Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE

DOI: 10.53555/jptcp.v31i5.6411

APPLICATION OF LASER TECHNOLOGY IN DENTAL SURGERY AND RECENT ADVANCES IN ORO-DENTAL HEALTHCARE

Dr Prafull Pujari[1*], Dr Vrushti Ramanuj[2], Dr Navdeep Singh[3], Dr Manish Bishnoi[4], Dr. Aditya Kulkarni[5], Dr Smita Ranjan[6]

[1*](Oral & Maxillofacial Surgery), Senior Resident, AIIMS Rajkot (Gujarat)
ORCID- 0000-0001-7748-2931
[2](Conservative Dentistry & Endodontics), Senior Resident, GMERS Morbi (Gujarat)
ORCID- 0009-0004-6318-5580
[3] (Oral & Maxillofacial Surgery), MDS, Amritsar (Punjab)
[4](Orthodontics & Dentofacial Orthopaedic) Senior Lecturer, Darshan Dental College & Hospital, Udaipur (Rajasthan) ORCID - 0009-0000-5617-6513
[5](Prosthodontics and crown and bridge) senior resident, AIIMS Rajkot(Gujarat)
ORCID- 0009-0000-7888-449X
[6](Conservative Dentistry & Endodontics) , MDS, Patna (Bihar)

***Corresponding Author:** Dr Prafull Pujari
*(Oral & Maxillofacial Surgery), Senior Resident, AIIMS Rajkot (Gujarat)
ORCID- 0000-0001-7748-2931

ABSTRACT:

The field of dental surgery has witnessed remarkable advancements in recent years, driven by the application of laser technology and innovative developments in oro-dental healthcare. This abstract provides a concise overview of the evolving landscape in dental surgery, highlighting the crucial role of laser technology and the latest trends in oro-dental healthcare. The ability to precisely target and remove infected or damaged tissue has significantly reduced patient discomfort and recovery times. Moreover, lasers in dentistry have minimized the need for traditional drilling and scalpels, making treatments more patient-friendly. Recent advances in oro-dental healthcare extend beyond technology, focusing on holistic patient care and preventive measures. The advent of tele-dentistry has enabled remote consultations and follow-ups, improving access to oral healthcare services, especially in underserved areas. This article highlights the pivotal role of laser technology in advancing dental surgery, making procedures less invasive and more patient-friendly. Furthermore, recent trends in oro-dental healthcare underscore a shift towards holistic care, preventive measures, and the integration of cutting-edge technologies.

KEY WORDS: Laser Dentistry, Dental Surgery, Laser Applications, Oro-Dental Healthcare, Dental Lasers, Preventive Dentistry

1. INTRODUCTION:

The field of dentistry has undergone a profound transformation in recent years, characterized by remarkable advancements in both technology and patient care. One of the key drivers behind this evolution is the application of laser technology in dental surgery, which has revolutionized the way oral health issues are diagnosed and treated. Simultaneously, the broader landscape of oro-dental healthcare has seen significant progress, emphasizing holistic approaches, prevention, and the integration of cutting-edge innovations. Due to its many benefits over other conventional current procedures, laser (light amplification by stimulated emission of radiation) applications in dentistry and clinical medicine are now regarded as patient-friendly techniques. Lasers can be employed in a wide range of dental and clinical operations since they are available in a variety of devices and wavelengths. Over the past few years, lasers have increasingly been used in clinical medicine and dentistry. Lasers are recommended for a wide range of treatments due to their various benefits. Conventional cavity preparation techniques include low- and high-speed hand pieces, which can be noisy, unpleasant, and stressful for patients.

Recent advances in oro-dental healthcare extend beyond technological innovation, encompassing a holistic approach to patient well-being. The emergence of tele-dentistry, for example, has democratized access to oral healthcare services, making it possible for individuals in underserved areas to receive expert consultations and follow-ups remotely. This has not only improved accessibility but also fostered a more patient-centric approach to dental care.

Moreover, contemporary oro-dental healthcare trends emphasize preventive measures and personalized treatment plans. Dentistry is shifting from a reactionary model to one that actively preserves natural teeth and enhances overall oral health. Bioactive restorative materials, for instance, promote tooth remineralization and reduce the need for invasive procedures, offering improved longevity and aesthetics for dental restorations. Artificial intelligence (AI) and digital dentistry tools have also emerged as powerful allies for dental professionals, enhancing diagnostic accuracy, treatment planning, and patient outcomes through predictive analytics and customized recommendations.

Oral health is a fundamental component of overall well-being, and its significance cannot be overstated. Oro-dental healthcare, which encompasses the care and maintenance of the mouth, teeth, gums, and associated structures, plays a pivotal role in ensuring not only a healthy smile but also the prevention of various systemic health issues. This multifaceted field combines the art and science of dentistry to provide a comprehensive range of services aimed at promoting, preserving, and restoring oral health.

