Indian Dental Association

ISSN: 09733442

Volume 41

Issue 2

KSDJ KARNATAKA STATE DENTAL JOURNAL

Official Publication of IDA Karnataka State Branch

CONTENTS

FROM EDITORS DESK

Dear Readers,

Dr. Mohan Kumar K. P
Hon. Editor

Dr. Patil Disha
Assistant Editor

The Impact of Diet on Dental Health The understanding of oral health has changed from a strictly clinical focus to a more holistic approach that recognizes the critical role of diet as contemporary dentistry advances. This editorial examines the significant impact that dietary decisions have on dental health, highlighting the necessity for dental practitioners to incorporate nutritional education into their procedures to provide the best possible care for their patients.

The Nuanced Connection Between Oral Health and Nutrition is crucial for maintaining dental health, according to a wealth of research. The foods we eat have the power to either prevent or exacerbate dental conditions. For instance, the main causes of tooth cavities and erosion are sweets and acidic meals, whereas a diet high in vitamins, minerals, and antioxidants supports the body's ability to fight infections and promotes healing in the oral cavity.

Maintaining the integrity of tooth construction requires essential minerals including calcium, phosphorus, and vitamin D. These components contribute to gum health in addition to helping with remineralization. Vitamins A, C, and K are also essential for maintaining healthy mucous membranes, which helps to prevent periodontal disease.

Dietary Decisions' Impact on Preventative Dentistry

Dietary practices are crucial for maintaining dental health, according to preventative dentistry. Dental practitioners need to actively inform their patients about the negative effects of unhealthy eating habits. The incidence of cavities and periodontal disorders can be considerably decreased by promoting a balanced diet rich in fruits, vegetables, whole grains, and lean meats.

Additionally, encouraging healthy snacking practices, stressing the advantages of chewing sugar-free gum, and promoting water over sugar-filled beverages can empower patients to make decisions that will improve their dental health.

Multidisciplinary Methods: Nutrition and Dentistry

A team effort is required to incorporate nutrition into dental treatment. Registered dietitians and dentists should collaborate to provide complete care that considers both nutritional and dental health. For patients, especially those with unique oral health issues or systemic illnesses associated with nutrition, this interdisciplinary interaction might result in customized dietary advice and therapies.

Teaching Upcoming Generations

Dental education must be the first step in implementing significant changes in patient care. Making nutrition a core part of dentistry education will give future dentists the skills and information they need to help their patients make better food choices. The foundation for a generation of dental practitioners that comprehend the relationship between oral health and nutrition is laid by this move towards a more integrative teaching approach.

Resolving Obstacles to Nutritious Diet

Barriers like socioeconomic position, availability to nutrient-dense meals, and nutritional knowledge still exist despite the abundant data linking diet to oral health. It is imperative that these issues be addressed, and dentists should advocate for community health programs that increase access to wholesome eating options. Additionally, knowing local dietary customs can assist in creating effective and courteous nutritional recommendations.

Final Thoughts

It is obvious that nutrition must play a major part in our procedures and patient education as our knowledge of dental health grows. We can enhance oral health outcomes and advance general well-being by recognizing the importance of dietary decisions and encouraging interdisciplinary collaborations.

Let's make a commitment to carrying on this important discussion and creating creative plans to include dietary expertise into our dental procedures. By working together, we can create a healthy future where nutrition and dental care are intertwined.

Warm regards,
Editorial Team.

PRESIDENT'S MESSAGE

Dear Members and Colleagues,

Dr. Bharath SV
President

As we gather to celebrate the latest issue of our state journal, I want to take a moment to reflect on our shared commitment to advancing dental health in India. This platform not only highlights our achievements but also fosters collaboration and innovation among dental professionals.

In recent months, we have faced numerous challenges, yet our resilience has shone through. The contributions featured in this edition demonstrate the remarkable dedication of our members to education, research, and community service.

Let us continue to support each other, share knowledge, and work towards elevating the standards of dental care across our nation. Together, we can make a significant impact on public health and the well-being of our communities.

Thank you for your unwavering commitment to our profession.

Warm regards,

Dr Bharath S V

President, Indian Dental Association Karnataka state

SECRETARY MESSAGE

Dear Readers,

I hope this message finds you well. On behalf of the Karnataka State Dental Journal (KSDJ), it is my pleasure to announce the release of the second issue for 2024. We are excited to bring you yet another edition filled with insightful articles, case studies, and research that aim to contribute to the growth and advancement of dental science and practice.

This year has been an encouraging journey for us, and we are proud to share that the journal continues to receive positive feedback and recognition from both the dental community and academia. Your continued support as readers and contributors has played a crucial role in making this possible. The success of KSDJ would not be where it is today without your engagement, and for that, we are deeply grateful.

As we move forward, we remain committed to bringing you the latest in dental research, clinical innovations, and professional development. We welcome your feedback, suggestions, and submissions for future issues, as your input is invaluable in shaping the journal.

Thank you once again for your readership and support. We look forward to your continued participation in making KSDJ a platform for knowledge sharing and professional growth.

Warm regards,

Dr. Mahesh Chandra K

Secretary, Karnataka State Dental Journal

Dr. Mahesh Chandra K
Secretary

INDIAN DENTAL ASSOCIATION KARNATAKA STATE BRANCH

OFFICE BEARERS : 2022-2023

President
Dr. Bharath SV

Hon Secretary
Dr Mahesh Chandra K

Treasurer
Dr. Sanjay Kumar. D

Editor in Chief
Dr. Mohan Kumar K.P

Joint Secretary
Dr. A. G. Annaji

Assistant Secretary
Dr. R. Chethan

CDE Chairman
Dr. Revan Kumar Joshi

CDH Chairman
Dr. Venkatesh Babu

President Elect
Dr. Bharath SV

Immd. Past President
Dr. Srinidhi D

Vice Presidents

Dr. Mahendra V. Pimpale | **Dr. Dhanu G.** | **Dr. M. G. S. Prasad** | **Dr. Aaquib Hashmi**

Executive Committee Members

Dr. M. L. V. Prabhuji
Dr. Shuban Alva
Dr. Pratap Kumar Shetty
Dr. Padma Raj Hedge
Dr. Shivu M. E.
Dr. H. R. Arunananda
Dr. Sushanth V. H.
Dr. Ali I. M.
Dr. Sachin Shivanaikar
Dr. Praveen S. Basandi
Dr. Shambulingappa P.

Dr. Umesh Allad Dr. Arshad Hussain
Dr. Vishwanath Patil
Dr. Sharan Shetty
Dr. Pramod Shetty
Dr. Sanath Shetty
Dr. Jitheesh Shetty
Dr. Girish Katti
Dr. Utkarsha Lokesh
Dr. Kirthi Shetty
Dr. Shishir Shetty
Dr. Nithish Shetty

Dr. Sudarshan Kumar R. N.
Dr. Yokesh V. R.
Dr. Raghunand Sindhe J.
Dr. Manjunath Sarangi
Dr. Jeevan Shetty
Dr. Dhayakar K. V.
Dr. Dhulappa Patil
Dr. Raghunath N.
Dr. Sheshadri R.
Dr. Nikita S.
Dr. Manjunath R. K.

Central Council Members

Dr. Rama Murthy T. K.
Dr. Mahesh Chandra K.
Dr. D. Srinidhi
Dr. V. Ranganath
Dr. Narendra Kumar M.
Dr. Annaji A. G.

Dr. Mahendra V. Pimpale
Dr. Shiva Prasad S.
Dr. Charan Kumar Shetty
Dr. Sanjay Kumar D.
Dr. Anirban Chatterjee
Dr. Raghavendra Pidamale

Dr. Ravi M. G.
Dr. Kiran Radder
Dr. Raghavendra Katti
Dr. H. P. Prakash
Dr. Veerendra Kumar S. C.
Dr. Ramachandra Mallan
Dr. Shiva Sharan Shetty

`

BREAKING FREE FROM TOBACCO: STRATEGIES FOR SUCCESSFUL CESSATION

Author:

Dr.(Mrs.)Sai Chandini Srinivas
Senior Lecturer
MMNGHIDS and RC, Belagavi ,Karnataka

INTRODUCTION

Tobacco use is a leading cause of preventable deaths worldwide, with millions of people succumbing to tobacco-related illnesses each year. Quitting tobacco is a challenging journey, but with the right strategies and support, it is possible to overcome nicotine addiction and live a healthier, tobacco-free life. In this article, we will explore effective tobacco cessation methods and resources to help individuals achieve their goal of quitting tobacco.

Nicotine Addiction:

Understanding nicotine addiction is crucial to successful cessation. Nicotine is a highly addictive substance that affects the brain's reward system, releasing feel-good chemicals like dopamine. This can lead to physical and psychological dependence, making it difficult to quit.

Tobacco has numerous harmful effects on the body, including:

1. Lung Cancer: Tobacco smoke contains over 70 known carcinogens, increasing the risk of lung cancer and other cancers.
2. Heart Disease: Tobacco use damages the cardiovascular system, leading to heart attacks, strokes, and other cardiovascular diseases.
3. Chronic Obstructive Pulmonary Disease (COPD): Long-term tobacco use can cause COPD, a progressive lung disease making breathing difficult.
4. Respiratory Problems: Tobacco smoke irritates the lungs, causing chronic bronchitis and emphysema.
5. Cancer: Tobacco use is linked to various cancers, including mouth, throat, esophagus, stomach, pancreas, kidney, bladder, and cervical cancer.
6. Premature Aging: Tobacco use accelerates aging, causing wrinkles, age spots, and a weakened immune system.
7. Infertility and Pregnancy Complications: Tobacco use can lead to infertility, miscarriage, stillbirth, and sudden infant death syndrome (SIDS).
8. Gum Disease and Tooth Loss: Tobacco use increases the risk of gum disease and tooth loss.
9. Eye Problems: Tobacco use can cause cataracts, glaucoma, and age-related macular degeneration.
10. Weakened Bones: Tobacco use can lead to osteoporosis and increased fracture risk.
11. Increased Risk of Infections: Tobacco use weakens the immune system, making users more susceptible to infections.
12. Mental Health: Tobacco use is linked to depression, anxiety, and schizophrenia.
13. Financial Burden: Tobacco use can lead to significant financial burdens due to healthcare costs and lost productivity.

14. Social Isolation: Tobacco use can lead to social isolation, as smokers may avoid social situations due to their habit.
15. Environmental Impact: Tobacco use contributes to environmental pollution through cigarette butt litter and tobacco cultivation.

Here are some effects of tobacco on oral health:

- Tooth Discoloration: Tobacco can stain the teeth, leaving them yellow or brown in appearance. This not only affects the aesthetic appeal of your smile but also indicates poor oral hygiene.

- Gum Disease: Tobacco use increases the risk of developing gum disease. The chemicals in tobacco products irritate the gums, causing them to become inflamed and prone to infection.

- Bad Breath: Smokers are also more likely to experience bad breath, also known as halitosis. The combination of tobacco smoke and the build-up of bacteria in the mouth creates an unpleasant odour that can be difficult to mask.

- Dry Socket: Smokers are three times more likely to develop a dry socket following a tooth extraction. A dry socket occurs when there is improper healing at the site of extraction.

- Oral Cancer: Tobacco use has been linked to an increased risk of oral cancer. The chemicals in tobacco products can damage the cells in the mouth and throat, leading to the development of cancerous tumours.

- Poor Healing: Tobacco use makes it harder for the immune system to fight infections. This slows down healing after tooth removal or injuries in the mouth.

- Mouth Ulcers: Tobacco can cause mouth ulcers or sores that do not go away.

- Tooth Loss: Tobacco use can cause tooth loss. Losing teeth towards the back of the mouth can create problems with chewing food. Losing teeth at the front of the mouth affects your ability to eat, your appearance, and can create problems with speech.

Strategies for Tobacco Cessation:

1. Set a Quit Date: Choose a specific date to quit tobacco and mark it on your calendar. This will give you a deadline to work towards and help you prepare mentally.
2. Get Support: Share your quit plan with friends and family, and consider joining a support group or talking to a counselor for encouragement and guidance.
3. Identify Triggers: Make a list of situations that trigger your desire to smoke or use tobacco, and develop a plan to avoid or manage them.
4. Use Nicotine Replacement Therapy (NRT): NRT can help reduce withdrawal symptoms and cravings. Options include gum, lozenges, patches, and inhalers.
5. Try Non-Nicotine Prescription Medications: Prescription medications like bupropion (Zyban) and varenicline (Chantix) can help reduce cravings and withdrawal symptoms.
6. Stay Active: Engage in physical activities like walking, jogging, or yoga to distract yourself from cravings and improve your mood.

7. Use Healthy Coping Mechanisms: Replace tobacco with healthier habits like reading, meditation, or hobbies.

CONCLUSION:

Quitting tobacco is a journey that requires patience, persistence, and support. By understanding nicotine addiction and using effective cessation strategies and resources, individuals can overcome tobacco dependence and live a healthier, tobacco-free life. Remember, every attempt to quit is a step closer to success – don't give up!

Remember, quitting tobacco can significantly reduce the risk of these harmful effects and improve overall health and well-being

MICRONUTRIENTS IN ORAL MUCOSAL HEALTH AND DEFICIENCY

AUTHORS:

1. Dr. Ashuja RB
   Lecturer, Department of Oral Pathology and microbiology, College of Dental Sciences, Davangere
2. Dr. Mohan Kumar KP
   Professor, Department of Oral Pathology and microbiology, College of Dental Sciences, Davangere
3. Dr. Bhavana S Bagalad
   Private practicioner, Ridhi dentistry, Shivkumar Swamy nagara, Hadadi road Davangere

CORRESPONDING AUTHOR:

Dr. Ashuja RB
Lecturer, Department of Oral Pathology and microbiology, College of Dental Sciences, Davangere
Ph.no: 8095576077
ashujarb@gmail.com

ABSTRACT:

Diet and nutrition play a crucial role in promoting and maintaining health throughout life, including preventing chronic diseases. They play a key role in disease prevention and health promotion. Clinical signs of nutritional deficiency can have a major impact on the oral cavity's function. Oral symptoms may be caused by a nutrient deficiency. Nutrition and oral health have a complex and interconnected relation. Nutrition affects the oral cavity on both a local and systemic level. Diet and nutrition impact oral health by influencing craniofacial development, growth, and soft tissue maintenance.

Keywords: Micronutrients, deficiency, vitamins, trace elements

INTRODUCTION

In order to maintain the body's optimal structure and function, nutrition is important. Healthy diet is essential, especially in the earliest phases of development and growth. American Dietetic Association states that “nutrition is an integral component of oral health”.

The growth, development, maintenance, repair of oral tissues, prevention of oral diseases like dental caries, dental erosion, developmental defects, oral infections and periodontal disease, hypo mineralization depend on the adequate intake of the proper nutrients.

Micronutrients are essential substances for human health contained in foods and are required only in small amounts. Micronutrients are necessary elements for human health that are found in food and are only needed in small amount.They divided into vitamins and essential trace minerals. Micronutrient malnutrition occurs when consumptions are too low to meet requirements of micronutrients. It impacts ⅓ to ½ of the global population.1

The early signs of nutritional deficiencies appear in the soft tissues in the form of thinning, inflammation and ulceration. Nutritional status and oral health reciprocally related and affect each other, nutritional deficiencies have an impairs oral function. Although micronutrients are needed only in small amounts for the human body to function properly, their deficiency leads to critical health problems.2Both short term and long-term consequences occur due to inadequate micronutrient intake.

Functions:

- Micronutrients play a key role in metabolism and tissue function.
- Micronutrients are substances that allow the body to generate vital enzymes, hormones and other elements for excellent health.[3]
- Micronutrients, which have anti-oxidant and anti-inflammatory characteristics, are essential for the health of the oral mucosa and structures.
- Micronutrients has biochemical functions cofactor in metabolism by modulating the enzyme activity, genetic control and also as an antioxidant.[4]

Nutrient Deficiencies:

The World Health Organisation (WHO) states that micronutrients, such as vitamins and minerals, are necessary elements that the body needs in order to carry out its functions. Along with less clinically significant reduction in energy, mental clarity, and general capacity, deficiencies in these micronutrients can result in visible and potentially dangerous health conditions. An increased risk of other illnesses and health issues, poor educational outcomes, and decreased productivity at work can all arise from this.[5]

It is also recognized that various micronutrient subclinical deficiencies are often harder to acknowledge and evaluate in the laboratory and are often complicated by the acute phase response.

