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President's message

Dear SPIK Members,

I am delighted to share some key updates in this issue of the SPIK Journal. This year, we successfully conducted the Oral Hygiene Day Celebrations and the Essay Competition, both of which saw remarkable participation and enthusiasm. These events truly highlight our collective dedication to promoting oral health and professional excellence.

I am also pleased to announce the renewal of the SPIK Charitable Society registration and the completion of our GST registration, ensuring the continued smooth functioning of our society. A special thanks to our Secretary, Dr. Mohammed Feroz, for his tireless efforts in making this possible.

Additionally, I would like to commend the editorial team, led by Dr. Shahana, for their outstanding work in bringing this journal to life. Their dedication is truly appreciated.

Let's continue our journey of collaboration and growth, and I look forward to even more successful initiatives in the year ahead.

Warm regards,

Dr. Mathew Thomas
President, SPIK

Secretary's Message

Dear SPIK members,

Welcome you all to the second issue of our Journal - 'JSPIK' of this current SPIK year.

Let me start by congratulating our enthusiastic Editor Dr. Shahna C Mohamed for bringing out the second issue of JSPIK on time. I request all our life members and associate members to continue contributing to the journal of our organization.

A humble request to all Heads of the departments and post-graduate guides to encourage the existing and fresh MDS batch students to take membership in SPIK.

A special word of appreciation to our Periodontal Health Care Convenor Dr.Subair.K for organizing public awareness programmes during oral hygeine day celebration on 1st August.

SPIK Essay competition 2024 is getting a good response from the PGs and the faculty. Acknowledge our Scientific Convenor Dr.Deepak Thomas for coordinating among the members. Upcoming programmes include SPIK Scholarship examination which will be hosted by Royal Dental College, Chalissery and Mid-term conference by Educare Institute of Dental Sciences, Kottakkal, , the details of which shall be communicated in due course.

Glad to inform that the society registration has been renewed from 2008 till 2024 as per Society act.

Once again requesting the continued support and cooperation of our members in all SPIK activities.

With regards,

Dr. Mohammed Feroz T.P
Secretary, SPIK

INFORMATION TO AUTHORS

About the Journal

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Address for communication

Dr Shahana C Mohamed, Editor JSPIK, Assistant Professor, Department of Periodontics, Government Dental College, Medical College P. O, Thiruvananthapuram - 695 011, Kerala, India. E-mail: editorspik@gmail.com

JSPIK

Cell free DNA: A Paradigm Shift in Diagnostic Sphere of Periodontics?

Devika G[1], Pooja R[2], Subbulakshmi Parthasarathi[3]

ABSTRACT

Periodontitis is a chronic multifactorial inflammatory disease affecting the periodontal tissues,and constitutes diagnostic and management challenges. Assessment of disease activity and identification of patients at risk of disease progression are not possible with conventional approaches. A biomarker is a material that is utilized to represent a biologic state and is an objective measure to assess the level of disease activity both now and in the future. The quest for new biomarkers, such as cell-free deoxyribonucleic acid (cfDNA), has been spurred by recent advancements in molecular diagnostics. An overview of current research on the use of cfDNA as a diagnostic marker in the diagnosis of periodontal disease is provided by this review article.

Keywords: Cell free DNA, Periodontitis, Diagnostic biomarker

Introduction

In recent years, multiple strong tools have emerged for deciphering various diseases in the field of medicine that has the potential to diagnose, screen, assess risk, and also to assist in the determination of staging, grading, and primary therapy selection. A biomarker is a substance used to indicate a biologic state and is an objective measure to evaluate the present and future disease activity. It is defined as a substance that is measured objectively and evaluated as an indicator of normal biologic processes, pathogenic processes, or pharmacologic responses to a therapeutic intervention.[1]

Periodontitis is a chronic multifactorial inflammatory disease associated with the accumulation of dental plaque, and characterized by progressive destruction of the teeth-supporting apparatus, including the periodontal ligament and alveolar bone.[2] Apart from the conventional diagnostic methods, various biomarkers have now evolved in detecting periodontitis. The biological media of choice in detecting periodontitis include saliva, serum and gingival crevicular fluid. According to recent research, immune system cells stimulate alveolar bone resorption by releasing cell free deoxyribonucleic acid (cfDNA) during periodontal inflammation. The genetic diversity of cfDNA results in certain obscurity which produce significant experimental and analytical challenges. Thus, a better comprehension of the factors that influence the characteristics of cfDNA is essential, although it is mainly absent currently.

The main intention of this review is to understand the potential role of circulating cfDNA as a diagnostic biomarker eminently in the field of Periodontics.

Cell free DNA

Mandel and Metais identified cell-free DNA (cfDNA) in human plasma in 1948 which is described as nucleic acid fragments detected in various body fluids.[3] The phrase refers to any type of extracellular deoxyribonucleic acid (DNA) molecule present in serum, plasma, or other bodily fluids of vertebrates. This includes foreign DNA, such as that originating from bacteria or viruses, as well as host genomic and mitochondrial DNA. The majority of the cfDNA

[1,2]Senior Lecturer, [3]Reader, Department of Periodontics, Asan Memorial Dental College and Hospital, Chennai, India. Corresponding Author: Dr. Devika G, E-mail: devikageetha93@gmail.com

molecules are found as double-stranded DNA (ds-DNA).[4,5] The prominent peak size of cfDNA is 167 bp, and its size profile often follows multiples of the ~ 180 bp nucleosomal unit.[6] Some of the factors that influence the release of cfDNA include infection, oxidative stress, age, gender, physical activity, smoking, diet, and pregnancy.[7] This genetic material becomes an information emporium by storing the signatures of cellular activity throughout the body.

Source of Origin

In a typical biospecimen, the aggregate cfDNA population has varied biological and structural properties. Different cellular sources and modes of origin frequently lead to the generation of distinctively different types of cfDNA, even if some overlap is prevalent. Understanding the biological role(s) of cfDNA and increasing its therapeutic value require a thorough stratification of the many cfDNA subtypes and a better grasp of the variables that may influence these traits of cfDNA. Source of cfDNA include apoptosis, necrosis, NETosis, erythroblast enucleation, macromolecular structures, and extracellular vesicles. (Figure 1)

- Apoptosis: Short DNA fragments are produced during apoptosis as a result of endonucleases processing the cell's DNA. Double-stranded pieces of roughly 150–200 base pairs are what make up CfDNA, which is derived from apoptosis.[8]
- Necrosis: One typical method of death in trauma and sepsis situations brought on by chemical or physical stressors is necrosis. This mechanism is connected across cfDNA in kilobase pairs. Necrosis-derived cfDNA is longer in length because it takes more time to remove necrotic cells, but apoptotic cell

Table 1: Summary of studies which investigated the role of cfDNA in Periodontics

Sl. No.	Author	Study	Conclusion
1	Hanyao Haung etal; 2022[25]	a. Investigated the relationship between cfDNA level and severity of inflammation in saliva and serum b. Compared the efficacy of two cfDNA scavengers (G3@SeHANS and PAMAM/G3) and its ability in reducing inflammatory boneloss in ligature induced periodontitis in murine model	a. Cf DNA is correlated with progression of periodontitis and it increases with increase in periodontits. b. Scavenging cfDNA to block hyperactive proinflammatory response is useful to treat uncontrolled localized inflammatory boneloss in periodontitis.
2	Zhu X etal; 2022[36]	Investigated the correlation between periodontal parameters and cfDNA concentrations in GCF, saliva and plasma in Chinese patients	CfDNA concentrates in GCF, saliva and plasma is increased with aggravation of periodontal inflammation
3	Lin et al; 2018[37]	Measured plasma cfDNA in squamous carcinoma patients using qualitative spectrometry and compared it with healthy subjects	CfDNA significantly increased in squamous cell carcinoma than healthy patients so, it can be used as a novel and easily accessible biomarker for squamous cell carcinoma.
4	Konecnaet al;2020[38]	Analysed salivary DNA concentration and dioxyribonuclease (DNAse) activity in periodontitis patients	Presence of inflammation is associated with increased total and mtDNA concentration in different fractions of saliva. Authors also commented that Extracellular DNA seems to be decreased in periodontitis.

clearance takes less time.[9]

- NETosis: NETosis, an active source of cfDNA, is the process that causes neutrophils to die after coming into contact with external stimuli. This specific procedure relies on neutrophils releasing extracellular traps (NETs), to kill and destroy microorganisms. Proteins called histones and DNA make up NETs. DNA is released in two types during the NET mechanisms: vital and suicidal NETosis. When neutrophils are in their vital state, they release DNA and carry out their phagocytic function against pathogens; however, when they are in suicidal NETosis, their death is predetermined after coming into touch with a pathogen.[10]
- Erythroblast enucleation: Following nuclear condensation, the orthrochromatic erythroblast proceeds through enucleation, which produces the reticulocyte, which is primarily composed of cytoplasm, and the pyrenocyte, which is composed of a tiny cytoplasmic ring surrounding the nucleus. Despite the fact that erythroblast enucleation has frequently been proposed as a possible source of cfDNA in the literature, there isn't much experimental support for this theory. Research has demonstrated that the majority of the donor-origin plasma cfDNA originated from hematopoietic lineage cells. White blood cells accounted for about 55% of the cfDNA's genesis, whereas erythrocyte progenitors contributed 30%.[11] Exercise-induced increases in cfDNA levels in blood were also linked to hematopoietic lineage cells.[12]
- Macromolecular structures: The word "virtosome" was first used in 2010 by Gahan and Stroun to refer to a circulating DNA-RNA-lipoprotein complex that was actively released from live cells. It is noteworthy that virtosomal and metabolic DNA share a number of characteristics.[13] There is a suggestion that this distinct DNA population arises from spontaneous DNA synthesis and happens apart from the high molecular weight chromatin mass found in cell nuclei.[14] Early research on the adult mouse heart, gut, and skeletal muscle revealed that the amount of metabolic DNA varied from 500,000 to 4,000,000 Daltons, or roughly 769 bp–6 Kbp.[15] It's interesting to note that cfDNA fragments with this size profile have been found in the supernatant of several cell lines that have been cultivated and have been proven to be a component of some extracellular vesicles cargo.[16]

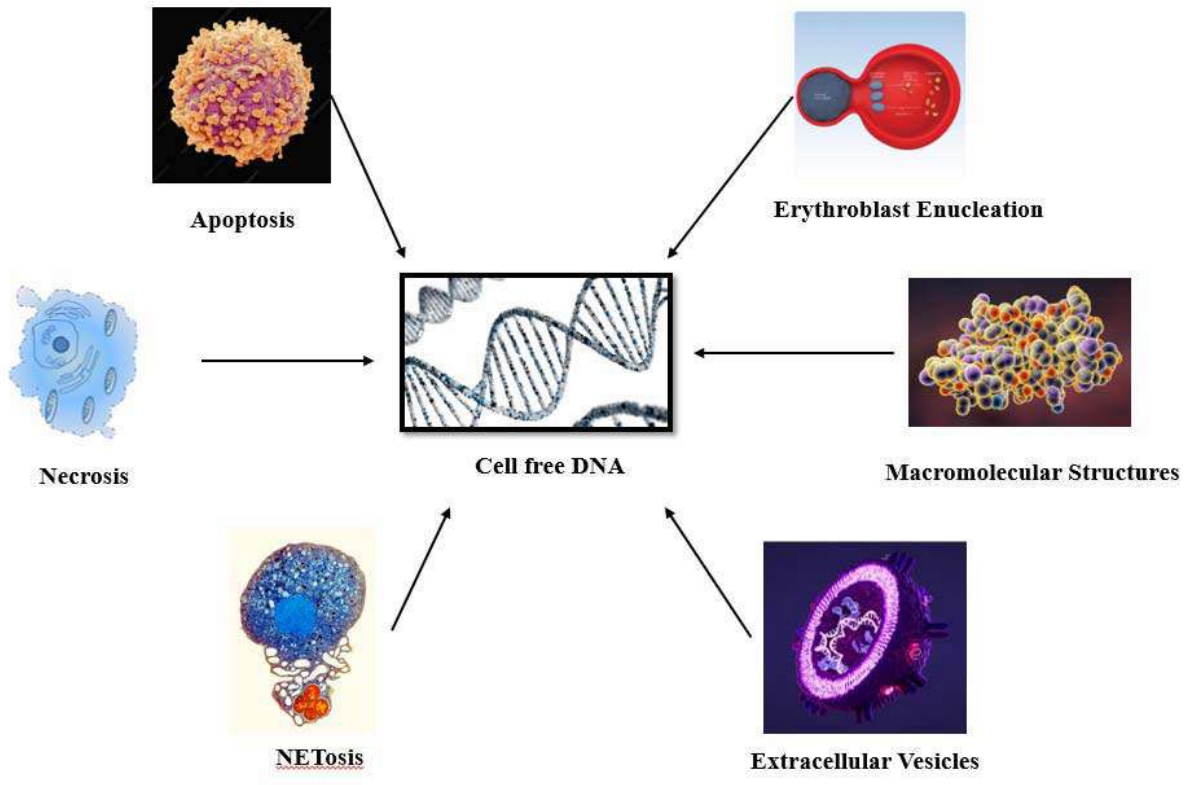

Figure 1: Sources of Cell free DNA (cfDNA)