Oro-dental healthcare spans a broad spectrum of services, from routine dental check-ups and preventive measures such as cleanings and fluoride treatments to advanced restorative procedures like dental implants and orthodontic treatments. Moreover, the field continually evolves, adapting to emerging technologies and scientific advancements to enhance patient care.

Beyond the clinical aspects, oro-dental healthcare extends to patient education, emphasizing the importance of good oral hygiene practices and their impact on overall health. It also encompasses research and innovation, driving the development of new treatments, materials, and technologies that improve the quality of care and patient outcomes.

2. LASER TECHNOLOGY

Laser technology, which stands for "Light Amplification by Stimulated Emission of Radiation," is a branch of technology that revolves around the use of coherent light to perform various tasks, including cutting, welding, engraving, measuring, and even medical procedures. Lasers emit highly focused and intense beams of light that can be precisely controlled, making them versatile tools in various fields.

The term LASER is an acronym for ‘Light Amplification by the Stimulated Emission of Radiation’ and was first introduced to the public in 1959, in an article by a Columbia University graduate student, Gordon Gould[1].

A systematic review confirms that with the expanding use of lasers on both hard and soft tissue in clinical dentistry, treatment planning and prognosis have significantly improved. In many ways, the introduction of this technology has turned dentistry into a painless, bloodless industry with better predictability and instant outcomes[4].

2.1. Mechanism of Laser Action

Laser light is a monochromatic light and consists of a single wavelength of light. It consists of three principal parts: An energy source, an active lasing medium, and two or more mirrors that form an optical cavity or resonator. For amplification to occur, energy is supplied to the laser system by a pumping mechanism, such as, a flash-lamp strobe device, an electrical current, or an electrical coil. This energy is pumped into an active medium contained within an optical resonator, producing a spontaneous emission of photons. Subsequently, amplification by stimulated emission takes place as the photons are reflected back and forth through the medium by the highly reflective surfaces of the optical resonator, prior to their exit from the cavity via the output coupler[2].

Due to its many benefits over other conventional current procedures, laser (light amplification by stimulated emission of radiation) applications in dentistry and clinical medicine are now regarded as patient-friendly techniques. Lasers can be employed in a wide range of dental and clinical operations since they are available in a variety of devices and wavelengths. Over the past few years, lasers have increasingly been used in clinical medicine and dentistry[3].

Since the 1960s, lasers have been used in dentistry, and their clinical uses have been evaluated. Many dental procedures involve lasers, which are noted for their simplicity, efficiency, comfort, and superiority over older methods. Lasers have been employed in various therapy approaches, from identifying small caries to planning and treating more severe lesions or cancers[4].

2.2. Effects of Lasers

The otolaryngologists, periodontists, and oral surgeons were the first specialists who used medical lasers intraorally to perform surgical applications in the soft tissue. Laser surgery in the sites, which have a lot of bleeding like cheeks, the floor of mouth and tongue provides good access to and control for the surgery. Many researchers have seen that the effects of a laser can reduce the effects of edema because it seals the blood vessels and lymphatic channels properly. Other laser devices that are used for soft and hard tissue surgery produce the laser on the middle, near infrared part of the electromagnetic spectrum, with one exception which is the low-level laser in the range of 810nm. Surgical diode lasers ranging between 800-830 nm diode use an active medium which consists of aluminium, gallium and arsenate; this media is also used in a 980 nm diode laser as well as that of a 1064 nm diode laser. Nd-YAG lasers include YAG which is the crystals of yttrium scandium, gallium and garnet doped with erbium and chromium; however, Er;YAG at a wavelength of 2940 nm uses erbium as the doping agent and a wavelength of 10 600 nm utilises carbon dioxide.[5]

2.3. Types of Lasers Used in Dentistry

There are different ways by which lasers are used in dentistry.

