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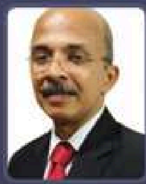

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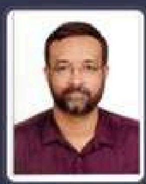

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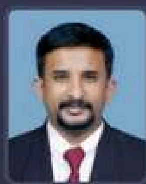

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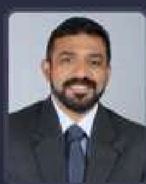

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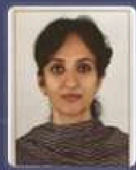

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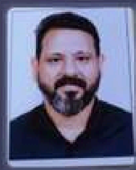

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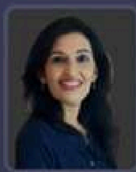

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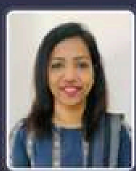

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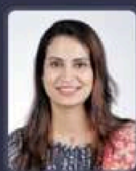

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EDITOR'S MESSAGE

Safeguarding the Future through Excellence in Dental Education

The future of dentistry depends on the strength of its educational foundations. High standards in dental education are essential to ensure that graduates are not only clinically competent but also ethical, evidence-based professionals. The quality of education we provide today directly shapes excellence of tomorrow's dental professionals. As new technologies and challenges emerge, our commitment to quality education safeguards public trust and patient care. Let us continue to uphold these standards, shaping a future that is both safe and progressive for our profession and the communities we serve. As editors, educators, and practitioners, we have a shared responsibility to champion these standards—not as an option, but as a necessity for the future of dentistry.

Dr.Prameetha George Ittycheria
Editor

ASSISTANT EDITOR'S MESSAGE

Greetings to all dear IDA Thiruvalla members!

The oral health condition around the world is highly alarming. As per WHO, nearly 3.5 billion people suffers from oral diseases. Despite, the advancement in the field of dentistry, oral care remains backseat in several countries. In this second issue of our journal "Taper" we aim to share knowledge and current breakthrough in the field of dentistry.

The effect of oral diseases is not just localized. Researchers has shown its link with systemic conditions such as cardiovascular diseases, diabetes mellitus. Therefore, its an absolute need of the hour to merge oral health into wider healthcare systems. This in turn could results in global reduction of oral diseases. Prioritizing oral health, it can be managed in certain ingenious ways such as community-based programs, research and digital health technologies. Our journal stands as a platform to create awareness, foster communication and building trust. So, lets join our hands together for a better tomorrow.

Dr. Merlin Thomas
Assistant Journal Editor

PRESIDENT'S MESSAGE

Dear Members,

It is with immense pride and pleasure that I present to you the second edition of TAPER, the official journal of IDA Thiruvalla. This publication stands as a testament to our branch's unwavering commitment to academic excellence, clinical progress, and professional unity.

As we navigate the ever evolving field of dentistry, TAPER serves as a platform not just to share knowledge, but also to celebrate the collective spirit of our fraternity. I extend my heartfelt thanks to all those who contributed for this edition. From clinical insights to personal perspectives, every contribution in this journal mirrors the vibrant and dynamic nature of our branch.

Our branch continues to grow in strength, driven by the active participation of our members and the tireless efforts of our editorial team, led by the dynamic and dedicated individuals behind this journal.

I extend my heartfelt congratulations to all contributors and express my sincere appreciation to the editorial board headed by Dr. Prameetha George Ittycheria and Dr. Merlin Thomas for their hard work in shaping this vibrant edition. Special gratitude to Dr. Sandra Arun for designing and compiling this issue.

Let this journal serve as a source of inspiration and encouragement for all of us to keep learning, sharing, and progressing together.

Wishing you all an enriching reading experience.

Warm regards,

Dr. Maya Mathai

President, IDA Thiruvalla

SLEEP-RELATED BREATHING DISORDERS (SRBDS) AND PERIODONTITIS

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ABSTRACT
Sleep is fundamental for health and well-being. An adequate amount and quality of sleep is a cardinal component of a healthy lifestyle at the basis of the prevention of many non-communicable chronic diseases. Recent evidence suggests that sleep disorders, particularly obstructive sleep apnea, represent an emerging risk factor for periodontal health. A new paradigm has evolved inter-connecting SRBDs& chronic periodontitis. So as to help a dentist to diagnose & manage SRBDs in dental scenario.This review article provides a critical appraisal of the existing literature concerning the association between sleep duration, sleep quality, sleep disorders in general, and obstructive sleep apnea with periodontal diseases, including gingivitis and periodontitis. The putative mechanisms underlying these associations are described as well as the potential clinical implications for diagnosis and treatment.
Keywords: Healthy lifestyle, SRBDS, Periodontal diseases, Periodontal health, Periodontitis, Sleep disorders

INTRODUCTION

Sleep is an essential part of the well-being of an individual. It is taken for granted as long as there are no problems associated with it. The panorama of sleep related disorders has been broadly classified as: Insomnia, Sleep related breathing disorders, Hypersomnias, Circadian rhythm sleep disorder, Parasomnia and Sleep related movement disorders.(1)
Sleep related breathing disorders (SRBDs) have been found to considerably impact the oral health.

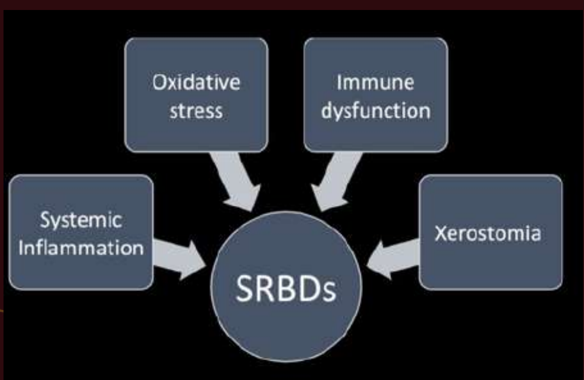
They have been broadly classified as
- obstructive sleep apnoea
- central sleep apnoea
- sleep related hypoventilation disorders.[2]

As per a systematic review in the Indian population prevalence of Obstructive Sleep Apnea has been found to be in around 37.4% of the Indian population.[3]

SLEEP-RELATED BREATHING DISORDERS (SRBDS) AND PERIODONTITIS

There is growing evidence linking sleep-related breathing disorders (SRBDs)—especially obstructive sleep apnea (OSA)—with an increased risk of periodontitis. (4) Though the exact nature of the relationship is still being researched, both conditions share common risk factors and may influence each other through inflammatory pathways. A number of observational studies and systematic reviews have found a positive association between OSA and periodontitis, especially moderate-to-severe periodontitis. Patients with OSA often have deeper periodontal pockets, more attachment loss, and higher plaque scores. The risk is higher in older adults, males, obese individuals, and those with comorbid conditions like diabetes.

THE CONNECTION: HOW SRBDS AND PERIODONTITIS MAY BE RELATED



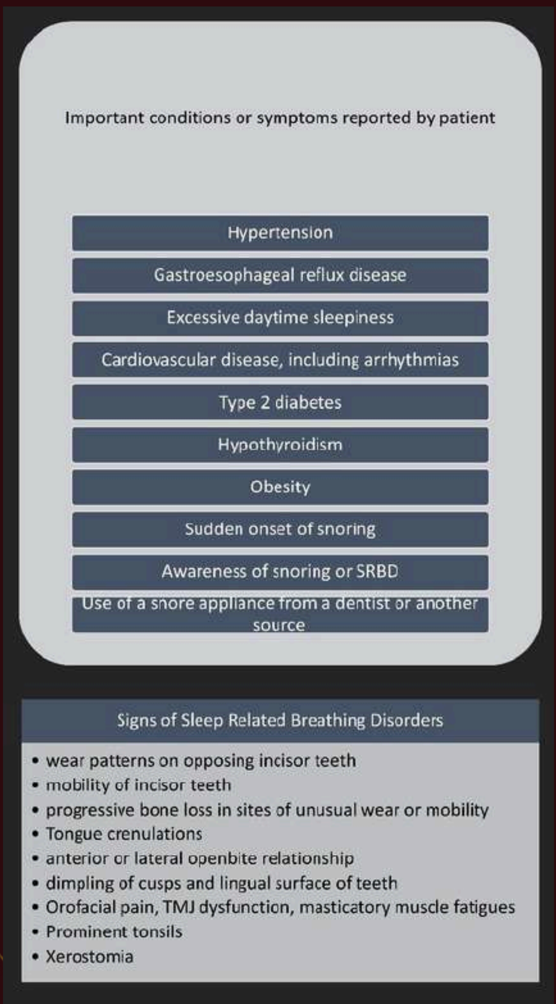
1. Systemic Inflammation
OSA is characterized by repeated episodes of partial or complete upper airway obstruction during sleep, leading to intermittent hypoxia (low oxygen levels) and sleep fragmentation. This triggers chronic systemic inflammation, which also plays a central role in the pathogenesis of periodontitis. Elevated levels of inflammatory markers (e.g., CRP, IL-6, TNF-α) are common in both conditions.

2. Oxidative Stress
Intermittent hypoxia increases oxidative stress, damaging tissues, including periodontal structures.

3. Immune Dysfunction
SRBDs can impair immune responses, making it harder to control bacterial infections like those involved in periodontitis.

4. Dry Mouth (Xerostomia)
Many individuals with OSA breathe through the mouth, especially when using CPAP (Continuous Positive Airway Pressure) therapy without humidification. Xerostomia contributes to bacterial overgrowth, plaque accumulation, and gingivitis or periodontitis.

- Dentists should screen for signs of SRBDs in patients with unexplained periodontal disease, especially if resistant to treatment.
- Medical providers treating OSA should encourage patients to maintain oral health, particularly if using oral appliances or CPAP(continuous positive airway pressure).
- Interprofessional collaboration between dentists, sleep specialists, and primary care providers can improve outcomes.



MANAGEMENT OF SRBDS

1. Timely diagnosis of the condition by the dentist or the general practioner
2. Otolaryngology or oromaxillofacial surgery for physical obstructions (e.g.tonsils, deviated septum, nasal polyps)
3. Positive Airway pressure therapy
4. Oral devices including mandibular repositioning device

CLINICAL RECOMMENDATIONS

- Encourage good oral hygiene and routine dental visits in patients with OSA.
- Treat dry mouth symptoms with hydration, saliva substitutes, or humidifiers for CPAP users.
- Consider periodontal evaluations in OSA patients and vice versa to ensure periodontium is stable during management of SRBDs.
- Identify sleep bruxism prior to prescribing oral devices and warn patients adequately that it would influence the life of their mandibular repositioning device

CONCLUSION

SRBDs and their impact on oral health is relatively a recent finding in the Indian population. Dentists are usually the first to diagnose these conditions. A timely identification and treatment would save the patients a life time of woes!

REFERENCES

1. THE INTERNATIONAL CLASSIFICATION OF SLEEP DISORDERS REVISED 1997. In: Sleep Medicine Secrets [Internet]. Elsevier; 2004 [cited 2025 May 28]. p. 213–5. Available from: https://linkinghub.elsevier.com/retrieve/pii/B9781560535928500312

2. Sateia MJ. International classification of sleep disorders-third edition: highlights and modifications. Chest. 2014 Nov;146(5):1387–94.

3. Suri TM, Ghosh T, Mittal S, Hadda V, Madan K, Mohan A. Systematic review and meta-analysis of the prevalence of obstructive sleep apnea in Indian adults. Sleep Med Rev. 2023 Oct 1;71:101829.