Vitamins deficiency in oral health:

a. Vitamin A

Function: Vitamin A is essential for maintaining epithelial tissues, including the oral mucosa. It is crucial for cell differentiation and proliferation, and it supports immune function.

Impact on Vitamin A deficiency Oral Mucosal Health:

Vitamin A deficiency led to impaired epithelial cell function and reduced mucosal integrity, increasing susceptibility to infections and mucosal lesions maturation problems, hyperkeratotic white patches, xerostomia, gingivitis, periodontitis, tooth morphogenesis defects, decreased odontoblast differentiation, and enamel hypoplasia are among the symptoms associated with Vitamin A deficiency.[6,7]

It is crucial for oral health because it promotes growth, heals wounds, and treats oral leukoplakia and submucous fibrosis. Along with immune defences, bone growth, normal cell development, preventing mucus-forming cells from keratinizing, cell differentiation, osteoclast stimulation, and correct tooth spacing, it is also essential for normal cell development. The production of glycoproteins like mucin also involves vitamin A.[6]

A retinol deficiency can lower the formation of mucin, which can impair tooth integrity, interfere with salivary flow, and raise the risk of caries. Reduced taste sensitivity and irregular tubular dentin development are further effects of vitamin Adeficiency.[8]

Shariati et al. found that vitamin A deficiency was associated with a higher prevalence of oral mucosal lesions and infections, such as xerostomia (dry mouth) and candidiasis. The findings highlight the importance of vitamin A in maintaining the structural integrity and immune defences of the oral mucosa.[9]

Cakarer et al.in hisreview indicated that adequate intake of vitamin A supports the health of oral epithelial tissues and reduces the risk of oral cancers. Vitamin A helps in maintaining the structural integrity of the oral mucosa and enhancing the immune response against infections.[10]

b. Vitamin B complex:

Function:vitamins, including B2 (riboflavin), B3 (niacin), B6 (pyridoxine), and B12 (cobalamin), are vital for cellular metabolism and the maintenance of healthy mucous membranes. foundational to cell metabolism and replication and are vital for neurological functions. These vitamins are crucial for cytotoxic cellular immunity, modulating T cell responses, and are found in a wide variety of foods.[11]

Impact on Vitamin B complex deficiency Oral Mucosal Health:

Deficiencies in B complex vitamins can manifest as various oral mucosal health issues such as angular cheilitis, glossitis, and mucosal ulcerations. Oral health can be significantly affected by deficiencies in vitamins B1 and B2, leading to conditions such as recurrent aphthous stomatitis (RAS), glossitis, and angular cheilitis may also impair postnatal amelogenesis, resulting in enamel hypo mineralization[12,13] along with erythema, papillary atrophy and candidiasis.[14]

Smith and Lazarus et al. found that deficiencies in B vitamins were linked to glossitis, cheilitis, and other mucosal abnormalities. The findings underscore the importance of B vitamins in maintaining healthy oral mucosa.[15]

Sakuta et al. research indicated that B vitamin supplementation improved the healing of oral mucosal lesions in elderly patients. The study highlights the necessity of adequate B vitamin levels for the maintenance and repair of oral mucosal tissues.[16]

c. Vitamin C

Function: Vitamin C is crucial for collagen synthesis, wound healing, and the integrity of connective tissues, including those in the oral mucosa. It also acts as an antioxidant.Vitamin C mostly maintains and regenerates healthy connective tissue in addition to its antioxidant properties.[17]

Impact on Vitamin C deficiency Oral Mucosal Health:

Deficiency in vitamin C can lead to conditions such as scurvy, characterized by bleeding gums, mucosal fragility, and impaired wound healing.Scurvy-related skeletal and vascular diseases most likely result from an inability to produce osteoid tissue. Due to alterations in the ameloblasts and odontoblasts, inadequate vitamin C during tooth formation may induce scurvy-like or scorbutic abnormalities in the teeth.

A vitamin C-deficient environment also causes atrophy of the odontoblasts and ameloblasts. Ascorbic acid deficiency-induced gingivitis also damages the periodontium, which leads to tooth movement. It is most likely caused by weaker collagen as a result of vitamin C deficiency, which leads to alveolar bone resorption. [18]

Chapple et al.demonstrated that vitamin C supplementation could enhance collagen synthesis and reduce oxidative stress in oral tissues, thus supporting the structural integrity and healing capacity of the oral mucosa.[19]

Van der Velden et al. showed that higher dietary vitamin C intake was associated with better periodontal health and reduced mucosal bleeding, indicating its importance in maintaining mucosal integrity.[20]

d. Vitamin D

Function: Vitamin D is essential for calcium absorption and bone health, and it also plays a role in the immune function of oral tissues and also contains anti-inflammatory properties.

Impact on Vitamin D deficiency Oral Mucosal Health:

Deficiency in vitamin D can impair mucosal immunity and increase the risk of infections and inflammatory conditions. Sufficient amounts of Vitamin D delay the onset and advancement of dental caries. In reality, the most recent in vitro research indicates that vitamin D has obvious fine-tuning, anti-inflammatory, and mineralization effects on the periodontium.

A severe vitamin D shortage in children can result in anomalies in the dentin and enamel due to improper tooth mineralization. Deficiency has been associated to periodontitis. Furthermore, patients who appear with oral neoplastic lesions are more likely to have a vitamin D shortage. It is also associated with an increased risk of pharyngeal, oral, and esophageal cancers, all of which are more prevalent in heavy smokers and individuals with severe alcoholism.[21]

Dietrich et al. found that higher serum levels of vitamin D were associated with lower rates of gingival inflammation and oral infections. The findings suggest that vitamin D supports mucosal immune function and integrity.[22]

Schröder et al. indicated that vitamin D supplementation reduced the incidence of mucosal lesions and infections, highlighting its role in maintaining mucosal health.[23]

e .Vitamin E

Functions:Mainly, it acts as an antioxidant, which is essential when there is an increased metabolic demand. It also has anti-inflammatory qualities and stimulates naïve T cells. Antioxidants, including vitamins E and C, protect oral tissues from oxidative stress, which can damage cells and contribute to the development of various oral diseases.[24]

Impact on Vitamin E deficiency Oral Mucosal Health:

Oxidative stress is implicated in the pathogenesis of numerous oral mucosal diseases, including periodontitis and oral cancer. Vitamin E is an antioxidant whose deficiency may be associated with oral cancer[25]. its deficiency can lead to suppressed anti-inflammatory system and depressed immune response of oral soft

tissue[26].Muscle and neurological problems are also a consequence of human vitamin E deficiency. Early diagnostic signs of deficiency include leakage of muscle enzymes such as creatine kinase and pyruvate kinase into plasma, increased levels of lipid peroxidation products in plasma, and increased haemolysis [27].

Chapple and Matthews reported that antioxidants reduced oxidative stress in oral tissues, improving the clinical outcomes in patients with mucosal diseases such as periodontitis. The findings suggest that antioxidant therapy can be beneficial in managing and preventing oral mucosal diseases [19].

Waddington et al. review suggested that antioxidant therapy could be beneficial in managing oral cancers by reducing oxidative damage to oral tissues, highlighting the potential role of antioxidants in maintaining mucosal health and preventing disease progression [28].

Minerals and oral health:

a. Zinc

Function: Zinc is essential for immune function, protein synthesis, and cell division. It plays a critical role in maintaining the health of epithelial tissues and mucosal immunity.

Impact on Zinc deficiency Oral Mucosal Health:

Zinc deficiency can lead to delayed wound healing, increased susceptibility to infections, and taste disturbances. The harmony of the oral tissues is maintained by zinc, an essential trace element. Atrophic glossitis, burning mouth syndrome, xerostomia, atrophic stomatitis, periodontitis, and dental cavities have all been associated to its deficiency. Zinc supplements are typically provided to these individuals in order to speed up their recovery. It should be assessed in cases of suspected oral lesions since it has also been found to be a significant indicator of oral squamous cell carcinoma (OSCC)[29]. Zinc, in the oral cavity can be found in saliva, dental plaque and in the hard tissues. It contributes to healthy teeth formation. Since taste buds are known to contain various zinc containing enzymes, zinc deficiency will cause taste disorders. Decreased of taste sensation and lingual trigeminal nerve sensitivities as well as reduced salivary flow has been associated with zinc deficiency[30].

Preshaw et al. study demonstrated that zinc deficiency was associated with delayed wound healing and increased susceptibility to mucosal infections. The findings suggest that adequate zinc levels are necessary for maintaining mucosal health and promoting healing[31].

Griffin et al. found that zinc supplementation reduced the incidence of oral ulcers and improved mucosal health, emphasizing the importance of zinc in maintaining mucosal integrity and preventing infections[32].

b. Iron

Function: Iron is critical for oxygen transport, DNA synthesis, and cellular metabolism. It plays a role in maintaining healthy epithelial tissues and supporting immune function.

Impact on Iron deficiency Oral Mucosal Health:

Iron deficiency can lead to conditions such as anaemia, which can manifest as pallor of

the oral mucosa, ankle cheilitis, atrophic glossitis, generalized oral mucosal atrophy, candidal infections, pallor, and stomatitis are the oral symptoms of iron deficiency anemia. More women than males are affected by Plummer-Vinson syndrome, also known as Paterson-Kelly syndrome, sideropenic dysphagia, or iron deficient anemia. The disorder is rare and is characterized by dysphagia, koilonychia, and dysphagia. Unusual oesophageal webs that are prone to malignant transformation cause dysphagia[33].It's possible that patients with OSMF had lower iron levels because iron is used in the production of collagen. Furthermore, reduced vascularity brought on by iron deficiency in the oral tissues promotes arecoline percolation even more. Increased arecoline percolation, which promotes fibroblastic proliferation and collagen production, results in further damage[34].

Jayadeep et al., suggested as head and neck carcinomas grow, serum ferritin levels rise and serum iron concentrations fall. As a result, heme can be utilised as a follow-up technique for patients in addition to nutritional assessment.

Bhattacharya et al. reported an interesting case of iron deficiency anaemia primarily resulted in development of oral submucous fibrosis which was successfully treated by oral administration of iron supplements and antioxidants[36]

c. Magnesium

Function: Magnesium is involved in numerous biochemical reactions, including those related to cellular metabolism and structural development of tissues.

Impact of Magnesium deficiency oral mucosal health:

Low magnesium levels can impair mucosal health, leading to increased susceptibility to lesions and infections. Relationship between periodontal diseases, calcium, and magnesium consumption, dietary practices play a major role in the health of periodontal tissue. Calcium and magnesium metabolism primarily determines the density of the alveolar bone, which supports teeth. In order to regulate electrical impulses in cells, magnesium and calcium work together. A shift in the ratio of calcium to magnesium may result in cellular malfunction. For healthy nerve function, there must also be an adequate supply of magnesium. About 50–60% of the magnesium in the body is stored in the teeth. Significant bone loss may arise from a small deficit[37].

Chiu et al. study found that higher magnesium intake was associated with improved mucosal health and reduced incidence of mucosal lesions. The findings suggest that magnesium plays a protective role in maintaining mucosal integrity[38].

Nishida et al.suggested that magnesium supplementation could enhance mucosal health and prevent lesions, particularly in vulnerable populations such as the elderly[39].

d. Calcium

Function: Calcium is essential for the development and maintenance of strong teeth and bones. It helps in forming and maintaining the tooth's structure, particularly the enamel.

Impact of Calcium deficiency oral mucosal health:

Calcium deficiency can have an impact on tooth development, resulting in a variety of

dental issues such as inappropriate tooth development, higher risk of tooth decay, decreased tooth structure, delayed tooth eruption, and poor jaw development40.Calcium deficiency contributes to gingival inflammation and periodontal disease, which result in decreased immune response, delayed healing, and osteoporosis[22]. Osteoporosis does not just affect your bones. It can also affect your teeth, as it can cause the jaw bone to weaken. Your jaw bone is the anchor for your teeth, so if it becomes damaged or weak; it is more likely your teeth will loosen and possibly fall out. Along with osteoporosis, a deficient level of calcium can increase your risk of periodontal, or gum, disease[41].

Adeyemo et al. found that inadequate calcium intake is associated with increased risk of dental caries and periodontal disease. This study emphasizes the importance of adequate calcium consumption for oral health[42].

A review by Watanabe and Dawes concluded that dietary calcium is critical for enamel remineralization, reducing the risk of tooth decay[43].

e. Fluoride

Function: Fluoride helps in the remineralization of tooth enamel and prevents dental caries.

Impact of Fluoride deficiency oral mucosal health:

Low fluoride levels in drinking water causes dental caries. Dental fluorosis is a type of enamel hypoplasia that can be brought on by high fluoride concentrations during the calcification stage of teeth. From minor white spots in the enamel to severe discoloration of the tooth structure, dental fluorosis can range in severity clinically. A number of variables, including the amount of fluoride in drinking water, the duration of exposure, the degree of calcification of teeth at the time of exposure, and the overall effect of excessive fluoride consumption on dental structure, influence this effect[7].

Marinho et al.confirmed the efficacy of fluoride in reducing dental caries in children and adolescents, supporting its use in preventive dental care[44].

A study by Ten Cate demonstrated that fluoride enhances enamel resistance to acid attacks from bacterial plaque[45]. It can lead to increased susceptibility to dental caries, cavity formation.

f. ***Iodine****:*

Function:It is important to sustain the daily functions of human body. Iodine plays an important role in general growth and developmentof the body along with maintaining metabolic processes.

Impact of Iodine deficiency oral mucosal health:

Inadequate synthesis of thyroid hormone due to iodine deficiency leads to hyper- or hypothyroidism. Thyroid diseases are a systemic abnormality that primarily manifests as mouth symptoms, and this deficiency causes them. Dry mouth, burning mouth syndrome, poor periodontal health, and macroglossia are all possible effects of hypothyroidism. An increased risk of periodontal disorders, early primary tooth exfoliation, mandibular and maxillary osteoporosis, and caries are associated with hyperthyroidism[46].

Additionally, S. and M. Venturi proposed that iodides may have a role in the

prevention of a number of disorders affecting the salivary and mouth glands47.

Littleton and Frohlich's study revealed that the skeletal remains from iodine-rich regions of the world had higher attrition, lower dental caries, and less premature tooth loss 48.

CONCLUSION:

It is essential to eat a well-balanced diet to maintain good oral health. Wide variety of dietary components including micronutrient and antioxidants are an integral part for optimum oral health and potential to accelerate wound healing after appropriate dental treatment.Micronutrient assessment of suspected individual and appropriate supplement therapy may assist in dental disease prevention. Future research should focus on establishing specific dietary recommendations and exploring the potential therapeutic uses of micronutrients in oral mucosal health management.