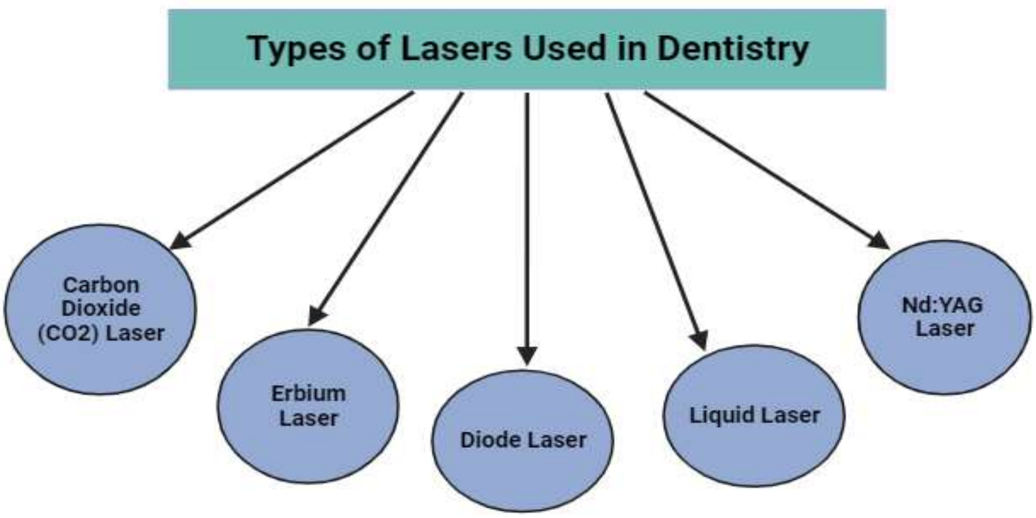

Fig- 2.1:Types of Lasers Used in Dentistry

2.3.1. Carbon Dioxide (CO_2) Laser

The CO_2 laser is a gas-active medium laser that incorporates a sealed tube containing a gaseous mixture with CO_2 molecules pumped via electrical discharge current. The light energy, whose wavelength is 10,600 nm, is placed at the end of the mid-infra-red invisible non-ionizing portion of the spectrum, and it is delivered through a hollow tube-like waveguide. The CO_2 laser's ability to provide the required power in continuous and gated modes using focused or non-focused hand-pieces gives this instrument the versatility and precision required for soft tissue surgical procedures[6].

Although many laboratory and clinical studies have been conducted with CO_2 lasers on dental hard tissue, only re-cently could these findings be clinically implemented be-cause there is currently only one 9300 nm CO_2 dental laser.

CO_2 lasers are particularly well-suited for soft tissue surgeries in dentistry. These procedures involve the manipulation, removal, or reshaping of the oral mucosa, gums, and other soft structures within the oral cavity. The high absorption of CO_2 laser light by water and the precise control it offers make it a valuable tool for these applications[7].

CO_2 lasers can also be utilized for hard-tissue procedures, although they are less commonly used for this purpose compared to other laser types like erbium lasers. Hard tissue surgeries involve the removal, ablation, or modification of dental hard tissues, primarily enamel and dentin[8].

2.3.2. Erbium Laser

Erbium hard tissue lasers have the capability to prepare enamel, dentin, caries, cementum, and bone in addition to cutting soft tissue. The ability of hard tissue lasers to reduce or eliminate vibrations, the audible whine of drills, microfractures, and some of the discomfort that many patients fear and commonly associate with high-speed handpieces is impressive. In addition, these lasers can be used with a reduced amount of local anesthetic for many procedures[9].

The erbium laser wavelengths (2.94 and 2.79 µm) are strongly absorbed by water and mineral; at 2.94 um, there is a strong absorption in water (800 cm) while the 2.79-um wavelength is coincident with a narrow hydroxyapatite ab- sorption band (400 cm ^{1})[10].

2.3.3. Diode Laser

Use of diode lasers in dentistry has grown in popularity over the years. When used by a properly trained and licensed dental professional and proper protocols are observed, efficacy of diode laser use for many procedures is possible. It is important that specific protocols be followed when using the diode laser to ensure safety of both patients and providers[11].

Diode laser is one of laser systems in which photons are produced by electric current with wavelengths of 810, 940 and 980nm. The application of diode laser in soft tissue oral surgery has been evaluated from a safety point of view, for facial pigmentation and vascular lesions and in oral surgery excision; for example frenectomy, epulis fissuratum and fibroma. The advantages of laser application are that it provides relatively bloodless surgical and post surgical courses with minimal swelling and scarring. We used diode laser for excisional biopsy of pyogenic granuloma and gingival pigmentation[12].

2.3.4. Liquid laser

A liquid dye is stimulated by liquid lasers to produce light radiation. Most of their "tunable" range is between 550 and 590nm. Their light can be seen. Dye lasers are frequently utilised for vascular reasons, including the treatment of rosacea, spider nevi, and angiomas in children and newborns. Other disorders, like psoriasis, where it is beneficial against new lesions, are treated with this type of laser less commonly[13].

2.3.5. Neodymium Yttrium Aluminum Garnet Laser

Nd:YAG lasers are used in both soft and hard tissue dental applications. They are commonly employed for periodontal procedures such as pocket sterilization and decontamination. Nd:YAG lasers can effectively remove soft tissue and calculus from root surfaces.

Nd:YAG lasers operate on the principle of light amplification by stimulated emission of radiation. The laser medium in these devices is a synthetic crystal composed of yttrium, aluminum, and garnet

($Y_3Al_5O_{12}$) into which neodymium ions (Nd^{3+}) are introduced as dopants. When energy is applied to the laser medium, it excites the neodymium ions, causing them to emit laser light at a specific wavelength of around 1064 nano-meters (in the near-infrared spectrum).
The combined application of Nd:YAG and Er:YAG laser irradiation as an adjunct to conventional non-surgical therapy showed a significant beneficial effect on periodontal treatment results[14].