4. Relationship of obstructive sleep apnea with periodontal condition and its local and systemic risk factors - PMC [Internet]. [cited 2025 May 28]. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10264262/

5. Newman and Carranza's Clinical Periodontology and Implantology - 14th Edition [Internet]. [cited 2024 Feb 3]. Available from: https://shop.elsevier.com/books/newman-and-carranzas-clinical-periodontology-and-implantology/carranza/978-0-323-87887-6

ORAL CANCER: DIAGNOSTIC APPROACHES FOR EARLY DETECTION

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ABSTRACT

Oral cancer ranks as the eighth most common cancer globally and poses a significant health burden, particularly in India and other Asian countries where incidence rates are notably higher. Detecting oral cancer at an early stage can result in a survival rate exceeding 90%. Timely screening and early diagnosis play crucial roles in reducing both morbidity and mortality. This paper reviews the current diagnostic techniques used in the early detection of oral cancer and methods for predicting prognosis.

Key words: Oral cancer, autofluorescence, early cancer detection, malignant transformation

INTRODUCTION

Oral cancer is the sixth most common cancer worldwide, with major risk factors including tobacco use, alcohol consumption, and persistent infection with oncogenic human papillomavirus (HPV) serotypes. Other contributing factors such as prolonged sun exposure and chronic mucosal irritation also increase the risk of developing malignancy.1 Early detection plays a pivotal role in improving survival outcomes, as diagnosis at an early stage significantly reduces mortality and allows for timely initiation of treatment. Screening should be prioritized regardless of the method employed, as taking the first step is more effective than in action.

Biopsy remains the gold standard for diagnosis, with accurate site selection, proper biopsy technique, and appropriate specimen handling being essential for precise histopathological evaluation. Treatment should be based on the biopsy report, with regular follow-up to monitor disease progression or recurrence. Although conventional oral examination (COE) (Figure 1) is widely used to detect potentially malignant disorders, it cannot reliably distinguish between progressive malignant lesions and non-progressive counterparts, highlighting the need for improved diagnostic adjuncts.2

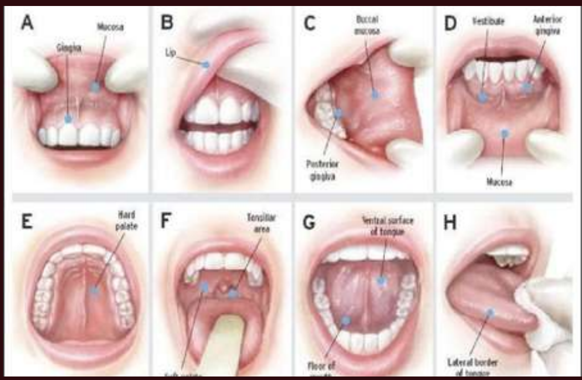

FIGURE 1- Conventional oral examination

The various diagnostic modalities for oral cancer detection includes the following:

- Visual examination
- Excision biopsy and Histopathology
- Oral brush biopsy (OralCDx)
- Toluidine blue
- Light-based detection systems
- Chemiluminescence (ViziLite Plus; Microlux/DL, Orascoptic-DK)
- Tissue fluorescence imaging (VELscope)
- Tissue fluorescence spectroscopy
- Biomarkers
- DNA-analysis
- Laser capture microdissection

LIGHT-BASED ORAL CANCER SCREENING AIDS

A variety of light-based screening technologies have been developed to support the early identification of precancerous and cancerous lesions in the oral cavity.. These devices are designed to serve as adjuncts to the conventional oral examination, enhancing the visualization of suspicious mucosal changes that may not be easily detectable under normal lighting conditions.

Commercially available systems such as ViziLite Plus with TBlue, VELscope, Microlux/DL, and Orascoptic DK operate on the principle that abnormal metabolic or structural changes in tissues alter their light absorption and reflectance characteristics, thereby facilitating the identification of potentially malignant areas.3

VELscope

The VELscope is a portable device that emits visible light at a wavelength of around 430 nm, stimulating natural tissue fluorescence to help identify abnormal areas. (Figure 2) It has been used for the screening and diagnosis of precancerous lesions in various organs, including the lungs, uterine cervix, and skin. In the oral cavity, healthy mucosa exhibits a pale green appearance due to natural tissue autofluorescence when stimulated by blue light in the 400–460 nm range. In contrast, dysplastic or malignant tissues appear darker because of reduced autofluorescence. While VELscope demonstrates high sensitivity in detecting abnormal tissue changes, its specificity remains low. The principle behind fluorescence imaging involves exposing tissues to a specific wavelength of light, which excites cellular fluorophores and produces autofluorescence, aiding in the visual differentiation of healthy and potentially malignant areas.4

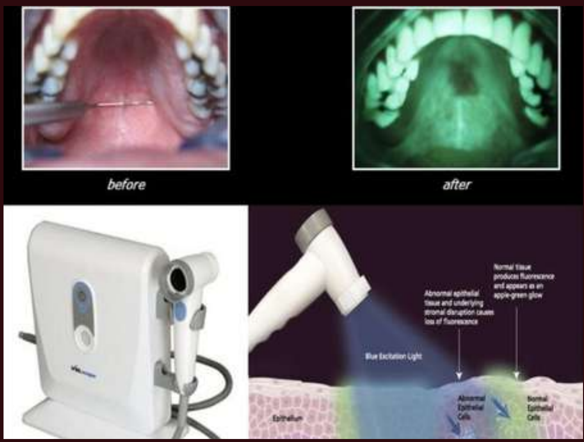

FIGURE 2- VELscope

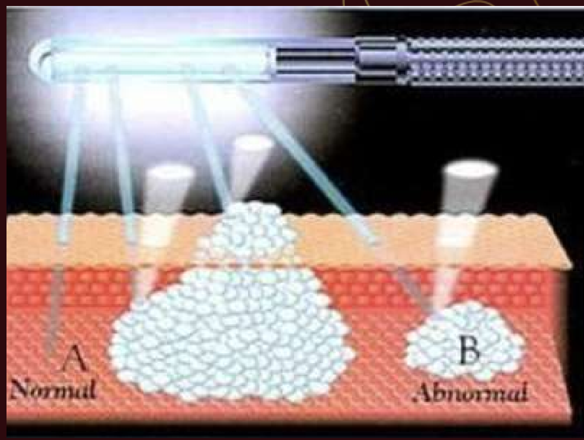

FIGURE 3- ViziLite

VIZILITE

The ViziLite procedure starts with an acetic acid rinse of the oral cavity, followed by the use of a chemiluminescent light stick that emits blue or white light within the 490–510 nm wavelength range to examine the oral tissues.(Figure 3) The acetic acid serves to remove the glycoprotein barrier and slightly desiccate the oral mucosa, enhancing the contrast between normal and abnormal tissues. Abnormal epithelial cells, which typically have a higher nuclear-to- cytoplasmic ratio, absorb and reflect light differently, appearing more acetowhite with brighter, sharper, and more defined margins compared to normal mucosa. ViziLite is often used in conjunction with toluidine blue staining to improve lesion detection.3 The ViziLite Plus system incorporates a tolonium chloride (TBlue) solution that helps highlight acetowhite lesions, enabling more accurate targeting for biopsy following the light-based examination.5

Orascoptic DK

Orascoptic DK utilizes a mild acetic acid rinse followed by examination with a compact three-in- one device that combines a battery-powered handheld light source and an illuminated mirror. (Figure 4) This system enhances the visualization of oral lesions by improving contrast between normal and abnormal tissues.4

FIGURE 4- Orascoptic DK

Microlux

Microlux operates similarly to ViziLite, requiring the patient to rinse with acetic acid before examination.

Rather than using a chemiluminescent light source, it employs a battery-operated fiberoptic system that emits visible light to illuminate the oral cavity.. Abnormal or irregular cells appear as whitish areas due to their altered light absorption and reflection characteristics.3

Identafi

Identafi employs multispectral fluorescence and reflectance technology to improve the detection and visualization of oral lesions. By combining anatomical imaging with fluorescence, fiber optics, and confocal microscopy, it enables precise mapping of suspicious areas within the oral cavity. The device employs three distinct wavelengths of light—white, violet, and green- amber—to elicit tissue responses and reveal abnormalities. The green-amber light (540–575 nm) is particularly useful for enhancing the visibility of vascular changes by improving the reflective contrast of the oral mucosa, aiding in the differentiation between normal and abnormal blood vessel patterns. Violet light enhances the natural fluorescence of healthy tissue, while suspicious or abnormal tissue appears darker due to reduced fluorescence.(Figure 5) A notable advantage of Identafi over VELscope is its compact size and enhanced accessibility to all areas within the oral cavity.6

FIGURE 5- Three distinct wavelengths

VITAL STAINING

Vital tissue staining serves as a valuable adjunct in the early detection of malignant and potentially malignant oral lesions. Toluidine blue (tolonium chloride), a metachromatic dye, selectively binds to mitochondrial DNA and highlights cells with increased or altered DNA content, which are characteristic of dysplastic or malignant transformation.[7] This staining technique assists in identifying clinically suspicious mucosal changes and is particularly useful for delineating the margins of lesions prior to surgical excision.(Figure 6) However, it is important to note that false-positive results may occur, which can limit its specificity.[4]

FIGURE 6- Vital tissue staining

BRUSH BIOPSY

The brush biopsy, introduced by CDx Laboratories (Suffern, NY) in 1999, emerged as a case- finding tool for oral cancer, particularly for evaluating lesions that may not typically warrant immediate scalpel biopsy due to their low clinical suspicion.8

Also known as the OralCDx Brush Test system, this technique involves collecting a full-thickness transepithelial cell sample from a mucosal lesion, encompassing superficial, intermediate, and basal/parabasal epithelial layers.9 A specially designed non-invasive brush is used to collect cells, which are then fixed on a glass slide, stained using a modified Papanicolaou method, and analyzed through a computer-assisted imaging system. Results are categorized as "positive" or "atypical" when cellular changes suggest epithelial dysplasia or malignancy, and "negative" when no abnormalities are detected. However, since brush cytology does not provide a definitive diagnosis, any atypical or positive results should be followed up with a confirmatory scalpel biopsy.10

TISSUE FLUORESCENCE SPECTROSCOPY

Tissue fluorescence spectroscopy utilizes a small optical fiber to deliver various excitation wavelengths and record reflected fluorescence spectra using a dedicated spectrograph and analysis software. This method eliminates subjective interpretation by providing quantitative fluorescence data. However, it is limited in its ability to accurately classify lesion types and is unsuitable for screening large areas or detecting new lesions, as the fiber can only assess a small portion of the mucosa.[10]

SALIVA AS A DIAGNOSTIC TOOL

Saliva is an easily accessible, non-invasive biological fluid composed primarily of water (98%), along with organic and inorganic components, including DNA, proteins, RNA, metabolites, and microorganisms. It mirrors the body's physiological and pathological conditions and has emerged as a promising tool for disease detection. Saliva collection is simple, cost-effective, and well- tolerated, making it ideal for point-of-care diagnostics. It has already shown potential in identifying various conditions, including viral (e.g., SARS-CoV-2), bacterial, fungal infections, cancer, and genetic disorders. Salivary diagnostics has led to the evolution of the term "Salivaomics," which encompasses various domains such as genomics and epigenomics (gene expression and methylation), transcriptomics (mRNA), proteomics (proteins), metabolomics (metabolites), lipidomics (lipids), and microbiomics (oral microflora).11-13

LASER CAPTURE MICRODISSECTION

Laser Capture Microdissection (LCM) is a powerful technique that enables the precise extraction of specific cell populations from tissue samples while preserving the morphology of both target and surrounding cells. When combined with rapid immunohistochemical staining, LCM allows for accurate isolation and study of cellular subsets.