REFERENCES:

1. Miller BDD, Welch RM. Food system strategies for preventing micronutrient malnutrition. Food and Agriculture Organization of the United Nations. 2013. 42 (13): 115-128.
2. Touger DR, Mobley C, Epstein JB. Nutrition and Oral Medicine. 2nd ed. New York: Springer. 2014. p. 111-28.
3. Faber M, Wenhold FAM. Trace elements and oral health. *Food Constituents and Oral Health* 331–349, 2009.
4. Bhavya S, Shahaziya F, Ibrahim F, Manjusha N. The Impact Of Micronutrients In Periodontal Health And Disease: A Neglected Pathway- A Review.Vol.30 (1) 2023): JPTCP 650-671.
5. Micronutrients. World Health Organization.
6. Enwonwu C, Phillips R, Falker WJ. Nutrition and oral infectious diseases: state of the science. Compend Cont Edu Dent. 2002;23(5):431–4.
7. 7.B Sivapathasundharam, KP Anitha.Oral aspects of metabolic diseases.W. G. Shafer, M. K. Hine, and B. M. LevyShafer's Textbook of Oral Pathology. Sivapathasundaram B, editor. Elsevier Health Sciences; Chennai, India, 9th edition ,2020. 874–879 p.630,640-42.
8. Rathee M, Bhoria M, Kundu R. Vitamin A and Oral Health: A Review. Ind J Appl Res. 2013;3(10):1–2.
9. Shariati, M., Razavi, S. M., Rashidkhani, B., & Amiri, P. (2016). Nutritional factors in relation to oral health. Advanced Biomedical Research, 5, 1-9.
10. Cakarer, S., Yaltirik, M., & Aydoğan, S. (2013). Influence of nutrition on oral and systemic health. Journal of Clinical and Diagnostic Research, 7(6), 1222-1224.
11. Chen, Y.B.; Wang, Y.F.; Hou, W.; Wang, Y.P.; Xiao, S.Y.; Fu, Y.Y.; Wang, J.; Zheng, S.W.; Zheng, P.H. Effect of B-Complex Vitamins on the Antifatigue Activity and Bioavailability of Ginsenoside Re after Oral Administration. *J. Ginseng Res.* **2017**, *41*, 209–214.
12. Edwards, K.A.; Tu-Maung, N.; Cheng, K. Thiamine Assays—Advances, Challenges, and Caveats. *ChemistryOpen* **2017**, *6*, 178–191.
13. Moskovitz, M.; Dotan, M.; Zilberman, U. The Influence of Infantile Thiamine Deficiency on Primary Dentition. *Clin. Oral Investig.* **2017**, *21*, 1309–1313
14. Vega-Coffey K. Folate Deficiency Clinical Presentation. Medscape. 2022.
15. Smith, A., & Lazarus, J. H. (2007). Vitamin B deficiencies and oral health. British Dental Journal, 203(3), 143-144.
16. Sakuta, H., Suzuki, T., & Yasui, T. (2005). Effect of vitamin B complex on oral

mucosal lesions. Gerodontology, 22(4), 216-223.
17. Gupta-Smith V. Health and Well-Being. World Health Organization.
18. Stegeman CA and Davis JR. The Dental Hygienist's Guide to Nutritional Care. 4th Edition. Elsevier Publication; 2014.
19. Chapple, I. L. C., & Matthews, J. B. (2007). The role of reactive oxygen and antioxidant species in periodontal tissue destruction. Periodontology 2000, 43(1), 160-232.
20. Van der Velden, U., Kuzmanova, D., & Chapple, I. L. (2011). Micronutritional approaches to periodontal therapy. Journal of Clinical Periodontology, 38, 142-158.
21. Botelho J, Machado V, Proença L, Delgado AS, Mendes JJ. Vitamin D Deficiency and Oral Health: A Comprehensive Review. Nutrients. 2020;12(5):1471.
22. Dietrich, T., Nunn, M., & Dawson-Hughes, B. (2005). Association between serum concentrations of 25-hydroxyvitamin D and gingival inflammation. American Journal of Clinical Nutrition, 82(3), 575-580.
23. Schröder, U., Fekete, Z., & Karlsson, L. (2011). Dental caries, vitamin D, and calcium. Scandinavian Journal of Public Health, 39(2), 7-11.
24. Elmadfa, I.; Meyer, A.L. The Role of the Status of Selected Micronutrients in Shaping the Immune Function. *Endocr. Metab. Immune Disord. Drug Targets* **2019**, *19*, 1100–1115.
25. Jacqueline N. Brian MDC. Prentice Hall Health complete review of dental hygiene. 2001.Available from [cited 2019 Dec 23]: https://openlibrary.org/works/OL16290519W/Prentice_Hall_Health_complete_review_of_dental_hy giene.
26. Touger-Decker R, Mobley C. Position of the Academy of Nutrition and Dietetics: Oral Healthand Nutrition. J Acad Nutr Diet 2013;113(5):693– 701.
27. Dietary reference for vitamin C, vitamin E, selenium, and carotenoids. Institute of Medicine (IOM), Food and Nutrition Board. Washington DC: National Academy Press; 2001
28. Waddington, R. J., Moseley, R., & Embery, G. (2000). Reactive oxygen species: A potential role in the pathogenesis of periodontal diseases. Oral Diseases, 6(3), 138-151.
29. Uwitonze AM, Ojeh N,Murererehe J,Atfi A, Razzaque MS. Zinc Adequacy Is Essential for Mainanance of Optimal Oral Health. Mdpij. 2020; 12 (94): 1-14.
30. C. A. Heyneman, "Zinc deficiency and taste disorders," *Annals of Pharmacotherapy*, vol. 30, no. 2, pp. 186–187, 1996.
31. Preshaw, P. M., & Taylor, J. J. (2011). How has research into cytokine interactions and their role in driving immune responses impacted our understanding of periodontitis? Journal of Clinical Periodontology, 38, 60-84.
32. Griffin, M. O., Fricovsky, E., & Ceballos, G. (2009). Tetracyclines: A pleiotropic family of compounds with promising therapeutic properties. Review of Cardiovascular Medicine, 10(3), 173-180.
33. B. D. Neville, D. D. Damm, C. M. Allen, and J. E. Bouquot, *Oral and Maxillofacial Pathology*, Elsevier, Chennai, India, 3rd edition, 2009
34. D. Desai, M. V. S. Kumar, R. J. Bathi, I. Gaurav, and R. Sharma, "Molecular analysis of trace elements in oral submucous fibrosis and future perspectives," *Univ Res Jol of Dent*, vol. 4(1), 2014, p 26–35.
35. A. Jayadeep, K. Raveendran Pillai, S. Kannan et al., "Serum levels of copper, zinc, iron and ceruplasmin in oral leukoplakia and squamous cell carcinoma," *Journal of Experimental & Clinical Cancer Research*, vol. 16, no. 3,1997, pp. 295–3
36. P. T. Bhattacharya, T. Khaitan, S. B. Sarkar, and R. Sinha, "Oral submucous

fibrosis secondary to iron deficiency anemia: a case report, etiopathogenesis and management," *The Journal of Nutrition, Health and Aging*, vol. 20, no. 2, pp. 205–208, 2016.

37. Bertolini FA. Magnesium: A Neglected Mineral Our Teeth & Bones Cannot Live Without. North Canton Smiles. 2023
38. Chiu, Y. H., Lai, K. L., & Yeh, H. W. (2013). Magnesium and the risk of periodontal disease. Journal of Dental Research, 92(11), 1045-1051.
39. Nishida, M., et al. (2000). Vitamin C and the risk for periodontal disease. Journal of Periodontology, 71(8), 1215-1223.
40. Marinho, V. C., et al. (2013). Fluoride toothpastes for preventing dental caries in children and adolescents. Cochrane Database of Systematic Reviews, (7).
41. Adegboye AR, Fiehn NE, Twetman S, et al. : Low calcium intake is related to increased risk of tooth loss in men. *J. Nutr.* 2010;140(10):1864–1868.
42. The Effects of a Calcium Deficiency on Your Oral Health .Apr 30, 2019 Oral Health
43. Watanabe, T., & Dawes, C. (1990). The role of dietary calcium in dental caries. Journal of Dental Research, 69(7), 1314-1317.
44. Adeyemo, W. L., et al. (2014). The relationship between dietary calcium intake and periodontal disease: A critical review. Journal of Periodontology, 85(8), 1073-1083
45. Ten Cate, J. M. (1990). In vitro studies on the effects of fluoride on de- and remineralization. Journal of Dental Research, 69, 614-619.
46. Achanta A, Khasbage SD. Oral Manifestations of Thyroid Disorders. J Res Med Dent Sci. 2022;10(9):012–6.
47. Venturi and M. Venturi, "Iodine in evolution of salivary glands and in oral health," *Nutrition and Health*, vol. 20, no. 2, pp. 119–134, 2009.
48. J. Littleton and B. Frohlich, "Fish-eaters and farmers: dental pathology in the Arabian Gulf," *American Journal of Physical Anthropology*, vol. 92, no. 4, pp. 427–447, 1993.

GLANDULAR ODONTOGENIC CYST: A CASE REPORT AND REVIEW OF LITERATURE

Author:

1. **Dr. Akalya P**
   Post Graduate Student, Department of Oral Pathology.GDC.
   Government Dental College and Research Institute, Bengaluru.Karnataka-560002.
2. **Dr. Sahana N S**
   Mds (Oral Pathology), Phd
   Professor And Head Of Department
   Government Dental College and Research Institute, Bengaluru.Karnataka-560002.
3. **Dr. Suresh T,**
   MDS (Oral Pathology)
   Associate Professor
   Government Dental College and Research Institute, Bengaluru.Karnataka.
4. **Dr. Ninad Vijay Chavan**
   MDS (Oral Pathology), Post Graduate Student
   Government Dental College and Research Institute, Bengaluru.Karnataka.
5. **Dr. Savita S Shiragur**
   MDS (Oral Pathology), Post Graduate Student
   Government Dental College And Research Institute, Bengaluru.Karnataka.
6. **Dr. Hida Shareefa**
   MDS (Oral Pathology), Post Graduate Student
   Government Dental College and Research Institute, Bengaluru.Karnataka

Correspondence Author:

Dr. Akalya P
Address: Room No 8, Department Of Oral Pathology, Government
Dental College &Amp; Research Institute, Bengaluru.
Email Address: Akalyapurushothaman@Gmail.Com

ABSTRACT:

BACKGROUND: Glandular odontogenic cyst (GOC) is uncommon jaw cyst of odontogenic origin with unpredictable and potentially aggressive behaviour. It is a rare developmental cyst with relatively low frequency of just 0.012–0.03%. Till now, less than 300 cases have been reported in the English literature. However, in our department in the span of 15 years we reported 3 cases of GOC.Herein we present a case report of a 26-year-old male with a complaint of swelling in the upper back tooth region and roof of the mouth which was later diagnosed as Glandular Odontogenic Cyst.

CASE PRESENTATION: A painful swelling was noted on the upper back tooth region and posterior palatal region. Intraoral occlusal radiograph and Orthopantomogram (OPG) was advised which revealed multilocular radiolucent areas with scalloped margins. Provisional diagnosis of ameloblastoma was given and biopsy was advised.

The histopathologic examination revealed cystic capsule with non-keratinized stratified squamous epithelium with 2-4 cell layer thickness, with some areas showing epithelial plaque, microcysts, hobnail cells and few clear cells. Contemplating all the histological features, final diagnosis of Glandular odontogenic cyst was given.

CONCLUSION: The presented case emphasizes the importance of histopathological examination of the unusual and rarely observed Glandular Odontogenic Cyst which can be missed due to similarities with other entities. Recurrence rates being very high, follow up of the cases is imperative.

Keywords: Glandular Odontogenic Cyst, Kaplan's criteria, Hobnail cells, Microcyst

INTRODUCTION

The glandular odontogenic cyst (GOC) is a locally aggressive rare developmental odontogenic cyst. It was first described in 1987 by VanWykand Padayachee as a "Botryoid" odontogenic cyst with glandular component" and called as "Sialo-Odontogenic Cyst." Histopathologically, Gardner et al. in 1988described the odontogenicepithelial lining of this cyst and gave the term "Glandular Odontogenic Cyst," which was later accepted by World Health Organization [1,2]

Clinically they appear as an asymptomatic swelling, generallysmall in size.Pain, paraesthesia has been reported in few cases and slight male predilection with a male: female ratio of 1.3: 1. This cyst reports to occur over a wide age range of 10-90 years, with a mean age of 49.5 years. The mandible is affected more commonly (87.2%) than the maxilla and anterior mandible (60%) is most affected. [3,4]GOC has a recurrence rate of 35.9%, especially when conservative surgical treatment is done.[3]

Radiographic appearance of GOC is quite indefinite and not pathognomonic. Therefore, in many cases it resembles a wide spectrum of lesions. The lesion may appear as an unilocular or multilocular radiolucency, usually with well-defined margins and sometimes with scalloped borders.[5]

Histologically, GOC exhibits a non-keratinized stratified squamous epithelial lining, focal plaque like thickenings within the epithelium,eosinophilic cuboidal or columnar cells (hobnail cells) microcysts, mucous cellswith minimal or complete absence of inflammation in the subepithelial connective tissue.[6]

The aim of this report is to present a case of GOC in a young male patient in the posterior maxillary region, which was quite rare and unusual.

CASE PRESENTATION:

A 26-year-old male patient reported to our institute with the chief complaint of swelling in the upper back tooth region and roof of the mouth since one and half years. The swelling was associated with pain in the past 6 months. On eliciting history, swelling was initially pea sized and gradually increased in size. Pain was insidious in onset, mild dull aching type and localised in upper right back tooth region. There is also history of dysphagia. His medical and dental history was non-contributory. Extraoral examination reveals mild facial asymmetry on right middle third of face with tender on palpation. Bilateral submandibular lymph nodes are palpable of size 0.5 x0.5cm, mobile and its non-tender.

Intraorally, irregular lobular shaped swelling noted on right buccal side and buccal cortical plate expansion noted from 18 to 15 region. On palatal side, irregular shaped swelling of size 4 x 3.5 x 3 cm is noted, which is variable in consistency- soft in anterior one third, fluctuant in middle one third and hard in posterior one third. Palatal plate expansion also noted. Swelling is tender on palpation.

Figure 1: a) Swelling noted in the upper right back tooth region b) Irregular shaped swelling in the right palate

Intraoral occlusal radiograph, OPGwere advised. Intraoral occlusal radiograph reveals well defined lobulated lesion with a scalloped margin from the rightupper second molar to the right upper first premolar, with slight involvement of the apices of the molars. Orthopantomogram (OPG) showed an expansilemultilocular radiolucency with scalloped margin on the right side of the posterior maxilla involving the roots of 16,17 and cortical thinning is also noted.

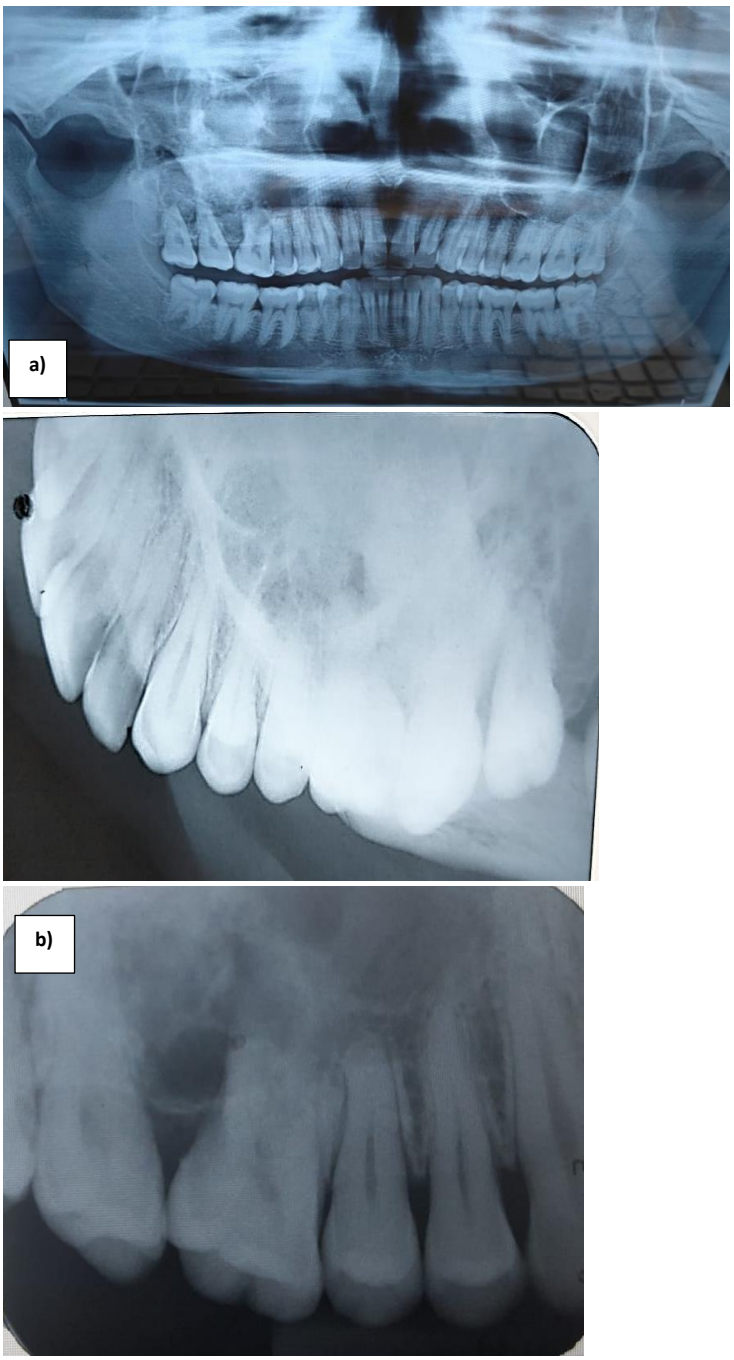


Figure 2: a) Orthopantomogram (OPG), b) Intraoral occlusal radiograph reveals multilocular radiolucency with ill-defined margins involving apices of molar teeth c) Intra oral periapical radiograph (IOPA) reveals multilocular radiolucency involving apices of molars and root resorption of first molar

On gross examination,the specimen received was greyish white in colour measuring about 1X 0.6 X 0.3 cm which is firm in consistency.