They are frequently found in biospecimens of humans. More investigation is required to ascertain whether the larger ~1-6 Kbp cfDNA fragments are genuinely a population of cfDNA originating from a regulated extrusion pathway, or if they are merely the result of passive release mechanisms like apoptosis or necrosis. Although it is an intriguing possibility that metabolic DNA could act as the precursor to larger cfDNA fragments.

- Extracellular Vesicles (EVs): Extracellular vesicles are a unique subset of cfDNA molecules that may be physiologically active.[17] EVs have been discovered as a method for the release of active cfDNA. EVs are classified into three main types: exosomes, microvesicles, and apoptotic bodies. EVs contain ribonucleic acid (RNA), mitochondrial DNA, proteins and fats, and genomic DNA.[18]

There are several different forms of cfDNA, including free fragments, attached to proteins, and enclosed in extracellular vesicles (EVs).[19] The term "cfDNA fragments" refers to molecules that are only DNA and nothing else.[20] The variety of cfDNA origins and forms highlights the intricacy and promise of this biomarker under different physiological and pathological circumstances. Nowadays, cfDNA is frequently employed as a biomarker in the fields of oncology and prenatal analysis, among other medical specialties. Researchers studying cardiovascular diseases (CVDs), autoimmune disorders, sepsis, and trauma have also become interested in cfDNA in recent years.

Types of Cell Free DNA

Human fluid contains three different types of cfDNA: bacterial DNA (also known as viral DNA), endogenous nuclear DNA (commonly known as genomic DNA), and mitochondrial DNA (mDNA).[21] EVs are capable of carrying mDNA as well as genomic material. In healthy patients, plasma cfDNA levels are usually less than 10 ng/mL. In instances of trauma, inflammation, cancer, heart disease, and systemic sickness, the concentration of cfDNA increases.[22]

Cell Free DNA and Periodontics

In a healthy patient, the NETs system facilitates the elimination of bacteria, pathogen-associated molecular patterns (PAMPs), and damage-associated molecular patterns (DAMPs), hence releasing peptides and cfDNA. DAMPs are made up of intracellular substances that the cells release as they undergo necrosis, such as proteins and nucleic acids.[23,24] Conversely, periodontitis is characterized by the presence of hyperactive polymorpho nucleate neutrophils (PNMs), which stimulate the NETs system, leading to alterations in homeostasis and persistent inflammation.[23]

Toll-like receptors (TLRs) play a crucial role in the recognition of pathogen-associated molecular patterns (PAMPs) from bacteria that cause periodontal disease. The development and establishment of periodontitis have been found to be linked with aberrant functioning of TRL9. One of the primary cfDNA receptors is TRL9, which interacts with alveolar bone inflammation to initiate the inflammatory response.[25] In the oral and pocket epithelium, TRL9 is typically found in the basement and sub-basement cells. Patients with periodontitis have higher TRL9 levels in their periodontal pockets than do healthy patients. This finding might be connected to the active function of cfDNA in the onset and advancement of periodontitis.[26]

A source of endogenous cfDNA is mitochondrial DNA (mtDNA). Maintaining health requires proper mitochondrial function. When it comes to periodontitis, the pathophysiology of the disease is influenced by mitochondrial dysfunction. Periodontal infections induce the NETs to become active, which results in the presence of mtDNA in the extracellular space.[27]

Cell-Free DNA as a Diagnostic Biomarker in Periodontitis

One objective of periodontal diagnostic methods is to give the clinician relevant information on the type, location, and severity of the periodontal disease that is currently present. Probing depths, bleeding on probing, clinical attachment levels, plaque index, and radiographs determining alveolar bone level are among the conventional periodontal diagnostic measures utilized in clinical settings. The field of oral and periodontal disease diagnostic research is progressing towards the use of objective indicators, including biomarkers, to identify and quantify periodontal risk. According to recent studies, immune system produces cell free DNA (cfDNA) when periodontitis occurs, which aids in the resorption of alveolar bone.[28]

A novel tool for determining the state of periodontitis may be CfDNA. The short length of cfDNA

may be a constraint on its search, however modern technological approaches enable its detection.[29] Fluorescence, genetic sequencing, and polymerase chain reaction (PCR) are these techniques. Blood, saliva, and gingival crevicular fluid (GCF) were tested for the presence of cfDNA in periodontology.[30] In these various biofluids, the amount of cfDNA in periodontopathic patients and healthy patients has been examined in several investigations. Studies investigating the role of cf DNA in Periodontics is summarized in Table 1.

Evaluation of CfDNA in GCF, Saliva and Serum

Evaluation of cf DNA in GCF

Collection of GCF can be done through two methods: the paper strip method and the washing approach.[31] Aspirating the liquid that comes out of the gingival pockets after they have been cleansed with an isotonic solution is the washing procedure. Fluid from the gingival crevice is collected for 30 seconds on each paper strip using the paper strip technique. Both approaches allow for the collection of the GCF, but because the paper strip method has a lower learning curve, it is preferred.

Research has demonstrated that as compared to healthy people, periodontitis sufferers had higher quantities of cfDNA in both GCF and saliva. This implies that the increased concentration of cfDNA in the bloodstream is a result of persistent inflammation in the periodontal tissue. It is challenging to determine its specificity in differentiating periodontitis from other inflammatory illnesses, as cfDNA levels may be influenced by age, smoking, and systemic diseases, among other things.[32]

Evaluation of cf DNA in Saliva

Different types of biomarkers can be found in a saliva sample. The components of saliva can be influenced by a wide range of variables, including stress, illness, and food. It can be used to assess the amounts of oxidative stress, antioxidants, periodontopathic bacteria, and other factors in the periodontal field. The cfDNA in saliva contains 30% microbial DNA and 70% endogenous DNA.[33]

Evaluation of cf DNA in Serum

As previously stated, cfDNA can be found in blood. Indeed, two preclinical investigations following the injection of Porphyromonas gingivalis (P. gingivalis) in mice revealed elevated quantities of cfDNA in plasma.[34,35]

Challenges

CfDNA analysis presents certain difficulties in diagnosing periodontal disease, despite its potential. Standardization of methods, test's sensitivity and specificity, and the requirement for extensive clinical trials to confirm its therapeutic value are a few of these.

Conclusion

CfDNA have been shown to be elevated in a number of chronic inflammatory disorders, including periodontal disease. It encourages the persistence of inflammation by actively contributing to the onset and development of the pathology in periodontitis. Its capacity to identify certain infections and host-reaction indicators can support early diagnosis and treatment tracking. Despite the intriguing positive results obtained by research, in using cfDNA scavengers as a therapeutic modality in treating uncontrollable inflammatory loss in murine induced periodontitits, more exploration has to be conducted to avail cfDNA as a treatment option in humans.[25] Such experimentations can contribute a new breakthrough in the therapeutic sphere in periodontics as well as in the field of medicine.

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Artificial Intelligence in Periodontics: A new era of Precision Diagnosis and Treatment

Lakshmi Damodaran[1], Aswathy M[2], Arun Narayanan[3], Mohammed Feroz T P[4]

ABSTRACT

Artificial intelligence (AI) has remarkably increased its presence and significance in a wide range of sectors, including dentistry. It can mimic the intelligence of humans to undertake complex predictions and decision making in the healthcare sector. Artificial Intelligence has emerged as a transformative tool in revolutionizing the diagnosis and treatment of periodontal diseases. The Integration of AI in diagnosis holds promise for proactive intervention, improved patient outcomes, and the potential to reshape the landscape of periodontal care.

Keywords: Artificial intelligence, Machine learning, Deep Learning, Periodontics

Introduction

Artificial intelligence (AI) is a broad concept encompassing the utilization of machines and technology to carry out tasks traditionally requiring human intelligence. It is an extensive branch which is concerned with building smart machines capable of performing tasks that typically require human intelligence.

According to "Barr and Feigenbaum," AI pertains to the field of computer science dedicated to creating an intelligent computer system which exhibits characteristics associated with intelligence in human behavior-understanding language, learning, reasoning, problem solving, and many more. AI, like other fields, is transforming as an emerging field of dentistry. It can perform several simple tasks in the dental clinic with greater precision, and fewer errors than human counterparts. AI plays a crucial role in aiding clinical diagnosis and formulating treatment plans. The prospects of artificial intelligence in the dental field are infinite and its use is rapidly advancing.[1]

Periodontitis is the sixth most prevalent disease in worldwide. It is characterised by microbially associated, host-mediated inflammation that results in loss of alveolar bone and periodontal attachment, leading to tooth loss and is challenging for clinicians to accurately recognize and diagnose. With the integration of artificial intelligence in periodontics and its ability to process vast amounts of data, identify patterns, and make precise predictions, AI is reshaping the way periodontal diseases are understood, diagnosed, and treated, ultimately leading to improved oral health outcomes for patients worldwide.[2]

History of Artificial Intelligence[3]

The concept of using computers to simulate intelligent behavior and critical thinking was first described by Alan Turing in 1950. In the book Computers and Intelligence, Turing described a simple test, which later became known as the "Turing test," to determine whether computers could exhibit human like intelligence.

John McCarthy, a mathematician coined the term artificial intelligence in 1956, and is widely recognized as the father of artificial intelligence. He selected this term to elucidate the potential of machines to execute tasks encompassing intelligent activities.

In 1978 Richard Bellman, an applied mathematician defined artificial intelligence as the automation of

[1,2]Postgraduate student, [3]Professor and Head, [4]Professor, Department of Periodontics, Kannur Dental College, Anjarakandy, Kannur, Kerala, India. Corresponding Author: Dr. Lakshmi Damodaran. E-mail: lakshmidnair93@gmail.com

activities associated with cognitive abilities, which includes learning, decision making and problem solving.