It plays a significant role in biomarker discovery and in constructing protein expression profiles ("protein fingerprints") for the early detection of oral squamous cell carcinoma.14

LAB-ON-A-CHIP

Microfluidic technology, also referred to as lab-on-a-chip or micro-total-analysis systems (TAS), integrates complex laboratory processes into a single miniaturized device. These chips are capable of identifying dysplastic and malignant oral cells by analyzing the expression of specific membrane-associated proteins and unique gene transcription patterns. This innovative platform is considered a biomedical parallel to the silicon chip revolution in electronics, offering potential for rapid, automated, and highly sensitive diagnostics.15

DNA-ANALYSIS

DNA image cytometry is a technique used to assess the ploidy status of cells, helping to evaluate their malignant potential. After staining with Feulgen dye, cellular DNA content is quantified and compared against a normal reference population. Computer-assisted analysis enhances precision and identifies deviations in DNA content, reflecting genomic instability—a hallmark of cancer progression. This method may help distinguish dysplastic lesions with high risk of malignant transformation.16

OPTICAL COHERENCE TOMOGRAPHY

Optical Coherence Tomography (OCT) is a non-invasive imaging modality that produces high- resolution, cross-sectional images of tissue architecture by capturing subsurface reflections of light. It enables the visualization of inflammation, dysplasia, and malignancy without radiation
exposure. The use of contrast agents, such as gold nanoparticles exhibiting surface plasmon resonance, can enhance image clarity.17 OCT offers real-time results and holds promise in both the diagnosis and follow-up of oral potentially malignant disorders and cancers.18

BIMODAL MULTISPECTRAL IMAGING SYSTEM (BMIS)

Bimodal Multispectral Imaging System (BMIS) is an advanced diagnostic tool that integrates tissue autofluorescence and diffuse reflectance (DR) to assess changes in oxygenated hemoglobin (HbO_2) absorption within the oral mucosa. This dual-modality approach enables the quantification of tissue abnormalities and assists in guiding biopsy site selection. The BMIS device features a compact monochrome camera equipped with a 5 MP CMOS sensor, 2.2-micron pixel size, and a resolution of 2592×1944 for high-quality image capture. Illumination is provided by a set of LEDs arranged around the camera lens, emitting light at four specific wavelengths—violet (405 nm), green (545 nm), yellow (575 nm), and red (610 nm)—to enhance tissue visualization.

Prior to imaging, the oral cavity is rinsed with water, followed by saline or an antibacterial mouthwash. A reference photograph of the lesion is captured using a mobile phone camera. For hygiene and safety, the screening probe is disinfected with isopropyl alcohol and covered with a transparent plastic cling film to avoid direct contact with oral tissues. The examination is conducted in a dimly lit environment to maintain calibration conditions. Upon activation, the probe initially emits violet light, which is used to detect oral potentially malignant lesions (OPMLs) through autofluorescence and to pinpoint areas requiring closer inspection.19

FIGURE 7- BMIS System

CONCLUSIONS

Early detection of oral cancer is essential for enhancing patient outcomes, with dental professionals playing a key role in this critical process. Enhancing the knowledge and diagnostic capabilities of clinicians regarding oral cancer risk factors and precancerous conditions is essential.

While several emerging diagnostic technologies—such as tissue fluorescence, saliva- based biomarkers, lab-on-a-chip systems, and OCT—show promise in aiding early detection, their integration into routine clinical practice remains limited. Current evidence supporting these tools is often anecdotal, with a lack of large-scale, methodologically robust clinical trials. Further research is needed to validate their effectiveness, establish correlations with histopathological findings, and assess their impact on patient survival and recurrence risk. Moving forward, rigorous evaluation and standardization of these technologies through prospective clinical studies will be key to their successful incorporation into early detection protocols, ultimately improving outcomes for individuals at risk of oral cancer.

REFERENCES

1. Chen S-H, Hsiao S-Y, Chang K-Y, Chang J-Y. New Insights Into Oral Squamous Cell Carcinoma: From Clinical Aspects to Molecular Tumorigenesis. International Journal of Molecular Sciences. 2021; 22(5):2252. https://doi.org/10.3390/ijms22052252.

2. Rodríguez-Molinero J, Del Carmen Migueláñez-Medrán B, Delgado-Somolinos E, Carreras- Presas CM, López-Sánchez AF. Advances in the Diagnosis, Monitoring, and Progression of Oral Cancer through Saliva: An Update. Biomed Res Int. 2022 Oct 25;2022:2739869. doi: 10.1155/2022/2739869. PMID: 36330456; PMCID: PMC9626200.

3. Mehrotra R, Gupta DK. Exciting new advances in oral cancer diagnosis: avenues to early detection. Head Neck Oncol. 2011 Jul 28;3:33. doi: 10.1186/1758-3284-3-33. PMID: 21798030; PMCID: PMC3170277.
4. Mehrotra R, Hullmann M, Smeets R, Reichert TE, Driemel O: Oral cytology revisited. J Oral Pathol Med 2009, 38:161-6
5. Lingen MW, Kalmar JR, Karrison T, Speight PM. Critical evaluation of diagnostic aids for the detection of oral cancer. Oral Oncol. 2008 Jan;44(1):10-22. doi: 10.1016/j.oraloncology.2007.06.011. Epub 2007 Sep 6. PMID: 17825602; PMCID: PMC2424250.
6. Messadi DV. Diagnostic aids for detection of oral precancerous conditions. Int J Oral Sci. 2013 Jun;5(2):59-65. doi: 10.1038/ijos.2013.24. Epub 2013 Jun 7. PMID: 23743617; PMCID: PMC3707069.
7. Epstein JB, Zhang L, Rosin M. Advances in the diagnosis of oral premalignant and malignant lesions. J Can Dent Assoc. 2002 Nov;68(10):617-21. PMID: 12410942.
8. Frist S. The oral brush biopsy: separating fact from fiction. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2003;96(6):654–5.
9. Eisen D, Frist S: The relevance of the high positive predictive value of the oral brush biopsy. Oral Oncol 2005, 41:753-755.
10. Fedele S. Diagnostic aids in the screening of oral cancer. Head Neck Oncol. 2009 Jan 30;1:5. doi: 10.1186/1758-3284-1-5. PMID: 19284694; PMCID: PMC2654034.
11. Khurshid Z, Asiri FYI, Al Wadaani H. Human Saliva: Non-Invasive Fluid for Detecting Novel Coronavirus (2019-nCoV). Int J Environ Res Public Health. 2020 Mar 26;17(7):2225. doi: 10.3390/ijerph17072225. PMID: 32224986; PMCID: PMC7178089.
12. Hamid H, Khurshid Z, Adanir N, Zafar MS, Zohaib S. COVID-19 Pandemic and Role of Human Saliva as a Testing Biofluid in Point-of-Care Technology. Eur J Dent. 2020 Dec;14(S 01):S123-S129. doi: 10.1055/s-0040-1713020. Epub 2020 Jun 3. PMID: 32492721; PMCID: PMC7775213.
13. Aro, K., Kaczor-Urbanowicz, K., & Martin Carreras-Presas, C. Salivaomics in oral cancer. Current opinion in otolaryngology & head and neck surgery. 2019; 27(2), 91-97. https://doi.org/10.1097/MOO.0000000000000502.
14. Muruganandhan J, Sujatha G, Patil S, Raj AT. Laser Capture Microdissection in Oral Cancer. J Contemp Dent Pract. 2018 May 1;19(5):475-476. PMID: 29807954.
15. Ziober BL, Mauk MG, Falls EM, Chen Z, Ziober AF, Bau HH: Lab-on-a-chip for oral cancer screening and diagnosis. Head Neck 2008, 30(1):111-21.
16. Bradley G, Odell EW, Raphael S, Ho J, Le LW, Benchimol S, Kamel-Reid S: Abnormal DNA content in oral epithelial dysplasia is associated with increased risk of progression to carcinoma. Br J Cancer 2010, 103(9):1432-42.

17. Kim CS, Wilder-Smith P, Ahn YC, Liaw LH, Chen Z, Kwon YJ: Enhanced detection of early-stage oral cancer in vivo by optical coherence tomography using multimodal delivery of gold nanoparticles. J Biomed Opt 2009, 14(3):034008.
18. Kim DH, Kim SW, Hwang SH. Efficacy of optical coherence tomography in the diagnosing of oral cancerous lesion: systematic review and meta-analysis. Head Neck. 2023 Feb;45(2):473-481. doi: 10.1002/hed.27232. Epub 2022 Oct 28. PMID: 36305811.
19. Narayanan S, Anand S, Prasanna R, Managoli S, Suvarnadas R, Shyamsundar V, Nagarajan K, Mishra SK, Johnson M, Dathurao Ramanand M, Jogigowda SC, Rao V, Gopinath KS.
Bimodal multispectral imaging system with cloud-based machine learning algorithm for real- time screening and detection of oral potentially malignant lesions and biopsy guidance. J Biomed Opt. 2021 Aug;26(8):086003. doi: 10.1117/1.JBO.26.8.086003. PMID: 34402266; PMCID: PMC8367825.

EMERGING APPLICATIONS OF LASERS IN PERIODONTAL CARE: A COMPREHENSIVE REVIEW

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ABSTRACT

The application of laser technology in periodontal therapy has introduced a significant advancement in the diagnosis and treatment of periodontal diseases. Lasers offer a minimally invasive alternative to conventional surgical techniques, with benefits including reduced bleeding, decreased postoperative discomfort, enhanced precision, and faster healing. Various types of lasers, such as diode (Gallium, Arsenic or Gallium, Aluminum, Arsenic), Nd:YAG (Neodymium:Yttrium-AluminumGarnet), Er:YAG(Erbium:Yttrium-Aluminum-Garnet), and CO_2, are employed for procedures ranging from soft tissue management and pocket decontamination to bone remodeling and photobiomodulation(PBMT). Laser-assisted periodontal therapies, including Laser-Assisted New Attachment Procedure (LANAP) and low-level laser therapy (LLLT), have shown promising results in improving clinical outcomes and promoting tissue regeneration. Despite their advantages, limitations such as high equipment cost, the need for specialized training, and lack of standardized treatment protocols remain. Ongoing research and technological improvements continue to expand the scope of laser use in periodontics, pointing toward a future of more effective, patient-friendly, and regenerative periodontal care. This article explores the types of lasers used in periodontics, their mechanisms of action, clinical applications, benefits, limitations, and future potential.

INTRODUCTION

The concept of lasers is based on Albert Einstein's theory of spontaneous and stimulated emission of radiation .The first working laser was made in 1960 by Theodore H. Maiman at Hughes Research Laboratories [1, 2]

Since then, researchers have studied the effects of both low and high-intensity lasers in dentistry, with a particular focus on Periodontology. In recent decades, technological advancements have significantly transformed dental practice, with lasers emerging as one of the most impactful innovations.

Among these innovations, lasers and similar devices were primarily developed as alternatives to conventional instruments traditionally used in periodontal therapy to substitute for curettes, scalpels, and other tools commonly employed in invasive periodontal procedures. Studies confirmed that dental lasers are an adjunctive tool in the treatment of periodontal disease and are not intended to replace conventional therapies [3, 4, 5]. By utilizing focused light energy, dental lasers offer a high degree of precision, reduced bleeding, faster healing and enhanced patient comfort compared to conventional surgical methods. Their application ranges from soft tissue procedures like gingivectomy and pocket decontamination to hard tissue treatments such as bone regeneration. As laser technology continues to evolve, its integration into periodontal therapy is redefining clinical protocols and setting new standards in patient care.

2. Properties of Lasers

The acronym LASER stands for Light Amplification by Stimulated Emission of Radiation [6]. Lasers possess distinct physical properties that differentiate them from conventional light sources. These characteristics not only define the behavior of laser light but also contribute significantly to their expanding role in modern dental and periodontal practice.Lasers are now widely used in periodontics for procedures such as soft tissue surgery, bacterial reduction, pocket decontamination, and biostimulation.

Understanding the core properties of lasers is essential for their effective and safe clinical application.

2.1. Monochromaticity

Laser light consists of a single wavelength, unlike ordinary light which contains multiple wavelengths. This monochromatic nature allows for selective interaction with specific tissue components, such as hemoglobin, melanin, or water. In periodontics, this property facilitates targeted treatment with minimal damage to surrounding tissues.

2. 2. Coherence

Laser beams exhibit spatial and temporal coherence, meaning the emitted light waves are in consistent phase. This coherence contributes to the laser's precision and focus, essential for delicate periodontal procedures like sulcular debridement, gingival contouring, and flap surgeries.