3. RISING TRENDS IN ORO-DENTAL HEALTHCARE

Orodental healthcare, which encompasses the interconnected realms of dental and oral health, is not immune to the rapid advancements and transformative changes occurring in the broader healthcare industry. These trends represent a response to evolving patient expectations, technological breakthroughs, and a heightened awareness of the crucial role that oral health plays in overall well-being. Digital dentistry involves the use of computer-aided design and manufacturing technology, which enables more accurate and efficient production of dental devices. On the other hand, regenerative medicine and nano dentistry can be considered promising area that combines the use of stem cells, growth factors, biomaterials, and nanotechnology to regenerate damaged tissue and improve treatment outcomes[15].

3.1. Telehealth and Tele dentistry

Tele dentistry is a combination of telecommunications and dentistry involving the exchange of clinical information and images over remote distances for dental consultation and treatment planning. Tele dentistry has the ability to improve access to oral healthcare, improve the delivery of oral healthcare, and lower its costs. It also has the potential to eliminate the disparities in oral health care between rural and urban communities[16].
Telemedicine is a collective term for various medical care concepts, which have in common the principal approach that medical services of health care for the population in the areas of diagnostics, therapy, and rehabilitation, as well as in medical decision-making consultation are provided over spatial distances (or temporal offset). Information and communication technologies are used for this purpose[17]. Despite the growth in tele dentistry research during the COVID-19 pandemic, the use of tele dentistry in daily clinical practice is still limited in most countries. Few countries have instituted tele dentistry programs at national level. Laws, funding schemes and training are needed to support the incorporation of tele dentistry into healthcare systems to institutionalize the practice of tele dentistry. Mapping tele dentistry practices in other countries and extending services to under-covered populations increases the benefit of tele dentistry[18].
It can be used as a service modality in three primary ways. These include the following: (i) consultations among dentists—for example, a general dentist and a specialist dentist can exchange patient photos and records, followed by a review and treatment planning discussion; (ii) a real-time face-to-face video conference consultation between a general dentist or specialist and a patient or family member in a distant, remote location; (iii) remote patient monitoring, collecting data in real time and transmitting them to the dentist in a remote location for examination and action as required[19].

3.1.1. Technology involved in Tele dentistry

The rapid development of Information and Communication Technology (ICT) is revolutionizing the field of oral healthcare through tele dentistry. Tele dentistry facilitates global connectivity, enabling patients, dentists, and specialists to interact and exchange crucial information for diagnosis and treatment. This technology offers two primary interaction types: "store-and-forward" for asynchronous communication and "real-time" for synchronous interaction. The former allows for the collection of clinical data, images, and treatment plans in a virtual storage space, enhancing diagnostic capabilities and patient counselling . The latter involves video conferencing, enabling instant review of medical records and fostering better doctor-patient communication. Additionally, the emergence of remote patient management further reduces healthcare costs, while mobile communication devices, such as cell phones and tablets, play an increasingly significant role in public health education and promotion. Tele dentistry is poised to revolutionize oral healthcare by bridging geographical gaps and providing efficient, cost-effective solutions[20].

3.2. Artificial Intelligence (AI) in Diagnosis

Artificial intelligence (AI) has grown tremendously in the past decade. The application of AI in tele dentistry can reform the way dental care, dental education, research, and subsequent innovations can happen remotely. Machine learning including deep learning-based algorithms can be developed to create predictive models of risk assessment for oral health related conditions, consequent complications, and patient stratification. Patients can be empowered to self-diagnose and apply preventive measures or self-manage some early stages of dental diseases. Applications of AI in tele dentistry can be beneficial for both, the dental surgeon and the patient. AI enables better remote screening, diagnosis, record keeping, triaging, and monitoring of dental patients based on smart devices[21].

This will take away rudimentary cases requiring run-of-the-mill treatments from dentists and enable them to concentrate on highly complex cases. This would also enable the dentists to serve a larger and deprived population in inaccessible areas. Its usage in tele dentistry can bring a paradigm shift from curative to preventive personalised approach in dentistry.

3.2.1. Imaging Modalities for Dental Disease Diagnosis

In traditional dental disease diagnosis, the images are evaluated by dentists to identify issues such as tooth lesions and cavities, and devise treatments accordingly. Dentists take several types of dental X-rays to record different mouth views. For example, for the detection of dental cavities, and to monitor mouth and teeth health, intraoral radiographs are used. In addition, dentists use extraoral radiographs to detect impacted teeth, monitor the development and growth of jaws, and identify potential problems in jaws, facial bones, and teeth.

Near-infrared imaging is a nonionizing photo-optical method leveraged for caries detection. This imaging employs long wave radiation against tooth sides. It penetrates objects deeper, thus acquiring good contrast between health and carious tissues. Near-infrared, mid-infrared, and long-infrared: These spectral ranges provide valuable information about the chemical composition and molecular structure of dental tissues; this helps in the detection and characterization of dental lesions [22].