TYPES OF ARTIFICIAL INTELLIGENCE

Artificial Narrow Intelligence (ANI)

This AI is trained and focused to perform specific tasks. ANI predominates the landscape of the AI application today. It enables very robust applications, such as Apple's Siri, Amazon's Alexa, and self-driving vehicles.[4]

Artificial General Intelligence (AGI)

It is a theoretical form of AI where a machine would have an intelligence equal to humans. It would be self-aware with a consciousness that would have the ability to solve problems, learn, and plan for the future.[4]

Artificial super intelligence (ASI)

ASI also known as superintelligence—would exceed the intelligence and ability of the human brain.[4]

KEY ASPECTS OF AI

Machine Learning (ML)

It is part of AI, which depends on algorithms to predict outcomes based on a dataset. The purpose of machine learning is to facilitate machines to learn from data so they can resolve issues without human input. ML approaches broadly fall under unsupervised and supervised learning. Unsupervised learning approaches focus on learning inherent groups within the given input data and have proven to be a useful exploratory tool. On the other hand, supervised learning techniques learn the mapping between the input data and the outcome of interest and subsequently uses this mapping to predict the outcomes of new input data.[5]

Deep Learning (DL)

It is a component of machine learning that utilizes the network with different computational layers in a deep neural network to analyze the input data. The purpose of deep learning is to construct a neural network that automatically identifies patterns to improve feature detection.[5]

Representation Learning (RL)

Representation learning is a subtype of ML in which the computer algorithm learns the features required to classify the provided data. This does not require a hand labeled data like ML.

AI can assist in the development of algorithms that can learn from information provided and make predictions. Machine learning creates algorithms based on data. One of the first type of AI algorithms to be developed was neural networks (NNs) (Figure 2). Deep learning neural networks are structures with numerous levels and enormous layers, whereas shallow learning neural networks are simple network structures with only a few layers.[5]

Artificial Neural Networks (ANNs)

This involves networks of highly interconnected computer processors that has the ability to learn from past examples, analyze nonlinear data, handle imprecise information, and generalize enabling application of the model to independent data thus making it a very attractive analytical tool in the field of medicine. The greatest advantage of these systems is that they have the capability to solve the problems that are too complex to be solved by conventional methods They are useful in various areas of medicinal science like diagnosis of diseases, biomedical identification, image analysis, and data analysis.[7]

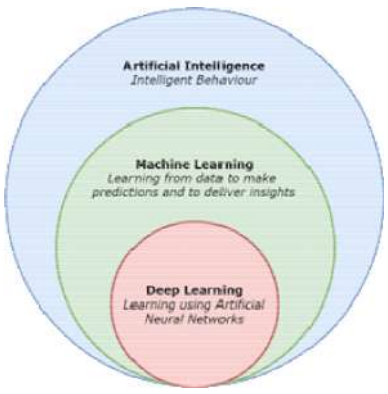

Figure 1: Key aspects of artificial intelligence[5]

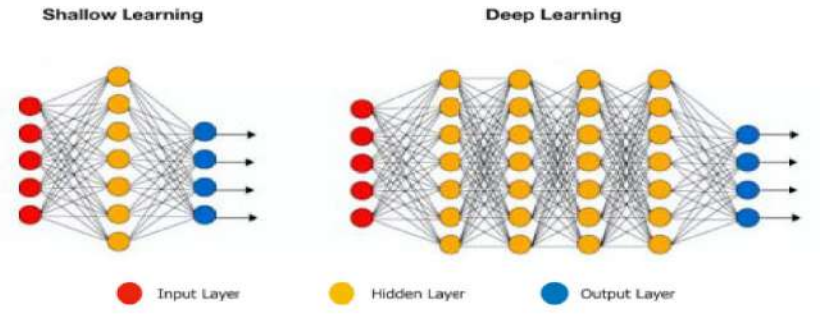

Figure 2: Neural network designs[7]

Clinical Decision Support System (CDSS)

A CDSS is a system between a broad dynamic (medical) knowledge database and an inferencing output mechanism that are a set of algorithms derived from evidence-based medical practice executed through medical logic modules. Currently, the intuitive interphase with voice controls are designed to assist the health care professional to work more efficiently with time saving and cost effective clinical dental practice. Clinical decision support system thus provides valuable information to dental personnel, patients or individuals or populations to produce faster, more systemic and superior dental health outcomes.[7]

Augmented Reality

Defined as "a technology that superimposes a computer-generated image on a user's perspective of the real world, accordingly giving a composite view."

Virtual reality

A computer-generated reenactment of a three-dimensional (3D) image or environment that can be communicated with, in an apparently real or physical path by an individual utilizing unique electronic equipment.

How do Artificial Intelligence Models Work?

AI function through two phases: "training" initially followed by testing. During training the model's parameters are set based on the provided training data. Subsequently, the model utilizes prior examples, such as patient data or diverse datasets, to establish these

Table 1: Comparative analysis of Various AI Techniques[7]

Algorithms	Benefits	Drawbacks	Uses
ANN	◆ Robustness ◆ Have a high level of fault tolerance ◆ Has the ability to solve tough problems ◆ They have memory that is dispersed.	◆ Hardware is required. ◆ Network behaviour unaddressed ◆ Selection of proper network structure	It is employed in the development of a toothache prediction model for the treatment of dental infection and decay.
CNN	◆ Simple to comprehend and put into practice ◆ It predicts images with accuracy and is computationally efficient without the need for human intervention. ◆ Weight sharing	◆ They don't retain the object's position or orientation. ◆ It is necessary to collect a large amount of training data. ◆ Inability to be spatially invariant to the received data	It is used in treatment of periodontitis and dental caries.
PNN	◆ PNNs surpass multilayer perceptron networks in terms of speed and accuracy. Outliers aren't as noticeable in PNN networks.	◆ More memory is required to store the model.	Used for root canal therapy for the treatment of damaged teeth.
SVM	◆ In high-dimensional spaces, SVM is more efficient. ◆ SVM requires a small amount of memory.	◆ For big data sets, the SVM algorithm is ineffective. ◆ The SVM will underperform if the number of features for each data point exceeds the number of training data samples.	Based on supervised training, it is used to classify and identify dental images as either normal or pathological flaw

parameters. The identified parameters are then applied to the test sets.[6]

Artificial intelligence models were considered "black boxes" because earlier, they provided output without any explanation of the underlying decision-making process. On the contrary, today's AI takes an input, generates a "heatmap" and provides a prediction. This generated heatmap visualizes which input variables decided the prediction.

ROLE OF AI IN DENTISTRY[8]

a) Diagnostic imaging holds a pivotal role across many healthcare fields, with AI being especially suitable to overcome the variability in subjective individual examination and to increase the effectiveness of care while lowering costs by eliminating routine tasks.

b) Digital health collection is widespread, and while so far these data are rather heterogenous, organizations are increasingly striving to provide cleaned, curated, and structured data.

c) AI allows to integrate different and heterogenous data domains, for example, medical/dental history, sociodemographic and clinical data, imagery data, biomolecular data, social network data, etc., thereby making the best use of these multi-level data and allowing to grasp their interaction.

d) AI facilitates research and discovery, by adding in silico experimentation options to conventional research hierarchies, complementing other research levels and existing modeling strategies.

e) AI increase the face-to-face time doctors/dentists and their patients. This may not only come via diagnostic assistance systems, but voice, speech, and text recognition and translation, enabling doctors/dentists to reduce time for record keeping.

f) AI technologies can help professionals provide their patients with high-quality dental treatment.

g) Dentists may employ AI systems as a supplemental tool to improve the precision of diagnosis, treatment planning, and treatment result prediction.

h) Diagnostic and treatment costs may be decreased, thereby relieving healthcare systems burdened by an ageing society with increasingly high numbers of complex, chronically ill cases.

AI IN PERIODONTICS

Periodontal diseases encompass a spectrum of conditions affecting the supporting structures of teeth, primarily involving the gums and surrounding tissues. Gingivitis, an early stage characterized by inflammation, can progress into more severe forms like periodontitis, leading to gingival recession, bone loss, and potentially resulting in tooth loss if left untreated. The challenge lies in detecting these diseases in their early stages when intervention can significantly alter their course.

Artificial intelligence and their role in differentiation of Chronic and Aggressive Periodontitis

Artificial Intelligence (AI) is playing an increasingly important role in differentiating between chronic and aggressive periodontitis, which is a critical distinction for ensuring accurate diagnosis and appropriate treatment. Chronic periodontitis generally progresses slowly and is influenced by local factors, while aggressive periodontitis is characterized by rapid attachment loss and bone destruction, often with a familial aggregation and disproportionate amounts of microbial deposits.

Key roles AI plays in differentiating Chronic and Aggressive Periodontitis:

a) Enhanced Diagnostic Accuracy

Image Analysis: AI algorithms, such as convolutional neural networks (CNNs), can analyze dental radiographs and 3D images (e.g., cone-beam computed tomography) to detect subtle differences in bone loss patterns and distribution. Aggressive periodontitis often presents with specific radiographic features, such as vertical bone loss or "arc-shaped" bone defects, which AI can detect with high precision.

Clinical Data Integration: AI models can integrate and analyze clinical parameters (e.g., probing depth, clinical attachment loss, bleeding on probing) alongside radiographic data to differentiate between chronic and aggressive forms. AI can spot patterns that may not be immediately obvious to clinicians, enhancing diagnostic accuracy.

b) Pattern Recognition and Classification

Machine Learning Algorithms: AI-driven machine learning models, including support vector machines (SVMs) and decision trees, are trained on large datasets of patient records to recognize patterns characteristic of chronic versus aggressive periodontitis. These algorithms can classify patients by analyzing

variables like age of onset, rate of disease progression, and systemic health factors.

Feature Extraction: AI can perform detailed feature extraction from clinical and radiographic data, identifying key markers that differentiate the two forms. For instance, aggressive periodontitis may exhibit a higher rate of progression relative to the amount of plaque or calculus present, which AI can quantify.

c)Predictive Analytics for Disease Classification

Risk Profiling: AI can evaluate risk factors such as genetic predisposition, immune response, and specific microbial profiles associated with aggressive periodontitis. Machine learning models can weigh these factors to predict the likelihood of a patient having aggressive versus chronic periodontitis.

Progression Analysis: By monitoring disease progression over time, AI can help determine if the disease is following a chronic slow progression or an aggressive rapid one. AI can flag cases that deviate from typical chronic patterns, suggesting a more aggressive form.

Integration of Genetic and Microbial Data

Genomic Analysis: AI can analyze genetic data to identify markers associated with aggressive periodontitis, such as polymorphisms in immune response genes. This genetic information, combined with clinical and radiographic data, enhances the differentiation process.

Microbiome Profiling: AI models can analyze microbial composition from subgingival plaque samples, identifying specific pathogens more prevalent in aggressive periodontitis, like Aggregatibacter actinomycetemcomitans. Differentiating microbial profiles can guide diagnosis and treatment planning.

d)Personalized Treatment Recommendations

Tailored Interventions: By accurately distinguishing between chronic and aggressive periodontitis, AI can support the formulation of personalized treatment plans. For aggressive periodontitis, more intensive or adjunctive therapies may be recommended earlier in the treatment process.

Decision Support Systems: AI-driven decision support systems can suggest treatment options based on a detailed analysis of the disease type, ensuring that aggressive cases receive timely and appropriate interventions.

e) Real-Time Monitoring and Feedback

Continuous Monitoring: AI tools can continuously monitor periodontal status through digital health records, wearable devices, or smart toothbrushes, providing real-time feedback on disease progression. This is particularly useful in aggressive periodontitis, where rapid changes may necessitate quick intervention.

Dynamic Adjustments: AI systems can dynamically adjust treatment protocols based on real-time data, helping to manage aggressive periodontitis more effectively compared to the typically more gradual management of chronic periodontitis.

APPLICATION OF AI IN PERIODONTAL DIAGNOSIS

a)Disease detection

Aberin and Goma. 2018[9] employed a CNN system to identify periodontal disorders. To be more precise, they utilized the CNN method to classify photos of individuals with healthy and unhealthy periodontium. Achieving a 75.5%accuracy rate suggest that CNN method was effective in distinguishing between healthy and unhealthy periodontium based on the image provided.

Lee et al. 2018[10] evaluated the prognosis of compromised teeth through periapical radiography by creating a deep CNN model with the Adam algorithm. They determined the prognosis with 81.0% accuracy in premolar and 76.7% accuracy in molar teeth.