2.3. Directionality

Lasers emit highly collimated beams, allowing them to travel in a straight, narrow path with minimal divergence. This directionality enhances control and accuracy during intraoral applications, enabling clinicians to perform minimally invasive procedures with superior visualization and reduced trauma.

2.4. High Intensity

Because laser energy is concentrated into a small area, it achieves a high power density, making it highly effective for cutting, ablation, and coagulation. In periodontics, this allows for efficient soft tissue management, improved hemostasis, and faster postoperative healing [7].

3. Laser Mechanisms and Their Interactions with Biological Tissues

Lasers work by emitting concentrated light energy at specific wavelengths, which interact with biological tissues through various mechanisms-absorption, reflection, transmission, and scattering. Figure 1 shows the four potential laser-tissue interactions. The nature of this interaction depends largely on the laser's wavelength and the tissue's composition, particularly its water, pigment, and mineral content. Each laser has a unique wavelength spectrum resulting in specific absorption characteristics. Figure 2 shows laser wavelengths. The wavelength of most of the lasers used in dentistry is in the red and near-infrared spectrum.

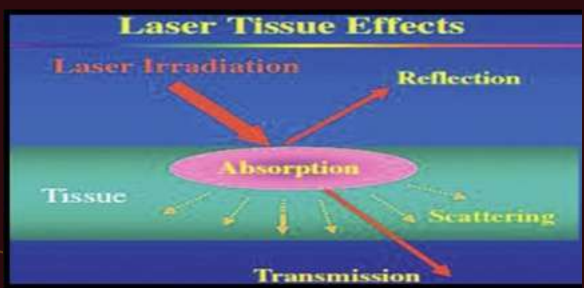

Figure 1. Four potential laser-tissue interactions. The laser beam may be reflected, absorbed, scattered, or transmitted [8,9]

Figure 2. Laser wavelengths [8, 9]

In periodontics, laser-tissue interaction typically results in one or more of the following effects: photothermal, photochemical, photoacoustic, and biostimulatory. Photothermal effects, for instance, cause coagulation, vaporization, or ablation of soft tissues, making lasers ideal for procedures such as gingival contouring or periodontal pocket debridement. Certain wavelengths, such as those of diode and Nd:YAG lasers, are highly absorbed by melanin and hemoglobin, allowing for efficient soft tissue treatment with minimal bleeding. On the other hand, Er:YAG and Er,Cr:YSGG lasers are better suited for hard tissue applications due to their affinity for water and hydroxyapatite. These controlled interactions not only enhance clinical precision but also reduce collateral damage, postoperative discomfort, and healing time, making lasers a valuable tool in periodontal therapy

3.1. Photothermal Interaction

This is the most common mechanism in soft tissue procedures. The laser energy is absorbed and converted into heat, leading to coagulation (hemostasis), vaporization (ablation of soft tissues), and carbonization (at higher temperatures).

This interaction is widely used for procedures like gingivectomy, frenectomy, and pocket decontamination.

3.2. Photochemical Interaction

In this process, laser energy triggers or enhances chemical reactions. One example is Photodynamic Therapy (PDT), where a photosensitizer and specific laser wavelength work together to destroy bacteria in periodontal pockets with minimal tissue damage.

3.3.Photoacoustic/ Photomechanical Interaction

Ultra-short laser pulses generate shockwaves that can disrupt tissue or bacterial biofilms. This interaction is particularly relevant in root surface debridement and calculus removal using erbium lasers.

3.4.Biostimulatory (Photobiomodulation) Effect

Low-level laser therapy (LLLT) promotes cellular regeneration, reduce inflammation, and accelerate wound healing. This is useful in managing postoperative discomfort and enhancing tissue repair in periodontal therapy.

4. Laser Operation parameters

The clinical effectiveness of lasers in periodontics is primarily based on their interaction with biological tissues.

When laser energy is delivered to periodontal tissues, several physical and biochemical effects can occur, depending on factors such as wavelength, power output, pulse duration, and tissue composition. The signature of laser is basically its wave length .The nature and outcome of laser–tissue interactions in periodontics depend on several interrelated factors. A proper understanding of these variables helps optimize treatment efficacy and minimize tissue damage. Figure 3 represents various laser operating parameters

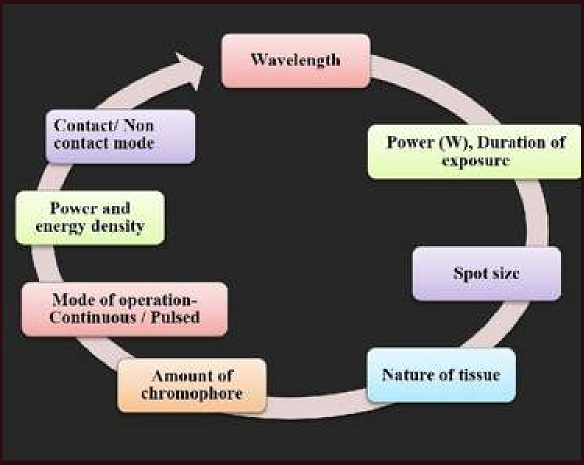

Figure 3. Laser operating parameters

4.1. Wavelength

Each laser emits light at a specific wavelength, which determines how it is absorbed by different tissue components such as water, hemoglobin, or melanin. For example, the diode and Nd:YAG lasers are well absorbed by pigmented tissues. On the other hand, Er:YAG and CO_2 lasers are highly absorbed by water, making them effective for both soft and hard tissues..

4.2. Power Output and Energy Density

Higher power settings increase the thermal effect, while lower settings may be used for biostimulation or superficial treatments. Energy density (fluence), which is energy per unit area, directly influences tissue penetration and the type of response (cutting vs. coagulation).

4.3. Mode of Delivery

Lasers can operate in continuous wave, pulsed, or super-pulsed modes. Pulsed delivery reduces thermal damage by allowing cooling periods between emissions, making it safer for sensitive periodontal tissues. Figure 4 represents various emission modes of laser.

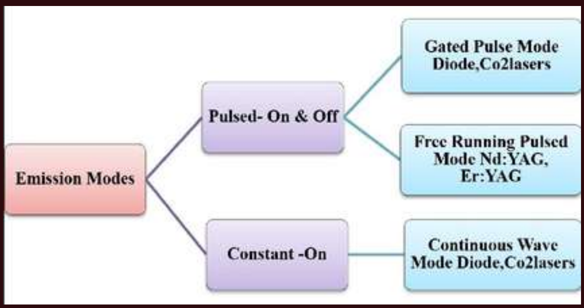

Figure 4. Emission modes of laser

4.4. Exposure Time

The duration of laser application affects the depth and extent of tissue response. Longer exposure may increase thermal damage, while shorter pulses offer more precise control.

4.5. Tissue Characteristics

Different tissues (e.g., inflamed vs. healthy, pigmented vs. non-pigmented) absorb laser energy differently. Moisture content, vascularity, and pigmentation all influence how the tissue reacts to laser irradiation.

4.6. Beam Focus

Laser energy can be delivered in two primary modes, each producing different clinical effects depending on the intended treatment goal:

4.6.1. Focused Mode:

In this mode, the laser beam is tightly concentrated onto a small area, resulting in high energy density. It is primarily used for precise incision, excision, and ablation of soft tissues. This mode enables controlled cutting with minimal bleeding due to effective coagulation.

4.6.2. Defocused Mode:

Here, the laser beam is intentionally dispersed over a wider area by increasing the distance between the laser tip and the tissue. This lowers the energy density and is commonly used for superficial tissue coagulation, hemostasis, or gentle tissue warming, as in photobiomodulation.

4.7. Laser spot size

Laser spot size refers to the diameter of the laser beam as it contacts the tissue and significantly influences the energy density delivered.

A smaller spot size concentrates energy for precise cutting or ablation, while a larger spot size spreads energy for broader, gentler effects such as coagulation or biostimulation. Adjusting the spot size allows clinicians to tailor laser effects based on the clinical objective in periodontal procedures.

4.8. Contact and non contact mode

In contact mode, the laser tip touches the tissue directly, allowing better tactile control and is commonly used for procedures like incision, excision, or debridement. In non-contact mode, the laser beam is applied at a distance from the tissue, ideal for coagulation, decontamination, or photobiomodulation. The choice between contact and non-contact modes depends on the desired clinical effect and the type of laser being used in periodontal therapy [8,9,7].

5. Laser-Based Approaches in Periodontal Treatment

Laser-based therapies have revolutionized periodontal treatment by offering a range of minimally invasive options for managing both soft and hard tissue conditions. These approaches are tailored to the specific clinical needs of patients and are selected based on the type of laser and its interaction with the target tissue. Key laser-based approaches in periodontal therapy are discussed below.

5.1. Laser-Assisted New Attachment Procedure (LANAP):

Laser-Assisted New Attachment Procedure (LANAP) is an advanced, FDA-cleared laser protocol designed for the treatment of moderate to severe periodontitis. This minimally invasive technique employs a Nd:YAG laser (wavelength 1064 nm) to selectively remove diseased epithelial tissue and bacterial pathogens from periodontal pockets while preserving healthy surrounding tissue. Following laser application, ultrasonic scalers and hand instruments are used to debride the root surfaces. A second pass of the laser then helps form a stable fibrin clot that seals the periodontal pocket and promotes regeneration. LANAP offers numerous clinical benefits, including the absence of sutures, reduced bleeding, minimal postoperative discomfort, and faster healing compared to traditional flap surgery. It also facilitates the regeneration of lost periodontal structures, making it possible to preserve teeth that might otherwise require extraction. LANAP is particularly suitable for treating moderate to severe chronic periodontitis, patients who are unwilling or unable to undergo conventional surgery, and cases of peri-implantitis .Despite its advantages, LANAP does have limitations. A, long-term success depends on careful case selection, patient compliance, and ongoing maintenance therapy. While clinical outcomes have been promising, more long-term studies are needed to fully validate LANAP as a mainstream periodontal treatment.

Nonetheless, LANAP represents a significant advancement in laser periodontics, offering a less invasive, regenerative alternative to traditional surgical approaches [10, 11].

5.2. Laser Curettage and Pocket Decontamination:

Diode and Nd:YAG lasers are frequently used for subgingival debridement and bacterial reduction in periodontal pockets, improving clinical attachment levels and reducing inflammation[12,13].

5.3. Gingivectomy and Gingivoplasty:

Lasers allow precise soft tissue removal and contouring with minimal bleeding, faster healing and improved patient comfort compared to traditional scalpel techniques [9].

5.4. Peri-implantitis Management:

Lasers are increasingly used in the non-surgical and surgical treatment of peri-implant infections, offering effective bacterial decontamination and promoting re-osseointegration [14].

5.5. Low-Level Laser Therapy (LLLT) /Photobiomodulation Therapy (PBMT):

Low-level lasers are used to stimulate cellular activity, reduce inflammation, and accelerate wound healing in periodontal tissues.

Low-Level Laser Therapy (LLLT) operates primarily by stimulating mitochondrial activity, particularly targeting the enzyme cytochrome c oxidase. This activation enhances cellular respiration and leads to increased production of adenosine triphosphate (ATP), which fuels various cellular processes. As a result, there is enhanced cell proliferation and tissue regeneration, along with modulation of the inflammatory response—key factors in promoting healing in periodontal tissues [15].LLLT offers several advantages in periodontal therapy. It is a non-invasive and painless treatment modality, making it highly comfortable for patients. Additionally, it presents minimal side effects when applied correctly and significantly accelerates tissue repair and healing, reducing recovery time. The most commonly used lasers for LLLT in periodontics include diode lasers with wavelengths such as 660 nm, 810 nm, and 980 nm. These are preferred for their effectiveness and versatility. Low-power Nd:YAG lasers are also utilized, especially for deeper tissue penetration and anti-inflammatory effects. Helium-Neon (He-Ne) lasers are another option, particularly valued for their role in biostimulation and soft tissue healing [16, 12 ,17]. Table1 shows various applications of LLT .