The stereomicroscopic image in Figure 3b shows thick cystic capsule.

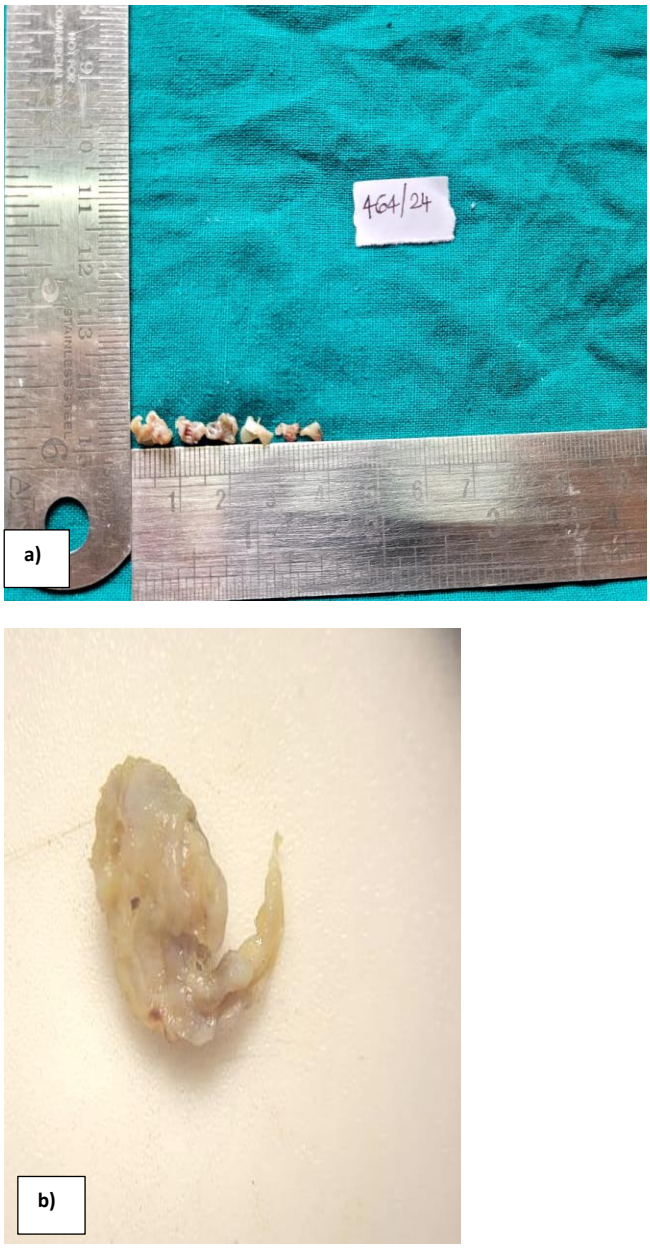
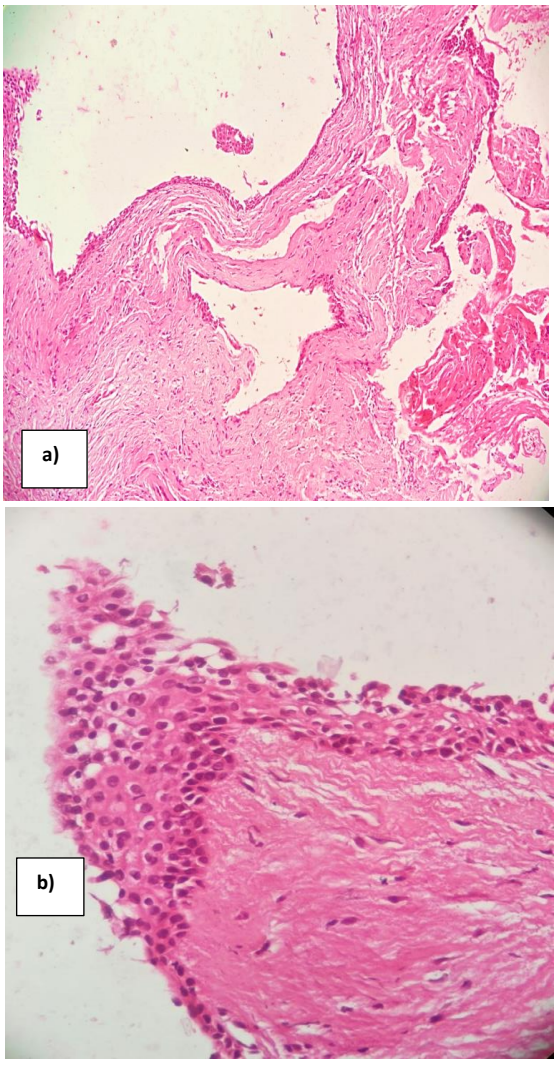


Figure 3: a)Grossing picture shows 6 soft tissue bits, largest bit measuring about 1 X 0.6 X 0.3 cm b)Stereomicroscopic image showing a thick cystic capsule

Histopathologic examination of Haematoxylin and Eosin-stained section revealed multiplecystic cavities lined by thin, non-keratinized stratified squamous epithelium made up of flat to cuboidal cells varying from 2-4 cell layers in thickness with flat epithelium connective tissue interface. Epithelial plaque like thickenings were noted in some areas.Numerous clear cells in spinous cell layer and few microcysts or duct like spaces were seen. The superficial layer of the epithelium showedeosinophilic cuboidal cells, also called “hobnail cells.”In certain planes of section these microcysts seem to open into the lumen, formed crypts like infoldings giving the papillary or corrugated surface. The connective tissue is mature made up of dense collagen fibres with multi cystic spaces lined by non-keratinised stratified squamous epithelium



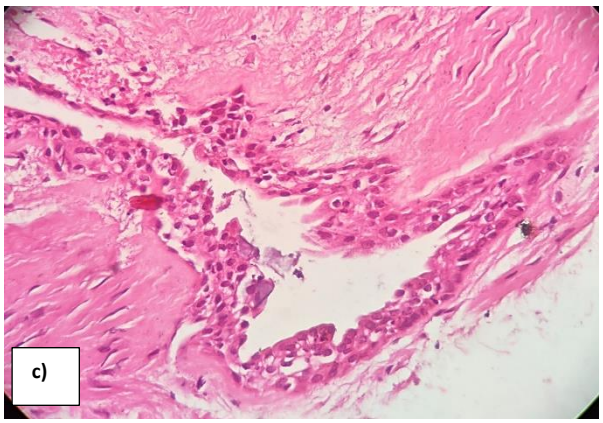


FIGURE 3: a) Non keratinized stratified squamous epithelium made up of flat to cuboidal cells varying from 2-4 cell layers in thickness (haematoxylin and eosin stain, original magnification x100) b)Epithelial plaque like thickenings (black arrows) (haematoxylin and eosin stain, original magnification x200) c)Numerous clear cells in the suprabasal and spinous layers of epithelium (haematoxylin and eosin stain, original magnification x400)

UNDERSTANDING OSSEOINTEGRATION: THE KEY TO SUCCESSFUL IMPLANT SURVIVAL

Author:

1. Dr. Vikram.S. Amberkar
   Professor Department Of Oral Pathology
   College Of Dental Sciences Davangere
2. Dr. Mohan Kumar K.P
   Professor Department Of Oral Pathology
   College Of Dental Sciences Davangere
3. Dr. Pramod. R .C
   Reader Department Of Oral Pathology
   College Of Dental Sciences Davangere
4. Niranjan K. C
   Prof And Hod Department Of Oral Pathology
   Sdm Dental College Dharwad

Corresponding author:

Dr. Vikram. S. Amberkar,
Professor Department Of Oral Pathology
College Of Dental Sciences Davangere

ABSTRACT

Dental implants have revolutionized modern dentistry, offering a reliable solution for the replacement of missing teeth. The success of dental implants is largely attributed to the phenomenon of osseointegration, which refers to the direct structural and functional connection between living bone and the surface of a load-bearing implant. Osseointegration plays a crucial role in the long-term stability and success of dental implants. The process of osseointegration involves several biological mechanisms, including initial blood clot formation, recruitment of osteogenic cells, formation of mineralized tissue, and remodeling of bone around the implant surface. The key players in osseointegration include osteoblasts, osteoclasts, fibroblasts, and various growth factors and cytokines. Understanding the mechanisms and factors influencing osseointegration is paramount for clinicians to achieve predictable outcomes in implant dentistry. Continued research and advancements in implant surface technology will further enhance our understanding and clinical management of osseointegration in dental implant.

Keywords: dental implants, osseointegration, healing, bone, cytokines,growth factors, failure

INTRODUCTION:

Osseointegration is a crucial element for the success and durability of dental implants. It refers to the process of the implant fusing with the surrounding jawbone, creating a robust and stable base for the artificial tooth or teeth.[1] During osseointegration, the bone cells of the jawbone grow and attach themselves to the implant's surface, creating a direct structural connection. This integration between the implant and the jawbone is essential to guarantee the stability and functionality of the dental implant. Moreover, osseointegration plays a pivotal role in preventing implant failure

and enables the successful restoration of missing teeth.[2]

Steps in Osseointegration: Before a dental implant can be placed, meticulous planning is required. This involves a comprehensive assessment of the patient's oral health, such as evaluating bone density and quantity through digital imaging techniques like cone beam computed tomography (CBCT). The next step involves surgically placing the dental implant into the jawbone. This procedure is typically performed under local anesthesia, ensuring patient comfort throughout the process. The implant is gently tapped into place, providing an ideal foundation for osseointegration.[3]

Healing and Biocompatibility: After implant placement, a critical period of healing begins. During this time, the dental implant becomes biocompatible with the surrounding bone tissue. The implant's surface characteristics and the body's response to the material contribute to the initiation of osseointegration.

Cellular Activity and Bone Formation: Osseointegration commences as the surrounding bone cells recognize the dental implant as a natural component. Bone cells, known as osteoblasts, attach to the implant's surface and begin depositing new bone tissue. The process of bone remodeling gradually integrates the implant into the jawbone, creating a strong bond over time.[4]

Advancements in Surface modification techniques for Enhanced Osseointegration:

Osseointegration, the direct structural and functional connection between living bone and the surface of a load-bearing implant, is a pivotal aspect of implantology. Ongoing research in surface modification techniques aims to optimize implant integration, addressing challenges such as delayed healing and long-term stability. Recent developments include the application of nanotechnology to modify implant surfaces at the nanoscale, allowing for precise control over topography and chemical composition. Nanostructured surfaces, such as titanium dioxide nanotubes, have demonstrated superior osseointegration properties by promoting cell adhesion, proliferation, and differentiation. Additionally, advancements in bioactive coatings, incorporating elements like hydroxyapatite and growth factors, have shown promise in enhancing the osteo-conductivity of implant surfaces. As highlighted in studies by Smith et al. (2023) and Lee et al. (2022), these innovative surface modifications not only facilitate faster bone healing but also contribute to the long-term success of dental and orthopedic implants.[5,6]

Emerging Technologies Shaping the Future of Implantology:

The landscape of implantology is rapidly evolving with the integration of cutting-edge technologies. One notable trend is the use of additive manufacturing, commonly known as 3D printing, to create patient-specific implants with intricate geometries. This approach, as evidenced by recent works by Zhang et al. (2021)[7]and Chen et al. (2023), enables precise customization, improving the fit and functionality of implants. Additionally, the incorporation of artificial intelligence (AI) in treatment planning and implant design is gaining momentum. AI algorithms analyze patient-specific data, such as bone density and morphology, to optimize implant

placement for enhanced osseointegration.[8] Moreover, the advent of smart implants equipped with sensors and real-time monitoring capabilities is revolutionizing postoperative care. These implants, discussed in studies by Altahi et al and French et al, provide valuable insights into the biomechanical environment, allowing for timely intervention in case of complications and ensuring the long-term success of osseointegrated implants.[9,10]

Biological Principles Underlying Osseointegration:

Osseointegration, a critical phenomenon in implantology, relies on a series of intricate biological processes that occur at the interface between the implant material and the host bone. The primary goal is the establishment of a stable and functional connection to support load-bearing implants. Initially proposed by Brånemark (1983), osseointegration involves a sequence of events, commencing with the early inflammatory phase. In this phase, the surgical trauma triggers the release of cytokines, growth factors, and chemokines, orchestrating a cascade of cellular events. Neutrophils and macrophages play pivotal roles in clearing debris and initiating the recruitment of osteogenic cells to the implant site.[11]

The establishment of a direct structural connection occurs during the maturation phase, as osteoblasts produce a mineralized matrix, integrating the implant into the surrounding bone tissue. The intricacies of these processes are governed by a multitude of molecular signals, including bone morphogenetic proteins (BMPs), transforming growth factor-beta (TGF-β), and vascular endothelial growth factor (VEGF). Recent studies by Albrektsson et al. (2019) and Cochran et al. (2021) further delve into the molecular and cellular events orchestrating osseointegration, elucidating the crucial role of the host response in achieving successful integration of dental and orthopedic implants. Understanding these biological principles is essential for advancing implant design and surface modification strategies to enhance osseointegration outcomes.[12,13]

Evaluation of Osseointegration: Various methods are available to assess the degree of osseointegration, including radiographic evaluation, histological analysis, and biomechanical testing. Radiographic techniques, such as periapical and panoramic radiographs, cone beam computed tomography (CBCT), and intraoral digital imaging, provide valuable information about bone-implant interface and bone density around the implant.

Clinical implications: Achieving successful osseointegration is critical for the long-term success of dental implants. Clinicians must carefully evaluate patient-specific factors and adhere to evidence-based surgical protocols to optimize osseointegration. Additionally, patient education and postoperative care play a crucial role in maintaining osseointegration and preventing complications

Failure in osseointegration: Osseointegration is a critical process indental implantology, referring to the direct structural and functional connection between living bone and the surface of a dental implant. While dental implants generally have a high success rate, there are situations where osseointegration may fail. Several factors can contribute to the failure of osseointegration in dental implants:

- Poor Bone Quality and Quantity: Inadequate bone density or volume at the implant site can impede the establishment of a stable osseointegrated interface. Insufficient bone may result from factors such as bone resorption, trauma, or the natural anatomy of the jaw.
- Infection: Peri-implantitis, an inflammatory condition affecting the tissues around dental implants, is a major cause of implant failure. Bacterial infection can compromise the stability of osseointegration, leading to bone loss and eventual implant failure.
- Implant overloading: Excessive forces placed on the implant during the healing phase or after the prosthetic restoration can disrupt the process of osseointegration. Overloading may result from factors like bruxism (teeth grinding), parafunctional habits, or improper occlusion.
- Implant Micro-motion: Stability during the early phases of healing is crucial for successful osseointegration. Micro-motions at the implant-bone interface, often caused by insufficient initial stabilization or improper surgical techniques, can hinder the formation of a strong bond.
- Inadequate surgical technique: Improper implant placement, incorrect angulation, or inadequate preparation of the implant site during surgery can compromise the success of osseointegration
- Medical Conditions and Medications: Certain systemic conditions (e.g., uncontrolled diabetes) or medications (e.g., bisphosphonates) can negatively impact bone healing and osseointegration.
- Smoking: Smoking has been associated with a higher risk of implant failure and compromised osseointegration. Nicotine and other substances in tobacco can hinder blood flow and impair healing processes
- Allergic Reactions: Rare, allergic reactions to materials used in dental implants may contribute to inflammation and impair the osseointegration process.
- Poor Implant Design or Quality: The design and quality of the implant itself can influence osseointegration. Factors such as surface characteristics, material composition, and implant geometry play a role in the long-term success of dental implants.[14,15]

CONCLUSION:

Preventive measures, thorough patient assessment, proper surgical techniques, and postoperative care are essential for minimizing the risk of osseointegration failure. Additionally, regular follow-up visits and good oral hygiene practices are crucial for monitoring implant health and preventing complications that could compromise the stability of dental implants.