3.3. 3D Printing and Digital Dentistry

Digital dentistry, often referred to as computer-aided dentistry (CAD/CAM), encompasses a range of technologies that leverage digital tools to enhance the practice of dentistry. At the core of this digital revolution is 3D printing, a cutting-edge manufacturing technology that has found a multitude of applications within the dental field. Together, these technologies are reshaping the traditional dental workflow, offering a host of advantages for both dental professionals and patients.

3D printing technologies used in dentistry include, among others, selective laser melting, stereolithography, fuse def position modeling, and digital light processing. Modern 3D printing has been used for the development of prototypes for several years, and it has begun to find its use in the world of manufacturing. Digital technology and 3D printing have significantly elevated the rate of success in dental implantology using custom surgical guides and improving the quality and accuracy of dental work[23].

3.3.1. Nomenclature and Classification of Additive CAD/CAM-Based Manufacturing

In additive manufacturing (AM) processes, objects are produced layer by layer on the basis of three-dimensional models. The term used in common parlance as a synonym for all additive processes is 3D printing.

According to the EN ISO/ASTM 52,900 terminology standard, an AM process is the “process of joining materials to make objects from 3D model data, usually layer by layer, as opposed to subtractive manufacturing methods” .
EN ISO 17296-2 describes the process fundamentals of additive manufacturing. It also provides an overview of the existing process categories, although such an overview can never be comprehensive, given the dynamic development of innovative technologies[24].
The following seven process categories can be distinguished within additive manufacturing,

- Vat photopolymerization (VPP)
- Material extrusion (MEX)
- Material jetting (MJT)
- Binder jetting (BJT)
- Powder-bed fusion (PBF)
- Directed energy deposition (DED)
- Sheet lamination (SHL)

3.3.2. Factors Affecting 3D Printing Products

Various factors, affecting 3D printing products are mentioned below (Figure 3.1).

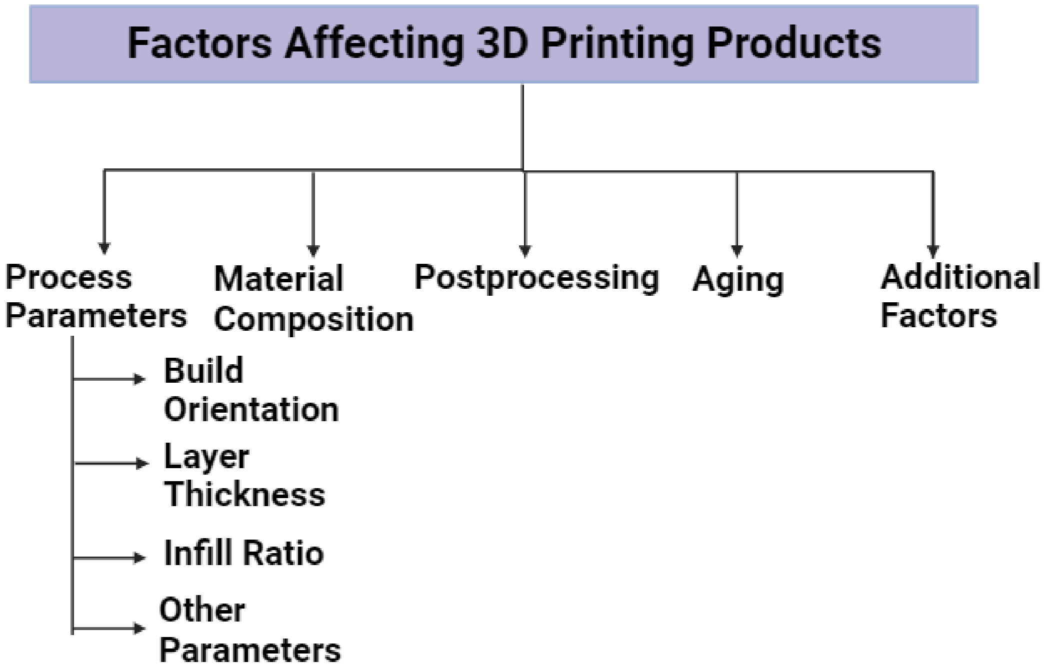

Fig 3.1 :Factors Affecting 3D Printing Products

3.4. Minimal Intervention Dentistry

Minimal Intervention Dentistry (MID) represents a fundamental shift in the philosophy and practice of dentistry. It is an approach that emphasizes the preservation of healthy tooth structure, prevention of dental diseases, and the use of minimally invasive techniques whenever possible. MID seeks to minimize the unnecessary removal of tooth structure and focuses on early detection and management of dental issues to prevent the need for extensive restorative treatments.
the aim of MID is to keep teeth healthy and functional for life. A most important element is achieved through implementing the important strategies for keeping teeth free from carious lesions. These strategies are considered to be: (i) early caries detection and risk assessment; (ii) remineralisation of demineralised enamel and dentine; (iii) optimal caries preventive measures; (iv) minimally invasive operative interventions and; (v) repair rather than replacement of restorations. It is self-evident that MID does not equate to cutting smaller cavities than before, as many dentists thought[25].