Table 1. *Application of LLT*	
Application	Description
Pain Reduction	- Reduces post-operative discomfort after scaling, root planing, or surgery. - Decreases the need for analgesics.
Anti-inflammatory Effects	- Modulates inflammatory responses in gingivitis and periodontitis. - Reduces swelling and redness in periodontal tissues.
Wound Healing	- Accelerates soft tissue healing after periodontal surgeries. - Promotes fibroblast proliferation and collagen synthesis.
Bone Regeneration	- May enhance osteoblastic activity. - Supports bone regeneration in defects or after implant placement.
Adjunct to Nonsurgical Therapy	- Enhances outcomes when combined with scaling and root planing. - Improves pocket depth reduction and attachment level gain.
Desensitization	- Reduces tooth sensitivity. - Affects nerve conduction and stimulates reparative dentin formation.

5.6. Photodynamic Therapy (PDT)

Photodynamic Therapy (PDT) is a minimally invasive and highly targeted treatment increasingly used as an adjunct to conventional periodontal therapy. It involves the application of a photosensitizing agent-commonly methylene blue or toluidine blue-into the periodontal pocket. This agent is then activated by low-power laser light within a specific wavelength range, typically in the red spectrum (630-690 nm).

Upon activation, the photosensitizer produces reactive oxygen species (ROS), mainly singlet oxygen, which selectively destroy pathogenic bacteria, disrupt biofilms, and reduce inflammation without harming healthy tissue. In periodontics, PDT serves multiple clinical applications. It enhances bacterial reduction when used alongside scaling and root planing, particularly against anaerobic pathogens like Porphyromonas gingivalis. It is also beneficial in the treatment of peri-implantitis, where it targets bacteria around implants without damaging titanium surfaces. In cases of chronic periodontitis, PDT helps improve clinical outcomes, such as pocket depth reduction and attachment level gain. Additionally, it is effective in managing gingivitis and early periodontitis by lowering inflammation and microbial load. PDT offers several advantages: it is non-invasive, painless, and does not lead to bacterial resistance. It selectively targets harmful microorganisms, preserves healthy tissue, has minimal side effects, and can be used repeatedly without complications. However, some limitations exist. The therapy requires specialized equipment and clinician training, and its effectiveness may vary depending on factors like pocket depth and the extent of photosensitizer penetration. While PDT is a powerful adjunct, it is not a complete replacement for mechanical debridement but rather a complementary tool to enhance periodontal therapy outcomes.

These laser-based approaches provide clinicians with versatile tools that enhance the effectiveness and efficiency of periodontal therapy. When used appropriately, they can lead to better clinical outcomes, reduced discomfort, and higher patient satisfaction. However, successful application requires proper case selection, understanding of laser-tissue interactions, and adherence to evidence-based protocols [18, 19].

6. Advantages and disadvantages of Laser Therapy in Periodontics

The use of lasers in periodontics has gained significant attention due to their precision, minimal invasiveness, and improved patient comfort. While lasers offer numerous clinical advantages, such as reduced bleeding, faster healing, and effective microbial control, they also present certain limitations. A balanced understanding of both the benefits and drawbacks is essential for their safe and effective integration into periodontal practice. A summary of the advantages and disadvantages of Laser therapy is shown in Table2.

7. Laser safety measures

Ensuring safety during laser use is critical to protect both the patient and clinical staff. Essential precautions include the use of appropriate protective eyewear specific to the laser wavelength, implementation of warning signs outside the operatory, and adherence to laser manufacturer guidelines.

Table 2. : *Advantages and Disadvantages of Lase Therapy in Periodontics* [20,21]

Advantages	Disadvantages
Minimally invasive, reduces need for sutures	High initial cost of equipment
Reduced bleeding due to coagulative effects	Requires specialized training and experience
Less postoperative pain and discomfort	Limited effectiveness on hard tissues like calculus and bone
Faster healing and tissue regeneration	Risk of thermal damage if used improperly
Antimicrobial effect reduces bacterial load	Lack of standardized clinical protocols
Increased patient comfort and acceptance	Cannot fully replace conventional periodontal surgical methods
Selective targeting of diseased tissue	May not be effective in deep or complex periodontal pockets

Additional measures include proper training, avoiding reflective instruments, using high-volume suction to reduce laser plume, and maintaining controlled beam exposure to prevent accidental tissue damage. A designated Laser Safety Officer (LSO) is recommended in clinical settings where lasers are regularly used [22].

8. Future Directions

The future of laser therapy in periodontics is promising, with ongoing research and technological advancements paving the way for broader and more effective clinical applications.

As laser systems become more sophisticated, with better wavelength control and integrated imaging, clinicians can expect enhanced precision in diagnosing and treating periodontal conditions. Emerging trends include the integration of laser-assisted regenerative procedures, such as guided tissue regeneration and PBMT, which promote cellular activity, wound healing, and tissue repair. The use of LLLT for stimulating periodontal ligament and bone regeneration is gaining attention due to its non-invasive nature and potential for long-term clinical benefits [21, 23, 24; 25,26].

Additionally, combining lasers with digital technologies may improve treatment planning and outcomes in complex periodontal cases. Personalized laser protocols based on genetic and microbiological profiling could also enhance treatment efficacy. However, for these future directions to be fully realized, further clinical trials, protocol standardization, and cost reduction are essential. With continued innovation and research, lasers are expected to play an increasingly central role in modern periodontal therapy, offering safer, faster, and more patient friendly treatment modalities.

9. Conclusion

Laser therapy presents several potential advantages in the management of periodontal and periimplant diseases. Current literature offers encouraging findings; however, much of the evidence is derived from case reports and case series, limiting the strength of clinical recommendations. To establish laser therapy as a reliable modality in periodontal care, well-designed randomized controlled trials are essential to validate its efficacy and long-term outcomes. Additionally, clinicians aiming to incorporate laser technology into their practice should undergo appropriate training to ensure its safe and effective use. Future research should focus on larger, multi-center studies involving multiple investigators to evaluate whether laser therapy offers a predictable and reliable approach to periodontal treatment, with consistent and sustained long-term outcomes.

References

1. Meshram P, Yeltiwar R, Phadnaik MB. " The Light Touch": Application of soft tissue diode Laser in periodontics-A report of three cases. JIDA: Journal of Indian Dental Association. 2013 Feb 1;7(2).

2. Bhat AM. Lasers in prosthodontics—An overview part 1: Fundamentals of dental lasers. The Journal of Indian Prosthodontic Society. 2010 Mar;10(1):13-26.

3. Newman MG, Takei H, Klokkevold PR, Carranza FA. Newman and Carranza's Clinical Periodontology E-Book: Newman and Carranza's Clinical Periodontology E-Book. Elsevier Health Sciences; 2018 May 29.

4. Theodoro LH, Marcantonio RA, Wainwright M, Garcia VG. LASER in periodontal treatment: is it an effective treatment or science fiction?. Brazilian oral research. 2021 Sep 24;35:e099.
5. Cobb CM. Lasers in periodontics: a review of the literature. Journal of periodontology. 2006 Apr;77(4):545-64.
6. Ishikawa I, Aoki A, Takasaki AA, Mizutani K, Sasaki KM, Izumi Y. Application of lasers in periodontics: true innovation or myth?. Periodontology 2000. 2009 Jun 1;50(1).
7. Altalhi AM, AlNajdi LN, Al-Harbi SG, Aldohailan AM, Al-Ghadeer JY, Al-Bahrani JI, Al-Gahnem ZJ, Alenezi AH, Al-Majid A. Laser therapy versus traditional scaling and root planing: a comparative review. Cureus. 2024 Jun 9;16(6):e61997.
8. 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 1;3(2):124-32
9. Aoki A, Sasaki KM, Watanabe H, Ishikawa I. Lasers in nonsurgical periodontal therapy. Periodontology 2000. 2004 Oct 1;36(1):59-97.
10. Jha A, Gupta V, Adinarayan R. LANAP, periodontics and beyond: a review. Journal of lasers in medical sciences. 2018 Mar 20;9(2):76.
11. Singh N, Uppoor A, Naik DG. LASER-assisted periodontal regeneration:“rays of hope in darkness”. Lasers in Dental Science. 2021 Sep;5(3):149-56.
12. Cobb CM. Lasers and the treatment of periodontitis: the essence and the noise. Periodontology 2000. 2017 Oct;75(1):205-95
13. Aoki A, Mizutani K, Mikami R, Ohsugi Y, Kobayashi H, Akizuki T, Taniguchi Y, Takeuchi Y, Katagiri S, Sasaki Y, Komaki M. Er: YAG laser-assisted comprehensive periodontal pocket therapy for residual periodontal pocket treatment: A randomized controlled clinical trial. Journal of Periodontology. 2023 Oct;94(10):1187-99.
14. Alpaslan NZ, Altindal D, Akbal D, Talmac AC, Keskin Tunc S, Ertugrul AS. Evaluation of the effect of Er, Cr: YSGG laser application on peri-implant crevicular fluid receptor activator of nuclear factor-kappa B ligand and osteoprotegerin levels in the non-surgical treatment of peri-implantitis: A randomized clinical trial. Journal of Periodontology. 2024 Oct;95(10):917-28
15. Sobouti F, Khatami M, Heydari M, Barati M. The role of low-level laser in periodontal surgeries. Journal of Lasers in Medical Sciences. 2015;6(2):45.
16. Dalvi S, Benedicenti S, Hanna R. Effectiveness of Photobiomodulation as an Adjunct to Nonsurgical Periodontal Therapy in the Management of Periodontitis-A Systematic Review of in vivo Human Studies. Photochemistry and photobiology. 2021 Mar;97(2):223-42.
17. Passanezi E, Damante CA, de Rezende ML, Greghi SL. Lasers in periodontal therapy. Periodontology 2000. 2015 Feb;67(1):268-91.

18. Ishikawa I, Aoki A, Takasaki AA, Mizutani K, Sasaki KM, Izumi Y. Application of lasers in periodontics: true innovation or myth?. Periodontology 2000. 2009 Jun 1;50(1).
19. Mills MP, Rosen PS, Chambrone L, Greenwell H, Kao RT, Klokkevold PR, McAllister BS, Reynolds MA, Romanos GE, Wang HL. American Academy of Periodontology best evidence consensus statement on the efficacy of laser therapy used alone or as an adjunct to nonâ surgical and surgical treatment of periodontitis and periâ implant diseases.
20. Sachelarie L, Cristea R, Burlui E, Hurjui LL. Laser Technology in Dentistry: From Clinical Applications to Future Innovations. Dentistry Journal. 2024 Dec 23;12(12):420.
21. Aoki A, Mizutani K, Taniguchi Y, Lin T, Ohsugi Y, Mikami R, Katagiri S, Meinzer W, Iwata T. Current status of Er: YAG laser in periodontal surgery. Japanese Dental Science Review. 2024 Dec 1;60:1-4.
22. Elavarasu S, Naveen D, Thangavelu A. Lasers in periodontics. Journal of Pharmacy and Bioallied Sciences. 2012 Aug 1;4(Suppl 2):S260-3.
23. Mizutani K, Aoki A, Coluzzi D, Yukna R, Wang CY, Pavlic V, Izumi Y. Lasers in minimally invasive periodontal and peri-implant therapy. Periodontology 2000. 2016 Jun;71(1):185-212.
24. Madi M, Mahmoud MM. The evaluation of healing effect of low-level laser treatment following gingivectomy. Beni-Suef University Journal of Basic and Applied Sciences. 2020 Dec;9:1-6.
25. Ponnaiyan D, Rughwani RR, Shetty G, Mahendra J. The effect of adjunctive LASER application on periodontal ligament stem cells. Frontiers in Cell and Developmental Biology. 2024 Jan 12;11:1341628.
26. Clem D, Heard R, McGuire M, Scheyer ET, Richardson C, Toback G, Gunsolley JC, Geurs N. A comparison of Er, Cr: YSGG laser to minimally invasive surgical technique in the treatment of intrabony defects: Twelve-month results of a multicenter, randomized, controlled study. Journal of Periodontology. 2024 Jul;95(7):621-31.