References:

1. Parithimarkalaignan S, Padmanabhan TV. Osseointegration: an update. J Indian Prosthodont Soc. 2013 Mar;13(1):2-6. doi: 10.1007/s13191-013-0252-z. Epub 2013 Jan 11. PMID: 24431699; PMCID: PMC3602536.
2. Isa ZM, Hobkirk JA. Dental Implants: Biomaterial, Biomechanical And Biological Considerations. Annals of Dentistry University of Malaya. 2000 Dec 29;7(1):27-35.
3. Schenk RK, Buser D. Osseointegration: a reality. Periodontology 2000. 1998 Jun;17(1):22-35.

4. Jayesh RS, Dhinakarsamy V. Osseointegration. J Pharm Bioallied Sci. 2015 Apr;7(Suppl 1): S226-9. doi: 10.4103/0975-7406.155917. PMID: 26015719; PMCID: PMC4439679.
5. Verma A, Singh SV, Arya D, Shivakumar S, Chand P. Mechanical failures of dental implants and supported prostheses: A systematic review. J Oral BiolCraniofac Res. 2023 Mar-Apr;13(2):306-314. doi: 10.1016/j.jobcr.2023.02.009. Epub 2023 Mar 3. PMID: 36923071; PMCID: PMC10009286.
6. Hao, CP., Cao, NJ., Zhu, YH. *et al.* The osseointegration and stability of dental implants with different surface treatments in animal models: a network meta-analysis. *Sci Rep* **11**, 13849 (2021). https://doi.org/10.1038/s41598-021-93307-4
7. Zhang C, Zhang T, Geng T, Wang X, Lin K, Wang P. Dental Implants Loaded With Bioactive Agents Promote Osseointegration in Osteoporosis: A Review. Front BioengBiotechnol. 2021 Feb 9;9:591796. doi: 10.3389/fbioe.2021.591796. PMID: 33644012; PMCID: PMC7903335.
8. Pandey C, Rokaya D, Bhattarai BP. Contemporary Concepts in Osseointegration of Dental Implants: A Review. Biomed Res Int. 2022 Jun 14;2022:6170452. doi: 10.1155/2022/6170452. PMID: 35747499; PMCID: PMC9213185.
9. Altalhi AM, Alharbi FS, Alhodaithy MA, et al. The Impact of Artificial Intelligence on Dental Implantology: A Narrative Review. Cureus. 2023 Oct 30;15(10):e47941. doi: 10.7759/cureus.47941. PMID: 38034167; PMCID: PMC10685062.
10. French D, Ofec R, Levin L. Long term clinical performance of 10 871 dental implants with up to 22 years of follow-up: A cohort study in 4247 patients. Clin Implant Dent Relat Res. 2021 Jun;23(3):289-297. doi: 10.1111/cid.12994. Epub 2021 Mar 25. PMID: 33768695; PMCID: PMC8359846.
11. Brånemark PI. Osseointegration and its experimental background. J Prosthet Dent. 1983 Sep;50(3):399-410. doi: 10.1016/s0022-3913(83)80101-2. PMID: 6352924.
12. Albrektsson T, Tengvall P, Amengual L, Coli P, Kotsakis GA, Cochran D. Osteoimmune regulation underlies oral implant osseointegration and its perturbation. Front Immunol. 2023 Jan 24;13:1056914. doi: 10.3389/fimmu.2022.1056914. PMID: 36761175; PMCID: PMC9902598.
13. Cochran DL, Jones AA, Sugita R, Brown MC, Prasad H, Kay GW. Twelve-month evaluation of a novel mineral-organic adhesive material used to stabilize dental implants placed in oversized osteotomies in vivo in an animal model. Clin Oral Implants Res. 2022 Apr;33(4):391-404. doi: 10.1111/clr.13899. Epub 2022 Feb 19. PMID: 35132693.
14. Levin L. Dealing with dental implant failures. J Appl Oral Sci. 2008 May-Jun;16(3):171-5. doi: 10.1590/s1678-77572008000300002. PMID: 19089213; PMCID: PMC4327689.
15. Kochar SP, Reche A, Paul P. The Etiology and Management of Dental Implant Failure: A Review. Cureus. 2022 Oct 19;14(10):e30455. doi: 10.7759/cureus.30455. PMID: 36415394; PMCID: PMC9674049.

THE SEARCH FOR SMILE DESIGN; PROPORTIONS OR PERCENTAGE?

Authors:

1. Dr. Basavanna R.S.
   Professor, Department Of Conservative Dentistry And Endodontics, College Of Dental Sciences, Davangere
2. Dr. Siddheswaran V
   Professor, Department Of Conservative Dentistry And Endodontics, College Of Dental Sciences, Davangere
3. Dr. Avinash Hegde
   Professor, Department Of Conservative Dentistry And Endodontics, College Of Dental Sciences, Davangere
4. Dr. Ishaan Adhaulia
   Professor, Department Of Conservative Dentistry And Endodontics, College Of Dental Sciences, Davangere
5. Dr. Dhanyakumar N.M
   Professor, Department Of Conservative Dentistry And Endodontics, College Of Dental Sciences, Davangere

Corresponding author:

Dr.Avinash Hegde, Post graduate student, Department of conservative and Endodontics, College Of Dental Sciences, Davangere
Email avinashhegde145@gmail.com

ABSTRACT

Aim: To evaluate the applicability of the golden proportion, Recurring Esthetic Dental (RED) proportion, and golden percentage in the widths of maxillary anterior teeth for designing smiles in the Karnataka population, for use in direct aesthetic restorations.

Methodology: Frontal images of 100 dental students were taken with a DSLR camera. Using Adobe Photoshop CS7, the widths of each maxillary anterior tooth and inter-canine width were measured digitally. The measurements were analyzed with paired t-tests ($P < 0.05$) based on three smile theories.

Results: The golden proportion was observed in 9% of participants, the RED proportion in 6%, with values increasing distally toward the canines, and the golden percentage in 27%.

Conclusion: None of the theories perfectly represented natural smile design. However, golden percentage when adjusted to specific ethnic group, proved to be a potential template for direct aesthetic restorations.

Keywords: Golden proportion, Recurring aesthetic dental proportion (RED), Golden percentage, Smile design, Direct aesthetic restoration, Ethnicity adjustment

INTRODUCTION

The field of dental aesthetics has introduced various proportion theories to determine the ideal relationships between the widths of maxillary anterior teeth. Among these are the Golden Proportion, the Recurring Esthetic Dental (RED) proportion, and the Golden Percentage, each offering a standardized method for achieving aesthetically pleasing dental restorations.[1][2][3]

The Golden Proportion, a mathematical principle used in art and architecture, applies to dentistry as the ratio of the central incisor's width to the lateral incisor's width, approximately

1.618.[1] The RED proportion suggests that the width of the central incisor divided by the width of the lateral incisor equals the width of the lateral incisor divided by the width of the canine.[2] The Golden Percentage theory relates the widths of the maxillary anterior teeth to the overall smile width, recommending that central incisors make up 25%, lateral incisors 15%, and canines 10% of the intercanine width.[3]

Previous studies have shown mixed results regarding these theories. For example, the Golden Proportion was observed in some individuals but not widely enough to serve as a universal standard. Additionally, aesthetic proportions of maxillary anterior teeth have varied significantly among different ethnic groups.[4][5]

This research aims to assess the applicability of the Golden Proportion, RED proportion, and Golden Percentage to the natural dentition of a Karnataka demographic. The goal is to create a standardized template for direct esthetic restorations, utilizing digital photography and computer analysis, to help clinicians meet the aesthetic preferences of this demographic.

The hypotheses are:

1. The Golden Proportion is applicable to the maxillary anterior teeth widths in the Karnataka population.
2. The RED proportion can be applied to the maxillary anterior teeth widths in the Karnataka population.
3. The Golden Percentage can be used to determine the width of maxillary anterior teeth relative to the total smile width in the Karnataka population.

MATERIALS AND METHODS

Participant Selection

The study included 100 dental students (31 males and 69 females), aged 19-27, all of Karnataka origin. Participants were required to have natural dentition in the maxillary anterior region without any missing teeth or anterior malalignment. Those with a history of orthodontic treatment or alterations in the size of maxillary anterior teeth were excluded.

Photography Procedure

Standardized frontal images of each participant's smile were taken using a NIKON D3300 digital camera equipped with a 40MM F2.8G 1:1 Macro lens. Subjects were positioned with their heads in a natural position, and the camera was placed 60 cm away to capture the area from the tip of the nose to the chin. Images were taken while the participants smiled and were then transferred to a computer for measurement using Adobe Photoshop 7's digital tools.

Measurement Method

To evaluate the golden proportion, the width of the central incisor was multiplied by 62% and compared to the width of the adjacent lateral incisor. This method was repeated for the lateral incisor and canine. The recurring aesthetic dental (RED) proportion was assessed by dividing the width of each lateral incisor by the width of the adjacent central incisor and the width of each canine by the width of the adjacent lateral incisor, with each result multiplied by 100. The golden percentage was determined by dividing the width of each central incisor, lateral incisor, and canine by the total width of the six maxillary anterior teeth, then multiplying by 100.

Statistical Analysis

Data were analyzed using a paired t-test with an alpha level of 0.05, ensuring a 95% confidence level to identify significant differences.

Fig 01**:** Camera position with fixed working distance

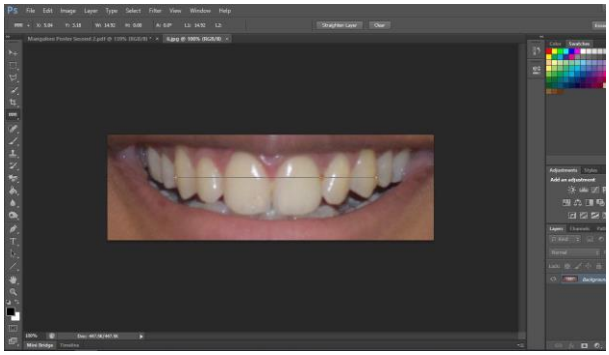


Fig 02**:** digital measurement tool in Adobe Photoshop 7 software

RESULTS:

Table 1: depicts the average width of the teeth ranging from the right canine to the left canine, including their mean inter-canine width as digitally measured.

Sample (n=100)	Right canine	Right lateral incisor	Right central incisor	Left central incisor	Left lateral incisor	Left canine	Inter chained width
Mean	4.09	5.33	8.29	8.3	5.37	4.13	35.54
Std deviation	0.27	0.27	0.31	0.28	0.24	0.28	0.9

TABLE 1: Mean measured width of all maxillary anterior teeth and mean intercanine

Golden Proportion

We determined the ratio of the width of the central incisor to the lateral incisor and the canine to the lateral incisor, identifying teeth that follow a value of 1.61 and 0.61 respectively, with a mean of ±0.05, to comply with the golden proportion. A mere 9% of the samples adhered to this proportion; 58% of the sample demonstrated this proportion only for central and lateral incisors, while 13% showed it exclusively for lateral incisors and canines.

RED Proportion

Similarly, we calculated the ratio of the central incisor width to the lateral incisor width and the lateral incisors width to the canine width. Those presenting recurring values with an average mean of ±0.05 were

assumed to follow the RED proportion. Only 6% of the total study population adhered to the RED proportion, with this proportion declining as we moved distally towards the canine.

Golden Percentage

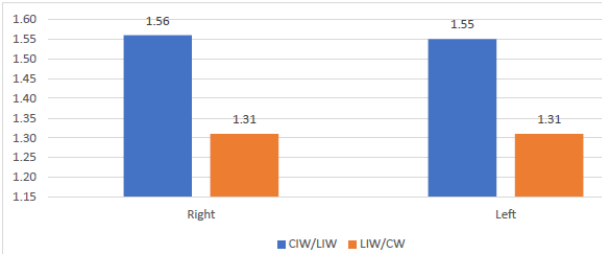
The ratios of individual teeth from right canine to left canine in relation to the inter-canine width were computed for each participant to determine each tooth's occupancy in the dental arch. Interestingly, 27% of the sample followed this proportion, with mean values aligning closely to the ideal percentage value.

All tests were conducted using a pre-set alpha of 0.05 to ensure 95% confidence in the significance of the findings. All data presented here, both parametric and non-parametric, passed normality and equivalent variation tests, ensuring the validity of our statistical analysis.

	Right		**Left**	
	CIW/LIW	CW/LIW	CIW/LIW	CW/LIW
Mean	1.56	0.77	1.55	0.76
Std deviation	0.09	0.05	0.07	0.06

TABLE 2: Mean golden proportion of study population,

CIW- central incisor width, LIW- lateral incisor width, CW- canine width



GRAPH 1; RED proportions of study population, CIW- central incisor width, LIW- lateral incisor width, CW- canine width

Mean golden percentage - right			**Mean golden percentage - left**		
Right canine	Right lateral incisor	Right Central incisor	Left central incisor	Left lateral incisor	Left canine
23	15	12	23	15	12

TABLE 3; mean golden percentage of study population with standard deviation of 0.01

DISCUSSION:

Discerning a mathematical or geometrical association amid teeth is vital for achieving an aesthetic restorative outcome. It would be advantageous if statistically dependable correlations supported extant relationship theories.

This study was carried out with 100 dental apprentices. Concerning the golden proportion theory, a concept revisited by Preston JD et al1 the most favourable outcomes in this study were observed between the perceived left lateral incisor width and perceived left canine width from the frontal perspective. Collective findings indicated that the golden proportion seemed non-existent. This aligned with studies conducted by Minoo Mahshid et al5 and Fayyad MA et al3. Assessing subjects with an aesthetic smile, they appraised the existence of the golden proportion by gauging the mesio-distal breadth of six anterior teeth using scanned images of individuals4. They deduced that the golden proportion, a concept discussed by Levin EI8, was absent in natural dentition4.

Regarding RED proportion, a term introduced by Ward DH2, in this particular

study, the ratio between central and lateral incisors and between lateral incisor and canine was inconsistent, increasing distally2. The 69.5-70.3% value, denoting the maxillary lateral incisor width to central incisor width ratio, concurred with the 70% RED proportion proposed by Ward2 and the mean proportion suggested by Fayyad et al3, ranging from 66 to 78%. The ratio between central and lateral incisors and between lateral incisor and canine is not constant, as proposed by Ward2, which was also stated by Mahajan et al5. Thus, this study lacks evidence to endorse the RED proportion theory when applied to natural dentition.

Concerning the Golden percentage theory for correlating the six anterior teeth, a principle discussed by Snow14 and later investigated by Murthy BV and Ramani N12, the present investigation implies that the mean values for the golden percentage for the central incisor are 23%14. The mean value for lateral incisors is 15%14. In terms of the golden percentage of canines, the study showed a mean value of 12%14. The lateral incisor values corresponded

with those suggested by Snow14, who advocated a value of 15 as the golden percentage for lateral incisors14. The central incisor figures were slightly lower, with estimated 25% for central incisors14. Canines exhibited slightly higher values than those recommended by Snow, who advised a value of 10 for canines14. Rosenstiel et al9 and Wolfart et al10 also made significant contributions to the understanding of anterior tooth proportions.

