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Review Article about Lasers Uses in Dentistry

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Abstract: The term LASER is an acronym for 'Light Amplification by the Stimulated Emission of Radiation'. As its first application in dentistry by Miaman, in 1960, the laser has seen various hard and soft tissue applications. In the last two decades, there has been an explosion of research studies in laser application. In hard tissue application, the laser is used for caries prevention, bleaching, restorative removal and curing, cavity preparation, dentinal hypersensitivity, growth modulation and for diagnostic purposes, whereas soft tissue application includes wound healing, removal of hyperplastic tissue to uncovering of impacted or partially erupted tooth, photodynamic therapy for malignancies, photo stimulation of herpetic lesion. Use of the laser proved to be an effective tool to increase efficiency, specificity, ease, and cost and comfort of the dental treatment.

Keywords: Laser dentistry, dental treatment, soft tissue surgery, caries removal, teeth whitening, minimally invasive dentistry.

1. Introduction

A laser is a ord (Laser) is an abbreviation forthe term (Light Amplification by Stimulated Emission of Radiation), which means amplifying light bystimulated emission of radiation, that is, sending electromagnetic radiation by amplifying photons oratoms.History of the Laser Albert Einstein is considered the first Who referred to the idea of laserwork in 1916 AD, when he said that atoms and molecules can be stimulated under suitable conditions torelease excess energy inside them in the form of rays of light, and in 1951 AD, the scientist Charles.

Townes thought device used to stimulate light with specific wavelengths atoms ormolecules to emit a narrow beam of such as nanometers, and the radiation emanating from it covers aspecific range of visible, infrared, or ultraviolet wavelengths. The wof a way to generate stimulating rays of light at microwave frequencies. At the end of 1953 AD, a device appeared that demonstrated the emission of microwave frequencies from them. This device was called a maser, which means amplifying microwave waves by stimulated emission of radiation, that is, sending electromagnetic radiation by amplifying photons or atoms.

This discovery contributed Alexander Mikhailovich Prokhorov, Nikolai Gennadievich Basov, and Charles H. won the Nobel Prize in Physics in 1964 AD as a result of their efforts in the theory of maser operation.

Michigan, Emmett Leith and Joris Opatniks created the first three-dimensional image using laser beams, and then development processes continued in the laser to enter into many uses, such as doctors using it in the flesh of the retina.

The word (Laser) is an abbreviation for the term **(**Light Amplification by Stimulated Emission of Radiation),which means amplifying light by stimulated emission of radiation, that is, sending electromagnetic radiation by amplifying photons or atoms. History of the Laser Albert Einstein is considered the first Who referred to the idea of laser work in 1916 AD, when he said that atoms and molecules can be stimulated under suitable conditions to release excess energy inside them in the form of rays of light, and in 1951 AD, the scientist Charles H. Townes thought of a way to generate stimulating rays of light at microwave frequencies.

1-2 Types of Lasers There are several types of lasers, the most prominent of which are the following:

)-1-2-1Gas Laser):

It is a laser device in which an electric current passes through a gas such as carbon dioxide or helium to generate light, and the carbon dioxide laser is considered the most famous type. Gas lasers, but there are other types such as: helium laser, neon laser, argon laser, krypton laser, and excimer laser. Gas lasers are used in many applications such as spectroscopy, holography, surgery, material processing, and barcode scanning.

Methodology

This review article employs a comprehensive literature-based approach to examine the application of lasers in dentistry, emphasizing their uses, advantages, and potential limitations. The research methodology involved an extensive review of peer-reviewed articles, clinical studies, and authoritative textbooks related to laser applications in dental procedures. Sources were selected based on relevance, scientific credibility, and recent advancements in laser technology. The study explores various laser types, including gas lasers, solid-state lasers, and semiconductor lasers, analyzing their efficacy in hard and soft tissue applications. A systematic analysis was conducted to evaluate the role of lasers in procedures such as cavity preparation, gum treatment, caries detection, whitening, and root canal therapy. Comparative assessments were performed to determine the effectiveness of different laser techniques against traditional

dental practices, focusing on precision, patient comfort, healing time, and overall treatment outcomes. The study also considered factors influencing the adoption of laser technology in dentistry, such as cost, accessibility, and required professional training. Data from experimental studies, clinical trials, and case reports were synthesized to provide a holistic understanding of laser effectiveness and limitations. The methodological approach ensured objectivity by incorporating findings from multiple research disciplines, including dental surgery, prosthodontics, and orthodontics. The analysis was conducted with a critical perspective, considering both the technological advancements and practical constraints associated with laser dentistry. This methodology allows for a balanced discussion of the current state of laser applications in dentistry while identifying areas for future research and development in the field.