NEXT-GEN PROSTHODONTICS: EVOLUTION OF 3-D PRINTING TECHNOLOGY

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ABSTRACT

Three-dimensional (3D) printing has emerged as a transformative force in prosthodontics, revolutionizing the design, fabrication, and delivery of dental prostheses. By integrating computer-aided design (CAD) with advanced materials, this technology allows for the creation of highly precise, customized, and esthetically pleasing restorations such as crowns, bridges, dentures, and surgical guides. The evolution of 3D printing—from stereolithography to selective laser sintering and fused deposition modeling—has enabled faster workflows, improved fit, and enhanced patient satisfaction. This review explores various 3D printing methods, materials, and their clinical applications in prosthodontics, including dental implants, fixed and removable partial dentures, complete dentures, and maxillofacial prosthetics. Despite advantages like high accuracy and reduced fabrication time, challenges such as high initial investment, limited material biocompatibility, and regulatory concerns persist. With ongoing innovations, including bioprinting and AI integration, 3D printing continues to redefine the landscape of modern prosthodontic care.

KEY WORDS:3-D Printing, Additive Manufacturing, Prosthodontics, Rapid Prototyping

INTRODUCTION

In recent years the field of prosthodontics has witnessed a paradigm shift, due to rapid advancements in technologies. Now 3-D printing emerged as a transformative force by redefining the way dental professionals approach the design, fabrication, and delivery of prosthetic solutions(1). Traditionally, prosthodontic procedures relied on labor-intensive and time-consuming manual techniques, often resulting in variability and limited customization.

The 3-D printing has revolutionized by enabling precise digital modeling of dental structures, rapid prototyping and fabrication of crowns, bridges, dentures, and surgical guides and also personalized treatment plans tailored to individual patient anatomy(2). This technology leverages computer-aided design (CAD) and advanced materials, allowing for the production of highly accurate, durable, and esthetically pleasing prostheses(3).

The integration of 3D printing into prosthodontics not only streamlines workflows but also enhances patient outcomes by reducing turnaround times and improving fit and function.
As the dental community continues to embrace digital transformation, understanding the principles, applications, and future directions of 3D printing in prosthodontics is essential. This review article explores the current state of 3D printing in prosthodontics, highlighting its clinical benefits, technological innovations, and the challenges that must be addressed to fully realize its potential in modern dental practice.

EVOLUTION OF 3-D PRINTING

The concept of 3D printing emerged in science fiction in the mid-20th century and began to materialize with patents for metal printing devices in the 1970s(1) . A major breakthrough came with Charles Hull's invention of stereolithography in the 1980s, followed by the development of Selective Laser Sintering (SLS) and Fused Deposition Modeling (FDM) in the late 1980s (1). By the late 1990s and early 2000s, 3D printing started to gain traction in dentistry, particularly in prosthodontics, as advancements in material science and CAD/CAM technology enhanced its capabilities (4). Current developments in 3D printing include various advancements that have major implications for multiple industries. These advancements involve new materials, such as waste materials and recycled sand, to improve sustainability (5).

Novel research has shown that 3D printing resulted in better results for prosthetic fit, aesthetic appeal, and patient satisfaction. Traditional prosthodontic fabrication relied on manual craftsmanship, which was time-consuming and prone to variability(2).
The introduction of 3D printing allowed for the creation of highly accurate, customized prostheses, significantly reducing production time and improving precision and fit (6). The convergence of 3D printing with digital dentistry—using intraoral scanners, CAD software, and digital workflows—has enabled seamless data transfer from patient scans to prosthesis fabrication(7).
This integration has led to the production of fixed dental prostheses, implants, surgical guides, and splints with enhanced accuracy and patient-specific customization 3D printing has streamlined laboratory procedures, reduced chairside time, and improved patient comfort and satisfaction (5). Challenges remain, including initial investment costs, material limitations, and the need for specialized skills(8). Future trends point toward further material innovation, integration with artificial intelligence, bioprinting, and regulatory standardization to ensure safety and broader adoption(8). 3D printing continues to set new standards for precision, efficiency, and customization in prosthodontics, heralding a new era in dental rehabilitation and patient care(9).

DIFFERENT METHODS IN 3-D PRINTING TECHNOLOGY

3-D Printing technology is classified by the American Society for Testing and Materials (ASTM) into seven processes according to the print method (8):

1) Vat photo polymerization
2) FDM (Fused Deposition Modelling)
3) PBF (Powder Bed Fusion)
4) Binder jetting or three-dimensional printing (3DP).
5) Material jetting or inkjet printing
6) DED (Direct Energy Deposition)
7) Manufacturing of laminated objects (LOM)

VAT PHOTO POLYMERIZATION

a) Stereolithography

This method is one of the first AM methods that was discovered in 1986 (4). This method is based on light polymerization and uses UV light or an electron beam to initiate the chain reaction of resin and monomer. The raw materials are in liquid form and include photopolymers such as polyamides, elastomers, pure polymer resins, composite resins, and ceramic + resin slurry (8). The construction platform is located in a tank of liquid photopolymer. By moving the construction platform up and using laser radiation, polymerization is done and the first layer is made. To make the next layers, the construction platform moves down and sinks into the tank so that the surface of the built layer is covered by liquid polymer, and polymerization is done again with the movement of the platform.

Printing by SLA has high quality and resolution, but this method is time-consuming and expensive, and the materials that can be used in it are very limited. On the other hand, the resin is sensitizing and causes inflammation due to contact with the eyes and skin (1). The energy of the light source and the amount of exposure are the main factors that control the thickness of each layer . In dentistry, SLA is used to make implants, casts, full removable prostheses, temporary veneers, cast models, and metal frames(8).

b) Digital light processing

DLP is a rapid printing method. it is used for resin designs. Similar to SLA, DLP uses a light source to cure layers at once, which aids in speeding up the process. It is widely used in prosthodontics for dental restorations and orthodontic models. Although DLP technology enhances the mechanical and antibacterial properties of polymethyl methacrylate (PMMA) composite resin for dental applications, it is restricted to photopolymers that emit odors, which can be an issue in office environments (1). The printing process and the materials used in it are the same as SLA, with the difference that in SLA, a laser is used for polymerization, but in DLP, a digital projector is used. The speed of this method is higher compared to SLA(8).

c) Continuous Digital light processing

The printing process and the materials used in it are the same as the previous two methods, with the difference that LED or oxygen is used for polymerization. This method is faster than SLA and less expensive than DLP (8).

FUSED DEPOSITION MODELLING

FDM has gained significant traction in prosthodontics due to its accessibility, cost-effectiveness, and versatility. This technology excels in creating complex diagnostic models, surgical guides, and orthodontic appliances(4). The filament is heated until the material becomes semi-liquid and the desired model is made layer by layer. Acrylonitrile butadiene styrene (ABS), polylactic acid (PLA), and polycarbonates are the most commonly used materials. The main feature of this method is the thermoplastic property of the polymer, which causes the layers to be connected during the printing process, and after printing, they turn into a solid state at room temperature. The melting point of the material should be low, and after melting, its viscosity should be enough to be smooth and come out of the nozzle easily. On the other hand, it should be strong enough to support the next layers (6). Layer thickness, diameter, filament orientation, and porosity are the most important factors that affect the mechanical properties of the printed material. Low cost, high speed, and easy processing are the most important advantages of FDM. Low mechanical strength, layered appearance, low surface quality, and low variety of thermoplastic materials are some of the limitations of this method (4)). The evolution of fiber reinforced composites has increased the mechanical strength of the FDM printed model. The orientation of the fibers, the bond between the fiber and the matrix, and the presence of porosity are the main challenges in using these composites. Rapid prototyping (RP) capabilities offered by FDM facilitate the iterative design and evaluation of dental devices, accelerating the development process (5).

POWDER- BED FUSION

In this method, a thin layer of powder is spread on a plate and then packed. The powder in each layer is connected by a laser or connector. These plates are layered on top of each other to make the final 3D product. Then, the powder additions are removed by vacuum, and if needed, the final processing of the details is done by infiltration, coating, and sintering. The distribution and size of the powder particles in the density of the printed area, is the most important effective factor in this method. In powders with low melting temperatures, a laser is used to connect the layers. In the powder with a high melting temperature, a liquid binder is used (8). The most important limitations of the powder bed fusion method are the slow and time-consuming process, high cost, and high porosity when using the binder (1).

a) Selective laser sintering (SLS)

SLS is applied for dental frameworks and bases. It uses a laser to fuse powdered material layers to create 3D objects. SLS can be used to print different polymers, metals, and alloys. In SLS, the laser does not completely melt the fabric, and the surface heat of the powder grains causes the layers to join together (8). This technology employs a laser to selectively fuse powdered material, layer by layer, to create precise 3D objects. This process results in highly detailed and accurate models with natural contours, making it particularly well-suited for complex dental conditions. However, it has defects such as possible inhalation hazards from particles, messy disposal of extra powder, and slower production speed compared to certain 3D-printing modalities (4).

b) Selective Laser Melting (SLM)

Unlike SLS, SLM is only used for special metals such as steel and aluminium. In SLM, the powder is completely melted and connected, which increases the mechanical strength (8). This method is used in prosthetics to make metal frames.

Electron Beam Melting (EBM)

EBM is an advanced additive manufacturing technique that uses an electron beam to melt metal powder, creating high-quality 3D structures. In the dental and maxillofacial fields, it is utilized for a range of applications, including dental implants, customized implant abutments, precise orthodontic appliances, and accurate surgical templates.

BINDER JETTING OR THREE-DIMENSIONAL PRINTING

This system is similar to the powder bed system (PBF) except that a liquid binder is used to connect the layers to each other. First, a layer of powder is deposited on the bed, and then it is aligned with the roller. Then, according to the information obtained by CAD, the binder drops are spread on the powder bed. The chemical properties of the binder, the shape and size of the powder particles, and the reaction between the binder and the powder play an important role in the 3DP process (4). The amount of porosity in this method is higher than using a laser.

MATERIAL JETTING OR INK JET PRINTING

Material jetting is an advanced 3D-printing technique that layers liquid materials to create dental restorations. In prosthodontics, it offers advantages such as high precision and biocompatibility, allowing for the production of restorations. Furthermore, material jetting enables RP, speeding up design and modification processes. It is a photopolymer injection system that makes the whole three-dimensional object layer by layer through several nozzles(4). The chemical basis of the material is similar to vat photopolymerization and it is cured by ultraviolet light. This method is used to make ceramics with a complex structure in tissue engineering.

In this process, a stable suspension of ceramics, such as zirconium oxide powder in water, is pumped by a nozzle onto a substrate and deposited(1). The drops form a continuous pattern that provides sufficient strength to support the next layers (7). Frequently used materials include photocurable resins for their accuracy, ceramics for their aesthetic appeal and biocompatibility, and metal alloys for their durability in implants and frameworks. This technology significantly enhances the quality and efficiency of dental restoration fabrication (10).

DIRECT ENERGY DEPOSOTION (DED)

They are used to make alloys. Raw materials are melted and then deposited and connected together. The difference between this method and SLM is that powder is not used in this method, and higher energy is needed to melt raw materials. Compared to SLM, DED has lower accuracy and lower surface quality, but it has the ability to make models with less complexity. This method is faster and cheaper (4).

LAMINATED OBJECT MANUFACTURING (LOM)

In this method, the materials are in the form of sheets that are cut layer by layer by laser or mechanical methods, and then they are connected. In this method, composites, ceramics, and metals can be used. Depending on the type of material, it requires final processing.LOM (without processing) has a lower surface quality and its dimensional accuracy compared to other methods of powder bed is less(8).