Wang Chau et al 2023[11] conducted a study to develop and to validate a novel AI system that can be used to diagnose gingivitis on intraoral photographs with accuracy at or above 0.90. A total of 567 frontal view intraoral photographs were taken from the study participants. Among the collected photographs, around 80%of the total were designated as training datasets, and the rest were designated as validation datasets. After training, the AI system was then instructed to diagnose the gingival status of intraoral photographs of the validation datasets. AI correctly predicted healthy and diseased tissue.

Papantanopoulos et al 2014[12] used an ANN to differentiate between aggressive periodontitis and chronic periodontitis in patients by using immunologic parameters, such as leukocytes, interleukins, and IgG antibody titers. The one ANN was 90–98% accurate

in classifying patients as aggressive periodontitis or chronic periodontitis.

b) Disease Classification

Periodontitis, a prevalent inflammatory disease in humans, is primarily caused by prolonged bacterial infection. Research focusing on the pathobiology of periodontal disease helps expand our understanding of this condition.

In 2014, Ozden et al[13] developed a classification system utilizing support vector machine (SVM), decision tree (DT), and ANNs to identify different types of periodontal diseases. The study involved 150 patients split into a training group consisting of 100 patients and a testing group consisting of 50 patients. Risk factor codes, periodontal data, and radiographically measured bone loss were used as inputs for the classification system, which produced six distinct periodontal conditions as outputs. DT and SVM were best to classify the periodontal diseases with a high accuracy according to the clinical research based on 150 patients. The performances of SVM and DT were found 98% with total computational time of 19.91 and 7.00 seconds, respectively. ANN had the worst correlation between input and output variable, and its performance was calculated as 46%.

c) Artificial intelligence–assisted clinical data and radiographic image analyses

The utilization of AI to assist and supplement clinicians to improve the overall accuracy of diagnosis

Table 2: Advantages of AI Over Conventional Diagnostic Methods

Aspect	AI Superiority	Conventional Methods
Accuracy and Precision	AI models, especially ML and DL, consistently identify patterns and subtle differences with high accuracy, reducing variability and errors	Relies on clinician expertise, which can vary, leading to inconsistencies and potential errors due to subjective interpretation.
Speed and Efficiency	AI analyzes large data volumes rapidly, providing near real-time results, aiding faster decision-making and treatment planning.	Can be time-consuming, especially with complex analyses or multiple diagnostic steps, slowing down the overall process.
Predictive Capabilities	AI excels in predictive analytics, forecasting disease progression, treatment outcomes, and patient responses, enabling proactive care	Limited predictive power, mostly reactive; focuses on diagnosing existing conditions without forecasting future risks or outcomes.
Integration of Multimodal Data	AI integrates clinical, radiographic, genetic, and lifestyle data, providing a comprehensive and personalized analysis of periodontal health.	Operates in silos, often focusing on specific data types without integration, leading to potentially incomplete or less accurate diagnoses.
Consistency and Reliability	AI offers high consistency, eliminating inter-observer variability by applying uniform criteria across cases, enhancing reliability.	Diagnostic outcomes can vary significantly with clinician experience, fatigue, or biases, impacting the reliability of diagnoses.
Learning and Adaptability	AI continually learns from new data, improving over time with each case, enhancing accuracy and diagnostic capabilities.	Static methods that do not improve automatically; rely on updates from research and continuous professional development.
Decision Support and Recommendations	AI provides decision support, suggesting diagnoses and treatment options based on comprehensive data analysis, aiding clinicians.	Typically lacks decision support features, requiring clinicians to interpret results and make decisions independently, leading to care variability.

is called augmented intelligence. The Internet of Medical Things (IoMT) is a cloud network–based advanced technology which is basically IoT that is applied to the medical field. It enables the collection and continuous monitoring of patients health status information for disease prevention.

Similarly in dentistry we have the Internet of Dental Things (IoDT). For example, a Bluetooth incorporated smart toothbrush can detect dental plaque, monitor real-time brushing location, sense brushing pressure, and document brushing behavior. These connected devices can then transfer this data to the dental electronic health records to aid clinicians in improving their patient's home care by customized behavioral modifications.

d) Ultrasonographic periodontal probe

In 1998, Companion et al, first published the results of an ultrasonographic periodontal probe at NASA Langley aiming to reduce the pain and inaccuracy that is common in manual probing. It has a hollow conical tip that is filled with water for coupling of the ultrasonic beam into the tissues.

Kevin Rudd et al in 2009 used the 3Dimensional parallel acoustic finite integration technique that simulates ultrasound propagation in the tip and the complex geometries of the periodontal tissues. A software then creates the 2 - Dimensional and 3- Dimensional geometry of the probe tip and the periodontal tissue structures and performs simulations which can produce realistic data which echoes corresponding to the periodontal pocket depths.

Table 3: Challenges and Ethical Considerations of AI

Category	Challenge	Description
Data Quality and Availability	Limited High-Quality Data	AI models need diverse and comprehensive datasets, which are often limited.
Bias in AI Models	Training Bias	Biased training data can lead to skewed AI results and disparities in care.
	Algorithmic Bias	AI models can inherit or introduce biases, causing unfair or incorrect outcomes.
Integration with Clinical Workflows	Adoption Challenges	Integrating AI can face resistance, require additional training, and need adaptation of new technologies
Technical Limitations	Model Interpretability	Many AI models lack transparency, making their decisions hard to understand and trust.
	Dependence on Continuous Updates	AI models require ongoing updates and retraining, which can be resource-intensive.
Cost and Accessibility	High Implementation Costs	Initial costs for AI systems, including software, hardware, and training, can be high for smaller practices.
	Accessibility Issues	Limited access to AI in low-resource settings may widen healthcare disparities.
Patient Privacy and Data Security	Sensitive Data Handling	AI requires access to personal health data, necessitating strong data security and privacy compliance
	Informed Consent	Patients must be informed about data use and risks, and consent must be obtained transparently.
Accountability and Responsibility	Clinical Responsibility	Determining who is accountable for AI-driven decisions is complex, especially when impacting patient outcomes.
	Human Oversight	Maintaining human oversight is essential to ensure clinicians can override AI recommendations.

e)Artificial intelligence in Detection of Halitosis

Artificial Olfaction, is a non-invasive technique for the assessment of the complete spectrum of exhaled volatile compounds. It employs an array of sensors, mainly based on nanomaterials, that semi-selectively and/or collectively assesses the composition of exhaled breath using analysis software and a database of breath patterns and then is processed toward a pattern-recognition application. A decision tree classifier then determines whether the subject suffers from oral or extra-oral halitosis. This innovative approach holds promise for more accurate and efficient diagnosis of halitosis.

f) Artificial Intelligence in Patient Management

Artificial intelligence based virtual dental assistants can perform several tasks in the dental clinic with greater precision, fewer errors and less manpower compared to humans. It can be used to coordinate appointments, managing insurance and paper works as well assisting clinical diagnosis or treatment planning. It is very useful in alerting the dentist about patients' medical history as well as habits like alcoholism and smoking. In dental emergencies, the patient has an option of emergency teleassistance especially when the practitioner is unavailable. Thus, a detailed virtual database of the patient can be created which will go a long way in providing ideal treatment for the patient.[10]

ADVANTAGES AND DISADVANTAGES OF ARTIFICIAL INTELLIGENCE

Advantages

- Accuracy
- Reduce the treatment time
- More systematic and structured collection of patient data

Disadvantages

- Expensive
- Adequate training is required
- Data are often used for both training and testing, leading to"data snooping bias."
- The outcomes of AI in dentistry are not readily applicable

AI has demonstrated significant advantages over conventional diagnostic methods and programmed diagnostic tools in the diagnosis and prediction of periodontal diseases, including the differentiation between chronic and aggressive periodontitis.

FUTURE OF AI IN DENTISTRY

In the future, advancement in dental technology will revolutionize the way patient care is delivered and managed. Dental colleges and clinics will harness the power of AI to create comprehensive patient libraries that contain electronic patient files, digital x ray images, and longitudinal tracking data. Additionally, the integration of 3 D intra oral scanning technology will enable distortion free examinations, enhancing diagnostic accuracy.[14]

Dental insurance companies can utilize AI algorithms to facilitate immediate claim approval. AI can play a pivotal role in dental education by providing objective feedback to students. Instead of traditional methods where each student's patient is examined by two faculty members, AI-driven assessments can offer unbiased evaluations based on comprehensive patient scans. This approach not only enhances the learning experience for students but also promotes standardized evaluations across educational institutions.[14]

Overall, the integration of AI in dentistry holds immense potential to enhance patient care, streamline administrative processes, and revolutionize dental education. These advancements pave the way for a future where dental services are more efficient, accessible, and patient-centered.

Conclusion

The integration of artificial intelligence into periodontics represents a pivotal moment in oral healthcare. From revolutionizing diagnostics and treatment planning to empowering patients with better education and care, AI stands as a catalyst for elevating the standards of periodontal practice. While challenges persist, the ongoing advancements in AI technologies hold immense promise for enhancing oral health outcomes and shaping the future of periodontics into a more precise, personalized, and patient-centric discipline. As the field evolves, embracing technological advancements while upholding ethical standards and patient-centric care remains paramount.

In conclusion artificial intelligence holds great promise for transforming the practice of periodontics

by improving diagnosis, treatment planning, patient management, and research. As AI technologies continue to evolve and mature, their widespread adoption has the potential to revolutionize the delivery of periodontal care, leading to better outcomes and enhanced patient experiences. However careful consideration of ethical, legal, and practical implication is essential to harness the full potential of AI in periodontics while ensuring patient safety and privacy.

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JSPIK

Canine Exposure Utilizing Apically Repositioned Flap- A Case Report

Anjali P Janardanan[1], Jose Paul[2], Johnson Prakash D'Lima[3], Senny Thomas Parackal[4], Reshma TS[5]

ABSTRACT

The maxillary canines are among the most commonly impacted teeth, following third molars in frequency. Permanent canine teeth play a fundamental role in functional occlusion and a balanced smile. Surgical canine exposure helps guide the canine into its anatomical position and occlusion. Guided canine exposures often require interdisciplinary treatment, such as a combination of orthodontic and surgical approaches. The selection of the optimal surgical method for impacted canine exposure is based on the position of the impacted tooth, the width of the overlying keratinized mucosa, and the depth of the vestibule. Several techniques have been proposed for the exposure of impacted canines. This case report offers valuable insights into the decision-making process for exposing impacted canines and the subsequent treatment using the apically positioned flap technique.