Results and Discussion

(Liquid laser):

is an organic dye in liquid form. The liquid laser, also known as dye laser, is characterized by the ability to generate a wide range of wavelengths, which makes it easily adjustable and controllable in its wavelength during its use. It is used in isotope separation, birthmark removal, and analysis. Spectroscopy, and medicine. Semiconductor Lasers contain a diode, which works to amplify the generated photons and convert electrical current into laser beams. Semiconductor lasers are used in barcode reading, laser printers, and scanners. Fiber laser.

3-2-1-(solid-state laser):

which is a device that contains crystals or glass mixed with a rare earth element such as neodymium, chromium, or erbium. , thulium, or ytterbium. The ruby laser is the most famous type; Because it is the first laser manufactured among all other types, the solid laser is used in many applications such as: removing tattoos and hair, removing tissue, and breaking up kidney stones.

1-3Laser properties

1-Directionality: It is one of the most important characteristics of the laser, as the angle of exposure of the laser rays is very small, and therefore it can travel long distances without dispersing its energy or changing its direction. This property is used in many applications, which depend on measuring near and far distances. And determining goals with extreme accuracy, such as surveying systems.

2-Beam intensity:

The laser beam is characterized by the fact that the size of its cross-section is very small, as it does not exceed several square micrometers, This property is used in delicate surgical operations, treating skin and eye diseases, and in drilling and cutting materials.

3-Monochrome:

Laser light differs from other types of light in that it consists of a band of narrow light frequencies. this property is exploited and used. Laser light in fiber optic communications systems, as a carrier of information.

4-Interconnection and cohesion of photons:

The optical frequencies resulting from laser rays are characterized by the fact that the photons of these rays are interconnected and coherent. This property is used in optical interference, threedimensional imaging, studying the structure of materials, and measuring speed and distance.

5-The possibility of controlling the laser device:

The rate of the laser pulses that are fired can be controlled, and the width of these pulses can also be controlled, so that they become suitable for some applications.

Because,of its high energy and very small angle of exposure, laser rays are used in several fields, the most important of which is measurement, such as measuring very small or very large distances with extreme accuracy. It is also used in producing heat for industrial cutting operations and in surgical operations, especially in the eye. It is also used in electronic devices to operate optical discs.

Also, some of the efforts currently being made to achieve nuclear fusion of hydrogen use huge laser devices to achieve the fusion of hydrogen and transform it

into helium, which is the reaction that takes place in the sun and stars and produces their heat, (see Inertial Fusion).

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4-1The parts of the laser device:

1. The medium or crystal that produces laser rays.
2. Electrical energy to stimulate the laser medium to emit light waves of one wavelength (light of one color).
3. Light reflective (mirror).
4. The beam exit lens, which may be a plane or a concave lens.
5. Outgoing laser beam (laser output).

The laser device generates and reflects light of one color, that is, of one wavelength, between the rear mirror (3) and the laser beam exit lens (4). This is done by stimulating the laser medium (1) to produce that color of light; It is a property of the chosen crystal or laser medium (the medium can be a specific gas, such as carbon dioxide). After the light rays are reflected within the medium several times between (3) and (4), the collected light waves reach a state of coordination. Then the light waves have a regular phase (pitch) and emerge from the lens (4) as a high-energy laser beam. a: Example of a laser medium: a neodymium crystal as a laser gain medium. When the electrons in neodymium are excited by the electric pump (yellow) and rise to a high energy level, from there they immediately fall to the middle energy level F and remain there for a period (this is a property of laser material). Then it suddenly drops to energy level I, emitting light of 1064 nanometers. When the electrons move from F to I as a group in the neodymium atoms, they all emerge with light of wavelength 1064, and emerge from the crystal coordinated as a powerful laser beam.