A research on Perception of Minimum Interventional Dentistry among Dental Undergraduate Students and Interns suggests that the majority of the participants in the study demonstrated proper knowledge, positive attitude, and appropriate practice in different aspects of MID. However, the use of magnification tools, such as loupes, still requires more extensive orientation for wider implementation. Additionally, undergraduate dental students tended to choose fluoride for remineralization, while interns were more proficient in MID practices compared to students[26].
MID promotes early diagnosis of dental issues through regular check-ups and diagnostic tools like digital radiography and laser fluorescence. Identifying problems at their earliest stages allows for less invasive interventions.

3.5. Regenerative Dentistry

Regenerative Dentistry is a cutting-edge branch of dentistry that focuses on restoring and regenerating damaged or lost oral tissues, including teeth, gums, bone, and other related structures. This field harnesses the body's natural healing mechanisms and employs advanced biotechnology and biomaterials to promote tissue repair, growth, and regeneration.
Regenerative dentistry is an emerging field of medicine involving stem cell technology, tissue engineering and dental science. It exploits biological mechanisms to regenerate damaged oral tissues and restore their functions. Research suggests that PRP treatment appears to have a bright future in clinical regenerative dentistry. Platelet-rich plasma (PRP) is a biological product that is defined as the portion of plasma fraction of autologous blood with a platelet concentration above that of the original whole blood. A super-mixture of key cytokines and growth factors is present in platelet granules. Thus, the application of PRP has gained unprecedented attention in regenerative medicine[27].

3.5.1. Clinical Applications for Dental Regenerative Medicine

The numerous bones of the craniofacial skeleton exhibit variable anatomical forms and exist in intimate relation to one another, as well as to abundant nerves and vessels. As such, bony reconstruction within this region often entails labour - intensive, multi-step operations with limited surgical access to morphologically complex defects. In the early stage of AM, stereolithographic models were introduced as an adjunct to standard diagnostic imaging and casts. These 3D models improved surgeon visualization of bony defects and their spatial relationship to adjacent structures, thus enhancing accuracy in preoperative evaluation, diagnosis, and treatment planning[28].
Here are some key clinical applications within dental regenerative medicine:

- Periodontal Regeneration
- Dental Pulp Regeneration
- Dental Implantology
- Dental Tissue Engineering
- Oral and Maxillofacial Reconstruction
- Aesthetic Dentistry
- Alveolar Ridge Preservation
- Orthognathic Surgery

3.6. Robotic Dentistry

With the rapid development of modern science and technology worldwide, robotics has become a popular research area and social concern. Robotics has been applied in many fields such as machinery, electronics, aerospace, and medicine. Among these, the application of robotics in medicine has attracted increasing attention. The successful application of medical robots has also garnered enthusiasm for research on robotics in dentistry, which breaks through the previous oral diagnosis and treatment models and promotes a new avenue of technological innovation[29].
Robotic dental systems consist of mechanical devices, computer algorithms, and imaging technologies designed to assist or replace human dental professionals in specific tasks. These systems

can be stationary or portable, depending on the procedure and clinical setting. It finds applications in a range of dental surgeries, including dental implant placement, tooth extractions, root canal treatments, and gum surgeries. Robotic systems can enhance the precision of these procedures, resulting in reduced trauma, faster recovery, and improved treatment outcomes.

3.6.1. Oral & Maxillofacial Surgery

Malignant lesions of the oropharynx are not always readily accessible, and conventional treatment must often resort to radiotherapy and/or chemotherapy. Salvage surgery is usually conducted through mandibulotomy with mandibular displacement and lip split. However, robotic oral and maxillofacial surgery has become an attractive possibility, especially in the treatment of oropharyngeal carcinoma. In addition to the treatment of pathological conditions, transoral robotic surgery has extensively been utilized for the surgical treatment of obstructive sleep apnea. Based on the apnea-hypopnea index, obstructive sleep apnea is categorized into mild, moderate, and severe. When the apnea-hypopnea index is >15, obstructive sleep apnea is linked with high morbidity and mortality.

The safety and precision in oral and maxillofacial surgery are influenced by human-associated factors including decreased vision, distraction, trembling, or decreased concentration. A report suggested an autonomous robotic system aimed to perform maxillofacial surgery under the supervision of the surgeon[30]. With the development of computer-assisted surgery, the preoperative design of maxillofacial surgery has continued to improve. However, solving the real-time accuracy and stability of drilling and cutting procedures remains a challenge.

The role of intelligent robots in oral implantation mainly includes[31] :

(1) preoperative digital 3D scanning of the implant site and imaging data collection/diagnosis analysis;

(2) digital implant surgery plan design; and

(3) real-time navigation and automatic drilling during the operation to improve the accuracy of dental implant surgery, reduce surgical trauma, and shorten the operation time.