Overall, it appears that the widths of the central incisors are slightly smaller, and canine widths are slightly larger than those proposed by the golden percentage theory. It might be more suitable to natural dentition to adopt values of 23% for centrals, 15% for laterals, and 12% for canines, as per the findings by Ahmed N et al6 and Parnia F et al11. The slight discrepancies in the values obtained in this study could potentially be ascribed to the ethnic variation of the subjects chosen in the present investigation7,13. This aligns with the findings by Lombardi RE, who noted the principles of visual perception's impact on denture esthetics7, and Haselton DR et al, who investigated the colour stability of provisional crown and fixed partial denture resins13. Further reinforcing this conclusion, Hulsey TC and Maynard JH15 provided a detailed analysis of width/length ratios of normal clinical crowns of the maxillary anterior dentition, offering valuable comparison data for interpreting the results obtained in our study. Their work emphasizes the natural diversity that exists in these ratios, suggesting that adjustments for ethnic group characteristics, as found in our study, may indeed be a necessary step in creating aesthetic restoration templates.

CONCLUSION:

Within the limitations of this study, the following CONCLUSIONs were drawn:

1. The golden proportion was observed in only 9% of the sample population. The prevalence was higher between the central and lateral incisors at 58%, compared to 13% between the lateral incisors and canines.
2. The Recurring Esthetic Dental (R.E.D.) proportion was not readily discernible among the six maxillary anterior teeth, with only 6% of the sample population exhibiting this proportion.

3. The golden percentage was followed by 27% of the population, with mean values resembling ideal percentage values: 23% for central incisors, 15% for lateral incisors, and 12% for canines.
4. To determine reliable width correlations between maxillary anterior teeth, it is crucial to consider ethnic and cultural variations. This understanding would aid clinicians in utilizing a suitable template for direct esthetic restoration

REFERENCES:

1) Preston JD, et al. The golden proportion revisited. J Esthet Dent. 1993;5:247.
2) Ward DH. Proportional smile design using the recurring esthetic dental (red) proportion. Dent Clin North Am. 2001;45(1):143-54.
3) Fayyad MA, Jamani KD, Agrabawi J. Geometric and mathematical proportions and their relations to maxillary anterior teeth. J Contemp Dent Pract. 2006;7(5):62-70.
4) Youssefi N, Shafiei F, Fakhrzadeh V, Gholami L, Jahangiri S. Golden proportion in smile design and maxillary anterior teeth: A review. World J Biol Pharm Health Sci. 2022;11(1):91-100.
5) Mahajan V, Nagpal A, Gupta R, Vaidya S, Jabeen F, Thakur K. Comparative Evaluation of Golden Proportion, Recurring Esthetic Dental Proportion and Golden Percentage in Himachal Demographic. J Adv Med Med Res. 2019;29(10):1-8.
6) Ahmed N, Halim MS, Khalid S, Ab Ghani Z, Jamayet NB. Evaluation of golden percentage in natural maxillary anterior teeth width: A systematic review. J Prosthet Dent. 2022;127(6):845-e1.
7) Lombardi RE. The principles of visual perception and their clinical application to denture esthetics. J Prosthet Dent. 1973;29(4):358-82.
8) Levin EI. Dental esthetics and the golden proportion. J Prosthet Dent. 1978;40(3):244-52.
9) Rosenstiel SF, Ward DH, Rashid RG. Dentists' preferences of anterior tooth proportion – a web-based study. J Prosthodont. 2000;9(3):123-36.
10) Wolfart S, Thormann H, Freitag S, Kern M. Assessment of dental appearance following changes in incisor proportions. Eur J Oral Sci. 2005;113(2):159-65.
11) Parnia F, Hafezeqoran A, Mahboub F, Moslehifard E, Koodaryan R, Moteyagheni R, Saleh Saber F. Proportional evaluation of anterior teeth and their relation to the golden standard. J Oral Health Oral Epidemiol. 2012;1(2):61-68.
12) Murthy BV, Ramani N. Evaluation of natural smile: Golden proportion, RED or Golden percentage. J Conserv Dent. 2008;11(1):16-21.
13) Haselton DR, Diaz-Arnold AM, Dawson DV. Color stability of provisional crown and fixed partial denture resins. The Journal of prosthetic dentistry. 2005 Jan 1;93(1):70-5.
14) Snow SR. Esthetic smile analysis of maxillary anterior tooth width: the golden percentage. J Esthet Dent. 1999;11(4):177-84.
15) Husley TC, Maynard JH. Width/length ratios of normal clinical crowns of the maxillary anterior dentition in man. The Journal of Clinical Periodontology. 1974;1(3):153-61.

AN INNOVATIVE APPROACH IN THE MANAGEMENT OF IDIOPATHIC PERFORATING INTERNAL RESORPTION – A CASE REPORT

AUTHORS:

1. Prathima B J- MDS,
   Conservative dentistry and endodontics, Senior lecturer
2. Prashanth B R- MDS,
   Conservative dentistry and endodontics, Professor
3. Rupali Karale- MDS,
   Conservative dentistry and endodontics, Professor and HOD

CORRESPONDING AUTHORS:

Dr Prathima B J
No 20, Tumkur Road, Yeswanthpur Suburb II Stage, Yeswanthpur, Bengaluru 560022
8951201943
Prathimabj2013@gmail.com

ABSTRACT

Internal root resorption (IRR) is an inflammatory condition that results in progressive destruction of intra-radicular dentinal walls due to osteoclastic activity.IRR could be asymptomatic and may present on routine radiographic examinations. Patients might experience symptoms of pulpitis at anearly stage, laterthe tooth might become necrotic and eventually develop symptoms of periradicular periodontitis.The diagnostic accuracy of IRR has been enhanced with the introduction of Cone-Beam CT imaging as it delivers definite 3-D diagnosis facilitatingappropriate treatment plan. This case report presents an interesting insight on the management of mutilated tooth having communicatingIRRusing MTA and Everstick fiber post.

Keywords-Internal root resorption (IRR), Cone-Beam-CT, MTA, Everstickfiber-post

INTRODUCTION

Internal root resorption (IRR) is an inflammatory condition that results in progressive destruction of intra-radicular dentin along the middle and apical thirds of the canal walls due to osteoclastic activity. It is relatively rare in occurrenceand the etiology and pathogenesis of the lesion have not been completely understood in comparison with external root resorption (ERR).1

The diagnostic accuracy of IRR based on conventional radiographic examination is limited by the fact that the produced images only provide a two-dimensional representation of a three-dimensional object.Radiographic imaging cannot reveal the location and nature of the resorptive defect and the thickness of the remaining root canal dentine.Furthermore, the anatomic structures might be superimposed and the image may be distorted.

The introduction of cone-beam computed tomography (CBCT) in endodontics has enhanced radiographic diagnosis and management of resorptive lesions. It provides information such as the lesion's size, shape and nature, including root perforations.2

Endodontically treated teeth with excessive loss of tooth structure would require to be restored with post and core to enhance the strength and durability of the tooth and to achieve retention for the restoration.Improvements in bondable dental

glass fiber systems which contain polymer (PMMA) and resin impregnated (Bis-GMA) unpolymerized glass fiber posts.3

Individually formed glass fiber post is soft, flexible and can be customized. Thus, can adapt to the morphology of the canal giving best choice for a curved, oval and large root canal. It has few advantages over metallic or prefabricated posts with high flexural strength and elasticity very similar to dentin which distributes the occlusal stresses equally to the root dentin reducing the risk of root fractures.4

This case report describes the successful management of an idiopathic perforated IRR associated with Upper anterior tooth.

CASE PRESENTATION

A 21-year-old male patientreported with a broken upper front tooth since many years and wanted to get it treated.Patient gave a history of trauma 10 years ago. He suffered from the toothache for which he had consulted local dentist and underwent root canal treatment which was incomplete due to some personal reasons. His medical history was not contributory.

On examination, there wasdiscolouredcoronal tooth noted wrt 11 which was measuring less than 50% of the adjacent tooth with wide access opening,without any coronal seal. It was non-tender on palpation and percussion, no sinus opening or pus discharge present with no mobility.21 showed coronal fracture involving dentin. With this,a provisional diagnosis of Previously Initiated Therapy with Non-Vital tooth wrt 11 was made.

Investigations were carried out. Firstly,Pulp sensibility testing, such as cold test and EPT were done which gave no response for 11 and positive response for 21 was appreciated.

Then, Periapical radiographs and CBCT were done which revealed a radiopaque filling material in apical 1/3 of root canal space. A faint radiopacity was seen at the apex suggestive of remnants of extruded intracanal medicament. A large, well demarcated oval shaped radiolucent cavity measuring approx.5*5mm [Mesiodistally and Occluso gingivally] noted in the coronal 1/3 of the root communicating into external root surface distally with a lateral radiolucency noted adjacent to it and the canal could not be followed through the lesion. Widened PDL space with intact LD was observed.

To assess the nature, location and severity of the resorptive lesion, limited CBCT 3D imaging of the region was taken after verbal consent obtained. Following analysis of the axial, sagittal and coronal slices, it was evident that the IRR of tooth 11 was extensive and had perforated at the middle third of canal in the mesial and distal aspects with thinning of radicular dentin at coronal third of the root.Extent of the resorption could be noted from the sagittal view.

With the history, clinical and radiographic findings, a final diagnosis of Previously Initiated Therapy with Asymptomatic Apical Periodontitis and Idiopathic perforating Internal Root Resorption 11 was made.

The patient was informed of the clinical findings, and various treatment options were discussed. It was finally decided to go with Root canal treatment followed by perforation repair with MTA andIntra canal reinforcement using Ever-stick post for 11 and Composite build up for 21 was made.

TREATMENT PROCEDURE

Before heading towards the treatment, Written consent was obtained from the patient. At the first visit, re treatment was initiated, old filling

material present in the canal was removed using #20- H file. Apical patency was obtained with #10 K file. Working Length was determined using electronic apex locator and confirmed radiographically. Later, canal was cleaned using 5.25% NaOCl and 0.9% Normal saline and dressed with calcium hydroxide[Apexcal]. Access cavity was temporized.

In the second visit,Cleaning and shaping was performed with step-back technique with conservative filing. Apical enlargement was done upto 45 K-file (Mani Inc., Japan). The canal was dried, calcium hydroxidewas placed for 2 weeks and the access cavity was temporized with Cavit G (3M ESPE, Germany).Further recall, the tooth was asymptomatic, final rinse of canal was done with 17% EDTA liquid, NaOCl and saline.Sectional obturation was done using calamus and AH Plus (DeTrey, Dentsply) sealer.

On gentle probing, bleeding was noted both from the mesial and distal canal walls near the resorptive defect. Thinning of buccal and palatal root walls was also observed. Bleeding was controlled and canal was dried using paper points. White MTA (ProRoot MTA, Dentsply, TN, US) was prepared according to the manufacturer's recommendations and filled incrementally to the coronal 1/3 of the canal towards mesial and distal walls to fill the perforation sites using pluggers.MTA was also placed over buccal and palatal root walls. Intraoperative radiographs revealed that MTA filled the thin canal walls and the resorption defect. A wet cotton pellet was put on the MTA, and the cavity was sealed with thecavit.

As the remaining dentin thickness was very less(<1mm), next step was intra radicular-reinforcement. Canal was irrigated with saline and dried. Depth of the canal was measured using k file and stopper was adjusted 2 mm short of estimated crown height. The post together with silicone sheet was cut to a suitable length using sharp scissor. 1.5 size ever-stick post (GC America INC. USA) was inserted and an additional post of shorter length was placed in the upper portion of canal which was condensedlaterally.

IOPAR was taken to confirm the placement of the post up to the desired length and density. Post was removed from the canal, for cementation- low viscosity dual cure cement (ParaCore® Core Build-Up, Coltène/ Whaledent USA) was used according to manufacturer's instructions.After removal of excess cement, post was light cured for 40 sec. Coronally, Ever-stick post was fanned out to the desired width of core. Core build up was carried out using composite. Then tooth preparation was done and a full coverage porcelain fused to metal crown were luted using glass ionomer cement. (GC FujiCEM, GC India)

DISCUSSION

Management of IRR is an endodontic challenge especially if the resorptive lesion is extensive and perforating. A correct diagnosis is important as the management of IRR is different from ERR.Once the diagnosis and prognosis of IRR have been established, root canal treatment is the treatment of choice. The rate of resorption may be rapid or slow and spontaneous repair is extremely rare, thus the wait and see approach is not appropriate.5

The aim of root canal treatment is to arrest the cellular activity responsible for the resorptive lesion by removing all the causative agents, disinfect and obturate the root canal system. However, the complex irregularities of the root canal system and the inaccessibility of IRR defect provide technical difficulties for thorough cleaning and obturation of the root

canal.6Sodium hypochlorite(NaOCL) and calcium hydroxide used in the chemo mechanical debridement is very important to disinfect the root canal space. Failure to remove the bacteria and organic debris in those areas may jeopardize the long-term success of the endodontic treatment.

Radiographically, internal resorption may be described as symmetrical or eccentric lesion with sharp, smooth and clearly defined margin, with a uniform density of radiolucency, and the outline of pulp chamber or root canal could not be followed through the lesion. In contrast, lesions caused by ERR may be asymmetrical and have ill-defined borders, with radio density variations in the body of the lesion. The canal wall should be traceable through ERR lesion because ERR is superimposed over the root canal. Parallax method is recommended for distinguishing internal and external resorptive defects.A second radiograph taken from a different mesio-distal angle would alter the relationship of the defect to the root canal but not in the case of IRR.1,2

Several case reports and studies have confirmed the usefulness of CBCT in diagnosing and managing resorptive lesions. Although diagnosing IRR is primarily made based on periapical radiograph, certain informations are lacking. In this present case, the complexity of the resorptive lesion with presence of perforation was clearly visible in CBCT images. This valuable information was shown to be extremely useful in the diagnosis, making a proper treatment plan and management.2,6

In the case of perforating IRR of tooth11, information obtained from CBCT scans means that greater care could be taken during root canal irrigation. As the exact location of the perforation had been determined preoperatively, the position and orientation of the side-venting irrigation needle tip was used to minimize the risk of extrusion of NaOCL.MTA was chosen for perforation repair because of its superior sealing properties, bacteriostatic effects, biocompatibility, Bone formation and its ability to set in presence of blood.7

This case presented uniqueness in problem that the root walls were very thin, restoring the same with the traditional method would have resulted in the risk of root fracture and restoration with the prefabricated post would have resulted in obturation of the large defect with the cementing medium, which creates a very weak area in the entire post-core-crown-tooth complex. When ever-StickPost (GC America INC. USA) was used, preparation of the root canals need not be as extensive as with traditional posts. Thus, the dentine was saved and the risk of perforation was reduced. The pulp chamber of the root canal was completely filled with fibres instead of cement. It is proposed in the literature that to prevent root fracture at least 1 mm of dentin must be maintained around the entire circumference of the channel.So, it was a necessary to place an everStickPost (GC America INC. USA) which reinforces the canal and transfer the occlusal load equally throughout the canal.4

Good adhesion between post and cement and cement and dentin is one of the important factors in load transfer, so ever-stick post was used because the monomers of the adhesive resins and cements can diffuse into the linear polymer phase, causes swelling of it, and by polymerization, it forms inter-diffusion bonding which is called as secondary semi-IPN structure. Improved bonding allows the transfer of loads from the crown-core system to the root through the root canal post.4At 6 months follow-up, the tooth was performing well in function and esthetics with complete resolvent of periapical lesion. The treatment

described in this case report is very simple and effective and helps to accomplish the patient's esthetic and functional requirements.

CONCLUSION

This case report was intended to share information on the management of IIRR, the use of CBCT in the decision-making process, and MTA as the material of choice for treating root perforation. Diagnosing the types of root resorption lesions is a big challenge as the clinical and radiographic presentation might be similar. CBCT has been very beneficial in the assessment and management of perforating IRR. When endodontic treatment is adequate in IRR, lesions can be halted and evidence of bony healing can be seen radiographically.The use of ever-StickPost for intraradicular reinforcement can be a simple and efficient procedure with excellent esthetic and functional results in a single sitting.