Keywords: Canine, impacted canine, apically positioned flap

Introduction

An impacted tooth is defined as a tooth that fails to erupt into its functional position.[1] Canines play a crucial role in the alignment, stability, and function of the dental arches. They are key components in guiding the proper occlusal relationship between the upper and lower teeth, ensuring efficient chewing, speech articulation, and facial aesthetics.[2]

Canine teeth contribute significantly to the aesthetic appearance of the smile. Their prominent position in the arches and their unique shape complement the overall facial harmony. Properly aligned and positioned canines enhance facial aesthetics, contributing to a confident and pleasing smile. Canine are one of the most impacted teeth after third molars. Absence of canine may lead to a flat upper lip. The occurrence of maxillary canine impaction ranges from 0.8% to 2.8% in prevalence.[3,4,5]

Among Western populations, approximately 85% of canine impactions are located in the palatal aspect, while 15% occur in the buccal aspect.[6] Bilateral impaction of canines is observed in about 8% of cases.[7] In Asian populations, buccally impacted canines are more frequently encountered.[8] Females exhibit a higher prevalence of maxillary canine impaction, with a female-to-male ratio ranging from 2.3:1 to 3:1.1.[3,9]

Early identification of tooth displacement is crucial in preventing maxillary canine impaction. Typically, boys experience the eruption of maxillary canines around age 13, while girls experience it around 12.3 years old.[10] The early mixed dentition phase is ideal for assessing the likelihood of impaction. Most impactions occur without symptoms, but they can lead to pathological complications such as root resorption in adjacent teeth, cyst development, loss of arch length, or referred pain.[2]

Etiology

There are several reasons hypothesized for maxillary canine impaction. There are two primary theories proposed to explain the occurrence of palatally dis-

[1]Post Graduate student, [2]Professor and Head, [3,4]Professor, [5]Senior Lecturer, Department of Periodontics, Annoor Dental College, and Hospital, Muvattupuzha, Kerala, India. Corresponding Author: Dr. Anjali P Janardanan
E-mail: anjalipjanardanan@gmail.com

placed maxillary canines such as the guidance theory and the genetic theory.[11] The guidance theory proposes that the canine erupts along the root of the lateral incisor, which serves as a guide, and if the root of the lateral incisor is absent or malformed, the canine will not erupt.[2] The genetic theory points to genetic factors as a primary origin of palatally displaced maxillary canines and include other possibly associated dental anomalies, such as missing or small lateral incisors.[12]

Several etiologic factors for canine impactions have been proposed: localized, systemic, or genetic[13]

LOCALIZED

- Tooth size–arch length discrepancies
- Failure of the primary canine root to resorb
- Prolonged retention or early loss of the primary canine
- Ankylosis of the permanent canine
- Cyst or neoplasm
- Dilaceration of the root
- Absence of the maxillary lateral incisor
- Variation in root size of the lateral incisor (that is,peg-shaped lateral incisor)
- Variation in timing of lateral incisor root formation
- Iatrogenic factors
- Idiopathic factors

SYSTEMIC

- Endocrine deficiencies
- Febrile diseases
- Irradiation

Figure 1: a) Clinical picture of impacted canine; b) IOPA of impacted canine.13. c) OPG showing impacted 13 and partially impacted 23

GENETIC

- Heredity
- Malpositioned tooth germ
- Presence of an alveolar cleft

SEQUELAE OF CANINE IMPACTION[14]

Shafer et al. suggested the following sequelae for canine impaction:

- Labial or lingual malpositioning of the impacted tooth,
- Migration of the neighbouring teeth and loss of arch length,
- Internal resorption,
- Dentigerous cyst formation,
- External root resorption of the impacted tooth, as well as the neighbouring teeth,
- Infection particularly with partial eruption, and
- Referred pain and combinations of the above sequelae.

Diagnosis of Canine Impaction

In order to make an accurate diagnosis, clinical examination must be accompanied by radiographic evaluation

Clinical Evaluation

- Study model analysis
- Morphology of adjacent tooth
- Contours of adjacent alveolar bone
- Mobility of adjacent tooth

Radiographic Evaluation

Intra oral radiograph

- Intra oral periapical (IOPA)
- Occlusal

Extra oral radiograph

Figure 2: Full thickness mucoperiosteal flap was reflected with periosteal elevators

Figure 3: Osseous reduction done

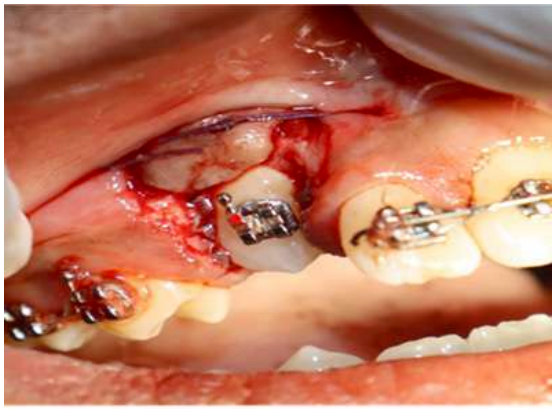

Figure 4: Flap was positioned apically with resorbable sutures.

Figure 5: Post-Operative After 3 months

- Orthopantomogram (OPG)
- Lateral cephalometric

Digital imaging

- Computed Tomography (CT)
- Cone Beam Computed Tomography (CBCT)

DECISION-MAKING

The treatment of impacted canines needs a multidisciplinary approach and is associated with increased treatment time and cost.

The choice of treatment is influenced by several factors such as

- The canine location
- Severity of impaction
- Patient's age
- Other patient consideration – socio-economic status, patient compliance etc.

Decision-making for choosing the best method of surgery for canine exposure depends on

- Position of impacted canine.
- The overlying keratinized tissue width.
- Vestibular depth.

If the keratinized tissue width is less than 3 mm, have to consider soft tissue augmentation and then re-evaluation for final decision-making about the surgical approach for canine exposure.[15]

If the keratinized tissue width is 3-5 mm, the vestibular depth is to be considered. If vestibular depth is adequate, apically positioned flap is the best approach which preserve and increase the overlying keratinized tissue width. In cases with shallow vestibule a closed exposure with flap replaced into the initial position is prefered.[15]

In case keratinized tissue width is more than 5mm depth of impaction, distance between tooth and the alveolar bone crest is assessed. When the tooth is far from the alveolar crest, closed exposure should be used to avoid secondary intention healing after surgery and access to the impacted tooth. When the tooth is near the alveolar crest, the flap should be prepared by open exposure and elimination of gingiva overlying the impacted tooth.[15]

Case Report

A 16 year old female patient referred from department of orthodontics for canine exposure with respect to 13 and no relevant medical history. Patient has been undergoing orthodontic treatment since 8 months. On clinical examination, the keratinized tissue width was found to be 3-5 mm with an adequate vestibular depth. The canine impacted buccally was noted on radiographic examination (Figure 1). Considering the parameter, apically positioned flap was decided as the technique for canine exposure. Written informed consent was obtained following a discussion of risks and benefits of the procedure.

Surgical procedure

Local anesthetic was administered. Mid crestal incision was given followed by vertical incision on mesial and distal aspect of impacted canine. Full thickness mucoperiosteal flap was reflected with periosteal elevators (Figure 2). On reflection, we noticed the bone covering buccal aspect of crown. Osseous reduction was done to expose the buccal aspect of the canine (Figure 3). An orthodontic bracket was positioned on the buccal aspect of the canine and flap was positioned apically with resorbable sutures (Figure 4). On evaluation after 3 months we could appreciate well preseved keratizined tissue covering the canine. (Figure 5).

Discussion

The success of treatment relies heavily on selecting the appropriate conservative surgical technique and applying proper orthodontic forces. Key factors influencing the periodontal prognosis of impacted canines include the quality of the periodontium, the width of the keratinized tissue, and the location of the tooth's emergence point or position of impaction.[16] In this case, there was an inadequate width of keratinized gingiva, with the canine positioned buccally and a thin layer of bone on the buccal aspect. Gingivectomy was the simplest and most efficient method for exposing the impacted canine. However, the use of the gingivectomy technique may lead to aesthetic complications, such as gingival recession and the formation of visually unappealing scarring. Careful planning of mucogingival surgeries, performed at the right time and with the proper technique, can help prevent future mucogingival issues.[17]

Conclusion

Selection of an appropriate surgical technique for canine exposure is important. The level and position of tooth impaction, bone thickness and available

keratinized soft tissue are the most important factors in selecting the surgical approach. Higher surgical knowledge and skills and use of current technologies like lasers should be considered in special cases.

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Management of Miller's Class I Gingival Recession using Zucchelli's Modified Coronally Advanced Flap Technique: A Case Report

Sandra Rachel Cheriyan[1], Sanjeev Ravindran[2], Shyamala Devi[3], Sruthy Rajeevan[4]

ABSTRACT

Background: Gingival recession, characterized by the apical displacement of marginal gingiva, presents clinical concerns, including compromised esthetics, increased root caries risk, and dentin hypersensitivity. Zucchelli's modified coronally advanced flap (CAF) technique offers improvements in root coverage and gingival tissue quality.

Case Summary: A 21-year-old female presented with tooth sensitivity in the maxillary left region, particularly exacerbated by brushing and intake of hot or cold foods. Clinical examination revealed Miller's class I recession on teeth 22, 23, and 24, attributed to aggressive tooth brushing. Zucchelli's CAF technique was employed for root coverage, involving oblique submarginal incisions, a split-full-split thickness flap, and flap adaptation with sling sutures.

Conclusion: Two weeks postoperatively, the patient exhibited satisfactory healing with adequate root coverage. Six-month follow-up revealed stable results and resolved sensitivity. This case demonstrated successful root coverage, excellent tissue contour, and increased keratinized tissue with stable results over two months. Zucchelli's modified CAF technique effectively addresses multiple adjacent recession defects and meets high esthetic demands.

Key words: Gingival recession, Coronally advanced flap, Zucchelli's technique.

Introduction

Periodontal therapy aims to restore and maintain periodontal health by reconstructing lost hard and soft tissues, preventing further tissue loss, and enhancing esthetics. One common esthetic concern in periodontal therapy is gingival recession.[1] Gingival recession, characterized by the displacement of marginal gingival tissue apical to the cemento enamel junction (CEJ), exposes the root surface and poses significant clinical concerns. This condition can result from various etiological factors, including traumatic injuries from aggressive tooth brushing and destructive periodontal disease. The exposed root surfaces not only compromise aesthetics but also increase the risk of root caries, dentin hypersensitivity, and further periodontal destruction.[2]

To address gingival recession, numerous surgical techniques have been developed, one of which is Zucchelli's technique. Introduced by Giovanni Zucchelli, this innovative approach to root coverage combines principles of plastic surgery and Periodontology to achieve optimal aesthetic and functional results.[3] The technique involves a modified coronally advanced flap (CAF) offering significant improvements in root coverage and gingival tissue quality.[3]

This case report details the successful application of Zucchelli's technique in the management of a patient with gingival recession. The report aims to highlight the procedural nuances, clinical outcomes,

[1]Post graduate student, [2]Professor and Head, [3]Professor, [4]Senior Lecturer, Department of Periodontics, PSM College of Dental Science and Research, Akkikavu, Thrissur, Kerala, India. Corresponding Author: Dr. Sandra Rachel Cheriyan
E-mail: sandracheriyan01@gmail.com

and the potential advantages of this technique in periodontal therapy. Through this case, we underscore the importance of selecting appropriate surgical interventions tailored to individual patient needs to enhance both aesthetic and functional outcomes in periodontal treatment.

Case Report

21-year-old female reported to Department of Periodontology with the complaint of tooth sensitivity in the maxillary left tooth region for the past two months. Sensitivity increases on tooth brushing and intake of hot and cold food. On clinical examination Miller's Class I recession was evident on teeth 22, 23, and 24 (Figure 1). In relation to tooth # 22 recession depth and width of 2mm, on tooth # 23 recession depth and width of 3mm and on tooth # 24 recession depth of 1mm and width of 2mm was present. The periodontium was healthy and with no inflammatory signs. The reason for the recession was attributed to faulty vigorous tooth brushing. Scaling and root planing was done and oral hygiene index was given. Proper brushing technique was advised and adequate time was given to change the technique. After two months, root coverage by Zucchelli's coronally advanced flap for root coverage was planned. Informed consent was obtained from the patient.

Figure 1: Pre - operative presentation

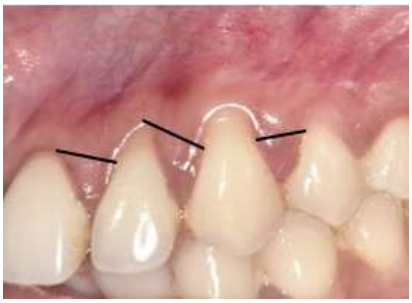

Figure 2 : Schematic representation of submarginal incision

Figure 3: Submarginal incision

Figure 4: Split full split thickness flap

Figure 5: De-epitheliazation of papilla

Figure 6: Coronal advancement and suturing

Figure 7: Two weeks postoperative presentation

Figure 8 : Six months postoperative presentation

SURGICAL PROCEDURE

Disinfection of the surgical site was performed using a 2% betadine solution. The procedure was carried out under local anesthesia, specifically Lignocaine HCl with 2% epinephrine at a ratio of 1:200,000. The incision outline was initially marked with an explorer.