Advantages of Application of Laser Technology in Dental Surgery:

- **Precision:** Lasers allow for precise tissue targeting, minimizing damage to surrounding healthy tissues during dental procedures.
- **Minimally Invasive:** Laser procedures are often minimally invasive, leading to reduced pain, swelling, and discomfort for patients.
- **Reduced Bleeding:** Lasers promote hemostasis, reducing bleeding during surgical procedures and improving visibility for the dentist.
- **Faster Healing:** Laser-treated tissues often heal more quickly, resulting in shorter recovery times for patients.
- **Bacterial Reduction:** Laser energy can disinfect and decontaminate treatment areas, reducing the risk of infection.
- **Cosmetic Dentistry:** Lasers are valuable in cosmetic dentistry for procedures like teeth whitening and gum contouring, offering improved esthetic outcomes.

Advantages of Recent Advances in Oro-Dental Healthcare:

- **Tele dentistry:** Tele dentistry enhances access to dental care, especially in underserved areas, and allows for remote consultations, improving patient reach and convenience.
- **Digital Dentistry:** Digital technologies, including 3D printing and CAD/CAM, improve treatment planning, customization, and the accuracy of restorations while reducing chair time.
- **Regenerative Dentistry:** Regenerative techniques offer the potential to repair and regenerate damaged oral tissues, leading to more natural and long-lasting outcomes.
- **Robotic Dentistry:** Robotic systems enhance precision in dental procedures, potentially reducing the margin of error and improving treatment results.
- **Patient-Centered Care:** Recent advances emphasize personalized treatment plans, preventive care, and minimally invasive procedures, enhancing the patient experience.

- **Cost-Effective Solutions:** Many recent advancements aim to make dental care more cost-effective, benefiting both patients and healthcare systems.
- **Improved Diagnostics:** Advanced imaging and diagnostic tools aid in early disease detection, leading to better treatment outcomes and prevention.
- **Sustainability:** Emerging trends in eco-conscious dentistry promote sustainability and environmental responsibility in oral healthcare.

Conclusion

In conclusion, the application of laser technology in dental surgery and recent advances in oro dental healthcare represent groundbreaking developments that have transformed the dental field. Laser technology has enabled precise, minimally invasive procedures with enhanced patient comfort, while recent advances encompass tele dentistry, digital dentistry, regenerative dentistry, and robotic dentistry, all contributing to improved patient care and outcomes. These innovations underscore dentistry's commitment to innovation and patient-centric care, promising a future of more precise, efficient, and accessible oral healthcare. In this dynamic landscape, dental professionals are poised to provide higher quality, patient-centric care, with an emphasis on prevention, minimally invasive treatments, and regenerative solutions. Patients, too, stand to benefit from reduced discomfort, faster recovery, and improved oral health outcomes. These advancements not only shape the present but also pave the way for an exciting future where oral healthcare is increasingly precise, efficient, and accessible.

Reference

1. Verma SK, Maheshwari S, Singh RK, Chaudhari PK. Laser in dentistry: An innovative tool in modern dental practice. National journal of maxillofacial surgery. 2012 Jul;3(2):124.
2. Gross AJ, Hermann TR. History of lasers. World J Urol 2007;25:217-20.
3. Alemu AG. Recent Development of Laser Assisted Dentistry and Clinical Applications. J Dent App. 2023; 9(1): 1120.
4. Liaqat S, Qayyum H, Rafaqat Z, Qadir A, Fayyaz S, Khan A, Jabeen H, Muhammad N, Khan MA. Laser as an innovative tool, its implications and advances in dentistry: A systematic review. Journal of Photochemistry and Photobiology. 2022 Oct 14:100148.
5. Luke AM, Mathew S, Altawash MM, Madan BM. Lasers: A review with their applications in oral medicine. Journal of lasers in medical sciences. 2019;10(4):324.
6. Garg N, Verma S, Chadha M, Rastogi P. Use of carbon dioxide laser in oral soft tissue procedures. National journal of maxillofacial surgery. 2015 Jan;6(1):84.
7. Garg N, Verma S, Chadha M, Rastogi P. Use of carbon dioxide laser in oral soft tissue procedures. National journal of maxillofacial surgery. 2015 Jan;6(1):84.
8. Xue VW, Zhao IS, Yin IX, Niu JY, Lo EC, Chu CH. Effects of 9,300 nm carbon dioxide laser on dental hard tissue: a concise review. Clinical, cosmetic and investigational dentistry. 2021 Apr 30:155-61.
9. van As G. Erbium lasers in dentistry. Dental Clinics. 2004 Oct 1;48(4):1017-59.
10. Strakas D, Gutknecht N. Erbium lasers in operative dentistry—a literature review. Lasers in Dental Science. 2018 Sep;2:125-36.
11. Ibacache MC, Arcos P, Sanchez S, Weinstein G. Use of diode lasers in dentistry. Clinical Dentistry Reviewed. 2020 Dec;4:1-7.
12. Azma E, Safavi N. Diode laser application in soft tissue oral surgery. Journal of lasers in medical sciences. 2013;4(4):206.
13. Oram Y, Karincaoğlu Y, Koyuncu E, Kaharaman F. Pulsed dye laser in the treatment of nail psoriasis. Dermatologic Surgery. 2010 Mar;36(3):377-81.
14. Laky M, Müller M, Laky B, Arslan M, Wehner C, Husejnagic S, Lettner S, Moritz A, Rausch-Fan X. Short-term results of the combined application of neodymium-doped yttrium aluminum garnet (Nd: YAG) laser and erbium-doped yttrium aluminum garnet (Er: YAG) laser in the