APPLICATION OF 3-D PRINTING IN PROSTHODONTICS

Printers are used in various fields of dentistry, including tissue engineering, implants, maxillofacial surgery, and prosthetics. One of the first uses of CAD-CAM was the creation of accurate anatomical models and surgical guides to help surgeons simulate the surgical procedure before surgery(8). In 1987, Brix and Lambrecht made the first anatomical models using lathes. Lathes were limited to making complex models. In 1992, Klein et al . introduced a method based on stereolithography. Implants can be made by the SLM method using titanium powder, which is biocompatible(1). Absorbable implants are also made of calcium and phosphate. Some studies used tricalcium phosphate and hydroxyapatite to make implants and reported acceptable results (3).

Dental Implants

Dental implants are artificial tooth roots that help replace missing teeth, ensuring a good fit for each individual. Advancements in 3D-printing technology have improved the incorporation of implants (5). An experimental study compared bone healing and implant stability among threaded implants, 3D-printed implants without spikes, and 3D-printed implants with spikes in four beagle dogs. Despite initial differences, all implants showed similar stability and bone integration after 12 weeks.

In addition, histomorphometry analysis confirmed comparable outcomes for bone-to-implant contact among the three implant types (8).

Custom Trays

Custom trays are crucial for taking impressions, registering bites, and making temporary restorations. Usually, these trays were handcrafted from acrylic or silicone over stone casts of patients' teeth. 3D printing now offers a faster and more accurate method for producing custom trays, while digital oral scans can also be used to create tailored trays (6).

Fixed Partial Dentures (FPDs)

FPDs or dental bridges are artificial tools that fill gaps left by missing teeth by connecting natural teeth or dental implants. In the past, fixed partial dentures were made using complex procedures such as creating wax patterns, casting in investment materials, and adding metal or ceramic veneers (5). 3D printing has made the production of fixed partial dentures faster and more tailored.

Removable Partial Dentures (RPDs)

RPDs serve as a solution for replacing missing teeth. These dentures are artificial teeth mounted on a framework that connects to the existing teeth and gums, facilitating ease of removal and cleaning (2). A recent systematic review showed that RPDs generally had high satisfaction rates (50-81%), influenced by factors such as age, gender, RPD experience, denture type (metal vs. flexible), and attachments.

Complete Dentures

CDs replace all teeth in the upper or lower dental arch to restore oral function and aesthetics for patients who have lost all their natural teeth . There is an ongoing discussion regarding the effectiveness and contentment of traditional full dentures compared to those made through 3D printing. A comparison of digital and traditional methods in creating CDs was conducted in 14 laboratory studies. Digital CDs typically exhibited acceptable adaptation and occlusal accuracy, occasionally surpassing traditionally fabricated CDs(1).

Maxillofacial Prostheses

Maxillofacial prosthetics assist in restoring facial appearance and oral functions following surgery or injury. Progress in 3D printing has enhanced precision, shortened surgery time, and boosted outcomes for maxillofacial surgery patients. Recent studies show that 3D-printed models can aid in treatment planning and radiography (8).

MATERIALS USED IN 3-D PRINTING AND ITS CLINICAL APPLICATION IN PROSTHODONTICS

MATERIAL TYPE	CHARACTERISTICS	CLINICAL APPLICATIONS
Photopolymer Resins	High resolution, smooth surface finish	Crowns and bridges, temporary prostheses, orthodontic models and aligners
Metal Alloys (e.g., Co-Cr)	High strength and durability Corrosion resistance	Implant-supported frameworks, dental models and frameworks, partial dentures
Polyether ether ketone (PEEK)	High strength-weight ratio, excellent wear resistance	Temporomandibular joint (TMJ) devices, removable partial dentures
Polylactic Acid (PLA)	Biodegradable, low toxicity, ease of printing	Temporary crowns and bridges, orthodontic appliances
Polyvinyl Alcohol (PVA)	Water soluble, excellent adhesion to build layers	Support structures during printing, dissolvable models for casting and molding
Thermoplastic Elastomers	Flexibility and resilience, impact resistance	Soft denture liners, bite guards, occlusal splints
Hybrid Composites	Combines properties of different materials, customizable properties	Hybrid denture bases, hybrid implant prostheses, hybrid restorative materials

ADVANTAGES AND DISADVANTAGE

ADVANTAGES

- High customization and precision
- Faster fabrication and workflow
- Cost reduction in materials/labor
- Improved patient outcomes
- On-site, versatile production
- Easy digital storage/replication
- Rapid prototyping capability

DISADVANTAGES

- High initial investment
- Limited material options
- Technical/labor training needed
- Post-processing requirements
- Quality control consistency
- Regulatory/standardization gaps
- Risk of machine/software failures

CONCLUSION

Three-dimensional (3D) printing has profoundly transformed the field of prosthodontics, ushering in a new era of precision, customization, and efficiency. With the integration of digital design and advanced printing technologies, prosthodontists can now create highly accurate, individualized dental prostheses that were previously unattainable using traditional fabrication methods.

3D printing enables the fabrication of prostheses with superior precision, leading to improved prosthesis fit and better marginal adaptation compared to conventional techniques. Patient-specific solutions are possible, allowing for optimized esthetics and comfort in restorations such as crowns, bridges, implants, and maxillofacial prosthetics. Digital workflows significantly reduce production times and enable practitioners to make rapid design modifications, enhancing both clinical outcomes and patient satisfaction. Ongoing improvements in printable biomaterials continue to expand the indications and durability of 3D-printed prosthodontic appliances.

Some printable materials still lack the ideal combination of strength, durability, and biocompatibility for all clinical scenarios. The initial investment and learning curve associated with digital workflows may be barriers to widespread adoption. Further research is necessary to fully validate the long-term durability and cost-effectiveness of 3D-printed prostheses in clinical practices.

REFERENCES

1. Alyami MH. The Applications of 3D-Printing Technology in Prosthodontics: A Review of the Current Literature. Cureus. 2024;16(9).
2. Katreva I, Dikova T, Abadzhiev M, Tonchev T, Dzhendov D, Simov M, et al. 3D-printing in contemporary prosthodontic treatment. Scr Sci Med Dent. 2016;2(1):7.

3. Beefathimathul H. Precision and Customization: The Role of 3D Printing in Modern Prosthodontics. Eur J Dent [Internet]. 2025 Jul 16;19(03):580–6. Available from: http://www.thieme-connect.de/DOI/DOI?10.1055/s-0044-1801276
4. Costa LPG da, Zamalloa SID, Alves FAM, Spigolon R, Mano LY, Costa C, et al. 3D printers in dentistry: a review of additive manufacturing techniques and materials. Clin Lab Res Dent [Internet]. 2021 Aug 18; Available from: https://www.revistas.usp.br/clrd/article/view/188502
5. Chander NG, Gopi A. Trends and future perspectives of 3D printing in prosthodontics. Med J Armed Forces India [Internet]. 2024 Jul;80(4):399–403. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0377123724000856
6. Kharat S, Dudhani SI, Kouser A, Subramanian P, Bhattacharjee D, Jhamb V. Exploring the Impact of 3D Printing Technology on Patient-Specific Prosthodontic Rehabilitation: A Comparative Study. J Pharm Bioallied Sci [Internet]. 2024 Feb;16(Suppl 1):S423–6. Available from: https://journals.lww.com/10.4103/jpbs.jpbs_643_23
7. Jun MK, Kim JW, Ku HM. Three-Dimensional Printing in Dentistry: A Scoping Review of Clinical Applications, Advantages, and Current Limitations. Oral. 2025;5(2):24.
8. Abedini A, Kazem Abd Shahi M, Behboodyzad F. A Literature Review Of 3D Printing In Dental Prosthesis. J Pharm Negat Results [Internet]. 2022;13(4):2039–50. Available from: https://pnrjournal.com/index.php/home/article/view/9539
9. Recent Trends of 3-D Printing in Dentistry- A review. Ann Prosthodont Restor Dent [Internet]. 2016 Nov 20;2(4):101–4. Available from: https://www.innovativepublication.com/admin/uploaded_files/APRD_2(4)_101-104.pdf
10. Jun MK, Kim JW, Ku HM. Three-Dimensional Printing in Dentistry: A Scoping Review of Clinical Applications, Advantages, and Current Limitations. Oral [Internet]. 2025 Apr 2;5(2):24. Available from: https://www.mdpi.com/2673-6373/5/2/24

PRESERVING NATURAL DENTITION AND ENHANCING PROSTHETIC REHABILITATION WITH CU-SIL DENTURE: A CASE REPORT

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ABSTRACT

The Cu-Sil denture offers a valuable prosthetic rehabilitation option for partially edentulous patients, particularly those who wish to preserve their remaining natural teeth and avoid extractions. This type of transitional denture addresses concerns about the aesthetic and emotional impact of tooth loss. This case report aims to detail a straightforward fabrication method for a Cu-Sil denture, highlighting its potential as a promising alternative for supporting and conserving natural dentition while providing effective prosthetic rehabilitation.

Keywords: Cu-Sil denture, Edentulism, Remaining natural teeth

INTRODUCTION

Edentulism significantly impacts an individual's oral health, function, appearance, and emotional well-being, necessitating prompt and effective intervention to enhance overall health and quality of life.1 Modern dentistry prioritizes the preservation of natural teeth, which is crucial for maintaining proper oral function and improving overall quality of life. Even in cases with numerous natural teeth still present, prosthetic rehabilitation can be achieved through various options, including overdentures, immediate dentures, transitional dentures, or complete dentures following the extraction of all remaining teeth. rve the alveolar crest structure.

They achieve this by providing a "bumper" and splinting effect for each natural tooth through the hard denture base. A key feature of Cu-Sil dentures is their soft elastomeric seal, which snugly holds the neck of each natural tooth. This seal effectively prevents food and fluids from accumulating around the natural teeth and their supporting structures, thereby contributing to their conservation.3 This innovative design makes Cu-Sil dentures an excellent choice for patients who wish to retain their remaining teeth without the need for complex laboratory procedures. Furthermore, a significant advantage of Cu-Sil dentures is their adaptability; they can be readily modified to accommodate any future tooth loss, offering a long-term, flexible solution for prosthetic rehabilitation.4

Cu-Sil dentures are advised for individuals who have few remaining teeth, whose general health or supporting tissue suggests a poor prognosis for full dentures, and who are not well enough to benefit from fixed or other detachable partial dentures. Cu-Sil dentures, however, might not be appropriate in situations where there are an excessive number of residual teeth, inadequate oral hygiene and infection control, or hostile undercuts that could interfere with the manufacture and positioning of the denture.5

Cu-Sil dentures can be fabricated using different methods, including conventional fashion, injection moulding fashion, and digital CAD-CAM and 3D printing. The method for fabricating Cu-Sil dentures in standard dental setups utilize long-term soft liners as necessary.6

The purpose of this case report is to provide prosthetic rehabilitation for a partially edentulous patient while conserving the remaining natural teeth and their supporting structures.

CASE 1

A 68-year-old female presented to the prosthodontics department reporting difficulty with speech and mastication due to the loss of most of her maxillary and mandibular teeth five years prior.

Following the intraoral examination, it was observed that only third molars remained in mandibular arches. All other teeth in mandibular arch had been extracted five years ago. Importantly, the remaining teeth were periodontally sound and in good condition. The extraoral examination yielded no clinically significant findings.

Considering the patient's age, impaired health, and socioeconomic status, the treatment plan was to fabricate a maxillary and mandibular Cu-Sil denture.

To begin the case, a primary impression was taken using irreversible hydrocolloid impression material (Algitex Alginate Impression Material - Dental Product of India), which was then cast in dental plaster.

To ensure minimal stress on the remaining teeth, custom trays were fabricated for both the maxillary and mandibular casts. The mandibular custom tray was designed with a double spacer (DPI-RR cold cure; Dental Products of India) specifically over the remaining teeth. Green stick impression compound (Pinnacle Tracing Sticks; Dental Products of India) was used for border molding the mandibular arch, and additional silicone light body impression material was used for the secondary impression (Zhermack Elite HD plus Light Body). Dental stone was poured into the secondary impressions to create the master casts. Subsequently, denture bases and occlusal rims were fabricated on these master casts. After recording the maxillo-mandibular relationship, both casts were mounted on an articulator.