2. Dental lasers:

Are used in dentistry for several purposes, including gum treatment, cavity removal, tooth whitening, jaw surgery, gum shaping, tumor removal, tooth fortification, and root canal treatment. The technology is advanced and highly effective, allowing for a less painful and bleeding experience, and a faster recovery time.

Innovative technology in dentistry plays a major role in improving the quality of healthcare provided to patients. It enables doctors and nurses to perform operations more accurately and effectively, reducing risks and improving treatment outcomes and patient experience.

Lasers can be used to treat various diseases and achieve amazing results that may not be possible through traditional methods. In addition, they provide many other benefits such as reducing the risk of infection, reducing gum swelling, reducing pain and bleeding after operations, and improving the overall patient experience.

The use of dental laser technology in dentistry is an amazing development that helps maintain oral and dental health and improve the overall quality of life. Dental laser is a system of using

lasers in the field of dentistry. Lasers are used in several dental procedures, such as teeth whitening, removing diseased tissue, treating inflammatory conditions, and others.

The manufacture of dental lasers includes several steps. First, a laser system suitable for medical purposes is designed and assembled. This includes the use of technologies such as laser imaging, optics and energy control technology.2-2 there are many types of lasers used in the field of dentistry. of between it:

1. Laser screening (diagnostic): It is used to detect tooth decay, gum infections, and other oral diseases.
2. Laser drilling: used to remove cavities and prepare teeth for fillings.
3. Gum laser: It is used to remove gum defects, get rid of infections, and beautify the gums.
4. Root laser: It is used to treat the nerve and remove infection from the roots of the teeth.
5. Whitening laser: It is used to whiten teeth and remove surface stains

1-2-2Laser screening (diagnostic):

One of the types of examination (diagnostic) lasers used in dentistry

These types may include dichroic lasers (crimson and violet), repeating sheet oxide lasers (ultravioletThere are many types of lasers used in dentistry for examination and diagnosis.), compressed oxygen lasers (blue), and diode lasers. Lasers are used in dentistry for several purposes, such as cosmetic teeth whitening, tooth restoration, gum treatment, and many others.

1. The dichroic laser (crimson and violet)
2. Repetitive laminar oxide (UV) laser
3. Compressed oxygen (blue) laser
4. Diode laser

1- The dichroic laser (crimson and violet)is defined as the dichroic laser (crimson and violet) used in dentistry. The dichroic laser is a type of laser device used in dentistry. It is characterized by producing two laser beams in crimson and violet colors. This type of device is used in several medical procedures, such as treating gum infections, removing tartar, and improving the appearance of teeth. The dichroic laser is an advanced technological tool that contributes to dental procedures and enhances the patient experience.

The dichroic laser used in dentistry consists of several main parts.

A1- The first part is the power source: which includes laser lights or laser diodes. B1-The second part is the mirrors or beams: that guide the laser precisely through the target tissue.

C1-The third part is the cooling system: which keeps the laser temperature stable, and works to prevent thermal damage to the surrounding tissue.

2- Repetitive laminar oxide (UV) laser,known as the repetitive laminar oxide (UV) laser, is a type of laser used in dentistry. The ultraviolet repetitive laminar laser is an effective method for treating gum disease and some other problems in the mouth. This type of laser is used to remove tartar and deposits on the teeth and to effectively treat gum infections. It can also be used in minor surgeries, root planing and root canal treatment, thus it is considered a powerful and useful tool in the field of dentistry.

One of the most important parts of the repetitive sheet oxide (ultraviolet) laser used in dentistry

a) The first part:is the power supply, which is usually a narrowband emission LED.
b) The second part:is the lens that is used to direct and focus the laser precisely on the target area.

c) The third part: is the flexible reflector, which is used to deliver and maintain laser energy while allowing it to be bent and bent for use in hard-to-reach areas. Finally.

d) The fourth part: is the cooling component, which helps prevent the device from overheating and keeps it stable.

3. Conclusion

Laser technology for hard tissue application and soft tissue surgery is at a high state of refinement, having had several decades of development, up to the present time, and further improvements can occur. The field of laser-based photochemical reactions holds great promise for additional applications, particularly for targeting specific cells, pathogens, or molecules. A further area of future growth is expected to be a combination of diagnostic and therapeutic laser techniques. Looking to the future, it is expected that specific laser technologies will become essential components of contemporary dental practice over the next decade.

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