treatment of periodontal disease: a randomized controlled trial. Clinical Oral Investigations. 2021 Nov;25:6119-26.
15. Haidar ZS. Current and emerging trends in oro-dental healthcare and cranio-maxillo-facial surgery. Journal of Oral Health and Craniofacial Science. 2023 Apr 14;8(1):001-6.
16. Jampani ND, Nutalapati R, Dontula BS, Boyapati R. Applications of teledentistry: A literature review and update. Journal of International Society of Preventive & Community Dentistry. 2011 Jul;1(2):37.
17. Wolf TG, Schulze RK, Ramos-Gomez F, Campus G. Effectiveness of Telemedicine and Teledentistry after the COVID-19 Pandemic. International journal of environmental research and public health. 2022 Oct 25;19(21):13857.
18. El Tantawi M, Lam WY, Giraudeau N, Virtanen JI, Matanhire C, Chifamba T, Sabbah W, Gomaa N, Al-Maweri SA, Uribe SE, Mohebbi SZ. Teledentistry from research to practice: a tale of nineteen countries. Frontiers in Oral Health. 2023 Jun 16;4:1188557.
19. Islam MR, Islam R, Ferdous S, Watanabe C, Yamauti M, Alam MK, Sano H. Teledentistry as an Effective Tool for the Communication Improvement between Dentists and Patients: An Overview. InHealthcare 2022 Aug 21 (Vol. 10, No. 8, p. 1586). MDPI.
20. McFarland KK, Nayar P, Chandak A, Gupta N. Formative evaluation of a teledentistry training programme for oral health professionals. European Journal of Dental Education. 2018 May;22(2):109-14.
21. Batra P, Tagra H, Katyal S. Artificial Intelligence in Teledentistry. Discoveries. 2022 Jul;10(3).
22. Shafi I, Fatima A, Afzal H, Díez ID, Lipari V, Breñosa J, Ashraf I. A Comprehensive Review of Recent Advances in Artificial Intelligence for Dentistry E-Health. Diagnostics. 2023 Jun 28;13(13):2196.
23. Zaharia C, Gabor AG, Gavrilovici A, Stan AT, Idorasi L, Sinescu C, Negruțiu ML. Digital dentistry-3D printing applications. Journal of Interdisciplinary Medicine. 2017 Mar 1;2(1):50-3.
24. Schweiger J, Edelhoff D, Güth JF. 3D printing in digital prosthetic dentistry: an overview of recent developments in additive manufacturing. Journal of Clinical Medicine. 2021 May 7;10(9):2010.
25. Frencken JE, Peters MC, Manton DJ, Leal SC, Gordan VV, Eden E. Minimal intervention dentistry for managing dental caries–a review: report of a FDI task group. International dental journal. 2012 Oct 1;62(5):223-43.
26. Abdelhafeez MM, Alharbi FM, Srivastava S, Eldwakhly E, Saadaldin SA, Soliman M. Perception of Minimum Interventional Dentistry among Dental Undergraduate Students and Interns. Medicina. 2023 Mar 24;59(4):649.
27. Xu J, Gou L, Zhang P, Li H, Qiu S. Platelet-rich plasma and regenerative dentistry. Australian dental journal. 2020 Jun;65(2):131-42.
28. Latimer JM, Maekawa S, Yao Y, Wu DT, Chen M, Giannobile WV. Regenerative medicine technologies to treat dental, oral, and craniofacial defects. Frontiers in bioengineering and biotechnology. 2021 Aug 6;9:704048.
29. Liu L, Watanabe M, Ichikawa T. Robotics in Dentistry: A Narrative Review. Dentistry Journal. 2023 Feb 24;11(3):62
30. Ahmad P, Alam MK, Aldajani A, Alahmari A, Alanazi A, Stoddart M, Sghaireen MG. Dental robotics: A disruptive technology. Sensors. 2021 May 11;21(10):3308.
31. Liu L, Watanabe M, Ichikawa T. Robotics in Dentistry: A Narrative Review. Dentistry Journal. 2023 Feb 24;11(3):62.