Oblique horizontal incisions were made, connecting the CEJ of one tooth to the gingival margin of the adjacent tooth (Figure 3). A split-thickness flap was reflected to the level of the root exposure. Apically, a full-thickness flap was then raised. Beyond the muco-gingival junction, a split-thickness flap was again reflected to ensure adequate coronal displacement. (Figure 4)

The anatomic interdental papilla was completely de-epithelialized to expose the underlying connective tissue and to eliminate the epithelium that might interfere with the healing process. (Figure 5)

After reflecting the flap, the root surface was examined for any remaining calculus. Thorough scaling and root planning was then performed to ensure a clean root surface. The flap was secured in place with sling sutures, ensuring precise adaptation. (Figure 6) The surgical site was then covered with periodontal dressing (Coe-Pak).

Postoperative Care

The patient was instructed not to remove or disturb the pack or the surgical site until the sutures were removed. Additional postoperative instructions were provided, including a course of antibiotics (Amoxicillin 500 mg three times a day) for three days. The use of a 0.12% chlorhexidine rinse was also advised.

Two weeks postoperatively, the periodontal dressing was removed. Healing was satisfactory, with adequate root coverage achieved. (Figure 7) A follow-up after six months revealed stable results, in relation to tooth # 22 there was recession depth reduction from 2mm to 0.5 mm, in relation to tooth # 23 there was complete coverage, in relation to tooth # 24 there was reduction of recession depth from 1mm to 0.5 mm and the patient reported no sensitivity. (Figure 8)

Discussion

Treating gingival recession is challenging, particularly when addressing patient-centered esthetic demands. Gingival recession creates a favourable environment for microbial plaque and calculus accumulation, which routine oral hygiene measures may not adequately address. This can lead to the development of root caries on exposed root surfaces.[4] The most important factor in the etiology of dentin hypersensitivity is the exposure of root surfaces resulting from gingival recession. Additionally, gingival recession often affects multiple adjacent teeth, necessitating simultaneous treatment of these contiguous areas.[5]

Over the past decades, numerous periodontal plastic surgery (PPS) procedures have been described in an attempt to cover exposed root surfaces. Among these methods, the most commonly employed is the 'coronally repositioned flap,' introduced by Bernimoulin in 1975 and modified by Allen & Miller in 1989.[7]

The Coronally Advanced Flap (CAF) procedure is widely recognized as the most predictable and reliable method for achieving root coverage, offering greater patient comfort and minimal surgical trauma. In the present case report, a modified CAF approach was employed to treat multiple adjacent recession defects in patients with high aesthetic considerations.[6,10,11,12]

Zucchelli and Sanctis further modified this technique in 2000.[9] This technique represents a novel modification of the coronally advanced flap (CAF) designed for the coverage of multiple teeth with gingival recession. This technique is distinguished by several key clinical features, including the absence of vertical releasing incisions and the use of a flap with variable thickness, combining areas of split and full thickness. The flap is then coronally repositioned to cover the exposed root surfaces effectively.

One of the unique aspects of Zucchelli's technique is the implementation of oblique submarginal incisions in the interdental areas. (Figure 2) These incisions are made obliquely, connecting the CEJ of one tooth to the gingival margin of the adjacent tooth. This design helps to minimize tension on the flap and promotes optimal healing.

The absence of vertical releasing incisions aids in preserving the blood supply to the flap, enhancing the healing process, and reducing postoperative

complications. The combination of split and full thickness in the flap allows for better adaptation and stabilization, contributing to successful root coverage and improved aesthetic outcomes.

It features an envelope-type flap without vertical releasing incisions, ensuring that the blood supply is not compromised and preventing unaesthetic scars along the incision line. Additionally, being a split-full-split thickness flap, it guarantees adequate coronal advancement, good anchorage, and ample blood supply to the surgical interdental papillae.[8]

In a case report, Walker et al. demonstrated the effectiveness of Zucchelli's technique for treating multiple recession defects, showing improvements in both root coverage and the increased width of keratinized tissue.[13] Agarwal et al. have demonstrated improved biological outcomes using a combination of PRF with Zucchelli's technique for unilateral adjacent recessions. However, no clinical comparisons were made with conventionally treated sites that did not use PRF.[14,15]

The case presented here demonstrates Zucchelli's modification of the coronally advanced flap. This new technique offers several clinical and biological advantages over the conventional method.[3] The use of this flap technique resulted in adequate root coverage with stable results observed over a period of six month. There was no scar formation, and the color match of the tissue was excellent. Additionally, the chief complaint of hypersensitivity was completely resolved following the surgery.

Conclusion

Within its limitations, the current case report demonstrated the effectiveness of Zucchelli's modified coronally advanced flap technique, achieving satisfactory root coverage, excellent tissue contour, and an increase in the amount of keratinized tissue. This modified approach has shown promising results in addressing multiple adjacent recession defects while meeting high aesthetic demands. More studies utilizing this procedure are necessary to provide firm evidence of prove the efficiency of this method.

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Microsurgical Advances in Periodontics

Silpa Jayan V[1], Sanjeev Raveendran[2], Shyamala Devi K P[3]

ABSTRACT

Periodontal microsurgery represents a significant advancement in the field of Periodontics, leveraging improved visual acuity provided by surgical microscopes to enhance the precision and outcomes of surgical procedures. The use of a surgical microscope allows for greater magnification compared to simple loupes, enabling the dentist or periodontist to perform intricate procedures with a level of detail that goes beyond unaided human capacities. While its application is well-established in various medical fields, its use in periodontics is still relatively underexplored, with limited studies highlighting its advantages. Nonetheless, periodontal microsurgery holds promise for optimizing outcomes in periodontal surgeries by combining specialized training and advanced equipment. This review discusses about the application of microsurgery in periodontics.

KEYWORDS: Magnification loupe, Periodontal microsurgery, Magnification system

INTRODUCTION

Microsurgery in the dental field signifies a precise approach to surgical procedures performed under the enhanced magnification provided by a microscope. Specifically, within the domain of Periodontics, it entails the refinement of existing basic surgical techniques, made achievable through the use of a surgical microscope, leading to improved visual acuity. First introduced in 1980 by Serafin, dental microsurgery represents a methodological evolution—a modification and enhancement of traditional surgical practices through the utilization of magnification for superior visualization. This methodology extends its relevance to various dental specialties, recognizing the finely tuned capabilities of the human hand, developed through appropriate training, to execute more delicate movements than the naked eye can control. Recent advancements in dentistry highlight the transformative impact of magnification and microsurgery on clinical practices. This shift has instigated a therapeutic revolution in dental surgery, necessitating the retraining of numerous dental surgeons and the reconfiguration of dental operating rooms. The acceptance of microscopic surgical therapy has been pivotal in steering this evolution, reflecting a natural progression from microsurgical innovations in the early 1970s to the culmination in contemporary dental microsurgery. In today's dental landscape, microsurgery is applied across a spectrum of procedures, ranging from intricate periodontal interventions to delicate endodontic surgeries. This underscores the versatility and significance of microsurgical techniques in modern dental practices.

[1]Post Graduate Student, [2] Professor and Head, [3]Professor, Department of Periodontics, PSM College of Dental Science and Research, Akkikavu, Thrissur, Kerala, India. Corresponding Author: Dr. Silpa Jayan V, E-mail: silpajayan95@gmail.com

Table 1: HISTORICAL PERSPECTIVE

1694	Amsterdam merchant	constructed the first compound lens microscope.
1876	Anton Van Leeuwenhoek a German ophthalmologist	introduced simple binocular loupes to ophthalmic surgery
1992	Carr	published an article outlining the use of the nine surgical microscopes during endodontic procedures.
1993	Shanelec and Tibbetts	presented a continuing education course on periodontal microsurgery at the American Academy of Periodontology

MICROSURGICAL TRIAD

The three elements, (Figure 1) i.e., magnification, illumination, and refined surgical skills by instruments, are called the microsurgical triad (Belcher et al. 2001), a prerequisite for improved accuracy in surgical interventions. Without anyone of these, microsurgery is not possible.[1]

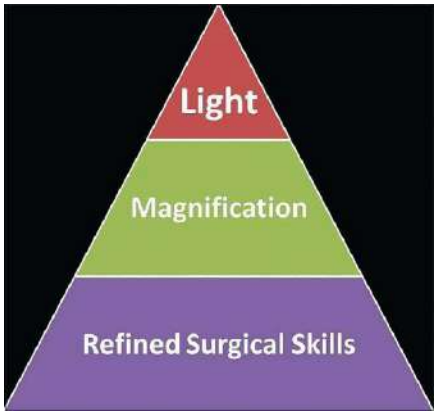

Figure 1: Triad of Microsurgery

PRINCIPLES OF MICROSURGERY[3]

As a treatment philosophy, microsurgery incorporates three essential principles:

1. Improvement of motor skills, thereby enhancing surgical ability.
2. An emphasis on passive wound closure with exact primary apposition of the wound edge.
3. The application of microsurgical instrumentation and suturing to reduce tissue trauma.

Treatment rendered with visual enhancement supplied by the microscope is termed microscopic. Improved outcomes obtained from microscopic surgical procedures have shifted toward precision microsurgery, which offers a more rapid and comfortable healing phase for the patient.[3]

ERGONOMICS IN MICROSURGERY[3]

Proper ergonomics is essential in microsurgery to reduce strain, minimize physiologic tremors, and improve precision. Surgeons should sit upright with legs extended forward, feet flat on the floor, and arms fully supported. The ulnar surface of the forearm and wrist should rest on a stable platform to minimize tremors. Good posture prevents neck and back injuries, while positioning the patient and chair to align with the surgeon and microscope ensures optimal comfort and control during procedures. The microsurgeon's position relative to the patient is an important consideration. The most precise rotary suturing motion for a right-handed person is from the 2 o'clock to the 7 o'clock position, while the most accurate movement for left-handed people is from the 10 o'clock to the 4 o'clock position. The persistent practice of alternative places around the entire 360-degree axis ultimately results in mastery of surgical skills necessary to render successful microsurgical treatment in all areas of the mouth.[3]

Figure 2: Clinician seated at microscope with correct posture and arms supported

MAGNIFICATION SYSTEM[2]

There are two types of optical magnification systems available to dentists, which include:

A. Loupes

B. Surgical Operating Microscope

LOUPES

The most common magnification system used in dentistry is magnification loupes. Loupes are fundamentally two monocular microscopes, with side-by-side lenses angled to focus on an object. The magnified image formed has stereoscopic properties created by the use of concurrent lens systems.

Three types of loupes are commonly used: (Figure 3)

1. Simple loupes
2. Compound loupes
3. Prism loupes

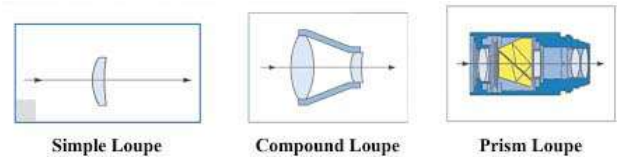

Figure 3: Three types of loupes

Simple loupes

Simple loupes consist of a pair of single, positive, side-by-side meniscus lenses. Each lens has two refracting surfaces, with one occurring as light enters the lens and the other when it leaves.

Its main advantage is that it is cost-effective.

The disadvantages include:

a) It is primitive with limited capabilities.

b) They are highly subjected to spherical and chromatic aberration, distorting the object's image.

