard software, and copied denture foundation with encoded data information. This technology actually fabricates the denture vase in a layering (layer by layer) technique. However, in extreme situations, patients may be advised for undergoing suitable pre-prosthetic surgery to enhance the performance of the prosthesis with optimal acceptability. Many of the researchers have also shown successful use of Lasers for clinically managing highly resorbed ridges, hyperplastic tissue and other malformed or abused tissues. Treatment of unsuitable alveolar ridges is also an imperative use of laser in Prosthodontics. With the advancing age, we notice alveolar ridge resorption due to systemic factors, hormonal factors and worsening of tooth supporting system. In fact, alveolar ridge resorption is usually multi-factorial in origin and generally

irreversible. In females, alveolar ridge resorption is seen at faster rate when compared to males. In a normal pattern of alveolar ridge resorption, vertical and lateral slopes of bone use to resorb concurrently make flat ridge platform. Alveolar ridge resorption also depends upon patients history of oral hygiene habit.^{9,12,15,16}

In complete dentures, clinical management of alveolar ridge's undercut can also be achieved successfully by laser technology. As per many researchers nominal bony undercut can be ignored and help in denture stability. However when there is severe undercut or bilateral undercut, the situation is not that easy to handle without surgical intervention. Usually, maxillary anterior region represents highest incidence and prevalence of bony undercut of the oral cavity. Therefore it is deemed necessary to manage these undercuts surgically before instituting prosthodontic therapy. Commonly all these laser based management is performed by using Er group of Lasers. Additionally all interrelated soft tissue treatment is executed by CO₂, diode and Nd:YAG lasers. Clinical management of enlarged maxillary tuberosity is also achieved by using right type and correct dose of lasers. Maxillary tuberosity usually created in the third molar region when there is absence of opposing dentition of occlusal stop. This actually leads to the development of hyperplastic tuberosity which mostly contains hyperplastic soft tissues.^{4,8,14} Any Prosthodontic intervention must be planned after due management of these irritating ridge region. Any ignorance of the maxillary tuberosity during the prosthetic planning may lead to ultimate failure of the treatment as well as prosthesis.

Amongst all the fields of Prosthodontics, fixed Prosthodontics is one area where lasers are extensively utilized. Clinicians must take care of the correct selection of laser type with suitable wavelength for a particular therapy. Crown lengthening procedure is actually important when there is insufficient clinical crown available to make accurate fixed Prosthodontics impressions and related crowns. Commonly, clinicians perform surgical exposure of the crown down to the free gingival margin to increase the effective length of crown.^{16,17} This is traditionally achieved by making standard incision in gingivo-incisal direction. Laser based Crown lengthening is considered superior than traditional surgical Crown lengthening since laser Crown lengthening cuts only at the tip and may be positioned parallel to long axis of the tooth during bony removal without much destruction. Crown lengthening may be performed by excising gingival tissue effectively.^{11,13,18} However, Crown lengthening can also be achieved by excising hard tissue by employing Erbium lasers. This way Crown lengthening can be done even without raising the flap.

Laser based troughing is also very popular laser based dental intervention which enables clinicians to make accurate impressions in fixed Prosthodontics. Lasers are primarily used to make a trough around the tooth prior to impression making. So, effectively it is an alternative to the traditional gingival retraction cord. Many of the pioneer workers have experienced that use of gingival retraction cord is very cumbersome and need other supports like haemostatic agents.^{19,20} Gingival retraction cord system is also a highly technique sensitive procedure which necessitates highly skilled operators. Lasers are also utilized effectively for modification of soft tissues around laminates. Lasers are also employed for clinical management of soft tissues around abutment. All procedures related to osseous crown lengthening is successfully achieved by lasers. In spite of these usages in fixed Prosthodontics, lasers are also used successfully for formation of oval pontic sites, removal of veneer and bleaching by diode lasers

In oral implantology, lasers have been extensively experimented and worked out since its inception. Primarily lasers are utilized in the atraumatic removal of failed implants. This kind of implant recovery is usually hassle free and easy to perform. Lasers are also used for exposing the implant site for making implant level impressions and related laboratory steps. Literature has well evidenced about minimum tissue shrinkage with laser therapy. Laser can also be utilized for effective preparation of implant placement site. It is predominantly indicated for mini implant in extraoral prosthetics. In mini implant systems, there is a high risk of onsite bleeding therefore lasers may be employed for best suited results and outcomes. Lasers are also indicated for effective cleaning of abused tissue nearby the implant. During these procedures, operators may have optimal access of surgical field owing to bloodless field of surgery. Even in case of peri-implantitis also, lasers can be utilized effectively to remove all granulation tissue and other interrelated entities. This is how we can have the greatest advantage of laser therapy i.e. minimal heat generation. However, we must keep in mind about the right selection of laser for a particular situation since all lasers cannot be employed for all situations. For example Nd:YAG and Ho:YAG lasers are not suitable for peri-implantitis. Many of the researchers have also tried laser for sinus lift procedure.

Lasers can also be used in the sinus lift procedure. The sinus lift procedure can be attempted by lateral osteotomy with limited sinus membrane perforation. The yttriumscandium-gallium-garnet (YSGG) laser is the best choice for precisely handling the sinus membrane.^{21,22,23} Lasers also assist bone graft placement as and when required and it ensures minimum necrosis and lowest pain or swelling. In maxillofacial Prosthodontics, lasers primarily offer three dimensional view and details of almost all maxillofacial defects. Therefore it will significantly aid in the accurate diagnosis and perfect treatment planning for a particular situation.

Conclusion

Lasers have literally opened newer avenues for many traditional therapies and approaches. Lasers also offer several benefits over conventional methods and techniques. In Prosthodontics, lasers are expensively utilized in almost every aspect including oral implantology. Its right use is very beneficial however it can be harmful also if potentially mishandled. It is therefore deemed necessary for the operator to be highly skilled and qualified enough for laser use. Nevertheless, keeping patient's comfort and overall tissue health in mind, the type of laser therapy to be employed should be thought.

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