Source(s) of support in the form of grants, equipment, drugs, or all of these; Nil

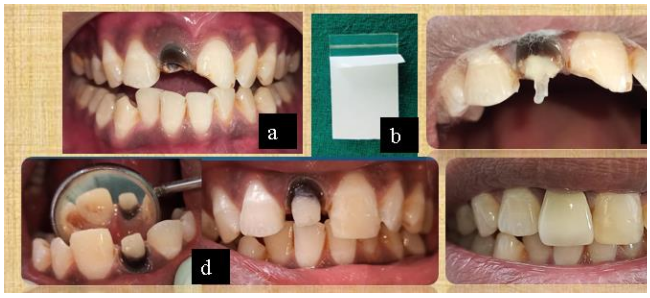


Fig1- clinical photographs depicting the management of IRR

a. Pre-op b. ever-stick post c. fanning out of ever-stick fibers to do the core build-up d. after crown prep f. post-op

Fig2- Radiographic images depicting the management of IRR

a. pre-op showing the old filling material in the canal b. CBCT images depicting size, position and extent of IRR c. Working length d. Calcium hydroxide placed e. master cone f. segmental obturation g. perforation repair with MTA h. root reinforcement using ever-stick post i. immediate post-op after crown cementation j. 6 months follow up showing the healing of lateral radiolucency in the perforated area

REFERENCES

1. M Fernandes I de Ataide R Wagle Tooth resorption part I - pathogenesis and case series of internal resorptionJ Conserv Dent2013 (16);148
2. S. Patel A. Dawood R. Wilson K. Horner F. Mannocci The detection and management of root resorption lesions using intraoral radiography and cone beam computed tomography - aninvivoinvestigationIntEndod J20094298318
3. Schwartz RS, Robbins JW. Post placement and restoration of endodontically treated teeth: a literature review. J Endod 2004 May;30(5):289-301
4. Vishal Parmar, Esthetic correction of maxillary central incisor with everstick post and all ceramic crown- A case report.April 20209(4):1-2
5. Walton RE, Leonard LA. Cracked tooth: an etiology for "idiopathic" internal

resorption?. J Endod 1986 Apr;12(4): 167-169

6. Nilsson E., Bonte E., Bayet F., Lasfargues J.J. Management of internal root resorption on permanent teeth. Int J Dent. 2013:92 (94);86
7. M Torabinejad N Chivian Clinical applications of mineral trioxide aggregateJ Endod1999253197205

NANOROBOTS IN DENTISTRY: SMALL IS THE NEW BIG

Authors:

1. Dr. Ghaneesha Prabhu Moye
   Post Graduate Student, Department of Conservative Dentistry and Endodontics
   College of Dental Sciences, Davangere, Karnataka, India
2. Dr. Nikita Laxmi Shobhakumar
   Post Graduate Student, Department of Conservative Dentistry and Endodontics
   College of Dental Sciences, Davangere, Karnataka, India
3. Dr. Basavanna R. S.
   Professor, Department of Conservative Dentistry and Endodontics
   College of Dental Sciences, Davangere, Karnataka, India
4. Dr. G. B. Shivamurthy
   Professor, Department of Conservative Dentistry and Endodontics
   College of Dental Sciences, Davangere, Karnataka, India
5. Dr. Dhanyakumar N.M.
   Professor and Head, Department of Conservative Dentistry and Endodontics
   College of Dental Sciences, Davangere, Karnataka, India

Corresponding Author:

Dr. Ghaneesha Prabhu Moye
Post Graduate Student, Department of Conservative Dentistry and Endodontics
College of Dental Sciences, Davangere, Karnataka, India

ABSTRACT

Nanorobotics, the creation of machines at the nanometre scale, holds promising yet unpredictable technological futures. Nanorobots, ranging from 0.1 to 10 μm, can be inspired by natural examples to perform various tasks. Initially utilized in medicine for cancer treatment, nanorobots are now seeing exciting applications in dentistry. This emerging field, called nano dentistry, offers innovative treatments like local anaesthesia, dentition renaturalization, permanent hypersensitivity relief, and complete orthodontic realignment in one visit. It also includes the use of mechanical dentifrobots for continuous oral health maintenance by eliminating caries-causing bacteria and repairing early decay. Dental nanorobots, equipped with specialized motility mechanisms and controlled by onboard nanocomputers, can precisely navigate human tissue, perform tasks, and respond to sensor stimuli. This review article provides an early glimpse into the potential impacts and future implications of nanorobotics in dentistry.

KEYWORDS: Nanorobots, Nanotechnology, Nanodentistry

INTRODUCTION:

“Great things are not done by impulse, but by a series of small things brought together.” The term "nano" comes from the Greek word for "dwarf" and refers to a scale of one billionth of a meter, or about the width of 10 atoms. Nanomaterials have dimensions under 100 nm, including atomic clusters, grains, fibers, and films.

The growing interest in nanotechnology's applications in dentistry has led to the emergence of nanodentistry. This field uses nanotechnology to design and construct nanorobots, which are poised to revolutionize medical science and dentistry. These nanorobots can induce oral analgesia, desensitize teeth, realign and straighten teeth, and improve their durability.

Although currently hypothetical and in the development phase, nanorobots promise advancements in preventive, restorative, and curative dental procedures.

NANOROBOTS:

A nanorobot is a microscopic machine engineered to execute specific tasks repeatedly and precisely at nanoscale dimensions, typically a few nanometers (1 nm = 10-9 meters) or smaller. Nanorobots have potential uses in assembling and maintaining complex systems. They could operate at the atomic or molecular level to construct devices, machines, or circuits, a process referred to as molecular manufacturing.

Dental nanorobots could employ specialized motility mechanisms to precisely navigate human tissue, acquire energy, and manipulate their environment in real time. These functions could be controlled by an onboard nanocomputer executing preprogrammed instructions based on local sensor inputs.

Morphology of nanorobots

Dental nanorobots, resembling spider-like structures, are designed to efficiently perform their tasks. Constructed from diamondoid structures and housed within nanotubes, their ultra-smooth surfaces minimize the likelihood of triggering the host's defense mechanisms.

Components of Nanorobots

The dental nanorobot will feature an onboard nanocomputer to store and execute planned tasks, process signals and external stimuli, interact with other nanocomputers, and respond to external control devices. A navigational network within the body will provide precise topographical accuracy for all circulating nanorobots and monitor their locations. Additionally, a camera will pinpoint the exact location of nanorobots inside the body. Assembling these nanorobots involves integrating actuators, sensors, power, control, communications, and interfacial signals across spatial scales and between organic and inorganic systems. Parts of the nanorobots consists of:

- 100nm manipulating arms,
- 10 nm sorting rotors for molecular-by-molecular purification,
- Smooth super hard surfaces made of atomically flawless diamond.

Mechanism of Action

APPROACHES IN NANOTECHNOLOGY:

1. Bottom-up approach: This approach arranges smaller components into more complex assemblies.
2. Top- down approach: This approach creates smaller devices by using larger ones to direct their assembly.
3. Functional approach: This approach develops components of the desired functionality without much importance to their assembly or structure.
4. The Biomimetic Approaches: Seeks to apply biomolecules for applications in Nanotechnology.
5. Speculative approach: This approach often takes a big picture view of nanotechnology, with more emphasis on

its societal implications than the details of how such inventions could actually be created.

NANOROBOTS IN DENTISTRY:

The increasing interest in nanotechnology's potential for dental applications is giving rise to a new field known as nanodentistry. Nanorobots can provide oral analgesia, desensitize teeth, realign and straighten misaligned teeth, and enhance their durability. Additionally, these nanorobots are utilized in preventive, restorative, and curative dental procedures.

APPLICATIONS OF NANOROBOTS IN DENTISTRY:

1. NANODIAGNOSIS:

In dentistry, nanotechnology has the potential to revolutionize diagnosis and treatment by allowing for more accurate and efficient diagnostic techniques. Nanotechnologies are being used in dental diagnosis, including in the use of smart dental probes as tiny, nanoscale sensors that can detect early signs of tooth decay by analyzing the chemical composition of a tooth’s surface. Smart probes can generate images of a tooth’s surface, providing dentists with more accurate and detailed information than conventional X-rays. Nano biosensors, as tiny nanoscale devices, can detect biomolecules in saliva that are associated with various oral diseases. Biosensors can quickly identify bacterial or fungal infections, making it easier for dentists to diagnose and treat conditions. Similarly, the vast field of nanoparticle imaging enables nanoparticles to highlight areas of inflammation or disease in the mouth .

Nanoparticles can also be used to target cancer cells, making it easier for dentists to identify and treat oral cancer. Similarly, Nano-based drug delivery systems can be used to deliver drugs directly to diseased or damaged areas of the mouth, reducing the need for invasive procedures. This approach can help minimize side effects and enhance the effectiveness of treatments .

In these various ways, nanotechnology enables advanced research methods in the field of dental science. More recently, dental laser technology has introduced a new optical phenomenon, which when irrigated in the oral cavity easily penetrates to micropores at the foci of demineralization . Such methods have proven effective in the detection and pathogenesis of diseases. Other diagnosis devices may include biosensor technologies carrying biological diagnostic elements with wide-scale implementation potential in oncology. Overall, nanotechnologies are opening exciting possibilities for more precise and efficient diagnosis and treatment in dentistry. As research advances, we can expect to see more innovative uses for this technology in dental care.

6. OPERATIVE NANODENTISTRY

Nano-Glass Ionomer Traditional glass ionomers, when combined with nanoparticles, result in nano-glass ionomers. These nanomaterials bring enhanced polishing, aesthetic qualities, and improved durability to dental applications. A formulation of ionomer cement, based on bonded nanofiller technology, incorporates various nanomaterials like nanofillers, nanoclusters, and Fluor aluminosilicate glass to bolster mechanical properties. These additives enhance the physical attributes of dental restorative materials, offering properties such as translucency, compressive strength, elasticity, and fluoride release. They outperform conventional glass ionomers, making them suitable for fluoride-rich environments and effective in preventing

caries upon acid exposure. Noncolumnar nanomaterials also find application in diverse clinical scenarios, enhancing crystallization properties and supporting restorative technologies.

• **NANOCOMPOSITES**:

Nanocomposites combine multiple materials, including polymers, metals, or ceramics, with nanoscale particles dispersed evenly within dental resins and coatings. These materials address issues like polymerization shrinkage, coating durability, and microhardness. Dental practitioners prefer nanocomposites for their superior structural integrity, longevity, and aesthetic appeal compared to traditional composites. Key nanofillers include aluminosilicate-based powders that offer excellent physical and chemical properties such as hardness, flexural strength, color density, and polishing retention.

Nanocomposites in restorative dentistry mimic natural enamel properties, providing strength, ion release, and effective fracture repair. They enhance remineralization and mechanical strength with additional nanofillers. Nanocomposite denture materials, incorporating inorganic nanofillers, demonstrate superior color retention, durability, and abrasion resistance compared to acrylic or microfiber compositions. Examples include Filtek Supreme, combining glass particles and amorphous calcium phosphate.

3. NANOTECHNOLOGY APPLICATIONS IN PROSTHODONTICS:

Prosthetic restorations like complete dentures or acrylic particle implants employ nanoparticles such as Ag, ZrO2, and TiO2. These nanoparticles enhance materials like polymethyl methacrylate (PMMA), reducing issues like candida-related stomatitis. Nano-zirconium oxide-modified PMMA improves denture hardness, biocompatibility, flexibility, strength, and dispersion properties. Nanoparticles like sodium triphosphate or tri-metaphosphate in chlorhexidine coatings for soft liner dentures provide antimicrobial properties. Nanohydroxyapatite/fluorapatite particles in zinc polycarboxylate cement improve

tensile strength, flexural strength, and overall physical properties compared to standard zinc polycarboxylate cement. Resin nanoceramic CAD/CAM blocks with improved tribological properties facilitate customized dental solutions.

3. NANOTECHNOLOGY APPLICATIONS IN ENDODONTICS:

Nanoparticles find diverse applications in endodontic treatments, serving as fillers, composites, sealers, and repair materials. Bio-ceramic nanoparticles like zirconia, glass ceramic, and bioglass enhance endodontic sealers' bonding strength and release calcium and phosphate ions. Examples include Di-methylamino hexadecyl methacrylate (DMAHDM), amorphous calcium phosphate (ACP) nanoparticles, and 2-methacryloyloxyethyl phosphorylcholine (MPC). Adhesive nanoparticles offer fast curing, dimensional stability, and enhanced bonding in root canal treatments. Silver nanoparticles combined with calcium hydroxide in intracanal medication effectively combat bacterial growth and biofilms, critical in root canal hygiene.

5. NANOTECHNOLOGY APPLICATIONS IN ORTHODONTICS:

Nanorobotics and nanocomposite formulations advance orthodontic treatments. Nanorobots and nanoelectromechanical systems accelerate tooth repair and movement. Nanoparticle-

based delivery systems in elastomeric ligatures enhance dental health with anti-cariogenic fluoride, antibiotic, and anti-inflammatory effects. Smart brackets with nanomechanical sensors provide efficient and precise orthodontic treatment, minimizing side effects and improving treatment outcomes. Three-dimensional force systems enhance predictability in tooth movement, reducing plaque retention and biofilm formation while adjusting applied force for optimal efficacy.

7. NANOTECHNOLOGY APPLICATIONS IN PERIODONTICS AND IMPLANTOLOGY:

Regenerative nanodentistry utilizes nanomaterials and techniques to repair damaged teeth, gums, and bone tissues. Nanoparticles like nanoporous titanium surfaces promote osseointegration, enhancing dental implant success rates. Tetracycline-loaded NPs and triclosan in nano-emulsion formulations provide prolonged drug delivery for periodontal treatments. Nanomaterials like gold, silver, titanium oxide, and hydroxyapatite enhance implant integration, surface topography, and bio-integrative properties. Nano-formulations aid in root canal therapy, promoting tissue regeneration and antimicrobial efficacy. Nano-coatings on dental implants exhibit reformative properties and nano-topography, influencing bone-implant interfaces and enhancing tissue responses.

7. NANOTECHNOLOGY APPLICATIONS FOR HYPERSENSITIVITY MANAGEMENT:

Nanorobots and nano-sized materials effectively manage tooth hypersensitivity by sealing and isolating exposed tooth roots from external stimuli. Gold nanoparticles are widely utilized in dentinal tubules, improving treatment outcomes. Reconstructive dental nanorobots regulate microtubules and mineralization agents to desensitize teeth, offering durable solutions to hypersensitivity.

Nano-Tissue Engineering Nanoparticles drive advancements in bone tissue engineering, offering biocompatible scaffold materials combined with stem cells and growth factors to promote new bone growth. Nanostructured materials enhance the success of dental implants and restorative procedures, improving osseointegration and treatment outcomes.

8. NANOTECHNOLOGY APPLICATIONS IN THE SURGICAL FIELD NANOROBOTS (NANOBOTS):

perform precise surgical tasks such as drug delivery, tissue biopsies, and blood clot removal, enhancing surgical outcomes. Nanoparticles in wound healing promote faster tissue regeneration, and nano-engineered materials reduce infection risks. Nanoparticles in imaging and diagnostics enhance imaging techniques like CT and MRI scans, improving diagnostic accuracy and treatment efficacy.

9. PREVENTIVE NANODENTISTRY:

Preventive nanotechnology utilizes nano-sized particles and materials to prevent and repair tooth ay and other oral health issues. Nanocomposite fillings and nanoparticle coatings protect against bacteria and enhance tooth enamel's protective barrier. Nanosensors detect early signs of oral health problems, enabling timely intervention. Nanogels and therapeutic toothpaste remineralize enamel and prevent cavities at the molecular level, improving overall oral health outcomes.