Figure 4 : Simple loupe

Compound loupes

Compound loupes consist of converging multiple lenses with intervening air spaces to gain additional refracting power, magnification, working distance, and field depth. They can be adjusted to clinical needs without an excessive increase in size or weight. Compound lenses can be achromatic, in addition to improved optical design. This is a feature that dentists should seek when selecting any magnifying loupe because an achromatic lens consists of two glass pieces, usually bonded together with clear resin.

Figure 5: Compound loupe

Prism loupes

Prism loupes are the most optically advanced type of loupe magnification presently available. These loupes contain Schmidt or roof-top prisms that lengthen the light path through a series of mirror reflections within the loupe. They increase the light way by virtually folding the light to shorten the loupe's barrel. They are superior to other loupes in terms of better magnification, more expansive depths of field, longer working distances, and larger areas of view.[2]

Figure 6: Prism loupe

SURGICAL OPERATING MICROSCOPE[2]

The operating microscope offers flexibility and comfort superior to magnifying loupes. It is much more expensive and is initially more challenging to use. For use in dentistry, operating microscopes are

designed on Galilean principles. They use the application of the magnifying loupes in combination with a magnification changer and a binocular viewing system so that it employs parallel binoculars for protection against eye strain and fatigue.

The optical unit of the microscope includes the following components: (Figure 7)

- Magnification charger
- Objective lenses
- Binocular tubes
- Eyepieces
- Lightning unit
- Additional attachments

Figure 7 Components of microscope

Table 2 : LOUPES VERSUS OPERATING MICROSCOPE

LOUPES	OPERATING MICROSCOPE
1.5x to 10x magnification	2.5x to 20x magnification
need additional illumination for magnification of 4x or greater.	Use excellent coaxial fiber-optic illumination,hence does not need additional light source.
Operator eye comfort is less as the eyes must converge to view the image	High comfort as it has parallel binoculars
Initially easy to use	Basic training required to use surgical microscope
Less expensive	More expensive

MICROSURGICAL NSTRUMENTS[3]

Proper instrumentation is fundamental for microsurgical intervention. With both magnification and microsurgical instruments, we reduce tissue trauma & bleeding. The foremost characteristics of microsurgical instruments are to make clean incisions that are established at a 90 degrees angle to the surface using ophthalmic microsurgical scalpels.3

Table 3: CLASSIFICATION OF MICROSURGICAL INSTRUMENTS[3]

LOUPES	OPERATING MICROSCOPE
• Simple loupes • Compound loupes • Prism loupes	
MICRO SURGICAL INSTRUMENTS	PERIODONTAL INSTRUMENTS
• Microneedle holder • Micro-forceps • Micro-scissors	A. Knives and scalpel blades: • Blade breaker knife • Crescent knife • Mini crescent knife • Spoon knife • Lamellar knife • Scleral knife B. Retractors and elevators C. Tying forceps • Platform • Non-platform

APPLICATION IN PERIODONTICS

Esthetic Surgical Procedures

In cosmetic surgical procedures targeting gingival restoration, various periodontal plastic surgery methods are valuable, such as pedicle and free soft tissue grafts. The direction of pedicle graft transfer determines its classification into rotational flaps (e.g., laterally sliding flap, papilla flap, or double papilla flap) or advanced flaps without rotation or lateral movement (e.g., coronally positioned flap). Combining the pedicle soft tissue graft with a membrane barrier, following guided tissue regeneration principles, is utilized for root coverage treatment. It is crucial to maintain a space between the guided tissue regeneration barrier and the root surface to ensure effective tissue regeneration.[3]

Root Surface Conditioning

In root coverage surgery, preparing the root surface is vital for the attachment of soft tissue to the tooth. Different methods, including mechanical, chemical, and biologic approaches, aim to establish new periodontal ligament attachment with the graft, promoting the formation of new cementum and Sharpey's fibers for successful outcomes.[4,5,6]

Periodontal Plastic Surgery

In periodontal plastic surgery, formerly known as mucogingival surgery, procedures aim to correct deformities of the gingiva or alveolar mucosa. Essential in periodontal practice, these surgeries consider advancements in medical microsurgery for realistic esthetic improvements while addressing periodontal issues, with a primary focus on enhancing esthetics.[7]

Root Coverage Procedures

The success of the root coverage procedure involves an atraumatic surgical approach, the skill of the surgeon, and excellent visualization of the operating field. All these factors can be fulfilled using a surgical microscope. Burkhardt et al.[8] showcased a noteworthy contribution (8% coverage) through the application of a microsurgical approach. Moreover, the extent of shrinkage is impacted by the surgical process. Microsurgical procedures demonstrated significantly enhanced outcomes compared to conventionally performed mucogingival surgery.

Papilla Reconstruction Procedures

Reconstructing lost interdental papillae is challenging due to limited space and unique vascular supply. Microsurgical procedures, employing magnification and specialized instruments, offer an atraumatic approach for placing donor tissue under short interdental papillae. This method improves visibility, reduces unnecessary incisions, and enhances predictability without compromising vascular supply, minimizing trauma and optimizing donor tissue survival.[9]

Implant Therapy

In implant therapy, the innovative use of microsurgery is evident in the sinus lift procedure and immediate implant placement. Research indicates that employing a microscope enhances motor coordination and accuracy for surgeons. The improvements extend to enhanced visual acuity, improved ergonomics, and better body posture. The surgical microscope plays a crucial role in visualizing the sinus membrane, and the magnification it provides is instrumental in the development and placement of implant sites.[10, 11]

Establishing An Esthetic Smile Line

Establishing an esthetic smile line involves addressing issues like gingival recession, irregular eruptive patterns, incisal wear, and excessive tissue growth. Achieving an ideal smile requires considerations of symmetry, lip position, and the relative gingival levels of adjacent teeth. In complex cases, periodontal plastic microsurgery may be necessary, involving the removal and replacement of tissue on specific teeth. W. Peter Nordland (2002) emphasized the significant role of periodontal plastic microsurgery in enhancing oral-facial esthetics.[12]

Sinus Lift Procedures

Microsurgical approaches in sinus lift procedures are gaining recognition. Using a periodontal endoscope with magnifications of 24x to 48x, subgingival visualization of the root surface is achieved. The surgical microscope aids in indirect visualization of the sinus membrane, minimizing perforation risks. Microsurgical techniques have also been reported to improve altered sensation caused by implants near the Inferior alveolar nerve, even without unscrewing them.[13]

Periodontal Flap Surgeries[14]

Originally from general surgical principles, periodontal flap procedures have been used since the latter part of the 19th century. Flap reflection, as a basic rule, is to gain exposure of the underlying tissues for whatever surgical procedure the surgeon has in mind. Flaps must be adequate to the clinical situation being treated. A surgical microscope has introduced the reality of considerably less invasive surgical incisions and flap reflections in Periodontics.

Crown Lengthening

Although the comparative studies of crown lengthening and ridge augmentation with microsurgical methods are limited, it seems logical to substantiate that magnification is beneficial for all such procedures.[13]

ADVANTAGES OF MICROSURGERY[15]

1. Microsurgery offers a more rapid and comfortable healing phase for the patient.
2. Allows the operator to achieve clinical results

that were thought unlikely consistently.

3. The improved visual acuity and ergonomics provide significant advantages to those who take the time to become proficient in microsurgical principles and procedures.[16]
4. Cleaner incisions obtained
5. Reduced hemorrhage

DISADVANTAGES OF MICROSURGERY15

As we upgrade our surgical maneuvers with the aid of microsurgical concepts, there are a few shortcomings of this modus operandi that need to be considered before its application.

1. It is much more demanding and technique sensitive
2. The cost incurred to establish a microsurgical set-up is also high.
3. Magnification systems used also pose some difficulties, including a restricted area of vision, loss of depth of field as magnification increases, and loss of visual reference points.
4. An experienced team approach mandates microsurgery and is time-consuming to develop.

MINIMALLY INVASIVE SURGICAL TECHNIQUE (MIS)

MIS was introduced in 1999 by Harrel.[17] The salient difference between the minimally invasive approach and more traditional regeneration approaches is using much smaller incisions to gain surgical access and debride the periodontal defect before placing the bone graft and membrane. The minimally invasive surgery technique (MIST) was explicitly designed to treat isolated intrabony defects using periodontal regeneration. In 2007, a similar minimally invasive surgical approach based on the concepts of MIS and incorporating elements of the papilla preservation technique was introduced. This technique was described as the Minimally Invasive Surgical Technique (MIST), and a later modification was termed the Modified Minimally Invasive Surgical Technique (MMIST).[18, 19]

EMERGING INNOVATIONS IN MICROSURGERY[20]

Video scope assisted minimally invasive surgery

The term video scope-assisted MIS (V-MIS) is used to describe MIS performed with a video scope. Harrel et al., in 2014, conducted a study to evaluate residual defects following nonsurgical therapy consisting of root planing with local anesthetic.[21] V-MIS was performed utilizing the video scope for surgical visualization.

Three-Dimensional On-Screen Microsurgery System (TOMS)

This system allows 3D visualization of the microsurgical field on a video monitor, eliminating the need for surgeons to view through a microscope. It provides a clear stereoscopic image and improved depth perception, aiding surgical precision.[20] It can be advantageous to the clinician and academician to organize or print these data and adapt it for tele-operations.

HDTV Single-Camera 3D System

This technique utilizes a high-definition camera attached to the microscope to provide 3D visualization and enables both real-time viewing and documentation of procedures. This stereoscopic 3D display provides a clear and accurate sense of depth perception. It has numerous applications in minimally invasive surgery.[20]

WOUND HEALING IN MICROSURGERY

The microscope is a tool that permits less traumatic and less invasive surgery. The use of 7-0 to 9-0 microsutures allows for more precise wound closure, encouraging rapid repair through primary healing, which requires less formation of granulation or scar tissue. Studies on wound healing show that microsurgical wounds can achieve anastomosis within 48 hours. In contrast, secondary wound healing is slower because it involves new tissue formation to fill gaps at the wound edges. Since surgical trauma is minimized during microsurgery, there is less cell damage and necrosis, resulting in reduced inflammation and pain.15

CONCLUSION

Periodontal microsurgery is in its infancy but will play a role in the future. It is a skill that requires practice to achieve proficiency. The small scale of microsurgery presents unique challenges in dexterity and perception. Its execution is technique sensitive and more demanding than are conventional periodontal procedures. As the benefits of the microscope are realized, it will be applied more universally. The use of magnification has increased in many areas of dentistry. The cardinal essentials of gentle tissue handling, accurate approximation, meticulous hemostasis, and minimal tissue

destruction are the hallmarks of the microsurgical approach. Understanding the optical principles that govern magnification is also essential for its successful application to dental procedures.

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JSPIK

Cracking the code of Chromogenic Dental Stain: Examining Treatment Options

Mishal Ann Mathew[1], Mariya Elizabath Sunil[2], Rinku C Rajeev[3], Anila S[4]

ABSTRACT

Chromogenic black dental staining is an external discoloration commonly observed in dental practice. Both primary and permanent dentitions can be impacted by them. There is conflicting evidence about what causes it, and different microbial, dietary, and iatrogenic factors are all potentially involved. It is essential for dentists and dental hygienists to acquire a thorough understanding of black stains in order to make precise diagnoses and provide suitable treatment. Dentists and dental hygienists still face a difficult task in treating black staining successfully, as it often recurs after professional treatment. The purpose of this article is to review different relevant treatment modalities for tooth staining due to chromogenic bacteria.