Artificial teeth were positioned using traditional methods, and a try-in procedure was performed to verify aesthetics and occlusion (fig 1). Following a successful try-in, traditional dewaxing was carried out. During the dough stage of the resin, heat cure acrylic (DPI heat cure; Dental Product of India) was mixed and applied to the dewaxed area.

This was followed by traditional curing. Once the denture was retrieved from the mold, it underwent finishing and polishing procedures (fig 2). The space in the maxillary partial denture around the remaining teeth can be expanded to provide a 3 mm clearance and Silicone liner can be applied to the surrounding acrylic neck area of the denture. The denture was finished, polished and insertion was done in maxillary and mandibular arch(fig 3,4,5). The patient was recalled on a periodic review which showed that the patient was comfortable in using the denture (fig 6).

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

CASE 2

A 50-year-old male patient presented to our department with chief complaints of difficulty chewing and dissatisfaction with his smile. He specifically sought replacement for his missing lower teeth.

Upon examination, only two teeth remained in his mandibular arch(32,35) (fig 7). Intraoral radiographs confirmed that these remaining teeth had adequate bone support. Given the patient's strong preference to retain his natural teeth, we decided to fabricate a transitional CU-SIL denture for his mandibular arch. We took diagnostic impressions of both his upper and lower jaws. Following this, a custom tray with a full-coverage spacer was fabricated on the mandibular diagnostic cast using autopolymerizing acrylic resin (DPI RR Cold Cure). Border moulding was performed using DPI Pinnacle tracing sticks (green stick compound), and a secondary impression was taken with Zhermack Elite HD Plus Light Body impression material. A master cast was then prepared from this impression. Occlusal rims were fabricated on the master cast, and bite registration was accurately recorded. A wax try-in of the denture was performed to evaluate the occlusion, as well as the dental and facial esthetics. Once approved, the denture proceeded to acrylization using DPI heat cure material(fig 8). Finally, the denture was finished, polished, and inserted (fig 9,10).

Figure 7, 8

Figure 9

Figure 10

DISCUSSION

When addressing patients with a limited number of remaining natural teeth, a comprehensive evaluation of all available treatment options is crucial. Transitional dentures, overdentures, and immediate dentures each present viable solutions, but are accompanied by their own distinct advantages and disadvantages.
Overdentures, for instance, may not be universally suitable due to the requirement for meticulous maintenance, involving multiple follow-up visits and often necessitating prior endodontic therapy.

Conversely, the prospect of full tooth extraction followed by immediate denture placement can have significant psychological impacts for the patient.7
By preserving natural teeth and their supporting tissues, this type of denture significantly contributes to the patient's mental and emotional well-being.

The primary objective of such dentures is to maintain the integrity of natural dentition and surrounding structures, thereby uplifting the patient's mood and emotional health.8
Compared to patients wearing traditional complete dentures, fixed, partial supported Cu-Sil-like dentures can enhance masticatory efficiency by improving prosthesis retention and stability. A notable advantage of Cu-Sil dentures is that they do not require specialized tools or supplies for their fabrication or maintenance. Furthermore, the denture can be readily adjusted to replace any natural teeth that may be lost in the future, extending its functional lifespan.9
Since Cu-Sil dentures preserve natural teeth and their supporting tissues, they have the potential to remain functional for an extended period. For individuals with a limited number of remaining natural teeth who wish to avoid extractions, Cu-Sil dentures offer a sensible and practical therapeutic alternative.6They can also be beneficial for patients with periodontal issues or those who prefer not to undergo other dental procedures. Additionally, Cu-Sil dentures can serve as a transitional denture for patients who require an interim solution.

Patients with single, isolated teeth or a strong desire to preserve their remaining natural teeth are also excellent candidates for Cu-Sil dentures.10

However, it is important to note that Cu-Sil dentures may not be suitable for all patients.

While commending this type of transitional denture, it is crucial to acknowledge that Cu-Sil dentures may not be appropriate for all patients. Specifically, they may not be suitable for individuals with an excessive number of remaining natural teeth, severe soft and hard tissue undercuts, high smile lines, or bruxism. Therefore, a careful and individualized evaluation of each patient's case and overall oral health is essential to determine the most appropriate and effective treatment option.11

Despite having only one or two permanent teeth remaining, the Cu-Sil denture maintains its stability and ease of manufacture, among other significant benefits. Furthermore, it plays a crucial role in helping patients retain proprioception, thereby minimizing any potential psychological impacts associated with tooth loss. This type of denture also enhances speaking, mastication, and overall aesthetics. A key feature of the Cu-Sil denture is its elimination of the need for conventional clasps. Instead, it utilizes an elastomeric gasket that splints, cushions, and stabilizes the teeth, providing excellent retention and effectively keeping food particles out, all while promoting good oral hygiene.12

However, there are certain potential drawbacks of Cu-Sil dentures that should be taken into account. Firstly, the soft liner typically has a short functional life and may require regular replacement.

Furthermore, plaque buildup can occur along the entire gingival margin of the remaining teeth covered by the denture, which could be detrimental to oral health. Lastly, it is critical to understand that Cu-Sil lower dentures are brittle when pressed against natural upper teeth.13

In this context, Cu-Sil dentures emerge as a particularly beneficial therapeutic strategy. They not only aid in preserving the patient's remaining natural teeth and the supporting bone structure but also offer considerable psychological benefits by allowing patients to retain their natural dentition and avoid the immediate and potentially distressing impact of complete tooth loss.13

CONCLUSION

For patients with very few remaining teeth, transitional dentures like the Cu-sil denture offer a great alternative to traditional treatments. These dentures enhance retention without needing special attachments and help maintain the vertical dimension of the bite.

Cu-sil dentures are beneficial because they contribute to the preservation of natural teeth and the integrity of the alveolar ridge. They also help maintain periodontal proprioception, which can have a significant positive psychological impact on patients.Ultimately, Cu-sil dentures are an excellent choice for individuals who prefer to avoid overdentures or the extraction of their remaining natural teeth.

REFERENCES

1.Rathee M, S D, Chahal S, Singh S. Cu-Sil Denture As A Transitional Prosthesis To Preserve The Remaining Natural Teeth Using Permanent Silicone Liner. Interdental J Kedokt Gigi. 2021 Dec 22;17(2):69–73

2.Vinayagavel, Sabarigrinathan, Gunasekar H. Cusil like Denture -Case Report. Int J Heal Sci Res Int J Heal Sci Res. 2014;1954(2):195–7.

3.Jain JK, Prabhu CR, Zahrane MA, Esawy MS, Ajagannanavar SL, Pal KS. Cu-sil dentures - a novel approach to conserve few remaining teeth: Case reports. J Int Oral Health. 2015 Aug;7(8):138-40.

4.Tyagi S, Thomas AM, Balla V, Kundra R. Cu-Sil dentures: A novel approach of Papillon-Lefèvre syndrome management. J Indian Soc Pedod Prev Dent. 2019;37(3):303–7.

5.Goel D, Talukder D, Datta P, Paul G, Singh S. Cu-Sil denture: an innovative approach to preserve the few remaining natural teeth: a case report. Int J Sci Reports. 2018 Dec 25;5(1):29.

6.Jain AR. Cu-Sil denture for patients with few remaining teeth - A case report. J Adv Pharm Educ Res. 2017;7(3):332–4.

7.Dange DSP, Dhage DDT, Mahale DKM, Khalikar DSA. Cusil denture: A new esthetic approach to improve retention, stability and preserve remaining natural teeth and bone in macroglossia patient. Int J Appl Dent Sci. 2022 Apr 1;8(2):337–40.

8.Alqutaibi AY. A within-subject comparison of the conventional clasp-retained with attachment-retained removable partial dentures. J Taibah Univ Med Sci. 2020 Aug; 15(4):305–11.

9.Rajan NS, Kumar MM, Sarath C, Dathan PC. Esthetic rehabilitation of periodontally compromised dentition using a combination of Gumfit and Cu-Sil Denture. J IDA Attingal Branch. 2017;7(1):29–31.

10.Fatahillah AS, Kridanto Kamadjaja MJ, Laksono H. Immediate Complete Overdenture – A case report. Indones J Dent Med. 2018 Mar 31;1(1):31.

11.Kang HS, Lee SY. Immediate fixed partial denture after tooth extraction in patients with systemic diseases: A clinical report. J Adv Prosthodont. 2016 Dec;8(6):511–4.

12.Hiremath S, Jairaj A. Cu-sil Denture-A Space Maintainer for Function- In Paediatric Patients. J Clin Diagn Res. 2017 Mar;11(3):ZD09-ZD11.

13.Mathiyazhagan Stalin, Manu Rathee, Surbhi Mittal, Sarthak Singh Tomar, Kritika Diwan, Senthilvelpalani Balavignesh: Preserving natural dentition and enhancing prosthetic rehabilitation with Cu-Sil denture : A case report.Indonesian Journal of Dental Medicine Volume 7 Issue 1 2024; 30-34

IDA HOPE
HELP OFFERED TO PROFESSIONALS IN EMERGENCIES

INDIAN DENTAL ASSOCIATION - KERALA STATE BRANCH

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Top up your insurance upto 1 Cr if the total claim amount exceeds your chosen limits

ELIGIBILITY

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- RECOGNISED BDS/MDS DEGREEE
- VALID DENTAL COUNCIL REGISTRATION
- AGE < 45 YEARS

HOW TO JOIN HOPE

Apply to Hon.Secretary, HOPE through your branch HOPE Representative with the following documents

1. Filled in original application form
2. Admission fees remitted as NEFT/DD/Online Transfer
3. One recent Passport Photograph
4. BDS/MDS Degree certificate and valid council registration
5. Age and address proofs

ADMISSION & RENEWALS

Upto age of 30 yrs - Rs.5000
31-40 yrs- Rs.7500
41-45 yrs - Rs.10000

RENEWALS IN APRIL – MAY

DEFAULTERS AND DROPOUTS

- HOPE members who do not renew by May 31st will not receive Benevolent Scheme Coverages but can renew upto June 30 with a fine
- After June 30 - no renewals possible and has to join afresh as per the age

IDA HOPE
HELP OFFERED TO PROFESSIONALS IN EMERGENCIES

INDIAN DENTAL ASSOCIATION - KERALA STATE BRANCH

IDA HOPE FORMATION

- Started as Professional Protection Scheme in 2002
- Later Merged PPS and Benevolent (Social Security Scheme) to form HOPE in 2007
- HOPE is a unique voluntary subscribed project of IDA KSB

4750 + MEMBERS AND GROWING EVERY DAY

HOPE LEGAL CELL (PROFESSIONAL PROTECTION SCHEME)

- Legal support in Medico/Dento legal cases- takes up the cases from beginning with a lawyer's notice
- Monetary support in court cases - Engages and supports the legal steps including Lawyer's fees and other expenses
- Compensation of upto Rs.3.5 lakhs if awarded will be paid by the scheme

Legal protection starts after one month of receiving payment and acceptance of filled up application forms by the Hon HOPE Secretary

For Legal Assistance Contact: Dr Ittyivirah Babu, Vice Chairman Legal Cell, 94967 24042

HOPE (BENEVOLENT SCHEME)

- Supporting the family in unfortunate event of Death or Total Permanent Disability
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For Assistance Contact: Dr Saji Kurian, Vice Chairman HBS, 98474 40646

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- Public Liability cover

RENEWALS - JULY

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JOURNAL GUIDELINES

Manuscript type : accepted are i) research ii) case report iii) review iv) short study
Article should be typed in times new roman size 12 A4 size paper. Use 1.5 spacing through out with a significant margin. Authors are advised to retain a soft copy for the reference and a soft copy of the article has to be sent to the editors email
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