10. NANO-MOLECULAR IMAGING IN DENTAL SCIENCE:

Nano-molecular imaging visualizes molecular changes in oral tissues, aiding in diagnosing

and treating dental diseases like caries and oral cancer. Techniques like nano-optical coherence tomography (OCT) and biosensors provide detailed information about oral disease markers, improving treatment outcomes and patient care.

11. OTHER APPLICATIONS OF NANODENTISTRY:

Nanotechnology enhances dental adhesives, surface disinfection, and surgical instruments. Nano-adhesives improve cavity protection and tissue adhesion, while nano-emulsions and nano-surface treatments enhance sterilization and surgical precision. Nano-instruments like stainless steel needles and crystals improve surgical outcomes, while ultrafine polishing with nano-materials reduces tooth roughness and biofilm formation.

These applications demonstrate the transformative potential of nanotechnology in dentistry, offering innovative solutions to enhance dental care outcomes across various specialties.

CHALLENGES FACED BY NANODENTISTRY:

1. Precise positioning and assembly of molecular-scale components.
2. Cost-effective techniques for mass-producing nanorobots.
3. Ensuring biocompatibility.
4. Coordinating the activities of numerous independent micron-scale robots simultaneously.
5. Addressing social issues related to public acceptance, ethics, regulation, and human safety.
6. High design costs.
7. Electrical systems that generate stray fields, potentially activating bioelectric-based molecular recognition systems in biology.
8. Challenges in interfacing, customization, and design complexity.
9. Potential security risks associated with nanorobots, including concerns about their misuse by terrorist groups. Nanotechnology's capability to affect the human body at the molecular level could potentially be exploited for malicious purposes against communities.

FUTURE PERSPECTIVES AND CONCLUSION:

This article has illustrated the transformative impact of Nano-dental science on enhancing the quality, aesthetics, durability, mechanical properties, resilience, sensitivity, and hyperactivity management of teeth. The evolution of nanotechnology in healthcare is projected to expand further, driven by anticipated advantages in efficacy and cost-efficiency, as well as social, environmental, public health, and occupational benefits, alongside the associated risks. Researchers are increasingly exploring novel dimensions of Nano-dental science to surmount existing limitations. Future research endeavors should prioritize overcoming these limitations and integrating socio-cultural and economic considerations into clinical applications of Nano dentistry. It is envisaged that Nano dentistry will progressively supersede conventional treatment modalities. During this transitional phase, sustained dedication to Nano-research, comprehensive safety assessments, and the formulation of effective marketing, acceptance, and promotion strategies are imperative for practical implementation.

REFERENCES

1. Smith AB, Jones CD. Applications of nanorobots in dental medicine: A review. Nanomedicine. 2019;14(5):589-602.

2. Brown EF, White GH. Nanorobotics in orthodontics: Current trends and future prospects. J Dent Res. 2020;99(3):321-335.
3. Lee JH, Park SH. Nanotechnology in oral and maxillofacial surgery: A systematic review. Int J Oral Maxillofac Surg. 2018;47(6):757-769.
4. Taylor K, Clark M. Nanorobots in endodontics: Opportunities and challenges. Endod Topics. 2021;45(2):189-203.
5. Garcia R, Martinez L. Nanorobotics in periodontology: A comprehensive review. Periodontol 2000. 2019;80(1):128-143.
6. Wang X, Zhang Y. Nanorobotics in implant dentistry: Current status and future directions. Implant Dent. 2020;29(4):346-358.
7. Harris L, Wilson K. Nanorobots for dental caries treatment: A feasibility study. J Dent Hyg. 2017;95(2):112-125.
8. Nguyen C, Miller P. Nanorobotics and oral cancer diagnosis: A systematic review. Oral Oncol. 2018;84:56-67.
9. Patel D, Taylor J. Emerging nanorobotic technologies in prosthodontics: A narrative review. J Prosthet Dent. 2022;127(1):42-55.
10. Lopez A, Garcia F. Nanorobotic devices for minimally invasive dental procedures: A scoping review. J Dent Educ. 2019;83(7):789-802.
11. Roberts S, Kelly M. Nanotechnology in pediatric dentistry: Applications and challenges. Pediatr Dent. 2021;43(5):375-387.
12. Thompson G, Young R. Role of nanorobots in root canal therapy: A review of the literature. J Endod. 2018;44(6):921-935.
13. Martinez C, Hernandez D. Nanorobotics in temporomandibular joint disorders: A systematic review. J Craniomandib Pract. 2020;38(3):201-215.
14. Baker H, Adams G. Nanorobotic systems for orthognathic surgery: A critical review. Int J Oral Surg. 2019;48(4):449-461.
15. Cook E, Parker J. Nanorobotic devices for plaque removal: A systematic review. J Clin Periodontol. 2017;44(9):876-889.
16. Lewis M, Morris N. Applications of nanorobots in cosmetic dentistry: A comprehensive overview. Cosmet Dent J. 2021;39(2):143-157.
17. Hall R, Bell S. Nanorobotic innovations in periodontal regeneration: A narrative review. J Periodontol. 2018;89(4):467-479.
18. Garcia S, Martinez O. Nanorobots in dental traumatology: A critical appraisal. Dent Traumatol. 2020;36(5):435-448.
19. Hill D, Wilson T. Potential of nanorobots in saliva diagnostics: A review. Oral Health Prev Dent. 2019;17(3):215-227.
20. Scott A, King L. Nanotechnology applications in oral implantology: A systematic review. Int J Oral Implantol. 2021;14(2):234-247.
21. Thomas R, Walker M. Nanorobots for biofilm removal in orthodontics: A scoping review. Eur J Orthod. 2018;40(5):521-535.
22. Cooper R, Wright P. Role of nanorobots in tooth remineralization: A comprehensive review. J Dent Res. 2020;99(8):923-936.
23. Sanchez A, Patel M. Nanorobots for dental pulp regeneration: A systematic review. Tissue Eng Part B Rev. 2017;23(6):567-579.
24. Ramirez L, Stewart K. Nanorobots in craniofacial surgery: Current state and future prospects. J Craniofac Surg. 2019;30(3):712-724.
25. Reed S, Brooks D. Nanotechnology in aesthetic dentistry: A critical review. Aesthet Dent J. 2021;39(4):378-391.
26. Hughes T, Griffin P. Applications of nanorobots in forensic odontology: A narrative review. Forensic Sci Int. 2018;285:109-121.
27. Jenkins R, Barnes J. Nanorobotics in dental trauma management: Current trends and future perspectives. Dent Traumatol. 2020;36(3):258-270.
28. Perry C, Moore K. Nanotechnology in oral cancer therapy: A systematic review. Oral Oncol. 2019;95:115-127.
29. Turner L, Ward S. Nanorobots for periodontal therapy: A critical appraisal. J Periodontal Res. 2018;53(1):1-14.
30. Roberts H, Mitchell G. Nanotechnology in dental materials: Applications and limitations. Dent Mater. 2021;37(1):63-71.

CONCILIATING CARIES WITH A COMPANION

Authors:

1. Dr. Vani Gupta
   Postgraduate Student, Dept of Conservative Dentistry and Endodontics
   College of Dental Sciences, Davangere, Karnataka, India
2. Dr. Amrita S
   Postgraduate Student, Dept of Conservative Dentistry and Endodontics
   College of Dental Sciences, Davangere, Karnataka, India
3. Dr. Neel V Hiremath
   Professor, Dept of Conservative Dentistry and Endodontics
   College of Dental Sciences, Davangere, Karnataka, India
4. Dr. Prakash Lokhande
   Professor, Dept of Conservative Dentistry and Endodontics
   College of Dental Sciences, Davangere, Karnataka, India
5. Dr. Dhanya Kumar N M
   Professor and Head, Dept of Conservative Dentistry and Endodontics
   College of Dental Sciences, Davangere, Karnataka, India

Corresponding Author:

Dr. Vani Gupta
Postgraduate Student, Dept of Conservative Dentistry and Endodontics
College of Dental Sciences, Davangere, Karnataka, India

ABSTRACT

Dental caries, a widespread disease, stems from imbalances in dental minerals and biofilms. Antibiotic use disrupts oral microbiota, increasing caries risk. Probiotics like Lactobacillus and Bifidobacterium enhance oral health by competing with pathogens and regulating pH. Prebiotics such as inulin and xylo-oligosaccharides selectively support beneficial microbes, aiding infection control and pH balance. Synbiotics combine probiotics and prebiotics, boosting survival against caries-causing challenges. Clinical trials are crucial to validate these strategies for oral health, understanding their impact on oral microbiota and long-term effects is essential.

In CONCLUSION, probiotics, prebiotics, and synbiotics offer promising strategies for improving oral health by balancing microbial flora and pH levels. Further clinical research is essential to validate their efficacy and long-term benefits in preventing dental caries.

Keywords: Prebiotics, Synbiotics, Probiotics, Dental Caries, Lactobacillus, Bifidobacterium

INTRODUCTION

Dental caries is a complex disease driven by imbalances in the composition of dental tissues and biofilms. Its widespread prevalence among adults, nearing 91%, underscores its global impact, surpassing expenditures on heart conditions in the USA since 2006. Antibiotic use disrupts the delicate balance of the human microbiome, leading to resistance and increased susceptibility to caries. Probiotic therapy, a novel preventive approach using beneficial microorganisms, is gaining traction in dentistry for its potential to prevent caries and periodontal diseases by displacing harmful bacteria and establishing a healthier oral

environment. This review explores probiotics' mechanisms, their evolution in cariology, and their clinical potential in dental care amid current global challenges.

NORMENCLATURE

In 1907, Nobel laureate and Russian bacteriologist Ilya Ilyich Metchnikoff first observed that certain bacteria could enhance human intestinal health, marking the discovery of probiotics. Since then, our understanding and terminology around probiotics have evolved significantly. Today, probiotics are defined as live microorganisms that, when consumed in adequate amounts, provide health benefits to the host, according to the World Health Organization and the Food and Agriculture Organization of the United Nations. In contrast, 'prebiotics' refers to ingredients that selectively promote the growth and activity of beneficial microorganisms in the gut, contributing to overall health. When probiotics and prebiotics are combined, they form what's known as 'synbiotics', offering potential synergistic benefits for health.

It's important to note that fermented foods, while rich in microorganisms that can act as probiotics, serve a different purpose than intentionally administered probiotics. Fermented foods undergo microbial activity to achieve stability, safety, and desirable taste characteristics. This process involves specific microorganisms that break down carbohydrates to produce various beneficial compounds like lactic acid, acetic acid, ethanol, carbon dioxide, and antimicrobial agents. Unlike probiotics intended for direct health benefits, the microorganisms in fermentation primarily aim to preserve and enhance the food product rather than intentionally altering human microflora, although some probiotic strains used in medicine and dentistry are derived from fermentation processes.

MODES OF ACTION OF ORAL PROBIOTICS

The precise mechanisms of how probiotics work are not fully understood. However, in general, probiotics typically operate through three main ways: (a) enhancing the body's immune response, (b) directly combating harmful pathogens, and (c) indirectly clearing out pathogens.

Probiotics and their extracellular products interact with the host’s mucous cells in a strain-specific manner, influencing the production of cytokines and chemokines. This interaction enhances the phagocytic activity of macrophages, neutrophils, and Natural Killer (NK) cells. For instance, strains such as B. lactis Bb-12, L. rhamnosus GG, and L. acidophilus La1 have been shown to boost the phagocytic capacity of leukocytes. Probiotics not only affect innate immunity but also stimulate adaptive immunity by raising IgA levels in the serum and influencing the development and balance of T helper cells, including the Th1/Th2 cell ratio.

In the oral environment, the effects of probiotics are less understood. Some specific probiotics can inhibit the interleukin-8 (IL-8) response in oral mucous cells triggered by periodontal pathogens and reduce other inflammatory markers like prostaglandin E2 (PGE2). However, changes in salivary IgA levels have not been observed. Additionally, L. paracasei has been shown to increase the detectable levels of certain defensins, such as salivary human neutrophil peptide 1–3.

Probiotic bacteria produce antimicrobial substances like bacteriocins, lactic acid, and hydrogen peroxide, which impact the host's microbiome by killing harmful pathogens

while allowing the probiotics to survive. For example, L. rhamnosus GG releases a broad-spectrum antimicrobial agent that targets a variety of Gram-positive and Gram-negative bacteria. L. reuteri produces reuterin and reutericyclin, which combat microbes by causing oxidative stress and disrupting their cellular functions.

Probiotics also help by competing with harmful bacteria for space and nutrients. When beneficial bacteria occupy the spots where pathogens would normally attach, they prevent infections from taking hold. Additionally, probiotics can secrete substances that make it harder for pathogens to stick to surfaces, or they can change the properties of the salivary pellicle, making it less suitable for harmful bacteria. These actions collectively help to maintain a healthy microbial balance in the host.

CARIES PROGRESSION

To understand how probiotics help prevent and treat caries, it's crucial to examine how caries form. The mouth is home to many microorganisms, which colonize both the soft tissues like gums and hard surfaces like teeth and dental appliances. The bacteria on the teeth are primarily responsible for caries. These bacteria group together to form a resilient structure called 'oral biofilm' or 'dental plaque.'

This biofilm consists of many microorganisms. Some are harmless, while others, known as 'opportunistic pathogens,' can become harmful under certain conditions. According to the 'Ecological Plaque Hypothesis,' these microorganisms coexist peacefully with each other and the host in a healthy state, playing a vital role in health. However, when this balance is disrupted, harmful bacteria dominate, leading to dysbiosis. In dysbiosis, these bacteria metabolize dietary sugars into lactic acid, which then dissolves the mineral crystals in the teeth, causing demineralization. If the acid is removed, remineralization can occur.

Caries formation is influenced by many factors, including saliva flow, tooth mineral composition, the oral microbiome, and diet. Infrequent sugar consumption allows acids to be neutralized by saliva or compounds in the plaque, maintaining a balance between demineralization and remineralization. Frequent sugar consumption, however, creates a persistently low pH in the mouth, favoring acid-loving and acid-producing bacteria like Streptococci and Actinomycetes. This results in more demineralization than remineralization. Different microorganisms are associated with various types and stages of caries development, suggesting a complex, multi-species involvement rather than a single-pathogen cause. Therefore, dental caries is not a straightforward infectious disease but a dynamic condition where the microbial players change over time, depending on the affected tissue and the stage of the lesion

CONCLUSION

The introduction of probiotics in cariology is promising for reducing the prevalence of caries. Importantly, probiotics can benefit patients of all ages and health statuses in various ways and can be easily and safely incorporated into daily routines through general guidance without requiring significant effort from patients, which is particularly important for older adults. However, our understanding of how oral probiotics work is still limited. More research is needed to comprehend their interactions with the host's cells and microbiome. For now, probiotics should be used as a preventive measure rather than a direct treatment for caries.

REFERENCE

1. Delcenserie, V.; Martel, D.; Lamoureux, M.; Amiot, K.; Boutin, Y.; Roy, D. Immunomodulatory Effects of Probiotics in the Intestinal Tract. Curr. Iss. Mol. Biol. 2008, 10, 37–54.
2. Schiffrin, E.J.; Brassart, D.; Selvin, A.L.; Rochat, F.; Donnet-Hughes, A. Immune modulation of blood leukocytes in humans by lactic acid bacteria: Criteria for strain selection. Am. J. Clin. Nutr. 1997, 66, 515S–520S. [CrossRef]
3. Pelto, L.; Isolauri, E.; Lilius, E.M.; Nuutila, J.; Salminen, S. Probiotic bacteria down-regulate the milk-induced inflammatory response in milk-hypersensitive subjects but 1474–1479.
4. Schiffrin, E.J.; Rochat, F.; Link-Amster, H.; Aeschlimann, J.M.; Donnet-Hughes, A. Immunomodulation of human blood cells following the ingestion of lactic acid bacteria. J. Dairy Sci. 1995, 78, 491–497.
5. Donnet-Hughes, A.; Rochat, F.; Serrant, P.; Aeschlimann, J.M.; Schiffrin, E.J. Modulaion of nonspecific mechanisms of defense by lactic acid bacteria: Effective dose. J. Dairy Sci. 1999, 82, 863–869.