Keywords: Tooth Discoloration, Probiotics, Enamel Micro-abrasion, Photodynamic therapy

INTRODUCTION

Teeth discoloration is a common dental finding associated with clinical and cosmetic issues.[1] Tooth staining occurs because of certain compounds that get incorporated into the pellicle, producing stains due to their basic color or chemical interaction at the tooth surface.[2] Vogel grouped tooth discoloration into two categories: intrinsic and extrinsic.[3] Later, Watts added a third type, internalized discolouration.[4] Black staining has also been referred to as exogenous tooth discoloration and chromogenic or pediatric staining.

Table 1: BLACK STAIN CLASSIFICATION[5]

SCORE 1	Parallel to the gingival edge, pigmented spots or a narrow line with incomplete coalescence
SCORE 2	Pigmented lines that are continuous and restricted to the cervical third of the tooth surface
SCORE 3	Pigmented stains that cover more than 50% of the cervical third

Actinomyces and Prevotella melanogenic bacteria, which are chromogenic, are assumed to be the predominant microbiological components.[6] The black pigmentation is thought to be a type of bacterial plaque with an insoluble ferric salt, most likely ferric sulphide, formed by the bacteria's production of hydrogen sulphide and the iron in the gingival exudate or saliva.[7] Perhaps because of this, some research indicate that eating certain vegetables, dairy products, and fruits high in iron can increase the likelihood of developing black stains.[2] Based on our current understanding, no prior research has put forward a comprehensive solution for reducing or eliminating chromogenic bacteria. This article seeks to compile different potential treatment approaches that have not yet been verified. The treatment options reported as of now include : 1. Photodynamic therapy with diode laser 2. Bleaching 3. Scaling and polishing and 4. Phototherapy 5. Enamel micro abrasion 6. Probiotics 7. Porcelain laminate veneers or crowns.

[1,2,3]House Surgeon, [4]Head of Department, Department of Periodontics, St. Gregorios Dental College, Kothamangalam, Ernakulam, Kerala, India. Corresponding Author: Dr. Mishal Ann Mathew, Email: misan99615@gmail.com

SCALING AND POLISHING

To remove the stain, a basic scaling and pumice paste polishing are frequently enough. It can sometimes be quite challenging to eliminate black stains that has been developed on the portions with pitted grooves.[8] In case the stains are hard to eliminate, a tissue can be utilized to blot away the extra water in the pumice paste, and then dry the tooth to concentrate and benefit more from the abrasive particles.[9] It is best to avoid using the ultrasonic scaler excessively as this could result in unintended enamel loss.[8] This is a treatment choice for extrinsic tooth discoloration due to chromogenic bacteria, tea, coffee, etc.[8]

BLEACHING

Bleaching is the process of lightening a tooth's color by applying a chemical substance to oxidize the organic pigmentation in the tooth.[10]

Table 2: Classification of bleaching treatment according to sturdevants[10]

I. Nonvital bleaching procedures: a. In -office nonvital bleaching technique b. Walking bleach technique
II. Vital bleaching procedures : a. In -office vital bleaching technique b. Dentist prescribed home applied technique

Both intrinsic and extrinsic tooth stains can be eliminated with external dental bleaching. Oxidizing agents, which are included in tooth bleaching solutions, gives them their primary bleaching effect by releasing an efficient bleaching component. The primary component of tooth whitening is hydrogen peroxide (H_2O_2), and consumers and dentists have come to accept dentist-supervised at-home teeth whitening using trays with 1–10% hydrogen peroxide or 10–22% carbamide peroxide.[11 - 15]

A 45-year-old man who had black staining for nearly 15 years was given a treatment regimen that included ultrasonic cleaning of his teeth and sodium bicarbonate jet therapy. Next, trays and 10% carbamide peroxide (Fórmula & Ação, São Paulo, SP, Brasil) were recommended for at-home bleaching under a dentist's supervision. A drop of bleaching gel is often applied to the buccal surfaces of teeth at night for 20 days as part of the normal procedure. Two modifications to this procedure were suggested: In addition to applying the bleaching gel to the buccal surfaces, the patient should also apply a drop of the gel to the lingual surfaces. This means that all of the teeth, including those with prosthetic crowns, should receive the bleaching gel. A reevaluation was scheduled for every three months for a year following the bleaching procedure. During this time, no recurrence of the pigmentation was seen, even in the absence of professional dental prophylaxis. Following that, the patient needed to come back once a year for a clinical assessment and teeth cleaning. There were only a few

Figure 1: Occlusal view before bleaching procedure[16]

Figure 2 :Occlusal view after one year of follow up after bleaching[16]

Figure 3: Occlusal view after 10 year of follow up after 10-year of bleaching[16]

tiny, black-spotted areas visible. Consequently, there were small areas of black extrinsic stains following a ten-year clinical follow-up. However, compared to previous bleaching, this relapse was not as frequent or severe[16]. Both extrinsic and intrinsic tooth staining can be removed by external dental bleaching.[11]

PHOTOTHERAPY

Phototherapy utilizes natural or artificial light to improve a health condition. Photodynamic therapy is a form of treatment that depends on exogenous chemicals, specifically light and an externally applied photosensitizer, to produce antimicrobial reactive oxygen species (ROS).[17] Phototherapy was employed in a study led by Albelda-Bernardo et al. to treat black chromogenic stains. The effects of antimicrobial phototherapy on discolored black tooth surfaces were examined in this study.[18] The mode of action is the inactivation of microbes caused by light.[19,20] Antimicrobial phototherapy (aPT) is an alternative for less aggressive, non-invasive treatment.[21] The phototherapy equipment was a GLO™ Science LLC, New York, America light emitter with a 3W power and a wavelength of 475 nm. On 31 volunteers, light was applied twice for a total of eight minutes. 64.5% of patients showed reduced pigmentation area after receiving aPT. In 48.4% of subjects, the colour of the plaque decreased. During the study, pigmentation area and depth of colour were restored to normal values. Colonization by the three bacterial species Aggregatibacter actinomycetemcomitans, Tannerella forsythia, and Porphyromonas gingivalis decreased.[18] This is treatment of choice for extrinsic tooth staining.

ENAMEL MICRO-ABRASION

Enamel micro-abrasion has been shown to be an efficient superficial approach, which is beneficial for minor to moderate stains of Fluorosis.[22] The materials used for this treatment include an abrasive paste, typically 6.6% hydrochloric acid with 20 - 160µ silicon carbide microparticles and bristle cups. The teeth are cleaned with pumice slurry followed by several 20 second applications of microabrasives. In conjunction with microabrasion, at home bleaching using 10% carbamide peroxide may be used to remove residual stains and improve the colour of the teeth. This method is capable of removing some superficial stains. In determining the efficacy of microabrasion, depth of stain plays a major role. Ultrasound, transillumination and visual assessment are commonly used invivo methods of depth determination. To determine the choice of treatment, Park et al. used an in vivo quantitative light-induced fluorescence method for assessing the level of enamel hypoplasia.[23] Microabrasion can be used to treat superficial enamel stains resulting from dental fluorosis, mineralized white spot lesions, surface irregularities, localized enamel hypoplasia and for enamel polishing post-orthodontic treatment.[24]

PHOTODYNAMIC THERAPY WITH LASER DIODE IN LOW LEVEL LASER THERAPY(LLLT) MODE

G S Menon et al. reported a case of 24-year-old female patient with black chromogenic stains. There was recurrence of the stains in spite of professional scaling before six months. Low-level laser treatment using 980nm was performed with diode laser in biostimulation mode, 0.5W continuous wave for 1 minute before scaling. After LLLT, a full mouth scaling and polishing of teeth was performed. At 6th and 12 months review, a decrease in black stains were observed. The result obtained was satisfactory to the patient. Further continuation of LLLT therapy during the follow up visits was requested by the patient. For the reduction of recurrences of Chromogenic Bacterial stains, laser therapy at lower levels is an easy and noninvasive therapeutic modality.[1] This is the treatment of choice for extrinsic tooth staining .

PROBIOTICS

Elena Bardellini et al, reported a randomised controlled study to evaluate the effectiveness of an oral probiotic, Streptococcus salivarius M18, in children with black stains.[25] The drug was given once daily for three months and they concluded that black stain in children could be prevented by administering S.salivarius M18. The strain M18 of S. salivarius displays a specific profile of bacteriocins and enzymes, releasing A2, 9, MPS, and M bacteriocins along with urease and dextranase enzymes. These bacteriocins, including Salivaricin A2, MPS, and 9, are all encoded on plasmids and can hinder the growth of Streptococcus

pyogenes. Salivaricin MPS is effective against Corynebacterium spp. and Streptococcus sanguinis, both of which are important for maintaining oral microbiota balance. Streptococcus mutans and Actinomyces are inhibited by Salivaricin M. These could be the possible mechanisms of prevention of black stain formation by S salivarius M18.

PORCELAIN LAMINATE VENEERS OR CROWNS

Deeper stains brought on by intrinsic reasons or enamel hypoplasia cannot be addressed with conservative techniques like bleaching and microabrasion; instead, restorative procedures like porcelain veneers and/or crowns are required. For many years, veneers have been a less invasive restorative method for enhancing the shape and color of teeth. According to reports, these repairs have a high success rate and a lengthy lifespan. Materials most typically used are feldspathic porcelain and lithium disilicate (LS2). It is possible to produce lithium disilicate using a bi-layered method or a minimal cut-back method. The degree of desired translucency, the strength of the underlying stain, and the clinician's preference all play a role in this. In order to increase bond strength and lower the chance of post-treatment irritation, veneer preparations for teeth are cautious and mostly involve enamel retention.[26]

CONCLUSION

Tooth staining is a common reason for individuals visiting dentists to enhance their appearance. This issue can be challenging for both the patient and the dentist, with various causes including staining due to chromogenic bacteria, underdevelopment of enamel to extensive dental fluorosis. Grasping how the condition develops is crucial for choosing the right treatment methods. Teeth with minor to moderate discoloration might respond well to less invasive treatments like enamel microabrasion and bleaching. However, bleaching, though gentle, can lead to sensitivity after treatment and may cause the discoloration to return. Teeth with severe discoloration require more intensive treatments such as porcelain veneers or full coverage crowns. It's vital for dentists to fully understand the causes and treatment options for tooth discoloration in the management of patients with black stains.

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Oral Hygiene Day 2024

On the occasion of Oral Hygiene Day, Department of Periodontics, Mahe Institute of Dental Sciences, successfully organized one week program, under the banner of SPIK. An awareness camp was held at Kannur Central Jail in association with Department of Public Health Dentistry. Dr. Subair, Professor, Department of Periodontics, post graduate students Dr. Indrajith and Dr. Marjana delivered an awareness lecture at the camp. Awareness talk on "Oral Hygiene" was given by Dr. Nanditha to the third year students in the department The students also participated in ISP Quiz competition. An awareness class was conducted for fourth year students by post graduate students. Poster competition was conducted for interns and certificates were awarded to the winners. Awareness related pamphlets, toothbrushes and toothpastes were distributed to the patients attending the OPD of Department of Periodontics.

SPIK CDE PROGRAM

A CDE program was organized at Kannur Dental College, Anjarakandy in association with SPIK on 28th May 2024. The program started with inaugural function at 09.30am followed by invocation. Dr. Mohammed Feroz T.P, Secretary SPIK welcomed the gathering. Dr. Arun Narayanan, Principal, Kannur Dental College, inaugurated the program by lighting the lamp. Dr. Deepthi V, Reader, Dept.of Periodontology. delivered the vote of thanks.

The resource person for the CDE was Dr. Arun Sadasivan, Professor and Head of Periodontology, Sree Mookambika Institute of Dental Sciences, Kulasekaram. Lectures were delivered on the topics – 'Bio- Clinical factors in Periodontal regeneration - Current Perspectives' and 'Periodontal considerations in Orthodontic therapy- An overview.' A total of 70 registrations were received from the SPIK members, Post graduate students from KMCT Dental College, Calicut; Govt. Dental College, Calicut and Malabar Dental College, Edappal.